(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 501 180 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
05.02.2025 Bulletin 2025/06

(21) Application number: **24191855.6**

(22) Date of filing: **30.07.2024**

(51) International Patent Classification (IPC):
A47F 3/04 *(2006.01)* ***F25D 21/04*** *(2006.01)*
F25D 23/02 *(2006.01)* ***F25D 23/06*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F25D 23/02; A47F 3/0434; F25D 21/04; F25D 23/025; F25D 23/063; F25D 23/069; F25D 21/08; F25D 2201/14; F25D 2323/021; F25D 2323/023; F25D 2400/02; F25D 2400/18; F25D 2400/36

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
GE KH MA MD TN

(30) Priority: **02.08.2023 KR 20230101321**

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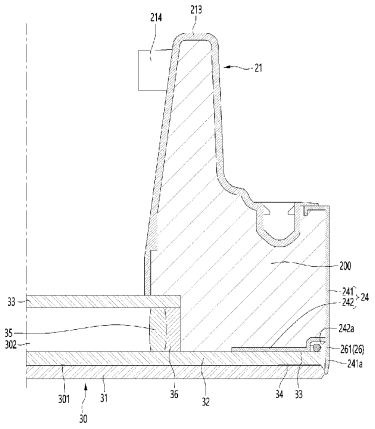
(54) REFRIGERATOR

(57) A refrigerator of an embodiment of the disclosure includes a cabinet forming a storage space; and a door configured to open and close the storage space, in which the door includes a door liner forming a rear of the door and having a liner opening; a panel assembly configured to see through a rear space of the door by a plurality of transparent panels; and an insulating material filled inside the door excluding the panel assembly, the panel assembly includes a first panel forming a front surface of the door; a second panel provided at a rear side spaced apart from the first panel and forming a first insulating layer between the second panel and the first panel; and a third panel provided at the rear side spaced apart from the second panel to cover the liner opening and forming a second insulating layer between the third panel and the second panel, and the first insulating layer is formed to be larger than the second insulating layer and protrudes further than an end portion of the second insulating layer.

[Fig. 10]



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Description

BACKGROUND

[0001] The disclosure relates to a refrigerator.

[0002] In general, a refrigerator is a home appliance that allows food to be stored at low temperatures in an internal storage space covered by a door. To this end, refrigerators are configured to keep stored food in optimal condition by cooling the inside of the storage space using cold air generated through heat exchange with the refrigerant circulating in the refrigeration cycle.

[0003] Recently, refrigerators are gradually becoming larger and more multi-functional in accordance with changes in eating habits and the trend of higher quality products, and refrigerators equipped with various structures and convenience devices are being released to ensure user convenience and efficient use of internal space.

[0004] For example, a refrigerator is being released that has a transparent panel assembly formed on the door, allowing the storage space behind the door to be visible even when the door is closed. In such a refrigerator, an insulating layer is provided on the panel assembly to maintain insulating performance.

[0005] However, although the heat passing through the panel assembly can be effectively blocked by the insulating layer, the insulating performance of the door deteriorates and power consumption increases due to the heat transmitted along the perimeter of the panel assembly through the spacers constituting the panel assembly.

SUMMARY

[0006] An object of the disclosure is to provide a refrigerator that prevents heat loss through a door that allows internal seeing-through.

[0007] An object of the disclosure is to provide a refrigerator that improves power consumption by improving the heater on the door and the mounting structure of the heater.

[0008] An object of the disclosure is to provide a refrigerator that can secure storage space capacity by reducing the thickness of the door.

[0009] The object is solved by the features of the independent claims. Preferred embodiments are given in the dependent claims.

[0010] A refrigerator of an embodiment includes a cabinet; and a door, a panel assembly having a plurality of transparent panels; insulating material inside the door excluding the panel assembly, the panel assembly includes a plurality of panels, wherein insulation layers are formed between the panels.

[0011] A refrigerator of an embodiment includes a cabinet; and a door, a panel assembly having a plurality of transparent panels; insulating material inside the door excluding the panel assembly, the panel assembly includes a plurality of panels, and a heater being in contact with one of the panels.

[0012] A refrigerator of an embodiment includes a cabinet; and a main door and a sub door in front of the main door, a panel assembly having a plurality of transparent panels; insulating material inside the door excluding the panel assembly, the panel assembly includes a plurality of panels, wherein the panel assembly may be provided in the sub door.

[0013] A refrigerator of an embodiment of the disclosure includes a cabinet forming a storage space; and a door configured to open and close the storage space, in which the door includes a door liner forming a rear of the door and having a liner opening; a panel assembly configured to see through a rear space of the door by a plurality of transparent panels; and an insulating material filled inside the door excluding the panel assembly, the panel assembly includes a first panel forming a front surface of the door; a second panel provided at a rear side spaced apart from the first panel and forming a first insulating layer between the second panel and the first panel; and a third panel provided at the rear side spaced apart from the second panel to cover the liner opening and forming a second insulating layer between the third panel and the second panel, and the first insulating layer may be formed to be larger than the second insulating layer and protrude further than an end portion of the second insulating layer.

[0014] In the following optional features are provided which might be combined with any one or multiple of the above embodiments.

[0015] The panel assembly may include a first spacer disposed between the first panel and the second panel.

[0016] The panel assembly may include a second spacer disposed between the second panel and the third panel.

[0017] The first spacer may be disposed farther from the center of the panel assembly than the second spacer.

[0018] The first insulating layer may be configured in a vacuum state.

[0019] The second insulating layer may be configured to be filled with insulating gas.

[0020] The thickness of the first insulating layer may be thinner than the thickness of the second insulating layer.

[0021] The door may include an upper frame forming an upper surface; a lower frame forming a lower surface; and a side frame configured to connect the upper frame and the lower frame and forming both left and right sides

[0022] The door liner may be coupled to the rear ends of the upper frame, the lower frame, and the side frame.

[0023] The panel assembly may be coupled to front ends of the upper frame, the lower frame, and the side frame.

[0024] The first panel and the second panel may be supported on the upper frame, the lower frame, and the side frame

[0025] The third panel may be supported on the door liner.

[0026] The first panel may cover the front opening of

the door formed by combining the upper frame, the lower frame, and the side frame.

[0027] The door may include a heater being in contact with the second panel.

[0028] The heater may be disposed along a perimeter of the first insulating layer.

[0029] The side frame may be formed of a metal material

[0030] The heater may be accommodated in the side frame

[0031] A heater groove may be formed in the side frame in which the heater is accommodated

[0032] The heater may include a heating part configured to generate heat while being in contact with the side frames on both left and right sides; a lower connection part connected to lower ends of the heating parts on both sides, and an upper connection part connected to upper ends of the heating part on both sides, and the lower connection part and the upper connection part may have lower electrical resistance than the heating part.

[0033] The heater may include a heating part bent into a plurality of rows along the side frame.

[0034] The heater may include a connection part connected to the upper ends of the heating part on both sides and configured to supply power.

[0035] A power line may be provided to supply power to the heater and may be connected to the end portion of the heater.

[0036] The power line and the heater may be connected by a connector in a recessed part formed in the upper frame.

[0037] At least a portion of the heater may be disposed to be in contact with a rear of the first panel and an end portion of the second panel.

[0038] A recessed handle groove may be formed on the lower surface of the lower frame to open the door.

[0039] An extension line of the rear of the third panel may be configured to pass through the handle groove.

[0040] The lower frame may extend upward from one side of the handle groove to form a lower support part supporting the second panel from the rear.

[0041] The door liner may be formed with a door dike protruding rearward from both left and right sides of the liner opening.

[0042] Storage member mounting parts may be provided which protrude in a direction facing each other and to which the door storage members are mounted.

[0043] The storage member mounting parts may be formed on the inner surfaces of the door dike on both left and right sides.

[0044] The front end of the door storage member may be located further forward than the rear end of the lower frame.

[0045] The door may further include an upper frame forming an upper surface of the door.

[0046] The door may further include a display device configured to display an operating state of the refrigerator

[0047] The upper frame may include a frame recessed part recessed downward from an upper surface of the upper frame

[0048] The door may further include a frame opening opened at the front surface of the frame recessed part and to which the rear of the first panel is exposed.

[0049] The display device may be inserted into the frame recessed part and may be mounted to be in contact with the rear of the first panel through the frame opening.

[0050] The display device may include a touch sensor, and the touch sensor may detect a manipulation when the first panel is touched.

[0051] An upper end of the second panel may extend more upward than the third panel and extend to be in contact with a lower end of the upper frame.

[0052] Perimeter of the first panel may be rounded and protrude further than an end portion of the second panel.

[0053] The door may include a main door configured to open and close the storage space and having an opening; and a sub-door provided in front of the main door and configured to open and close the opening

[0054] The panel assembly may be provided in the sub door.

[0055] The refrigerator of an embodiment of the disclosure has the following effects.

[0056] According to an embodiment of the disclosure, the first insulating layer is formed by combining the first panel and the second panel, and the second insulating layer is formed by combining the second panel and the third panel, and the first insulating layer has a structure that extends further outward than the second insulating layer. Therefore, even if the cold air inside the refrigerator is transmitted to the third insulating layer, it cannot move forward and moves laterally along the third insulating layer and the second insulating layer, thereby bypassing and lengthening the heat transfer path, preventing loss of cold air and improving power consumption.

[0057] In particular, the first panel and the second panel forming the first insulating layer extend to a position adjacent to the end portion of the door, thereby preventing cold air from being transmitted to the front surface of the door by the first insulating layer.

[0058] In addition, the first insulating layer is composed of a vacuum insulating layer, so that the overall thickness of the panel assembly can be reduced. Accordingly, there is an advantage in that the capacity of the door storage space disposed in the door may be increased or the arrangement of the door insulating material can be improved.

[0059] Additionally, the heater disposed along the perimeter of the door has the advantage of reducing power consumption by driving the heater by partially generating heat at appropriate locations.

[0060] In addition, the heater is disposed along the side frame made of metal, so that placement of the heater is easy and at the same time, it is possible to prevent condensation from forming on the side frame by blocking cold air transmitted to the side frame.

[0061] In addition, the display device is disposed to be

in contact with the first panel, allowing touch manipulation input and display of the operating state by manipulating the front surface of the door, and thus there is an advantage in that convenience of use is improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0062]

FIG. 1 is a front view illustrating a refrigerator of an embodiment of the disclosure.
FIG. 2 is a view illustrating a state where the door of the refrigerator is open.
FIG. 3 is a perspective view illustrating the door.
FIG. 4 is an exploded perspective view of the door viewed from the front.
FIG. 5 is an exploded perspective view of the door viewed from the rear.
FIG. 6 is an exploded perspective view of a panel assembly, which is one component of the door.
FIG. 7 is a perspective view illustrating the disposition of electric wires at the upper ends of the door and the cabinet.
FIG. 8 is a view illustrating the heater disposition inside the door.
FIG. 9 is a top view illustrating the heater.
FIG. 10 is a cross-sectional view taken along line 10-10 of FIG. 3.
FIG. 11 is a view illustrating the heater disposition at the lower portion of the door.
FIG. 12 is a perspective view taken along line 12-12 of FIG. 3.
FIG. 13 is a cross-sectional view taken along line 13-13 of FIG. 3.
FIG. 14 is a cross-sectional view of part A of FIG. 13.
FIG. 15 is a cross-sectional view of part B of FIG. 13.
FIG. 16 is a cross-sectional view of part A of FIG. 13 of another embodiment of the disclosure.
FIG. 17 is a cross-sectional view of part B of FIG. 13 of another embodiment of the disclosure.
FIG. 18 is a view illustrating a state where a heater is disposed of another embodiment.
FIG. 19 illustrates a state where the sub door of a refrigerator is opened of another embodiment.
FIG. 20 illustrates an exploded view where the panel assembly of the sub door is separated.
FIG. 21 is a cross-sectional view taken along line 21-21 of FIG. 19.
FIG. 22 is a cross-sectional view taken along line 22-22 of FIG. 19.
FIG. 23 is a front view illustrating a sub door of another embodiment of the disclosure.
FIG. 24 is a perspective view taken along line 24-24 of FIG. 23.
FIG. 25 is a cross-sectional view illustrating the mounting structure of the display, which is a component of the sub door.
FIG. 26 is a cross-sectional view taken along line 26-26 of FIG. 23.
FIG. 27 is a view illustrating other refrigerators to which an embodiment is applied.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0063] Hereinafter, specific embodiments will be described in detail along with the drawings. However, the disclosure cannot be said to be limited to the embodiments in which the idea of the disclosure is ed, and other disclosures that are regressive or other embodiments included within the scope of the disclosure can be easily suggested by adding, changing, or deleting other components. In addition, it should be noted in advance that, for convenience of explanation and understanding, as an example, the following embodiments only illustrate a refrigerator in which the refrigerating chamber is provided above the freezing chamber and the disclosure is not limited thereto, and the disclosure is applicable to all types of refrigerators equipped with a door including a panel assembly. In addition, it should be noted in advance that the disclosure is applicable not only to refrigerators but also to other electronic products including doors including panel assemblies. Additionally, when components included in multiple embodiments of the disclosure are the same as each other, they may be denoted by the same reference numerals to prevent duplication of description. Also, the configurations of different embodiments may be combined or replaced with each other. In an embodiment, the direction in which a front surface of the door illustrated in FIGS. 1 and 2 faces may be referred to as a front direction, the direction toward the cabinet based on the front surface of the door may be referred to as a rear direction, the direction toward the floor where the refrigerator is installed may be referred to as a lower direction, and the direction away from the floor may be referred to as an upper direction. Additionally, the direction toward the center of the panel assembly may be referred to as the inside, and the direction away from the center of the panel assembly may be referred to as the outside. In addition, when you want to talk about an undefined direction, you can redefine and explain the direction based on each drawing.

[0064] FIG. 1 is a front view illustrating a refrigerator of an embodiment of the disclosure, and FIG. 2 is a view illustrating a state where the door of the refrigerator is open.

[0065] As illustrated, the refrigerator 1 of an embodiment includes a cabinet 10 in which a storage space is formed and a door 20 that opens and closes the storage space. For example, the storage space may be divided into upper and lower sections, and a refrigerating chamber 11 may be provided at the upper portion and a freezing chamber 12 may be provided at the lower portion.

[0066] The refrigerating chamber 11 consists of one space and may be opened and closed by a pair of refrigerating chamber doors 20a. The freezing chamber

12 may be provided at the lower portion of the refrigerating chamber 11. In addition, the freezing chambers 12 and 13 may be divided into left and right sides to form independent storage spaces, and may be controlled to different temperatures. In addition, the freezing chambers 12 and 13 may be opened and closed by the pair of freezing chamber12 doors 20, respectively. Meanwhile, the refrigerating chamber 11 may be referred to as an upper storage space, and the freezing chamber 12 may be referred to as a lower storage space.

[0067] The door 20 may include a refrigerating chamber door 20a that opens and closes the refrigerating chamber 11 and a freezing chamber door 20b that opens and closes the freezing chamber 12. A pair of the refrigerating chamber doors 20a and the freezing chamber doors 20b may be provided on both left and right sides, respectively. The refrigerating chamber door 20a may be referred to as an upper door, and the freezing chamber door 20b may be referred to as a lower door.

[0068] Additionally, hinges 13 may be connected to the upper end and the lower end of the door 20. Hinges 13 and 14 are provided at the upper end and the lower end of the door 20, and may be rotatably coupled to the cabinet. Some of the doors 20 may be rotated by being coupled by hinges 13 and 14, and other doors may be configured to slide in and out.

[0069] At least one of the doors 20 may include a panel assembly 30 capable of seeing through a storage space behind the door 20. For example, the panel assembly 30 may be provided on the refrigerating chamber door 20a and may be provided on both the left and right refrigerating chamber doors 20a. Of course, the panel assembly 30 may also be provided on the freezing chamber door 20b and may be provided on at least one of the four doors 20.

[0070] The panel assembly 30 may form at least a portion of the front surface of the refrigerating chamber door 20a. The panel assembly 30 is composed of a plurality of panels 31, 32, and 33 (see

[0071] FIG. 6), and the plurality of panels 31, 32, and 33 may be transparent to be capable of seeing through. Accordingly, when the refrigerating chamber door 20a is closed, the inside of the refrigerating chamber 11 or the door storage member 27 at the rear of the refrigerating chamber door 20a may be seen through the panel assembly 30.

[0072] Hereinafter, the structure of the refrigerating chamber door 20a will be examined in more detail with reference to the drawings. In the following, the refrigerating chamber door 20a will be referred to as the door 20.

[0073] FIG. 3 is a perspective view illustrating the door, FIG. 4 is an exploded perspective view of the door viewed from the front, FIG. 5 is an exploded perspective view of the door viewed from the rear, and FIG. 6 is an exploded perspective view of a panel assembly, which is one component of the door.

[0074] As illustrated, the door 20 may include a panel assembly 30 forming the front surface of the door 20, a door liner 21 forming the rear, and an insulating material 200 filled between the panel assembly 30 and the door liner 21.

[0075] The door 20 may include an upper frame 22 and a lower frame 23 that form the upper and lower surfaces of the door 20. The upper frame 22 and the lower frame 23 may be combined with the panel assembly 30 and the door liner 21.

[0076] The door 20 may further include side frames 24 forming both left and right sides of the door 20.

[0077] The foaming liquid may be injected into the closed space formed by combining the upper frame 22, the lower frame 23, the panel assembly 30, the door liner 21, and the side frame 24 to form the insulating material 200.

[0078] A liner opening 211 may be formed in the center of the door liner 21. The liner opening 211 may penetrate the door liner 21. Additionally, the rear of the panel assembly 30 may cover the liner opening 211.

[0079] The door liner 21 may form a door dike 213 that protrudes rearward along the perimeter of the liner opening 211. In addition, a storage member mounting part 214 is formed in the inner area of the door dike 213 so that the door storage member 27 may be mounted.

[0080] Meanwhile, the door 20 may include a lighting device 25. The lighting device 25 may illuminate the storage space behind the panel assembly 30 and allow the storage space to be selectively visible through the panel assembly 30.

[0081] In other words, when the lighting device 25 is turned on, the storage space becomes bright and the storage space can be seen through the seeing-through part 311 of the panel assembly 30. In addition, when the lighting device 25 is turned off (OFF), the storage space is not visible, and the seeing-through part 311 may be seen in an opaque black color like the opaque part 312.

[0082] The lighting device 25 may be provided at the rear of the panel assembly 30. As an example, the lighting device 25 may be provided in the lighting opening 212 formed in the door liner 21. Additionally, the lighting opening 212 is located above the liner opening 211 and may irradiate light downward.

[0083] The lighting device 25 may include a light emitting member 252, a light case 251, and a light cover 253. The light emitting member 252 may include a substrate on which a plurality of LEDs are mounted. The light case 251 may be mounted on the door liner 21 to form a space for accommodating the light emitting member 252. Additionally, the light case 251 may be placed in contact with the rear of the panel assembly 30. In addition, the light cover 253 covers the light case 251 and the lighting opening 212, and allows light emitted from the light emitting member 252 to be transmitted.

[0084] The lighting device 25 may be provided on both left and right sides of the liner opening 211 rather than on the upper end of the door 20. Additionally, the lighting device 25 may be provided on one side of the storage space of the cabinet 10 instead of the door 20.

[0085] The panel assembly 30 may include a plurality of panels 31, 32, and 33 spaced apart in the front and rear direction. Additionally, the panel assembly 30 may include a plurality of insulating layers 301 and 302 (see FIG. 10). The insulating layers 301 and 302 may be referred to as an insulating space or an insulating area.

[0086] The front surface of the panel assembly 30 may form at least a portion of the front surface of the door 20. For example, the front surface of the panel assembly 30 may form the entire front surface of the door 20. Additionally, the rear of the panel assembly 30 may form a portion of the rear of the door 20 by covering the liner opening 211.

[0087] In detail, the panel assembly 30 may include a first panel 31 forming the front surface, a second panel 32 provided behind the first panel, and a third panel 33 forming the rear. The second panel 32 may be spaced apart from the first panel 31 and the third panel 33, and may be disposed between the first panel 31 and the third panel 33. The first panel may be referred to as a front panel, the second panel may be referred to as a middle panel, and the third panel may be referred to as a rear panel. The first panel 31, the second panel 32, and the third panel 33 may be made of glass and may be formed in a square plate shape.

[0088] For example, the first panel 31 may be made of tempered glass. The first panel 31 may form the entire front surface of the door 20.

[0089] A seeing-through part 311 may be formed in the center of the first panel 31, and an opaque part 312 may be formed around the seeing-through part 311. The seeing-through part 311 is a part that can be seen through and a may be formed to be transparent part. Additionally, the opaque part 312 may be formed in black and the rear components may be hidden not to be exposed. As an example, the opaque part 312 may be formed by printing. The opaque part 312 may be referred to as a bezel part.

[0090] In addition, the size of the seeing-through part 311 may be smaller than the second panel 32 and the third panel 33. Additionally, the size of the seeing-through part 311 may be smaller than the liner opening 211.

[0091] The second panel 32 may be provided behind the first panel 31. The second panel 32 may be formed of insulating glass (low-e glass). Of course, the second panel 32 may also be formed of plain glass (clear glass). The second panel 32 may be formed to a thickness that satisfies thermal insulating performance and processability. The second panel may be referred to as the vacuum panel or vacuum insulating glass (VIG).

[0092] A first spacer 34 may be provided between the first panel 31 and the second panel 32. The front surface of the first spacer 34 may be in contact with the rear of the front panel 31, and the rear of the first spacer 34 may be in contact with the front surface of the second panel 32. Additionally, the first spacer 34 may be disposed along the opaque part 312.

[0093] The first spacer 34 may be made of an adhesive material and may provide airtightness between the first panel 31 and the second panel 32. Accordingly, the first spacer 34 may also be referred to as a sealing member. Additionally, the first spacer 34 may also be referred to as a vacuum spacer.

[0094] For example, the first spacer 34 may be formed of a frit material. Additionally, the first spacer 34 may be made of frit glass or glass sealant. When the first spacer 34 is made of a frit material, the first spacer is joined between the first panel 31 and the second panel 32 by plastic processing and thus the first panel 31 and the second panel 32 may be combined in an airtight manner.

[0095] In a state where the first spacer 34 is plastic processed between the first panel 31 and the second panel 32, a first insulating layer 301 may be formed between the first panel 31, the second panel 32, and the first spacer 34. The first insulating layer 301 is in a vacuum state and may be referred to as a vacuum insulating layer. The first insulating layer 301 may block cold air from the rear of the vacuum panel 35 from being transmitted to the front thereof.

[0096] Meanwhile, a plurality of supporting members 323 may be provided within the first insulating layer 301. The supporting member 323 may have a front surface in contact with the first panel 31 and a rear in contact with the second panel 32. Additionally, the supporting member 323 may be formed to have a height corresponding to the thickness of the first insulating layer 301. The supporting member 323 may be made of a transparent material. Additionally, a plurality of the supporting members 323 may be disposed at regular intervals throughout the entire area of the first insulating layer 301.

[0097] The first insulating layer 301 may be formed to a minimum thickness that can effectively block cold air from the storage space from being transmitted. For example, the thickness of the first insulating layer 301 is approximately 0.1 mm to 1 mm, so that the overall thickness of the panel assembly 30 may be minimized while ensuring insulating performance and formability. The thickness of the first insulating layer 301 may be the same as the thickness of the first spacer 34 and the supporting member 323. The thickness of the first insulating layer 301 may be thinner than the thickness of the second insulating layer 302.

[0098] An exhaust hole 321 may be formed in the second panel 32. The exhaust hole 321 communicates with the first insulating layer 301 to exhaust air from the first insulating layer 301, and allows the first insulating layer 301 to be in a vacuum state. The exhaust hole 321 may be located in an area inside the first spacer 34.

[0099] At this time, the exhaust hole 321 may be located outside the second spacer 35. In other words, the exhaust hole 321 is provided on one side of the second panel 32 exposed to the rear of the panel assembly and may be hidden by the front opaque part 312.

[0100] A hole cover 322 may be provided in the exhaust hole 321. The hole cover 322 may be formed of a material that covers the exhaust hole 321 after the first insulating layer 301 is exhausted. As an example, the

hole cover 322 may be formed of a frit material. Additionally, the hole cover 322 may also be hidden by the opaque part 312 in a state of being mounted.

[0101] The third panel 33 may be disposed behind the second panel 32. The third panel 33 may be formed of insulating glass. Additionally, the third panel 33 may be formed to be smaller than the size of the second panel 32. Additionally, the third panel 33 may be sized to cover the liner opening 211.

[0102] A second spacer 35 may be disposed between the second panel 32 and the third panel 33. The second spacers 35 allow the second panels 32 to be spaced apart from each other to maintain a constant distance.

[0103] The second panel 32 may be adhered to the front surface of the second spacer 35, and the third panel 33 may be adhered to the rear of the second spacer 35. The second spacer 35 may be formed in the shape of a square frame with an opening in the center, and the front surface thereof may be adhered to the second panel 32 and the rear thereof may be adhered to the third panel 33. As an example, the second spacer 35 may be formed of a thermo plastic spacer (TPS) material. In other words, the second spacer may be formed of an insulating plastic material. The first spacer 341 may be made of a metal material such as aluminum.

[0104] A sealed second insulating layer 302 may be formed between the second panel 32 and the third panel 33. Insulating gas is injected into the second insulating layer 302 to ensure insulating performance. As an example, the insulating gas may be argon (Ar) gas. The thickness of the second insulating layer 302 is approximately 12 mm to 14 mm, which is the most efficient for insulation and can minimize the thickness of the panel assembly 30.

[0105] Meanwhile, the second spacer 35 may be disposed along the perimeter of the third panel 33. The second spacer 35 may be located at a position away from the end portion of the first panel 31 by a set distance L1. At this time, the distance L1 from the end portion of the first panel 31 to the second spacer 35 may be formed to be smaller than the distance L2 from the end portion of the first panel to the end portion of the seeing-through part 311, that is, the width of the opaque part 312.

[0106] The second spacer 35 may be located between the inner end of the opaque part 312 and the outer end of the first panel 31. Additionally, the second spacer 35 may be located further outside the first spacer 34.

[0107] Both first spacer 341 and the second spacer 35 are disposed behind the opaque part 312 and may be hidden by the opaque part 312 when viewed from the front.

[0108] Meanwhile, sealant 344 may be applied to the outer surface of the second spacer 35. The sealant 344 may fill the space between the second panel 32 and the third panel 33, and may form airtight space between the second spacer 35, the second panel 32, and the third panel 33. The sealant 344 may be omitted.

[0109] When the panel assembly 30 is viewed from the rear, the first panel 31 and the second panel 32 may have a shape that protrudes more outward than the third panel 33. The portion protruding from the end portion of the third panel 33 may be referred to as a protrusion. The protrusion may be formed along the perimeter of the panel assembly 30. In addition, the protrusion may extend outward and be supported by the upper frame 22, the lower frame 23, and the side frame 24. In other words, the first panel 31 and the second panel 32 may cover the front opening of the door 20 formed by combining the upper frame 22, lower frame 23, and side frame 24.

[0110] In addition, such protrusions may serve to increase the heat transfer path transmitted from the rear of the panel assembly 30. Therefore, heat loss through the panel assembly 30 may be prevented and power consumption may be reduced.

[0111] Meanwhile, a heater 26 may be disposed in the panel assembly. The heater 26 may prevent condensation from forming on the front and peripheral surfaces of the door 20. The heater may be disposed along the protrusion. In other words, the heater 26 may be disposed along the perimeter of the second panel 32 and may be in contact with the rear of the second panel 32. The heater 26 may be in contact with a portion of the perimeter of the first panel 31.

[0112] Hereinafter, the heater 26 will be examined in more detail with reference to the drawings.

[0113] FIG. 7 is a perspective view illustrating the disposition of electric wires at the upper ends of the door and the cabinet, FIG. 8 is a view illustrating the heater disposition inside the door, and FIG. 9 is a top view illustrating the heater.

[0114] As illustrated, the heater 26 may be formed in a wire shape and may be disposed along the perimeter of the panel assembly 30. Of course, if necessary, the heater 26 may have a structure such as a film or a planar heating element.

[0115] The heater 26 may generate heat partially out of the entire heater. In other words, since the heater 26 is disposed behind the first insulating layer 301, there is no need to heat the entire panel assembly 30 when cold air is not transmitted to the front of the first insulating layer 301. Accordingly, the heater 26 may be configured to partially generate heat.

[0116] For example, the heater 26 may be configured to generate heat only in portions corresponding to both left and right ends of the door. In other words, the heater 26 may be configured to generate heat only at the portion in contact with the side frame 24 made of metal. As another example, the heater 26 may be configured to generate heat only at the portion in contact with the lower frame 23. As another example, the heater 26 may be configured to generate heat at a portion in contact with the side frame 24 and the lower frame 23.

[0117] As an example, the heater 26 may include a heating part 261 extending along both left and right sides of the door 20, a lower connection part 262 connecting the lower ends of the heating part 261 on both left and

right sides, an upper connection part 263 connected to the lower ends of the heating part 261 on both left and right sides.

[0118] Additionally, the heater 26 may be configured to generate heat only from the heating part 261. In detail, the heating part 261 includes a heating wire having resistance therein, and therefore may be configured to generate heat by resistance when power is applied. The heating part 261 may be formed to have a length corresponding to the length of the side frame 24 in the vertical direction. The heating part 261 may be formed to be equal to or smaller than the length of the door 20 or the panel assembly 30 in the vertical direction. For example, the length L3 of the heating part may be shorter than the length L4 of the side frame 24 in the vertical direction and longer than the length L5 of the liner opening 211 in the vertical direction.

[0119] In addition, the upper connection part 263 and the lower connection part 262 may have lower electrical resistance than the heating part 261. The upper connection part 263 and the lower connection part 262 may serve to transmit power to the heating parts 261 on both left and right sides. Accordingly, the upper connection part 263 and the lower connection part 262 may be composed of electric wires that do not generate resistance for heat generation. Power consumption thereof can be reduced by minimizing and optimizing the heat-generating part of the heater 26.

[0120] In particular, the upper frame 22 and the lower frame 23 on which the upper connection part 263 and the lower connection part 262 are disposed may be formed of a plastic material. In addition, since the transfer of cold air to the outside of the door 20 can be blocked by the insulating material 200 and the first insulating layer 301, the upper connection part 263 and the lower connection part 262 may be configured so as not to generate heat.

[0121] The lower connection part 262 may be disposed along the lower frame 23. The upper connection part 263 may be disposed between the upper frame 22 and the rear of the second panel 32. At this time, the upper connection part 263 may extend to the entrance and exit part 221 formed in the upper frame 22. Additionally, a groove into which the upper connection part 263 is inserted may be formed on the front surface of the upper frame 22. The groove may guide the upper connection part 263 toward the entrance and exit part 221 and form a path for placing the upper connection part 263.

[0122] In detail, the upper surface of the upper frame 22 may be open and a downward recessed part 220 may be formed. In addition, the upper frame 22 may further include an upper cover 229 that covers the open upper surface of the recessed part 220 and forms the upper surface of the door 20.

[0123] An entrance and exit part 221 may be formed inside the recessed part 220 to guide the power line 14 connected to the heater 26. The entrance and exit part 221 may form a passage communicating with the inside of the door 20 through the recessed part 220. The entrance and exit part 221 may be placed close to one end connected to the hinge 13 on both left and right sides of the door 20. In other words, a hinge mounting part 222 on which the hinge 13 is mounted is formed at a side end of the upper frame 22, and the entrance and exit part 221 may be disposed on one side adjacent to the hinge mounting part 222. Accordingly, the power line 14 guided into the door 20 through the hinge 13 may be easily entered and exited.

[0124] As illustrated in FIG. 7, a hinge 13 coupled to the door 20 may be provided on the upper surface of the cabinet 10. The hinge 13 may include a hinge plate 131. One end of the hinge plate 131 may be fixed to the upper surface of the cabinet 10, and the other end thereof may be axially coupled to the hinge mounting part 222. Additionally, the hinge 13 may include a hinge cover 132 that covers the hinge plate 131.

[0125] The power line 14 connected to the heater 26 may be guided from one side of the cabinet 10 to the door 20 through the hinge cover 132 and may be guided inside the recessed part 220 of the upper frame 22. Additionally, the power line 14 may be guided from the inside of the recessed part 220 through the entrance and exit part 221 to the inside of the door 20 and connected to the heater 26.

[0126] The power line 14 may be connected to the heater 26 to supply power to the heater 26. The power line 14 may be divided into a plurality of portions and configured to be easily coupled to the heater 26 through the door 20 in the cabinet 10.

[0127] For example, the power line 14 may include a first power line 141 extending from the cabinet 10 to the door 20, and a second power line 142 connected to the heater 26 inside the door 20. The first power line 141 may extend from one side of the cabinet 10 through the hinge cover 132 to the hinge mounting part 222. Accordingly, even if the door 20 is opened or closed, the first power line 141 may be guided to the door 20 without being exposed to the outside.

[0128] The first power line 141 is guided into the recessed part 220 through the hinge mounting part 222. In addition, power line connectors 140 are provided at the end portions of the first power line 141 and the second power line 142, respectively, and the first power line 141 and the second power line 142 may be connected by combining the power line connectors 140. In other words, the first power line 141 and the second power line 142 may be connected to each other within the recessed part 220.

[0129] Additionally, the second power line 142 may be connected to the heater 26 after passing through the entrance and exit part 221. In detail, a heater connector 260 may be connected to the end portion of the second power line 142 and the end portion of the heater 26. The heater connector 260 may be provided in the upper connection part 263. Therefore, the second power line 142 may be guided to the inside of the door 20 through the

entrance and exit part 221 and may be connected to the upper connection part 263 by combining the heater connector 260.

[0130] FIG. 10 is a cross-sectional view taken along line 10-10 of FIG. 3.

[0131] Looking at the disposition of the heater 26 with reference to the drawings, the heater 26 may be mounted on the side frame 24. In detail, the heating part 261 of the heater 26 may be mounted on the side frame 24.

[0132] The side frame 24 may be made of a metal material. The side frame 24 may include a side surface portion 241 forming the outer surface of the door 20, and a panel support part 242 extending from the side surface portion 241 toward the inside of the door 20. The panel support part 242 extends from the upper end to the lower end of the side frame 24 and may support the rear of the second panel 32 from the rear. The panel support part 242 may be formed perpendicular to the side surface portion 241. Additionally, the panel support part 242 may be formed parallel to the second panel 32.

[0133] A heater groove 242a may be recessed in the panel support 242. The heater groove 242a may be formed to accommodate the heater 26. The heater groove 242a may be located at a corner portion where the panel support part 242 and the side surface portion 241 meet.

[0134] Accordingly, when the panel assembly 30 is mounted, the second panel 32 can be supported on the panel support part 242. At this time, the heater 26 may be in contact with the rear of the second panel 32 while being accommodated in the heater groove 242a. Additionally, the heater 26 may be in contact with an end portion of the second panel 32 where the first spacer 34 is located. Accordingly, cold air transmitted along the rear of the second panel 32 due to the operation of the heater 26 may be prevented from passing through the first spacer 34. In other words, the heater may be located between the outer end portion of the second panel 32 and the inner end of the first spacer 34.

[0135] Additionally, the heater 26 may prevent condensation from occurring due to cold air transmitted through the panel assembly 30. In addition, the heater 26 may minimize power consumption by generating heat only in the heating part 261 that is in contact with the side frame 24.

[0136] Meanwhile, the side frame 24 may further include a side support part 241a extending forward from the side surface portion 241. The side support part 241a may support both ends of the first panel 31. The first panel 31 may be formed to be somewhat larger than the second panel 32, and an end portion of the first panel 31 may be formed to be rounded. As another example, when the first panel 31 and the second panel 32 have the same size, the side support part 241a may support both ends of the first panel 31 and the second panel 32.

[0137] The side support part 241a protrudes further forward than the panel support part 242 and may protrude to overlap the side end of the first panel 31. At this time, the side support part 241a comes into contact with the rounded end portion of the first panel 31. Additionally, the side support part 241a may be formed so as not to protrude further than the front surface of the second panel 32. Accordingly, when viewed from the front, it may appear as if the entire front surface of the door 20 is formed by the first panel 31.

[0138] FIG. 11 is a view illustrating the heater disposition at the lower portion of the door, and FIG. 12 is a perspective view taken along line 12-12 of FIG. 3.

[0139] Looking at the disposition of the heater 26 at the lower portion of the door 20 with reference to the drawing, the lower frame 23 may have a frame front surface 232 formed behind the second panel 32. Additionally, a lower cover part 231 protruding forward may be formed at an end of the front surface 232 of the frame. The lower cover part 231 may support the first panel 31 from below. Additionally, the lower cover part 231 may protrude forward to cover the lower surface of the second panel 32 and the lower surface of the first panel 31.

[0140] Additionally, a shaft insertion part 233 into which the hinge shaft of the hinge 14 is inserted from below may be formed on one of the left and right sides of the lower frame 23. A shaft bush 234 to which the hinge shaft is coupled may be inserted inside the shaft insertion part 233.

[0141] By forming the shaft insertion part 233, a portion of the lower surface of the lower frame 23 may be formed with a lower protrusion 231a that protrudes upward in a stepped manner from the lower cover part 231. In other words, the lower end of the front surface of the lower frame 23 may be formed to be stepped by the lower cover part 231 and the lower protrusion 231a.

[0142] The heater 26 may be disposed on the upper surface of the lower protrusion 231a. Additionally, the lower end of the first panel 31 and the lower end of the second panel 32 may be formed to be stepped. In detail, the lower end of the first panel 31 is supported by the lower cover part 231, and the lower end of the second panel 32 may be in contact with the heater 26 disposed on the lower protrusion 231a. Accordingly, the heater 26 may be simultaneously in contact with the rear of the first panel 31 and the lower end of the second panel 32 when mounted on the lower frame 23. In other words, the heater 26 is disposed in the space between the first panel 31 and the second panel 32 and the lower frame 23 formed by mounting the panel assembly 30, and may be in contact with the first panel 31 and the second panel 32.

[0143] Accordingly, cold air transmitted along the second panel 32 may be in contact with the heater 26 at the lower end of the second panel 32. Additionally, cold air from the second panel 32 may no longer be transmitted to the outside when the heater 26 generates heat. Meanwhile, the heater 26 may be the lower connection part 262 that does not substantially generate heat.

[0144] Hereinafter, in the refrigerator of the embodiment of the disclosure having the above structure, the

state of cold air delivery through the panel assembly 30 will be described with reference to the drawings.

[0145] FIG. 13 is a cross-sectional view taken along line 13-13 of FIG. 3, FIG. 14 is a cross-sectional view of part A of FIG. 13, and FIG. 15 is a cross-sectional view of part B of FIG. 13.

[0146] As illustrated, when the panel assembly 30 is mounted, the first panel 31 may form the entire front surface of the door 20. Additionally, the first panel 31 and the second panel 32 may be supported on the upper frame 22, lower frame 23, and side frame 24. Additionally, the third panel 33 is supported on the door liner 21 and covers the liner opening 211.

[0147] The upper portions of the first panel 31 and the second panel 32 may be supported by the upper frame 22. The upper frame 22 may support the upper portions of the first panel 31 and the second panel 32 from above and rear when the panel assembly 30 is mounted.

[0148] In detail, an upper cover part 223 protruding forward may be formed at the upper end of the upper frame 22. The upper cover part 223 may be in contact with the upper ends of the first panel 31 and the second panel 32. The upper cover part 223 may be configured to pass over the upper end of the second panel 32 and cover the first panel 31 from above.

[0149] Additionally, the upper cover part 223 may extend beyond the upper end of the second panel 32 to cover a portion of the upper end of the first panel 31.

[0150] Additionally, the upper cover part 223 may be formed to be in contact with either the first panel 31 or the second panel 32.

[0151] Meanwhile, an upper support part 224 may be further formed on the front of the upper frame 22 to support the upper portion of the second panel 32 from the rear. The upper support part 224 may be formed on the front surface of the upper frame 22. In addition, the upper support part 224 may be located below the upper cover part 223. Additionally, the upper support part 224 may form a surface that is in contact with the rear of the second panel 32.

[0152] As an example, the upper support part 224 may be composed of a plurality of grooves and protrusions, and the front surface of the plurality of protrusions may be in contact with the rear of the second panel 32 to support it. The upper support part 224 may have a predetermined width in the vertical direction and may stably support the upper part of the second panel 32.

[0153] Therefore, when the first panel 31 and the second panel 32 are coupled to each other, they are in contact with the upper and rears of the first panel 31 and the second panel 32 by the upper frame 22 and thus a stable mounting condition may be guaranteed.

[0154] In this state, the inside of the door 20 is filled with the insulating material 200, and the inner space of the door 20 formed by combining the panel assembly 30, the upper frame 22, the lower frame 23, the side frame 24, and the door liner 21 may be filled with the insulating material 200.

[0155] By forming the first insulating layer 301 to be thin, the panel assembly 30 may be configured to have a slimmer overall thickness. In addition, the insulating material 200 filled inside the door 20 may be in contact with and support the perimeter of the panel assembly 30. In other words, the outer surface of the second spacer 35 or the outer surface of the sealant 36 may be supported by the insulating material 200.

[0156] A portion of the door liner 21 may extend from the rear of the third panel 33 to cover a portion of an end portion of the third panel 33. Additionally, the insulating material 200 may also be in contact with a portion of the rear of the third panel 33. Accordingly, the corner of the third panel 33, that is, the corner of the panel assembly 30, is in contact with the insulating material 200 from the bottom and rear, and the panel assembly 30 may be fixed more stably and firmly in a state filled with the insulating material 200.

[0157] Meanwhile, the storage space behind the door 20 can be selectively visualized through the seeing-through part 311 of the panel assembly 30 according to the on/off state of the door light 25.

[0158] In a state where the door 20 is closed, cold air inside the storage space is in contact with the third panel 33 and is prevented from being transmitted forward by the second insulating layer 302. In addition, the cold air in contact with the third panel 33 may move outward along the third panel 33, move forward along the end portion of the third panel 33 or the second spacer 35 in contact with the third panel 33, and thus be delivered to the second panel 32.

[0159] Cold air delivered to the second panel 32 is blocked by the first insulating layer 301 and cannot be transferred forward. In addition, some of the cold air delivered to the second panel 32 moves outward along the second panel 32. Cold air moved to the outer end portion of the second panel 32 may be transferred to the first spacer 34 disposed at the end portion of the second panel 32. However, cold air transmission at a location adjacent to the first spacer 34 may be blocked by driving the heater 26 disposed at the end portion of the second panel 32. Accordingly, condensation may be prevented by the first insulating layer 301 and the heater 26 disposed throughout the front surface of the door 20.

[0160] Meanwhile, as illustrated in FIG. 10, cold air delivered to both ends of the second panel 32 is not transferred forward due to the operation of the heater 26 mounted on the side frame 24. In particular, the operation of the heater 26 blocks the transfer of cold air to the side frame 24 in contact with the second panel 32, thereby preventing condensation in the side frame 24.

[0161] In addition to the above-described embodiments, the disclosure may be possible in various other embodiments.

[0162] Another embodiment of the disclosure is characterized in that the door light is in contact with the rear of the panel assembly, and the door storage member has a

structure that extends further forward. Another embodiment of the disclosure may differ only in the disposition of the door light and the structure of the door liner and door storage member, but all other configurations may be the same. Accordingly, the same components are denoted by the same reference numerals, with detailed descriptions omitted.

[0163] Hereinafter, another embodiment of the disclosure will be described in detail with reference to the drawings.

[0164] FIG. 16 is a cross-sectional view of part A of FIG. 13 of another embodiment of the disclosure, and FIG. 17 is a cross-sectional view of part B of FIG. 13 of another embodiment of the disclosure.

[0165] As illustrated, the door 20 of another embodiment of the disclosure may include the panel assembly and the door liner. Additionally, the door may further include an upper frame and a lower frame.

[0166] The upper frame 22 and the lower frame 23 may support the upper and lower portions of the panel assembly 30.

[0167] In particular, the upper frame 22 may include an upper cover part 223. The upper cover part 223 may protrude forward to cover the upper end of the first panel 31 and the upper end of the second panel 32 from above. Additionally, the upper cover part 223 may contact the upper end of the first panel 31 and the upper end of the second panel 32. Additionally, the upper cover part 223 may extend to cover the entire upper end of the second panel 32 and a portion of the first panel 31.

[0168] Additionally, the upper frame 22 may include an upper support part 224. The upper support part 224 is formed at the rear of the second panel 32 and may support the rear of the second panel 32. Therefore, in a state where the first panel 31 and the second panel 32 are combined, the upper frame 22 may support the upper end of the first panel 31 and the second panel 32 and The upper portion of the rear of the second panel 32.

[0169] Meanwhile, the lower ends of the first panel 31 and the second panel 32 and the lower part of the rear of the second panel 32 may be supported by the lower cover part 231 and the lower support part 236 of the lower frame 23.

[0170] In a state where the panel assembly 30 is mounted, the door light 25 may be in contact with the third panel 33.

[0171] The door light 25 may include a light case 251, a light emitting member 252, and a light cover 253. The light case 251 has one surface supported by the rear of the third panel 33 and may be mounted inside the door dike 213. At this time, the outer surface of the light case 251 can be spaced apart from the inner surface of the door liner 21, and a space that can be filled with the insulating material 200 may be secured.

[0172] Accordingly, the surrounding area of the door light 25 may be sufficiently insulated by the insulating material 200, and the increase in temperature inside the refrigerator may be minimized even when the door light 25 is operated. The light cover 253 covers the openings of the door liner 21 and the light case 251 and may be exposed downward.

[0173] The door light 25 is in contact with the end portion of the rear of the third panel 33 and may be in contact with the position corresponding to the disposition position of the second spacer 35. Accordingly, the heat generated when the door light 25 is operated heats the end portion of the third panel 33. Therefore, cold air transmitted to the second spacer 35 along the third panel 33 by heat generated when the door light 25 operates may be blocked.

[0174] Meanwhile, the door liner 21 may include a lower liner 216 in contact with the rear of the third panel 33. The lower liner 216 may extend downward from the rear of the third panel 33 to the door dike 213. The lower liner 216 may be disposed at a position facing the rear of the door storage member 27. Accordingly, when the door storage member 27 extends forward to the lower part of the liner 216, the volume of the door storage member 27 may be increased.

[0175] Additionally, a storage member mounting part 214 may be formed on the door dike 213. The storage member mounting part 214 may protrude from the door dike 213 on both left and right sides in a direction facing each other. When mounting the door storage member 27, the storage member mounting part 214 may be inserted into the storage member groove 271 formed on both side surfaces of the door storage member 27.

[0176] In addition, in a state where the door storage member 27 is mounted, the front end of the door storage member 27 may be positioned further forward than the lower frame 23. At this time, the front surface of the door storage member 27 may be positioned further forward from the storage member mounting part 214, and thus the door storage member 27 may be stably mounted.

[0177] Additionally, a handle groove 235 may be recessed in the lower frame 23. Additionally, a lower support part 236 extending upward may be further formed on the front surface of the handle groove 235. The lower support part 236 may be in contact with the rear of the second panel 32 and support the second panel 32 from the rear. Additionally, the second panel 32 may be in contact with the front surfaces of the lower support part 236 and the handle groove 235 at the same time.

[0178] Meanwhile, the panel assembly 30 may be formed to have a thinner thickness due to the first insulating layer 301. Also, the extension line L at the rear of the panel assembly 30 may be located within the width W of the handle groove 235. In other words, the extension line L on the rear of the panel assembly 30 may extend to pass through the handle groove 235. Therefore, the panel assembly 30 may have an overall slim structure, and by slimming the thickness of the panel assembly 30 and the door 20, it is possible to secure additional space for placing the door storage member 27.

[0179] In addition, due to the structure of the second panel 32 and the first panel 31 protruding further outward

than the third panel 33 and the second spacer 35, the transmission path of cold air moving through the panel assembly 30 may be increased, and condensation on the front surface and both side surfaces of the door 20 may be prevented through the disposition of the heater 26.

[0180] In addition to the above-described embodiments, the disclosure may have various other embodiments.

[0181] Another embodiment of the disclosure is characterized in that heaters are disposed in a plurality of rows on the side frames on both left and right sides to prevent condensation on the side surface of the door. Other embodiments of the disclosure may differ only in part of the structure of the heater, but all other configurations may be the same. Accordingly, the same components are denoted by the same reference numerals, with detailed descriptions omitted.

[0182] Hereinafter, another embodiment of the disclosure will be described in detail with reference to the drawings.

[0183] FIG. 18 is a view illustrating a state where a heater is disposed of another embodiment of the disclosure, and FIG. 18 is illustrating a state where the panel assembly is removed from the door.

[0184] As illustrated, the door 20 of another embodiment of the disclosure may include the panel assembly 30 (see FIG. 4), a door liner 21, an upper frame 22, a lower frame 23, and a side frame 24.

[0185] The panel assembly 30 forms the front surface of the door 20 and may cover the door liner 21. In addition, in a state where the panel assembly 30 is mounted, the outer end thereof may be supported by the upper frame 22, the lower frame 23, and the side frame 24.

[0186] Additionally, the door 20 may further include a heater 26'. The heater 26' is disposed in the vertical direction along the side frames 24 disposed on both left and right sides and may extend to the outside of the door 20 through the upper frame 22.

[0187] The heater 26' may include a heating part 261' and a connection part. The heating part 261' may heat both left and right ends of the side frame 24 and the panel assembly 30. The heating part 261' may be disposed on the side frame 24. Additionally, the heating parts 261' may be disposed in a plurality of rows in the vertical direction. For example, the heating parts 261' may be disposed in two rows and may be continuously bent at the lower end of the side frame 24 to extend in the vertical direction. At this time, a heater groove 242a may be formed in the side frame 24, and the heater groove 242a may be formed to accommodate a plurality of rows of heating parts 261'.

[0188] The connection part 262' is for supplying power to the heating part 261', is connected to the upper end of the heating part 261', and may extend to the entrance and exit part 221 of the upper frame 22. The connection part 262' may be formed to have a lower resistance than the heating part 261'. For example, the connection part 262' may be configured to supply power to the heating part 261' without generating heat.

[0189] Each connection part 262' is connected to the heating parts 261' on both left and right sides, and the connection part 262' may extend to the outside of the upper frame 22 through the entrance and exit part 221. At this time, the upper frame 22 may be provided with a power line 14 extending from the cabinet 10, and the power line 14 and the connection part may be connected to each other by a heater connector 260.

[0190] In this way, the side frame 24 made of metal may be heated by the heaters 26' disposed in a plurality of rows on both sides of the side frame 24. And both ends of the side frame 24 in contact with the heating part 261' can be heated. Accordingly, it is possible to prevent condensation from forming on the left and right sides of the door 20 and the left and right sides of the front surface due to cold air transmitted through the left and right sides of the panel assembly 30. In addition, there is an advantage in that unnecessary power consumption is reduced and intensive heating is possible at the point where condensation occurs due to the heating parts 261' disposed in a plurality of rows on the side frame 24.

[0191] In addition to the above-described embodiments, the disclosure may have various other embodiments.

[0192] Another embodiment of the disclosure is characterized in that the door consists of a main door and a sub door, and a panel assembly and a heater are disposed on the sub door. Another embodiment of the disclosure has the same panel assembly as the above-described embodiment, and the same components are denoted by the same reference numerals without detailed description.

[0193] Hereinafter, another embodiment of the disclosure will be described in detail with reference to the drawings.

[0194] FIG. 19 is a view illustrating a state where the sub door of a refrigerator is opened of another embodiment of the disclosure, FIG. 20 is an exploded view illustrating a state where the panel assembly of the sub door is separated, FIG. 21 is a cross-sectional view taken along line 21-21 of FIG. 19, and FIG. 22 is a cross-sectional view taken along line 22-22 of FIG. 19.

[0195] As illustrated in the drawing, at least one of the doors 20a of another embodiment of the disclosure may be configured as a double door structure consisting of a main door 60 and a sub door 50. For example, both of the pair of refrigerating chamber doors 20a may be configured as a double door structure.

[0196] In detail, the main door 60 is axially coupled to the cabinet 10 by hinges 13 and 14 (see FIG. 2). The main door 60 can open and close the refrigerating chamber 11 by rotating. Additionally, an opening 600 may be formed in the main door 60. The opening 600 penetrates the main door 60 in the front and rear direction and may communicate with the refrigerating chamber 11. Therefore, even when the main door 60 is closed, the refrigerating chamber 11 may be accessed through the opening 600.

[0197] Meanwhile, a door storage space 610 in which a door storage member 612 is provided may be provided inside the opening 600. Accordingly, the door storage space 610 and the door storage member 612 may be seen through the panel assembly 30.

[0198] The sub door 50 may be axially coupled to the main door 60 by a hinge device 15. Additionally, the sub door 50 may rotate to cover the main door 60 from the front. The sub door 50 may open and close the opening 600.

[0199] The sub door 50 may include a panel assembly 30, and may be configured to see the storage spaces 610 and 11 behind the door 20 through the panel assembly 30.

[0200] Additionally, a transparent display may be provided between the plurality of panels constituting the panel assembly 30 to enable screen output. Accordingly, both seeing-through and screen output of the storage spaces 610 and 11 may be possible through the panel assembly 30 of the sub door 50.

[0201] Looking at the structure of the sub door 50 in more detail, the sub door 50 may include a panel assembly 30, a door liner 51, an upper frame 52, a lower frame 53, and a side frame 54.

[0202] The panel assembly 30 forms the front surface of the sub door 50 in a state of being installed and may cover the liner opening 511 formed in the door liner 51. The panel assembly 30 may include a first panel 31, a second panel 32, and a third panel 33 that are sequentially disposed in the front and rear direction. Additionally, a first spacer 34 may be provided between the first panel 31 and the second panel 32 to form a first insulating layer 301. The first insulating layer 301 may be a vacuum insulating layer. A second spacer 35 may be provided between the second panel 32 and the third panel 33 to form a second insulating layer 302. The second insulating layer 302 may be filled with insulating gas.

[0203] Additionally, the first panel 31 and the second panel 32 may extend further outward than the third panel 33 to form a protrusion. Accordingly, the cold air on the rear of the third panel 33 moves along the third panel 33, the second spacer 35, and the second panel 32, thereby increasing the heat transfer path, and thus loss of cold air may be prevented.

[0204] Since the specific structure of the panel assembly 30 is the same as the above-described embodiment, detailed description thereof will be omitted.

[0205] A heater 26 may be provided at the rear of the panel assembly 30. The heater 26 may be disposed along the inner perimeter of the sub door 50. As an example, the heater 26 may be disposed along the upper frame 52, lower frame 53, and side frame 54.

[0206] The heater 26 may include a heating part 261, a lower connection part 262, and an upper connection part 263. The lower connection part 262 and the upper connection part 263 may have a smaller electrical resistance than the heating part 261. In addition, the lower connection part 262 and the upper connection part 263 do not generate heat and may only perform the function of transmitting power to the heating part 261. Since the structure of the heater 26 is the same as the above-described embodiment, the detailed description thereof will be omitted.

[0207] A heater connector 260 is provided at the end portion of the upper connection part 263, and the heater connector 260 may be located at a position corresponding to the entrance and exit part 221 of the upper frame 52. In addition, a power line 14 connected to the heater 26 may be disposed inside the entrance and exit part 521. The power line 14 and the upper connection part 263 may be connected to each other by a heater connector 260.

[0208] A portion of the heater 26 may extend in the vertical direction along the side frame 54. Additionally, a portion of the heater 26 may extend in the left and right directions along the lower frame 53.

[0209] In detail, the side frame 54 may include a side surface portion 541 forming a side surface of the sub door 50 and a panel support part 542 supporting the second panel 32. A side protrusion 541a that protrudes further forward than the panel supporter 542 is formed on the side surface portion 541 to support the outer end of the first panel 31.

[0210] Additionally, a heater groove 542a is formed in the panel support part 542, and the heater 26 may be disposed in the heater groove 542a. The heater groove 542a may be formed at a corner where the panel support part 542 and the side surface portion 541 are in contact with each other.

[0211] In addition, in a state where the panel assembly 30 is mounted, the heating part 261 may be in contact with the rear of the second panel 32 and the side frame 54. Therefore, when the heating part 261 generates heat, cold air transmitted along the second panel 32 may be blocked from being transmitted to the side frame 54 and the first panel 31. Of course, the side frame 54 may be made of plastic material.

[0212] The lower frame 53 may include a lower surface portion 531 that forms the lower surface of the sub door 50, and a lower support part 532 that extends upward from the lower surface portion 531 and supports the second panel 32. Additionally, the lower surface portion 531 may further include a lower cover part 531a that protrudes further forward than the lower support part 532. The lower support part 532 may be in contact with the lower end of the first panel 31 and may be spaced apart from the lower end of the second panel 32.

[0213] The heater 26 may be disposed inside the space formed by the first panel 31, the second panel 32, the lower cover part 531a, and the lower support part 532. Accordingly, the lower connection part 262 may be disposed in a space where the rear of the first panel 31, the lower surface of the second panel 32, and the lower frame 53 are in contact with each other.

[0214] Meanwhile, the double door structure as in the embodiment of the disclosure may be applied to the refrigerating chamber door 20a of the refrigerating cham-

ber door 20a and the freezing chamber door 20b. In addition, only one refrigerating chamber door 20a of the pair of refrigerating chamber doors 20a may be configured as a double door structure. In addition, the panel assembly 30 may be disposed only on one side of the refrigerating chamber door 20a of the refrigerating chamber doors 20a on both sides. Of course, if necessary, the freezing chamber door may also be configured to have a double door structure.

[0215] In addition to the above-described embodiments, the disclosure may have various other embodiments.

[0216] Another embodiment of the disclosure is characterized in that a display device that may be operated by touch is mounted on the upper surface of the door. Another embodiment of the disclosure may differ only in the display device and a portion combined with the display device, and all other configurations may be the same. Accordingly, the same components are denoted by the same reference numerals, with detailed descriptions omitted.

[0217] Hereinafter, another embodiment of the disclosure will be described in detail with reference to the drawings.

[0218] FIG. 23 is a front view illustrating a sub door of another embodiment of the disclosure, FIG. 24 is a perspective view taken along line 24-24 of FIG. 23, FIG. 25 is a cross-sectional view illustrating the mounting structure of the display, which is a component of the sub door, and FIG. 26 is a cross-sectional view taken along line 26-26 of FIG. 23.

[0219] As illustrated, the door 50' may have the same structure as the sub door 50 of the above-described embodiment.

[0220] The door 50' may include a panel assembly 30, a door liner 51, an upper frame 52, a lower frame 53, and a side frame 54.

[0221] The panel assembly 30 may have the same structure as the above-described embodiment. The panel assembly 30 forms the front surface of the sub door 50 in a state of being installed and may cover the liner opening 511 formed in the door liner 51. The panel assembly 30 may include a first panel 31, a second panel 32', and a third panel 33 that are sequentially disposed in the front and rear direction. Additionally, a first spacer 34 may be provided between the first panel 31 and the second panel 32' to form a first insulating layer 301. The first insulating layer 301 may be a vacuum insulating layer. A second spacer 35 may be provided between the second panel 32' and the third panel 33 to form a second insulating layer 302. The second insulating layer 302 may be filled with insulating gas.

[0222] Additionally, the first panel 31 and the second panel 32' may extend further outward than the third panel 33 to form a protrusion. Accordingly, the cold air on the rear of the third panel 33 moves along the third panel 33, the second spacer 35, and the second panel 32', thereby increasing the heat transfer path, and thus the loss of cold air may be prevented.

[0223] A display device 28 may be provided on the rear of the first panel 31. In addition, the display device 28 may be visualized through the first panel 31. Additionally, a manipulation may be input to the display device 28 by touching the first panel 31.

[0224] Meanwhile, the seeing-through part 311 may be formed in the center of the first panel 31, and an opaque part 312 may be formed around the seeing-through part 311. In addition, the opaque part 312 may be removed at a position of the opaque part 312 corresponding to the display device 28 to form a transparent display part 313. The display device 28 may be seen through the display part 313.

[0225] The display device 28 may be mounted on the upper frame 52. A downward frame recessed part 524 may be formed on the upper surface of the upper frame 52. The frame recessed part 524 may be depressed to accommodate the display device 28. In addition, the upper frame 52 may be further provided with a cover that covers the frame recessed part 524 in a state where the display device 28 is mounted.

[0226] A frame opening 525 may be formed on the front surface of the frame recessed part 524. The frame opening 525 may correspond to the size of the front surface of the display device 28. Additionally, the frame opening 525 may be formed at a position corresponding to the display part 313. Therefore, when the display device 28 is mounted, the display device 28 may be disposed on the rear of the first panel 31 through the frame opening 525 and exposed through the display part 313.

[0227] The display device 28 may include a case 280 that accommodates the PCB 283 and a display 284 provided on the front surface of the case 280. A touch sensor 285 may be provided on the front surface of the display 284. When a user touches the first panel 31, the touch sensor 285 may detect it. The touch sensor 285 may be integrated into one component of the display 284. Additionally, the touch sensor 285 may be placed separately on one side away from the display 284.

[0228] Additionally, the case 280 may include a front part 281 and a rear part 282. The front part 281 forms a front surface and the display 284 may be mounted thereon. In addition, the rear part 282 may form the back side. Additionally, an elastic part 282a may be formed on the rear part 282 to press the display device 28 forward. The elastic part 282a extends upward from the lower end of the rear of the case 280 and may extend toward the rear as it extends upward. Additionally, the elastic part 282a may be formed of an elastically deformable material. Therefore, when the display device 28 is inserted into the frame recessed part 524, the elastic part 282a may be in contact with the inner surface of the case 280 and thus the front surface of the case 280, that is, the display 24 may be in close contact with the rear of the first panel 31 through the frame opening 525.

[0229] Meanwhile, the upper end of the second panel 32' may extend further upward than the third panel 33.

Additionally, the upper end of the second panel 32' may extend lower than the first panel 31. The upper end of the second panel 32' may be extended to be in contact with the lower surface of the upper frame 52. Accordingly, the first insulating layer 301 formed between the first panel 31 and the second panel 32' may be formed up to the lower end of the upper frame 52.

[0230] In other words, the second panel 32' may be formed lower than the first panel 31 at the portion where the display device 28 is placed. Accordingly, the display device 28 may be in direct contact with the first panel 31, and a touch manipulation of the first panel 31 made of plain glass or tempered glass can be recognized by the touch sensor 285. The touch sensor 285 is composed of a capacitance sensor and can effectively detect touch manipulation of the first panel 31.

[0231] The upper end of the second panel 32' may extend to be in contact with the lower surface of the upper frame 52. Additionally, a downwardly protruding panel restraint part 529 may protrude downward from the lower surface of the upper frame 52. The panel restraint part 529 extends to be in contact with the upper end of the rear of the second panel 32' and may restrain the second panel 32'.

[0232] A handle groove 535 may be recessed in the lower surface of the lower frame 53. Therefore, the door 50' may be rotated by holding the handle groove 535.

[0233] The side frame 54 may be formed of a metal material. Additionally, the side frame 54 may be formed by continuously bending a plate-shaped metal material multiple times.

[0234] In detail, the side frame 54 may form a side surface part 541 and a panel support part 542 extending from the inner surface of the side surface part 541 to support the first panel 31. Additionally, the heater groove 543 in which the heater 26 is accommodated may be recessed in the panel support part 542. Additionally, a side support part 541a extending further forward than the panel support part 542 and supporting the side end of the first panel 31 may be formed on the side surface portion 541. The side surface portion 541, the panel support part 542, the heater groove 543, and the side support part 541a may be integrally formed by continuously bending or forming a plate-shaped metal material.

[0235] Meanwhile, the second panel 32' may be formed to be positioned between the end portion of the third panel 33 and the end portion of the panel support 542 so as not to interfere with the panel support 542.

[0236] The door liner 51 may form the rear of the door 50'. Additionally, a liner opening 511 that is covered by the third panel 33 may be formed in the center of the door liner 51. In addition, a door dike 513 may be formed along the perimeter of the liner opening 511, and a storage member mounting part 514 on which the door storage member 27 is mounted may be formed in the door dike 513.

[0237] Additionally, a door light 55 may be mounted on the door liner 51. The door light 55 may include a light case 551 mounted on the door liner 51, a light emitting member 552 accommodated inside the light case 551, and a light cover 553 which covers an opening surface of the light case 551.

[0238] The door light 55 may be disposed on both left and right sides of the liner opening 511 and may emit light in directions facing each other. Additionally, a light opening 515 into which the door light 55 is mounted may be formed in the door liner 51. The door light 55 may be in contact with the rear of the third panel 33 in a state of being installed.

[0239] Additionally, a heater 26 may be disposed along the perimeter of the panel assembly 30. The heater 26 may be in contact with the rear of the second panel 32' and may be disposed along the side frame 54 and the lower frame 53. In addition, the heater 26 may be connected to a power line flowing through the upper frame 52 to generate heat.

[0240] Meanwhile, due to the stepped extension structure of the first panel 31, the second panel 32', and the third panel 33 around the panel assembly 30, the cold air from the third panel 33 cannot move to the first panel 31 in the shortest distance, and the heat transfer path becomes longer. Therefore, power consumption may be reduced by preventing loss of cold air in the storage space.

[0241] The operation of the heater 26 may prevent cold air from being transmitted to the side frame 54 made of metal. Additionally, it is possible to prevent condensation from occurring on the front surface of the first panel 31.

[0242] Meanwhile, the panel assembly and doors including the panel assembly of the embodiment of the disclosure may be applied to refrigerators having various structures.

[0243] FIG. 27 is a view illustrating other refrigerators to which an embodiment of the disclosure is applied.

[0244] As illustrated in FIG. 27 (a), the refrigerator 2 of an embodiment of the disclosure may include a cabinet 10 forming a storage space and a door 20 opening and closing the storage space.

[0245] The storage space may include a refrigerating chamber 11 and a freezing chamber 12 formed on both left and right sides. Additionally, the door 20 may include a refrigerating chamber door 20a that opens and closes the refrigerating chamber 11 and a freezing chamber door 20b that opens and closes the freezing chamber 12. Additionally, the refrigerating chamber door 20a and the freezing chamber door 20b may be disposed side by side on both left and right sides.

[0246] Additionally, the panel assembly 30, similar to the above-described embodiment, may be disposed on the refrigerating chamber door 20a to provide visibility into the storage space. The refrigerating chamber door 20a may have a double door structure of a main door and a sub door, as in the above-described embodiment.

[0247] Additionally, the panel assembly 30 may be provided on the freezing chamber door 20b.

[0248] As illustrated in FIG. 27 (b), the refrigerator 3 of an embodiment of the disclosure may include a cabinet

10 forming a storage space and a door 20 opening and closing the storage space.

[0249] The storage space may be divided in the vertical direction to form an upper storage space 11a and a lower storage space 12a. For example, the upper storage space 11a may be a refrigerating chamber and the lower storage space 12a may be a freezing chamber.

[0250] In addition, the door 20 is provided with an upper door 20c that opens and closes the upper storage space 11a by rotation and may be provided with lower doors 20d and 20e that open and close the lower storage space 12a by pulling in and out.

[0251] In addition, the panel assembly 30, similar to the above-described embodiment, may be disposed on the upper door 20c to see through the storage space. The upper door 20c may have a double door structure of a main door and a sub door, as in the above-described embodiment.

[0252] As illustrated in FIG. 27 (c), the refrigerator 4 of an embodiment of the disclosure may include a cabinet 10 forming a storage space and a door 20 opening and closing the storage space.

[0253] The storage space may be divided in the vertical direction to form an upper storage space 11b and a lower storage space 12b. For example, the upper storage space 11b may be a freezing chamber, and the lower storage space 12b may be a refrigerating chamber.

[0254] In addition, the door 20 may be provided with an upper door 20f that opens and closes the upper storage space 1 1b by rotation and may be provided with a lower door 20g that opens and closes the lower storage space 12b by rotation.

[0255] In addition, the panel assembly 30, similar to the above-described embodiment, may be disposed on the lower door 20g to see through the storage space. The lower door 20g may have a double door structure of a main door and a sub door, as in the above-described embodiment.

[0256] As illustrated in FIG. 27 (d), the refrigerator 5 of an embodiment of the disclosure may include a cabinet 10 in which a storage space is formed and a door 20h that opens and closes the storage space 11c.

[0257] The storage space 11c may be configured as a single space, and the storage space 11c may be opened and closed by a rotating door 20h.

[0258] In addition, the panel assembly 30, similar to the above-described embodiment, may be disposed on the door 20g to see through the storage space. The door 20g may have a double door structure of a main door and a sub door, as in the above-described embodiment.

[0259] Meanwhile, panel assemblies and doors including panel assemblies of embodiments of the disclosure may be applicable to home appliances with various structures in addition to refrigerators. As an example, the panel assembly and the door including the panel assembly of an embodiment of the disclosure may also be applied to home appliances which are equipped with a door that opens and closes the space of a cabinet such as a washing machine, dryer, plant cultivation device, air conditioner, styler (clothing care machine), and cooking appliance.

Claims

1. A refrigerator comprising:

a cabinet (10) forming a storage space; and
a door (20) configured to open and close the storage space, wherein the door (20) includes:

a door liner (21) forming a rear of the door (20) and having a liner opening (211);
a panel assembly (30) having a plurality of transparent panels (31, 32, 33); and
an insulating material (200) filled inside the door (20) excluding the panel assembly (30), wherein the panel assembly (30) includes:

a first panel (31) forming a front surface of the door (20);
a second panel (32) provided at a rear side spaced apart from the first panel (31) and forming a first insulating layer (301) between the second panel (32) and the first panel (31); and
a third panel (33) provided at the rear side spaced apart from the second panel (32) to cover the liner opening (211) and forming a second insulating layer (302) between the third panel (33) and the second panel (32), and
wherein the first insulating layer (301) is formed to be larger than the second insulating layer (302) and protrudes further than an end portion of the second insulating layer (302).

2. The refrigerator of claim 1, wherein the panel assembly (30) includes:

a first spacer (34) disposed between the first panel (31) and the second panel (32); and
a second spacer (35) disposed between the second panel (32) and the third panel (33), and
wherein the first spacer (34) is disposed farther from the center of the panel assembly (30) than the second spacer (35).

3. The refrigerator of claim 1 or 2, wherein the first insulating layer (301) is configured in a vacuum state,

wherein the second insulating layer (302) is configured to be filled with insulating gas, and

wherein the thickness of the first insulating layer (301) is thinner than the thickness of the second insulating layer (302).

4. The refrigerator of any one of the preceding claims, wherein the door (20) includes:

an upper frame (22) forming an upper surface;
a lower frame (23) forming a lower surface; and
a side frame (24) configured to connect the upper frame (22) and the lower frame (23) and forming both left and right sides,
wherein the door liner (21) is coupled to the rear ends of the upper frame (22), the lower frame (23), and the side frame (24), and
wherein the panel assembly (30) is coupled to front ends of the upper frame (22), the lower frame (23), and the side frame (24).

5. The refrigerator of any one of the preceding claims, wherein the door (20) includes a heater (26) contacted with the second panel (32), and the heater (26) is disposed along a perimeter of the first insulating layer (301).

6. The refrigerator of claim 5, wherein the side frame (24) is formed of a metal material, and wherein a heater groove (242a) in which the heater (26) is accommodated is recessed in the side frame (24).

7. The refrigerator of claim 5 or 6, wherein the heater (26) includes:

a heating part (261) configured to generate heat while being in contact with the side frame (24) on both left and right sides;
a lower connection part (262) connected to lower ends of the heating parts (261) on both sides, and
an upper connection part (263) connected to upper ends of the heating part (261) on both sides, and
wherein the lower connection part (262) and the upper connection part (263) have lower electrical resistance than the heating part (261).

8. The refrigerator of any one of the claims 5 or 6, wherein the heater (26) includes:

a heating part (261) bent into a plurality of rows along the side frame (24), and
a connection part connected to the upper ends of the heating part (261) on both sides and configured to supply power.

9. The refrigerator of any one of the preceding claims 5-8, wherein at least a portion of the heater (26) is disposed to be in contact with a rear of the first panel (31) and an end portion of the second panel (32).

10. The refrigerator of any one of the preceding claims 4-9, wherein a recessed handle groove (235) is formed on the lower surface of the lower frame (23) to open the door (20), and
wherein an extension line (L) of the rear of the third panel (33) is configured to pass through the handle groove (235), preferably the lower frame (23) extends upward from one side of the handle groove (235) to form a lower support part (236) supporting the second panel (32) from the rear.

11. The refrigerator of any one of the preceding claims, wherein the door (20) further includes a display device (28) configured to display an operating state of the refrigerator.

12. The refrigerator of claim 11, wherein the door (20) further includes
an upper frame (22) forming an upper surface of the door (20); wherein the upper frame (22) includes:

a frame recessed part (524) recessed downward from an upper surface of the upper frame (22); and
a frame opening (525) opened at the front surface of the frame recessed part (524) and to which the rear of the first panel (31) is exposed, and
wherein the display device (28) is inserted into the frame recessed part (524) and is mounted to be in contact with the rear of the first panel (31) through the frame opening (525).

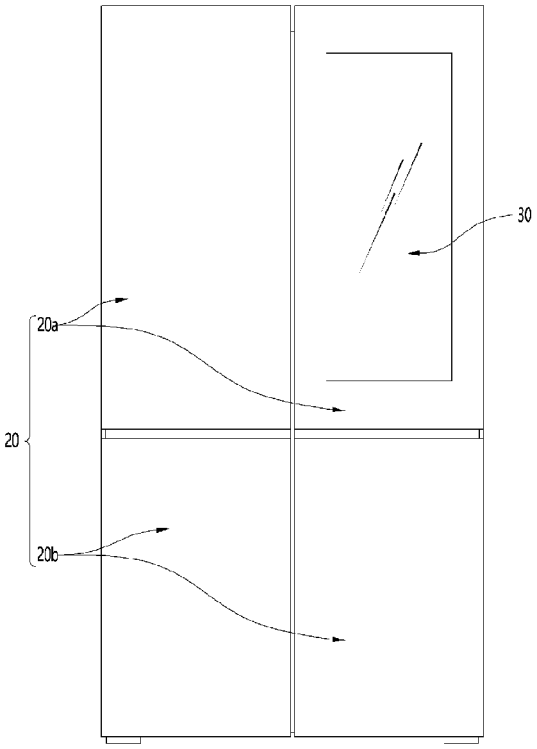
13. The refrigerator of claim 11 or 12, wherein the display device (28) includes a touch sensor (285), the touch sensor (285) is configured to detect a manipulation when the first panel (31) is touched.

14. The refrigerator of any one of the preceding claims, wherein an upper end of the second panel (32) extends more upward than the third panel (33) and extends to be in contact with a lower end of the upper frame (22).

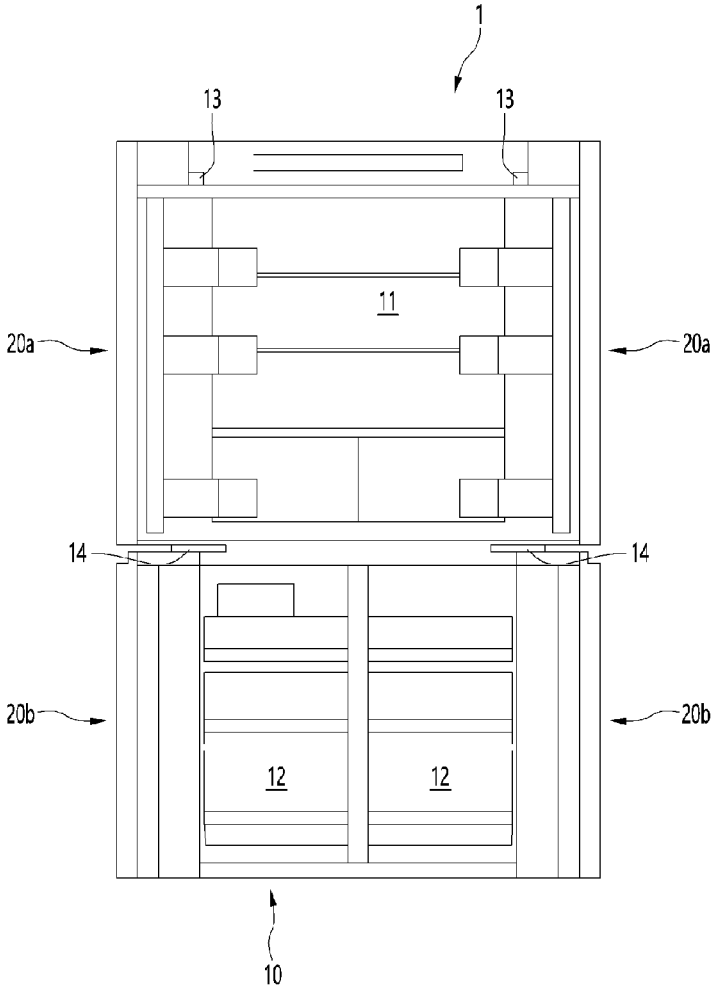
15. The refrigerator of any one of the preceding claims, wherein the door (20) includes:

a main door (60) configured to open and close the storage space and having an opening (600); and
a sub-door (50) provided in front of the main door (60) and configured to open and close the opening (600), wherein the panel assembly (30) is provided in the sub door (50).

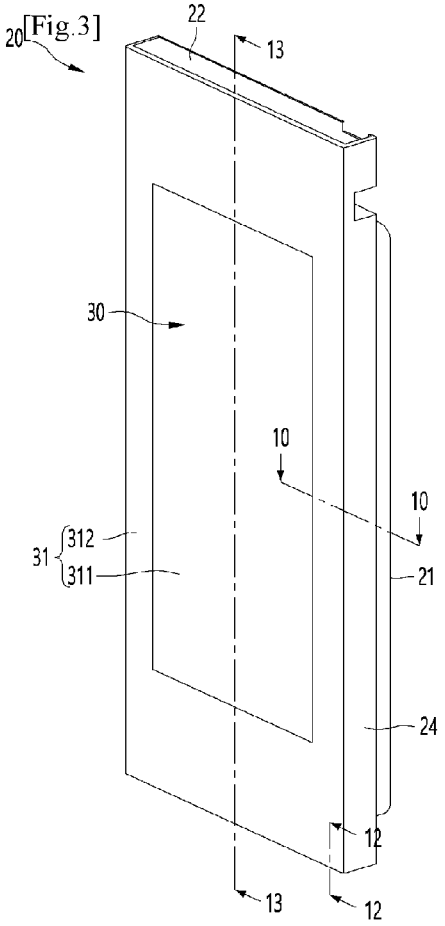
[Fig. 1]



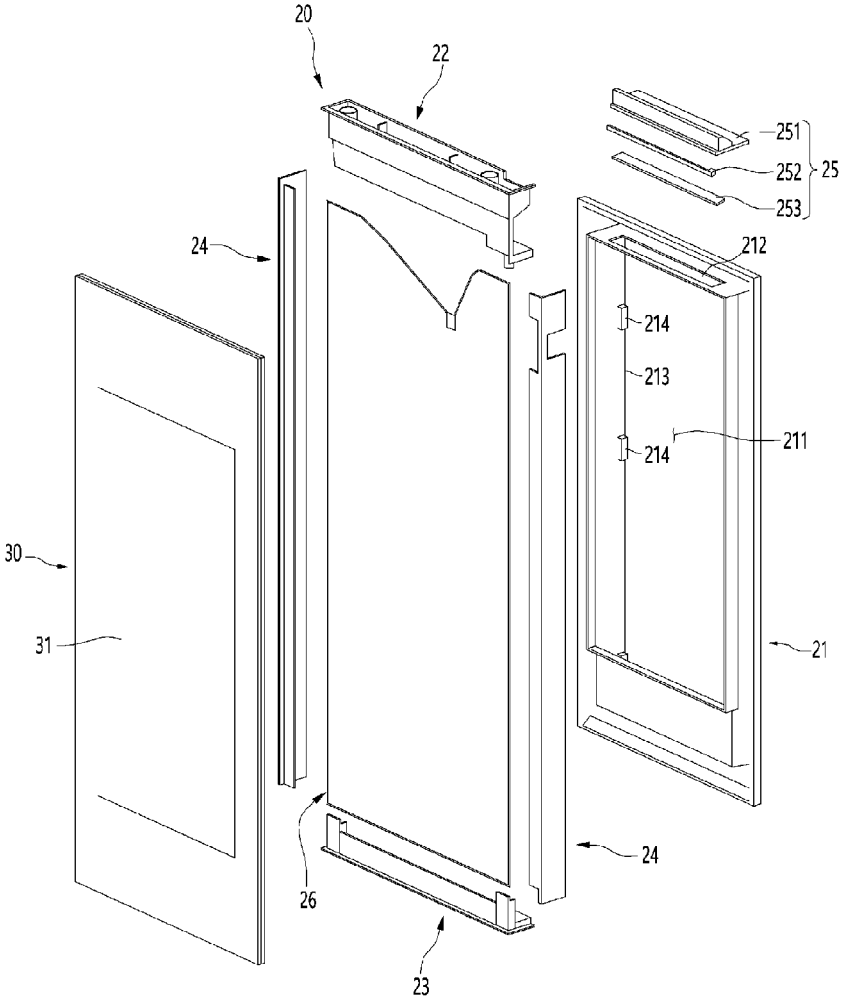
[Fig. 2]



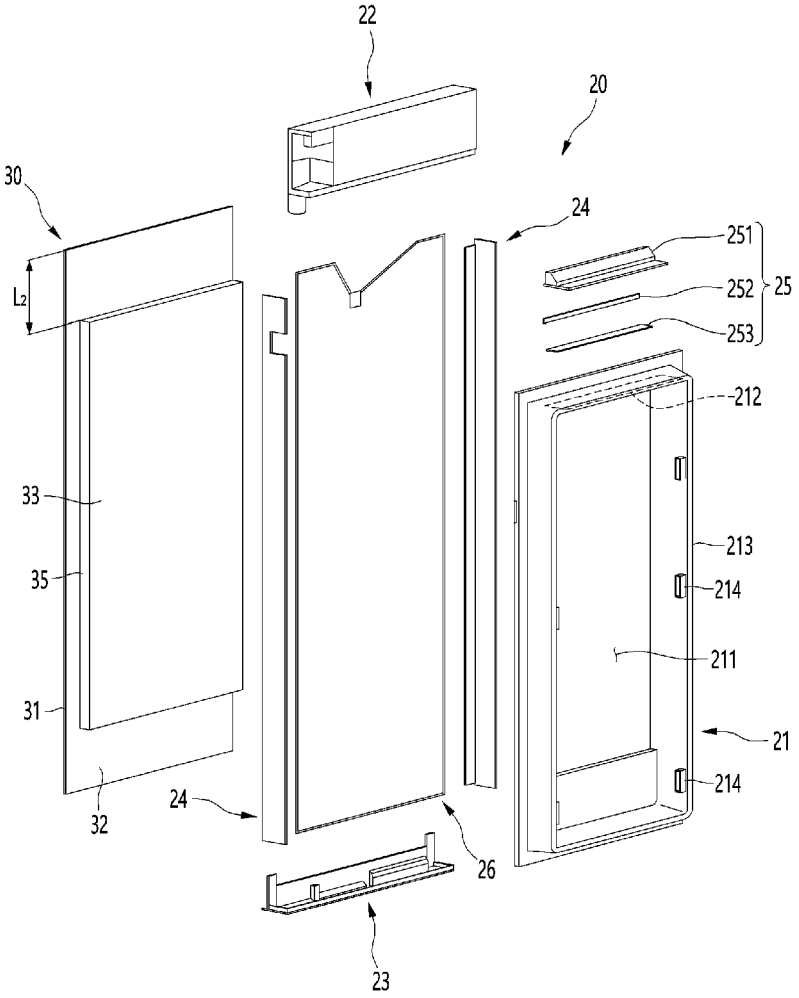
[Fig.3]


20
22
13
30
10
10
31
312
311
21
24
12
13
12

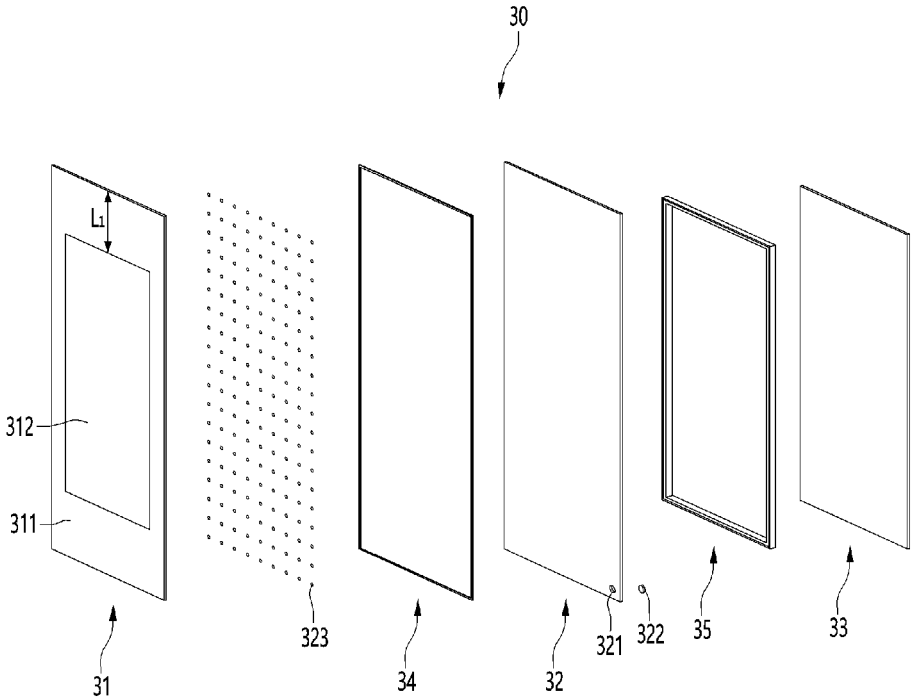
[Fig. 4]


20
22
251
252
253
25
24
212
214
213
214
211
30
31
21
24
26
23

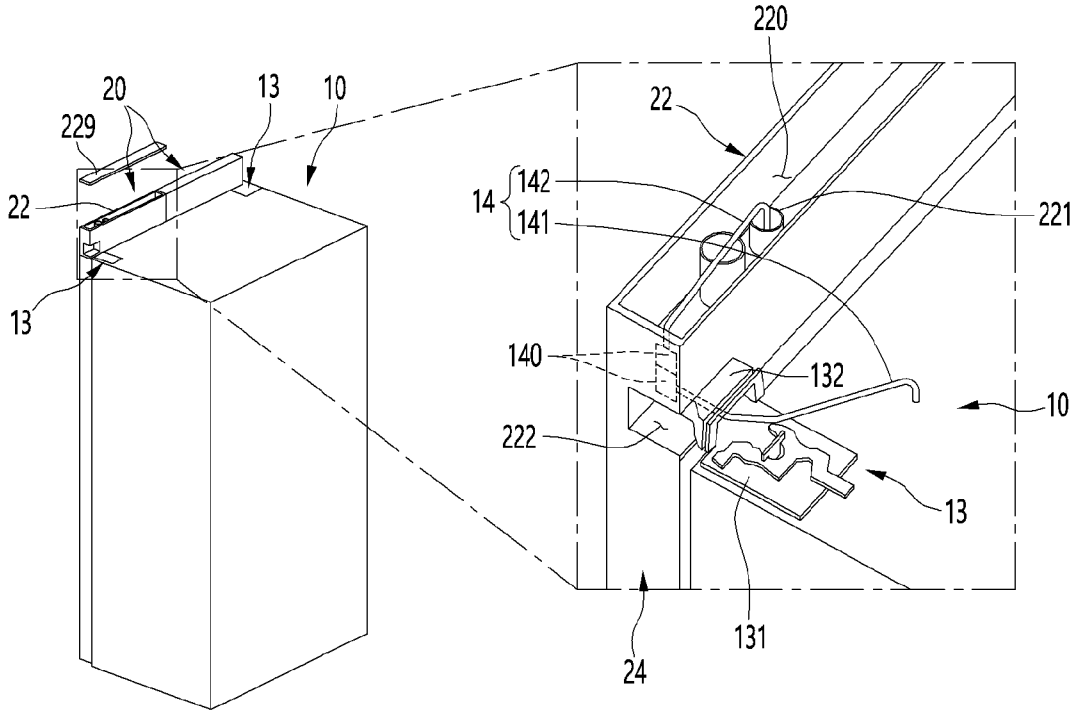
[Fig. 5]


22
20
30
24
251
252
253
25
L2
212
33
213
35
214
211
31
21
214
24
32
26
23

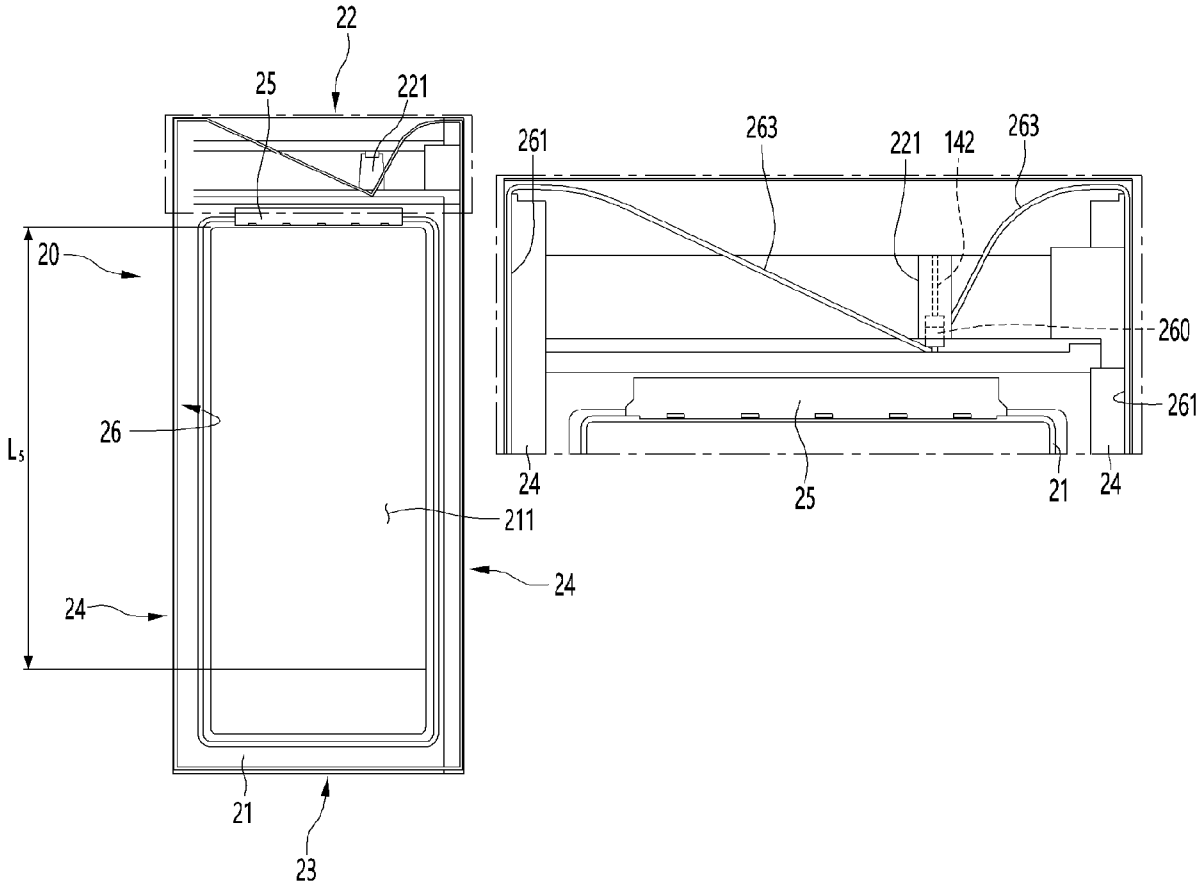
[Fig. 6]


30
L1
312
311
31
323
34
32
321
322
35
33

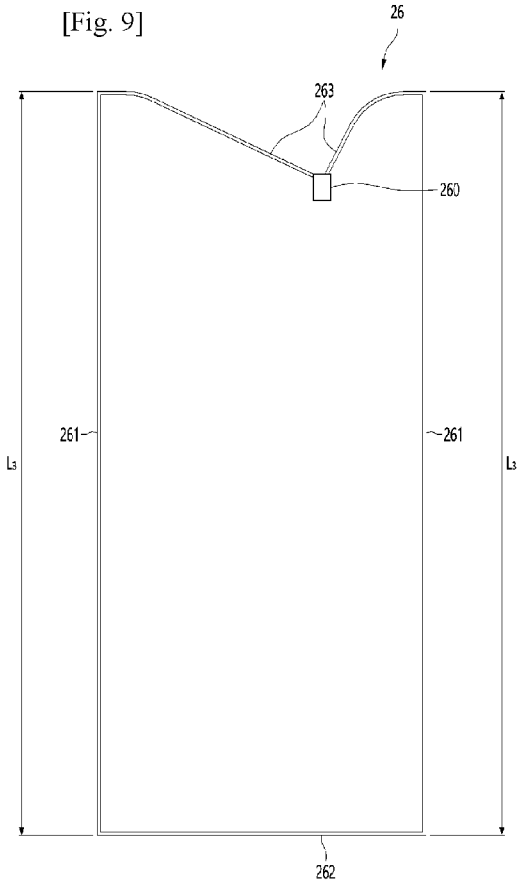
[Fig. 7]


220
22
20
13
10
229
22
13
14
142
141
221
140
132
10
222
13
131
24

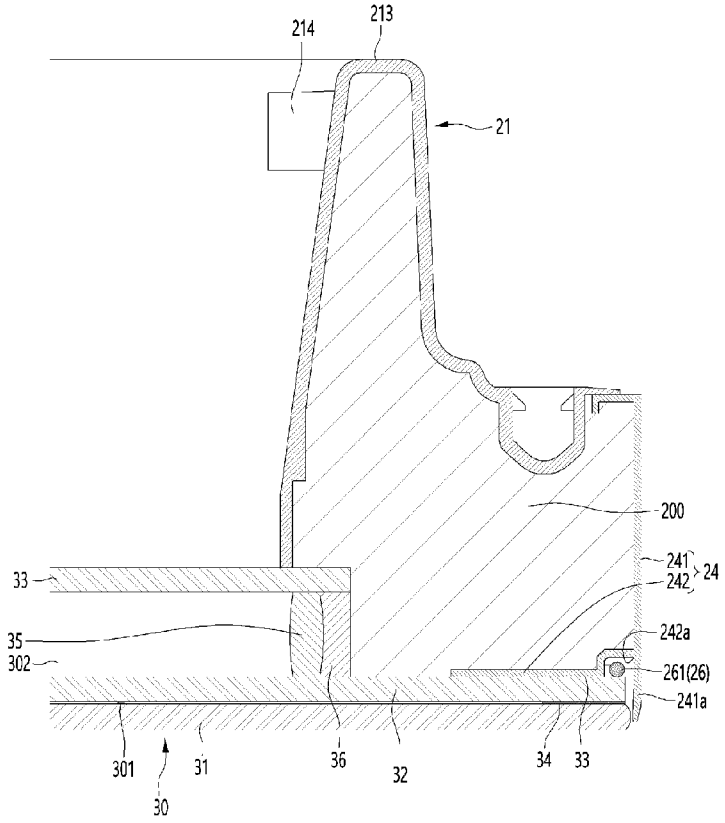
[Fig. 8]


22
25
221
261
263
221
142
263
20
260
26
261
L_5
24
25
21
24
211
24
24
21
23

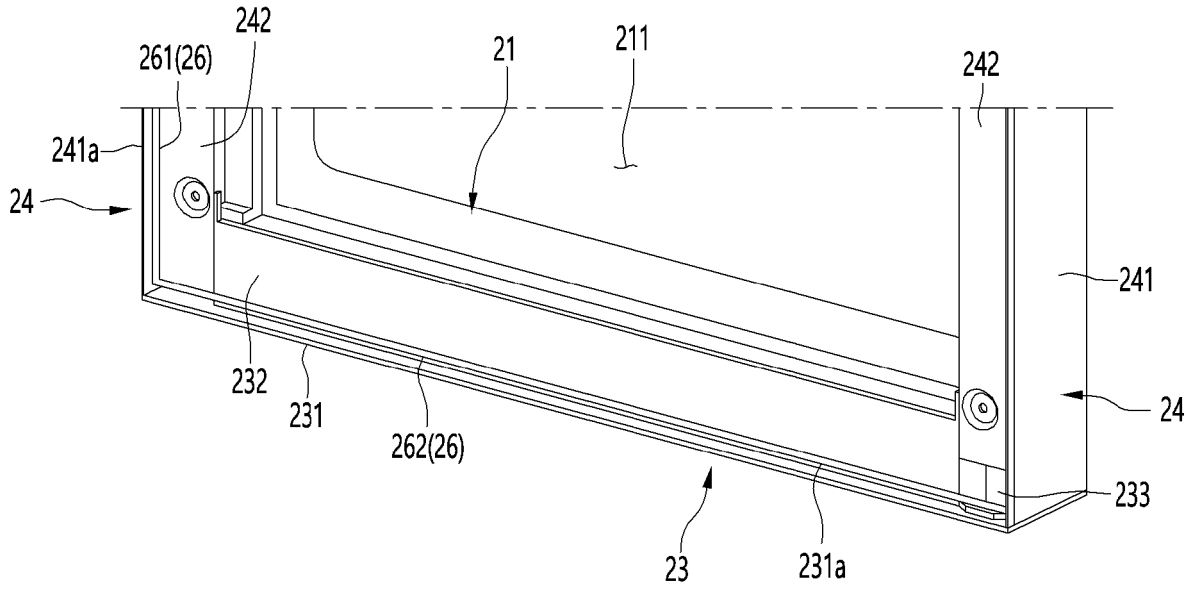
[Fig. 9]


26
263
260
261
261
L3
L3
262

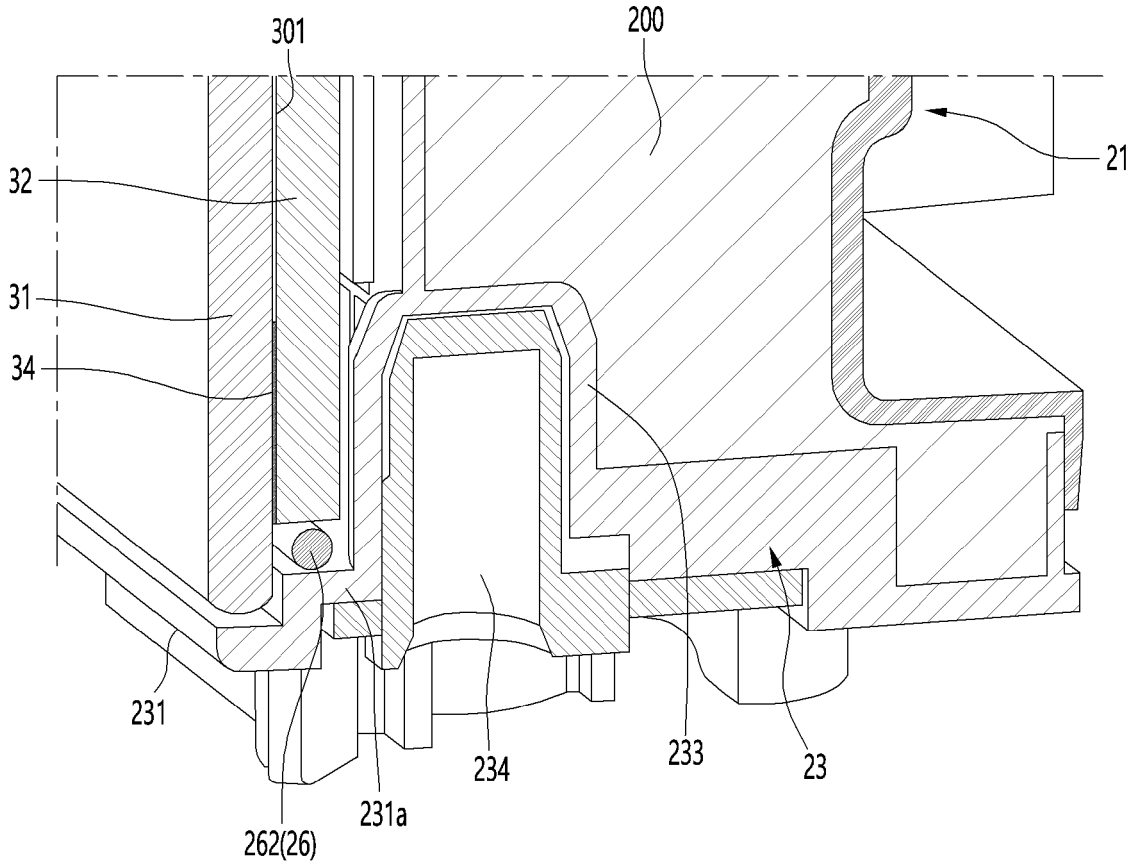
[Fig. 10]


214
213
21
200
241
242
24
33
35
302
242a
261(26)
241a
301
31
36
32
34
33
30

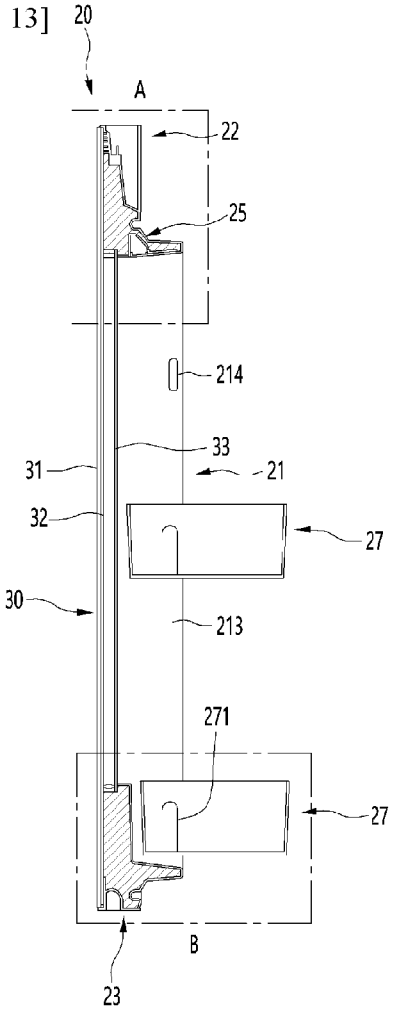
[Fig. 11]


242
261(26)
21
211
242
241a
24
241
24
232
231
262(26)
233
23
231a

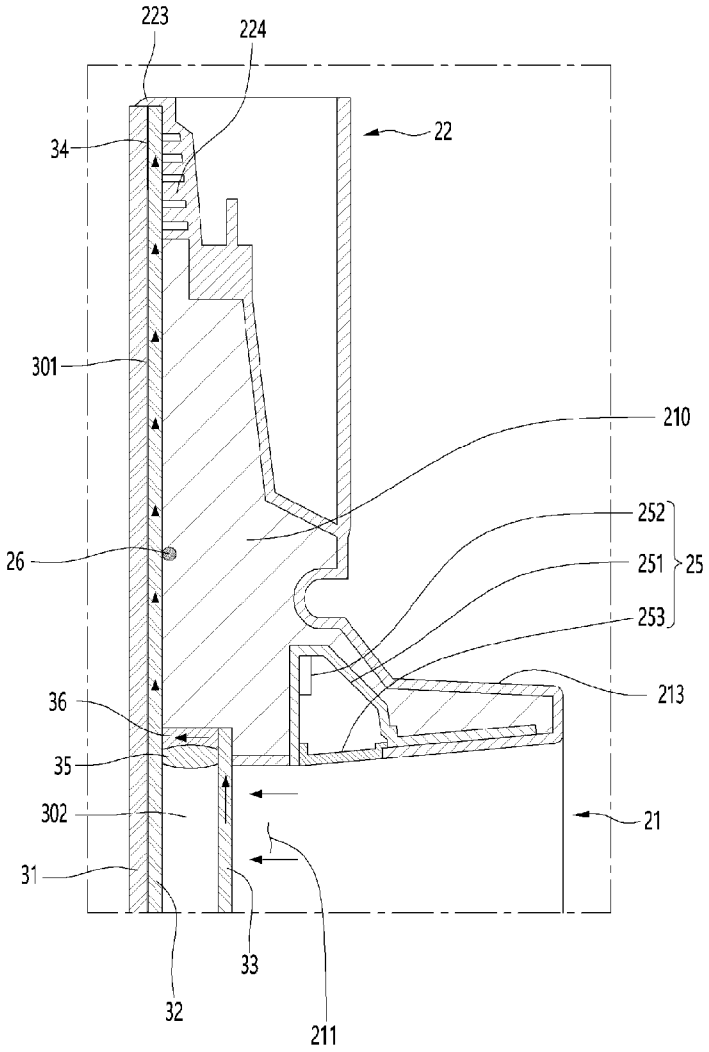
[Fig. 12]


301
200
21
32
31
34
231
234
233
23
231a
262(26)

[Fig. 13]


20
A
22
25
214
33
31
21
32
27
30
213
271
27
B
23

[Fig. 14]


223
224
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301
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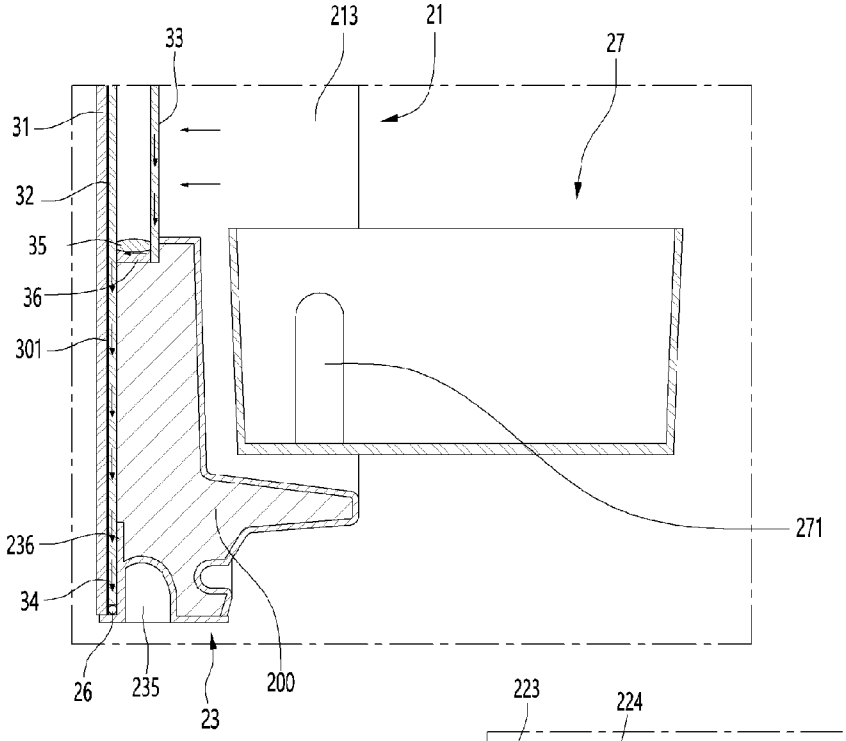
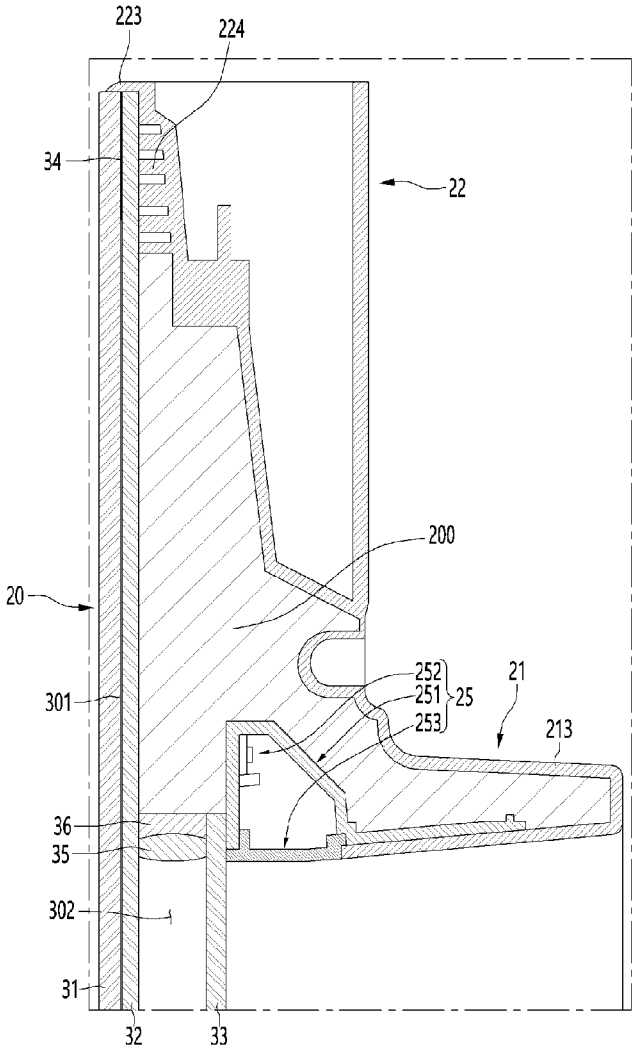
251
25
253
213
36
35
302
21
31
33
32
211

[Fig. 15]


213
21
33
27
31
32
35
36
301
271
236
34
26
235
23
200

[Fig. 16]


223
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200
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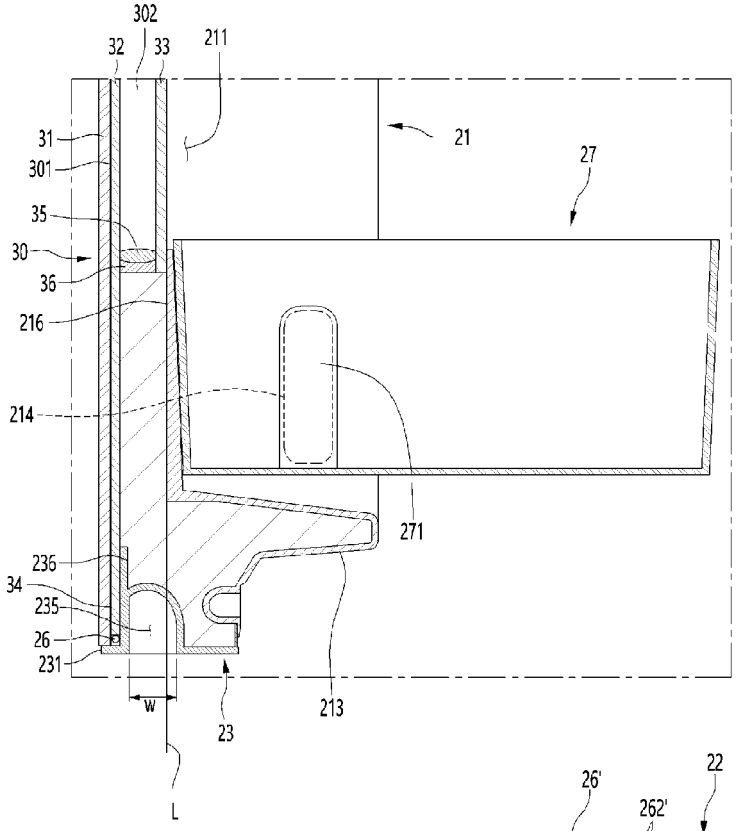
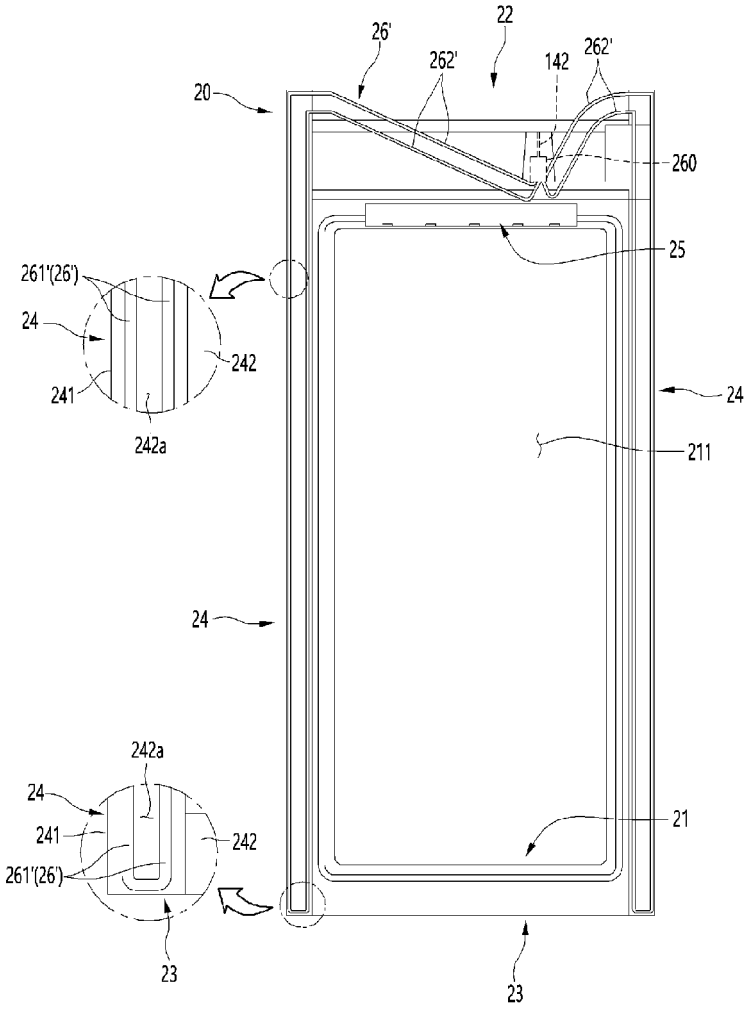
253
25
21
213
301
36
35
302
31
32
33

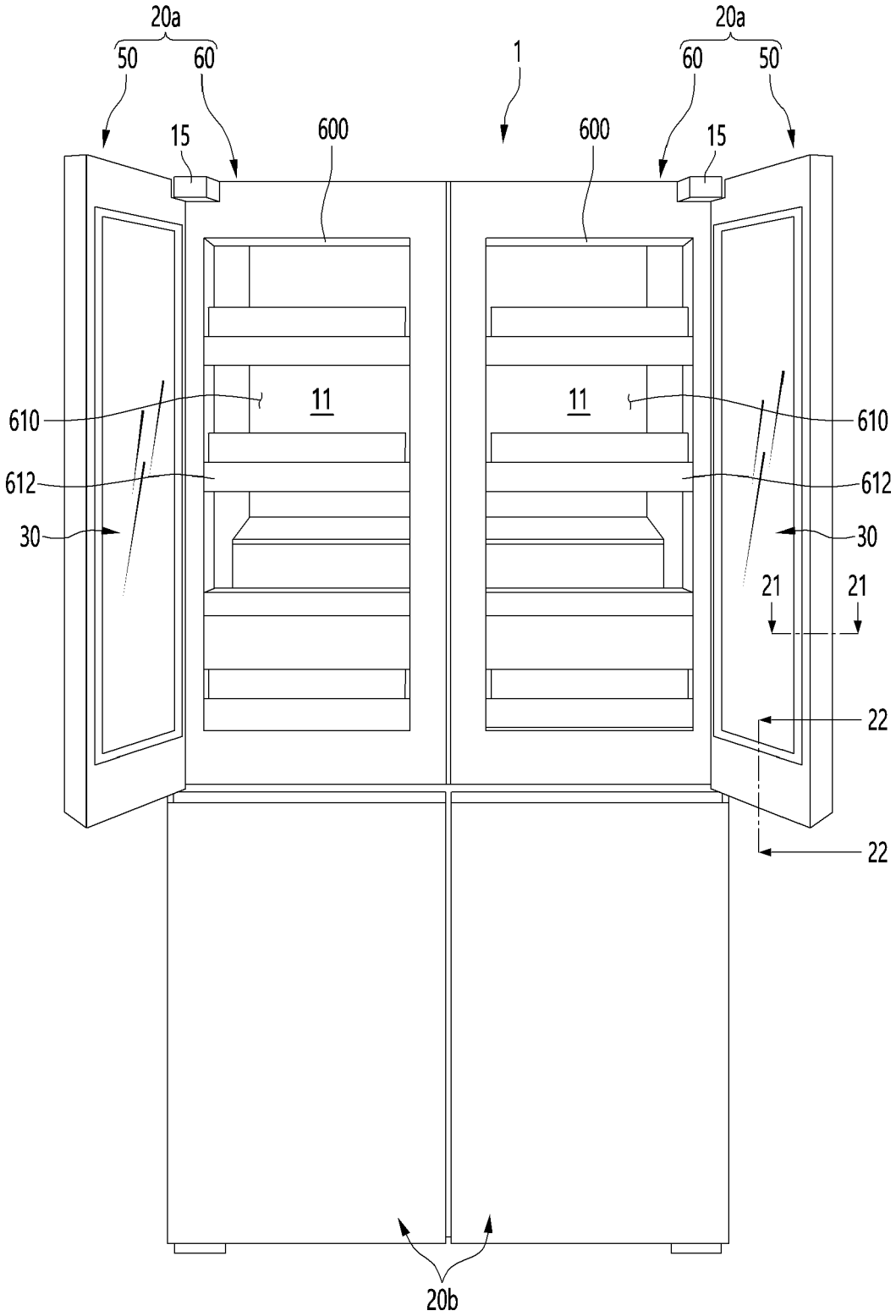
[Fig. 17]


302
32
33
211
31
301
35
30
36
216
214
21
27
271
236
34
235
26
231
w
23
213
L

[Fig. 18]


22
26'
262'
142
262'
20
260
25
261'(26')
24
242
241
242a
24
211
24
242a
24
241
242
261'(26')
21
23
23

[Fig. 19]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1
20a
60
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11
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612
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610
612
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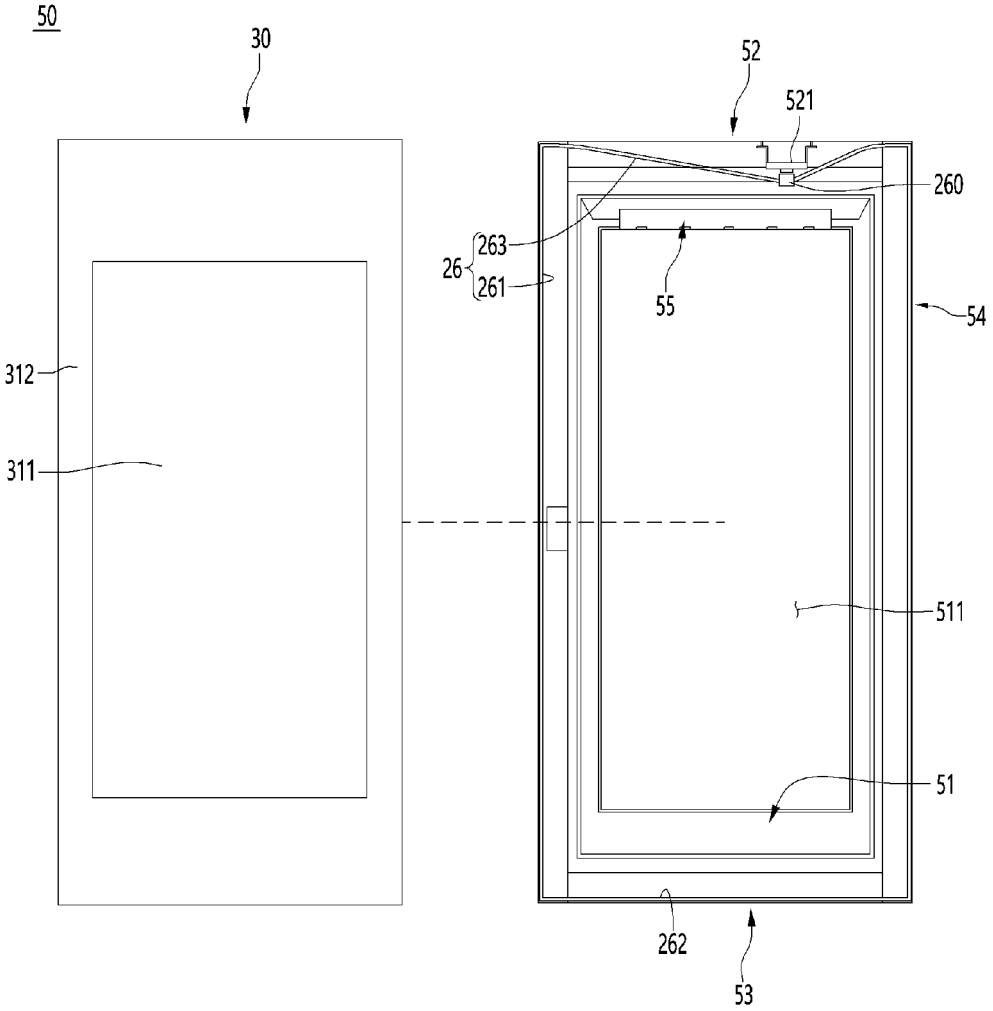
21
21
22
22
20b

[Fig. 20]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521
260
263
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261
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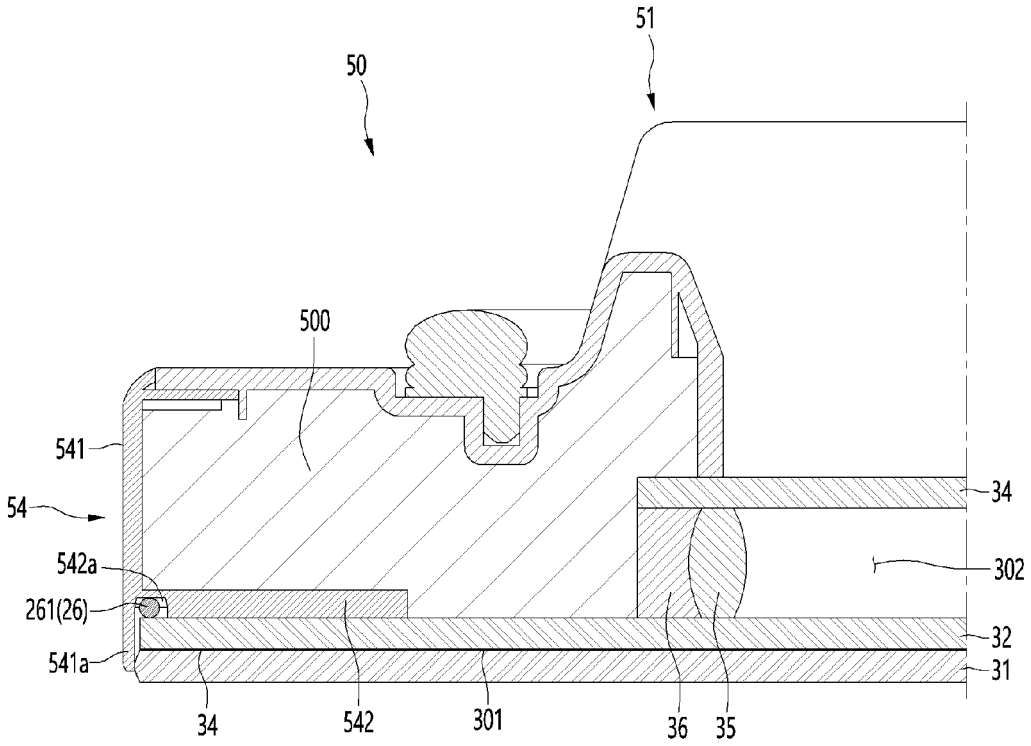
54
312
311
511
51
262
53

[Fig. 21]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261(26)
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542
301
36
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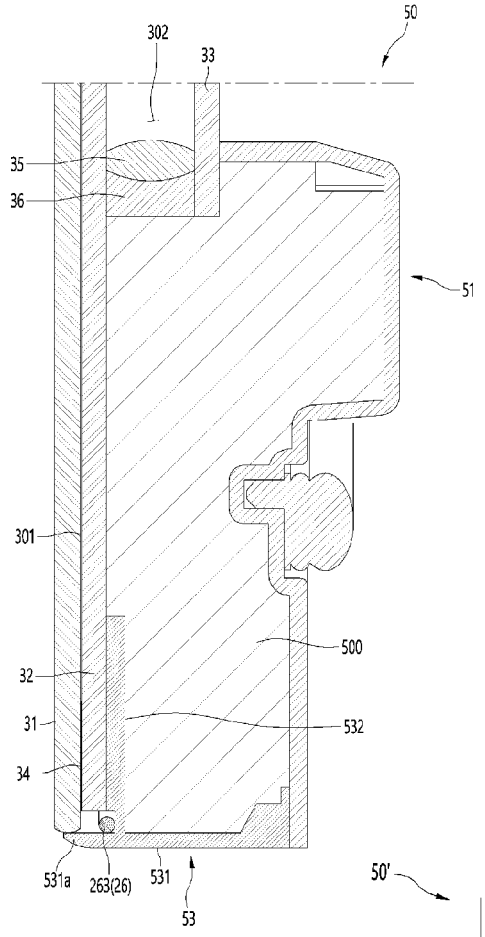
34
302
32
31

[Fig. 22]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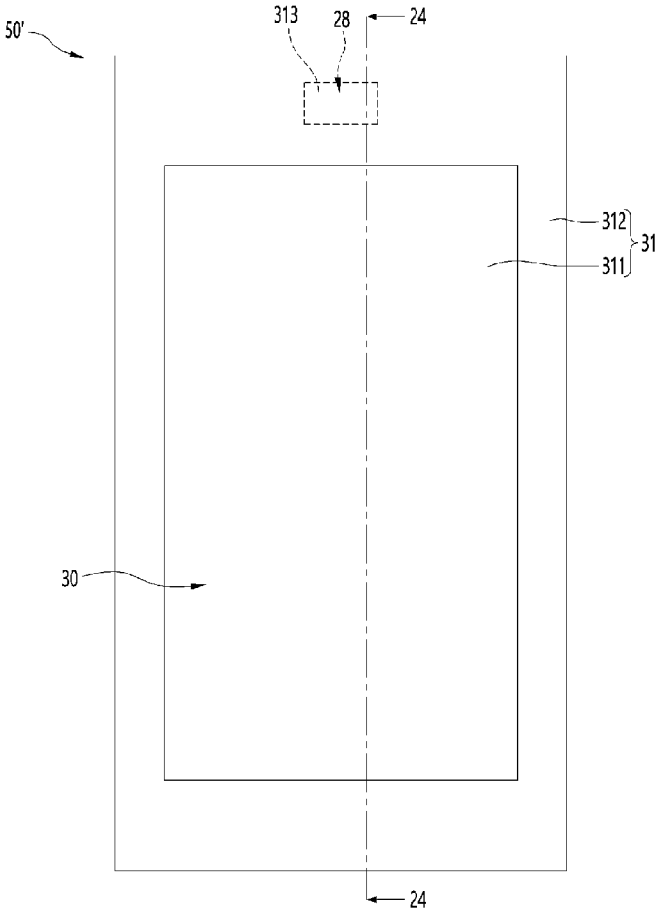
531a
263(26)
531
53

[Fig. 23]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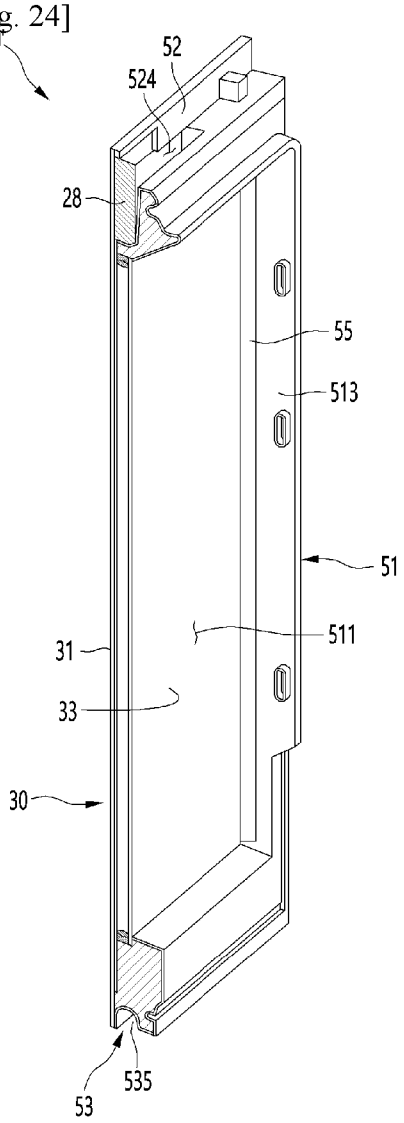
311
30
24

[Fig. 24]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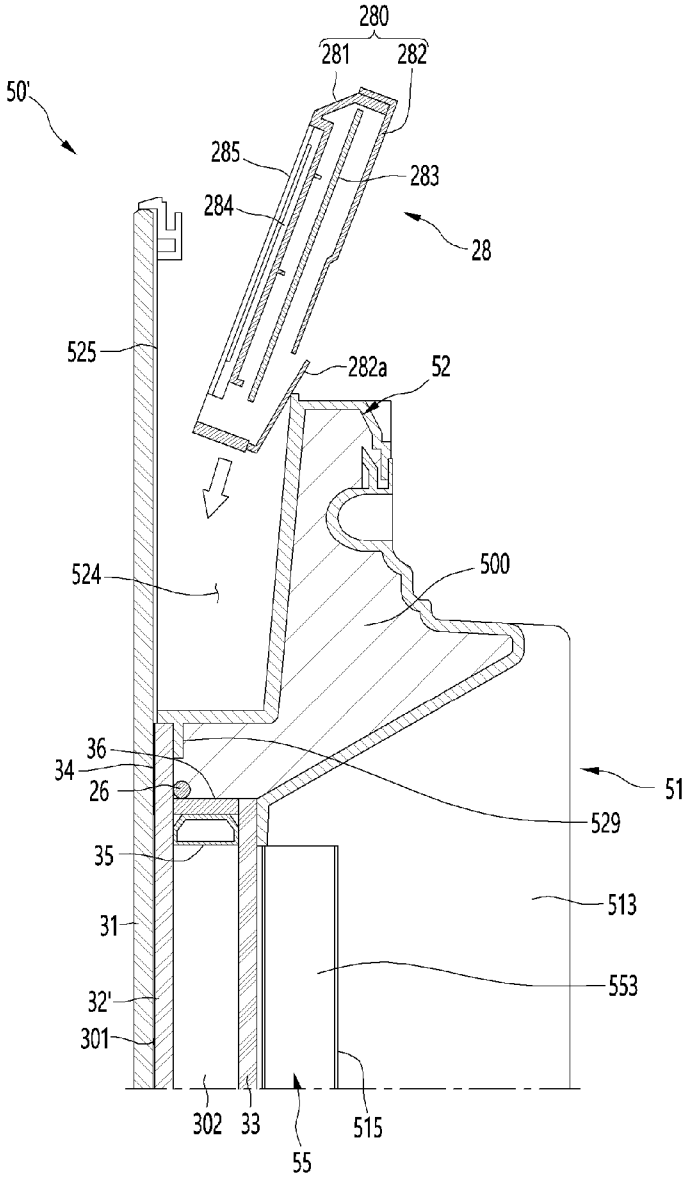
51
511
31
33
30
535
53

[Fig. 25]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282
50'
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28
525
282a
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524
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51
529
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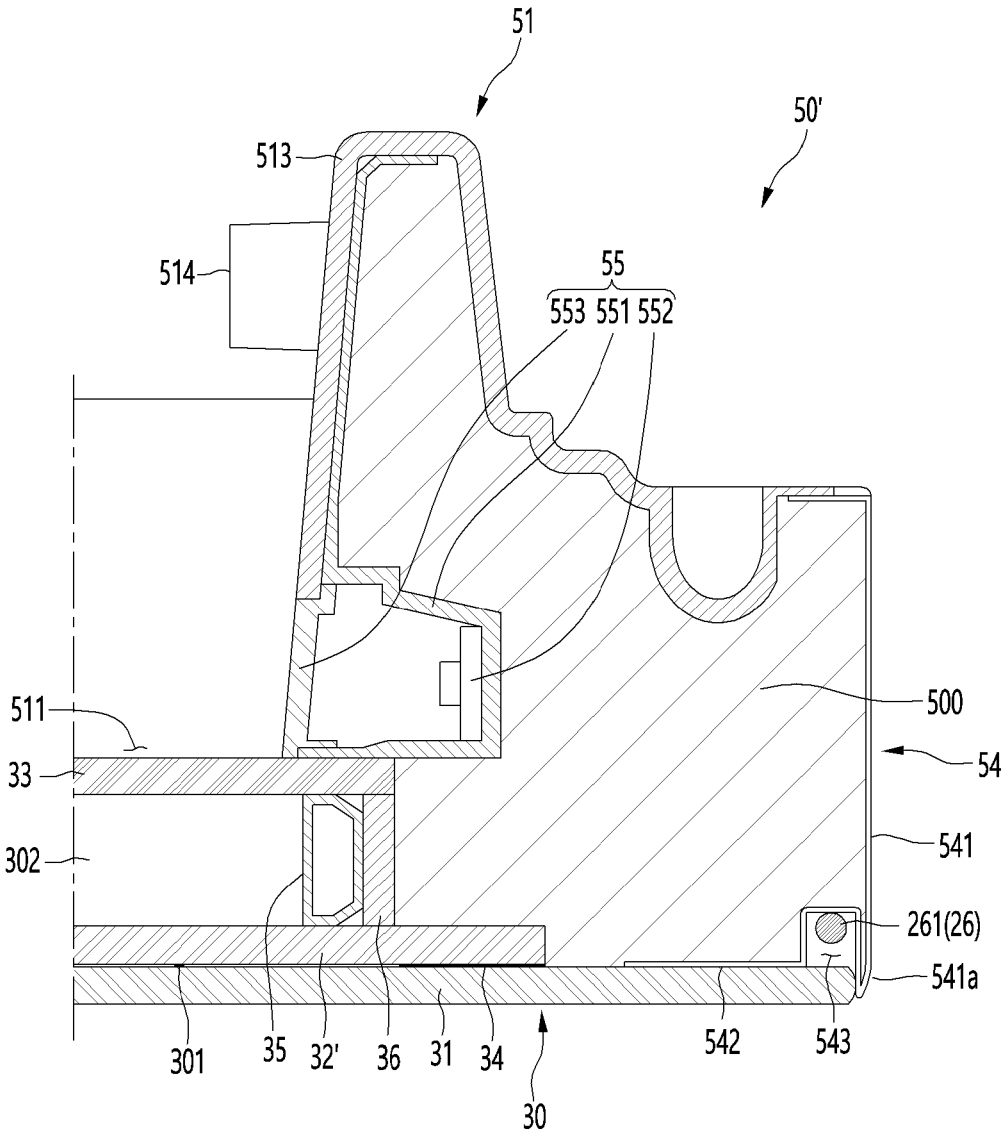
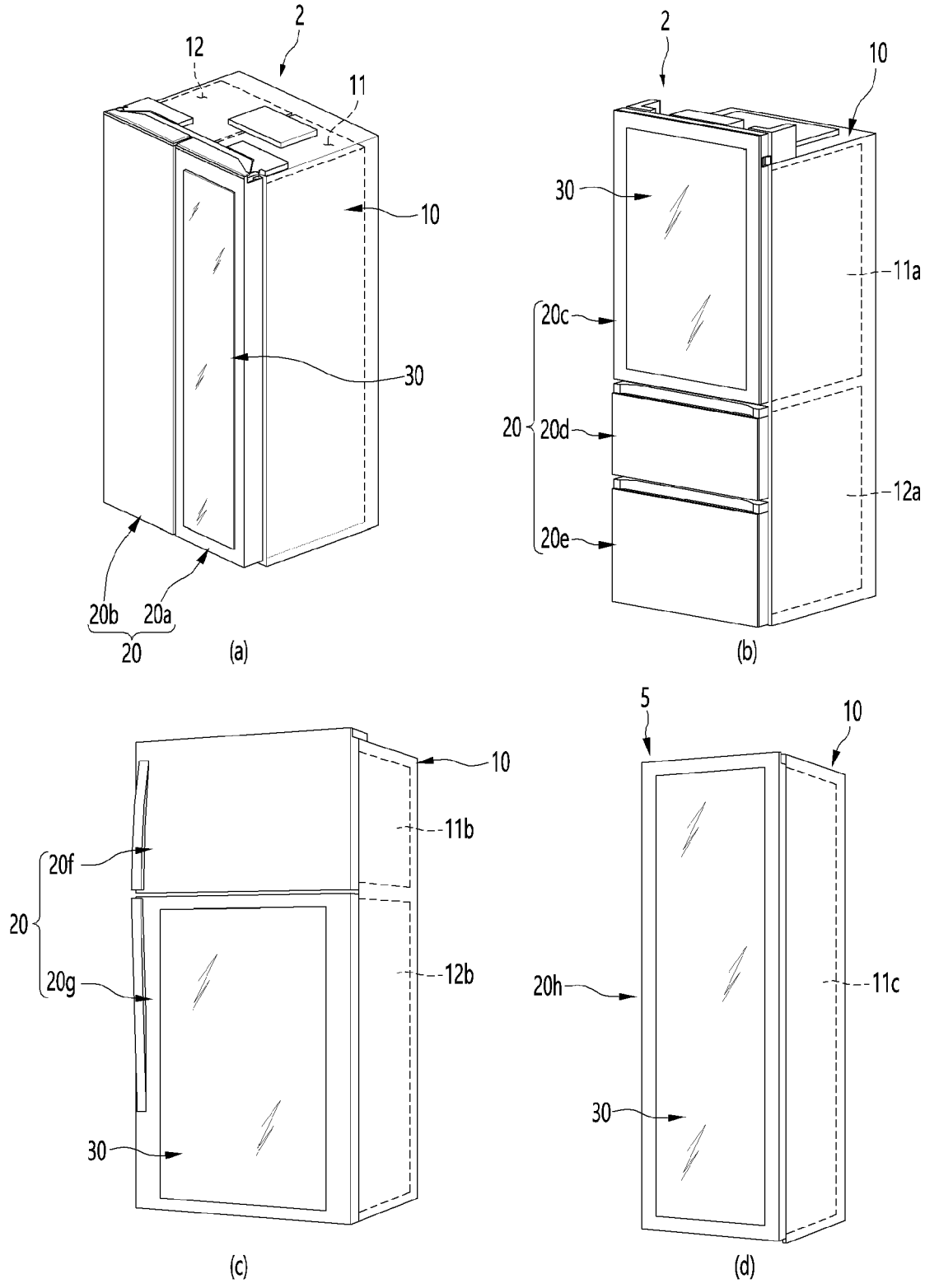
31
553
32'
301
302
33
515
55

[Fig. 26]


51
50'
513
514
55
553 551 552
511
33
302
500
54
541
261(26)
541a
301
35
32'
36
31
34
30
542
543

[Fig. 27]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10
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20b
20a
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(a)
2
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11a
20c
20
20d
12a
20e
(b)
10
11b
20f
20
20g
12b
30
(c)
5
10
20h
11c
30
(d)

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EUROPEAN SEARCH REPORT

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EP 24 19 1855

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	US 2021/325107 A1 (KANG CHANUK [KR] ET AL) 21 October 2021 (2021-10-21) * the whole document *	1,2, 4-11, 13-15	INV. A47F3/04 F25D21/04 F25D23/02 F25D23/06
Y		3,12	
Y	US 2022/325948 A1 (LEE DONGHO [KR] ET AL) 13 October 2022 (2022-10-13) * the whole document *	3	
Y	US 10 564 769 B2 (LG ELECTRONICS INC [KR]) 18 February 2020 (2020-02-18) * the whole document *	12	
X	US 2018/274852 A1 (KANG CHANUK [KR] ET AL) 27 September 2018 (2018-09-27) * the whole document *	1,2,4, 10,11, 13,15	
X	US 11 614 268 B2 (LG ELECTRONICS INC [KR]) 28 March 2023 (2023-03-28) * the whole document *	1,2,4, 10,11, 13,15	TECHNICAL FIELDS SEARCHED (IPC) F25D A47F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	22 November 2024	Kolev, Ivelin

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22-11-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2021325107 A1	21-10-2021	AU 2021202356 A1	04-11-2021
		EP 3896373 A1	20-10-2021
		EP 4253883 A2	04-10-2023
		KR 20210128689 A	27-10-2021
		US 2021325107 A1	21-10-2021
		US 2023082275 A1	16-03-2023
		US 2024093933 A1	21-03-2024
US 2022325948 A1	13-10-2022	AU 2021200796 A1	28-10-2021
		CN 113785166 A	10-12-2021
		EP 3911902 A1	24-11-2021
		KR 20210125376 A	18-10-2021
		US 2021318061 A1	14-10-2021
		US 2022325948 A1	13-10-2022
		WO 2021206279 A1	14-10-2021
US 10564769 B2	18-02-2020	CN 105739746 A	06-07-2016
		EP 3037760 A1	29-06-2016
		KR 20160078194 A	04-07-2016
		US 2016188093 A1	30-06-2016
		US 2019107913 A1	11-04-2019
		US 2020125210 A1	23-04-2020
US 2018274852 A1	27-09-2018	AU 2018239789 A1	22-08-2019
		CN 110382981 A	25-10-2019
		EP 3378359 A1	26-09-2018
		KR 20180108287 A	04-10-2018
		US 2018274852 A1	27-09-2018
		US 2020248959 A1	06-08-2020
		US 2021247133 A1	12-08-2021
		US 2022074648 A1	10-03-2022
		US 2022381505 A1	01-12-2022
		US 2023392857 A1	07-12-2023
		WO 2018174576 A1	27-09-2018
US 11614268 B2	28-03-2023	EP 3333515 A1	13-06-2018
		EP 3611450 A1	19-02-2020
		KR 20180067367 A	20-06-2018
		KR 20230156894 A	15-11-2023
		US 2018164026 A1	14-06-2018
		US 2020217580 A1	09-07-2020
		US 2023175759 A1	08-06-2023

EPO FORM P0459

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