



## Description

### The Background

#### 1. The field

[0001] The present disclosure relates to home appliances, in particular refrigerators.

#### 2. Description of the related art

[0002] In general, a refrigerator is a home appliance that allows food to be stored at a low temperature in an internal storage space shielded by a refrigerator door and is configured so that the stored food can be stored in an optimal state by cooling the inside of the storage space using cold air generated through heat exchange with the refrigerant circulating in the refrigeration cycle.

[0003] As such, refrigerators are gradually becoming larger and multifunctional according to changes in dietary habits and the trend of luxury products, and refrigerators with various structures and convenience devices in consideration of user convenience are being released.

[0004] Refrigerators are being developed that are provided with a proximity detection device for detecting a user's proximity to the refrigerator and perform an operation according to the user's proximity detection.

[0005] In Korean Patent Laid-open Publication No. 10-2021-0145302, a detection device is disclosed which is installed at the bottom of the lower door to detect a user's foot and opens the door based on the detection result.

[0006] However, in the prior art, even if a sensor for detecting the surrounding state is provided, there is a problem in that the sensor cannot accurately detect the surrounding state due to a problem of a location where the sensor is provided or a structure in which the sensor is mounted.

[0007] Thus, further improvement is required to provide a detection structure providing a reliable detection result and being easy to assemble and to mount at the home appliance door.

### The Summary

[0008] An object of an embodiment of the present disclosure is to provide a home appliance or a refrigerator having a proximity sensor that is disposed not to be easily seen by a user while ensuring the user's proximity detection performance.

[0009] An object of an embodiment of the present disclosure is to provide a home appliance or a refrigerator that detects a user's proximity and changes the outer appearance of a front door.

[0010] The object is solved by the features of the independent claims. Preferred embodiments are given in the dependent claims.

[0011] A refrigerator of an embodiment of the present

disclosure includes a cabinet having a storage space; a door for opening and closing the cabinet; and a detection device provided on one surface of the door for recognizing a user in front of the door and/or for detecting ambient brightness

[0012] Preferably a portion of the detection device protrudes in one direction from the door, and the other portion thereof is accommodated inside the door.

[0013] In one or more embodiments, the detection device may include a detection member for detecting a user's proximity.

[0014] In one or more embodiments, the detection device may include a case mounted on a lower surface of the door to shield the detection member.

[0015] The case may be exposed to the lower surface of the door.

[0016] In one or more embodiments, the detection device may include an opening shielded by the case formed on the lower surface of the door.

[0017] In one or more embodiments, a portion of the detection member may protrude downward from the opening.

[0018] The detection member may be inclined with respect to the lower surface of the door.

[0019] In one or more embodiments, a front end of the detection member may protrude downward more than the rear end thereof, e.g. the detection member may be inclined or may be directed to floor in front of the home appliance/refrigerator.

[0020] The door may be rotatably mounted to the cabinet by a hinge device.

[0021] In one or more embodiments, the detection member may be provided on one side close to the hinge device among the left and right sides of the door.

[0022] In one or more embodiments, one side end of the left and right ends of the detection member closer to the hinge device may be disposed to face more forward than one side end farther from the hinge device.

[0023] The case may include a case body, and a detection member accommodation portion

[0024] The case body may be provided for shielding the opening of the lower surface of the door.

[0025] The detection member accommodation portion may protrude downward from the case body and forms a recessed portion in which the detection member is accommodated.

[0026] The detection member accommodation portion may include a front surface extending downward from the case body.

[0027] The detection member accommodation portion may accommodate the light receiving portion and the light emitting portion of the detection member.

[0028] The detection member accommodation portion may include a lower surface extending from the lower end of the front surface toward the case body.

[0029] The detection member may be supported by the front and bottom surfaces.

[0030] The front surface may be formed to be inclined

toward the rear with respect to the front surface of the door as it extends downward.

**[0031]** In one or more embodiments, a fixing portion to which a screw penetrating the detection member is fastened may be formed in the case body in a state where the detection member is accommodated in the detection member accommodation portion.

**[0032]** In one or more embodiments, a PCB mounting portion extending upward and intersecting the case body may be formed on the case body.

**[0033]** In one or more embodiments, a PCB connected to the detection member may be mounted in the PCB mounting portion.

**[0034]** In one or more embodiments, a light mounting portion which is opened downward and in which a door light radiating downward is accommodated may be formed on the case body.

**[0035]** In one or more embodiments, a light cover may be mounted on the light mounting portion.

**[0036]** In one or more embodiments, the light cover may be formed of a material capable of transmitting light and for shielding the door light.

**[0037]** In one or more embodiments, the door may include an upper door connected to the cabinet by a hinge device to be rotatable; and a lower door disposed below the upper door.

**[0038]** In one or more embodiments, a handle may be provided on the upper end of the lower door for opening the lower door.

**[0039]** In one or more embodiments, the detection device may protrude between the upper door and the lower door.

**[0040]** The door may include an upper door for opening and closing the upper storage space.

**[0041]** In one or more embodiments, a lower door may be provided that opens and closes the lower storage space.

**[0042]** In one or more embodiments, the upper door may include a door body and a panel assembly coupled to the door body to form a front outer appearance of the door.

**[0043]** In one or more embodiments, a door cover may be provided forming an upper surface of the door.

**[0044]** In one or more embodiments, the detection device may be mounted on the door cover.

**[0045]** The detection device may include an illuminance sensor and a sensor module mounting portion recessed downward from the door cover for accommodating the illuminance sensor.

**[0046]** In one or more embodiments, a sensor cover may be formed of a material capable of transmitting light and shielding an opening of the sensor module mounting portion.

**[0047]** In one or more embodiments, the sensor cover may include a cover protrusion protruding upward from the door cover and accommodating an upper end portion of the illuminance sensor therein.

**[0048]** In one or more embodiments, a first inclined por-

tion extending forward from the cover protrusion and inclined downward toward the front.

**[0049]** In one or more embodiments, the detection portion of the illuminance sensor may detect light entering through the first inclined portion.

**[0050]** The illuminance sensor may be mounted in a state of being inclined at a set angle in the sensor module mounting portion.

**[0051]** The sensor module mounting portion may include a body portion having an upper surface open and recessed downward from the door cover and accommodating the illuminance sensor.

**[0052]** In one or more embodiments, the illuminance sensor may be mounted in a state of being inclined backward as it goes upward from the lower end of the body portion.

**[0053]** In one or more embodiments, the door cover may include a cover portion forming an upper surface of the upper door.

**[0054]** In one or more embodiments, the door cover may include a PCB mounting portion extending downward from the lower surface of the cover portion

**[0055]** In one or more embodiments, a sensor PCB may be mounted on one side of the PCB mounting portion.

**[0056]** In one or more embodiments, an electric wire connected to the detection device may be connected to the sensor PCB.

**[0057]** In one or more embodiments, the door may include a door body; and a panel assembly coupled to the door body to form the front outer appearance of the door.

**[0058]** In one or more embodiments, the panel assembly may include a front plate forming an outer appearance of the front surface of the door and through which light is transmitted.

**[0059]** In one or more embodiments, the door may include a lighting device that irradiates light.

**[0060]** In one or more embodiments, a control portion may be provided for controlling the operation of the lighting device.

**[0061]** In one or more embodiments, the control portion may be configured to control the intensity of a light source of the lighting device based on the external illuminance value detected by the detection device.

**[0062]** A refrigerator of an embodiment of the present disclosure may include a cabinet having an upper storage space and a lower storage space; an upper door for opening and closing the upper storage space; and a lower door for opening and closing the lower storage space, in which the lower door may include a door body; an upper cap deco connected to an upper end of the door body and forming a portion of the front surface and the upper surface of the lower door; and a detection device for recognizing a user in front of the door and/or detecting ambient brightness, the detection device may be provided inside the upper cap deco.

**[0063]** The detection device may be a sensor module.

**[0064]** In one or more embodiments, a detection hole

communicating with the sensor module may be formed on the front surface of the upper cap deco.

[0065] In one or more embodiments, a sensor opening may be provided on the upper surface of the upper cap deco being opened and into which the sensor module is inserted.

[0066] In one or more embodiments, the detection device may include a cover for shielding the sensor opening.

[0067] In one or more embodiments, the detection device may include a sensor device having the illuminance sensor and/or proximity sensor.

[0068] A fixing member may be provided to which the sensor device and the cover are coupled.

[0069] The door may include a door body and a panel assembly coupled to the door body to form the front outer appearance of the door.

[0070] In one or more embodiments, the panel assembly may include a front plate forming an outer appearance of the front surface of the door and through which light is transmitted; a lighting device that irradiates light; and a control portion for controlling the operation of the lighting device, and the control portion may be configured to adjust the intensity of the light source of the lighting device when the detection device detects that the user is adjacent to the door.

[0071] In the refrigerator and/or home appliance of the proposed embodiment, the following effects can be expected.

[0072] According to an embodiment of the present disclosure, there is an advantage in providing a refrigerator and/or home appliances equipped with a detection device disposed not to be easily seen by a user while ensuring detection performance.

[0073] An embodiment of the present disclosure has an advantage of providing a home appliance and a refrigerator that change the outer appearance of the front door by detecting a user's proximity or ambient brightness.

#### **Brief description of the drawings**

[0074]

FIG. 1 is a front view illustrating a refrigerator of a first embodiment of the present disclosure.

FIG. 2 is a front view illustrating a state where a door of the refrigerator is opened.

FIG. 3 is an exploded perspective view of a structure in which the door panel and the door body are coupled.

FIG. 4 is an exploded perspective view of a state where the door panel is viewed from the front.

FIG. 5 is an enlarged view illustrating portion A of FIG. 1.

FIG. 6 is a partial perspective view illustrating a state where the door is viewed from below.

FIG. 7 is an exploded perspective view illustrating a mounting structure of a detection device and a door

of the first embodiment of the present disclosure.

FIG. 8 is an exploded perspective view illustrating a state where the detection device is viewed from one direction.

FIG. 9 is an exploded perspective view illustrating a state where the detection device is viewed from another direction.

FIG. 10 is a cutaway perspective view taken along line 10-10 of FIG. 4.

FIG. 11 is a view illustrating a state where the refrigerator detects a user.

FIG. 12 is a front view of a refrigerator of another embodiment of the present disclosure.

FIG. 13 is an enlarged view illustrating section B of FIG. 12.

FIG. 14 is a partial perspective view illustrating a state where the door of the refrigerator is viewed from below.

FIG. 15 is a partial perspective view illustrating the lower portion of the door from which the detection device is separated of an embodiment of the present disclosure.

FIG. 16 is a perspective view of a state where the detection device is viewed from one direction.

FIG. 17 is an exploded perspective view illustrating a state where the detection device is viewed from another direction.

FIG. 18 is a cutaway perspective view taken along line 18-18' of FIG. 13.

FIG. 19 is a view illustrating a state where the refrigerator detects a user.

FIG. 20 is a perspective view illustrating a state where a refrigerator of a second embodiment of the present disclosure is viewed from the front.

FIG. 21 is a perspective view illustrating a state where an upper door equipped with a sensor module of a second embodiment of the present disclosure is viewed from the front.

FIG. 22 is an exploded perspective view illustrating a state where an upper door equipped with the sensor module is viewed from above.

FIG. 23 is a view illustrating a state where a sensor cover, which is one component of the sensor module is viewed from below.

FIG. 24 is a view illustrating a state where a door cover on which the sensor module is mounted is viewed from above.

FIG. 25 cross-sectional view of a portion of the door cover where the sensor module is mounted.

FIG. 26 is a cross-sectional view for explaining a state where the sensor module is mounted.

FIG. 27 is an exploded perspective view illustrating a structure in which a door panel, a door body, and a door cover are coupled of an embodiment of the present disclosure.

FIG. 28 cross-sectional view of a state where the door cover is coupled to the door body.

FIG. 29 is a perspective view illustrating a state

where the door cover is viewed from the front.

FIG. 30 is an exploded perspective view illustrating a state where an upper door equipped with a sensor module of a third embodiment of the present disclosure is viewed from above.

FIG. 31 is a view illustrating a state where the door cover on which the sensor module is mounted is viewed from above.

FIG. 32 cross-sectional view of a state where the sensor module is mounted on the door cover.

FIG. 33 is a block diagram illustrating the flow of control signals of the refrigerator.

FIG. 34 is a control flowchart illustrating a method of controlling brightness of a light source of ambient brightness.

FIG. 35 view illustrating a change in outer appearance of a refrigerator of ambient brightness.

FIG. 36 perspective view of a refrigerator of another embodiment of the present disclosure.

FIG. 37 is a perspective view illustrating a state where a refrigerator of a fourth embodiment of the present disclosure is viewed from the front.

FIG. 38 is a front view illustrating a state where the door of the refrigerator is opened.

FIG. 39 is a perspective view illustrating a state where a lower door equipped with a sensor module of a fourth embodiment is viewed from the front.

FIG. 40 exploded perspective view of a state where the sensor module is viewed from the front.

FIG. 41 exploded perspective view of a state where the sensor module is viewed from the rear.

Fig. 42 is a cross-sectional view taken along line 42-42 in Fig. 39.

FIG. 43 is a cross-sectional view taken along line 43-43 of FIG. 39.

Fig. 44 is a cross-sectional view taken along line 44-44 of Fig. 39.

FIG. 45 is an exploded perspective view illustrating a state where a sensor module of a fifth embodiment of the present disclosure is viewed from the front.

FIG. 46 is a control flowchart illustrating a method of controlling brightness of a light source of ambient brightness.

FIG. 47 view of a change in outer appearance of a refrigerator of ambient brightness.

FIG. 48 is a control flowchart illustrating a method of controlling the brightness of a light source of a user's distance detection.

FIG. 49 view of changes in outer appearance of a refrigerator of a user's distance detection.

FIG. 50 is a view illustrating an example of adjusting the color of home appliances to which the panel assembly is applied using a remote device.

ings. However, the present disclosure cannot be said to be limited to the embodiments in which the concept of the present disclosure is presented, and other disclosures that are degenerative by addition, change, deletion, or the like of other components or other embodiments included within the scope of the present disclosure can be easily suggested.

**[0076]** Before the description, the direction is defined. In the embodiment of the present disclosure, the direction in which the front surface of the door faces as illustrated in Fig. 1 can be defined as a front direction, the direction facing the cabinet with respect to the front surface of the door can be defined as a rear direction, the direction facing the bottom surface on which the refrigerator is installed can be defined as a downward direction, and the direction away from the bottom surface can be defined as upward direction.

**[0077]** FIG. 1 is a front view illustrating a refrigerator of a first embodiment of the present disclosure, and FIG. 2 is a front view illustrating a state where a door of the refrigerator is opened.

**[0078]** As illustrated, the outer appearance of the refrigerator 1A of the embodiment of the present disclosure may be formed by a cabinet 10 forming a storage space and a door 20 opening and closing the storage space of the cabinet 10.

**[0079]** For example, the cabinet 10 may form a storage space. The storage space may be divided in the up and down direction, with a refrigerating chamber 11 formed at an upper portion and a freezing chamber 12 formed at a lower portion. 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. An arrangement of the refrigerating chamber 11 formed at a lower portion and the freezing chamber 12 formed at the upper portion is also possible with the present invention. Furthermore, the storage space may be also or alternatively divided in the left and right direction and/or in up and down direction.

**[0080]** The door 20 may be configured to open and close the refrigerating chamber 11 and the freezing chamber 12, respectively. For example, the door 20 may be rotatably mounted on the cabinet 10 being connected by hinge devices 204 and 205, and the refrigerating chamber 11 and the freezing chamber 12 may be opened and closed by rotation, respectively. The invention might be also applied to a refrigerator having one or more drawer type doors.

**[0081]** The door 20 may include a several doors associated to the respective storage chambers. E.g. the refrigerating chamber door 201 may be provided for opening and closing the refrigerating chamber 11 and a freezing chamber door 202 may be provided for opening and closing the freezing chamber 12. The refrigerating chamber door 201 may be referred to as an upper door, and the freezing chamber door 202 may be referred to as a lower door.

**[0082]** One or more handles 201a and 202a may be

## The Detailed description

**[0075]** Hereinafter, specific embodiments of the present disclosure will be described in detail with draw-

formed on the refrigerating chamber door 201 and/or the freezing chamber door 202. The one or more handles may be also or alternatively realized as recess.

**[0083]** Meanwhile, the door 20 forms the front outer appearance of the refrigerator 1A in a closed state, and may form the front outer appearance of the refrigerator 1A.

**[0084]** At least a portion of the front surface of the door 20 may be configured to be illuminated to shine in a color set by the operation of the lighting device 36.

**[0085]** FIG. 3 is an exploded perspective view illustrating a structure in which a panel assembly 30 and a door body 40 are coupled, and FIG. 4 is an exploded perspective view illustrating a state where the panel assembly 30 is viewed from the front.

**[0086]** The door 20 may include a door body 40 forming the overall shape of the door 20, and a panel assembly 30 forming the front outer appearance of the door 20. The door 20 may be configured such that the panel assembly 30 is mounted on the front surface of the door body 40.

**[0087]** The door body 40 may include a body plate 41 forming a front surface and a door liner 42 forming a rear surface. The body plate 41 may be disposed to face the rear surface of the panel assembly 30. The door liner 42 may include a gasket that is in close contact with the cabinet 10 along a rear circumference.

**[0088]** The door body 40 may include side decos 44 (decoration elements) formed at both left and right sides of the door body 21.

**[0089]** The door body 40 may include an upper cap deco 43 and a lower cap deco 45 forming upper and lower surfaces of the door body 40. An insulator 400 may be filled inside the door body 40.

**[0090]** The panel assembly 30 is formed in a plate shape, and may form the front outer appearance of the door 20 in a state of being mounted on the front surface of the door body 40.

**[0091]** The panel assembly 30 may be detachably mounted to the door body 40 in an assembled state. The upper and lower ends of the panel assembly 30 may be fixed to the upper cap deco 43 and the lower cap deco 45.

**[0092]** The panel assembly 30 may have a structure that can be separated from and mounted on the door body 40 for service and maintenance.

**[0093]** The panel assembly 30 may be configured to emit light from the entire front surface and may be configured to shine in various colors.

**[0094]** The panel assembly 30 may include a front plate (or door plate) 31 forming a front outer appearance and a lighting device 36 for radiating light so that the front plate 31 shines or is illuminated by the light output by lighting device 36.

**[0095]** The panel assembly 30 may include a light guide plate 33 for guiding light emitted from the lighting device 36.

**[0096]** Light emitted from the lighting device 36 may be guided to the front plate 31 by or through the light

guide plate 33 so that the front surface of the panel assembly 30 may be configured to shine in various colors.

**[0097]** The front plate 31 may be transparent so that light reflected by the light guide plate 33 may pass through.

**[0098]** The front plate 31 may be formed to have a color and may be formed to appear in a different color depending on an operation or an on/off state of the lighting device 36.

**[0099]** In a state where the lighting device 36 is turned off, components inside the panel assembly 30 may be prevented from being visible to the outside through the front plate 31 due to the color of the front plate 31 itself.

**[0100]** The light guide plate 33 may be located at a rear of the front plate 31 and may be spaced apart from the front plate 31 and may be configured to guide light emitted from a lighting device 36 disposed below or adjacent to the light guide plate 33 forward or frontwards.

**[0101]** Light can be transmitted to the front plate 31 by the light guide plate 33, and at this time, the pattern of the light guide plate 33 can be set so that the entire front surface of the front plate 31 can shine with uniform brightness or depending on a light guide pattern formed in the light guide plate 33.

**[0102]** Meanwhile, a support member 32 may be provided between the front plate 31 and the light guide plate 33 if necessary. The support member 32 is a component to which the light guide plate 33 and the front plate 31 are fixedly mounted, and in particular, the light guide plate 33 and the front plate 31 can be maintained at a predetermined distance.

**[0103]** An upper bracket 34 may be provided at an upper end of the panel assembly 30. The upper bracket 34 may have a structure coupled to the support member 32 and a structure coupled to the back cover 39.

**[0104]** A lower bracket 35 may be provided at a lower end of the panel assembly 30. The lower bracket 35 may have a structure coupled to the support member 32 and a structure coupled to the back cover 39.

**[0105]** A lighting device 36 may be mounted on the lower bracket 35. The lighting device 36 emits light for determining the color and brightness of the front surface of the panel assembly and is configured to emit light toward the light guide plate 33.

**[0106]** The back cover 39 forms a rear surface of the panel assembly 30 and may be combined with the upper bracket 34 and the lower bracket 35. The back cover 39 may be formed of a metal material such as stainless steel or aluminum.

**[0107]** In this way, the panel assembly 30 is provided with a lighting device 36, and the light emitted from the lighting device 36 passes through the front plate 31, so that the front surface of the door can be brightly lit.

**[0108]** The structure of the panel assembly 30 and the door body 40 may be applied to both the upper door 201 and/or the lower door 202 (or left and right door). Accordingly, front surfaces of both the upper door 201 and the lower door 202 may be brightly lit by the lighting device 36.

**[0109]** Meanwhile, the panel assembly 30 may not include a light guide plate, and a lighting device may be disposed behind the panel. That is, the panel assembly 30 may be configured in a direct type method in which light is directly radiated toward the lighting panel.

**[0110]** In addition, the panel assembly 30 may have an LCD display structure or an electrophoretic display structure or OLED structure. That is, the panel assembly 30 may be configured with various panel structures capable of changing the front outer appearance of the door 20.

**[0111]** FIG. 5 is an enlarged view illustrating portion A of FIG. 1, FIG. 6 is a partial perspective view illustrating a state where the door is viewed from below, and FIG. 7 is an exploded perspective view illustrating a mounting structure of a detection device and a door of the first embodiment of the present disclosure.

**[0112]** A refrigerator of a first embodiment of the present disclosure includes a cabinet 10 having a storage space; a door 20 for opening and closing the cabinet 10; and a detection device 50 of the first embodiment provided on a lower surface of the door 20 for recognizing a user in front of the door 20, and a portion of the detection device 50 protrudes downward from the lower surface of the door 20, and the remaining portion thereof may be accommodated inside the door 20. So, the detection device 50 is partly accommodated inside the door 20.

**[0113]** The detection device 50 may include a detection member 52 (Fig. 8) that detects a user's proximity and a case 51 mounted on the lower surface of the door 20 to shield the detection member 52 and exposed to the lower surface of the door 20.

**[0114]** An opening shielded by the case 51 is formed on a lower surface of the door 20, and a portion of the detection member 52 may protrude downward from the opening.

**[0115]** The detection member 52 is disposed inclined with respect to the lower surface of the door 20, and the front end of the detection member 52 may protrude downward more than the rear end. So the detection member 52 is inclined and rotated to the horizontal axis and vertical axis.

**[0116]** The door 20 is rotatably mounted to the cabinet by a hinge device 205, and the detection member 52 may be provided on one side of the door being closer to the hinge device 205 among both left and right sides of the door.

**[0117]** A shielding portion 452 protrudes downward from the lower surface of the door and covers at least a portion of the hinge device 205, and the protruding height of the detection device 50 may be equal to or smaller than the protruding height of the shielding portion 452.

**[0118]** The detection member 52 may be disposed inclined with respect to the front surface of the door.

**[0119]** Among both left and right ends of the detection member 52, one end closer to the hinge device 205 may be disposed to face more forward than one end farther from the hinge device 205.

**[0120]** The detection member 52 is disposed inclined with respect to the lower surface of the door, and the front end of the detection member 52 may be disposed lower than the rear end.

**[0121]** The case 51 may include a case body 511 for shielding the opening of the lower surface of the door, and a detection member accommodation portion 512 protruding downward from the case body 511 and forming a recessed portion in which the detection member 52 is accommodated.

**[0122]** The detection member accommodation portion 512 may include a front surface extending downward from the case body 511 and disposed with a light receiving portion and a light emitting portion of the detection member 52; and a lower surface extending from the lower end of the front surface toward the case body 511, and the detection member 52 may be supported by the front surface and the lower surface.

**[0123]** As the front surface extends downward, the front surface may be inclined toward the rear with respect to the front surface of the door.

**[0124]** The front surface may be disposed so as to be inclined away from the front surface of the door as the front surface extends laterally based on the front surface of the door.

**[0125]** At least the front surface of the case 51 may be formed of a light-transmitting material.

**[0126]** In the case body 511, a fixing portion to which a screw penetrating the detection member 52 is fastened may be formed in a state where the detection member 52 is accommodated in the detection member accommodation portion 512.

**[0127]** The case body 511 is formed with a PCB mounting portion 614 that extends upward and intersects the case body 511, and a PCB connected to the detection member 52 may be mounted on the PCB mounting portion 614.

**[0128]** In the case body 511, a light mounting portion 513 which is opened downward and in which a door light 53 for irradiating light downward is accommodated is formed, and in the light mounting portion 513, a light cover 551 which is formed of a material capable of transmitting light and shielding the door light 53 may be mounted.

**[0129]** The door 20 may include a lower cap deco 35 forming a lower surface of the door.

**[0130]** A mounting portion for a detection device 50 is recessed to accommodate the detection member 52 and may be formed on the lower surface of the lower cap deco 35, and a support portion 455 may protrude from the inside of the mounting portion for a detection device 50 to support the detection member 52 from the rear.

**[0131]** The door 20 may be connected to the cabinet 10 by a hinge device 205 and include a rotatable upper door 201 and a lower door 202 disposed below the upper door 201, a handle 202a for opening the lower door 202 may be provided on an upper end of the lower door 202, and the detection device 50 may protrude between the upper door 201 and the lower door 202.

**[0132]** The detection device 50 may be disposed on one side closer or close to the hinge device 205 among both left and right sides of the upper door 201.

**[0133]** The lower surface of the door 20 may be provided with a detection device 50 for detecting a user's proximity. The detection device 50 may be provided on the lower surface of the upper door 201 in a state where the upper door 201 and the lower door 202 are disposed vertically and may protrude downward, that is, toward the upper surface of the lower door 202. Therefore, the detection device 50 may detect the proximity of the user to the front of the refrigerator 1A.

**[0134]** So, the detection device 50 may be provided at a height of the home appliance or refrigerator being not close to the floor. It is preferably provided at a height of the home appliance or refrigerator allowing to detect a person, preferably the body, in front of the home appliance or refrigerator, e.g. at a height of 0,50m to 1,5m.

**[0135]** Looking at this in more detail, the lower surface of the door 20 may be formed by the lower cap deco 35. A hinge bracket 451 coupled to the hinge device 205 may be mounted on the lower cap deco 35. The hinge bracket 451 may be provided at one end of both left and right ends of the lower surface of the door 20. A hinge hole 451a into which a hinge shaft of the hinge device 205 is inserted may be formed in the hinge bracket 451.

**[0136]** A door stopper 451b protruding downward may be formed on the hinge bracket 451. The door stopper 451b allows the door 20 to stop at a set angle when the door 20 is opened.

**[0137]** A door opening device 453 may be provided at a side of the hinge bracket 451. The door opening device 453 is for automatically opening the door 20 and may push the cabinet 10 to open the door 20 when an open signal is input to the door. The door opening device 453 may be mounted on the lower surface of the door 20, that is, the lower cap deco 35.

**[0138]** The lower cap deco 35 may be formed with a shielding portion 452 that shields at least a portion of the hinge device 205. The shielding portion 452 may be formed at the front corresponding to the hinge bracket 451 and may extend downward from the lower cap deco 35. The shielding portion 452 may extend in left and right direction and may extend further than at least the hinge bracket 451.

**[0139]** The door opening device 453 may be omitted. Then the door is operated manually by the user.

**[0140]** The shielding portion 452 may extend further than the door opening device 453 to shield the stopper 451b and the door opening device 453. To this end, the shielding portion 452 may protrude downward from the lower surface of the door 20 by a set height H2. The protrusion height H2 of the shielding portion 452 may be smaller than the distance H1 between the lower surface of the upper door 201 and the upper surface of the lower door 202. Therefore, when opening and closing the door 20, the shielding portion 452 is not interfered with the door.

**[0141]** A handle 201a may be further formed on the lower surface of the lower door, preferably at the lower cap deco 35. The handle 201a is for opening the upper door 201, and may be recessed so that the user can insert his or her hand. The handle 201a may be formed on one side opposite to the arrangement position of the hinge device 205 among the left and right sides of the door 20. That is, the handle 201a may be disposed at a location far from the hinge device 205 and may facilitate opening of the door 20.

**[0142]** A detection device 50 may be mounted on the lower cap deco 35. The detection device 50 may be located between the hinge bracket 451 and the handle 201a without interference. Among the left and right sides of the door 20, the detection device 50 may be located on one side closer to the hinge device 205.

**[0143]** Alternatively, as in the present embodiment, when a pair of doors 20 are disposed on both left and right sides and the horizontal width of the door 20 is small, a portion of the detection device 50 is may be located in the center of the lower cap deco 35. However, the detection member 52, which is a main component of the detection device 50, may be located on one side close to the hinge device 205 among both left and right sides of the door 20.

**[0144]** When a pair of doors 20 are disposed on both left and right sides, the detection device 50 may be provided on one door 20 among the doors 20 on both left and right sides.

**[0145]** The detection device 50 may be mounted on a detection device mounting portion 454 mounted on the lower surface of the door 20. The detection device 50 may form a portion of the lower surface of the door 20 in a state of being mounted on the detection device mounting portion 454. The detection device 50 may include a detection member 52 that detects a user's proximity and a case 51 in which the detection member 52 is mounted.

**[0146]** The case 51 may include a case body 511 for shielding the opening of the detection device mounting portion 454 and a detection member accommodation portion 512 protruding downward from the case body 511. The case body 511 may form the same plane as the lower surface of the lower cap deco 35 in a state of being mounted on the door 20.

**[0147]** The detection member accommodation portion 512 includes the detection member 52 therein, and may be formed of a light-transmitting material so that light irradiated from the detection member 52 can pass there-through. Alternatively, only the front surface 512a through which light is substantially transmitted among the detection member accommodation portion 512 may be formed of a light-transmitting material, if necessary.

**[0148]** The detection member accommodation portion 512 or the entire case 51 may be formed of a light-transmitting material. In addition, the detection member accommodation portion 512 may be formed to protrude obliquely from the lower surface of the door 20 to facilitate a user's detection. The detection member accommoda-



tion portion 512 may also be referred to as a case protrusion.

**[0149]** The detection member accommodation portion 512 may include a front surface 512a protruding outward from the case body 511. The front surface 512a may be in contact with the light receiving portion 522 and the light emitting portion 523 of the detection member 52.

**[0150]** The front surface 512a is formed to face forward and may be disposed to face a user located in front of the refrigerator 1A. Accordingly, the front surface 512a may determine a substantially inclined direction of the detection member accommodation portion 512.

**[0151]** The detection member 52 may include a light receiving portion 522 and a light emitting portion 523.

**[0152]** The front surface 512a may be formed in a planar shape and may be inclined with respect to the front surface of the door 20. At this time, the front surface 512a may be formed to secure an area for disposing the light receiving portion 522 and the light emitting portion 523 of the detection member 52 while minimizing the height H3 protruding downward from the door 20 at the same time.

**[0153]** The protruding height H3 of the detection member accommodation portion 512 is smaller than the distance H1 between the lower surface of the upper door 201 and the upper surface of the lower door 202.

**[0154]** The protruding height H3 of the detection member accommodation portion 512 can be formed equal to or smaller than the protruding height H2 of the shielding portion 452.

**[0155]** The front surface 512a may be inclined toward the rear as it extends downward. For example, an angle  $\alpha 1$  between the front surface 512a and the lower surface of the door 20 may be approximately  $30^\circ$ . Accordingly, by minimizing the protrusion of the detection member accommodation portion 512, the outer appearance is improved, and the user's hand is prevented from being pinched or interfered with the front surface.

**[0156]** In particular, the detection member accommodation portion 512 is located at a position facing the handle 202a at the upper end of the lower door 202. When the user grabs the handle 202a of the lower door 202 to open and close the lower door 202, the user's hand can be prevented from interfering with the protruding detection member accommodation portion 512.

**[0157]** The front surface 512a may be disposed in an inclined state with respect to the front surface of the door 20. The front surface 512a may extend away from the front surface of the door 20 as it moves away from the hinge device 205. For example, an angle  $\alpha 2$  between the front surface 512a and the front surface of the door 20 may be approximately  $15^\circ$ . Therefore, while the detection member 52 is disposed at an eccentric position on one side of the door 20, it radiates light toward the front of the center of the refrigerator 1A, so that the user can easily detect proximity and ensure reliable operation.

**[0158]** Since the front surface 512a has a structure having an inclination with the front and bottom surfaces

of the door 20, the detection device 50 can accurately detect the user and minimize external exposure to improve the appearance. In addition, it is possible to prevent the user's hand from being caught or interfered with the door when the user operates the door 20.

**[0159]** The detection member accommodation portion 512 may further include a lower surface 512b forming a lower surface of the detection member accommodation portion 512. The lower surface 512b may extend from the lower end of the front surface 512a to the case body 511.

**[0160]** The lower surface 512b may have an inclination that increases toward the rear with respect to the lower surface of the door 20.

**[0161]** The detection member accommodation portion 512 may further include side surfaces 512c forming protruding side surfaces of the detection member accommodation portion 512. The side surface 512c may connect the front surface 512a and the lower surface 512b and the case body 511.

**[0162]** Meanwhile, a detection member restricting portion 512d (Fig. 9) may be formed at one side of the circumference of the detection member accommodation portion 512. The detection member restricting portion 512d may be formed at a corner portion where end portions of the front surface 512a and the side surface 512c meet and may protrude into the detection member accommodation portion 454. Accordingly, the detection member restraining portion 512d may temporarily restrain one side of the detection member 52 in a state where the detection member 52 is inserted into the detection member accommodation portion 512. The screw 525 may be fastened in a state where the detection member 52 is constrained to the detection member restricting portion 512d.

**[0163]** A light cover 55 that shields the door light 53 and transmits light of the door light 53 may be provided on the case body 511. Therefore, through the detection device 50, the user can be detected and the lower portion of the upper door 201 can be illuminated. The light cover 55 may be disposed on a side of the detection member accommodation portion 512.

**[0164]** When the detection device 50 is mounted, the detection member 52 and the door light 53 may be mounted on the door 20 while being coupled to the case body 511.

**[0165]** Meanwhile, the lower cap deco 35 may be formed with the detection device mounting portion 454 recessed to mount the detection device 50 thereon. The detection device mounting portion 454 forms a space in which the detection device 50 can be accommodated and may form an opening shielded by the case body 511. That is, an opening may be formed on the lower surface of the door 20 by the detection device mounting portion 454.

**[0166]** Therefore, when the detection device 50 is mounted on the detection device mounting portion 454, the case body 511 may form the same plane as the lower

surface of the lower cap deco 35. The detection member 52 and the door light 53 may maintain a state accommodated in a space inside the detection device mounting portion 454.

**[0167]** Meanwhile, a support portion 455 may be formed inside the detection device mounting portion 454. The support portion 455 may be formed at a position corresponding to the detection member 52 and may protrude from a circumferential surface of the detection device mounting portion 454.

**[0168]** The support portion 455 may protrude to support the detection member 52 from the rear in a state where the detection device 50 is mounted. The support portion 455 may be inclined or stepped toward the front from the bottom to the top. Therefore, when the detection device 50 is mounted, the detection member 52 is supported from the rear by the support portion 455 and may be in close contact with the detection member accommodation portion 512. Even when the door 20 is repeatedly opened and closed, the detection member 52 may not be separated or moved.

**[0169]** A support rib 456 may be formed inside the detection device mounting portion 454. The support rib 456 is for supporting one side of the case body 511 and may protrude from the circumferential surface of the detection device mounting portion 454.

**[0170]** The support ribs 456 extend in the vertical direction, and a plurality of support ribs may be continuously arranged at regular intervals. The end portion of the support rib 456 can support the case body 511 from below, and thus, when the detection device 50 is mounted, it is possible to keep the case body 511 mounted in an accurate position.

**[0171]** Hereinafter, the structure of the detection device 50 will be described in more detail with reference to the drawings.

**[0172]** FIG. 8 is an exploded perspective view illustrating a state where the detection device 50 is viewed from one direction, FIG. 9 is an exploded perspective view illustrating a state where the detection device 50 is viewed from another direction, and FIG. 10 is a cutaway perspective view taken along line 10-10 of FIG. 4.

**[0173]** The detection device 50 may include the case 51 and the detection member 52. The case 51 may be mounted on the door 20 with the detection member 52 coupled thereto.

**[0174]** The case 51 may be formed by injection molding of a plastic material, and at least the front surface of the detection member accommodation portion 512 may be formed of a material capable of transmitting light. The case 51 may include the case body 511 formed in a plate shape. The case body 511 may be formed in a shape corresponding to the opening formed in the lower cap deco 35.

**[0175]** Body protrusions 511a and 511b are formed at both left and right ends of the case body 511 and can be coupled to the lower cap deco 35.

**[0176]** A guide rib 511c may protrude from an upper

surface of the case body 511. The guide rib 511c may be formed along at least a portion of the circumference of the case body 511. When the case body 511 is mounted on the lower cap deco 35, the guide rib 511c is in contact with the inner surface of the detection device mounting portion 454 to further fix the case body 511.

**[0177]** The detection member accommodation portion 512 may be formed in the case body 511. The detection member accommodation portion 512 may form a recessed space on the upper surface of the case body 511 so that the detection member 52 can be accommodated therein. At this time, the detection member accommodation portion 512 may protrude downward from the case body 511.

**[0178]** The detection member accommodation portion 512 may include the front surface 512a, the lower surface 512b, and the side surface 512c and may be formed in a shape corresponding to the detection member 52 or suited to at least partly accommodate the detection member 52. The detection member accommodation portion 512 may be inserted and mounted with the detection member 52, and may be fixed in contact with the front, bottom and side surfaces of the detection member 52 in a state where the detection member 52 is mounted.

**[0179]** In particular, the front ends of the light receiving portion 522 and the light emitting portion 523 for irradiating and receiving light for the user's detection are disposed on the front surface of the detection member 52, and the front surface of the detection member 52 may be in close contact with the front surface 512a of the detection member accommodation portion 512. That is, the shape of the detection member accommodation portion 512 may be formed in a corresponding shape so that the front and bottom surfaces of the detection member 52 and both left and right sides may be in close contact with each other.

**[0180]** A fastening portion 515 for fixing the detection member 52 may be formed on one side of the case body 511. The fastening portion 515 may protrude from a position adjacent to the detection member accommodation portion 512. The fastening portion 515 is fastened to the screw 525 penetrating the detection member 52 and may be formed at a position corresponding to the fixed end 524 of the detection member 52.

**[0181]** The detection member 52 is inserted into the detection member accommodation portion 512 and is primarily fixed, and may be firmly fixed to the fastening portion 515 by fastening the screw 525.

**[0182]** The detection member 52 is for sensing the user's proximity and may be referred to as a proximity sensor. For example, the detection member 52 may include an infrared sensor, a laser sensor, an ultrasonic sensor, a magnetic sensor, a vision camera, and the like, and various devices capable of detecting a user's proximity in a non-contact manner may be used.

**[0183]** In this embodiment, the detection member 52 may be configured as an infrared sensor. In addition, the detection member 52 may include a detection member

case 51 forming an external shape. The detection member case 51 may be formed in a shape corresponding to the shape of the detection member accommodation portion 512 and inserted into the detection member accommodation portion 512.

**[0184]** The detection member case 51 may include a light emitting portion 523 in which a light emitting element 523a is disposed and a light receiving portion 522 in which a light receiving element 522a is disposed. The light emitting portion 523 and the light receiving portion 522 may be disposed on both sides of the detection member case 51, and may have an open front surface to emit light and receive light to detect a user's proximity.

**[0185]** Opened front surfaces of the light emitting portion 523 and the light receiving portion 522 may be in close contact with the front surface of the detection member accommodation portion 512.

**[0186]** The fixed end 524 may be formed on both sides of the rear end of the detection member case 51. When the detection member 52 is mounted, the fixing end 524 on one side of the fixed ends 524 on both sides may be disposed to overlap the fastening portion 515, and may be fixed to each other by fastening the screw 525. Accordingly, the detection member 52 can maintain a state of being firmly fixed to the case 51 and maintain its mounting position even when the door 20 is repeatedly opened and closed.

**[0187]** In particular, the rear end of the detection member 52 may be supported by the support portion 455, and the front end of the detection member 52, that is, the light emitting portion 523 and the light receiving portion 522 may be kept a state of being in close contact with the front surface of detection member accommodation portion 512.

**[0188]** Even without a separate fixing operation, when the detection device 50 is mounted on the detection device mounting portion 454 in a state where the detection member 52 is coupled to the case 51, naturally, the flow of the detection member 52 is restricted by the support portion 455 and can be maintained in close contact with the detection member accommodating portion 512.

**[0189]** When the open front surfaces of the light emitting portion 523 and the light receiving portion 522 are kept in close contact with the front surface of the detection member accommodation portion 512 through which light can pass through, the recognition performance of the detection member 52 may be guaranteed.

**[0190]** Meanwhile, a PCB mounting portion 514 may be formed on one side of the case body 511. The PCB mounting portion 514 may extend upward from one end of the case body 511. For example, the PCB mounting portion 514 extends along the front end of the case body 511, and the PCB for controlling the operation of the detection member 52 may be mounted thereon. Alternatively, the PCB 54 may be connected to the door light 53 in addition to the detection member 52 to control the operation of the door light 53.

**[0191]** When the detection device 50 is mounted on

the detection device mounting portion 454, the PCB mounting portion 514 is inserted into the detection device mounting portion 454 and may come into contact with the inner wall surface of the detection device mounting portion 454. Therefore, when the detection device 50 is mounted, it can serve as an auxiliary guide and support for the detection device 50.

**[0192]** A light mounting portion 513 to which the door light 53 is mounted may be further formed on the case body 511. The light mounting portion 513 may be disposed on the side of the detection member accommodation portion 512.

**[0193]** The light mounting portion 513 may be disposed farther away from the hinge device 205 than the detection member accommodation portion 512. Accordingly, the door light 53 can be disposed closer to the door 20 or the center of the refrigerator 1A, and can effectively illuminate the lower side of the door 20. So, the door light has a larger distance to the hinge device 205 or rotation axis of the door than the detection device 52.

**[0194]** The door light 53 may include a substrate 531 and one or more or a plurality of LEDs 532 disposed along a lower surface of the substrate 531. A connector 533 is provided at one end of the substrate 531 and may be connected to the connector 533 disposed on one side of the light mounting portion 513.

**[0195]** The light mounting portion 513 is recessed upward from the case body 511, and a lower surface thereof may be opened.

**[0196]** The open lower surface of the light mounting portion 513 may be shielded by a light cover 55. The light cover 55 may be formed of a transparent material capable of transmitting light. Cover protrusions 552 and 553 are formed on both left and right sides of the light cover 55 so that the light cover 55 can be detachably attached to the light mounting portion 513.

**[0197]** A cover rib 554 may be formed on an upper surface of the light cover 55. The cover rib 554 may extend upward along the circumference of the light cover 55 and may be in contact with the inner surface of the light mounting portion 513.

**[0198]** A door light fixing portion for fixing the door light 53 may be formed inside the light mounting portion 513. The door light fixing portion may include a plurality of upper support portions 513b disposed along the upper surface of the light mounting portion 513 and a lower support portion 513a disposed below and away from the upper support portion 513b. The upper support portion 513b extends in the front and rear direction, and a plurality of upper support portions may be continuously arranged at regular intervals in the left and right direction.

**[0199]** At least a portion of the upper support portion 513b may be formed in a hook shape so that the substrate 531 is caught and restrained. The lower support portion 513a may be positioned below the upper support portion 513b by a thickness of the substrate 531 and may be disposed on at least one end of both left and right ends of the light mounting portion 513. Accordingly, the sub-

strate 531 may be inserted and fixed between the upper support portion 513b and the lower support portion 513a.

**[0200]** Hereinafter, the operation of the refrigerator 1A will be described in more detail with reference to drawings. FIG. 11 is a view illustrating a state when or where the refrigerator detects a user.

**[0201]** As illustrated in the drawing, the refrigerator 1A may detect the proximity of the user U by the detection device 50 when the user U approaches within a set distance.

**[0202]** In detail, in order to determine that the user U is approaching to use the refrigerator 1A (or home appliance), it must be able to effectively detect when the user U is located within a set distance from at least the front surface of the refrigerator 1A (or home appliance).

**[0203]** For example, the user U who does not intend to operate the refrigerator 1A usually passes the refrigerator at a distance of 600 mm or more. Normally, the user U opens and closes the door 20 at a distance of about 300 mm from the front of the refrigerator 1A. Therefore, in order to determine that the user U is approaching to use the refrigerator 1A, it is necessary to effectively determine the user U within a set distance of approximately 300 mm to 600 mm.

**[0204]** As illustrated in (a) of FIG. 11, the detection device 50 may be located on at least one door 20 of the pair of upper doors 201 disposed on both left and right sides. For example, the detection device 50 may be provided in the door 20 on the left side among doors on both sides.

**[0205]** The detection device 50 may be located on the left side close to the hinge device 205 located on the left side of both left and right sides to prevent interference during the opening and closing operation of the upper door 201 and the lower door 202 by the user U.

**[0206]** Although the detection device 50 is located at a position biased to one side, the detection device 50 may be inclined with respect to the front surface of the door 20. Therefore, the light emitted from the detection member 52 to detect the user U is radiated toward the front and right directions, and an approach of the user U within the set distance from the center of the refrigerator 1A can be effectively detected. So, the inclination of the detection member 52 is directed to the center of the refrigerator or home appliance.

**[0207]** As illustrated in (b) of FIG. 11, the detection device 50 may be provided at a lower end of the upper door 201 located above the lower door 202. The detection device 50 may be disposed inclined with respect to the lower surface of the upper door 201. Accordingly, the light emitted from the detection member 52 to detect the user U is radiated forward and downward, and it is possible to effectively detect that the user U is approaching within the set distance.

**[0208]** In particular, the detection device 50 is located higher than the lower door 202 and therefore may be disposed at an appropriate height for detecting a user within the set distance.

**[0209]** The detection device 50 is located at a higher position than the lower door 202 from the ground, but due to the inclined arrangement structure, the user U approaching the refrigerator 1A is effectively detected, and a user (U) located far beyond the set distance is not detected, and thus there is an advantage in preventing the operation of the lighting device 36 due to false detection.

**[0210]** That is, the detection device 50 can effectively detect a user U approaching to use the refrigerator 1A due to its arrangement structure, and at the same time, it does not interfere with opening and closing the door 20, external exposure can also be minimized.

**[0211]** When the user (U) is sensed through the detection device 50, the refrigerator 1A may perform various operations.

**[0212]** For example, when the user U approaches, the lighting device 36 may be turned on so that the front surface of the door 20 is illuminated. If the front surface of the door 20 is already shining, it may be made to glow in a different color when the user approaches.

**[0213]** Alternatively, when the user approaches, the user's glare may be prevented by lowering the front illumination of the door 20. Alternatively, when a user approaches, the door 20 may perform a specific lighting pattern operation. For example, a plurality of doors 20 may be sequentially illuminated or may show a specific flow, or the outer appearance state of the doors 20 may show various dynamic changes. Alternatively, if the user moves away from the refrigerator 1A again, it may return to its original state or may slightly go off into an off state of no illumination.

**[0214]** The detection device 50 may be operated in conjunction with the door light 53 as well as the lighting device 36. That is, when a user's approach is detected, the door light 53 is turned on to visualize the positions of the handles 201a and 202a.

**[0215]** In addition, the detection device 50 may be linked with various devices provided in the refrigerator 1A.

**[0216]** Meanwhile, the embodiments of the present disclosure are not limited to the above-described embodiments and may have various embodiments. Another embodiment of the present disclosure is characterized in that a refrigerator having a door arrangement structure different from the refrigerator of the present disclosure is provided with a detection device, and the detection device has a structure configured independently without a door light.

**[0217]** In order to prevent duplication of description, the same reference numerals are used for the same components, and detailed description thereof will be omitted. In addition, if necessary, it may be indicated on the drawings using reference numerals without separate explanation.

**[0218]** Hereinafter, a refrigerator of another embodiment of the present disclosure will be described in more detail with reference to the drawings.

**[0219]** FIG. 12 is a front view illustrating a refrigerator of another embodiment of the present disclosure, FIG. 13 is an enlarged view illustrating section B of FIG. 12, FIG. 14 is a partial perspective view illustrating a state where the door of the refrigerator is viewed from below, and FIG. 15 is a partial perspective view illustrating the lower portion of the door from which the detection device is separated of an embodiment of the present disclosure.

**[0220]** As illustrated in the drawings, a refrigerator 1B of another embodiment of the present disclosure may include a cabinet 10 and a door 20 forming a storage space.

**[0221]** The cabinet 10 may include an upper storage space and a lower storage space. The upper storage space may be opened and closed by an upper door 201. The upper door 201 is a rotational door and can be rotatably mounted to the cabinet 10 by hinge devices 204 and 205. A handle 201a may be formed at a lower end of the upper door 201. The lower storage space may be opened and closed by a lower door 203.

**[0222]** The lower door 203 may be configured as a door 20 introduced and withdrawn in a draw manner. In addition, a handle 203a is formed at an upper end of the lower door 203 so that the lower door 203 can be introduced and withdrawn. A plurality of lower doors 203 may be provided and may be arranged vertically. The lower storage space consists of one storage space and can be opened and closed by two lower doors 203. Alternatively, the lower storage space may be configured as a separate space partitioned vertically and opened and closed by each of the lower doors 203.

**[0223]** A detection device 60 may be mounted at the lower end of the upper door 201, that is, the lower cap deco 45. The detection device 60 may be mounted at a position biased toward one side closer to the hinge device 205 among the left and right sides of the lower surface of the upper door 201.

**[0224]** The detection device 60 may be disposed on the side of the hinge bracket 451 to which the hinge device 205 is mounted. A hinge hole 451a into which a hinge shaft is inserted may be formed in the hinge bracket 451. In addition, a restraining member 457 for maintaining the upper door 201 in a closed state may be provided in the hinge bracket 451.

**[0225]** A shielding portion 452 may be formed in front of the hinge bracket 451. The shielding portion 452 extends downward from the lower surface of the upper door 201 and may shield at least a portion of the hinge bracket 451 from the front. In addition, the shielding portion 452 may shield the restraining member 457 from the front.

**[0226]** The detection device 60 may be mounted on the detection device mounting portion 454 opened to the lower surface of the upper door 201. The detection device mounting portion 454 may be formed on the lower surface of the lower cap deco 45. The detection device mounting portion 454 is opened downward and may form a space recessed into the upper door 201. Accordingly, a portion of the detection device 60 including the detection mem-

ber 52 may be accommodated inside the detection device mounting portion 454.

**[0227]** A support rib 456 for supporting the PCB mounting portion 614 may be formed on an inner surface of the detection device mounting portion 454. A support portion 455 for supporting the detection member 52 from the rear may be further formed on an inner surface of the detection device mounting portion 454. The support portion 455 may be formed at a position facing the rear surface of the detection member 52.

**[0228]** The support portion 455 may protrude to have a slope corresponding to that of the rear surface of the detection member 52. Therefore, when the detection device 60 is mounted on the detection device mounting portion 454, the support portion 455 may support the detection member 52 from the rear, and the detection member 52 may be in close contact with the inside of the detection member accommodation portion 612.

**[0229]** The detection device 60 may include a case 61 for shielding the detection device mounting portion 454.

**[0230]** The case 61 may include a case body 611 for shielding the detection device mounting portion 454 and a detection member accommodation portion 612 protruding from the case body 611 and accommodating the detection member 52. The case body 611 may form a portion of the lower surface of the upper door 201.

**[0231]** The detection member accommodation portion 612 may protrude downward from the lower surface of the upper door 201. The detection member accommodation portion 612 may also be referred to as a case protrusion. At this time, the protrusion height H3 of the detection member accommodation portion 612 may be smaller than the distance H1 between the lower surface of the upper door 201 and the upper surface of the lower door 203.

**[0232]** The protruding height H3 of the detection member accommodation portion 612 may be equal to or smaller than the protruding height H2 of the shielding portion 452. The detection device 60 can easily detect the user and minimized protruding height to prevent interference during the user's opening/closing manipulation of the door 20.

**[0233]** Hereinafter, the detection device 60 will be described in more detail with reference to the drawings.

**[0234]** FIG. 16 is a perspective view illustrating a state where the detection device is viewed from one direction, FIG. 17 is an exploded perspective view illustrating a state where the detection device is viewed from another direction, and FIG. 18 is a cutaway perspective view taken along line 18-18' of FIG. 13.

**[0235]** As illustrated in the drawing, the detection member 52 and the detection device case 61 to which the detection member 52 is mounted may be included. The detection device case 61 may be mounted on the detection device mounting portion 454 in a state of being coupled with the detection member 52.

**[0236]** The case 61 may include a case body 611 for shielding the detection device mounting portion 454 and

a detection member accommodation portion in which the detection member 52 is mounted. The case body 611 may be formed in a shape corresponding to the detection member accommodation portion 612. In addition, body protrusions 611a and 611b are formed on the case body 611 so that the case body 611 can be mounted on the detection device mounting portion 454.

**[0237]** A guide rib 611c may be formed along the circumference of the detection device mounting portion 454.

**[0238]** The detection member accommodation portion 612 may be mounted on the case body 611. The detection member accommodation portion 612 may be formed in the same shape as the detection member accommodation portion 512 of the above-described embodiment. The detection member accommodation portion 612 may be formed in a corresponding shape so that the detection member 52 can be accommodated.

**[0239]** The detection member accommodation portion 612 may include a front surface 612a extending downward from the case body 611, a lower surface 612b connected to the lower end of the front surface 612a and the case body 611, and the both side surfaces 612c connecting the front surface 612a and the lower surface 612b may be included.

**[0240]** The front surface 612a may protrude downward from the door 20 when the detection device 60 is mounted and may be exposed forward. In this case, the front surface 612a may be inclined toward the rear as it extends downward. For example, an angle  $\alpha_1$  between the front surface 612a and the lower surface of the door 20 may be approximately  $30^\circ$ .

**[0241]** In addition, the front surface 612a may be disposed in an inclined state with respect to the front surface of the door 20. The front surface 612a may extend away from the front surface of the door 20 as it moves away from the hinge device 205. For example, an angle  $\alpha_2$  between the front surface 612a and the front surface 612a of the door 20 may be approximately  $15^\circ$ .

**[0242]** The detection member 52 may be inclined to correspond to the front surface 612a of the detection member accommodation portion 612 in a state of being mounted on the detection member accommodation portion 612. That is, the detection member 52 may be substantially inclined with respect to the lower surface and the front surface of the door 20.

**[0243]** Meanwhile, a fastening portion 615 for fixing the detection member 52 may protrude from the case body 611. The fastening portion 615 may be coupled to each other by a fixed end 524 of the detection member 52 and a screw 525.

**[0244]** The detection member 52 may have the same structure as the detection member 52 of the above-described embodiment. That is, the detection member 52 includes a detection member case 61, and the detection member case 61 may include a light emitting portion 523 in which a light emitting member 523a is disposed and a light receiving portion 522 in which a light receiving mem-

ber 522a is disposed. In addition, the fixed end 524 may be further formed in the detection member case 61.

**[0245]** The front surface of the detection member 52 may be in close contact with the front surface 612a of the detection member accommodation portion 612. That is, the front surfaces of the light emitting portion 523 and the light receiving portion 522 are in close contact with the front surface of the detection member accommodation portion 612, and all the light emitted from the light emitting portion 523 and the light incident on the light receiving portion 522 may pass through the front surface 612a of the detection member accommodation portion 612.

**[0246]** Accordingly, the front surface 612a of the detection member accommodation portion 612 may be formed of a material capable of transmitting light. In addition, the entire case 61 or the detection member accommodation portion 612 may be formed of a material capable of transmitting light.

**[0247]** A PCB mounting portion 614 may be formed on one side of the case body 611. The PCB mounting portion 614 protrudes upward from the case body 611, and a PCB 64 connected to the detection member 52 may be mounted therein.

**[0248]** Hereinafter, the operation of the refrigerator 1B will be described in more detail with reference to drawings.

**[0249]** FIG. 19 is a view illustrating a state where the refrigerator detects a user.

**[0250]** As illustrated in the figure, the refrigerator 1B can detect the proximity of the user U by the detection device 60 when the user approaches within a set distance.

**[0251]** In detail, in order to determine that the user U is approaching to use the refrigerator 1B, the detection device 60 must be able to effectively detect when the user U is located within a set distance from at least the front of the refrigerator 1B.

**[0252]** For example, in order to determine that a user approaches to use the refrigerator 1B, it is necessary to effectively determine a user within a set distance of approximately 300 mm to 600 mm.

**[0253]** As illustrated in (a) of FIG. 19, the detection device 60 is configured to prevent interference when the user U opens and closes the upper door 201 and the lower door 203 and, to do this, the detection device 60 may be located on the right side close to the hinge device 205 among the left and right sides of the door 20. Although the detection device 60 is located at a position biased to one side, the detection device 60 may be inclined with respect to the front surface of the door 20. Therefore, the light emitted from the detection member 52 to sense the user is directed forward and to the left, and it is possible to effectively detect that the user is approaching from the center of the refrigerator 1B within the set distance.

**[0254]** As illustrated in (b) of FIG. 19, the detection device may be provided at a lower end of the upper door

201 located above the lower door 203. The detection device 60 may be disposed inclined with respect to the lower surface of the upper door 201. Accordingly, the light emitted from the detection member 52 to detect the user U is radiated forward and downward, and it is possible to effectively detect that the user U is approaching within the set distance.

**[0255]** In particular, the detection device 60 is located higher than the lower door 203, and thus can be disposed at an appropriate height for detecting the user U within the set distance. The detection device 60 is located at a higher position from the ground than the lower door 203, but due to its inclined arrangement structure, the detection device 60 effectively detects the user U approaching the refrigerator 1B and does not detect the user located at the location which is far beyond the set distance, and thus there is an advantage in that the operation of the lighting device 36 due to false detection is prevented.

**[0256]** That is, the detection device 60 can effectively detect a user U approaching to use the refrigerator 1B due to its arrangement structure, and at the same time, the detection device does not interfere with opening and closing the door 20 and external exposure may also be minimized.

**[0257]** When detecting the user U through the detection device 60, the refrigerator 1B may perform various operations as in the above-described embodiment.

**[0258]** Meanwhile, the detection device 60 may include an illuminance sensor for detecting ambient brightness. The detection device 60 equipped with an illuminance sensor may detect ambient brightness and control the brightness of the door of the detected brightness.

**[0259]** FIG. 20 is a perspective view illustrating a state where a refrigerator of a second embodiment of the present disclosure is viewed from the front.

**[0260]** A refrigerator of a second embodiment of the present disclosure includes a cabinet having an upper storage space and a lower storage space; an upper door for opening and closing the upper storage space; a lower door for opening and closing the lower storage space; and a sensor module 150 that detects ambient light where the cabinet is disposed, wherein the upper door includes a door body; and a panel assembly coupled to the door body to form a front outer appearance of the door; and a door cover 146 forming an upper surface of the door, and the sensor module 150 may be mounted on the door cover 146.

**[0261]** Here, the sensor module 150 may also be referred to as a detection device.

**[0262]** The sensor module 150 may include an illuminance sensor 152.

**[0263]** The illuminance sensor 152 may be accommodated in a sensor module mounting portion 153 recessed downward from the door cover 146.

**[0264]** The sensor module 150 may further include a sensor cover 151 made a material capable of transmitting light and shielding the opening of the sensor module mounting portion 153.

**[0265]** This sensor module 150 is equipped with a detection sensor capable of detecting user approach and may also be used as a sensor for user detection.

**[0266]** The sensor cover 151 includes a cover protrusion 1511 which protrudes upward from the door cover 146 and in which an upper end of the illuminance sensor 152 is accommodated, and a first inclined portion 1512 extending forward from the cover protrusion 1511 and formed to be inclined downward toward the front and the detection portion 1521 of the illuminance sensor 152 may detect light entering through the first inclined portion 1512.

**[0267]** The sensor cover 151 may include a first extension portion 1514a extending from the front end of the first inclined portion 1512 toward the panel assembly.

**[0268]** The illuminance sensor 152 may be mounted on the sensor module mounting portion 153 in an inclined state at a set angle.

**[0269]** A sensor fixing portion 1534 to which an upper end of the illuminance sensor 152 is fixed is provided on the lower surface of the sensor cover 151, and the sensor fixing portion 1534 may include a cutout formed by cutting one side.

**[0270]** The sensor module mounting portion 153 includes a body portion 1532 having an open upper surface and being recessed downward from the door cover 146 to accommodate the illuminance sensor 152. In the illuminance sensor 152, the body portion 1532 may be mounted in an inclined state toward the rear as it goes upward from the lower end.

**[0271]** The sensor module mounting portion 153 includes a fixing portion 1534 protruding obliquely upward from the rear surface of the body portion 1532, and the illuminance sensor 152 may have a fixing hole through which the fixing portion 1534 passes.

**[0272]** A mounting portion 1536 is formed on the lower surface of the body portion 1532 and protrudes upward to mount on the lower portion of the illuminance sensor 152, and the lower portion of the illuminance sensor 152 may be disposed closer to the front surface of the front and rear surfaces of the body portion 1532 and the upper end of the illuminance sensor 152 may be disposed closer to the rear surface of the front and rear surfaces of the body portion 1532.

**[0273]** A microphone mounting portion 161 to which the microphone module 160 is mounted may be formed on the door cover 146.

**[0274]** An open electric wire opening 1533 may be formed on one side of the body portion 1532 so that electric wires can be introduced and withdrawn.

**[0275]** The door cover 146 includes a cover portion 1461 forming an upper surface of the upper door and a PCB mounting portion 147 extending downward from a lower surface of the cover portion 1461, a sensor PCB is mounted on one side of the PCB mounting portion 147, and an electric wire connected to the sensor module 150 may be introduced and withdrawn through the electric wire opening 1533 to be connected to the sensor PCB.

**[0276]** The upper door may include an upper cap deco that forms the upper surface of the door body and has an upper surface that is open to form a space in which the PCB mounting portion 147 is accommodated, the panel assembly may include a rearwardly protruding mounting protrusion 302, and a protrusion accommodation portion 1433 into which the mounting protrusion 302 is inserted may be provided on the front surface of the upper cap deco.

**[0277]** The upper cap deco 143 may include a cap deco electric wire hole 1435 prepared to allow electric wires to be introduced and withdrawn, and an electric wire which connects to the PCB mounted on the PCB mounting portion 147 and electrical components inside the upper door may be introduced and withdrawn through the upper cap deco electric wire hole 1435.

**[0278]** The refrigerator 1C of an embodiment of the present disclosure may be mounted in harmony with furniture or walls in an indoor space.

**[0279]** In this arrangement structure of the refrigerator 1C, the front surface of the refrigerator 1C, that is, the front surfaces of the doors 20 and 30 may be configured to be very close to the furniture or walls and be located on the same or adjacent plane to create a sense of unity.

**[0280]** In this way, the refrigerator 1C is installed adjacent to the furniture or wall 0 to have a sense of unity with each other, which can be referred to as a built-in structure.

**[0281]** Alternatively, the refrigerator 1C may be installed independently without being disposed adjacent to the furniture or wall.

**[0282]** A sensor module 150 for detecting brightness around the refrigerator 1C may be provided in the door 20. The sensor module 150 may detect the brightness of indoor lighting or ambient brightness.

**[0283]** The sensor module 150 may be mounted on the upper door 21 of the upper door 21 and the lower door 22. The sensor module 150 may be provided on an upper surface of the upper door 21.

**[0284]** The sensor module 150 may be provided on a door cover 146 forming an upper surface of the upper door 21. Since the sensor module 150 is provided on one side of the upper surface of the upper door 21, exposure of the sensor module 150 from the front of the refrigerator can be minimized.

**[0285]** A manipulation portion 14 for controlling the overall operation of the refrigerator 1C may be provided on the upper surface of the cabinet 10. The manipulation portion 14 may also be referred to as a controller.

**[0286]** The manipulation portion 14 may control the lighting device 36 as well as the cooling operation of the refrigerator so that the front surface of the door is brightly lit in a color set by the user.

**[0287]** The controller 14 may receive a user's voice signal and control the operation of the refrigerator of the user's voice command.

**[0288]** A microphone module 160 capable of receiving a user's voice signal may be provided on an upper sur-

face of the upper door 21. The microphone module 160 may be provided on one side of the door cover 146 forming the upper surface of the upper door 21.

**[0289]** FIG. 21 is a perspective view illustrating a state where an upper door equipped with a sensor module of a second embodiment of the present disclosure viewed from the front, and FIG. 22 is an exploded perspective view illustrating a state where an upper door equipped with the sensor module is viewed from above.

**[0290]** The door body 40 may include an upper cap deco 143 and a lower cap deco 45 forming upper and lower surfaces of the door body 40.

**[0291]** The open upper surface of the upper cap deco 143 may be shielded by the door cover 146.

**[0292]** The sensor module 150 may be provided on the door cover 146. The sensor module 150 may be disposed adjacent to one end of the door cover 146.

**[0293]** The door cover 146 includes a cover portion 1461 that shields the open upper surface of the upper cap deco 143, and a sensor module mounting portion 153 recessed from the cover portion 1461 in the direction of the upper cap deco 143 and thus in which the illuminance sensor 152 is mounted.

**[0294]** The sensor module mounting portion 153 may be formed by opening a portion of the cover portion 1461 and recessed downward.

**[0295]** The sensor module mounting portion 153 provides a space in which the illuminance sensor 152 for detecting ambient brightness may be mounted. The illuminance sensor 152 may be provided in the accommodation space 1431 of the upper cap deco 143 while being mounted on the sensor module mounting portion 153.

**[0296]** In addition, the sensor module 150 includes a sensor cover 151 covering the opening 1531 of the sensor module mounting portion 153. The sensor cover 151 may be formed of an injection-molded material through which light around the refrigerator is installed. For example, the sensor cover 151 is formed of a transparent injection molding material or a glass material through which light can pass through, so that the illuminance sensor 152 can detect external light.

**[0297]** That is, while the illuminance sensor 152 is installed on the sensor module mounting portion 153, the sensor module mounting portion 153 may be covered by the sensor cover 151. In addition, ambient light may pass through the sensor cover 151, and the illuminance of light passing through the sensor cover 151 may be detected by the illuminance sensor 152.

**[0298]** The sensor module 150 may be provided on the upper left door 21a. At this time, the sensor module 150 may be provided on one side adjacent to the upper right door 21b among both left and right sides of the upper left door 21a. That is, the sensor module 150 may be disposed close to the center when looking at the refrigerator as a whole.

**[0299]** In other words, the sensor module 150 is preferably disposed close to the center of the cabinet. In this case, ambient brightness in which the refrigerator is in-



stalled may be recognized more accurately.

**[0300]** Meanwhile, a microphone mounting portion 161 to which the microphone module 160 is mounted may be formed on one side of the door cover 146. The microphone mounting portion 161 may be provided to be spaced apart from one side where the sensor module 150 is installed. That is, the microphone mounting portion 161 may be provided on the other side adjacent to the furniture or wall among the left and right sides of the door cover 146.

**[0301]** The microphone mounting portion 161 may include a microphone protrusion 1611 protruding upward from the door cover 146 and a microphone inclination portion 1612 inclined downward from the front surface of the microphone protrusion 1611 toward the front. A microphone hole 1613 may be formed in the microphone inclined portion 1612.

**[0302]** The microphone module 160 may be provided below the microphone mounting portion 161. The microphone module 160 is configured to receive a user's voice. With this structure, the user's voice received through the microphone hole 1613 can be transmitted to the controller 14 through the microphone module 160.

**[0303]** The sensor module 150 may include, for example, a door cover 146, an illuminance sensor 152, and a sensor cover 151. Alternatively, the sensor module 150 may include, for example, a sensor module mounting portion 153, an illuminance sensor 152, and a sensor cover 151.

**[0304]** FIG. 23 is a view illustrating a state where a sensor cover, which is one component of the sensor module is viewed from below.

**[0305]** Describing the sensor cover 151, the sensor cover 151 may be formed of a transparent plastic injection molding material or a glass material so that the illuminance sensor 152 can detect the external light.

**[0306]** The sensor cover 151 may be mounted at a position corresponding to the opening 1531 of the sensor module mounting portion 153 to shield the opening 1531.

**[0307]** The sensor cover 151 may include a cover protrusion 1511 protruding upward from the opening 1531.

**[0308]** The sensor cover 151 may include a first inclined portion 1512 extending forward from the cover protruding portion 1511 and a second inclined portion 1513 extending backward from the cover protruding portion 1511.

**[0309]** The cover protrusion 1511 may protrude upward from the door cover 146. A structure in which an upper surface of the illuminance sensor 152 can be mounted may be provided on the lower surface of the cover protrusion 1511. That is, the cover protrusion 1511 and the illuminance sensor 152 may be disposed to contact each other.

**[0310]** The cover protrusion 1511 may be formed to have a minimum height at which the detection portion 1521 formed in the illuminance sensor 152 can recognize external light.

**[0311]** The detection portion 1521 of the illuminance

sensor 152 may be spaced apart from an upper end of the illuminance sensor 152 downward by a set distance. Therefore, in order for the sensor 1521 to detect external light coming from the front of the sensor cover 151, the sensor cover 151 needs to protrude beyond the door cover 146 to a set height.

**[0312]** Meanwhile, when the sensor cover 151 excessively protrudes upward with respect to the door cover 146, there is a problem in that the sensor cover 151 can be easily exposed from the outside. In addition, when the refrigerator 1C is disposed adjacent to furniture or a wall, a space into which light from external lighting or natural light can enter may be limited.

**[0313]** In one embodiment of the present disclosure, the first inclined portion 1512 is provided at the front end of the cover protrusion 1511 to minimize the height h1 of the cover protrusion 1511, and the detection portion 1521 can detect external light.

**[0314]** In detail, the first inclined portion 1512 may be formed to be inclined downward from the front end of the cover protrusion 1511 toward the front. The first inclined portion 1512 may extend from a front end of the cover protrusion 1511 to a front end of the opening 1531 of the sensor module mounting portion 153.

**[0315]** With this structure, since the cover protrusion 1511 is located at the rear of the sensor module mounting portion 153 based on the center, exposure thereof to the outside can be minimized.

**[0316]** In addition, an area through which light from the outside is transmitted can be maximized by the first inclined portion 1512. For example, a light is provided in a room where the refrigerator 1C is installed, and light emitted from the light may pass through the first inclined portion 1512 and reach the detection portion 1521.

**[0317]** For example, in the first inclined portion 1512, the angle  $\Theta 2$  formed by an imaginary line L3 extending in the front and rear direction of the first extension portion 1514a and a center line L4 of a vertical section of the first inclined portion 1512 may be 15 degrees to 30 degrees, preferably 15 degrees to 25 degrees, and more preferably 18 degrees to 22 degrees. Within the angle range, light entering the space between the upper surface of the cabinet and the wall or furniture reaches the detection portion 1521 as much as possible, thereby improving reliability of the sensor module 150.

**[0318]** The sensor cover 151 may further include a second inclined portion 1513 inclined downward toward the rear from the rear end of the cover protrusion 1511. The second inclined portion 1513 may be shorter than the length of the first inclined portion 1512 extending in the front and rear direction. The second inclined portion 1513 allows the sensor cover 151 to be more stably mounted on the door cover 146.

**[0319]** In addition, the second inclined portion 1513 may provide a portion of a space in which the illuminance sensor 152 can be mounted on the sensor module mounting portion 153. In detail, at least a portion of the fixing portion 1534 to which the illuminance sensor 152 is fixed

may be accommodated in a space between the opening 1531 formed in the second inclined portion 1513 and the sensor cover 151.

**[0320]** Meanwhile, the sensor cover 151 may include an extension portion 1514 seated on an upper surface of the sensor module mounting portion 153. The extension portion 1514 may be formed to extend along the circumferences of the cover protrusion 1511 and the first and second inclined portions 1513.

**[0321]** The sensor cover 151 may include a first extension portion 1514a extending forward from one end of the first inclined portion 1512.

**[0322]** The first extension portion 1514a may be located in a mounting groove 1536 provided on an upper surface of the sensor module mounting portion 153. The first extension portion 1514a may extend from one end of the first inclined portion 1512 in a direction in which the panel assembly 30 is provided.

**[0323]** A first hooking portion 1515a may be provided on a lower surface of the first extension portion 1514a to be hooked into the first coupling groove 1535a of the sensor module mounting portion 153.

**[0324]** The first extension portion 1514a may extend from the front end of the opening 1531 to the front end of the door cover 146. External light is transmitted through the first extension portion 1514a, and the sensor 1521 can detect the brightness of the external light. Therefore, it is preferable to secure a wide area as much as possible for the first extension portion 1514a.

**[0325]** The sensor cover 151 may further include a second extension portion 1514b extending rearward from one end of the second inclined portion 1513. The second extension portion 1514b may be shorter than the length of the first extension portion 1514a in the front and rear direction.

**[0326]** The second extension portion 1514b may be mounted in a mounting groove 1536 provided in the sensor module mounting portion 153. A second hooking portion 1515b may be provided on a lower surface of the second extension portion 1514 to be hooked into the second coupling groove 1535b of the sensor module mounting portion 153.

**[0327]** On both sides of the sensor cover 151, a pair of third hooking portions 1515c that are hooked and constrained by the third coupling groove 1535c of the sensor module mounting portion 153 may be provided.

**[0328]** A cover coupling portion 1516 protruding downward from the lower surface of the sensor cover 151 and provided with the first, second, and third hooking portions may be formed. The cover coupling portion 1516 may be disposed along the circumference of the opening 1531. The cover coupling portion 1516 is accommodated in the coupling groove 1535 to prevent the sensor cover 151 from being separated from the sensor module mounting portion 153.

**[0329]** A sensor fixing portion 1534 for fixing the illuminance sensor 152 may be provided on a lower surface of the sensor cover 151.

**[0330]** The sensor fixing portion 1534 may be formed to protrude downward from a lower surface of the sensor cover 151 at a position corresponding to an upper end of the illuminance sensor 152. The sensor fixing portion 1534 may include a first sensor fixing portion 1534 extending downward from the front end of the cover protrusion 1511 and a second sensor fixing portion 1534 extending downward from the rear end of the cover protrusion 1511.

**[0331]** The illuminance sensor 152 may be mounted between the first sensor fixing portion 1534 and the second sensor fixing portion 1534.

**[0332]** The first sensor fixing portion 1534 may contact at least a portion of the front surface of the illuminance sensor 152.

**[0333]** A length at which the first sensor fixing portion 1534 extends from the cover protrusion 1511 may be extended to a set length that does not interfere with light detection of the detection portion 1521.

**[0334]** In detail, the lower end of the first sensor fixing portion 1534 may be spaced upward from the upper end of the detection portion 1521.

**[0335]** The first sensor fixing portion 1534 may have a first cutout 1517c in which a portion thereof is cut. In addition, the detection portion 1521 may be located below the first cutout 1517c.

**[0336]** The first cutout 1517c may minimize interference of light entering the sensor cover 151 by the sensor fixing part 1534 in a state where the illuminance sensor 152 is mounted on the sensor fixing portion 1534.

**[0337]** The second sensor fixing portion 1534 may be spaced apart from the first sensor fixing portion 1534 to the rear. The second sensor fixing portion 1534 may contact at least a portion of the rear surface of the illuminance sensor 152.

**[0338]** The length of the second sensor fixing portion 1534 extending downward from the cover protrusion 1511 is longer than the length extending downward of the first sensor fixing portion 1534, so that the an area in contact with the illuminance sensor 152 may be maximized.

**[0339]** In particular, when the illuminance sensor 152 is inclined at an angle set in the sensor module mounting portion 153, the illuminance sensor 152 may be biased backward due to a load. At this time, the second sensor fixing portion 1534 can more stably support the rear surface of the illuminance sensor 152.

**[0340]** The second sensor fixing portion 1534 may have a second cutout 1517d in which a portion thereof is cut. The second cutout 1517d forms a space so that a fixing portion 1534, which will be described later, can be inserted into the illuminance sensor 152. That is, the fixing portion 1534 passes through the second cutout 1517d and may be inserted into the illuminance sensor 152 so that the illuminance sensor 152 is inclinedly mounted to the sensor module mounting portion 153 at a set angle.

**[0341]** The second cutout 1517d may have a size corresponding to that of the fixing portion 1534. The length

of the second cutout 1517d in the horizontal direction may be shorter than the length of the first cutout 1517c in the horizontal direction.

**[0342]** The second sensor fixing portion 1534 may have a third cutout 1517e formed at both side ends. The third cutout 1517e may provide a space through which an electric wire connected to the sensor PCB 1523 provided in the illuminance sensor 152 can be introduced and withdrawn.

**[0343]** FIG. 24 is a view illustrating a state where a door cover on which the sensor module is mounted is viewed from above, and FIG. 25 is a cross-sectional view illustrating a portion of the door cover where the sensor module is mounted.

**[0344]** A sensor module mounting portion 153 recessed downward to receive the illuminance sensor 152 may be formed in the door cover 146.

**[0345]** In one embodiment of the present disclosure, the sensor module mounting portion 153 is formed on the door cover 146 as an example, but is not limited thereto. For example, the sensor module mounting portion 153 may be formed on a hinge cover that shields a hinge connecting the cabinet 10 and the door 20 from above.

**[0346]** In the sensor module of an embodiment of the present disclosure, the illuminance sensor 152 may be mounted to the sensor module mounting portion 153 in an inclined state at a set angle. The illuminance sensor 152 may be disposed inclined forward from the top to the bottom. In other words, the illuminance sensor 152 may be inclined so as to approach the panel assembly 30 from top to bottom.

**[0347]** With this structure, a height required for the detection portion 1521 to detect external light can be minimized. Accordingly, a height at which the cover protrusion 1511 protrudes upward can be minimized, thereby preventing the sensor module 150 from being exposed to the outside.

**[0348]** In addition, by arranging the illuminance sensor 152 at an angle, the amount of light detectable by the detection portion 1521 can be maximized. In particular, when the refrigerator 1C is installed adjacent to a furniture or a wall, a space through which external light can enter upward of the refrigerator 1C may be limited. In addition, the external light may be located higher than the refrigerator 1C and reach the detection portion 1521 along a path inclined downward. At this time, by disposing the illuminance sensor 152 inclined at a set angle, it is possible to more reliably recognize the light emitted from the external light.

**[0349]** Accordingly, the sensor module mounting portion 153 may be provided with a structure in which the illuminance sensor 152 can be fixed in an inclined state at a set angle.

**[0350]** The sensor module mounting portion 153 may be formed closer to the front end of the front end and the rear end of the door cover 146. That is, the sensor module mounting portion 153 may be formed adjacent to the panel assembly 30.

**[0351]** In detail, the sensor module mounting portion 153 includes an opening 1531 provided to allow the illumination sensor 152 to be introduced and withdrawn, and a body portion 1532 that provides a space recessed downward from the door cover 146 to accommodate the illumination sensor 152.

**[0352]** The sensor module mounting portion 153 may be recessed downward along the circumference of the opening 1531 and may include a mounting groove 1536 in which the extension portion 1514 of the sensor cover 151 is seated.

**[0353]** In addition, the sensor module mounting portion 153 includes a coupling groove 1535 provided to be constrained to the hanging portion. The mounting groove 1536 and the coupling groove 1535 may be formed stepwise by having different recessed depths from the door cover 146 downward.

**[0354]** A fixing portion 1534 on which the illuminance sensor 152 is mounted may be formed on one surface of the body portion 1532. A fixing hole 1522 may be provided at one side of an upper end of the illuminance sensor 152. At least a portion of the fixing portion 1534 may pass through the fixing hole 1522 so that the illuminance sensor 152 may be fixed to the fixing portion 1534.

**[0355]** With this structure, the upper end of the illuminance sensor 152 may be fixed to the fixing portion 1534.

**[0356]** The fixing portion 1534 may protrude forward from the rear surface of the body portion 1532. The fixing portion 1534 may extend to be inclined upward from the rear surface of the body portion 1532 toward the front. That is, the fixing portion 1534 may extend from the body portion 1532 toward the fixing hole 1522.

**[0357]** The fixing portion 1534 may include a first fixing portion 1534a connected to the rear surface of the body portion 1532 and a second fixing portion 1534b inserted into the fixing hole 1522.

**[0358]** The second fixing portion 1534b may support the illuminance sensor 152 from the rear in a state where the illuminance sensor 152 is mounted on the first fixing portion 1534a.

**[0359]** When the illuminance sensor 152 is mounted on the first fixing portion 1534a, it is possible to prevent the illuminance sensor 152 from moving.

**[0360]** If necessary, a second fixing hole into which a fastening member passing through the fixing hole 1522 is inserted may be provided in the second fixing portion 1534b. The fastening member passes through the fixing hole 1522 and the second fixing hole, so that the illuminance sensor 152 may be more firmly mounted to the fixing portion 1534.

**[0361]** The first fixing portion 1534a and the second fixing portion 1534b may have different diameters. The diameter of the first fixing portion 1534a may be larger than the diameter of the second fixing portion 1534b. With this structure, it is possible to prevent the illuminance sensor 152 from being biased backward.

**[0362]** A mounting portion 1536 protruding upward from a lower surface of the body portion 1532 and sup-

porting a lower end of the illuminance sensor 152 may be provided.

**[0363]** The mounting portion 1536 is provided to contact at least a portion of the lower end of the illuminance sensor 152 to fix the position of the illuminance sensor 152.

**[0364]** The mounting portion 1536 may be provided at a position biased forward from the central portion of the body portion 1532. That is, the lower end of the illuminance sensor 152 may be mounted adjacent to the front surface of the body portion 1532. An upper end of the illuminance sensor 152 may be mounted adjacent to a rear surface of the body portion 1532. With this structure, the illuminance sensor 152 may be disposed closer to the front from top to bottom.

**[0365]** The mounting portion 1536 may include a pair of first mounting portions 1537 supporting both left and right sides of the illuminance sensor 152.

**[0366]** The first mounting portion 1537 may be provided on one side and the other side of the illuminance sensor 152, respectively. The illuminance sensor 152 may be inserted between the pair of first mounting portions 1537.

**[0367]** The mounting portion 1536 may include a second mounting portion 1538 supporting both front and rear sides of the illuminance sensor 152.

**[0368]** The second mounting portion 1538 may protrude upward from a lower surface of the body portion 1532 and support the front and rear sides of the illuminance sensor 152. A plurality of second mounting portion 1538 may be provided as needed.

**[0369]** In detail, the second mounting portion 1538 may include a 2-1 mounting portion 1538a that contacts the front surface of the illuminance sensor 152 and supports the illuminance sensor 152 from the front. A plurality of the 2-1 mounting portions 1538a may be formed to be spaced apart in a horizontal direction.

**[0370]** The 2-1 mounting portion 1538a may vertically extend upward from the lower surface of the body portion 1532. Accordingly, the 2-1 mounting portion 1538a may prevent the lower end of the illuminance sensor 152 from moving forward as the illuminance sensor 152 is inclined.

**[0371]** The second mounting portion 1538 may include a 2-2 mounting portion 1538b that contacts the rear surface of the illuminance sensor 152 and supports the illuminance sensor 152 from the rear. The 2-2 mounting portion 1538b may be disposed rearwardly spaced from the 2-1 mounting portion 1538a.

**[0372]** The 2-2 mounting portion 1538b may be inclined in a direction closer to the rear surface of the body portion 1532 from the lower side to the upper side. With this structure, the rear surface of the inclined illuminance sensor 152 may be stably supported.

**[0373]** The sensor module mounting portion 153 may further include a separation portion 1537 protruding upward from a lower surface of the body portion 1532 and contacting the lower surface of the illuminance sensor 152. The illuminance sensor 152 may be spaced apart

from the lower surface of the body portion 1532 by the separation portion 1537.

**[0374]** With this structure, the illuminance sensor 152 can be stably mounted on the sensor module mounting portion 153 in an inclined state.

**[0375]** An electric wire opening 1533 may be formed in the sensor module mounting portion 153 so that an electric wire connected to the sensor PCB 1523 may be introduced and withdrawn. In detail, at least a portion of one surface of the body portion 1532 may be opened. For example, at least a portion of one side surface or lower surface of the body portion 1532 is opened to allow electric wires to be introduced and withdrawn.

**[0376]** Hereinafter, a structure in which the sensor module detects light from an external light source and detects ambient brightness will be described in detail.

**[0377]** FIG. 26 is a cross-sectional view for explaining a state where the sensor module is mounted.

**[0378]** The illuminance sensor 152 may have a lower end adjacent to the front surface of the body portion 1532 and an upper end adjacent to the rear surface of the body portion 1532.

**[0379]** At this time, the angle formed between the center line L1 of the vertical section of the illuminance sensor 152 and the center line L2 of the vertical section of the front surface of the body portion 1532 may be approximately 10 to 30 degrees, preferably 20 to 30 degrees, more preferably 25 degrees.

**[0380]** In other words, the body portion 1532 may be formed to extend in a vertical direction parallel to an extension line of the panel assembly in a vertical direction.

**[0381]** In addition, an angle between the center line L1 of the vertical section of the illuminance sensor 152 and the vertical extension line of the panel assembly may be about 10 to 30 degrees, preferably 20 to 30 degrees, more preferably 25 degrees.

**[0382]** To this end, the angle  $\theta 1$  between the center line L1 of the vertical section of the first mounting portion 1537 and the center line L2 of the vertical section of the 2-1 mounting portion 1538a may be approximately 10 to 30 degrees, Preferably 20 to 30 degrees, more preferably 25 degrees.

**[0383]** In this way, since the illuminance sensor 152 is disposed obliquely, even if the detection portion 1521 is not disposed higher than the door cover 146, there is an advantage in that light from an external light source can be detected.

**[0384]** For example, the cover protrusion 1511 may be formed to have a height of approximately 1 to 4 mm, 2 to 3.5 mm, or approximately 2.9 mm based on the upper surface of the door cover 146.

**[0385]** In addition, the angle formed between the first inclined portion 1512 and the upper surface of the door cover 146 may be approximately 15 degrees to 30 degrees, preferably 15 degrees to 25 degrees, more preferably 18 degrees to 22 degrees.

**[0386]** Meanwhile, the external light source may be provided above the upper surface of the refrigerator 1C.

Accordingly, the light emitted from the external light source may pass through the sensor cover 151 along an inclined path. In addition, light passing through the sensor cover 151 may reach the detection portion 1521.

**[0387]** Hereinafter, the coupling structure of the door cover 146, the panel assembly 30, and the door body 40 will be described in detail.

**[0388]** FIG. 27 is an exploded perspective view illustrating a structure in which a door panel, a door body, and a door cover are coupled of an embodiment of the present disclosure, FIG. 28 is a cross-sectional view illustrating a state where the door cover is coupled to the door body, and FIG. 29 is a perspective view illustrating a state where the door cover is viewed from the front.

**[0389]** The upper surface of the door body 40 may be formed by an upper cap deco 143, and the upper cap deco 143 may be combined with an upper end of the panel assembly 30 and an upper end of the door liner 42.

**[0390]** To this end, a protrusion accommodation portion 1433 into which the mounting protrusion 302 formed in the panel assembly 30 is inserted may be formed in the upper cap deco 143.

**[0391]** In detail, the panel assembly 30 may include an upper bracket 34 forming an upper surface of the panel assembly 30. In addition, the panel assembly 30 may further include a lower bracket 35 forming a lower surface of the panel assembly 30.

**[0392]** Upper and lower ends of the back cover 39 forming the rear surface of the panel assembly 30 may be coupled to the upper bracket 34 and the lower bracket 35, respectively.

**[0393]** A mounting protrusion 302 protruding rearward may be formed on a rear surface of the upper bracket 34. A plurality of the mounting protrusions 302 protrude along the rear surface of the upper bracket 34, and may be coupled to the protrusion receiving portion 1433 of the upper cap deco 143.

**[0394]** The upper cap deco 143 includes a front portion 1431 facing the upper bracket 34 and a bottom portion 1432 seated in the space between the the door body 40 and the door liner 42 to shield and the upper surface of the door body 40 which is opened.

**[0395]** A protrusion accommodation portion 1433 accommodating the mounting protrusion 302 is formed on the front portion 1431. The protrusion accommodation portion 1433 may be formed in a structure surrounding the outer surface of the mounting protrusion 302.

**[0396]** A protrusion opening 393 through which the mounting protrusion 302 of the upper bracket 34 passes when the upper bracket 34 is mounted may be formed at an upper end of the circumference of the back cover 39.

**[0397]** The mounting protrusion 302 is inserted into the protrusion accommodation portion 1433 so that the panel assembly 30 can be combined with the upper cap deco 143.

**[0398]** Meanwhile, the door cover 146 includes a restraining portion 1462 extending downward from the cover portion 1461 and inserted into the accommodation

groove 1434.

**[0399]** A protrusion 1463 protruding upward from the bottom portion 1432 may be formed on the door cover 146, and a restraining portion 1462 may be provided on the protrusion 1463.

**[0400]** An accommodation groove 1434 in which the restraining portion 1462 of the door cover 146 is accommodated may be formed in the upper cap deco 143. The restraining portion 1462 is inserted into the accommodation groove 1434, and the door cover 146 can be combined with the upper cap deco 143.

**[0401]** A cap deco electric wire hole 1435 may be formed in the upper cap deco 143 to allow electric wires to be introduced and withdrawn. The cap deco electric wire hole 1435 may extend upward from the bottom surface of the upper cap deco 143. The cap deco electric wire hole 1435 allows electric wires connected to a plurality of PCBs mounted on the PCB mounting portion 147 provided on the door cover 146 to be connected to electric wires connected to electric components inside the door.

**[0402]** Meanwhile, the door cover 146 may include a cover portion 1461 for shielding the upper cap deco 143 and a PCB mounting portion 147 on which PCBs are mounted. The cover portion 1461 may be formed in a shape corresponding to the opening of the upper cap deco 143.

**[0403]** A microphone mounting portion 161 may be integrally formed on one side of the cover portion 1461. In addition, a sensor module may be provided on the other side of the cover portion 1461.

**[0404]** The PCB mounting portion 147 may be formed to extend downward from the lower surface of the cover portion 1461, and a plurality of PCBs 160 and 61 may be mounted on the front surface facing the panel assembly 30. Alternatively, if necessary, a plurality of PCBs 160 and 61 may be disposed on both sides of the front and rear surfaces of the PCB mounting portion 147.

**[0405]** The PCBs 160 and 61 mounted on the PCB mounting portion 147 may include a door PCB 160 which controls the operation of the lighting device 36 or the like or processes a voice signal received from the microphone module 160. In addition, the PCBs mounted on the PCB mounting portion 147 may include a sensor PCB 1523 that recognizes and processes information detected by the sensor module 150.

**[0406]** Cables 162 connected to the door PCB 160 and the sensor PCB 1523 may be disposed in the PCB mounting portion 147. In addition, the cables 162 connected to the plurality of PCBs 160 and 61 may be configured to be connected to a connection cable connected to the manipulation portion 14.

**[0407]** The PCB mounting portion 147 may further include a PCB fixing portion 1471 protruding along the circumference of the plurality of PCBs 160 and 61 to maintain the mounted state of the PCBs 160 and 61. A plurality of PCB fixing portion 1471 may be formed in a shape corresponding to each of the PCBs 160 and 61.

**[0408]** For example, the PCB fixing portion 1471 may

include a first PCB fixing portion 1471a formed along the circumference of the sensor PCB 1523. The first PCB fixing portion 1471a may be disposed on one side adjacent to the sensor module 150. In addition, the sensor PCB 1523 may be connected to the sensor module 150 through a connection cable 162.

**[0409]** An electric wire opening 1533 may be formed on one side of the sensor module mounting portion 153 and thus a connection cable 162 may connect the PCB 1523 mounted on the illuminance sensor 152 and the sensor PCB 1523 mounted on the PCB mounting portion 147.

**[0410]** The PCB fixing portion 1471 may include a second PCB fixing portion 1471b formed along the circumference of the door PCB 160. The second PCB fixing portion 1471b may be disposed adjacent to the first PCB fixing portion 1471a. The door PCB 160 may be electrically connected to the microphone module 160 and a connection cable 162.

**[0411]** Meanwhile, a plurality of cable fixing portions 1534 for fixing the connection cable 162 may be formed in the PCB mounting portion 147. The cable fixing portion 1534 may protrude from the PCB mounting portion 147 and may be formed to accommodate the connection cable 162.

**[0412]** The cable fixing portion 1534 may include a first cable fixing portion 1472a disposed between an upper end of the PCB mounting portion 147 and the first PCB fixing portion 1471a.

**[0413]** The cable fixing portion 1534 may include a plurality of second cable fixing portions 1472b arranged below the PCB mounting portion 147 along the lower end of the PCB mounting portion 147.

**[0414]** The cable fixing portion 1534 may include a plurality of third cable fixing portions 1472c arranged from the side of the second PCB fixing portion 1471b toward the microphone mounting portion 161.

**[0415]** For example, the electric wire 162 connected to the illuminance sensor 152 may pass through the electric wire opening 1533 formed in the body portion 1532 and be connected to the sensor PCB 1523. In addition, electric wires connected to the sensor PCB 1523 may be guided to one side of the PCB mounting portion 147. In this case, electric wires connected to the sensor PCB 1523 may be fixed to the second cable fixing portion 1472b. The electric wires guided to one end of the second cable fixing portion 1472b may be electrically connected to the electric wires connected to the manipulation portion 14 while being mounted on the third cable fixing portion 1472c.

**[0416]** In addition, electric wires extending to one side of the PCB mounting portion 147 pass through cap deco electric wire holes 1435 and can be connected to electric wires connected to electric components inside the door 20, such as the lighting device 36.

**[0417]** Hereinafter, the sensor module 150 of another embodiment of the present disclosure will be described in detail.

**[0418]** FIG. 30 is an exploded perspective view illustrating a state where an upper door equipped with a sensor module of a third embodiment of the present disclosure is viewed from above, FIG. 31 is a view illustrating a state where the door cover on which the sensor module is mounted is viewed from above, and FIG. 32 is a cross-sectional view illustrating a state where the sensor module is mounted on the door cover.

**[0419]** In the sensor module 170 of the third embodiment, the illuminance sensor 172 may be vertically mounted on the sensor module mounting portion 173. In other words, the illuminance sensor 172 may be disposed so that the illuminance sensor 172 is perpendicular to a virtual center line of the upper surface of the door cover 146.

**[0420]** The sensor module 170 of the third embodiment only has a different structure for vertically mounting the illuminance sensor 172 on the sensor module mounting portion 173 and may be the same as the sensor module 150 of the above-described embodiment.

**[0421]** The sensor cover 171 of the other embodiment includes a cover protrusion 1711 protruding upward from the door cover 146 so that an upper end of the illuminance sensor 172 is partially accommodated. In addition, a first inclined portion 1712 inclined downward from the front end of the cover protruding portion 1711 is included. In addition, a second inclined portion 1713 inclined downward from the rear end of the cover protruding portion 1711 may be included. In this case, the angle  $\theta_3$  between the door cover 146 and the first inclined portion 1712 of the first inclined portion 1712 may be approximately 30 to 50 degrees or 40 to 50 degrees.

**[0422]** In this case, the cover protrusion 1511 of the sensor cover 151 described above may be referred to as a first cover protrusion, and the cover protrusion 1511 formed on the sensor cover 171 of the other embodiment may be referred to as a second cover protrusion.

**[0423]** The second cover protrusion 1711 may have a height greater than that of the first cover protrusion 1511 relative to the door cover 146.

**[0424]** The lower surface of the sensor cover 171 of the other embodiment may include a sensor fixing portion 1734 for supporting the upper end of the illuminance sensor 172. The sensor fixing portion 1734 may include a first sensor fixing portion 1734a contacting the front surface of the illuminance sensor 152 and a second sensor fixing portion 1734b contacting the rear surface of the illuminance sensor 152.

**[0425]** In addition, the first sensor fixing portion 1734 may be provided with the first cutout to minimize interference with the detection portion 1521.

**[0426]** The sensor module mounting portion 173 of the other embodiment may include a third mounting portion 1736 protruding upward from the lower surface of the door body 40. The third mounting portions 1736 may be formed as a pair spaced apart in the front and rear direction. A lower end of the illuminance sensor 172 may be inserted and fixed between the pair of third mounting por-

tions 1736.

**[0427]** In detail, the pair of third mounting portions 1736 may include a 3-1 mounting portion 1736a supporting the front surface of the illuminance sensor and a 3-2 mounting portion 1736b supporting the rear surface of the illuminance sensor.

**[0428]** The third mounting portion 1736 may be formed to extend vertically upward from the lower surface of the body portion 1732.

**[0429]** Meanwhile, the front surface of the door 20 of an embodiment of the present disclosure may have a structure in which light can be selectively emitted. In addition, the front surface of the door 20 may be configured to shine with a color or brightness set by the user. Therefore, the user can change the color of the front surface of the door 20 without replacing the door 20.

**[0430]** FIG. 33 is a block diagram illustrating the flow of control signals of the refrigerator.

**[0431]** In the refrigerator of an embodiment of the present disclosure, the color of the panel 31 may be determined by the operation of the lighting device 36. For example, the lighting device 36 may be operated and set through a remote device 2 separated from the refrigerator. The refrigerator can communicate with the remote device 2 through the communication unit 17 connected to the control portion 13, and the user can manipulate the operation of the lighting device 36 through the remote device 2.

**[0432]** The user can generally manipulate and set the operating state of the lighting device 36, such as the operating time, operating conditions, and light emission color of the light source, through manipulation of the remote device 2. For example, simple manipulation and setting of the lighting device 36 may be possible through an application installed in a user's mobile phone or a dedicated program.

**[0433]** Meanwhile, the operation of the lighting device 36 may be performed through a user's manipulation of the manipulation portion 14. The manipulation portion 14 may be provided on one side of the refrigerator 1E and may be input by a manipulation such as touching or knocking on the panel 31.

**[0434]** In addition, the lighting device 36 may be operated by a sensor. The sensor may be, for example, a user proximity sensor 151 that detects the user's proximity.

**[0435]** When a user approaches the refrigerator 1E by a set distance to use the refrigerator, the user detection sensor 151 detects this and transmits a signal to the control portion 13 and the lighting device 36 may be turned on. In addition, when the user moves away from the refrigerator, the user detection sensor 151 detects this and transmits a signal to the control portion 13 so that the lighting device 36 is turned off.

**[0436]** In addition, when the user detection sensor 151 detects that the user is very close to the refrigerator, the lighting device 36 may be turned off or the brightness may be gradually dimmed to prevent the user from glare.

In addition, when the user moves away from the refrigerator 1E again, the lighting device 36 may be turned on again or returned to its original brightness.

**[0437]** In addition, the sensor may be the illuminance sensor 152. The illuminance sensor 152 detects the illuminance of an indoor space and may be disposed at the same position as the position where the user sensor 151 is disposed.

**[0438]** In addition, the lighting device 36 may be operated of the detected illuminance of the illuminance sensor 152. For example, when the detected illuminance of the illuminance sensor 152 becomes less than the set illuminance and becomes dark, the control portion 13 may lower the amount of light output from the lighting device 36 to prevent the user's glare. When the detected illuminance of the illuminance sensor becomes higher than the set illuminance and becomes brighter, the control portion 13 may increase the amount of light output from the lighting device 36.

**[0439]** Meanwhile, the sensors may include both the illuminance sensor 152 and the user sensor 151, and the illuminance sensor 152 and the user sensor 151 act in combination to control the control portion 13 and thus the lighting device 36 may be turned on or off or controlled to adjust the amount of light output from the lighting device 36.

**[0440]** The control portion 13 may be connected to the microphone 18. Therefore, of the voice signal received from the microphone 18, the LED 362 can be made to shine in a set color, and the front color of the door 20 may indicate the input state of the voice signal or the set state of the function.

**[0441]** Meanwhile, the lighting device 36 may be turned on and off at a time set by the timer 16.

**[0442]** Regardless of the operating state of the refrigerator 1E, the brightness and color of the front surface of the door 20 may be adjusted of a user's setting.

**[0443]** FIG. 34 is a control flowchart illustrating a method of controlling brightness of a light source of ambient brightness, and FIG. 35 is a view illustrating a change in outer appearance of a refrigerator of ambient brightness.

**[0444]** The control portion controls the intensity of the light source of the lighting device to be less than 50% with respect to 100% when the external illuminance value is less than the first set value, when the external illuminance value is greater than or equal to the first set value and less than a second set value, the intensity of the light source of the lighting device is controlled to 50% or more to less than 70% with respect to 100%, and when the external illuminance value is greater than or equal to the second set value, the intensity of the light source of the lighting device may be controlled to 70% or more to less than 100%.

**[0445]** The refrigerator 1C of the present disclosure can adjust the amount of light output from the lighting device 36 of the surrounding brightness in which the refrigerator is installed.

**[0446]** In detail, the control portion 13 may perform step

S 1 of detecting the illuminance of the room in which the refrigerator 1C is installed (hereinafter referred to as 'external illuminance') by the illuminance sensor.

**[0447]** If the detected external illuminance is equal to or less than the first reference value S2, the lighting device 36 performs a step S3 of adjusting the output of the light source to be 50% or less based on the maximum output of the light source of 100%.

**[0448]** Alternatively, the step of adjusting the output of the light source of the lighting device 36 may be performed so that the difference between the external illuminance and the illuminance of the front surface of the door satisfies a set range.

**[0449]** In addition, when the external illuminance exceeds the first reference value and is less than or equal to the second reference value S4, the lighting device 36 may perform a step S5 of adjusting the output of the light source to be 70% or less based on 100% of the maximum output of the light source.

**[0450]** At this time, the second reference value has a larger value than the first reference value.

**[0451]** In addition, when the external illuminance exceeds the second reference value (S6), the lighting device 36 may perform a step S7 of adjusts the output of the light source to be 100% or less based on the maximum output of 100% of the light source.

**[0452]** In this way, the control portion 14 can adjust the brightness of the panel assembly 30 by detecting the ambient brightness where the refrigerator is installed and adjusting the output of the light source of the lighting device 36.

**[0453]** When the ambient brightness in which the refrigerator is installed is bright (FIG. 34 (a)), the light source of the lighting device 36 may be controlled so that the front surface of the door is illuminated more brightly of the ambient brightness.

**[0454]** When the ambient brightness in which the refrigerator is installed becomes dark (FIG. 34 (b)), the intensity of the light source of the lighting device 36 may be controlled to be lowered.

**[0455]** Therefore, in a dark room, the brightness of light emitted from the front of the door is also adjusted to be dark, so that the user's glare can be prevented.

**[0456]** FIG. 36 is a perspective view illustrating a refrigerator of another embodiment of the present disclosure.

**[0457]** In the refrigerator 1D of another embodiment of the present disclosure, the display portion 180 may be provided on the front side of the door 20 disposed on one side of the upper door 21. The display portion 180 can display and manipulate the operating state of the refrigerator 1D.

**[0458]** The display portion 180 may include a display for displaying state information of the refrigerator 1D and various manipulation buttons for setting an operation of the refrigerator 1D. The operation of the refrigerator 1D can be operated by manipulating the manipulation buttons.

**[0459]** In addition, the display portion 180 may be provided to output set image information. The display portion 180 may be controlled to output an image having a color harmonizing with the light color of the door 20 equipped with the lighting device 36. Therefore, the door with the display portion 180 and the door without the display portion 180 can be controlled to form a sense of unity.

**[0460]** FIG. 37 is a perspective view illustrating a state where a refrigerator of a fourth embodiment of the present disclosure is viewed from the front and FIG. 38 is a front view illustrating a state where the door of the refrigerator is opened.

**[0461]** The refrigerator 1E of the fourth embodiment includes a door 20 configured to open and close an upper storage space and a lower storage space, respectively.

**[0462]** The door 20 may include an upper door 201 that is rotatably mounted on the cabinet 10 to open and close the upper storage space 11 and a lower door 202 that opens and closes the lower storage space 12 by being introduced and withdrawn from the cabinet 10 in a draw manner

**[0463]** A shelf 110 may be provided in the upper storage space 11.

**[0464]** Meanwhile, in the refrigerator of the fourth embodiment, a sensor module may be provided in the lower door 202.

**[0465]** FIG. 39 is a perspective view illustrating a state where a lower door equipped with a sensor module of a fourth embodiment is viewed from the front, FIG. 40 is an exploded perspective view illustrating a state where the sensor module is viewed from the front, FIG. 41 is an exploded perspective view illustrating a state where the sensor module is viewed from the rear, FIG. 42 is a cross-sectional view taken along line 42-42 in Fig. 39, FIG. 43 is a cross-sectional view taken along line 43-43 of FIG. 39, and FIG. 44 is a cross-sectional view taken along line 44-44 of Fig. 39.

**[0466]** The refrigerator of the fourth embodiment includes a cabinet 10 having an upper storage space and a lower storage space; an upper door 201 opening and closing the upper storage space; and a lower door 202 opening and closing the lower storage space, and the lower door 202 includes a door body 40, an upper cap deco 243 connected to an upper end of the door body 40 and forming a portion of a front surface and an upper surface of the lower door 202, and a sensor module 250 that senses the surroundings where the cabinet 10 is disposed, and the sensor module 250 is provided inside the upper cap deco 243, and a detection hole communicating with the sensor module 250 may be formed on the front surface of the upper cap deco 243.

**[0467]** The sensor module 250 may include at least one of an illuminance sensor for measuring external illuminance and a proximity sensor for detecting a distance to a user.

**[0468]** A sensor opening 2431 into which the sensor module 250 is inserted may be formed on an upper surface of the upper cap deco 243.



**[0469]** The sensor module 250 may include a cover 252 for shielding the sensor opening 2431, a sensor device 253 including the illuminance sensor or proximity sensor, and a fixing member 254 coupled with the sensor device 253 and the cover 252.

**[0470]** The cover 252 may include a shielding portion 2521 formed in a plate shape to shield the sensor opening 2431 from above, and a cover coupling portion 2522 coupled to the upper cap deco 243.

**[0471]** The cover coupling portion 2522 includes a plurality of cap deco coupling portions 2522a coupled to the upper cap deco 243 and a fixing member coupling portion 2522b inserted into the fixing member 254, and the fixing member coupling portion 2522b may be formed longer in a horizontal direction than the cap deco coupling portion 2522a.

**[0472]** The fixing member 254 includes a recessed portion recessed backward on the front portion forming the front surface of the sensor module 250, and a detection portion to which the light of the sensor device 253 is irradiated may be disposed on the rear surface of the recessed portion.

**[0473]** The fixing member 254 includes a front portion forming a front surface of the sensor module 250, and an insertion portion into which the cover coupling portion 2522 is inserted at a rear surface of the front portion, and the insertion portion may include an insertion hole whose upper surface is open so that the cover coupling portion 2522 is inserted from above and a locking hole that is engaged with the cover coupling portion 2522.

**[0474]** The fixing member 254 may protrude backward at a position corresponding to the recessed portion to form a detection portion accommodation portion 2545 in which the detection portion is accommodated.

**[0475]** The fixing member 254 includes a side portion that is bent and extended from the front portion to form a side surface of the sensor module 250, and device fixing portions 2546 that are formed to come into contact with both side surfaces of the sensor device 253 and fix the sensor device 253 may be formed between the side portions and the detection portion accommodating portion.

**[0476]** The side portion may be mounted on the fixing rib 2433 formed on the upper cap deco 243.

**[0477]** The sensor module 250 may include an illuminance sensor 152 that detects the indoor illuminance. The amount of light emitted from the light source of the lighting device 36 may be adjusted of the ambient brightness detected by the illuminance sensor 152.

**[0478]** The sensor module 250 may include a proximity sensor 151 capable of recognizing a distance between the refrigerator and a user. The proximity sensor 151 is equipped with an infrared sensor or the like to recognize a user's approach. When it is sensed that the user is close to the refrigerator, the amount of light of the light source may be adjusted so that the front surface of the door is brighter than when the user is not near the refrigerator.

**[0479]** The sensor module 250 may be provided above

the lower door 202. When the sensor module 250 is provided on the upper portion of the lower door 202, the sensor module 250 can detect the distance between the refrigerator and the user and the indoor illumination more accurately than when the sensor module 250 is provided on the upper door 201.

**[0480]** If the sensor module 250 is provided above the upper door 201, of the height of the user, the sensor module 250 may not be able to detect whether or not the user is close.

**[0481]** In addition, when the sensor module 250 is provided above the upper door 201, the sensor module is adjacent to the indoor lighting, so that the user can perceive it as brighter than the indoor illumination felt by the user. Therefore, the sensor module 250 is preferably provided in the lower door 202 of the upper door 201 or the lower door 202, and more preferably provided in the upper portion of the lower door 202.

**[0482]** The sensor module 250 may be provided inside the upper cap deco 243 forming the upper surface of the lower door 202.

**[0483]** Alternatively, the lower door 202 may have a handle portion 243 formed to be gripped by a user at an upper portion. The handle portion is not limited, but may be recessed more rearward than the door panel 31 of the lower door.

**[0484]** The sensor module 250 may be provided on the lower door 202 singly or in plural numbers.

**[0485]** For example, when the lower storage space is opened and closed by introducing and withdrawing the lower door 202 as a drawer-type door, the sensor module 250 may be spaced apart from both sides of the lower door 202 and mounted as a pair.

**[0486]** Alternatively, when the lower storage space is opened and closed by rotation of the lower door 202 by a hinge device, the sensor module 250 may be mounted singly on one side of the lower door 202.

**[0487]** A sensor opening 2431 into which the sensor module 250 can be inserted may be formed on an upper surface of the upper cap deco 243. The sensor opening 2431 may be formed so that the sensor module 250 can be inserted and mounted from the outside.

**[0488]** The sensor opening 2431 may be shielded by the cover 252 of the sensor module 250. The front surface of the sensor module 250 may be closely attached to the rear surface of the front plate 31 in a state of being inserted inside the upper cap deco 243.

**[0489]** A detection hole 2432 may be formed on the front surface of the upper cap deco 243. The detection hole 2432 may be formed by opening.

**[0490]** When a user approaches the front of the door, the light emitted from the detection hole 2432 is reflected to the user and enters the detection hole 2432, so that the presence of the user can be detected. In addition, indoor light enters through the detection hole 2432 so that the illuminance sensor 152 can detect the indoor illuminance.

**[0491]** The detection hole 2432 may have a smaller

diameter in a direction closer to the detection portion 2531. In this case, since light rays received through the detection hole 2432 can be concentrated on the detection portion 2531, reliability can be further improved.

**[0492]** A sensor opening 2431 into which the sensor module 250 is inserted may be formed on an upper surface of the door 20, and the detection hole 2432 may be formed on a front surface of the door 20. Since the sensor module 250 must be inserted into the sensor opening 2431, the size of the sensor opening 2431 may be larger than that of the detection hole 2432.

**[0493]** The detection hole 2432 may be formed to a size capable of allowing light rays to go out or enter. With this structure, when a user looks at the refrigerator door 20 from the front, the relatively large sensor opening 2431 is located on the upper surface of the door and may not be visible from the outside.

**[0494]** Since the detection hole 2432 is located on the front side of the door, there is an advantage in that it can accurately measure whether or not the user is approaching and the indoor illumination without interference from other components.

**[0495]** The sensor module 250 may include a cover 252, a sensor device 253 to which the illuminance sensor 152 and the proximity sensor 151 are mounted, and a fixing member 254 for fixing the sensor device 253 inside the upper cap deco 243.

**[0496]** The cover 252 is formed in a plate shape and includes a shielding portion 2521 that shields the sensor opening 2431 from above and a cover coupling portion 2522 coupled to the upper cap deco 243.

**[0497]** The shielding portion 2521 may be formed in a shape corresponding to the sensor opening 2431. For example, both sides of the front surface of the upper cap deco 243 may include rounded portions 243a protruding forward in a rounded manner.

**[0498]** The sensor module 250 may be accommodated inside the rounded portion 243a. The front end of the cover 252 may include a curved surface in a shape corresponding to the outer end of the rounded portion 243a.

**[0499]** The cover coupling portion 2522 may be formed to extend downward from the shielding portion 2521. The cover coupling portion 2522 may be formed at a front end, a rear end, and both side ends of the shielding portion 2521, respectively.

**[0500]** The cover coupling portion 2522 is not limited, but may be formed in a hook shape. A plurality of cover coupling portions 2522 may be formed, some of which may be coupled to the upper cap deco 243, and the rest of them may be coupled to the fixing member 254.

**[0501]** In detail, a sensor coupling portion 2434 protruding inward may be included below the sensor opening 2431. The cover coupling portion 2522 is combined with the sensor coupling portion 2434 so that the sensor module 250 can be inserted into the upper cap deco 243 and fixedly mounted.

**[0502]** Since among the plurality of cover coupling portions 2522, the cover coupling portion 2522 coupled to

the sensor coupling portion 2434 is coupled to the upper cap deco 243, it may be referred to as a cap deco coupling portion. The cap deco coupling portion 2522a may be formed in plurality by extending downward from both side ends and the rear end of the cover 252, respectively.

**[0503]** The cover coupling portion 2522 may be inserted into the fixing member 254 to couple the cover 252 to the fixing member 254. Among the plurality of cover coupling portions 2522, the cover coupling portion 2522 coupled to the fixing member 254 may also be referred to as a fixing member coupling portion 2522b.

**[0504]** The fixing member coupling portion 2522b may be formed in a hook shape to be inserted into and coupled to the insertion portion 2544 of the fixing member 254.

**[0505]** The fixing member coupling portion 2522b may be formed longer in a horizontal direction than the cap deco coupling portion 2522a.

**[0506]** A reinforcing rib 2523 may be further included in the fixing member coupling portion 2522b. For example, the reinforcing rib 2523 may connect the lower surface of the fixing member coupling portion 2522b and the shielding portion 2521. With this structure, the reinforcing rib 2523 may guide a direction in which it is inserted into the insertion portion 2544.

**[0507]** The fixing member 254 may include a front portion 2541 forming a front surface of the sensor module 250 and a side portion 2542 bent and extended backward from the front portion 2541.

**[0508]** A recessed portion 2543 recessed inward (rearward) may be formed on the front surface of the front portion 2541. A detection portion 2531 of the sensor device 253 may be disposed on a rear surface of the recessed portion 2543.

**[0509]** Due to the recessed portion 2543, the thickness of the fixing member 254 in the front and rear direction may be smaller than the thickness of the front portion 2541 excluding the recessed portion 2543.

**[0510]** Light irradiated from the detection portion 2531 passes through the recessed portion 2543, and at this time, there is an advantage in that light lost by the recessed portion 2543 can be minimized. In addition, when external light enters the sensor module 250, light lost by the recessed portion 2543 can be minimized. Therefore, there is an advantage of more accurately detecting the distance between users or ambient brightness detected by the sensor module 250.

**[0511]** An insertion portion 2544 into which the fixing member coupling portion 2522b of the cover 252 is inserted may be included on the rear surface of the front portion 2541. The insertion portion 2544 may include an insertion hole 2544a having an open upper surface so that the fixing member coupling portion 2522b can be inserted from above, and a locking hole 2544b engaged with the fixing member coupling portion 2522b.

**[0512]** A guide rib 2544c for guiding a direction in which the fixing member coupling portion 2522b is inserted may be further formed on a surface facing the locking hole 2544b. The guide rib 2544c may include a plurality of ribs

2544c that protrude rearward from the rear surface of the front portion 2541 and extend in the vertical direction.

**[0513]** The guide rib 2544c comes into contact with the fixing member coupling portion 2522b when the fixing member coupling portion 2522b is inserted, so that the fixing member 254 may be more firmly mounted to the cover 252.

**[0514]** The front portion 2541 may include a detection portion accommodation portion 2545 formed to protrude rearward from a position corresponding to the recessed part 2543 on the rear surface of the front portion 2541. The sensing unit accommodation portion 2545 may protrude rearward from the rear surface of the front portion 2541 and surround the detection portion 2531 so that the detection portion 2531 can be accommodated inwardly.

**[0515]** The detection portion accommodation portion 2545 may be larger than the entire area of the detection portion 2531, so that the detection portion 2531 may be spaced apart from the detection portion accommodation portion 2545 inwardly.

**[0516]** A device fixing portion 2546 for fixing the sensor device 253 may be included on a rear surface of the front portion 2541.

**[0517]** The device fixing portions 2546 protrude from the rear surface of the front portion 2541 to the rear and may be provided as a pair on both sides of the detection portion accommodation portion 2545.

**[0518]** The device fixing portion 2546 may protrude longer than the protruding length of the detection portion accommodation portion 2545 from the rear surface of the front portion 2541. The device fixing portion 2546 may extend in the vertical direction longer than the length of the detection portion accommodation portion 2545 extending in the vertical direction.

**[0519]** An upper end of the device fixing portion 2546 may be positioned higher than the detection portion accommodation portion 2545. In addition, the lower end of the device fixing portion 2546 may be positioned on the same plane as the lower end of the detection portion accommodation portion 2545.

**[0520]** The distance between the pair of device fixing portions 2546 may correspond to the distance from the width of the sensor device 253. Both ends of the sensor device 253 may be fixed by the device fixing portion 2546 while the detection portion 2531 is accommodated in the detection portion accommodation portion 2545. With this structure, it is possible to prevent the sensor device 253 from moving in the left and right directions and being separated from the fixing member 254.

**[0521]** Each of the pair of device fixing portions 2546 may further include a protrusion 2546a extending from the rear end toward the inside, that is, in a direction closer to the detection portion 2531. The protrusion 2546a may be coupled with the protrusion accommodation portion 2532 provided in the sensor device 253. The protrusion 2546a and the protrusion accommodation portion 2532 may guide the sensor device 253 to be properly mounted on the fixing member 254. In addition, since the protrusion

2546a is inserted into and fixed to the protrusion accommodation portion 2532, it is possible to prevent the sensor device 253 from moving in a vertical direction.

**[0522]** A device coupling portion 2567 may be further included between the side portion 2542 and the device fixing portion 2546 on the rear surface of the front portion 2541. The device coupling portion 2567 may extend rearward from the rear surface of the front portion 2541 and may be formed in a hook shape to come into contact with a portion of the rear surface of the sensor device 253. A plurality of device coupling portions 2567 may be formed. A reinforcing rib 2567a may be further formed on the device coupling portion 2567 to prevent the device coupling portion 2567 from being damaged in the process of mounting the sensor device 253 to the fixing member 254.

**[0523]** The side portion 2542 may be bent and extended backward from the front portion 2541 and mounted on the fixing rib 2433 formed on the upper cap deco 243.

**[0524]** The fixing rib 2433 is accommodated between the side portion 2542 and the device coupling portion 2567, so that the sensor module 250 may be mounted on the upper cap deco 243.

**[0525]** The sensor device 253 may be formed in a plate-like rectangular shape as a whole. The sensor device 253 may include the illuminance sensor 152 and the proximity sensor 151. The illuminance sensor 152 and the proximity sensor 151 may be separately provided in the sensor device 253. Alternatively, a proximity and illuminance sensor in which the illuminance sensor and the proximity sensor are integrally implemented may be used.

**[0526]** The sensor device 253 may include a detection portion 2531 that emits light to the outside or receives light entering the sensor module 250.

**[0527]** For example, the detection portion 2531 may include a light emitting portion that emits infrared light and an infrared light receiving portion for detecting proximity by detecting infrared rays of the light emitting portion reflected from an object. In addition, it may include a visible light receiving portion for detecting ambient visible light to detect the illuminance.

**[0528]** Alternatively, the detection portion 2531 may include, for example, an optical sensor in which the light emitting portion, the infrared light receiving portion, and the visible light receiving portion are integrally formed.

**[0529]** The sensor device 253 may include the detection portion 2531 and a PCB substrate 2533 on which the detection portion 2531 is mounted.

**[0530]** The sensor device 253 may be inserted inward through the sensor opening 2431 of the upper cap deco 243 in a state of being mounted on the fixing member 254 and mounted thereon.

**[0531]** The detection portion 2531 may irradiate or receive light rays through the detection hole 2432 formed in the upper cap deco 243 to detect whether or not the user is approaching and the brightness of the room.

**[0532]** Meanwhile, the front surface of the door 20 may

have a structure capable of selectively emitting light and may be configured to emit light with a set color or brightness. Accordingly, the user can change the color or brightness of the front surface of the door 20 without separating or disassembling the door 20, and can change the overall outer appearance of the refrigerator 1E.

**[0533]** FIG. 45 is an exploded perspective view illustrating a state where a sensor module of a fifth embodiment of the present disclosure is viewed from the front.

**[0534]** The sensor module 250' of the fifth embodiment may provide a sensor device 253' equipped with a proximity sensor and an illuminance sensor, and a space in which the sensor device 253' is accommodated, and may include a case 255 to which the sensor device 253' is fixed.

**[0535]** The sensor module includes a recessed portion 2543' recessed in a direction in which the sensor device 253' is accommodated on one surface of the case 255, and within the area of the recessed portion 2543', a detection portion 2531' through which light from the sensor device is irradiated may be located.

**[0536]** The sensor module 250' may include a protrusion 2548a which is mounted on the recessed portion 2543', shields the recessed portion 2543', and protrudes forward from a position corresponding to the detection portion 2531', and the protrusion 2548a may be inserted into the detection hole 2432'.

**[0537]** A sensor module 250' of the fifth embodiment may be mounted on the upper portion of the lower door 202. A detection hole 2432' may be formed on the front surface of the upper cap deco 243 forming the upper surface of the lower door 202 and through which light rays of the detection portion 2531' of the sensor module come out.

**[0538]** The sensor module 250' includes a sensor device 253' in which the proximity sensor 151 and the illuminance sensor 152 are mounted and a case 255 which provides a space in which the sensor device 253' is accommodated and to which the sensor device 253' is fixed.

**[0539]** The sensor module 250' may further include a cover 252' that opens and closes the open detection hole 2432'.

**[0540]** The sensor device 253' may include a detection portion 2531' through which light is irradiated or received, and a PCB substrate on which the proximity sensor 151 and the illuminance sensor 152 are mounted.

**[0541]** The sensor device 253' may be accommodated inside the case 255. The case 255 may have a sensor opening 2431' through which light emitted from the detection portion 2531' passes at a position corresponding to the detection portion 2531'.

**[0542]** A recessed portion 2543' recessed in a direction in which the sensor device 253' is accommodated may be provided in one surface of the case 255. The sensor hole 2543 a' may be provided in an area of the recessed portion 2543'.

**[0543]** The sensor module 250' may further include a transmission portion 2548 having a size corresponding

to that of the recessed portion 2543' and mounted on the recessed portion 2543'.

**[0544]** The transmission portion 2548 may include a protrusion 2548a protruding forward from a position corresponding to the detection portion 2531' while shielding the recessed portion 2543'. This protrusion 2548a may be inserted into the open detection hole.

**[0545]** The transmission portion 2548 may be formed of an injection-molded material of a transparent material. For example, the transmission portion 2548 may be made of a transparent ABS injection molding material.

**[0546]** Meanwhile, the sensor module 250' of the fifth embodiment may be inserted inside the door 20 while the sensor device 253' is mounted on the case 255. The sensor module 250' may be shielded by a cover 252'.

**[0547]** The cover 252' may include an upper portion 2521' which contacts the upper surface of the upper cap deco 243 inwardly and a front portion 2522' which extends downward from the upper surface portion 2521' and forms a front surface of the cover 252.

**[0548]** An open detection hole 2432' may be formed in the front portion 2522' at a position corresponding to the protrusion 2548a and the detection portion 2531'.

**[0549]** The cover 252' may be formed in the same color as the upper cap deco 243. The opened detection hole 2432' is shielded by the transmission portion 2548, and the sensor module 250' may be prevented from being exposed in front of the door 20.

**[0550]** Meanwhile, when the external illuminance detected by the illuminance sensor is less than or equal to a reference value, the control portion may control the illuminance of light emitted from the lighting device to be lowered. The control portion may increase the amount of light output from the lighting device when the proximity sensor detects that the user is close to the refrigerator.

**[0551]** When the proximity sensor does not detect that the user is close to the refrigerator, the control portion may turn off the lighting device or control the amount of light output to be smaller than the amount of light output when it is detected that the user is close to the refrigerator.

**[0552]** FIG. 46 is a control flowchart illustrating a method of controlling brightness of a light source of ambient brightness and FIG. 47 is a view illustrating a change in outer appearance of a refrigerator of ambient brightness.

**[0553]** The refrigerator 1E of the present disclosure may set a first mode for adjusting the amount of light output from the lighting device 36 of ambient brightness in which the refrigerator is installed. For example, when the first mode is activated, the amount of light output from the lighting device 36 may be adjusted so that the brightness of the front surface of the door becomes dark accordingly when ambient brightness becomes dark.

**[0554]** The control portion 13 may perform a first mode checking step S10 of detecting whether the first mode is activated.

**[0555]** When the first mode is activated, a step S11 of detecting the illuminance of the room in which the refrigerator 1E is installed (hereinafter referred to as 'external

illuminance') by the illuminance sensor and determining whether the external illuminance is equal to or less than a reference value may be performed.

**[0556]** When the external illuminance is equal to or less than the reference value, the step S12 of adjusting the output of the light source of the lighting device 36 so that the difference between the external illuminance and the illuminance of the front surface of the door is within a set range may be performed.

**[0557]** Alternatively, the control portion may control the illuminance of light emitted from the lighting device to be lowered.

**[0558]** In the state where the output of the light source is adjusted, a step S13 of determining whether a set time has elapsed (S13) may be performed. When the set time has elapsed, the proximity sensor 151 may detect the external illuminance and a step S11 of determining whether the external illuminance is equal to or less than a reference value may be performed.

**[0559]** As illustrated in FIG. 47, when the ambient brightness in which the refrigerator is installed is bright (FIG. 47 (a)), the light source of the lighting device 36 is adjusted, and thus it can be controlled so that the difference between the external illuminance and the illuminance value of the front surface of the door satisfies a set range. That is, when the external illuminance exceeds a standard, the front surface of the door may be controlled to shine more brightly.

**[0560]** When the ambient brightness in which the refrigerator is installed becomes dark (FIG. 47 (b)), the light source of the lighting device 36 is adjusted and thus it can be controlled so that the difference between the external illuminance and the illuminance value of the front surface of the door satisfies a set range. Therefore, in a dark room, the brightness of light emitted from the front of the door is also adjusted to be dark, so that the user's glare can be prevented.

**[0561]** FIG. 48 is a control flowchart illustrating a method of controlling the brightness of a light source of a user's distance detection, and FIG. 49 is a view illustrating changes in outer appearance of a refrigerator of a user's distance detection.

**[0562]** The refrigerator 1E of the present disclosure may set a second mode in which the front surface of the door is brightly lit by increasing the amount of light output from the lighting device 36 when recognizing that the user is approaching the refrigerator.

**[0563]** For example, when the second mode is activated by the user, the lighting device 36 is turned off in a state where the user is not close to the refrigerator 1E, or the amount of light output from the lighting device 36 can be controlled to be less than or equal to a set value.

**[0564]** When it is detected that the refrigerator 1E is close to the refrigerator for use by user, the amount of light output from the lighting device 36 may be adjusted so that the front surface of the refrigerator door is brightly lit.

**[0565]** In detail, the control portion 13 may perform a

second mode checking step S20 of detecting whether the second mode is activated.

**[0566]** When the second mode is activated, the control portion 13 may perform a step S21 in which the proximity sensor 151 detects a user's approach.

**[0567]** When a user's approach is detected by the proximity sensor 151, the control portion 13 may perform step S22 of increasing the output of the light source of the lighting device 36.

**[0568]** When the user approach is detected, the amount of light output from the lighting device 36 may be controlled to be a set value or more. These setting values may be set by the user.

**[0569]** At this time, the speed of change of the output of the light source may be controlled to be a set value or less. That is, when the control portion 13 detects a user's approach, the control portion 13 controls the speed change of the amount of light on the front of the door to be a set value or less, so that the user can recognize that the front surface of the door is gradually getting brighter.

**[0570]** Meanwhile, a step S23 in which the control portion 13 turns off the lighting device 36 or controls the output of the light source of the lighting device 36 to a set value or less when the user does not approach the refrigerator (S23) can be performed.

**[0571]** That is, as illustrated in FIG. 49, when the user does not approach the refrigerator (FIG. 49 (a)), the lighting device 36 is turned off, and the outer appearance of the front surface of the door may be formed using the color of the panel assembly 30 itself (S24).

**[0572]** Alternatively, in a state where the user does not approach the refrigerator, the lighting device 36 is turned on, and the front surface of the door may be illuminated in a color set by the user. At this time, the output of the light source of the lighting device 36 may be controlled to a set value or less.

**[0573]** In a state where the user approaches the refrigerator (FIG. 49 (b)), the lighting device 36 is turned on, and the front surface of the door may be illuminated in a color set by the user.

**[0574]** At this time, by controlling the output of the light source of the lighting device 36 to exceed a set value, the front surface of the door may shine brighter than the brightness of the light in a state where the user does not approach.

**[0575]** When the lighting device 36 increases the output of the light source to exceed the set value, the rate of change of the output of the light source is the set value or less, so that the user can recognize that the front of the door is slowly and brightly lit.

**[0576]** FIG. 50 is a view illustrating an example of adjusting the color of home appliances to which the panel assembly is applied using a remote device.

**[0577]** Although the present disclosure has been described by taking a refrigerator as an example for convenience of explanation, it is not limited thereto, and it is possible to apply it to home appliances that can form an outer appearance by the panel assembly 30.

**[0578]** In detail, the outer appearance of the home appliance of the embodiment of the present disclosure may be formed by the panel assembly 30, and the outer appearance may be changed to a color set by the user of the operation of the lighting device 36. The panel assembly may be expressed in various colors by light emitted from the rear.

**[0579]** The home appliance may be any one of a refrigerator 1E, an air conditioner 5, a dishwasher 6, a clothes care machine 7, a washing machine 8, or a cooking appliance 9, and the same structure as the panel assembly 30 of an embodiment of the present disclosure is applied to each of them so that the outer appearance color of the front surface can be freely changed.

**[0580]** For example, as in the above-described embodiment, in the refrigerator 1E, the panel assembly 30 may be provided on the front surface of the door 20 that opens and closes the cabinet 10. In addition, the panel assembly 30 lights up in a set color of a user setting, and the outer appearance color of the front surface of the refrigerator 1E can be changed.

**[0581]** The indoor device of the air conditioner 5, the dishwasher 6, the clothes care machine 7, the washing machine 8, or the cooking appliance 9, for example, each form an outer appearance, and a heat exchange device and a fan are provided inside, or Cases 51, 61, 71, 81, and 91 forming a washing space or a space for storing or washing or drying clothes or a cooking space may be included. The front surface of the case may be formed by panel assemblies 511, 621, 721, 811, and 921. This panel assembly has the same structure as the above-described panel assembly 30 of the refrigerator and can emit light.

**[0582]** Accordingly, the panel assembly can shine in a set color of a user setting, and the front outer appearance color of the home appliance can be changed to the set color.

**[0583]** In the home appliance of an embodiment of the present disclosure, the user can control the color of the panel assembly by manipulating the remote device 2.

**[0584]** The remote device outputs the menu screen 2b first and manipulates the panel color change menu 2b 1 through the menu screen 2b.

**[0585]** When the user selects the panel color change menu 2b 1, the remote device 2 outputs the color selection screen 2c from the menu screen 2b, and the user can select the position of the panel 31 to be changed and the color of the panel 31 to be changed on the color selection screen.

**[0586]** A panel position selection menu 2c1 is displayed on the color selection screen 2c, and the panel 31 mounted on the door 20 at a desired position among the plurality of doors 20 can be selected. The panel 31 of the door 20 selected by the user may be displayed in the panel position selection menu 2c1.

**[0587]** After selecting a desired position of the panel 31, the user can select and input the color selection menus 2c2 and 2c3 displayed on the color selection screen

2c. For example, the color selection menus 2c2 and 2c3 may display all colors that can be displayed on the panel 31 in the form of a color picker capable of checking and extracting color codes.

**[0588]** Of the user's selection of the third color, the control portion 13 may control the lighting device 36 to be turned on in the second color so that the panel 31 is displayed in the third color.

## Claims

1. A refrigerator comprising:

a cabinet (10) having a storage space;  
a door (20) for opening and closing the cabinet (10); and  
a detection device (50) provided on one surface of the door (20), the detection device (50) is provided for recognizing a user in front of the door (20) and/or for detecting ambient brightness, wherein at least a portion of the detection device (50) is accommodated inside the door (20).

2. The refrigerator of claim 1, wherein the detection device (50) includes

a detection member (52) for detecting a user's proximity; and  
a case (51) mounted on a lower surface of the door (20) to shield the detection member (52), the case (51) is exposed to the lower surface of the door (20), wherein an opening shielded by the case (51) is formed on the lower surface of the door (20), and wherein a portion of the detection member (52) protrudes downward from the opening.

3. The refrigerator of claim 2, wherein the detection member (52) includes a light receiving portion (522) and a light emitting portion (523); and/or the detection member (52) is inclined with respect to the lower surface of the door (20), and/or wherein a front end of the detection member (52) protrudes downward more than the rear end thereof.

4. The refrigerator of claim 2 or 3, wherein the door (20) is rotatably mounted to the cabinet (10) by a hinge device (205), wherein the detection member (52) is provided on one side closer to the side of door (20) having the hinge device (205) among the left and right sides of the door, and/or wherein one side end of the left and right ends of the detection member (52) being closer to the hinge device (205) is disposed to face more forward than one side end farther from the hinge device (205).

5. The refrigerator of claim 3 or 4, wherein the case (51) includes

a case body (511) for shielding the opening of the lower surface of the door (20);  
a detection member accommodation portion (512) protruding downward from the case body (511) and forming a recessed portion in which the detection member (52) is accommodated; and/or  
wherein the detection member accommodation portion (512) includes:

a front surface (512a) extending downward from the case body (511) and disposed with the light receiving portion (522) and the light emitting portion (523) of the detection member (52); and  
a lower surface (512b) extending from the lower end of the front surface (512a) toward the case body (511),  
wherein the detection member (52) is supported by the front and lower surfaces (512a, 512b).

6. The refrigerator of any one of the preceding claims, wherein the detection device (50) further includes a door light (53) and a light mounting portion (513) opened downwardly and in which the door light (53) radiating downwardly is accommodated, wherein a light cover (55) is mounted on the light mounting portion for shielding the door light (53)

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

an upper door (201); and  
a lower door (202) disposed below the upper door (210), wherein the detection device (50) protrudes between the upper door (201) and the lower door (202).

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

a door body (40);  
a panel assembly (30) coupled to the door body (40) to form a front outer appearance of the door (201); and/or  
a door cover (146) forming an upper portion of the upper door (201), wherein the detection device (50, 60) is mounted on the door cover (146).

9. The refrigerator of claim 8, wherein the detection device (50, 60) includes:

an illuminance sensor (152);  
a sensor module mounting portion (153) re-

cessed downward from the door cover (146) and accommodating the illuminance sensor (152); and  
a sensor cover (151) formed of a material capable of transmitting light and for shielding an opening of the sensor module mounting portion (153).

10. The refrigerator of claim 9, wherein the sensor cover (151) includes:

a cover protrusion (1511) protruding upward from the door cover (146) and accommodating an upper end portion of the illuminance sensor (152) therein; and  
a first inclined portion (1512) extending forward from the cover protrusion (1511) and inclined downward toward the front; and  
wherein a detection portion (1521) of the illuminance sensor (152) is configured to detect light entering through the first inclined portion (1512).

11. The refrigerator of claim 9 or 10, wherein the illuminance sensor (152) is mounted in a state of being inclined at a set angle in the sensor module mounting portion (153).

12. The refrigerator of any one of the preceding claims 8-11, wherein the door (20) includes:

a front plate (31) forming an outer appearance of the front surface of the door (20) and through which light is transmitted;  
a lighting device (36) that irradiates light, wherein the operation of the lighting device is controlled by a control portion (13), wherein the control portion (13) is configured to control the intensity of a light source of the lighting device (36) based on a value detected by the detection device (50, 60).

13. The refrigerator of any one of the preceding claims, wherein the lower door (201) includes:

a door body (40);  
an upper cap deco (143) connected to an upper end of the door body (40) and forming a portion of the front surface and the upper surface of the lower door (202); and  
a detection device (250) for recognizing a user in front of the door (202) or for detecting ambient brightness,  
wherein the detection device (250) is provided inside the upper cap deco (143), and  
wherein a detection hole (2433) communicating with the detection device (250) is formed on the front surface of the upper cap deco (143).

14. The refrigerator of claim 13, wherein a sensor opening (2431) which is opened and into which the detection device (250) is inserted is formed on the upper surface of the upper cap deco (143), wherein the detection device (50) includes: 5

a cover (252) for shielding the sensor opening (2431);  
a sensor device (253) having the illuminance sensor (152) or proximity sensor (151); and 10  
a fixing member (254) to which the sensor device and the cover are coupled.

15. The refrigerator of claim 13 or 14, wherein the door (202) includes: 15

a door body (40); and  
a panel assembly (30) coupled to the door body (40) to form the front outer appearance of the door (202); wherein the panel assembly (30) includes: 20

a front plate (31) forming an outer appearance of the front surface of the door (202) and through which light is transmitted; 25  
a lighting device (36) that irradiates light; and  
a control portion (13) for controlling the operation of the lighting device (36), wherein the control portion (13) is configured to adjust the intensity of the light source of the lighting device (36) when the detection device (250) detects that the user is adjacent to the door (202). 30  
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FIG. 1

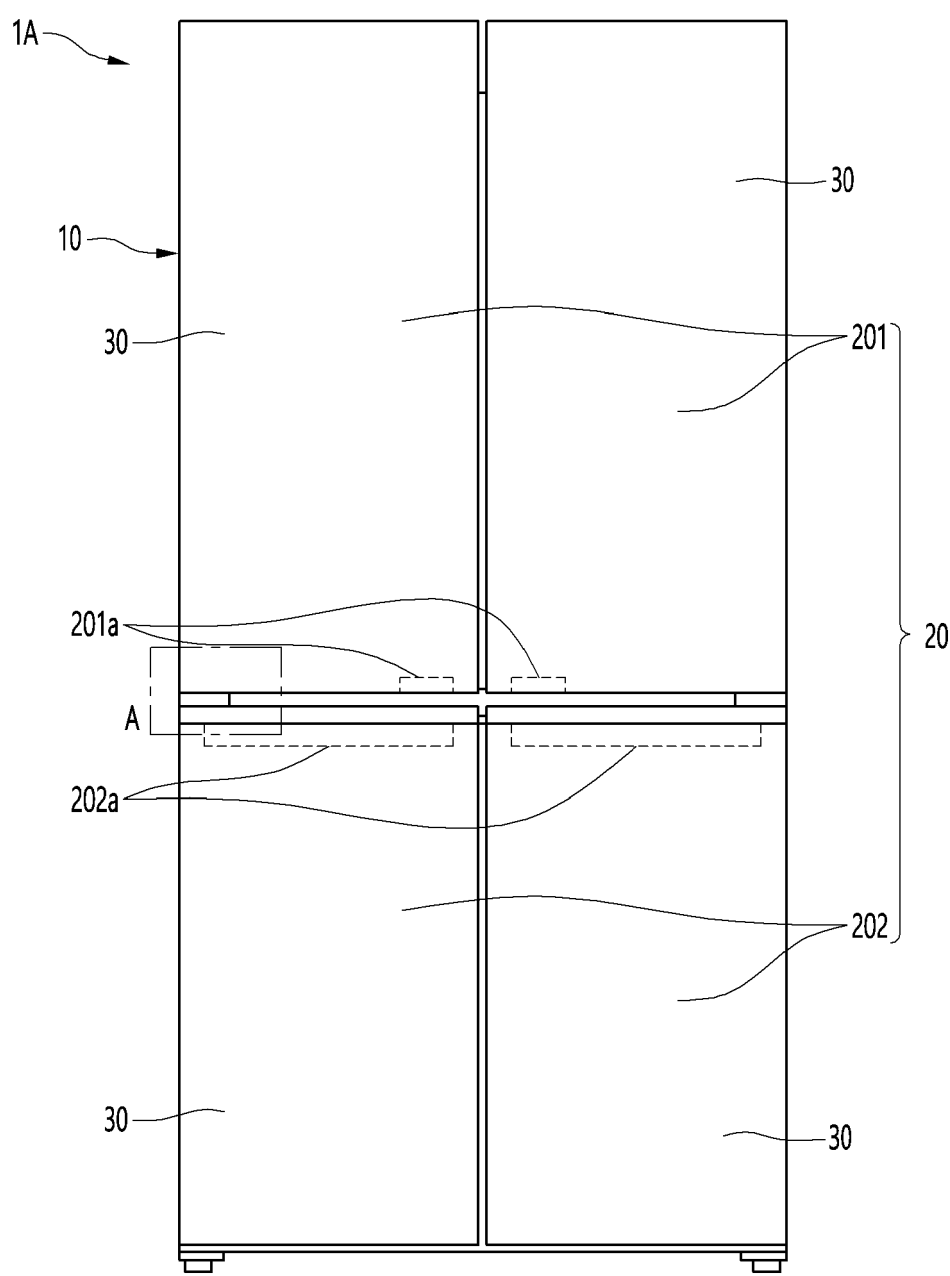


FIG. 2

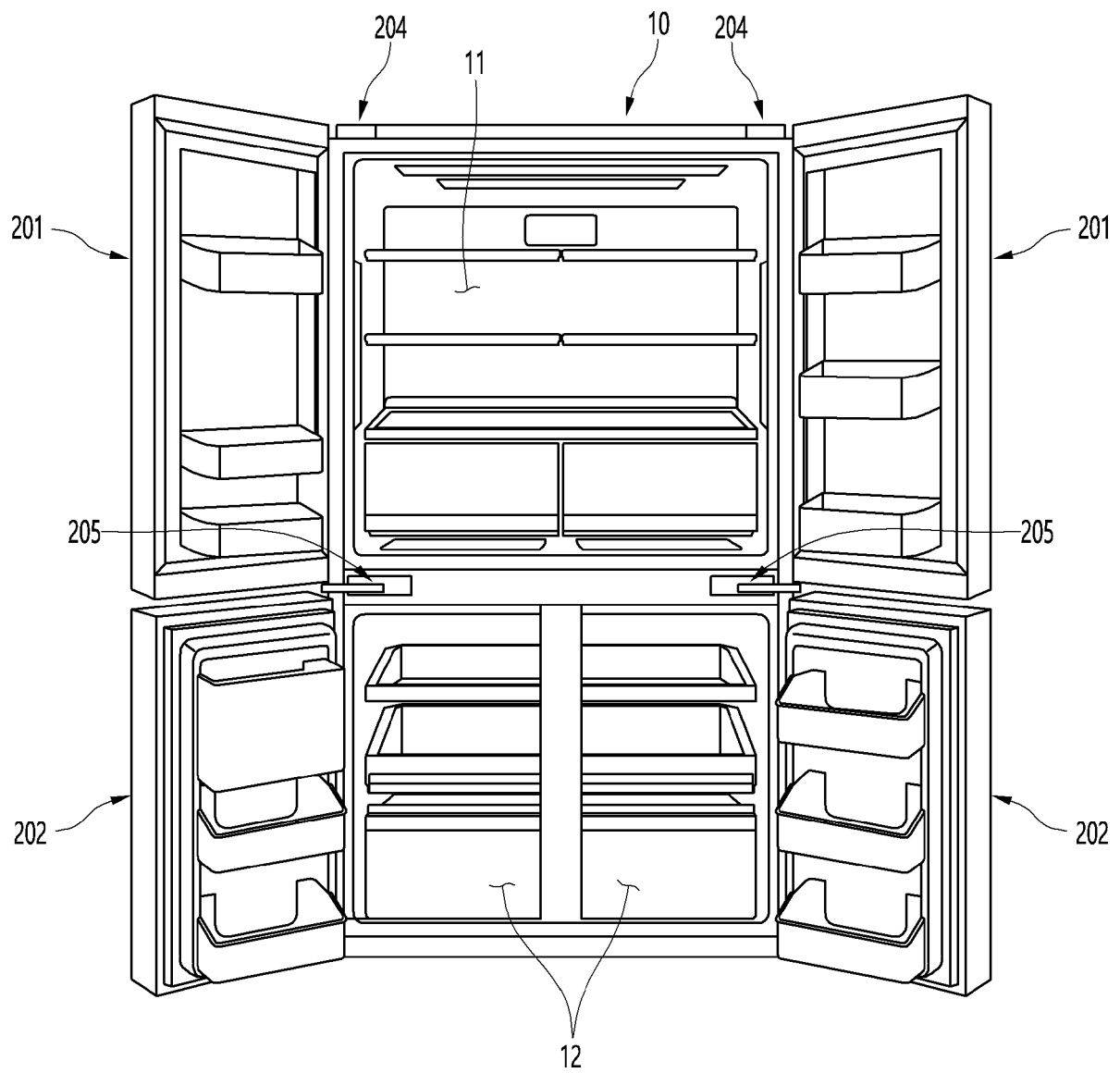


FIG. 3

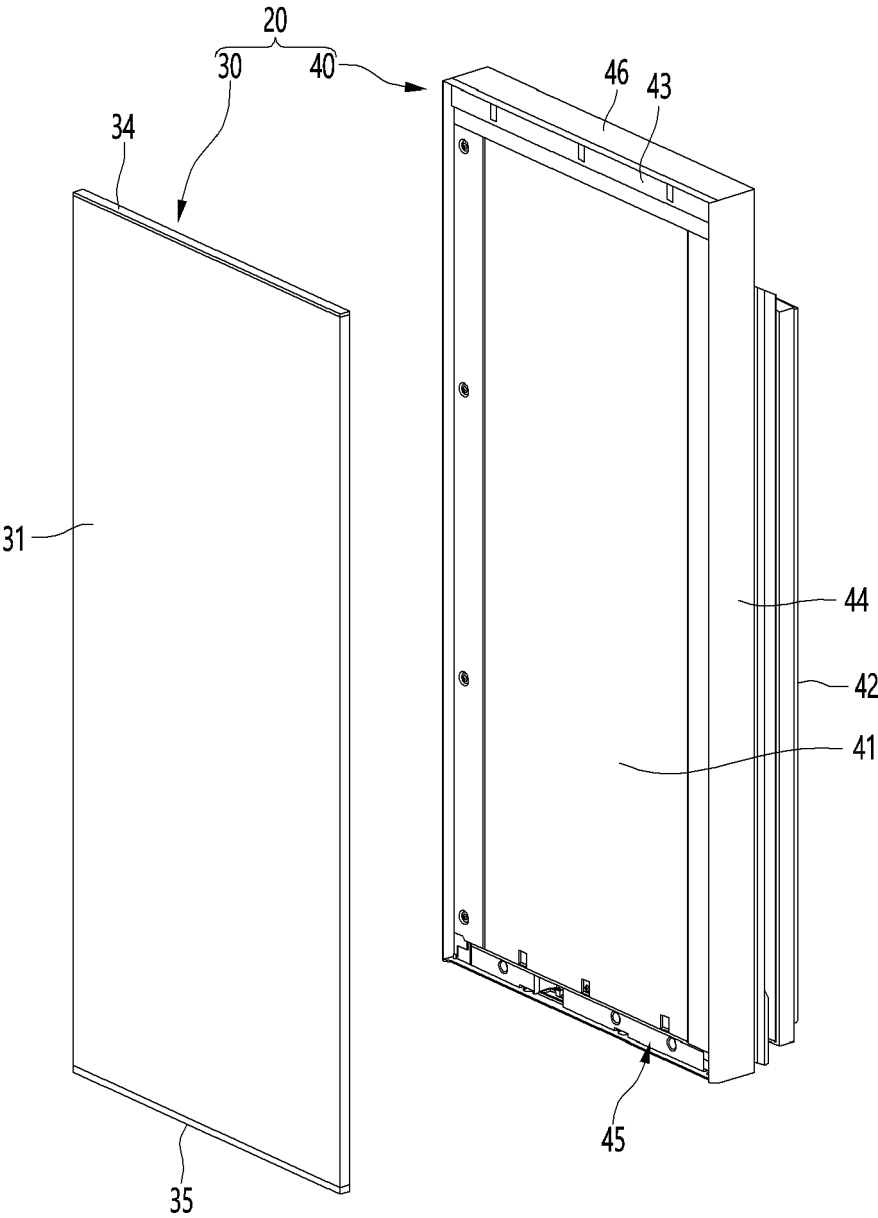


FIG. 4

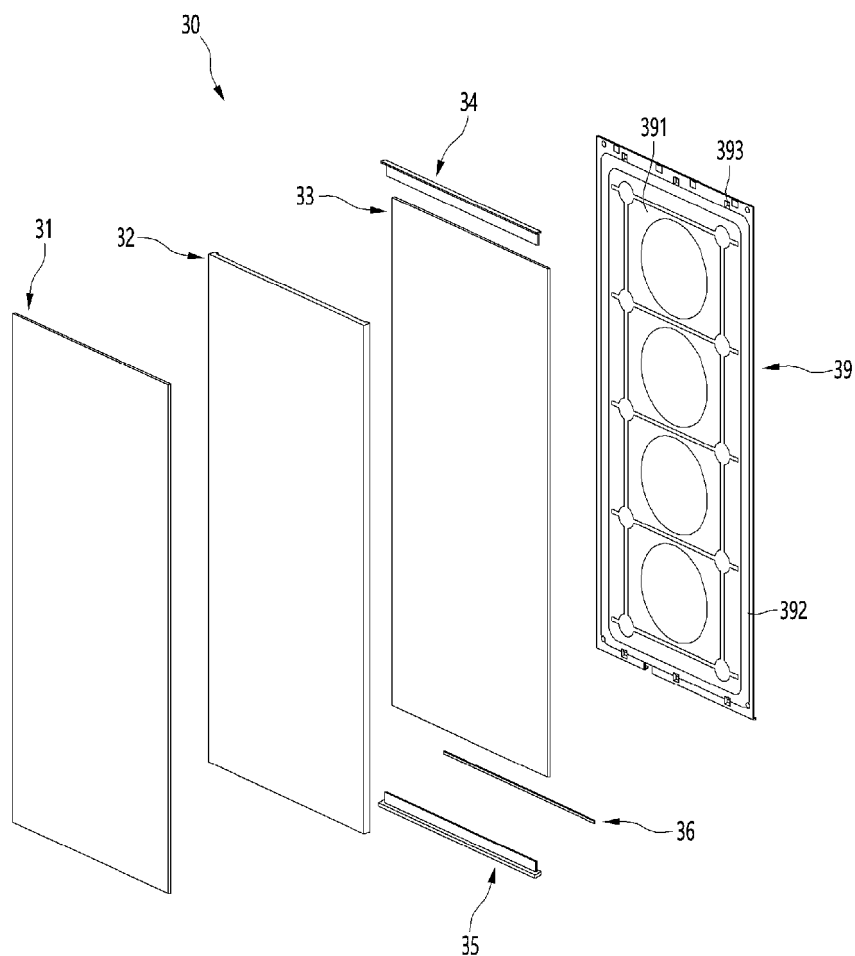


FIG. 5

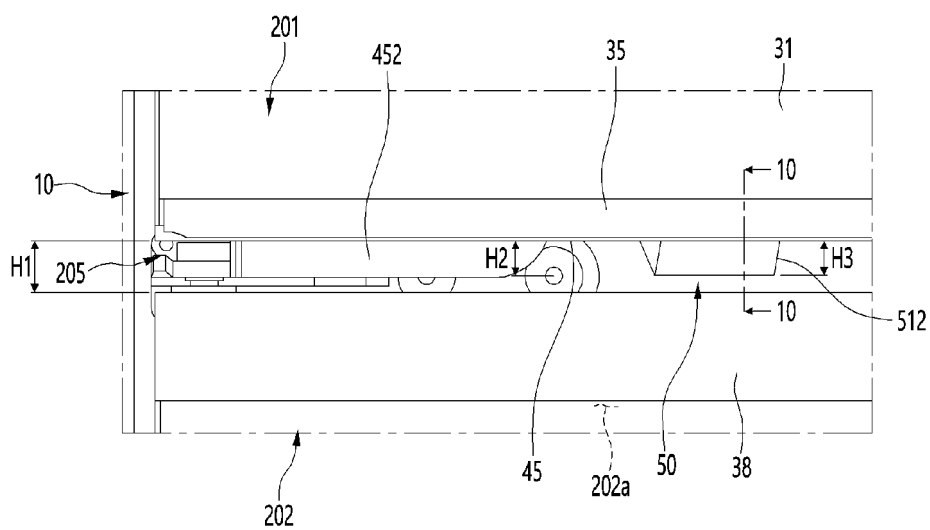


FIG. 6

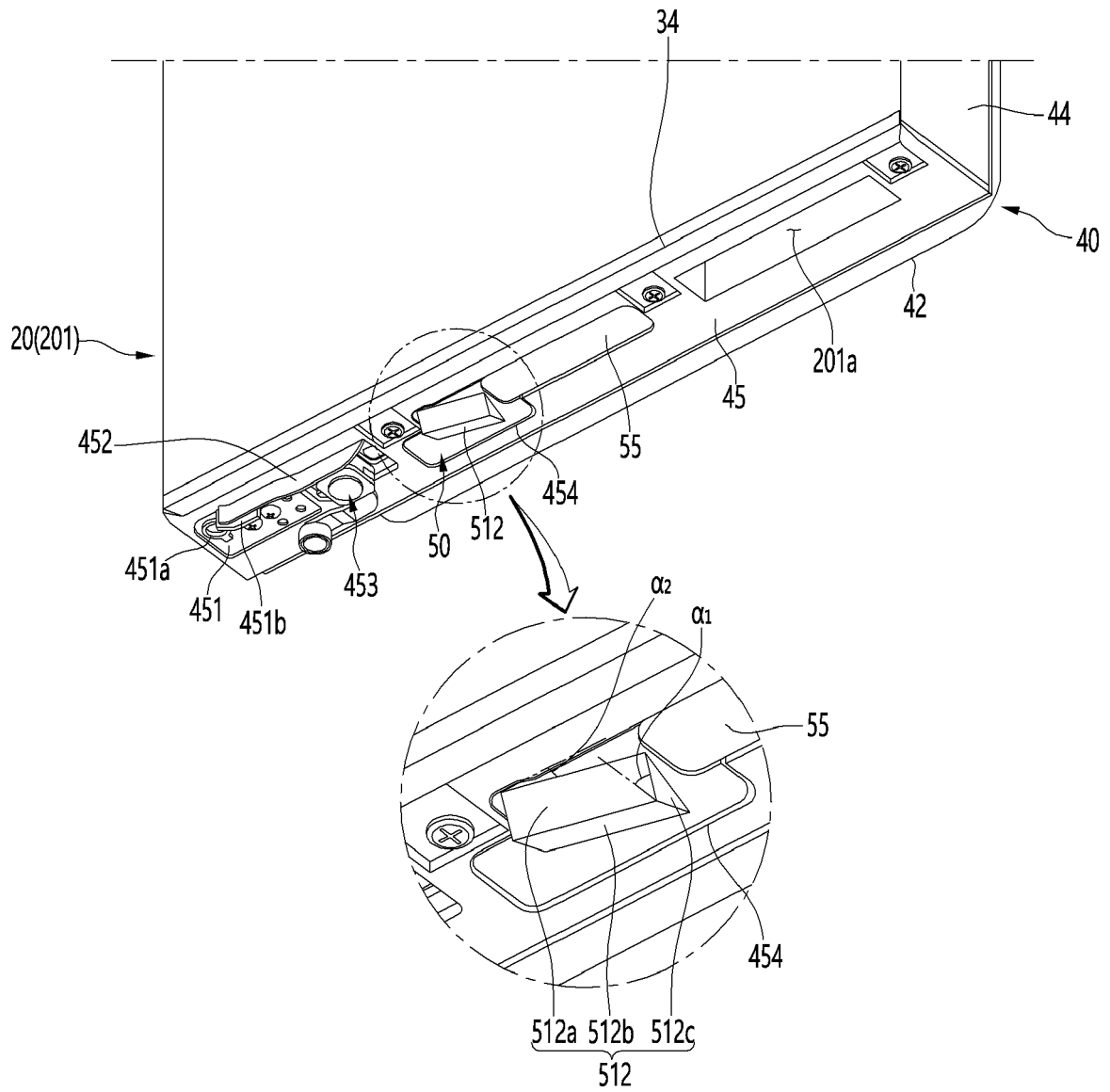


FIG. 7

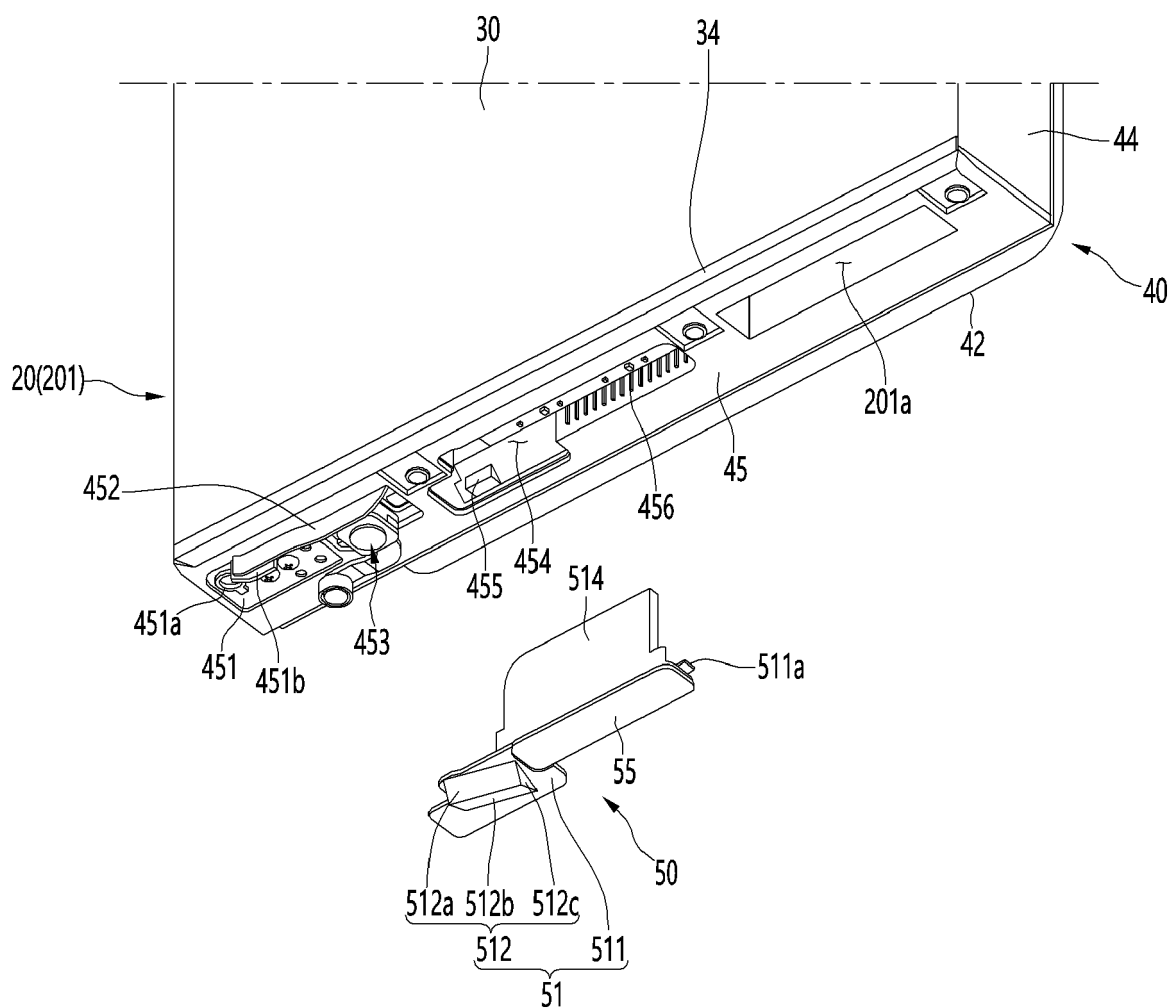


FIG. 8

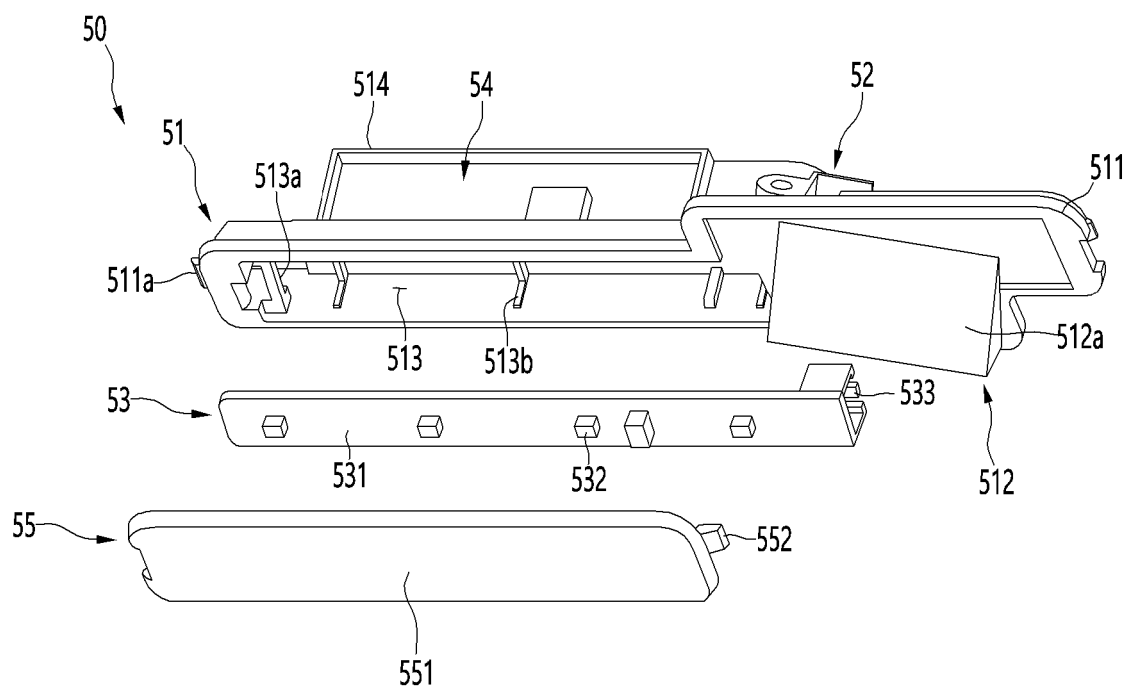


FIG. 9

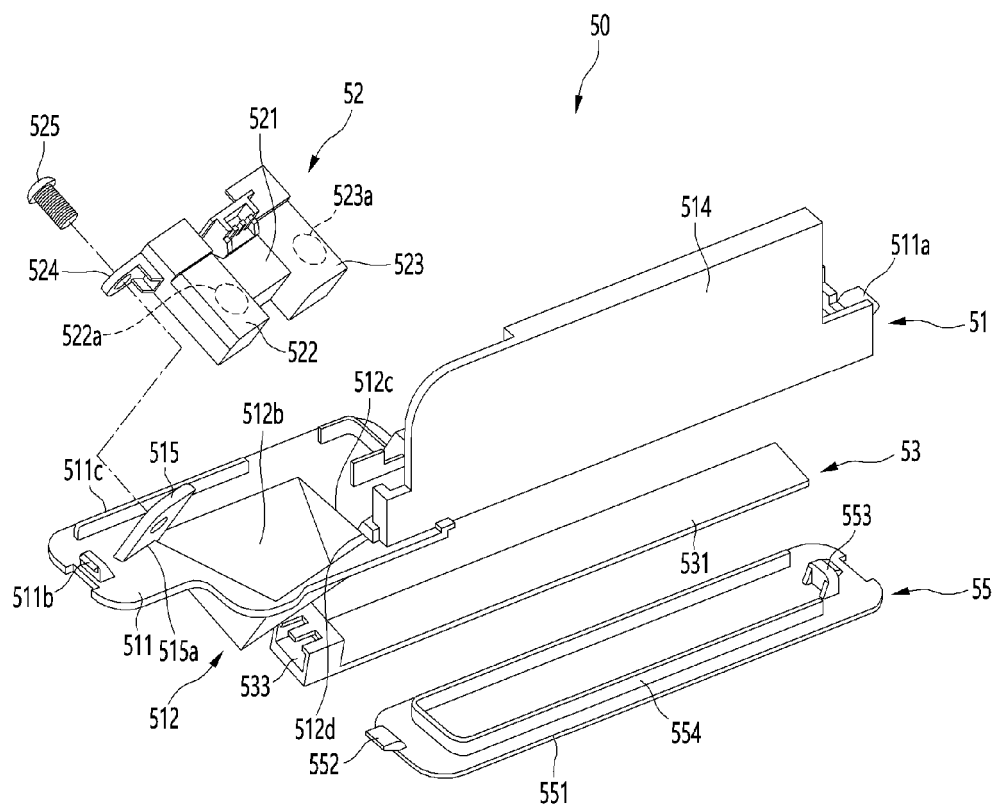


FIG. 10

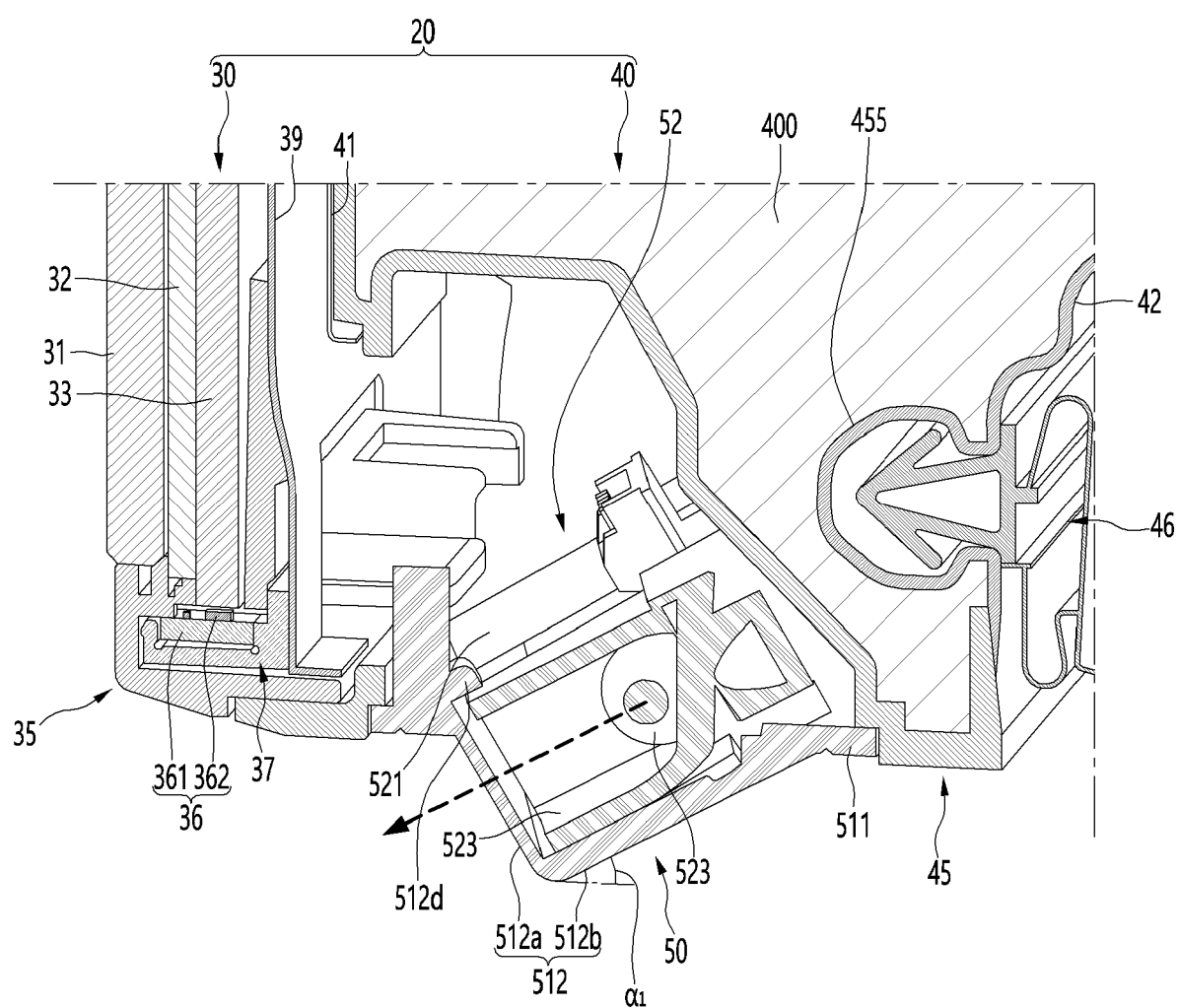




FIG. 11

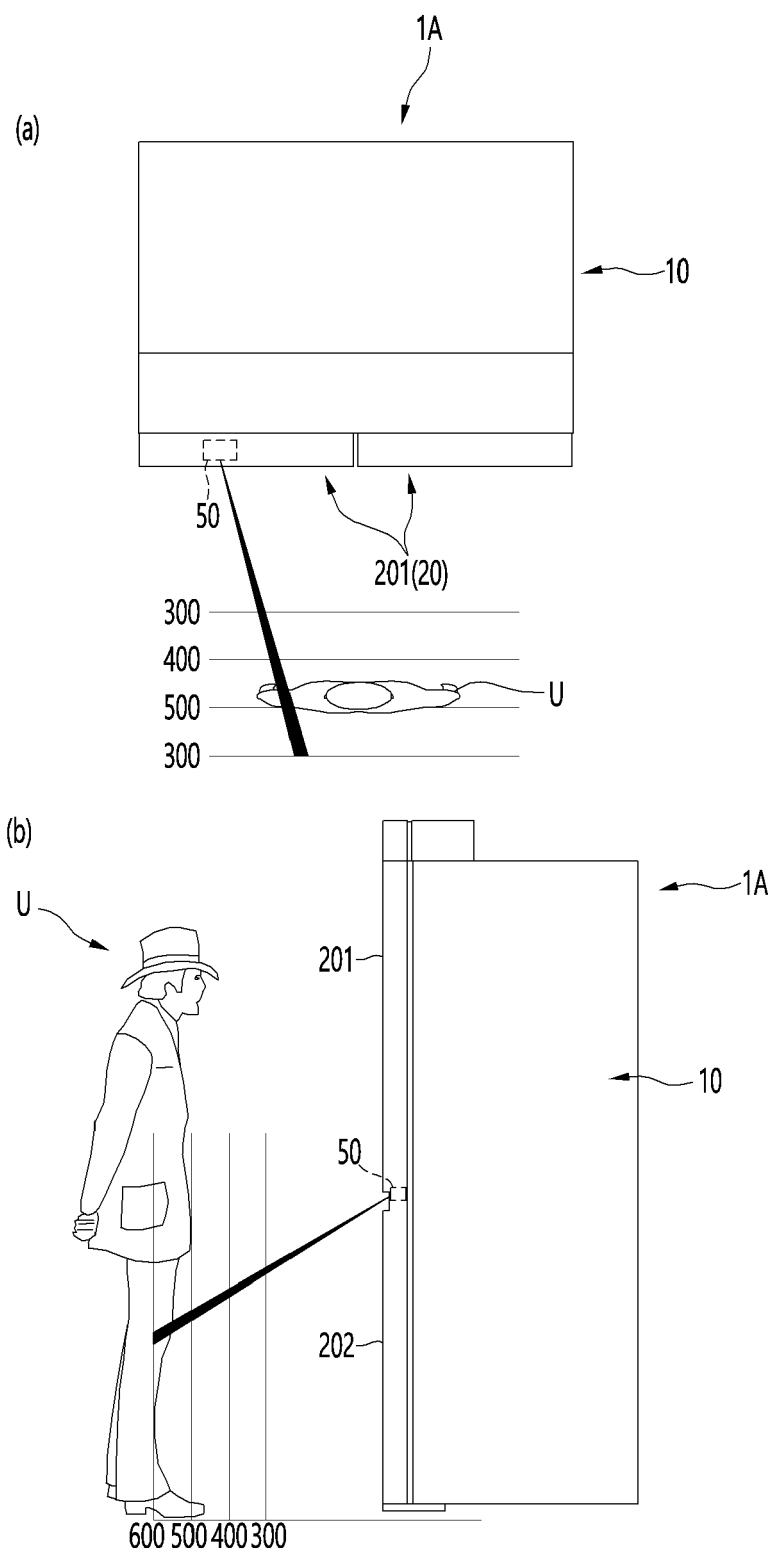


FIG. 12

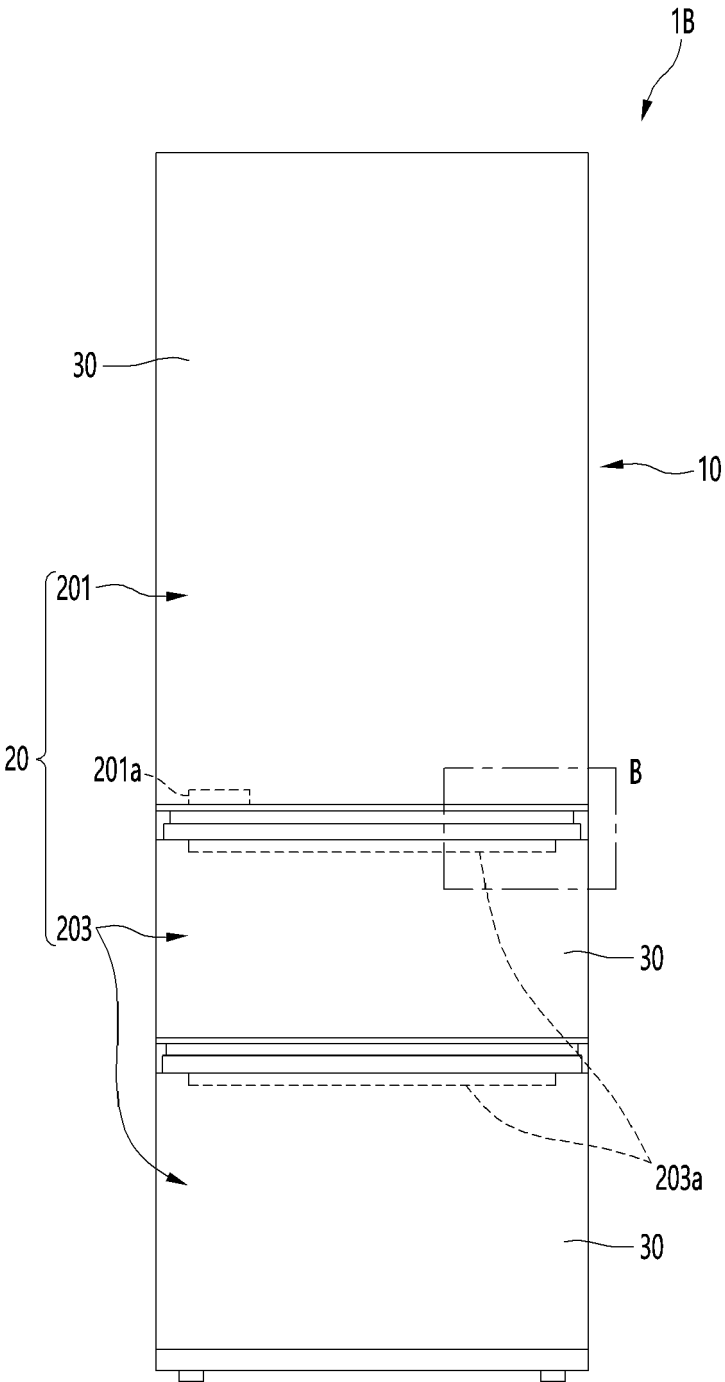


FIG. 13

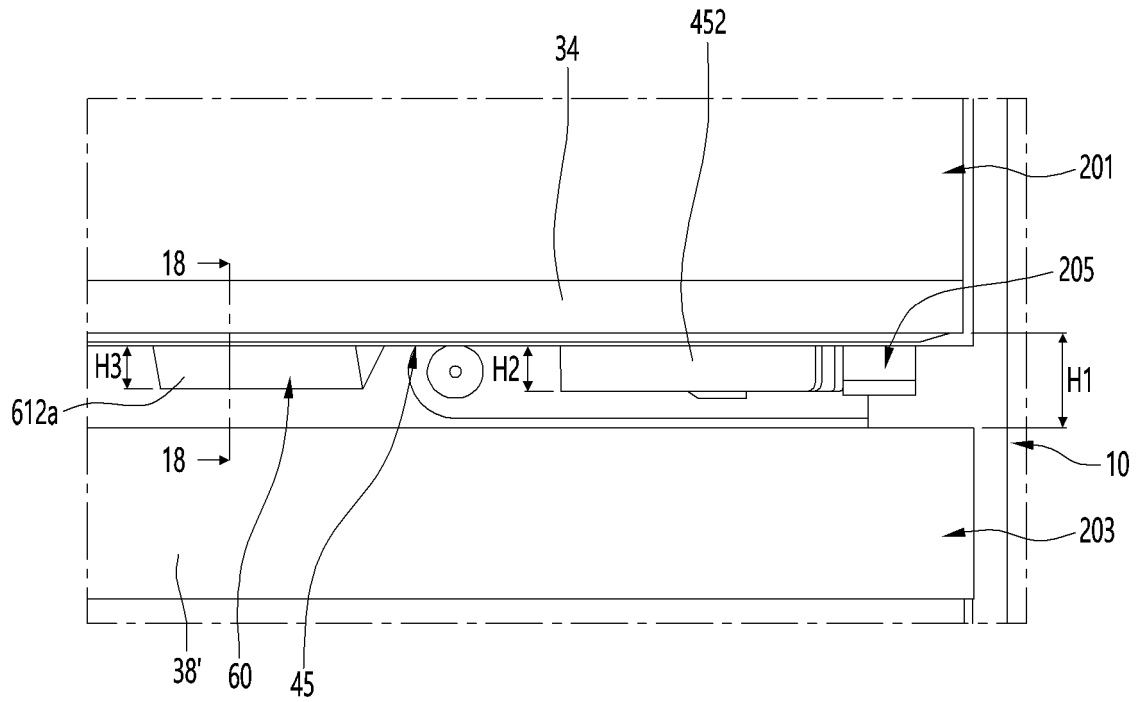


FIG. 14

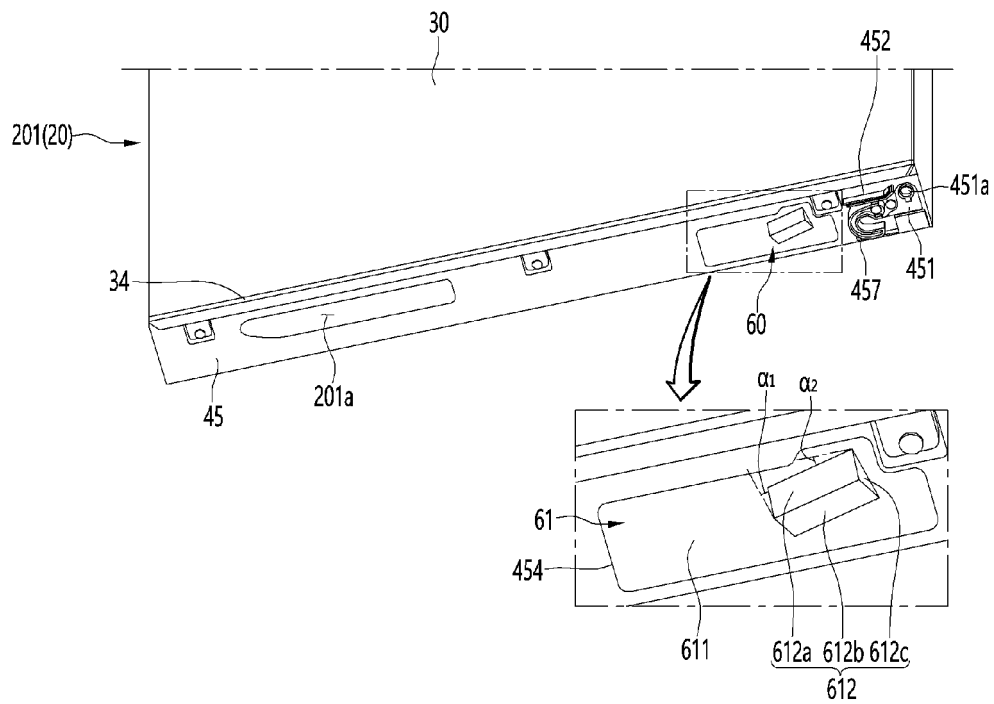


FIG. 15

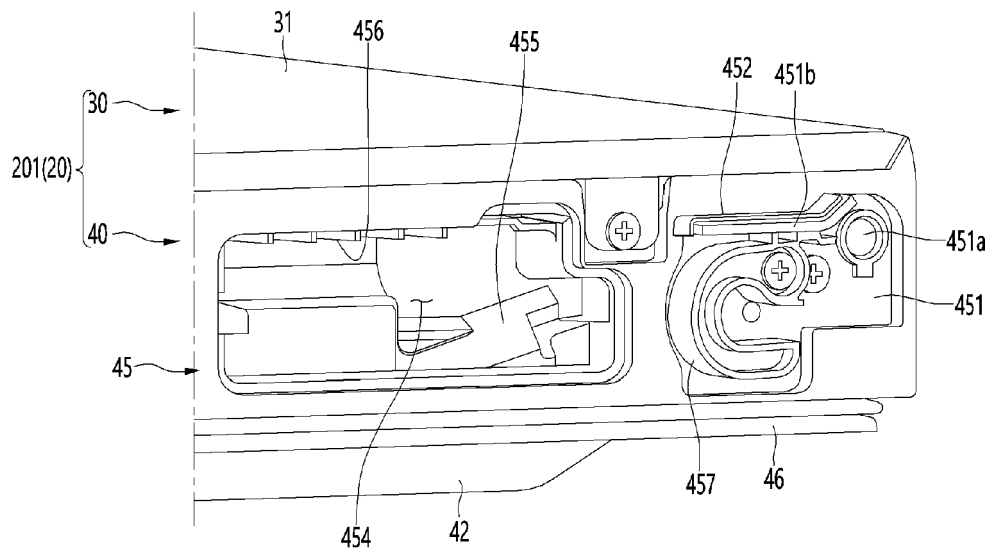


FIG. 16

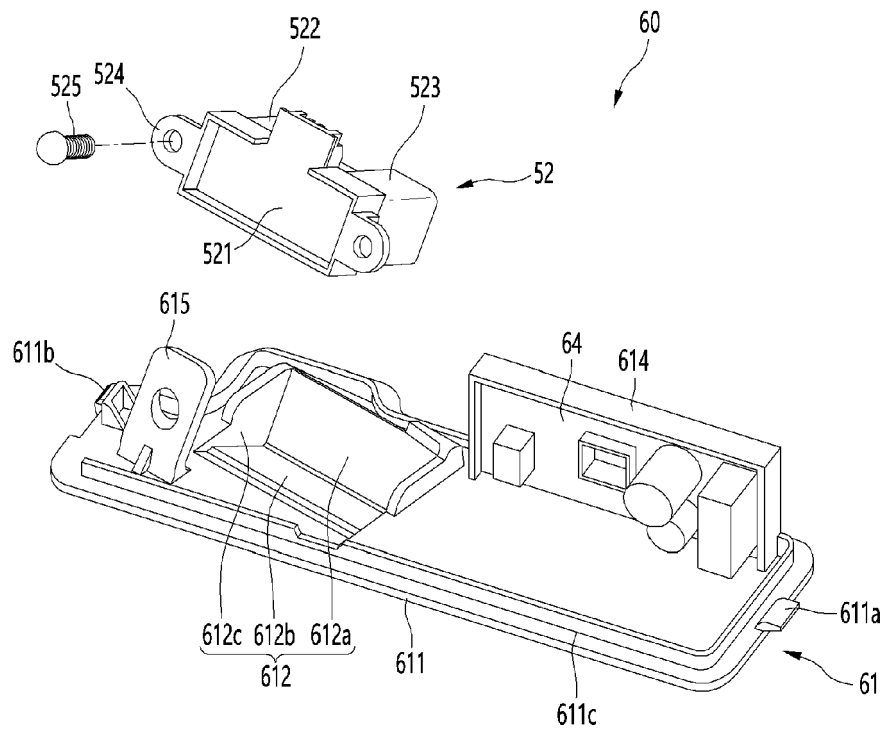


FIG. 17

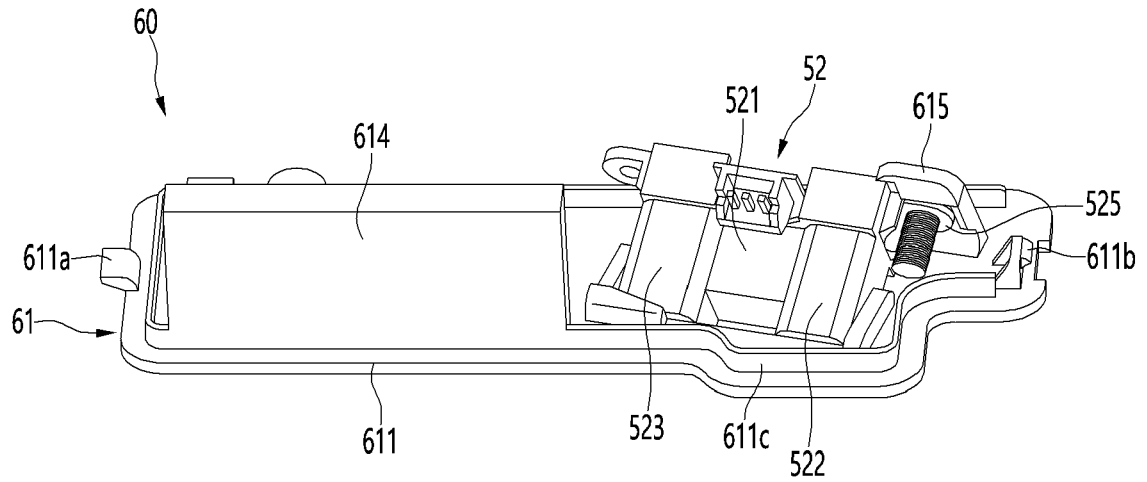


FIG. 18

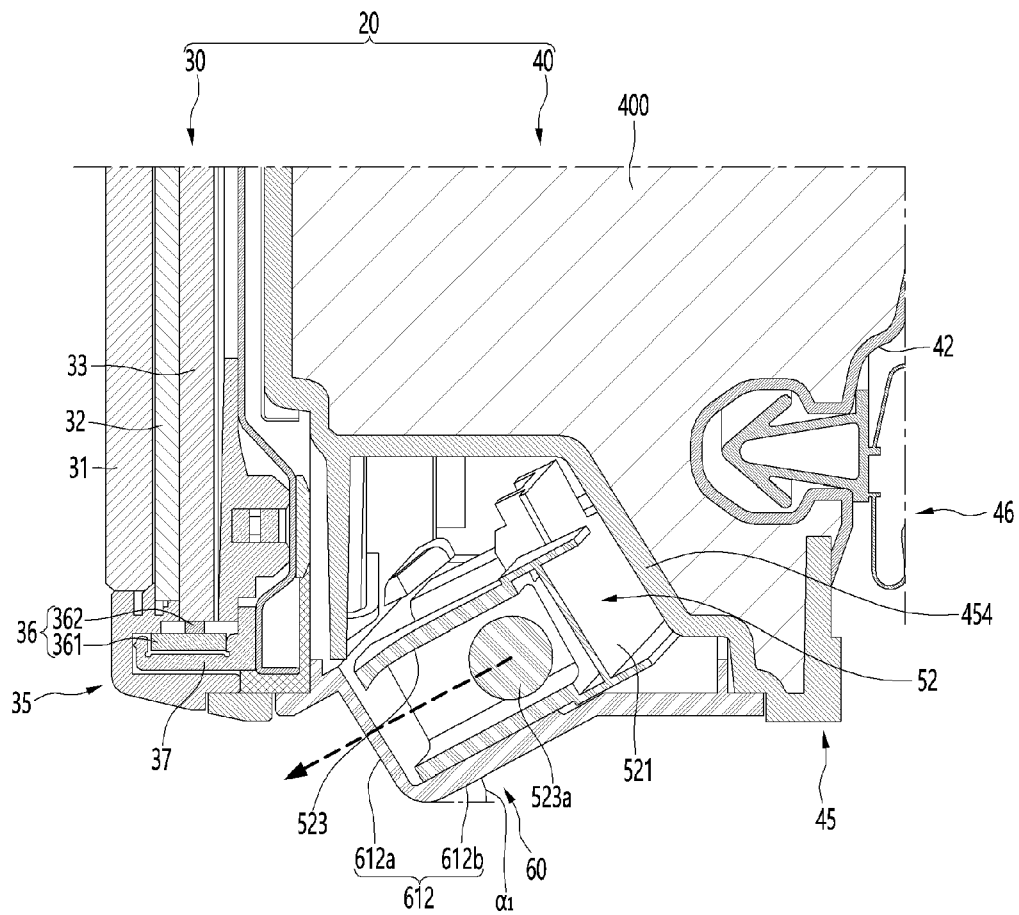


FIG. 19

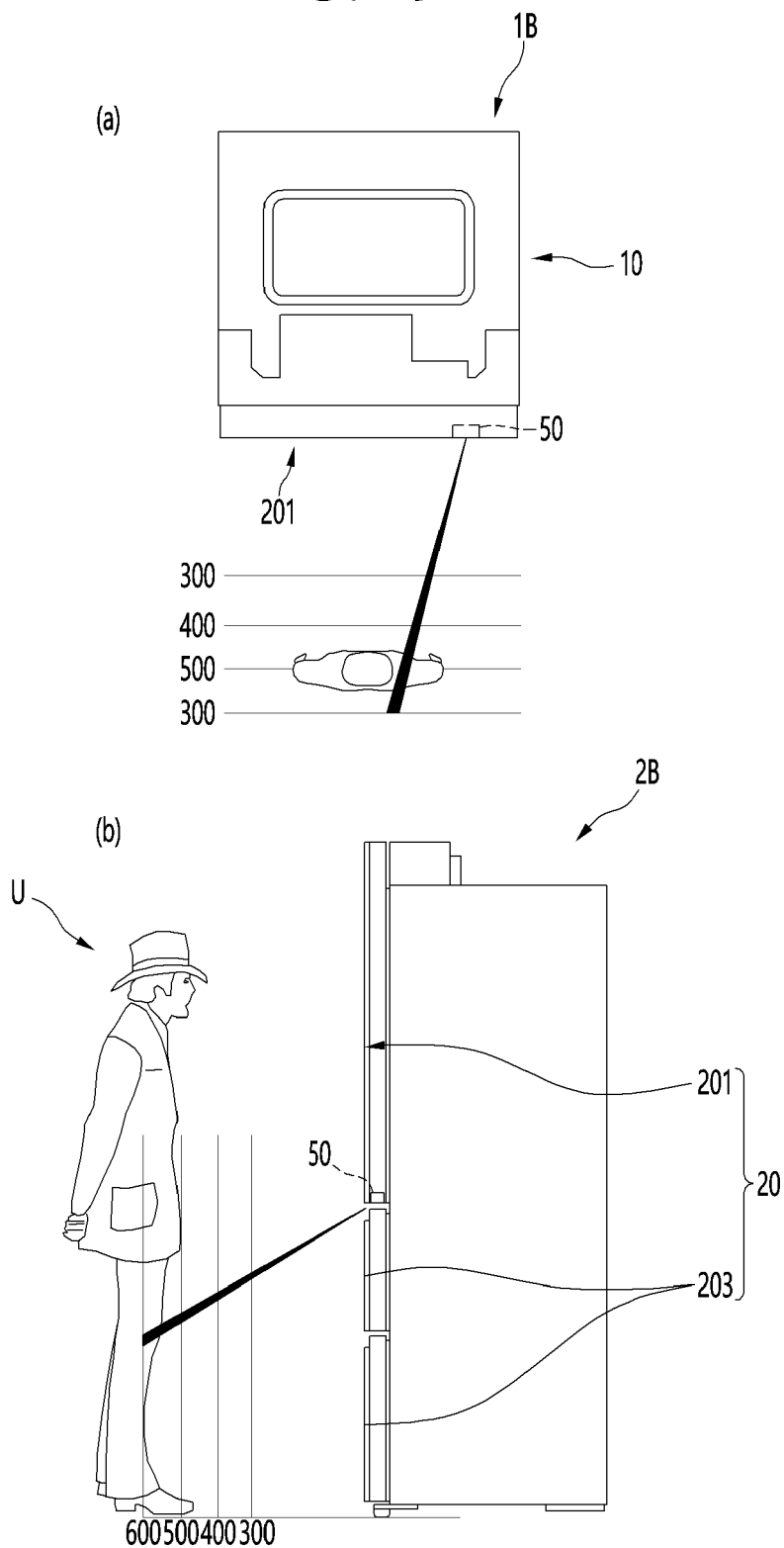


FIG. 20

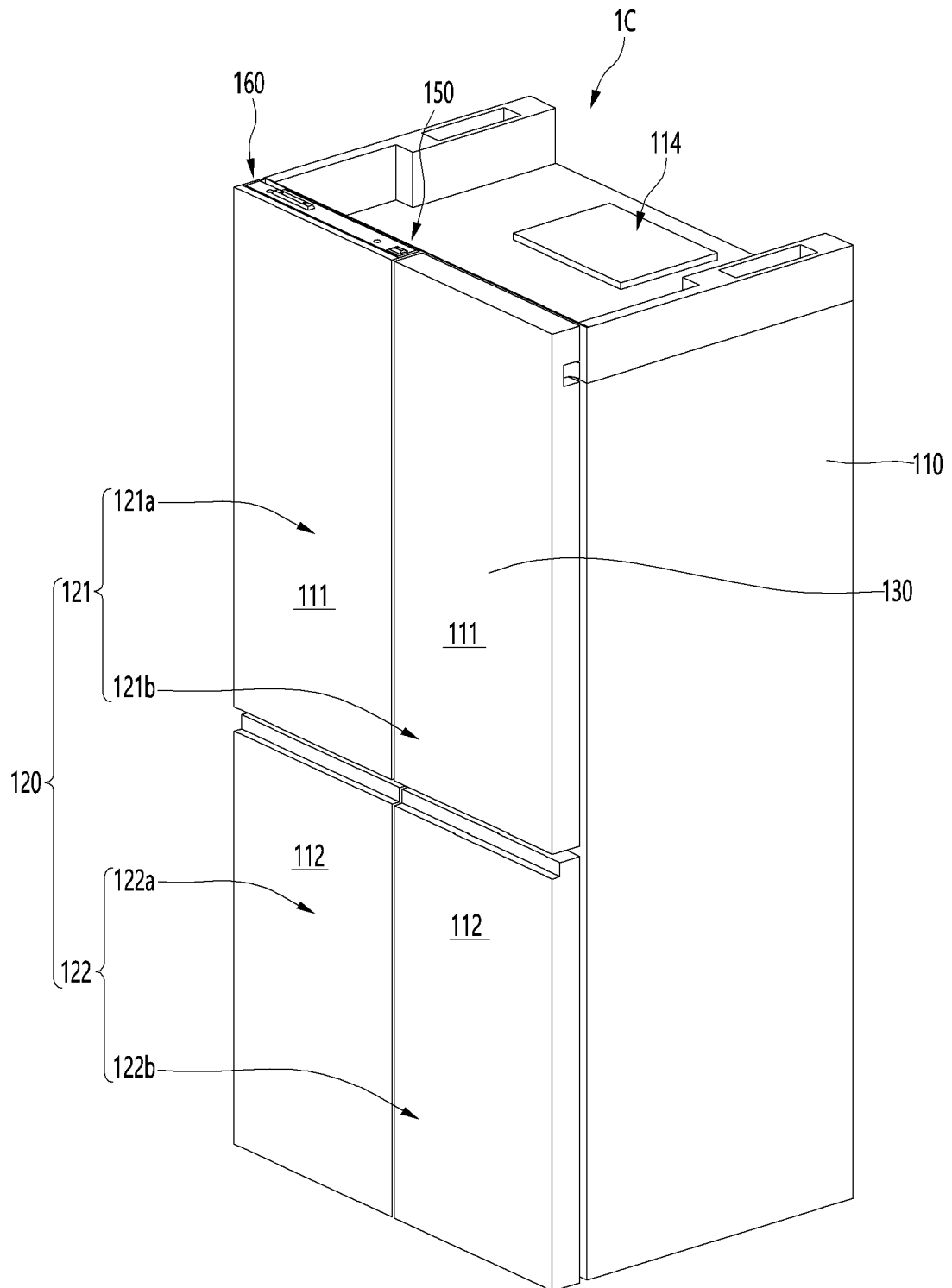


FIG. 21

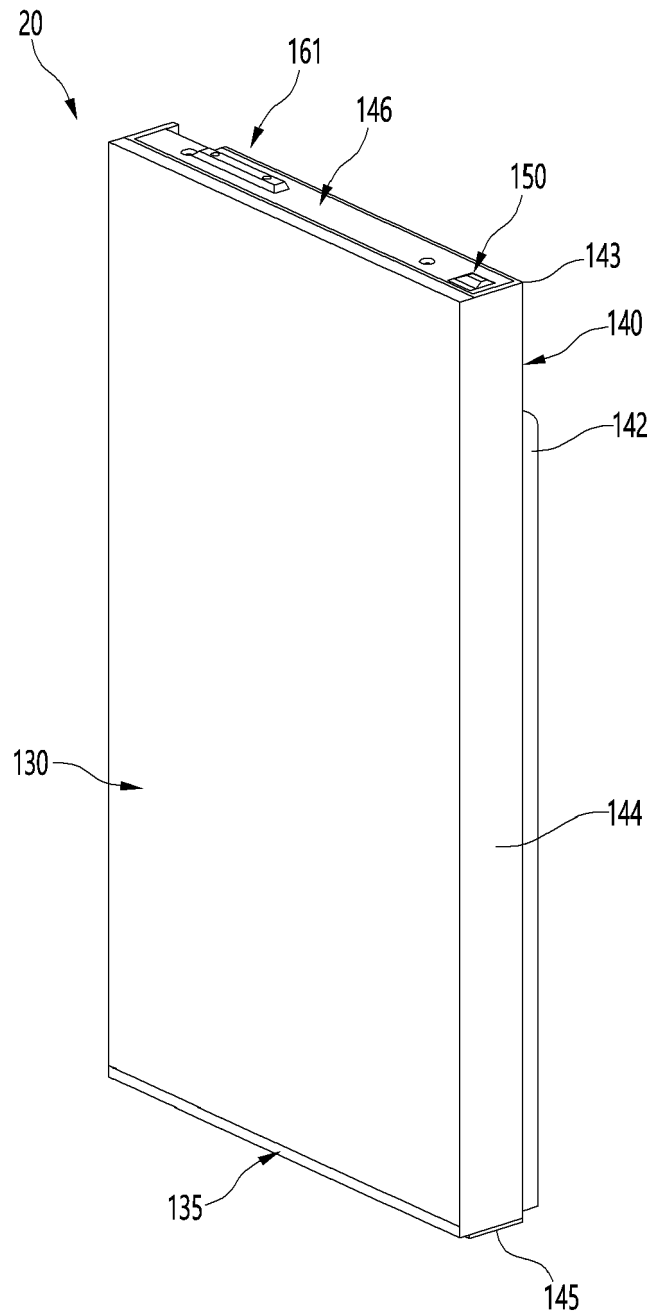




FIG. 22

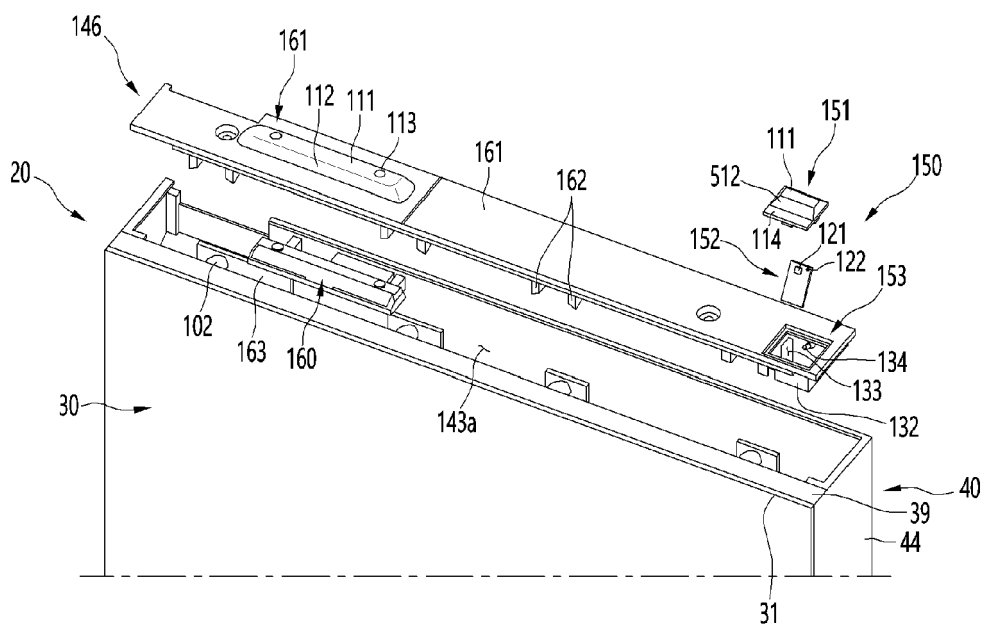


FIG. 23

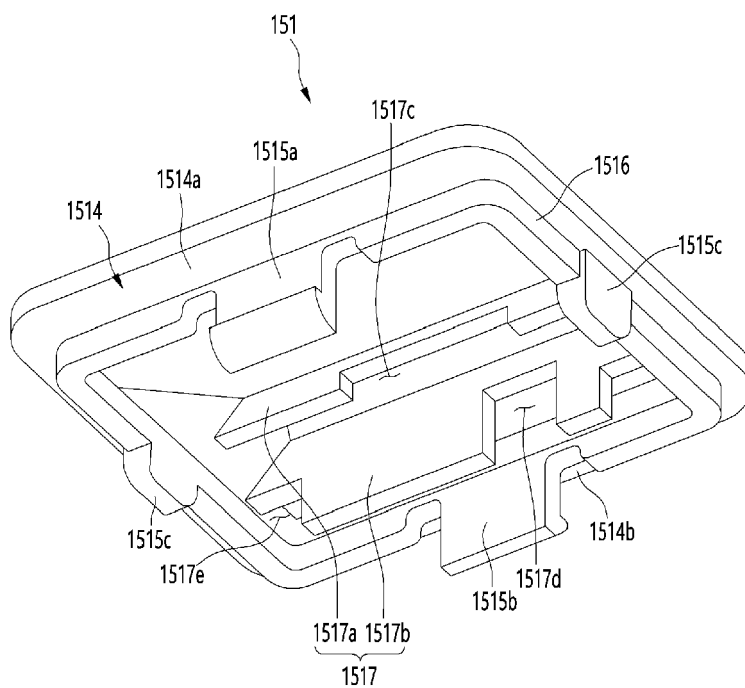


FIG. 24

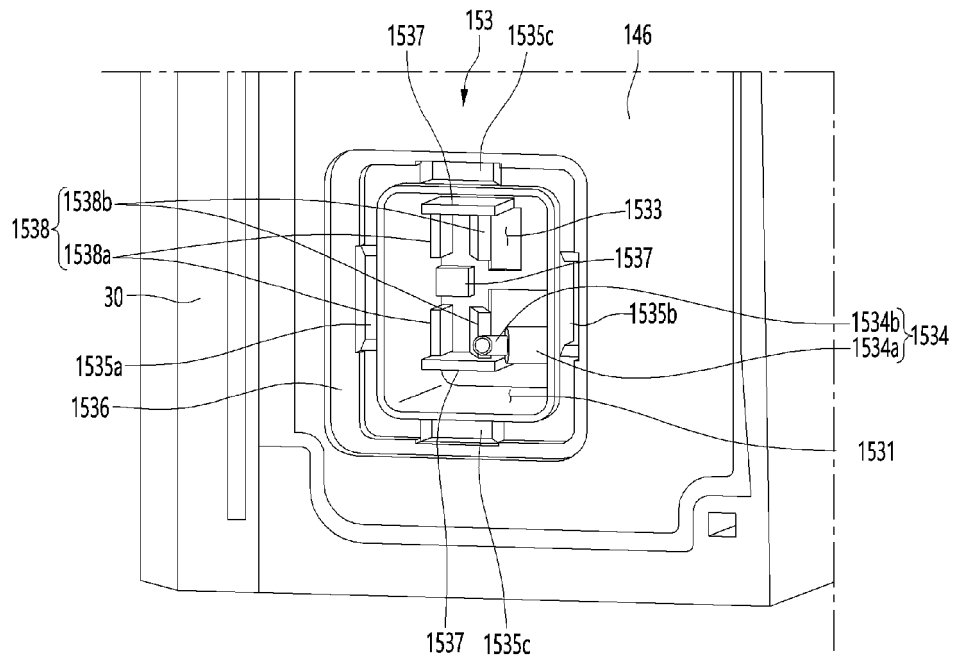


FIG. 25

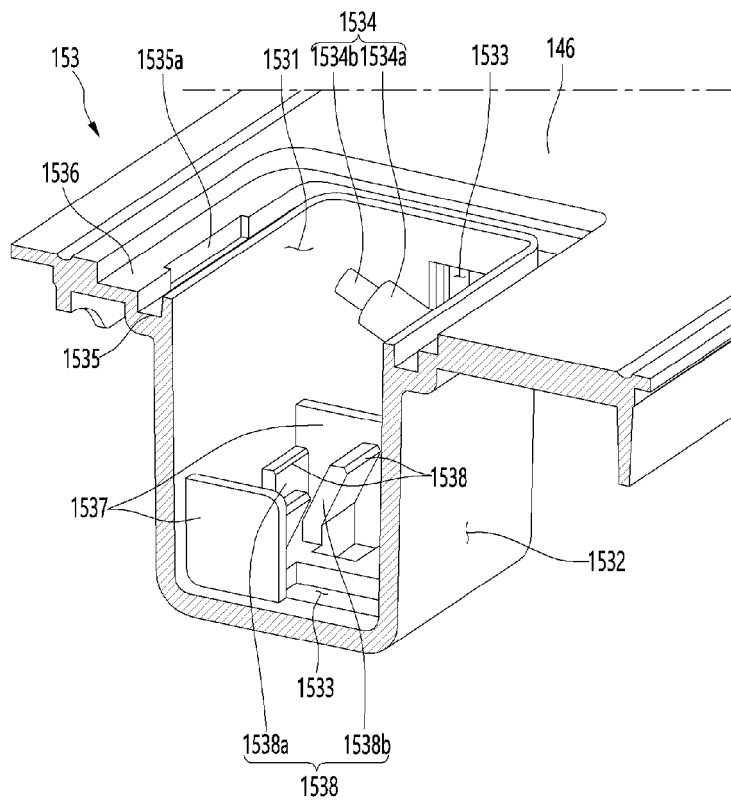


FIG. 26

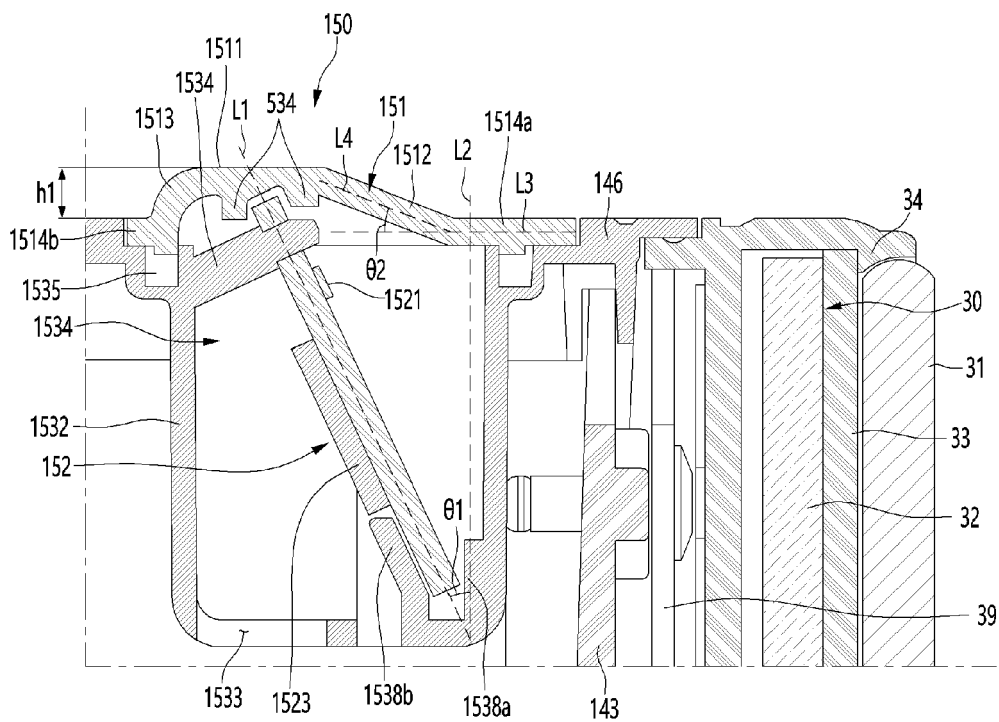


FIG. 27

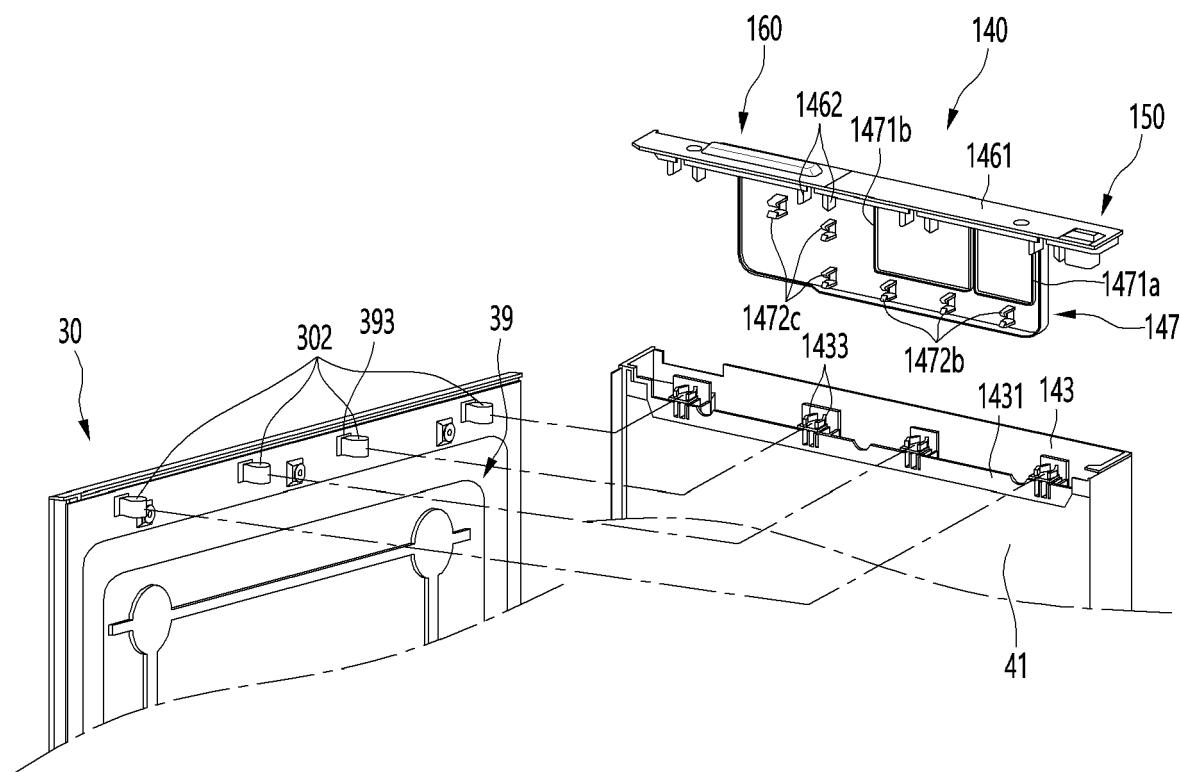


FIG. 28

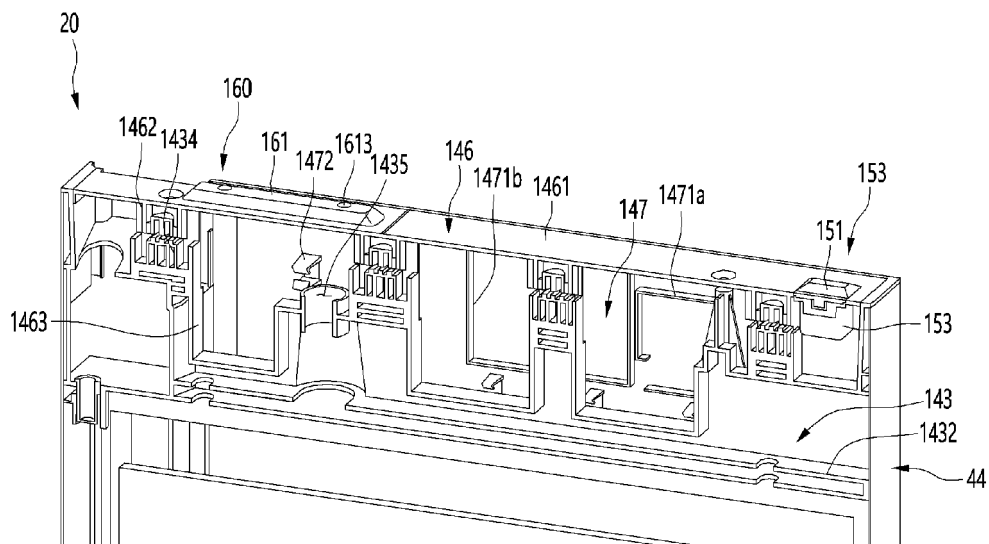


FIG. 29

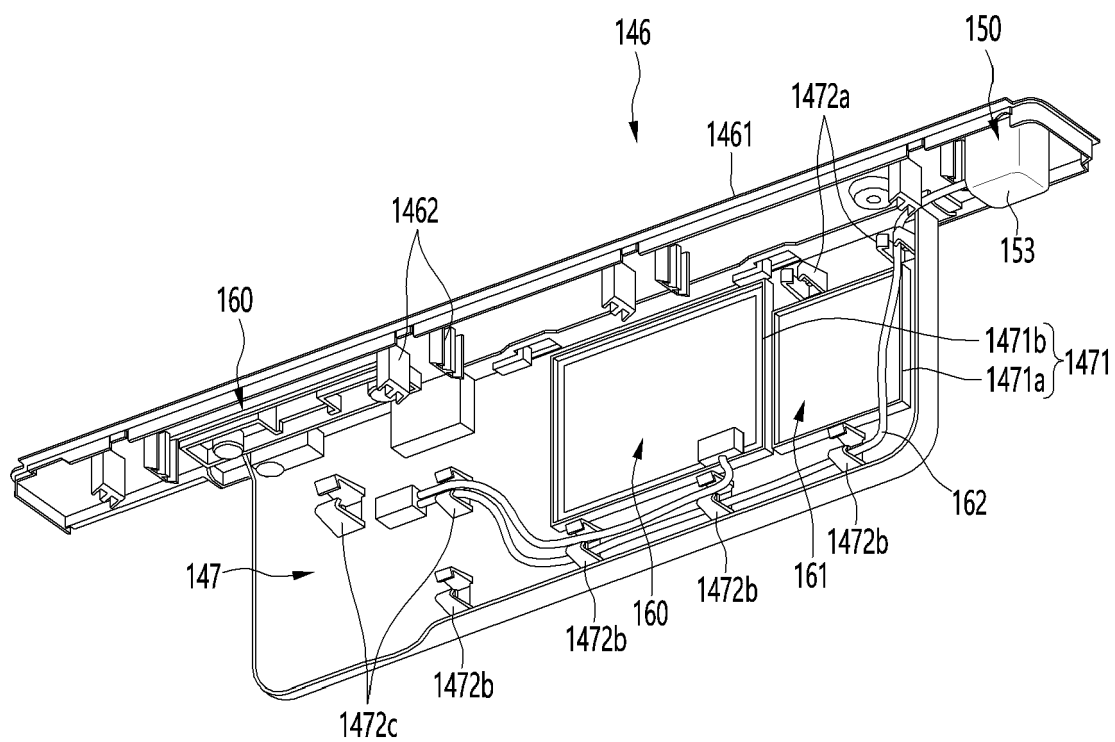


FIG. 30

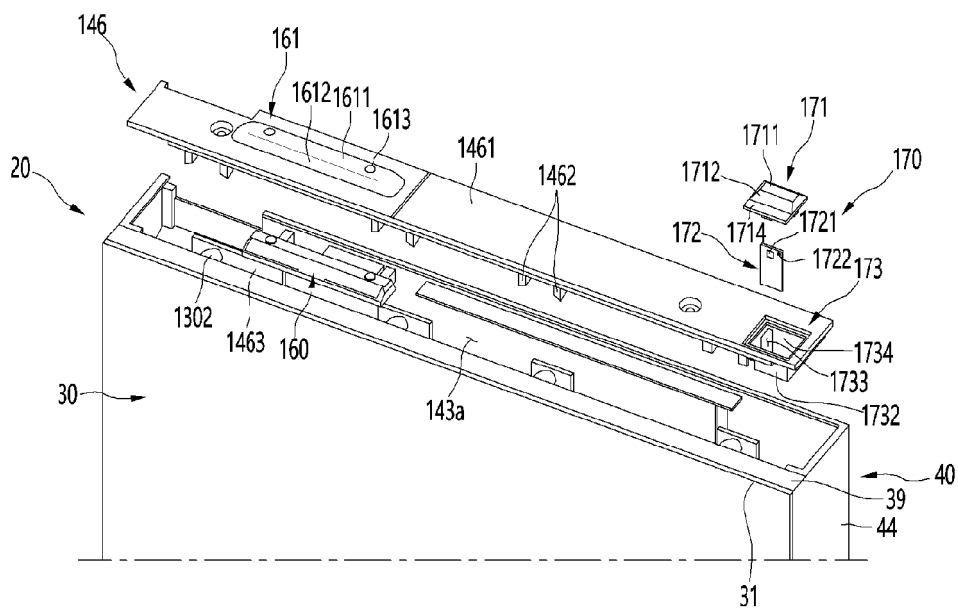


FIG. 31

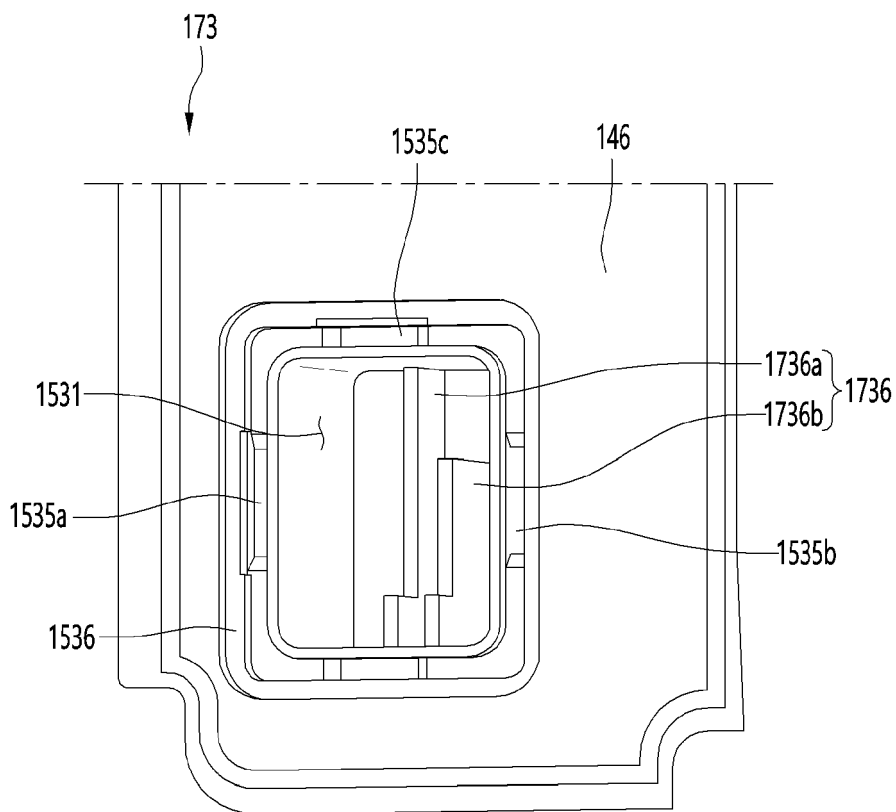


FIG. 32

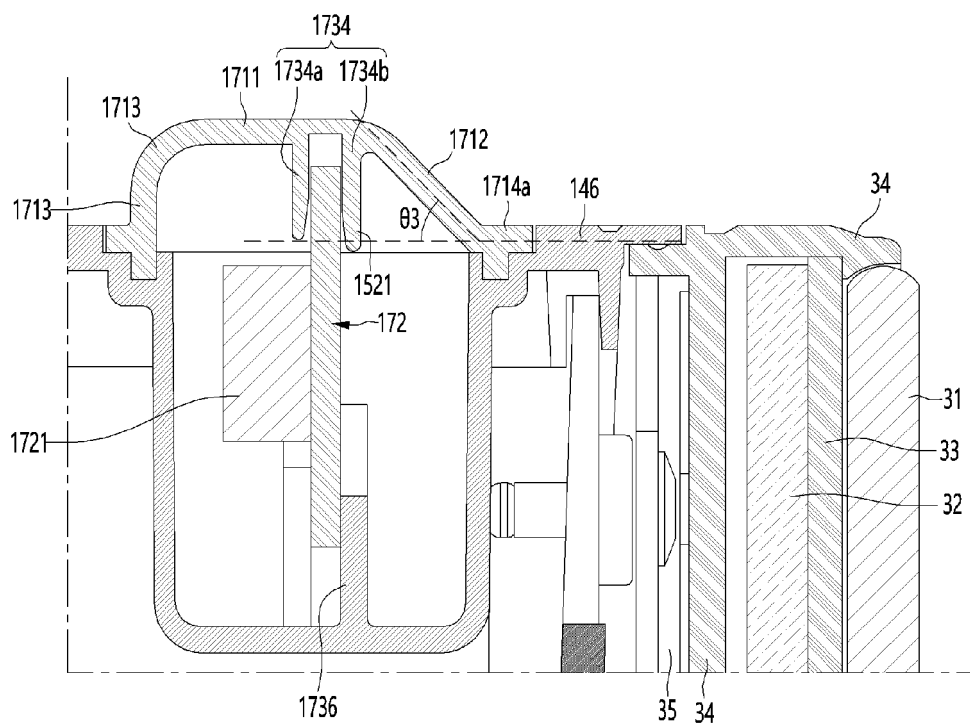


FIG. 33

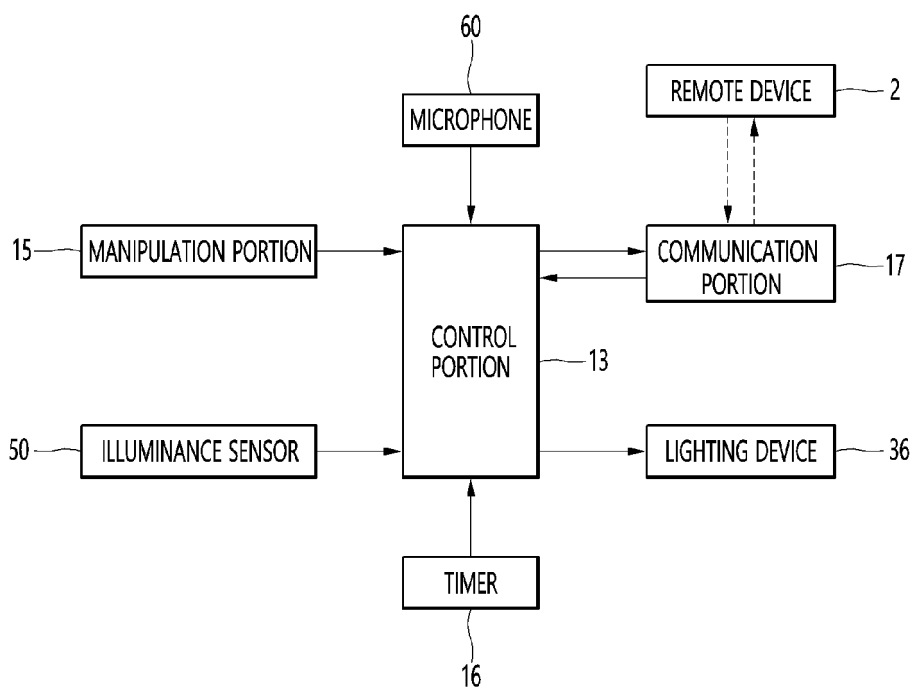


FIG. 34

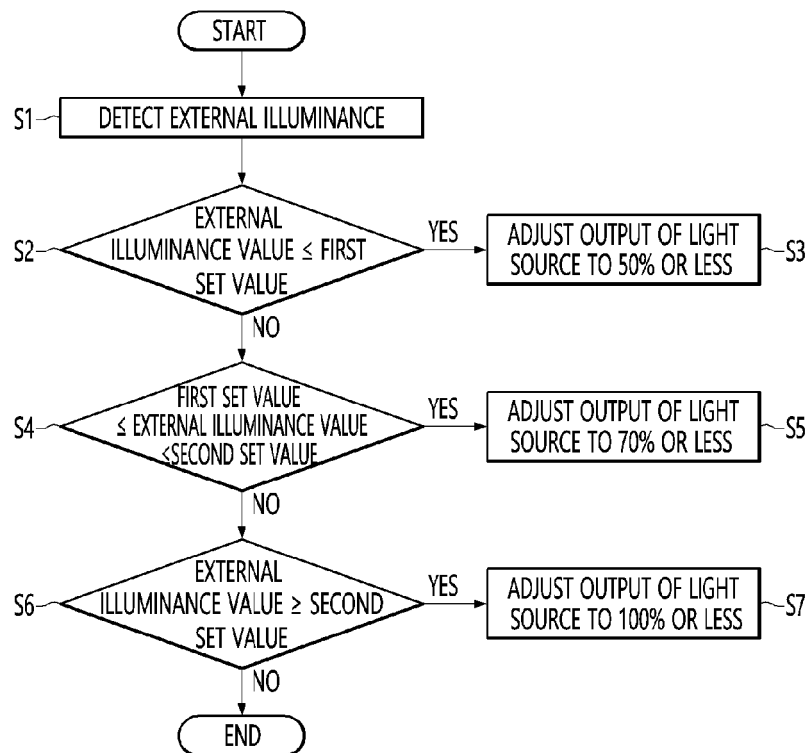


FIG. 35

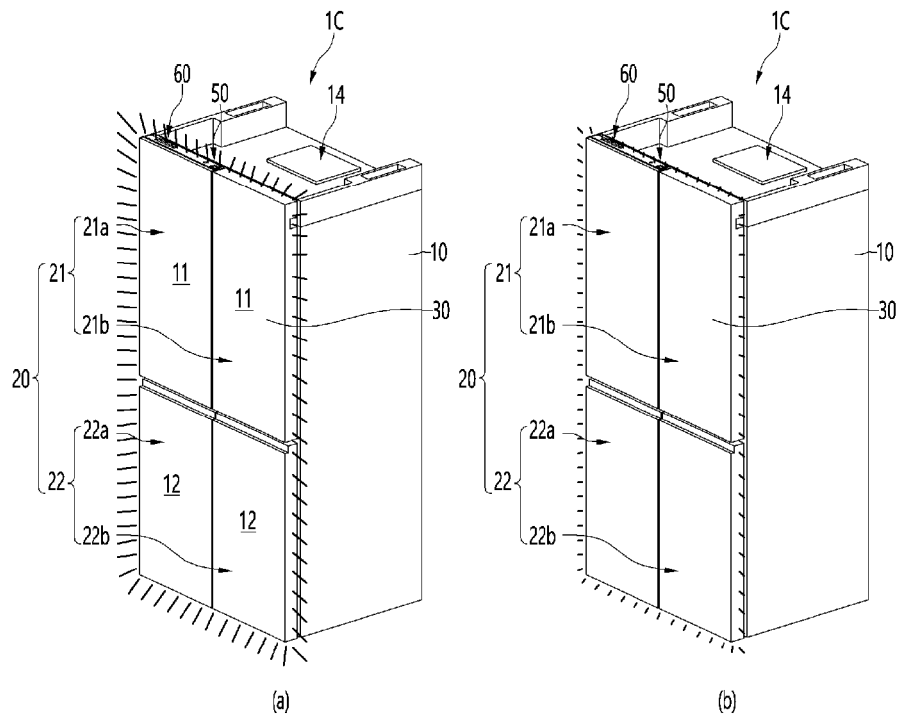


FIG. 36

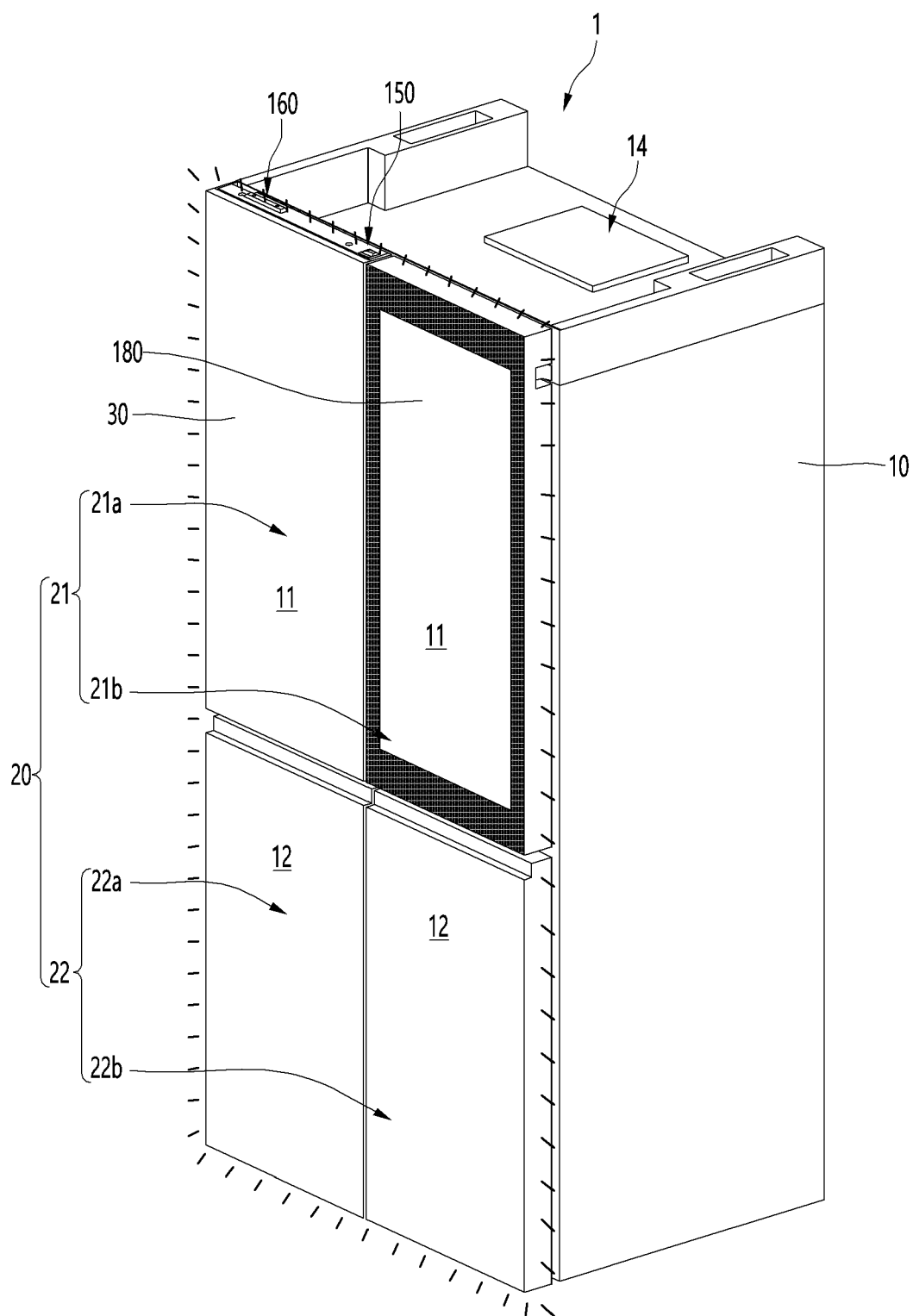




FIG. 37

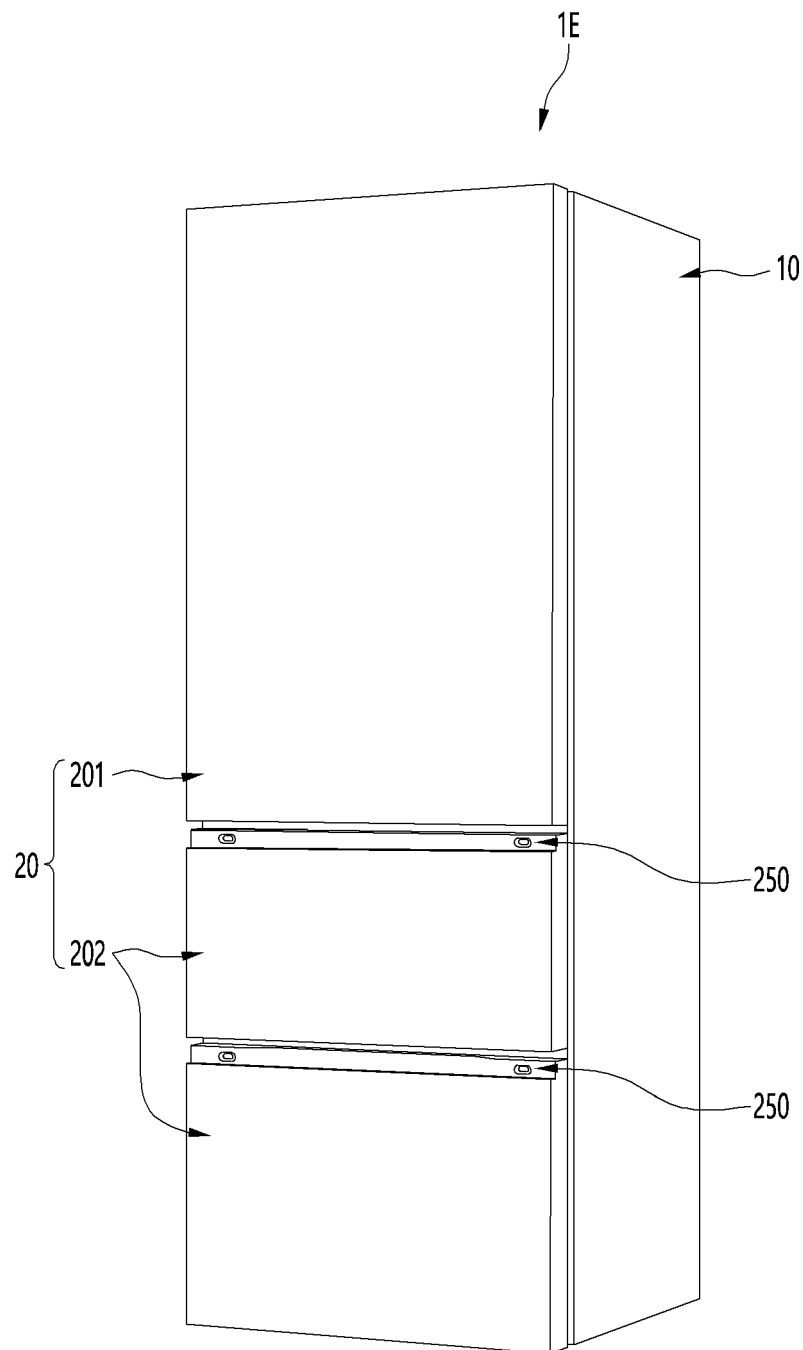


FIG. 38

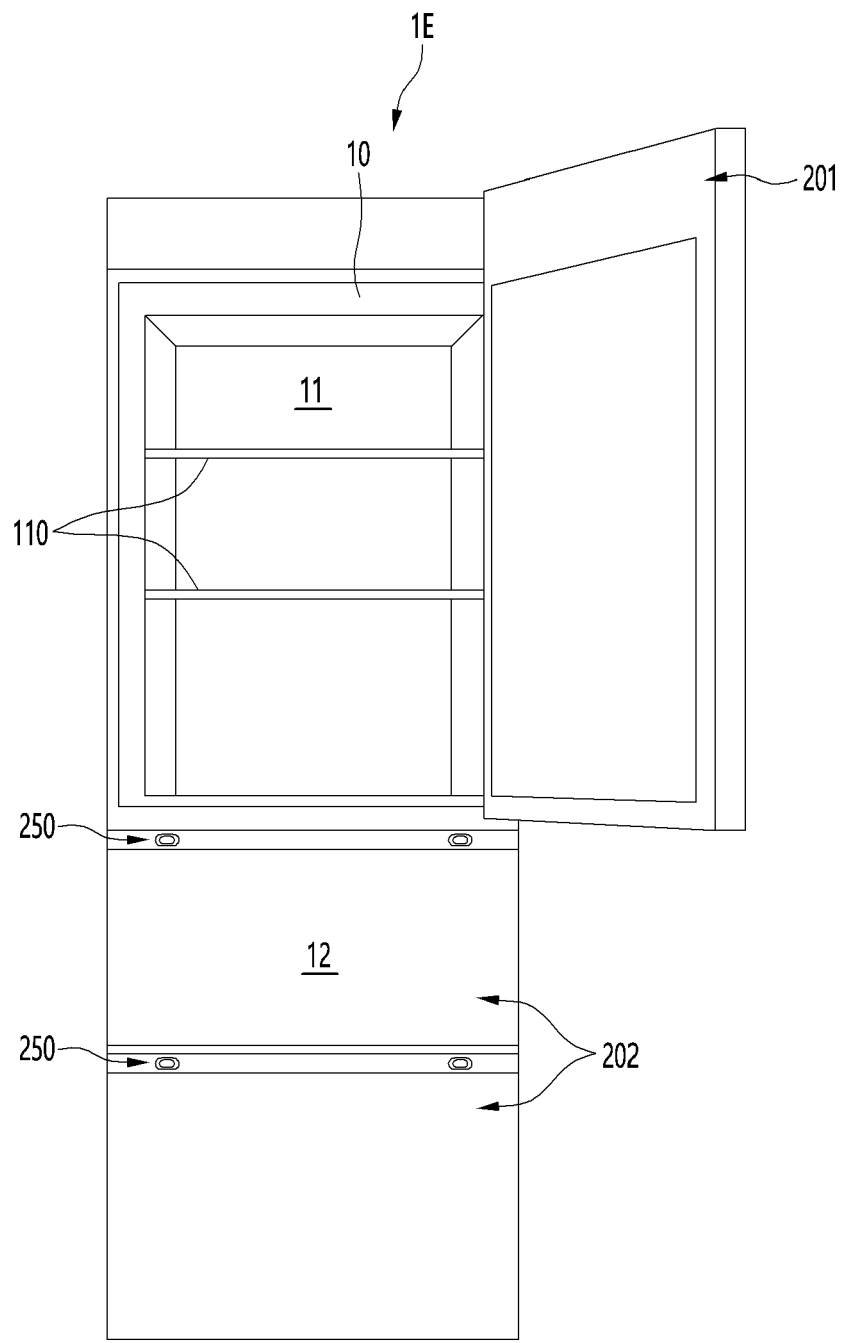


FIG. 39

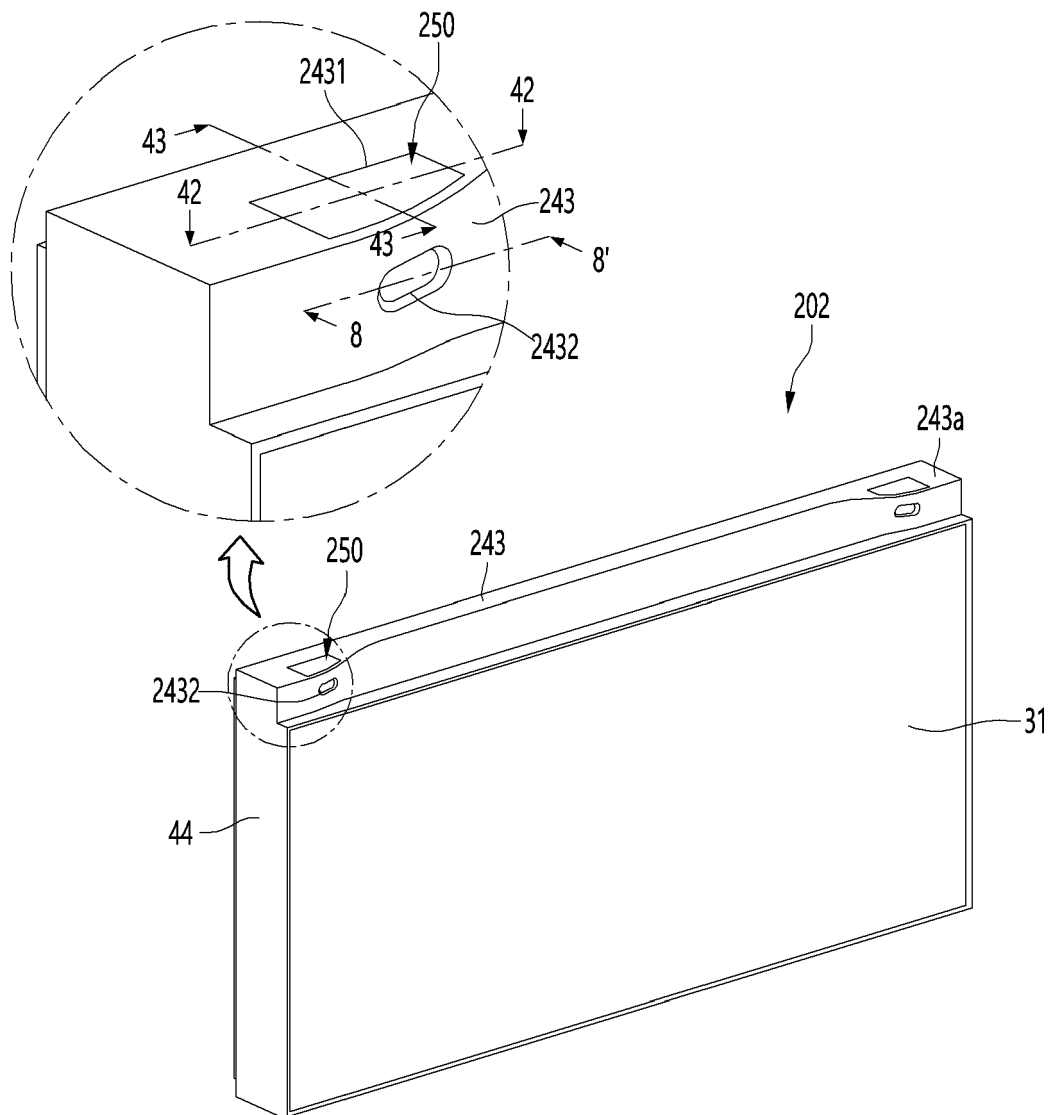


FIG. 40

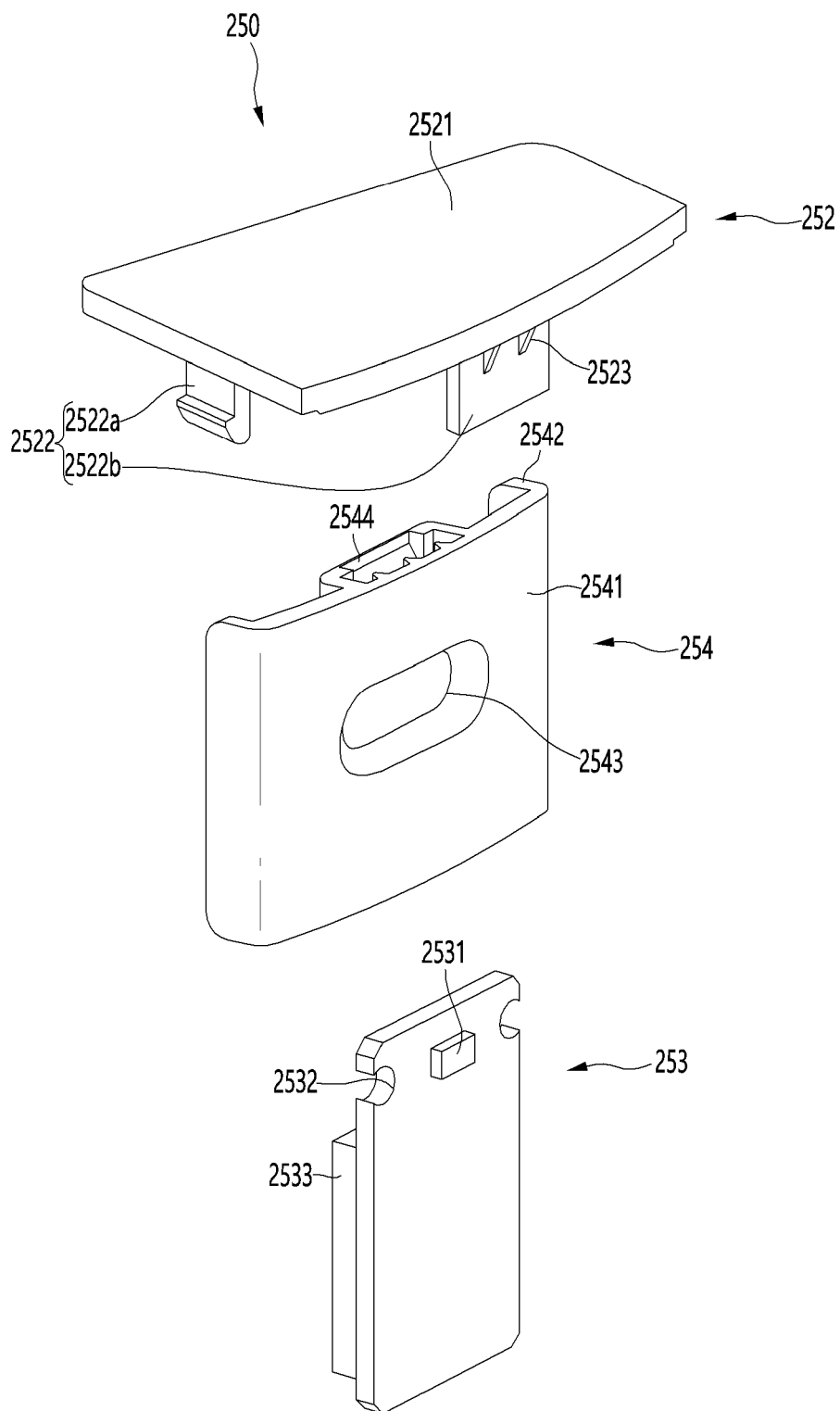


FIG. 41

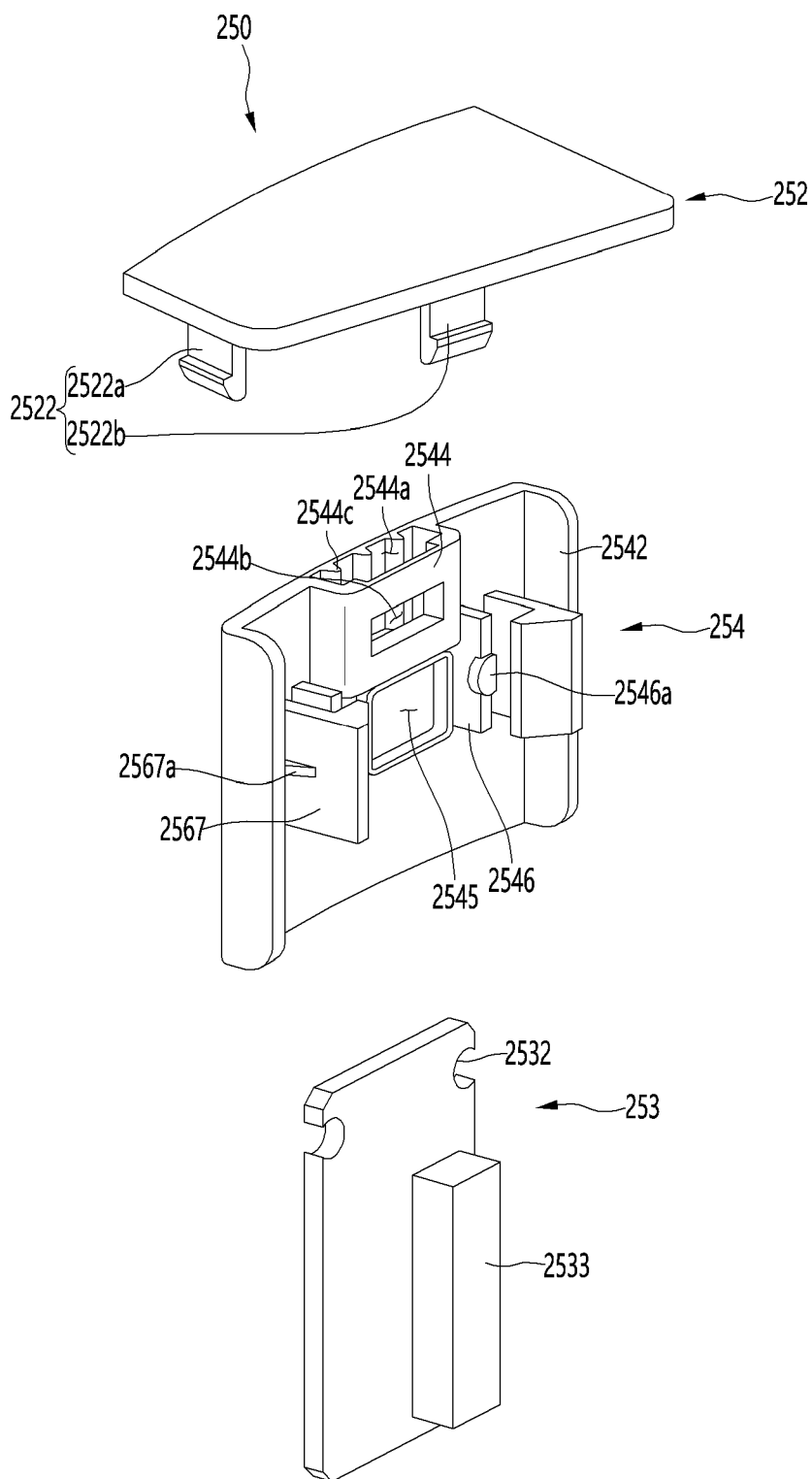


FIG. 42

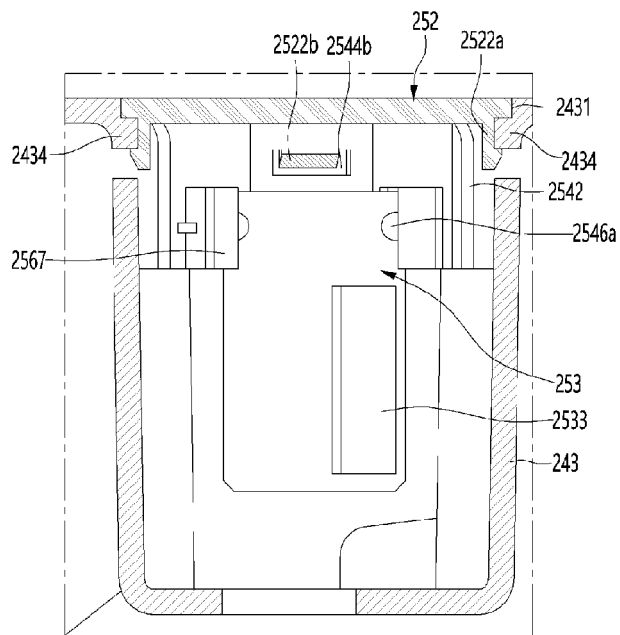


FIG. 43

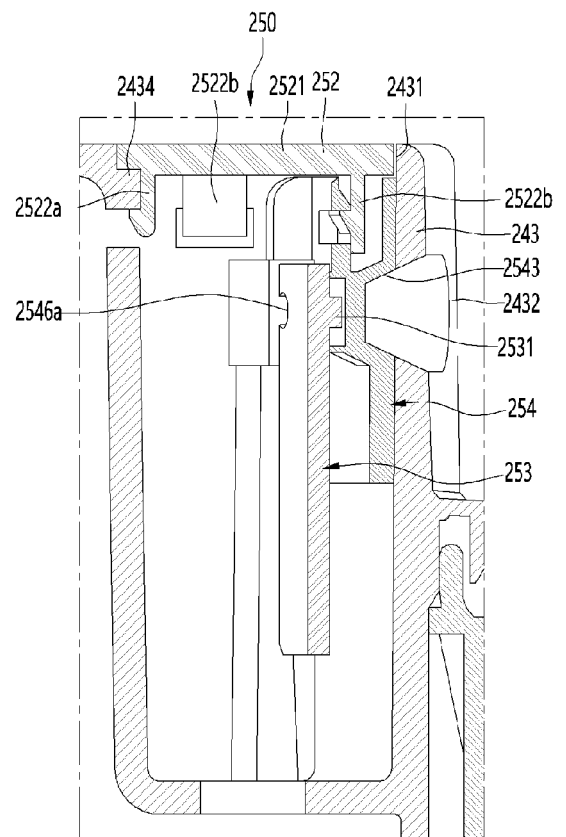


FIG. 44

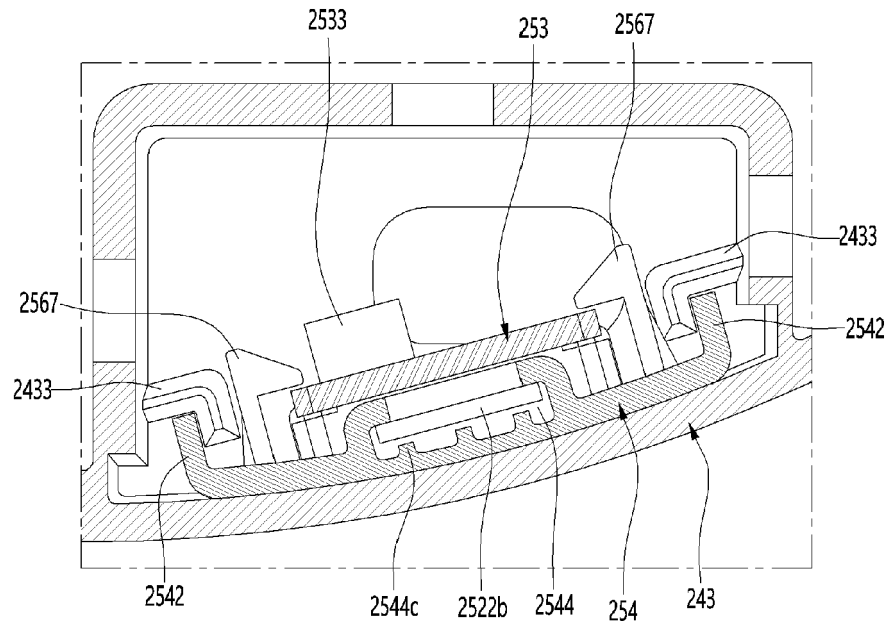


FIG. 45

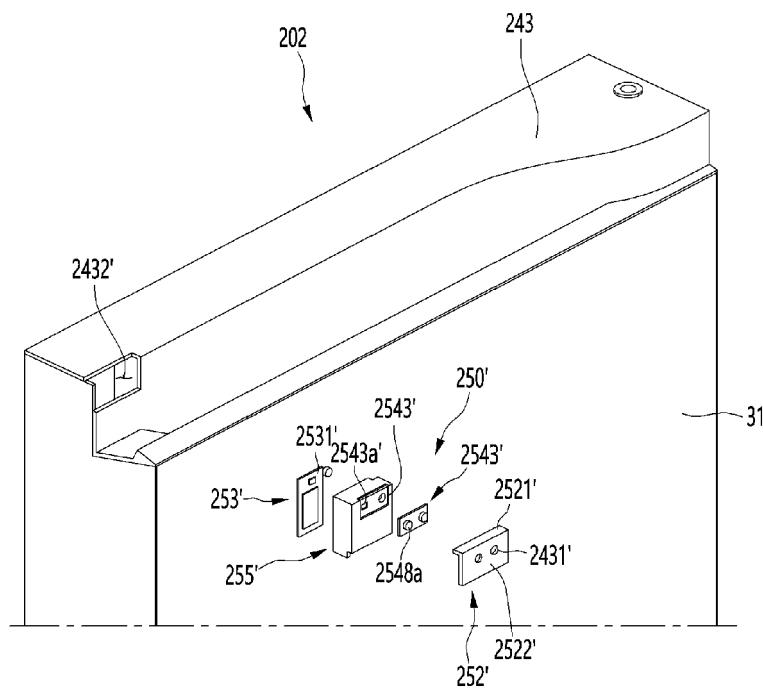


FIG. 46

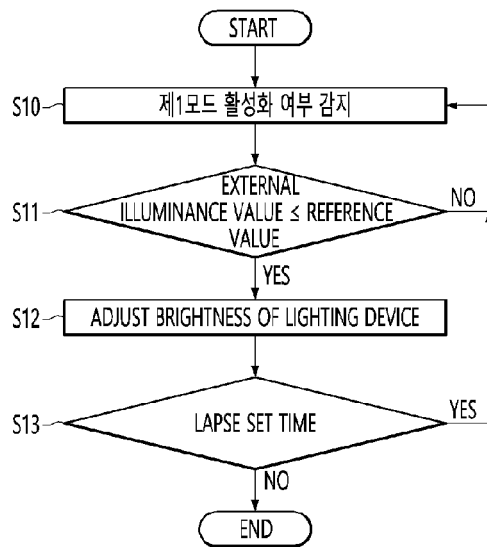


FIG. 47

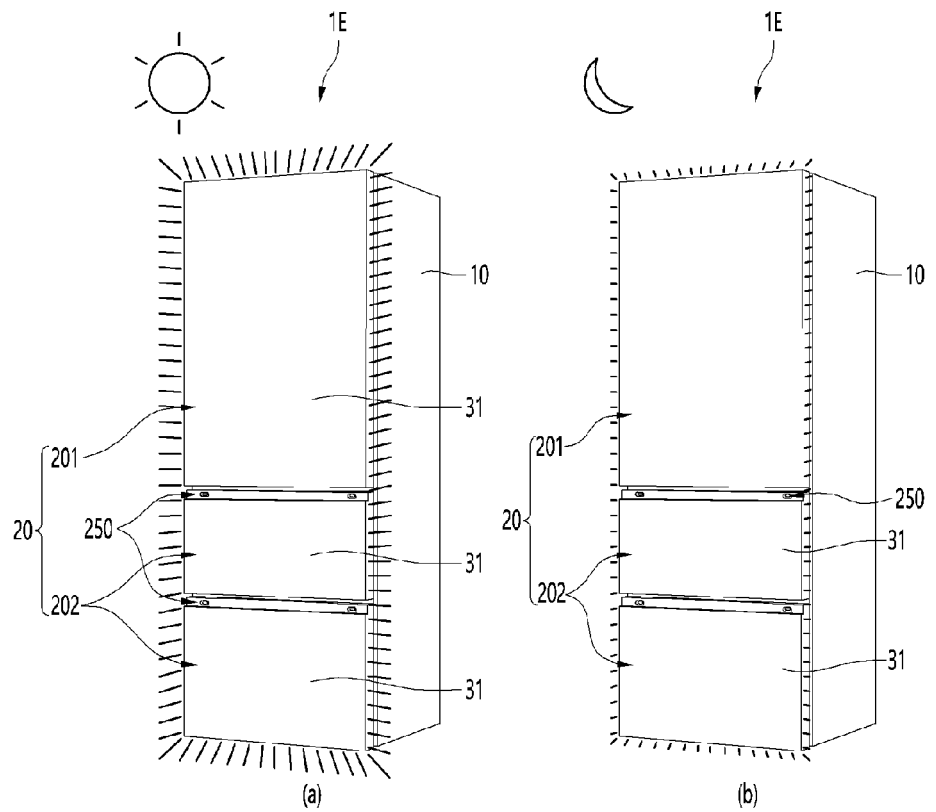




FIG.48

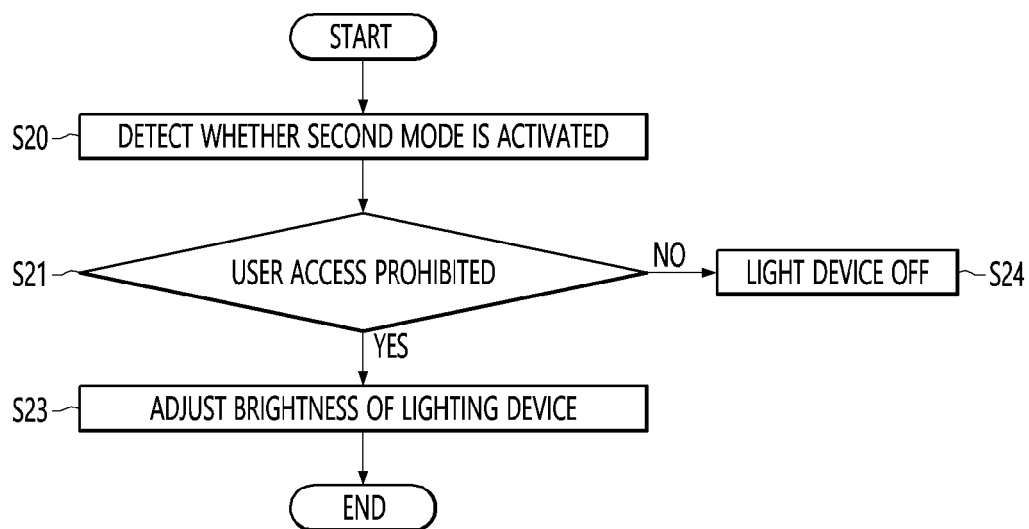


FIG. 49

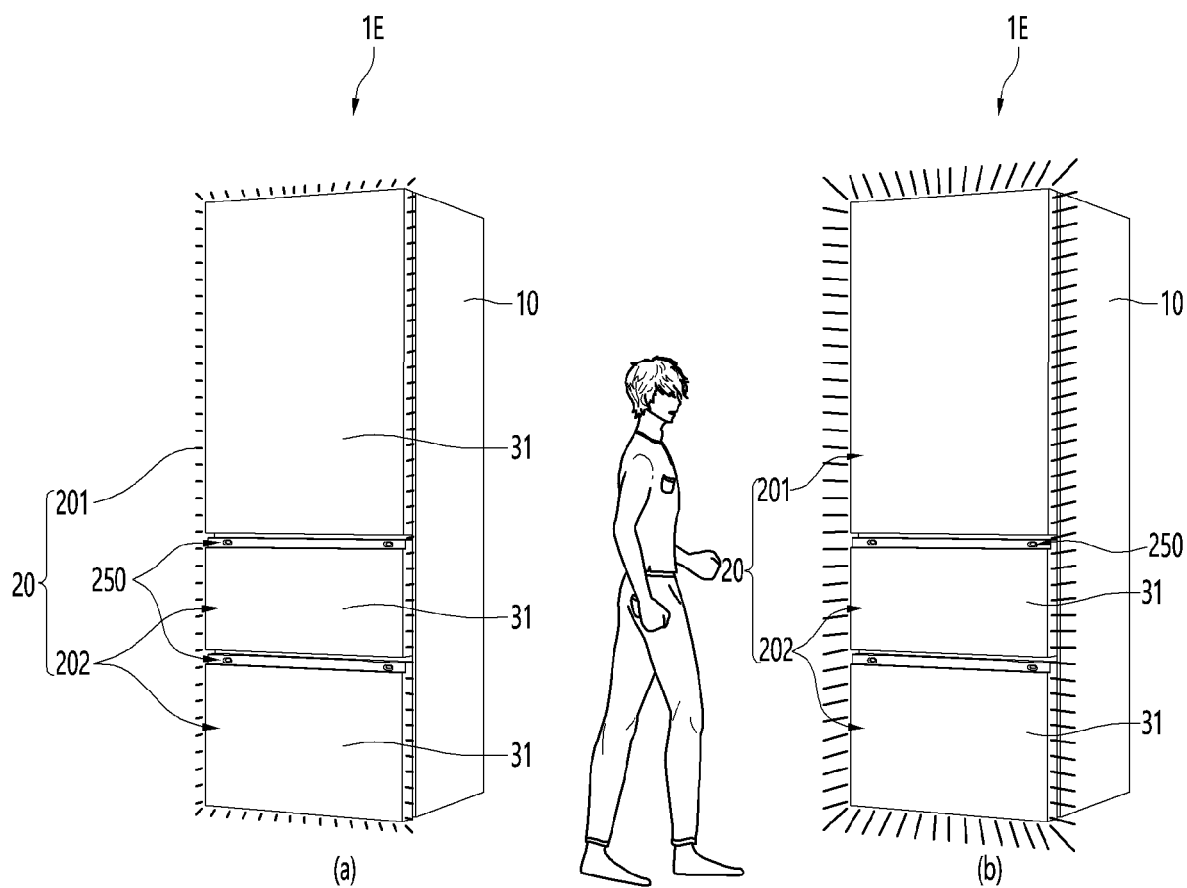
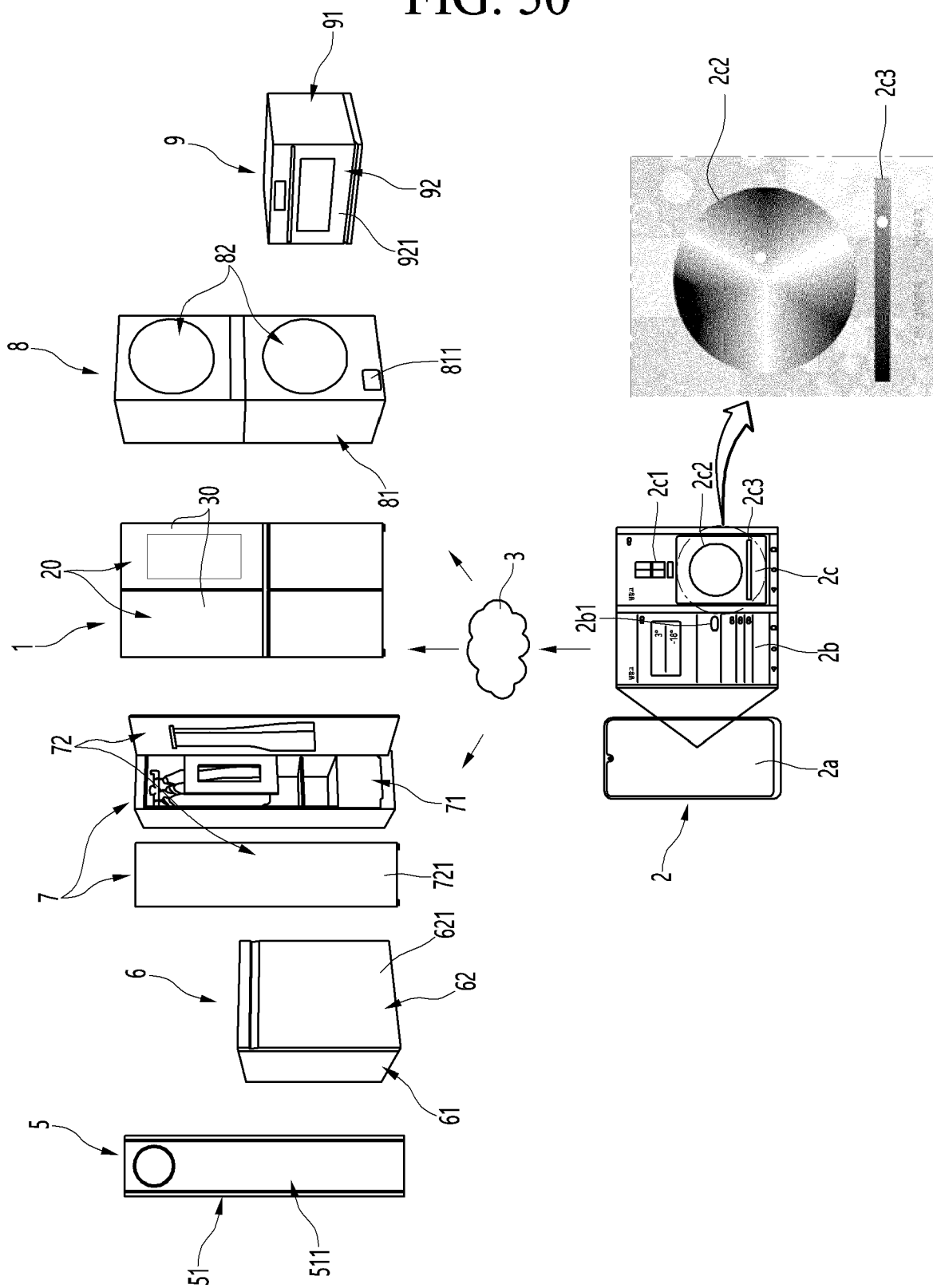


FIG. 50





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