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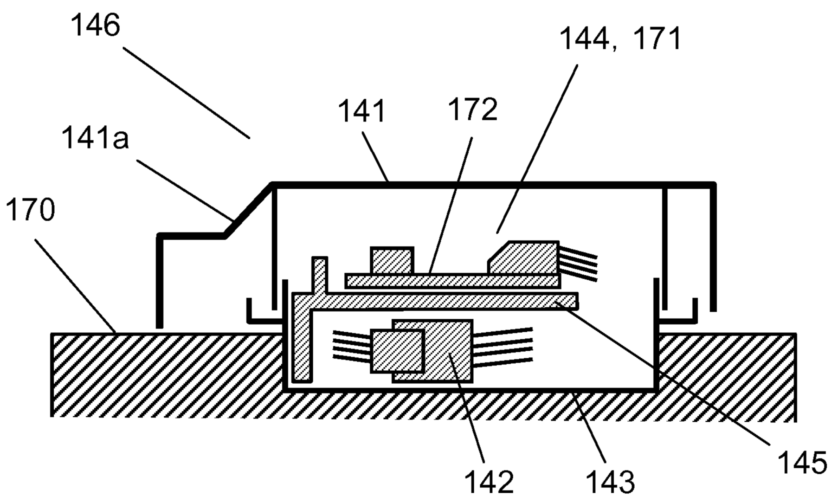
(54) REFRIGERATOR

(57) A refrigerator includes doors laterally disposed in an upper portion of the refrigerator, a rotary partition body disposed in any one of the doors and having a dew condensation prevention heater, temperature sensor (171), humidity sensor (144), and a control unit that controls power supply to the dew condensation prevention heater, based on an input from temperature sensor (171) and humidity sensor (144). Temperature sensor (171) and humidity sensor (144) are disposed so as to be covered by hinge cover (141) which covers a hinge of the other door.

FIG. 5



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Description

TECHNICAL FIELD

[0001] The present invention relates to a refrigerator in which a front surface opening of a storage chamber disposed in an upper portion of a main body is closed by right and left doors.

BACKGROUND ART

[0002] In order to satisfy various users' needs, a household refrigerator having large capacity has been commercialized so that refrigerator employs diversified cooling storage temperature and many doors for each storage chamber. The refrigerator has been commercialized so far in various forms such as a top freezer type in which a freezing chamber is disposed in an upper portion of a refrigerating chamber, a mid-freezer type in which a freezing chamber is disposed between an upper refrigerating chamber and a lower vegetable chamber, a bottom freezer type in which a freezing chamber is disposed in a bottom portion, a type in which a longitudinally elongated freezing chamber and a vegetable chamber are juxtaposed with each other below an upper refrigerating chamber, and a side-by-side type in which a freezing chamber and a refrigerating chamber are laterally juxtaposed with each other.

[0003] In recent years under this product environment, in view of useability, the refrigerator is configured so that a refrigerating chamber frequently used and having the largest storage capacity is closed using right and left doors and is disposed in a top stage. An ice making chamber and a temperature switching chamber are installed below the refrigerating chamber, and a vegetable chamber is installed below the ice making chamber and the temperature switching chamber. A freezing chamber is installed in the bottom portion. In recent years, this type has mainly been introduced.

[0004] In order to prevent external air from entering the refrigerating chamber through a portion between right and left doors, right and left hinged double doors of the above-described refrigerating chamber has a longitudinally elongated rotary partition body disposed on an open end side inner surface of one door. The rotary partition body is rotated to the other door side when one door is closed. The rotary partition body further has a suction surface which is suctioned to a gasket disposed on the door when the rotary partition body is rotated. A refrigerator has been widely used which prevents dew condensation by affixing a surface heater for preventing the dew condensation into a surface portion where the rotary partition body is in contact with the external air.

[0005] In recent years, sensors (temperature and humidity sensors) capable of detecting not only external air temperature but also external air humidity have been widely used. The refrigerator having the temperature and humidity sensor placed thereon detects temperature and humidity around the refrigerator so as to optimally control a cooling state of the refrigerator (for example, refer to PTL 1).

[0006] Hereinafter, referring to FIGS. 11 and 12, a refrigerator in the related art in which a hinge unit of a door includes a sensor will be described.

[0007] FIG. 11 is a front view of the refrigerator in the related art, and FIG. 12 is a view illustrating a configuration of the hinge unit of the refrigerator in the related art.

[0008] As illustrated in FIGS. 11 and 12, a top surface portion of refrigerator 1 has hinge unit 13 including hinge 11 for connecting and fixing the door to a fixed end side of right and left doors 2a and 2b in front of the top surface portion, and hinge cover 12 for covering hinge 11. In left door 2a, rotary partition body 23 disposed along an open end of door 2a and rotated in response to opening and closing of door 2a is disposed on an open end side to which door 2a is not fixed. Surface heater 24 is disposed inside rotary partition body 23 (refer to FIG. 11). As illustrated in FIG. 12, in hinge unit 13, external air temperature sensor 14 for detecting external air temperature and external air humidity sensor 15 for detecting external air humidity are arranged adjacent to each other. Hinge unit 13 is provided with a harness of surface heater 24 and a linking connector (both are not illustrated), all of which are accommodated inside hinge cover 12. Hinge cover 12 has a ventilation hole for obtaining external air ventilation, thereby improving detection accuracy of external air temperature sensor 14 and external air humidity sensor 15.

[0009] However, according to the above-described configuration in the related art, a configuration is adopted as follows. Electronic components of external air temperature sensor 14 and external air humidity sensor 15 to which a weak voltage of a direct current is supplied and the harnesses of surface heater 24 of rotary partition body 23 to which an alternating current of 100 V is supplied are arranged at the same location or adjacent to each other. In recent years, a solid state relay (SSR) is often used for heater control. In this case, the number of switching times increases when a heater energizing rate is controlled. Therefore, the electronic component using the weak voltage has a problem in that the electronic component is likely to be affected by the noise of the alternating current and a switching frequency.

Citation List

Patent Literature

[0010] PTL 1: Japanese Patent Unexamined Publication No. 2013-72595

SUMMARY OF THE INVENTION

[0011] The present invention is made in view of the above-described problems, and aims to provide a refrigerator in which an electronic component is not disposed in the vicinity of an electric path of an AC voltage, and whose quality is improved by preventing erroneous detection caused by malfunction of the electronic component, and system breakdown.

[0012] Specifically, according to an example of exemplary embodiments of the present invention, there is provided a refrigerator including a main body, a left side door and a right side door which are disposed in an upper portion of the main body, a rotary partition body disposed in any one door of the left side door and the right side door and having a dew condensation prevention heater, a temperature sensor disposed in the main body, a humidity sensor disposed in the main body, and a control unit that controls power supply to the dew condensation prevention heater, based on an input from the temperature sensor and the humidity sensor. The refrigerator further includes a hinge cover that covers a hinge of the other door of the left side door and the right side door. The temperature sensor and the humidity sensor are covered by the hinge cover.

[0013] According to this configuration, an electronic component is not disposed in the vicinity of an electric path of an AC voltage. Accordingly, the electronic component is less likely to be affected by noise generated by electromagnetic waves. Therefore, erroneous detection caused by malfunction of the electronic component and system breakdown can be prevented, and the quality of the refrigerator can be improved.

[0014] An AC (alternating current) cord and an AC connector which supply power to the dew condensation prevention heater, and a sensor component using a DC (direct current) low voltage are accommodated separate from each other. Accordingly, there is no possibility that the malfunction may occur due to the noise generated after the electronic component is affected by the electromagnetic waves of the AC voltage of 100 V. Therefore, it is possible to provide a high quality refrigerator. Furthermore, even in a case of designing, manufacturing and assembling the door, the process is simplified by separately providing the component and the cord with the alternating current and the direct current. Therefore, the cost can be reduced.

[0015] In the refrigerator according to an example of the exemplary embodiment of the present invention, a height of a top surface of the hinge cover may be configured so that portions of the top surface which are above the temperature sensor and the humidity sensor are higher than an other portion of the top surface.

[0016] According to this configuration, a large surrounding space can be obtained for the humidity sensor. Accordingly, the detection accuracy is improved, and even if the hinge unit is viewed from the periphery of the refrigerator, a step difference is less likely to be visible. Compared to a case where the hinge cover is entirely increased in height, the appearance can be further improved. The different height improves the rigidity of the hinge cover, thereby achieving the improved strength. Accordingly, the hinge cover alone is less likely to be deformed. There is no possibility that the humidity sensor and the hinge cover may come into contact with each other when the hinge cover is attached during the manufacturing process work.

The height of the hinge cover is configured to be equal to or lower than the height of the overall refrigerator, and the dimensions of the overall product are not changed.

[0017] In the refrigerator according to an example of the exemplary embodiment of the present invention, a configuration may be adopted as follows. The temperature sensor and the humidity sensor each have a detection element, and each board or a common board in which the detection element is located. A bracket for supporting the each board or the coomon board and a case covered by the hinge cover that covers the hinge of the other door are further provided. The bracket is disposed inside the case.

[0018] According to this configuration, it is possible to prevent the humidity sensor from having difficulties in detecting the humidity since the humidity sensor is affected by a deformed attachment fixing portion due to the pressure deformation during a urethane foaming process and the attachment position is misaligned due to uneven assembly work during the process of attaching the humidity sensor. The humidity sensor is more accurately attached. Accordingly, it is possible to provide the refrigerator which can very accurately detect the humidity.

[0019] In the refrigerator according to an example of the exemplary embodiment of the present invention, a first rib may be disposed in an outer periphery of the hinge cover. A second rib may be disposed inside the first rib.

[0020] According to this configuration, there is no possibility that the electronic board may be broken down and damaged or the electronic board is disconnected due to damage to harness coating since water or an insect enters the refrigerator when the water appearing in the environment of using the refrigerator is applied to the refrigerator. Furthermore, it is possible to prevent the influence of static electricity applied from the hinge or a metal portion of an outer shell. Accordingly, it is possible to provide the refrigerator which is very safe and satisfactory in quality.

[0021] In the refrigerator according to an example of the exemplary embodiment of the present invention, the case may be disposed in a recessed portion disposed in a top surface portion of the refrigerator. A connector for connecting the control unit to an operation unit disposed in at least one of the right and left side doors may be located inside the case. The bracket may be disposed above the connector.

[0022] According to this configuration, the temperature sensor and the humidity sensor can be compactly accommodated in a narrow space inside the hinge cover without changing external dimensions of the hinge cover. When the humidity sensor detects the humidity, it is possible to adopt a configuration in which the humidity sensor is less likely to be affected by cold energy from the inside of the refrigerator.

[0023] In the refrigerator according to an example of the exemplary embodiment of the present invention, the temperature sensor and the humidity sensor may be disposed above a top surface of the main body.

[0024] According to this configuration, the temperature sensor and humidity sensor, and the communication port which opens in the outer periphery of the hinge cover are arranged on substantially the same horizontal plane. Accordingly, the air around the temperature sensor and humidity sensor is less likely to be stagnant, and the humidity sensor can have the more improved response ability in detecting the humidity.

[0025] In the refrigerator according to an example of the exemplary embodiment of the present invention, a plurality of communication ports may be disposed the outer periphery of the hinge cover. The plurality of communication ports may be disposed in the vicinity of the humidity sensor.

[0026] According to this configuration, ventilation resistance can be reduced between the external air and a detection portion of the humidity sensor. Accordingly, it is possible to improve the detection accuracy and the response ability of the humidity sensor when the external air humidity is changed.

[0027] In the refrigerator according to an example of the exemplary embodiment of the present invention, the temperature sensor and the humidity sensor may be configured to serve as a sensor module in which a peripheral circuit is installed on the common board.

BRIEF DESCRIPTION OF DRAWINGS

[0028]

FIG. 1 is a front view illustrating a state where a door of a refrigerator is opened according to Exemplary Embodiment 1 of the present invention.

FIG. 2 is a sectional view when a refrigerator is laterally viewed according to Exemplary Embodiment 1 of the present invention.

FIG. 3 is a sectional view of a main portion of a rotary partition body of the refrigerator according to Exemplary Embodiment 1 of the present invention.

FIG. 4 is a perspective view when the refrigerator is viewed from a top surface according to Exemplary Embodiment 1 of the present invention.

FIG. 5 is a sectional view taken along line 5-5 in FIG. 4.

FIG. 6 is a view illustrating a procedure of attaching a humidity sensor of the refrigerator according to Exemplary Embodiment 1 of the present invention.

FIG. 7A is a perspective view when a hinge cover on the right side of the refrigerator is viewed from a front surface according to Exemplary Embodiment 1 of the present invention.

FIG. 7B is a perspective view when the hinge cover on the right side of the refrigerator is viewed from a rear surface according to Exemplary Embodiment 1 of the present invention.

FIG. 8 is a sectional view when a refrigerator is laterally viewed according to Exemplary Embodiment 2 of the present invention.

FIG. 9 is a sectional view obtained by enlarging a heat insulating partition of the refrigerator according to Exemplary Embodiment 2 of the present invention.

FIG. 10 is a sectional view when a refrigerator is laterally viewed according to Exemplary Embodiment 3 of the present invention.

FIG. 11 is a front view of a refrigerator in the related art.

FIG. 12 is a view illustrating a configuration of a hinge unit of the refrigerator in the related art.

DESCRIPTION OF EMBODIMENTS

[0029] Hereinafter, exemplary embodiments according to the present invention will be described with reference to the drawings. The invention is not limited by these exemplary embodiments.

(Exemplary Embodiment 1)

[0030] FIG. 1 is a front view illustrating a state where a door of a refrigerator is opened according to Exemplary Embodiment 1 of the present invention. FIG. 2 is a sectional view when the refrigerator is laterally viewed according to Exemplary Embodiment 1. FIG. 3 is a sectional view of a main portion of a rotary partition body of the refrigerator according to Exemplary Embodiment 1. FIG. 4 is a perspective view when the refrigerator is viewed from a top surface according to Exemplary Embodiment 1. FIG. 5 is a sectional view taken along line 5-5 in FIG. 4. FIG. 6 is a view illustrating a procedure of attaching a humidity sensor according to Exemplary Embodiment 1 of the present invention. FIG. 7A is a perspective view when a hinge cover is viewed from a front surface according to Exemplary Embodiment 1 of the present invention. FIG. 7B is a perspective view when the hinge cover is viewed from a rear surface.

[0031] In FIG. 1, refrigerator 101 has left side door 102 located on the left side when viewed from a front surface and right side door 103 located on the right side when viewed from the front surface. FIG. 1 illustrates a state where left side door 102 and right side door 103 are opened. Refrigerating chamber 105 is disposed behind left side door 102 and right side door 103. Ice making chamber 106 is disposed behind a lower portion of left side door 102. Freezing chamber 107 and vegetable chamber 108 are disposed sequentially from above in a lower portion of ice making chamber 106. Switching chamber 109 is disposed behind a lower portion of right side door 103 and in the vicinity of the right side of ice making chamber 106.

[0032] Left side door 102 and right side door 103 are respectively configured to be opened to the right side and left side while being supported by hinge unit 146 having hinge 140 (refer to FIG. 4). Rotary partition body 104 is disposed on a non-support side (open end side) of left side door 102. Rotary partition body 104 is rotated in a direction indicated by an arrow in FIG. 3 in response to opening and closing operations of left side door 102. In a state where left side door 102 is closed, rotary partition body 104 closes the non-support side of left side door 102 and right side door 103 via door gasket 125 (refer to FIG. 3). This prevents cool air from leaking out of refrigerating chamber 105.

[0033] In order to refrigerate and store foodstuffs, temperature of refrigerating chamber 105 is normally set to 1°C to 5°C under a condition that temperature which does not freeze the foodstuffs is set as the lower limit. In many cases, vegetable chamber 108 is set to 2°C to 7°C, which is equal to or slightly higher than the temperature of refrigerating chamber 105. If the temperature of vegetable chamber 108 is lowered, leaf vegetables can be maintained to be fresh for a long period of time. The temperature of freezing chamber 107 is normally set to -22°C to -18°C in order to freeze and store the foodstuffs. In some cases, in order to improve a frozen storage state, the temperature is set to the lower temperature, for example, such as -30°C to -25°C.

[0034] Refrigerating chamber 105 and vegetable chamber 108 are called refrigerating temperature regions since each interior is set to plus temperature. Freezing chamber 107 and ice making chamber 106 are called freezing temperature regions since each interior is set to minus temperature.

The interior of switching chamber 109 can be set between the refrigerating temperature and the freezing temperature.

[0035] As illustrated in FIG. 2, in top surface portion 170 of refrigerator 101, a recessed portion is disposed stepwise in a direction toward a rear surface of refrigerator 101, and machine chamber 119 is disposed in the recessed portion.

[0036] Compressor 117 is disposed in the stepwise recessed portion. Compressor 117, a dryer (not illustrated) for removing moisture, a condenser (not illustrated), a radiating pipe for radiating heat which includes front surface heat radiation pipe 114, capillary tube 118, and cooler 112 are annularly connected in this order, thereby forming a refrigeration cycle. This refrigeration cycle is hermetically filled with a refrigerant, thereby performing a cooling operation.

[0037] In machine chamber 119, a machine chamber fan (not illustrated) for radiating heat is located between the condenser and compressor 117. In the machine chamber fan, the temperature inside the machine chamber is lowered through the convection of the air inside machine chamber 119 so that external air is fetched into machine chamber 119. In this manner, heat radiation performance of the heat radiation pipe is improved.

[0038] In recent years, in order to protect the environment, a flammable refrigerant is often used as the refrigerant.

[0039] In a case where a three-way valve or a switching valve is used during the refrigeration cycle, a functional component thereof can be located inside machine chamber 119.

[0040] Refrigerating chamber 105, ice making chamber 106, and switching chamber 109 are partitioned by first heat insulation partition 121. Ice making chamber 106 and switching chamber 109 are partitioned by second heat insulation partition 122. Ice making chamber 106 and switching chamber 109, and freezing chamber 107 are partitioned by third heat insulation partition 123. Freezing chamber 107 and vegetable chamber 108 are partitioned by fourth heat insulation partition 124.

[0041] Second heat insulating partition 122 and third heat insulating partition 123 are components assembled to the refrigerator after a foaming process serving as one of manufacturing processes of refrigerator 101 is performed. Therefore, foamed polystyrene 120 is used as a heat insulator inside second heat insulation partition 122 and third heat insulation partition 123.

[0042] In the present exemplary embodiment, foamed polystyrene 120 is used as the heat insulator inside each insulating partition of first heat insulating partition 121, second heat insulating partition 122, third heat insulating partition

123, and fourth heat insulating partition 124.

[0043] As the heat insulator, foamed polystyrene 120 is usually and often used as in the present exemplary embodiment. However, hard urethane foam may be used in order to improve heat insulation performance and rigidity.

[0044] In order to further reduce the thickness of the partition structure, a vacuum heat insulator having high insulating capability may be inserted into the partition. In this case, the thickness of the partition structure can be reduced. Accordingly, an internal volume of refrigerator 101 can be increased.

[0045] While a movable portion of the door is secured, a cooling air passage is formed in a space obtained by reducing each shape of second heat insulating partition 122 and third heat insulating partition 123 or by removing each heat insulating partition. In this manner, cooling capacity can be improved. Each central portion of second heat insulating partition 122 and third heat insulating partition 123 is cut off so as to form an air passage. In this manner, it is possible to reduce the material.

[0046] U-shaped metal steel plates 151, 152, 153, and 154 are arranged on the outer side (front side) from first heat insulating partition 121 to fourth heat insulating partition 124. When the door is closed, the door gasket is suctioned to each steel plate. In this manner, cold air is prevented from leaking out of the refrigerator. Furthermore, inside steel plates 151, 152, 153, and 154, front surface heat radiation pipe 114 is located so as to be in close contact with respective steel plate 151, 152, 153, and 154. According to this configuration, dew condensation is prevented from occurring since the temperature of the steel plate is lowered by heat conduction due to cold air blowing from the inside of the low temperature storage chamber.

[0047] As illustrated in FIG. 2, cooling chamber 111 covered by cooling chamber cover 115 is disposed on a rear surface of refrigerator 101. Inside cooling chamber 111, as a representative example, cooler 112 for generating fin-and-tube type cool air is longitudinally located in an upward/downward direction, behind second heat insulating partition 122 and third heat insulating partition 123 which serve as heat insulating partition walls and on a rear surface of freezing chamber 107. As a material of cooler 112, aluminum or copper is used.

[0048] Cold air blower fan 113 for blowing air by using a force convention method of blowing cold air generated by cooler 112 to each storage chamber of refrigerating chamber 105, ice making chamber 106, switching chamber 109, freezing chamber 107, and vegetable chamber 108 is disposed in the vicinity (for example, the upper space) of cooler 112. As a defrosting device for defrosting frost adhering to cooler 112 or cold air blower fan 113 during cooling, radiant heater 136 made of a glass tube is disposed in a lower space of cooler 112.

[0049] A type of the defrosting device is not particularly specified. In addition to radiant heater 136, a pipe heater in close contact with cooler 112 may be used. Both the radiant heater 136 and the pipe heater may be used.
In this case, for example, supplying power to each heater of radiant heater 136 and the pipe heater is controlled so that each timing is shifted. In this manner, it is possible to efficiently raise the temperature of cooler 112. Accordingly, the defrosting time can be shortened, and thus, energy saving can be realized.

[0050] The fact that the defrosting time can be shortened means that the non-cooling time is shortened during the defrosting. Therefore, it is possible to suppress the rise in the temperature of the inside of the refrigerator and the food inside the refrigerator during the defrosting, and thus, it is possible to improve the fresh storage of the food.

[0051] Cooling chamber cover 115 includes a duct for blowing the cold air from cold air blower fan 113 into each storage chamber. The cold air of cooler 112 is directly blown to ice making chamber 106, switching chamber 109, and freezing chamber 107 through this duct.

[0052] Discharge ports for discharging the cold air to each of ice making chamber 106, switching chamber 109, and freezing chamber 107 are disposed on a front face of cooling chamber cover 115. A flow rate of each discharge port is distributed in accordance with a loading ratio of three chambers of ice making chamber 106, switching chamber 109, and freezing chamber 107. A damper serving as an opening/closing device is located on an upstream side of the air passage of the discharge port of switching chamber 109, and the air volume can be adjusted by the damper in accordance with the temperature inside the storage chamber. In this manner, the temperature inside the refrigerator can be adjusted to temperature in a range from the refrigerating temperature to the freezing temperature, which is set for switching chamber 109.

[0053] Cold air blower fan 113 may be directly attached to and located in inner box 110 of refrigerator 101. Cold air blower fan 113 is located in second heat insulating partition 122 assembled after the urethane foaming process, and is subjected to component block processing. In this manner, it is possible to reduce the manufacturing cost.

[0054] Heat radiation pipes mainly formed of a metal material such as copper or iron are located in refrigerator 101 for the purpose of heat radiation and surface dew condensation prevention. In the present exemplary embodiment, the heat radiation pipes are respectively located on a top surface, a rear surface, and a bottom surface around a side surface of the refrigerator 101. Furthermore, front surface heat radiation pipe 114 is also located on a front surface portion with which the door gasket of the door of the respective storage chambers 106, 107, 108, and 109 come into contact.

[0055] Next, rotary partition body 104 will be described with reference to FIG. 3.

[0056] As illustrated in FIG. 3, rotary partition body 104 is configured to include door gasket 125, partition plate 127 forming suction surface 126 of door gasket 125, heat insulator 128 made of foamed polystyrene located inside rotary partition body 104, partition frame body 129 made of a synthetic resin which covers a peripheral edge portion of partition plate 127 and an outer surface of heat insulator 128, and dew condensation prevention heater 130 serving as heating means located in the center of an inner surface of partition plate 127. Between heat insulator 128 and partition frame body 129, reinforcing plate 131 configured to include a material having a small coefficient of thermal expansion, for example, a metal plate, is disposed in the height direction of the refrigerator, that is, substantially in the entire region in the height direction of rotary partition body 104.

[0057] In the present exemplary embodiment, reinforcing plate 131 is located inside rotary partition body 104, and partition frame body 129 covering the peripheral edge portion of partition plate 127 and the outer surface of heat insulator 128 is formed of a resin. In this manner, heat transfer from outside is suppressed, and thus, energy saving is achieved. Reinforcing plate 131 may be located outside rotary partition body 104.

[0058] In a case where partition plate 127 is configured to include the metal member, partition plate 127 can have a function as a suction surface of door gasket 125. In this manner, the configuration of rotary partition body 104 can be simplified, and thus, the cost can be reduced.

[0059] As illustrated in FIG. 3, dew condensation prevention heater 130 is used as heating means inside rotary partition body 104. Dew condensation prevention heater 130 is attached to substantially the entire region in the height direction of partition plate 127. The power is supplied so as to generate heat. In this manner, dew condensation is prevented from occurring on the surface of rotary partition body 104 and door gasket 125 closely attached thereto. The surface of rotary partition body 104 tends to have a temperature distribution particularly spreading in the upward/downward direction due to the internal temperature distribution of refrigerating chamber 105 or convection of the discharge cold air.

[0060] In the present exemplary embodiment, a unit heat value (W/m) of dew condensation prevention heater 130 is changed in accordance with the above-described temperature distribution. In this manner, the surface temperature of partition plate 127 of rotary partition body 104 is uniform. Accordingly, the power consumption can be reduced. A dew condensation prevention heater may be used which is configured to include a heater wire having a constant unit heat value (W/m). In this case, the manufacturing process and the management process of the heater can be simplified. Accordingly, the cost is reduced.

[0061] Next, a configuration of hinge unit 146 to which humidity sensor 144 is attached will be described.

[0062] As illustrated in FIGS. 2 and 4, metallic hinge 140 for fixing right side door 103 of refrigerating chamber 105 to a main body of refrigerator 101 is disposed on the right side when viewed from the front surface of top surface portion 170 of refrigerator 101. Hinge 140 is covered by hinge cover 141 formed of a resin. Humidity sensor 144 is located inside hinge cover 141 (refer to FIG. 5). That is, humidity sensor 144 is covered by hinge cover 141.

[0063] Hinge unit 146 includes hinge 140, hinge cover 141 which covers the hinge, connector 142, and base hinge 143 serving as a case which accommodates connector 142 and which is covered by hinge cover 141. Connector 142 connects control board 137 (refer to FIG. 4) serving as a control unit located behind top surface portion 170 of refrigerator 101 and an operation board of an operation unit located on right side door 103 of refrigerator 101 to each other. The operation unit is disposed on at least one of left side door 102 and right side door 103. Base hinge 143 is disposed in a recessed portion disposed in front of top surface portion 170 of refrigerator 101 (refer to FIGS. 4 and 5).

[0064] As illustrated in FIGS. 4, 5, 7A, and 7B, hinge cover 141 largely occupies an internal space of hinge cover 141 at a portion where humidity sensor 144 is installed. Accordingly, on the top surface of hinge cover 141, the height of the portion corresponding to the upper side of humidity sensor 144 is made higher than that of other portions. On the other hand, as illustrated in FIG. 4, in a case of the portion covering hinge 140 of right side door 103, the height of the top surface of hinge cover 141 is made lower than that of the portion corresponding to the upper side of humidity sensor 144. Therefore, hinge cover 141 has at least two portions having mutually different heights.

[0065] As illustrated in FIGS. 4, 5 and 7A, hinge cover 141 is configured to have inclined surface 141a inclined toward the front surface side and right surface side of refrigerator 101. Accordingly, even if hinge unit 146 is visually observed from the periphery of refrigerator 101, a step difference thereof is less likely to be visible. Therefore, compared to a case where hinge cover 141 is entirely increased in height, the appearance can be further improved.

[0066] As illustrated in FIG. 2, hinge cover 141 is configured so that the height of the top surface of hinge cover 141 is equal to or lower than the height of the highest portion of top surface portion 170 of refrigerator 101. Accordingly, the outer dimensions of the overall product are not changed, compared to products developed so far.

[0067] A portion where humidity sensor 144 is installed has a large internal space of hinge cover 141. Accordingly, the air around humidity sensor 144 is less likely to be stagnant. Therefore, it is easy to detect the humidity, thereby leading to improved detection accuracy. Furthermore, hinge cover 141 is configured so that the height of the top surface of hinge cover 141 varies depending on portions. Accordingly, the rigidity is further improved, compared to a case where hinge cover 141 is configured to entirely have the same height. Therefore, the strength of hinge cover 141 is improved. In this manner, hinge cover 141 alone is less likely to be deformed. Accordingly, hinge cover 141 can be prevented from being deformed and coming into contact with humidity sensor 144 while the attachment work of hinge cover 141 is carried out during the manufacturing process.

[0068] As described above, humidity sensor 144 is accommodated in hinge cover 141 disposed on the right side when viewed from the front surface of top surface portion 170 of refrigerator 101. On the other hand, an AC cord and an AC connector for supplying power to dew condensation prevention heater 130 (refer to FIG. 3) are accommodated in the hinge cover on left side door 102 side of refrigerating chamber 105 in which rotary partition body 104 is disposed. In this way, humidity sensor 144 is separated from the AC cord and the AC connector which supply the power to dew condensation prevention heater 130, and is accommodated for low voltage use on the right side of the refrigerator. In this manner, there is no possibility that noise may be generated by the influence of electromagnetic waves of the AC voltage of 100 V, and that humidity sensor 144 may erroneously detect the humidity. Accordingly, it is possible to provide a high quality refrigerator.

[0069] In a case where the AC voltage and the DC voltage or the respective harnesses of the high voltage and the low voltage need to be unavoidably installed close to hinge 140 side or close the same door side due to the product specification or the assembly method, it is necessary to take sufficient noise countermeasures. In this case, for example, in addition to arranging the harnesses so as not to intersect or not to come into contact with each other inside hinge cover 141, it is necessary to arrange the harnesses apart from each other as far as 100 mm or farther.

[0070] Next, an attachment configuration of humidity sensor 144 will be described with reference to FIG. 6. As illustrated in FIG. 6, humidity sensor 144 according to the present exemplary embodiment is configured to serve as a sensor module obtained by installing a detection element together with a peripheral circuit on small board (module board) 172.

[0071] Humidity sensor 144 is installed inside hinge cover 141. Accordingly, it is necessary to consider a procedure at the time of assembly and the interference with other components inside hinge cover 141. In the present exemplary embodiment, as illustrated in FIG. 6, board 172 having humidity sensor 144 installed thereon is first fixed to bracket 145 of a sensor receiver. Next, board 172 together with the bracket 145 is located in and fixed to base hinge 143 serving as the case. That is, board 172 having humidity sensor 144 installed thereon is indirectly fixed to base hinge 143 while being supported by bracket 145 made of a member different from that of base hinge 143 which supports connector 142.

[0072] As illustrated in FIG. 6, board 172 having humidity sensor 144 installed thereon has round opening 172 a in a portion having no electronic component installed thereon. Projection 145a whose dimension is the same as or smaller than that of opening 172a projects from bracket 145. When humidity sensor 144 is attached to bracket 145, opening 172a is fitted to projection 145a. In this manner, board 172 of humidity sensor 144 and bracket 145 are fixed to each other not only by a claw disposed in bracket 145 but also by opening 172a and projection 145a. Both of these are fixed in a multiple stage.

[0073] As described above, humidity sensor 144 is formed on small board (module board) 172. During a production process, a plurality of boards are produced and divided at a time. Therefore, when the boards are divided, a trace of joints remains slightly on an end surface of the board in some cases. Accordingly, a claw for supporting humidity sensor 144 on bracket 145 is disposed by avoiding the joint of the board and the installed portion of the board itself. Humidity sensor 144 and bracket 145 are fixed by the claw. This prevents humidity sensor 144 from malfunctioning after being damaged by bracket 145 during the attachment process of humidity sensor 144.

[0074] Bracket 145 is formed in a shape conforming to an internal shape of base hinge 143, and is configured to be attached by a claw disposed in base hinge 143. In this manner, a position of humidity sensor 144 is fixed. In this manner, it is possible to prevent a possibility that humidity sensor 144 may have difficulties in detecting the humidity due to the misaligned position of humidity sensor 144 which is caused by uneven attachment or uneven assembly, or a possibility that humidity sensor 144 may detect the misaligned value.

[0075] Bracket 145 of humidity sensor 144 is disposed above connector 142. In this manner, a small space inside hinge cover 141 is utilized. Without changing the outer dimensions of hinge cover 141, humidity sensor 144 can be compactly located therein. A detector of humidity sensor 144 is disposed in an intermediate portion in the height direction in the internal space of hinge cover 141. Therefore, the air around humidity sensor 144 is less stagnant, and humidity sensor 144 is less likely to be affected by cold energy from the inside of refrigerator 101. Accordingly, the detection accuracy is improved.

[0076] As described above, humidity sensor 144 and bracket 145 are disposed three-dimensionally and compactly on connector 142. Accordingly, it is no longer necessary to change the outer dimensions of hinge cover 141, compared to a configuration of the hinge cover in the related art. Therefore, it is not necessary to change a size of a mold required for the manufacturing process of hinge cover 141. Accordingly, a molding machine the same as those in the related art can be used, and the molding cost does not greatly fluctuate. The molding cost can be considerably reduced since hinge cover 141 is produced by remodeling the existing mold.

[0077] In the present exemplary embodiment, from a viewpoint of the refrigerator manufacturing process, base hinge 143 and connector 142 are located before the urethane foaming process is performed, thereby reducing the production man-hour for assembling refrigerator 101. On the other hand, as in the present exemplary embodiment, humidity sensor 144 is attached to bracket 145, and is accommodated in base hinge 143 after the urethane foaming process is performed. In this manner, even in a case where the ambient temperature is high (in summer, approximately 60°C) due to the foaming heat during the urethane foaming process, humidity sensor 144 can be attached without being affected by the heat.

[0078] It is possible to prevent devices from being affected by a component deformed due to the high pressure when the urethane is foamed. In particular, base hinge 143 is formed of a resin from the viewpoint of coping with static electricity. Accordingly, a bottom surface tends to be a protruding surface after being affected by the foaming pressure when the urethane is foamed. Therefore, if humidity sensor 144 is configured to be directly attached to base hinge 143 without providing bracket 145, in a case where base hinge 143 is deformed by receiving the pressure when the urethane is foamed, the portion having humidity sensor 144 attached thereto on is not stable in flatness. Therefore, this causes uneven attachment accuracy of humidity sensor 144 depending on the season or the time.

[0079] In particular, the urethane amount in the main body of refrigerator 101 depends on the amount of vacuum heat insulators, pipes, or wiring components which are located inside refrigerator 101. However, since the filling amount is approximately 5 kg, the foaming pressure is high when the urethane is foamed. Therefore, in order to prevent deformation of respective members of refrigerator 101, these members are pressed using a jig during the urethane foaming process. However, deformation of the outer wall of refrigerator 101 or a portion having a large flat portion such as inner box 110 can be easily suppressed using the jig. However, since hinge unit 146 including base hinge 143 is a small component, hinge unit 146 is less likely to be pressed by the jig. Therefore, hinge unit 146 is likely to be deformed during the urethane foaming process.

[0080] Refrigerator 101 has a height of approximately 2 m, and internally has a hollow portion. Therefore, a portion filled with the urethane (heat insulator) is roughly an outer wall portion of refrigerator 101. During the urethane foaming process, the urethane needs to be foamed without causing cavities or cracks in the urethane which affect the cooling performance of the main body of refrigerator 101. Therefore, in view of the fluidity of the urethane, the filling amount of the urethane is slightly increased in some cases. In this case, the foaming pressure further increases. Therefore, depending on the production environment at the time of production, the members are likely to be deformed in some cases.

[0081] In contrast, in the present exemplary embodiment, humidity sensor 144 is attached to bracket 145, and is accommodated inside base hinge 143 after the urethane foaming processes performed. Accordingly, humidity sensor 144 can be disposed without being affected by the pressure deformation during the urethane foaming process. Therefore, the attachment accuracy of humidity sensor 144 can be improved, and the uneven attachment can be reduced. Accordingly, high detection accuracy can be obtained.

[0082] Humidity sensor 144 and temperature sensor 171 (to be described later) are disposed above a reference surface (flat surface at the upper portion of the outer box) of top surface portion 170 of refrigerator 101. Humidity sensor 144 is configured to have a horizontal plane substantially the same as that of the communication port which opens in the outer periphery of hinge cover 141. In this manner, the air around humidity sensor 144 is less likely to be stagnant, thereby generating air convection. Accordingly, the detection accuracy is improved.

[0083] As illustrated in FIG. 7B, hinge cover 141 has a plurality of communication ports 150 configured by partially cutting out outer peripheral rib (first rib) 147. In this manner, the external air around top surface portion 170 of the main body of refrigerator 101 is likely to be fetched into hinge cover 141, thereby improving the detection accuracy. Communication port 150 is disposed in the vicinity of humidity sensor 144 located inside hinge cover 141. Furthermore, in the present exemplary embodiment, in order to improve the detection accuracy, humidity sensor 144 is disposed on a route connecting the respective communication ports 150 to each other.

[0084] Furthermore, second rib 148 is disposed inside communication port 150 configured by cutting out first rib 147. Even if water is applied to a portion of hinge cover 141 depending on the environment of using refrigerator 101, the second rib 148 is provided. Accordingly, it is possible to prevent the water from entering humidity sensor 144 which is a electronic component and a connection portion of humidity sensor 144.

[0085] In second rib 148, a plurality of slits 149 for communicating with the inside of hinge cover 141 are disposed above the height substantially the same as the height at which humidity sensor 144 is disposed.

[0086] A slit is also disposed in the horizontal direction between second rib 148 and the inside of hinge cover 141. In this manner, the ventilation resistance is relaxed between the inside of hinge cover 141 having humidity sensor 144 disposed therein and the outside of the hinge cover 141, thereby achieving satisfactory detection accuracy and response ability.

[0087] For example, the dimension of the slit 149 is set so that the width is 0.5 mm or narrower. In this manner, it is possible to prevent invasion of insects. Accordingly, it is possible to prevent disconnection from occurring due to the electronic component damaged by the insects or the damaged harness covering.

[0088] Particularly in foreign countries, depending on the installation environment, small insects such as ants may invade the refrigerator. Accordingly, slit 149 of refrigerator 101 according to the present exemplary embodiment is set to have dimensions (width 0.5 mm or smaller) through which even small insects cannot enter.

[0089] Since second rib 148 is located, humidity sensor 144 is prevented from being affected by the static electricity. In particular, the static electricity is likely to occur during drying days in winter time. Humidity sensor 144 serving as an electronic component malfunctions or fails due to the influence of the static electricity in some cases. Second rib 148 is located as in the present exemplary embodiment. In this manner, a creepage distance can be secured from top surface portion 170 on the outer wall of refrigerator 101 or a metal portion of hinge 140 to which the static electricity is easily applied, to humidity sensor 144. Accordingly, it is possible to prevent malfunction and system breakdown of humidity sensor 144 which are caused by the static electricity.

[0090] Next, humidity sensor 144 used in refrigerator 101 according to the present exemplary embodiment will be described.

[0091] Various types are used as humidity sensor 144. For example, an assman psychrometer based on the thermodynamic principle, and an electronic sensor such as a resistance type or a capacity type in which electric characteristics are changed by adsorbing and desorbing moisture. The present exemplary embodiment employs a capacitive-type humidity sensor whose capacitance is changed in response to the moisture amount by a humidity sensitive film adsorbing the moisture. In a detection range of capacitive-type humidity sensor 144, a ratio between the detected humidity (relative humidity) in the vicinity of humidity sensor 144 which is detected by humidity sensor 144 and the relative humidity of the external air (around refrigerator 101) has a linear (constant) characteristic. Therefore, the detection result of humidity sensor 144 is used so as to accurately detect the relative humidity of the external air. In a case where humidity sensor 144 itself is exposed to water or is wet due to dew condensation, or in a case where the temperature is equal to or lower than the dew point temperature, it can be determined that the detected humidity is 100%.

[0092] Instead of using the capacitive-type humidity sensor, it is also possible to use a resistive-type humidity sensor which is an electronic type. In this case, there is an advantage that the production of the sensor is facilitated compared to the capacitive-type humidity sensor. Therefore, in a case of using the resistance-type humidity sensor, it is possible to reduce the cost of the humidity sensor itself, thereby leading to product cost reduction.

[0093] In the sensor module on which humidity sensor 144 according to the present exemplary embodiment is mounted, temperature sensor (thermistor) 171 for detecting the temperature is also mounted on board (module board) 172. The thermistor may erroneously detect the temperature in a case where the ambient temperature excessively fluctuates. Therefore, it is desirable that temperature sensor 171 is disposed apart from a portion where the temperature thermally fluctuates due to a structure of refrigerator 101 to such an extent that temperature sensor 171 is not affected by the temperature. In refrigerator 101 according to the present exemplary embodiment, the pipes mainly formed of a metal material such as copper or iron are located for the purpose of heat radiation and surface dew condensation prevention. Accordingly, temperature sensor 171 is disposed at a distance of 80 mm or farther from the pipes.

[0094] In the present exemplary embodiment, the heat from the pipes is also transferred to the steel plate covering the outer wall of refrigerator 101 so that the temperature of the outer wall surface is equal to or higher than the dew point temperature of the external air. In this manner, dew condensation is prevented from occurring. Therefore, in order to prevent temperature sensor 171 from being affected by the heat transferred from the steel plate, temperature sensor 171 is disposed at a distance of 15 mm or farther from the steel plate. Furthermore, temperature sensor 171 is disposed apart from the pipe. Accordingly, even if the static electricity is generated in the pipe portion, the static electricity is less likely to be applied to the element and the connection portion of the electronic component.

[0095] An operation and operation effect of refrigerator 101 configured as described above will be described below.

[0096] If the temperature inside refrigerator 101 rises due to heat invasion from the outside or opening and closing of the door, and if a refrigerating chamber sensor (not illustrated) detects that the temperature is equal to or higher than the temperature for actuating compressor 117, compressor 117 is activated so as to start cooling inside the refrigerator. While the high temperature and high pressure refrigerant discharged from compressor 117 finally reaches a dryer (not illustrated) disposed in machine chamber 119, particularly in a condenser (not illustrated) and a heat radiation pipe (not illustrated) installed in the outer box, the refrigerant is cooled and liquefied through heat exchange with the air outside the outer box and the urethane heat insulator inside the refrigerator.

[0097] The liquefied refrigerant is decompressed by capillary tube 118, flows into cooler 112, and is subjected to the heat exchange with the internal air around cooler 112 inside the refrigerator. The heat exchanged cold air is blown into the refrigerator by cold air blower fan 113 in the vicinity thereof, and cools the inside of the refrigerator. Thereafter, the refrigerant is heated, gasified, and returns to compressor 117. In a case where the inside of the refrigerator is cooled and the temperature detected by a freezing chamber sensor (not illustrated) is equal to or lower than the stopping temperature, the operation of compressor 117 is stopped.

[0098] In the present exemplary embodiment, the cold air whose heat exchange is completed by cooler 112 is stirred by cold air blower fan 113 located in the vicinity, and is blown into the refrigerator. However, cold air blower fan 113 may not be required. A small refrigerator of 150 L or less which is sold in Japan or a direct cooling refrigerator mainly sold in an overseas area with low external air humidity may not have cold air blower fan 113 mounted thereon in some cases. Some refrigerators do not have not only a fan inside the refrigerator, but also a fan (machine chamber fan) outside the refrigerator.

[0099] In the present exemplary embodiment, compressor 117, the condenser (not illustrated), and the machine chamber fan are located in machine chamber 119. In a case where the external air temperature is in a range of medium temperature to high temperature, the efficiency of the refrigeration cycle is improved by operating the machine chamber fan.

[0100] The above-described operation cycle is repeated, thereby performing the cooling operation of refrigerator 101.

[0101] During the cooling operation of refrigerator 101, rotary partition body 104 is cooled by the influence of the temperature of refrigerating chamber 105 whose temperature is lowered. In this case, the surface temperature of the atmospheric open portion (portion in contact with the external air) of partition plate 127 is lowered. In order to compensate for the lowered temperature and to set the temperature of the atmospheric open portion of partition plate 127 so as to be equal to or higher than the dew point temperature, based on the temperature and humidity of the external air, power is supplied to dew condensation prevention heater 130 serving as a heating prevention unit. In this manner, dew condensation can be prevented from occurring in partition plate 127, and the quality of refrigerator 101 is ensured.

[0102] In the present exemplary embodiment, partition plate 127 forming suction surface 126 of door gasket 125 of rotary partition body 104 is made of a synthetic resin, and has lower thermal conductivity, compared to a case of a steel plate. Therefore, for example, the heater conductivity for maintaining the dew point temperature of 23.9°C when the temperature is 30°C and the humidity is 70% as the external air condition can be reduced as much as approximately 10%, compared to the case where partition plate 127 is the steel plate. The reason is that a material of partition plate 127 with which door gasket 125 comes into contact employs a synthetic resin having low thermal conductivity so as to suppress a decrease in the temperature of an atmosphere-exposed portion of partition plate 127. Therefore, partition plate 127 made of the synthetic resin is used. In this manner, the power consumption can be reduced.

[0103] Furthermore, in the present exemplary embodiment, as illustrated in FIG. 5, humidity sensor 144 and temperature sensor 171 are mounted on hinge unit 146 of top surface portion 170 of refrigerator 101. Humidity sensor 144 and temperature sensor 171 always performs a detecting operation after refrigerator 101 is turned on so as to start the operation. The control unit on the control board of refrigerator 101 converts the detected voltage into the temperature or the humidity, and calculates the temperature or the humidity by using a predetermined calculation expression.

[0104] In this way, it is possible to properly control a power supplying rate of dew condensation prevention heater 130 by using the detected humidity and temperature of the external air. In this manner, it is possible to reduce the power consumption.

[0105] In contrast, in a case where humidity sensor 144 is not mounted, it is not possible to detect the external air humidity. Accordingly, it cannot be recognized whether the temperature of the surface of partition plate 127 reaches the dew point temperature. Therefore, based on the temperature detected by the external air temperature sensor, assumed temperature at which the relative humidity of the external air reaches 100% is calculated. The power supplying rate is set so that the temperature of partition plate 127 is equal to or higher than the assumed temperature. This prevents the dew condensation in partition plate 127 whose temperature reaches the dew point temperature.

[0106] On the other hand, in the present exemplary embodiment, humidity sensor 144 can be used so as to detect the relative humidity. Accordingly, the dew point temperature can be calculated from the detected temperature and relative humidity. The heater may be controlled so that the surface temperature of partition plate 127 is close to the dew point temperature. Accordingly, the power supplying rate of the heater can be reduced. In the present exemplary embodiment, in view of variations in products and installation environment, the power supplying rate of the heater is set so that the surface temperature of partition plate 127 is equal to or higher than the dew point temperature + 2°C (2K).

[0107] In Particular, in a low humid environment where the dew point temperature is low, the dew point temperature is significantly lower than the external air temperature. Therefore, as in the present exemplary embodiment, in a case where the power supplying rate is set in accordance with the dew point temperature calculated based on the detected temperature and relative humidity, the power supplying rate can be significantly reduced, compared to a case where the power supplying rate is set based only on the external air temperature. Accordingly, the energy saving can be realized throughout the year.

[0108] In addition to the energy saving realized as a result of reducing an input to the heater by reducing the power supplying rate of the heater, another energy saving effect is achieved by reducing heat entering the inside of the refrigerator. That is, in the present exemplary embodiment, in a case where the power is supplied to the heater of rotary partition body 104, it is experimentally understood that a ratio of the movement of the heat between the outward movement and the inward movement in the refrigerator is approximately 7:3. Therefore, reducing the power supplying rate for the heater leads to a reduced cooling load obtained by reducing the heat entering the inside of the refrigerator. Therefore, for example, the rotational speed of compressor 117 can be reduced. Accordingly, the energy saving effect can be further obtained.

[0109] Here, in the present exemplary embodiment, the power supplying rate for rotary partition body 104 of dew condensation prevention heater 130 is specifically set as follows. First, the humidity detected by humidity sensor 144, the temperature detected by temperature sensor 171, the absolute humidity calculated therefrom, and the temperature detected by the external air temperature sensor of the refrigerator main body are used so as to calculate the relative humidity of the external air (around the refrigerator). The power supplying rate is determined corresponding to the calculated relative humidity and the external air temperature.

[0110] In some cases, the humidity fluctuates depending not only on the natural environment but also on the use environment. For example, the humidity fluctuates, when cooling is performed by an air-conditioner in summer, when heating is performed by the air-conditioner in winter, or when heating is performed by a kerosene fan heater. In this case, the fluctuations depend on the installation environment. However, in a case where humidity sensor 144 is located in the vicinity of the air-blowing passage of the air-conditioner, or in a case where wind of the air-conditioner directly blows on humidity sensor 144, the humidity suddenly fluctuates in the vicinity of humidity sensor 144. In this case, it takes time to stabilize the temperature and humidity inside the living room. Therefore, there is a possibility that temperature sensor 171 and humidity sensor 144 may detect values different from those of the actual temperature or humidity.

[0111] For example, in a case where the wind blows on refrigerator 101 during the heating, the detected temperature is high, and the detected humidity is low. However, the absolute humidity is less likely to be affected by the heating. In the present exemplary embodiment, the power supplying rate is calculated in view of not only the calculated relative humidity but also the absolute humidity. Accordingly, it is possible to provide high quality refrigerator 101 which is less likely to be affected by the heating in controlling dew condensation prevention heater 130 using humidity sensor 144.

[0112] On the other hand, during the cooling, the air inside the living room is dehumidified. However, refrigerator 101 according to the present exemplary embodiment has humidity sensor 144 and temperature sensor 171. Thus, it is possible to recognize a change in the absolute humidity before and after the cooling is performed. Accordingly, the refrigerator is less likely to be affected by the cooling in controlling dew condensation prevention heater 130 using humidity sensor 144, and the control can be stably performed.

[0113] As described above, the detection control is performed when humidity sensor 144 detects the humidity. In this manner, humidity sensor 144 is not affected by the cooling or the heating. Therefore, it is possible to provide stable and high quality refrigerator 101.

[0114] In the present exemplary embodiment, humidity sensor 144 is mounted on hinge unit 146. However, without being limited thereto, any place may be selected as long as the external air humidity can be accurately detected therefrom.

[0115] In the present exemplary embodiment, in view of the external appearance of refrigerator 101, product specifications inside the refrigerator, refrigerator product lineups at home and abroad, manufacturing processes, and common use of components, the sensor module having humidity sensor 144 and temperature sensor 171 is mounted on base hinge 143. However, for example, the sensor module may be mounted on hinge cover 141 side. In this case, the configuration for attaching and installing the sensor module can be simplified, and the mold cost can be minimized. Therefore, it is possible to minimize the production cost for the overall product.

[0116] From the viewpoint of detection performance, the sensor module may be mounted on a door portion of left side door 102 or right side door 103. In this case, the humidity of the external air can be accurately detected without being affected by an operation state of refrigerator 101 or heat radiation from compressor 117 and the condenser. In this case, the sensor module can be mounted on an operation board of a temperature setting sensor or an illuminance sensor mounted on the refrigerator door introduced in recent years. In this manner, it is possible to reduce the number of components, to reduce the management cost, and to reduce the installation space by integrating the module board and the operation board of the sensor with each other.

[0117] The sensor module having humidity sensor 144 may be mounted on machine chamber 119. In this case, humidity sensor 144 is installed in the vicinity of the machine chamber fan installed particularly for promoting heat radiation. In this manner, the external air is circulated by the forced convection of the fan. Accordingly, even in a case where it rains, even in a state where a humidifier is operated around the refrigerator, or even in a situation where the humidity suddenly fluctuates, highly sensitive detection can be realized. In this case, humidity sensor 144 is installed slightly apart from the main flow of the convection on the upstream side of the machine chamber fan. In this manner, it is possible to adopt a configuration in which humidity sensor 144 is less likely to be affected by dust when the external air flows into the refrigerator.

[0118] The temperature of the surface of partition plate 127 is more accurately detected. Accordingly, the energy saving can be achieved. For example, a non-contact type detection sensor such as a thermopile can be located in the vicinity of partition plate 127 so as to directly detect the surface temperature. In this manner, the more accurate detection can be performed, and the energy saving can be further achieved.

[0119] As the refrigerant for the refrigeration cycle in recent years, isobutane which is a flammable refrigerant having a low global warming potential coefficient is used from the viewpoint of protecting the global environment. Isobutane is hydrocarbon, and has a specific gravity approximately two times that of the air at normal temperature and atmospheric pressure (at 2.04, 300K). Therefore, in a case where isobutane leaks from the refrigeration system while compressor 117 is operated and stopped, isobutane leaks downward since isobutane is heavier than the air. In particular, in a case where isobutane leaks from a condenser having high pressure inside the cooling system, there is a possibility that the leakage amount may increase. However, in the present exemplary embodiment, hinge unit 146 having humidity sensor 144 disposed therein is disposed in top surface portion 170 of refrigerator 101, and is installed above the position where the condenser is installed. Therefore, there is an extremely low possibility that humidity sensor 144 may be affected by the leakage.

[0120] In the present exemplary embodiment, an example has been described in which dew condensation prevention heater 130 is attached to left side door 102, and in which temperature sensor 171 and humidity sensor 144 are attached to right side door 103. However, the present invention is not limited to this example. For example, conversely, dew condensation prevention heater 130 may be attached to right side door 103, and temperature sensor 171 and humidity sensor 144 may be attached to left side door 102.

[0121] In the present exemplary embodiment, a case has been described where humidity sensor 144 and temperature sensor 171 are configured to serve as the sensor module in which the sensors are mounted on the same board serving as the common board. However, all of these may be configured to be separate from each other.

(Exemplary Embodiment 2)

[0122] In Exemplary Embodiment 2 according to the present invention, an example of controlling a refrigerator by using a result detected by humidity sensor 144 and temperature sensor 171 according to Exemplary Embodiment 1 will be mainly described. Refrigerator 201 according to the present exemplary embodiment is different from refrigerator 101 according to Exemplary Embodiment 1 in that surface heater 158 is used instead of front surface heat radiation pipe 114 of refrigerator 101 according to Exemplary Embodiment 1. A front view illustrating a state where the door of refrigerator 201 is opened according to Exemplary Embodiment 2 of the present invention is the same as the front view in FIG. 1.

[0123] FIG. 8 is a sectional view of refrigerator 201 according to exemplary embodiment 2 of the present invention when refrigerator 201 is laterally viewed, and FIG. 9 is an enlarged sectional view of a heat insulating partition. FIG. 9 illustrates third heat insulating partition 123 as an example. The same reference numerals will be given to configurations the same as those of Exemplary Embodiment 1, and different elements will be described.

[0124] In FIGS. 8 and 9, first heat insulating partition 121, second heat insulating partition 122, third heat insulating partition 123, and fourth heat insulating partition 124 are filled with foamed polystyrene 120, similarly to Exemplary Embodiment 1. A rear surface side of each heat insulating partition is filled with urethane foam.

[0125] In each heat insulating partition, U-shaped steel plates 151, 152, 153, and 154 made of metal are respectively arranged outside the chambers. The door gasket suctions each steel plate, thereby preventing the cold air from leaking out of the chamber. Furthermore, inside the steel plate, surface heater 158 is used instead of front surface heat radiation pipe 114 according to Exemplary Embodiment 1. Surface heater 158 is located so as to be in close contact with metal steel plate 153, as illustrated in an example using third heat insulating partition in FIG. 9. This prevents dew condensation from occurring due to steel plate 153 whose temperature is lowered caused by heat conduction due to the cold air blowing from the inside of the low temperature storage chamber.

[0126] In the present exemplary embodiment, the power supplying rate of the voltage applied to surface heater 158 located in each heat insulating partition is calculated and determined using a value of the relative humidity of the external air, which is calculated in accordance with the humidity detected by humidity sensor 144. In this manner, as a result, the power can be supplied using the power supplying rate corresponding to the dew point temperature. That is, the heater can be accurately and easily controlled so that the temperature of the heat insulating partition is close to the dew point temperature. Furthermore, adhesion is further improved between surface heater 158 and the steel plate, compared to a case of using front surface heat radiation pipe 114. Accordingly, heat transfer loss decreases. Therefore, in a case where the power supply to surface heater 158 is controlled in accordance with the dew point temperature calculated based on an input from humidity sensor 144 and temperature sensor 171 as in the present exemplary embodiment, the energy saving can be achieved throughout the year, compared to a case of using front surface heat radiation pipe 114.

[0127] In a case where front surface heat radiation pipe 114 is located in the heat insulating partition, the pipe which is substantially circular and the steel plate are in line contact with each other. Therefore, a member for promoting heat transfer from the heat radiation pipe to the steel plate and a cushioning material for pressing contact are required inside the steel plate. In contrast, since surface heater 158 is used, the steel plate and surface heater 158 can be brought into surface contact with each other, thereby increasing an area where surface heater 158 is in close contact with the steel plate. In this manner, heat transfer loss can be prevented, and the heating can be efficiently performed. Even in a case where the heat radiation pipe is a flat pipe whose cross section has an elliptical shape, the heat transfer loss similarly occurs.

[0128] It is possible to use an optimal heater in which heat generation capacity (W), unit heat generation capacity (W/m), and distribution of unit heat generation capacity (W/m) of surface heater 158 are individually set for the respective heat insulating partitions in accordance with the temperature range inside the chambers adjacent to each other. In this manner, even in a case where the same heater control is performed on the respective surface heaters, unnecessary heat generation of surface heater 158 is prevented. Therefore, the surface temperature of the steel plate of the respective heat insulating partitions can be optimized.

[0129] For example, in the heat insulating partition adjacent to the freezing temperature region, the temperature is greatly different from the temperature of the external air. Accordingly, as surface heater 158 inside the heat insulating partition, those which have large capacity are used. On the other hand, in the heat insulating partition adjacent to the refrigerating temperature region, the temperature is less different from the temperature of the external air. Accordingly, as surface heater 158 inside the heat insulating partition, those which have small capacity are used.

[0130] The power supplying rate for the plurality of surface heaters 158 may be individually controlled so that the respective heat insulating partitions corresponding to surface heaters 158 have the same surface temperature. In this case, unit heat generation capacity (W/m) of the plurality of surface heaters 158 can be unified. Accordingly, the components can be shared with each other, and the cost reduction can be achieved.

[0131] Unit heat generation capacity (W/m) of the plurality of surface heaters 158 disposed inside one heat insulating partition can be changed in accordance with the temperature distribution inside the adjacent chamber. In this manner, the uniform surface temperature of the steel plate of the heat insulating partition is obtained, and the temperature distribution is no longer uneven. Accordingly, the power consumption can be further reduced. On the other hand, heater wires whose unit heating capacity (W/m) is the same as each other may be used, and the length of the heater wires may be changed in the plurality of surface heaters 158. In this case, the manufacturing process and the management process of the heater can be simplified.

[0132] In the present exemplary embodiment, metal steel plates 151, 152, 153, and 154 respectively have a U-shape (angular U shape) which is bent into the chamber as large as approximately 90 degrees. However, the metal steel plates may have a shape whose end surface face portion is bent inward as large as 180 degrees. In this case, the end portion of the steel plate has a double structure. Accordingly, it is possible to suppress a possibility that the heat enters the inside of the chamber after the heat transferred from the external air, the heat radiation pipe, and the heater to the inside of the chamber through the end surface portion. In this manner, a cooling load amount inside the chamber can be reduced, thereby leading to the energy saving. At the same time, heat transfer of the cold energy from the inside of the chamber to the outside of the chamber can also be suppressed. Accordingly, the surface temperature of the steel plate is less likely to be lowered. Therefore, the power supplying rate of surface heater 158 can be decreased, thereby leading to the energy saving.

[0133] A material of the steel plate of each heat insulating partition may be changed to resins. In this case, resins such as ABS resin, polystyrene (PS), and polypropylene (PP) have lower thermal conductivity compared to the steel plate. Accordingly, heat transfer to the inside of the chamber is suppressed. Therefore, the energy saving can be further achieved. First heat insulating partition to fourth heat insulating partition 121, 122, 123, and 124 are integrally molded using any one of the above-described resins. In this manner, it is possible to improve the appearance without misalignment in the engagement between the components. At the same time, the number of components can be reduced. Accordingly, it is possible to reduce the manufacturing man-hour and the management cost, thereby achieving the cost reduction.

[0134] The foamed polystyrene 120 located inside the heat insulating partition may be replaced with urethane foam which has high insulating capability. In this case, the urethane foam is allowed to have the heat conductivity representing the heat insulating capability which is improved approximately three times compared to foamed polystyrene 120. Accordingly, the required heater capacity can be reduced.

[0135] Unlike molded foamed polystyrene 120 (foamed polystyrene), in a case of using the urethane foam, urethane is foamed by being poured into the heat insulating partition. Therefore, after the foaming process, the urethane and the surrounding component are in close contact with each other. Accordingly, the strength of the heat insulating partition itself can be increased. The heat insulating partition is bridged in refrigerator 201 in the horizontal direction. Accordingly, an increase in the strength of the heat insulating partition leads to an increase in the strength as the refrigerator main body. Therefore, it is possible to provide robust and strong refrigerator 201.

[0136] As a trend of the refrigerator in recent years, the capacity of the refrigerator has progressively increased. However, the dimensions in the depth direction and the height direction are mostly determined depending on a house kitchen space in many cases. Therefore, in a case where a large capacity refrigerator is produced, it is necessary to secure the capacity in the width direction. In recent years, the dimensions have been enlarged up to approximately 700 mm to 800 mm. Here, as the width of the refrigerator main body becomes wider, the width of the door becomes wider. Accordingly, the weight of the food stored in the door portion becomes heavier. When the door is opened, the weight is applied to the door, and the main body is affected by the weight. Accordingly, it is necessary to further increase the strength of the main body.

[0137] In this case, as described above, foamed polystyrene 120 located inside the heat insulating partition employs the urethane foam having high insulating capability. In this manner, the strength of the heat insulating partition is increased, thereby increasing the strength of the main body. If the connection portion between the heat insulating partition and the main body is fixed using the steel plate, the strength of the main body increases.

[0138] In the present exemplary embodiment, in refrigerator 201 configured as described above, the power supplying rate of the heater is calculated and determined using the value of the relative humidity of the external air which is calculated in accordance with the humidity detected by humidity sensor 144. Therefore, as a result, the heater can be controlled using the power supplying ratio corresponding to the dew point temperature determined based on the detected temperature and humidity. Accordingly, the energy saving can be realized throughout the year.

[0139] In case of using front surface heat radiation pipe 114, piping is required on the side surface of refrigerator 201. Accordingly, the heat enters the inside of refrigerator 201 from the piping portion located on the side surface. In contrast, in a case of using the heater as in the present exemplary embodiment, it is possible to minimize the heat entering from the side surface portion of the refrigerating chamber and freezing chamber. Therefore, it is possible to further improve the energy saving effect.

[0140] However, in this case, there is no heat source on the side surface portion of refrigerator 201. Accordingly, there is a possibility that the dew condensation may occur particularly in the vicinity of the door on the side surface portion of freezing chamber 107. In order to cope with the possibility, the side surface heat radiation pipe located on the side surface portion may be located on the side surface portion by extending the heat radiation pipe to the vicinity of the door on the front surface of refrigerator 201.

(Exemplary Embodiment 3)

[0141] In Exemplary Embodiment 3 according to the present invention, another example of controlling a refrigerator by using a result detected by humidity sensor 144 and temperature sensor 171 according to Exemplary Embodiment 1 will be mainly described. Refrigerator 301 according to the present exemplary embodiment is different from refrigerator 101 according to Exemplary Embodiment 1 in that control valve 139 for switching the flow passage of the refrigerant is used during the refrigeration cycle of refrigerator 301. A front view illustrating a state where the door of refrigerator 301 is opened according to Exemplary Embodiment 3 of the present invention is the same as that in FIG. 1.

[0142] FIG. 10 is a sectional view when the refrigerator is laterally viewed according to Exemplary Embodiment 3 of the present invention. The same reference numerals will be given to configurations the same as those of Exemplary Embodiment 1 and Exemplary Embodiment 2, and different elements will be described.

[0143] As illustrated in FIG. 10, compressor 117, a condenser (not illustrated), the heat radiation pipe including front surface heat radiation pipe 114, capillary tube 118, and cooler 112 are annularly connected in this order, thereby forming the refrigeration cycle. Control valve 139 is located in machine chamber 119 where compressor 117 is disposed. Control valve 139 adjusts the switching of the flow passage of the refrigerant sealing in the refrigeration cycle.

[0144] Control valve 139 is connected between the condenser and the heat radiation pipe, and switched between a case where front surface heat radiation pipe 114 is included in the route and a case where front surface heat radiation pipe 114 is not included in the route by passing through a bypass pipe. According to this configuration, in a case where the refrigerant does not pass through front surface heat radiation pipe 114, the high temperature refrigerant does not pass through the heat insulating partition. Accordingly, it is possible to minimize the heat entering the inside of the chamber from the heat radiation pipe. In this manner, the cooling load amount inside the chamber can be reduced. Therefore, the energy saving can be achieved.

[0145] In the present exemplary embodiment, the power supplying rate of control valve 139 which represents a ratio between a time during which the refrigerant flows into front surface heat radiation pipe 114 located in each heat insulating partition and a time during which the refrigerant does not flow into front surface heat radiation pipe 114 is calculated and determined using the value of the relative humidity of the external air which is calculated in accordance with the humidity detected by humidity sensor 144. In this manner, as a result, the power supplying rate corresponding to the dew point temperature is set. Therefore, it is possible to minimize a possibility that the heat which is hotter than the external air may enter the inside of the chamber through the heat radiation pipe whose temperature becomes high due to the high temperature refrigerant. In this manner, the cooling load amount can be reduced. Furthermore, the rotational speed of compressor 117 can be lowered accordingly. Therefore, the energy saving can be further realized throughout the year.

[0146] In the present exemplary embodiment, control valve 139 is disposed in machine chamber 119 in the upper portion of refrigerator 301. However, control valve 139 may be disposed in the machine chamber disposed in the lower portion of refrigerator 301.

[0147] In the present exemplary embodiment, a configuration in a case of switching the flow passage by switching control valve 139 has been described. However, a control valve for adjusting a flow rate may be used. In a case where the valve is switched as in control valve 139 according to the present exemplary embodiment, the power is alternately supplied between a case where the refrigerant flows into front surface heat radiation pipe 114 and a case where the refrigerant does not flow into front surface heat radiation pipe 114. The average temperature of front surface heat radiation pipe 114 is lowered by adjusting the power supplying rate so that the surface temperature of the respective steel plates 151, 152, 153, and 154 is close to the dew point temperature. In a case of using the valve for adjusting the flow rate, the circulation amount of the refrigerant is adjusted. In this manner, the average surface temperature of the respective steel plates 151, 152, 153, and 154 can be similarly close to the dew point temperature.

[0148] In the present exemplary embodiment, the flow passage of the refrigerant flowing in front surface heat radiation pipe 114 is switched by control valve 139. However, in addition to front surface heat radiation pipe 114, a side surface heat radiation pipe (not illustrated) and a rear surface heat radiation pipe (not illustrated) may be used as the overall heat radiation pipe including both of these or the heat radiation pipe in which both of these are independent of each other. In this manner, the flow passage of the refrigerant flowing in the heat radiation pipe may be switched.

[0149] In this case, control valve 139 is switched. Accordingly, while insufficient heat radiation is prevented by always ensuring the sufficient heat radiation capability of the condenser, and heat radiation using each heat radiation pipe is minimized. In this manner, it is possible to reduce a possibility that the heat may enter the inside of the chamber.

[0150] Particularly in a case where the external air temperature is in a range from the low temperature to the medium temperature, there is a possibility that the refrigerant may be in an excessively condensed state due to excessive heat radiation. Even in this case, the heat radiation capability can be adjusted as described above. In this manner, it is possible to operate the refrigerator with high quality regardless of whether the external air temperature is low or external air temperature is high.

INDUSTRIAL APPLICABILITY

[0151] As described above, according to the present invention, it is possible to provide a refrigerator which can reduce power consumption for controlling a dew condensation prevention unit in accordance with a detection result of a humidity sensor while detection accuracy of the humidity sensor is improved and an external appearance is maintained in high quality. According to the present invention, components can be highly integrated with each other when electronic components such as sensors for detecting external air temperature and humidity are disposed in a hinge unit. Therefore, an assembly configuration thereof can be simplified. Furthermore, the improved detection accuracy of the sensors enables the power consumption to be minimized at the time of preventing dew condensation. Therefore, energy saving and quality improvement can be achieved. Accordingly, the present invention is widely applicable to household and commercial refrigerators and other freezing and refrigerating devices.

REFERENCE MARKS IN THE DRAWINGS

[0152]

1	REFRIGERATOR
2a, 2b	DOOR
11	HINGE
12	HINGE COVER
13	HINGE UNIT
14	EXTERNAL AIR TEMPERATURE SENSOR
15	EXTERNAL AIR HUMIDITY SENSOR
23	ROTARY PARTITION BODY
24	SURFACE HEATER
101, 201, 301	REFRIGERATOR
102	LEFT SIDE DOOR
103	RIGHT SIDE DOOR
104	ROTARY PARTITION BODY
105	REFRIGERATING CHAMBER
106	ICE MAKING CHAMBER
107	FREEZING CHAMBER
108	VEGETABLE CHAMBER
109	SWITCHING CHAMBER
110	INNER BOX
111	COOLING CHAMBER
112	COOLER
113	COLD AIR BLOWER FAN
114	FRONT SURFACE HEAT RADIATION PIPE
115	COOLING CHAMBER COVER
117	COMPRESSOR
118	CAPILLARY TUBE
119	MACHINE CHAMBER
120	FOAMED POLYSTYRENE
121	FIRST HEAT INSULATING PARTITION
122	SECOND HEAT INSULATING PARTITION
123	THIRD HEAT INSULATING PARTITION
124	FOURTH HEAT INSULATING PARTITION
125	DOOR GASKET
126	SUCTION SURFACE
127	PARTITION PLATE
128	HEAT INSULATOR

129	PARTITION FRAME BODY
130	DEW CONDENSATION PREVENTION HEATER
131	REINFORCING PLATE
136	RADIANT HEATER
137	CONTROL BOARD
139	CONTROL VALVE
140	HINGE
141	HINGE COVER
141a	INCLINED SURFACE
142	CONNECTOR
143	BASE HINGE (CASE)
144	HUMIDITY SENSOR
145	BRACKET
145a	PROJECTION
146	HINGE UNIT
147	OUTER PERIPHERAL RIB (FIRST RIB)
148	SECOND RIB
149	SLIT
150	COMMUNICATION PORT
151, 152, 153, 154	STEEL PLATE
158	SURFACE HEATER
170	TOP SURFACE PORTION
171	TEMPERATURE SENSOR
172	BOARD (MODULE BOARD)
172a	OPENING

Claims

1. A refrigerator comprising:

a main body;
a left side door and a right side door which are disposed in an upper portion of the main body;
a rotary partition body disposed in any one door of the left side door and the right side door and having a dew condensation prevention heater;
a temperature sensor disposed in the main body;
a humidity sensor disposed in the main body;
a control unit that controls power supply to the dew condensation prevention heater, based on each input from the temperature sensor and the humidity sensor; and
a hinge cover that covers a hinge of the other door of the left side door and the right side door,
wherein the temperature sensor and the humidity sensor are covered by the hinge cover.

2. The refrigerator of Claim 1,
wherein a height of a top surface of the hinge cover is configured so that portions of the top surface which are above the temperature sensor and the humidity sensor are higher than an other portion of the top surface.

3. The refrigerator of Claim 1 or 2,
wherein the temperature sensor and the humidity sensor each have a detection element, and each board or a common board in which the detection element is located,
wherein a bracket for supporting the each board or the common board and a case covered by the hinge cover are further provided, and
wherein the bracket is disposed inside the case.

4. The refrigerator of any one of Claims 1 to 3,
wherein a first rib is disposed in an outer periphery of the hinge cover, and
wherein a second rib is disposed inside the first rib.

5. The refrigerator of Claim 3,

wherein the case is disposed in a recessed portion disposed in a top surface portion of the main body,
wherein a connector for connecting the control unit to an operation unit disposed in at least one of the right and left side doors is located inside the case, and
wherein the bracket is disposed above the connector.

6. The refrigerator of any one of Claims 3 to 5,
wherein the temperature sensor and the humidity sensor are disposed above a top surface of the main body.

7. The refrigerator of any one of Claims 1 to 6,
wherein a plurality of communication ports are disposed on the outer periphery of the hinge cover, and
wherein the plurality of communication ports are disposed in proximity to the humidity sensor.

8. The refrigerator of any one of Claims 3 to 7,
wherein the temperature sensor and the humidity sensor are configured to serve as a sensor module in which a peripheral circuit is installed on the common board.

FIG. 1

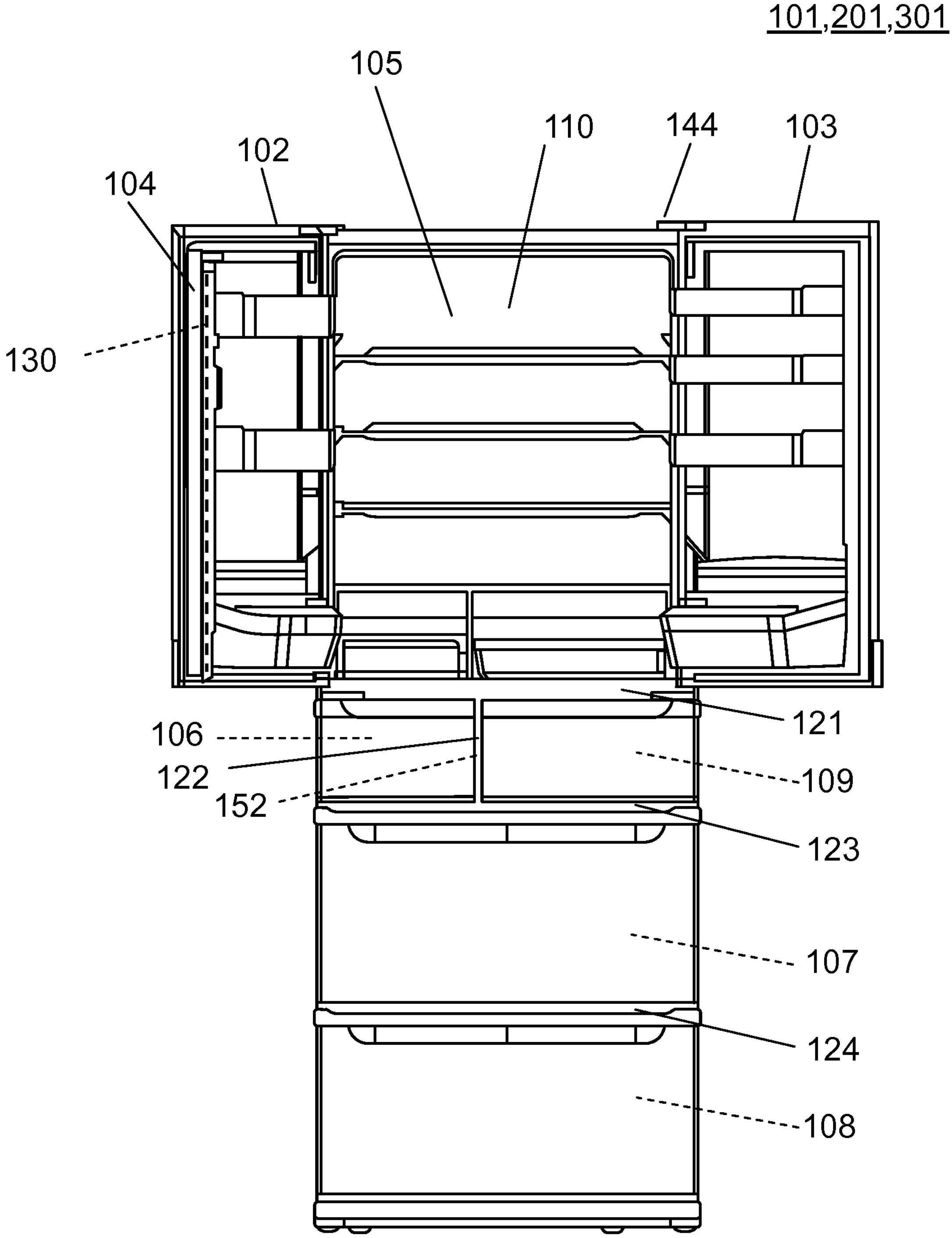
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FIG. 2

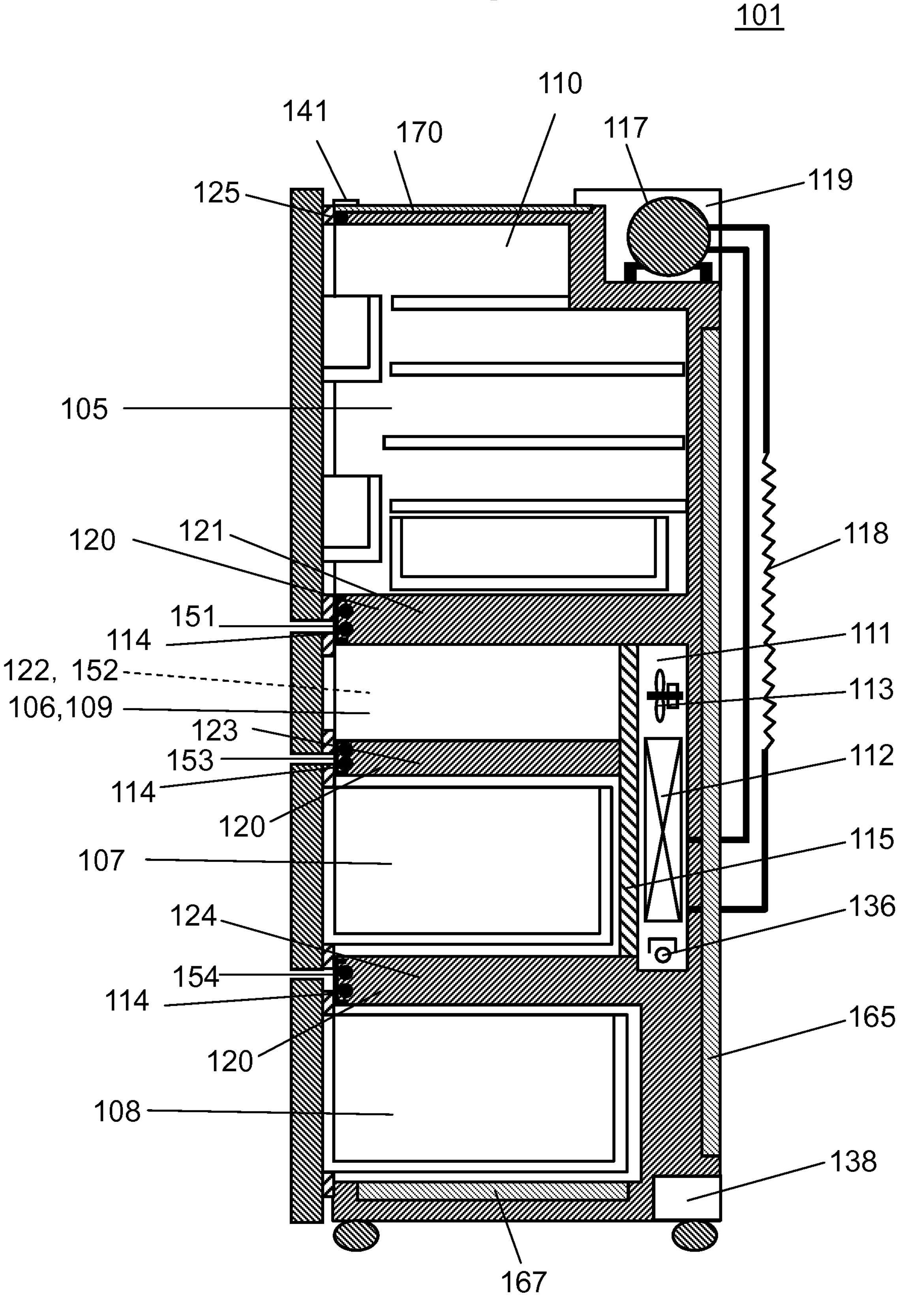
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FIG. 3

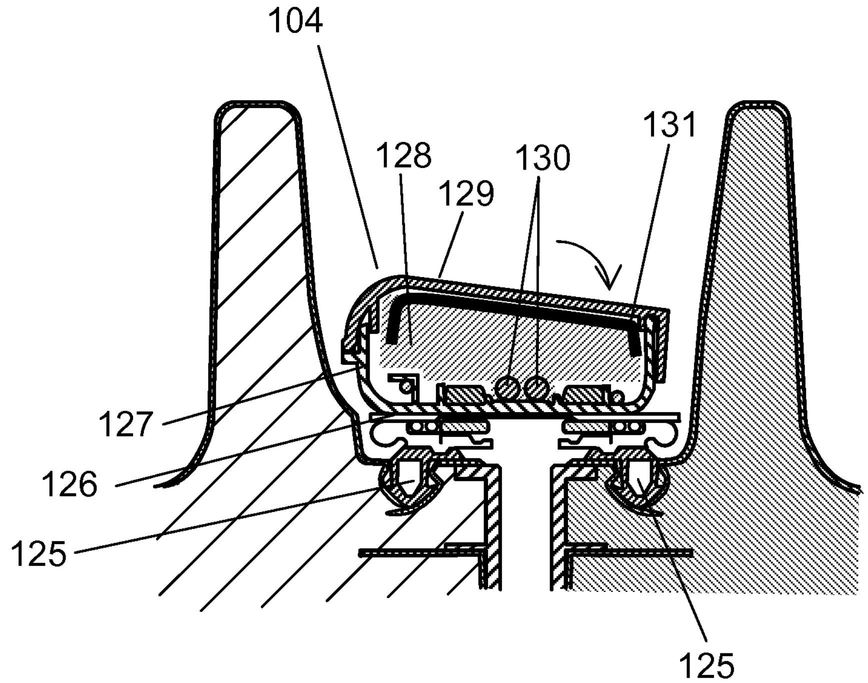
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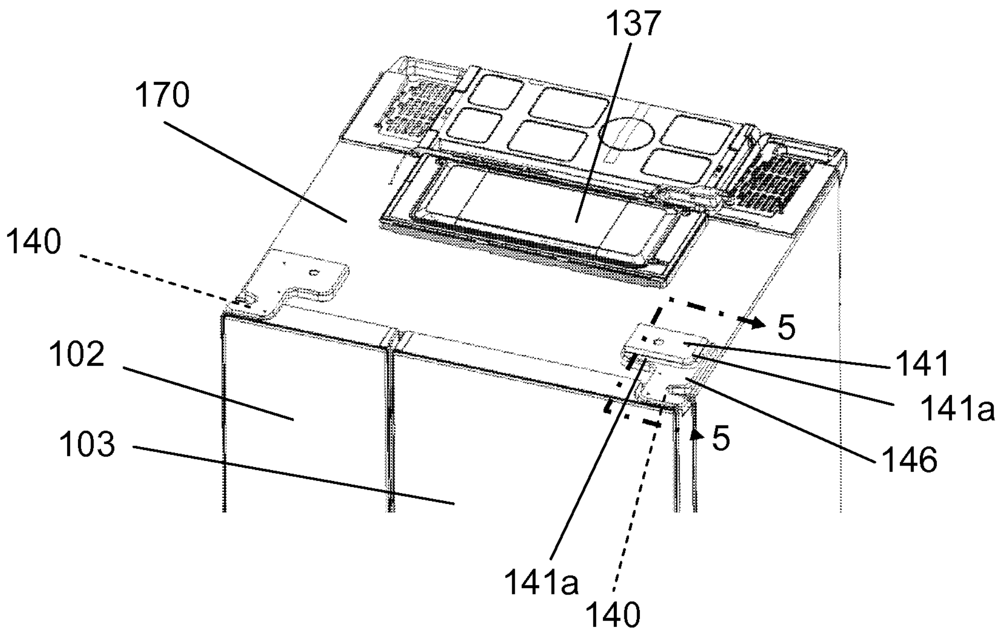
FIG. 4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103
141a
140

FIG. 5

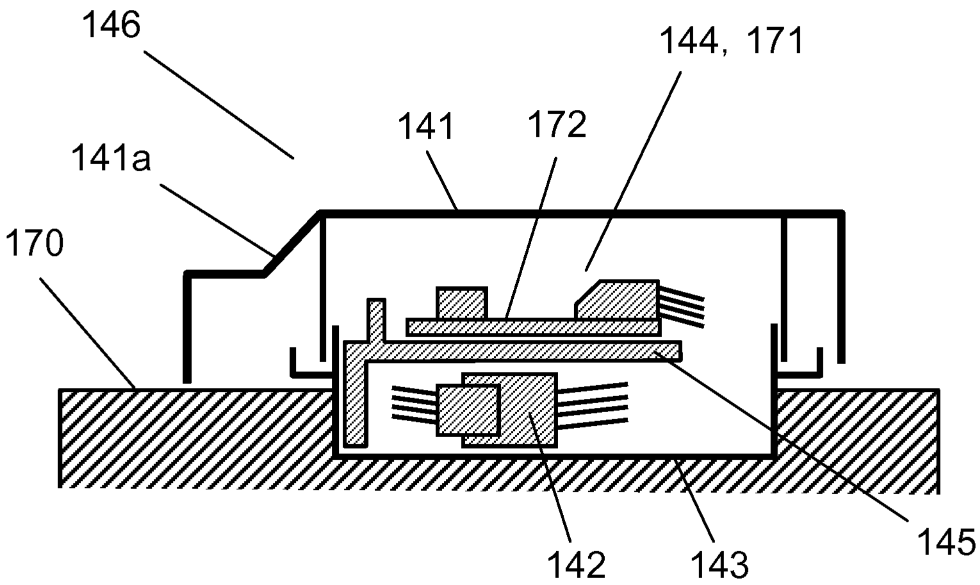

FIG. 6

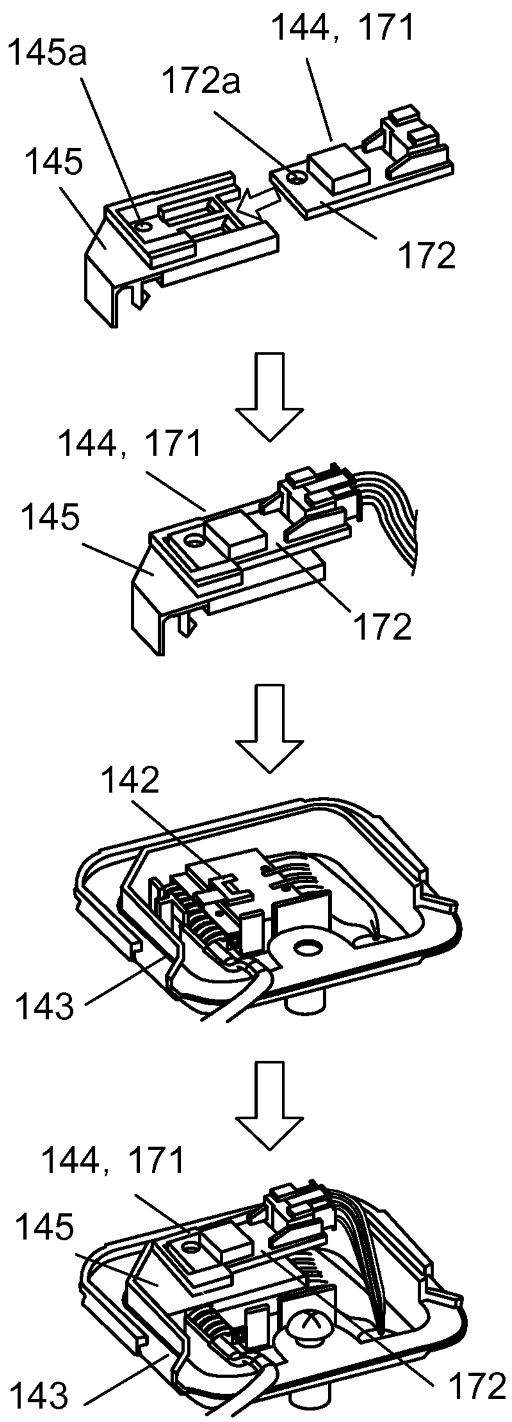
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FIG. 7A

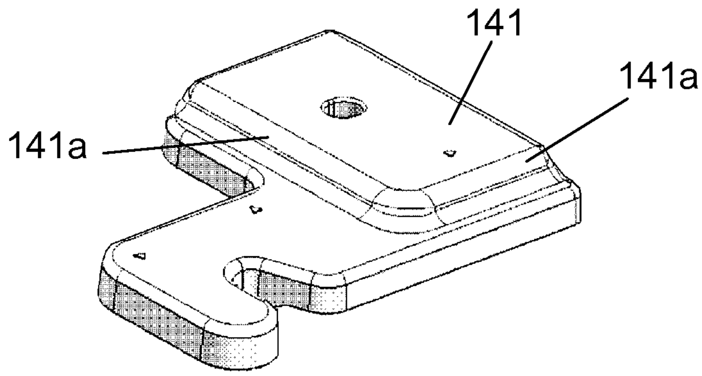

FIG. 7B

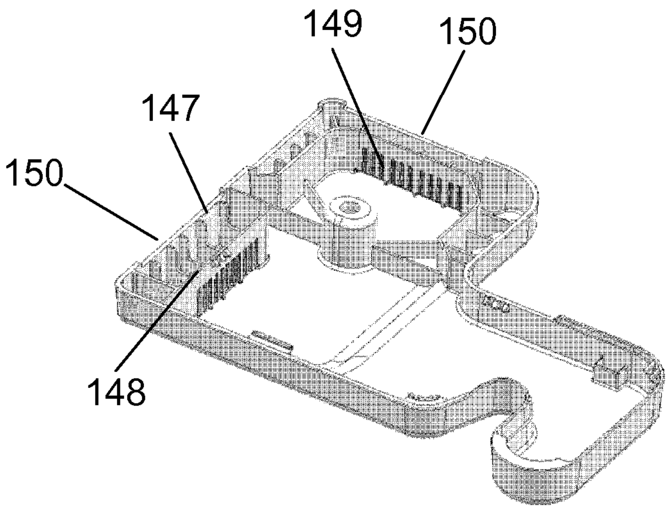

FIG. 8

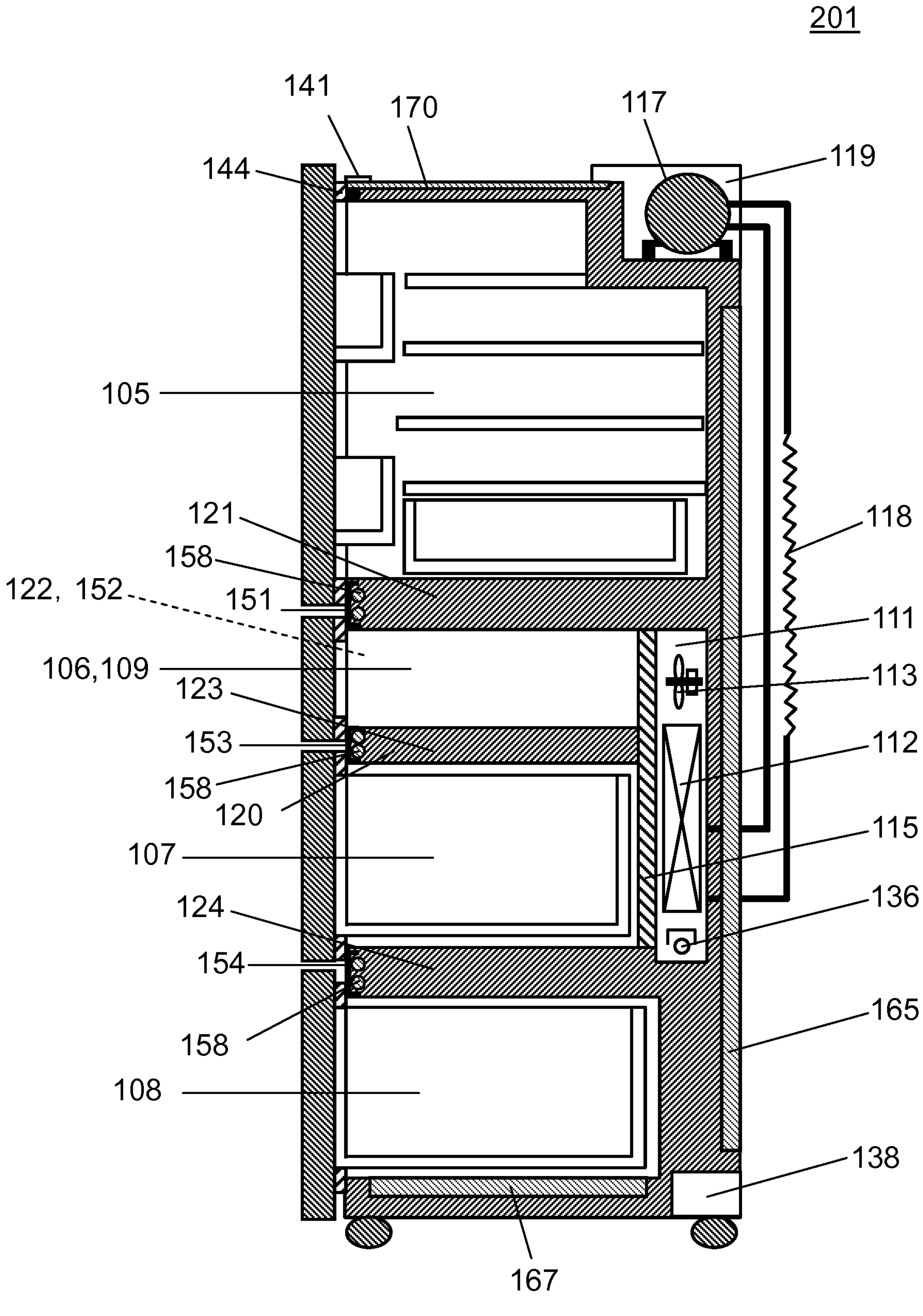
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FIG. 9

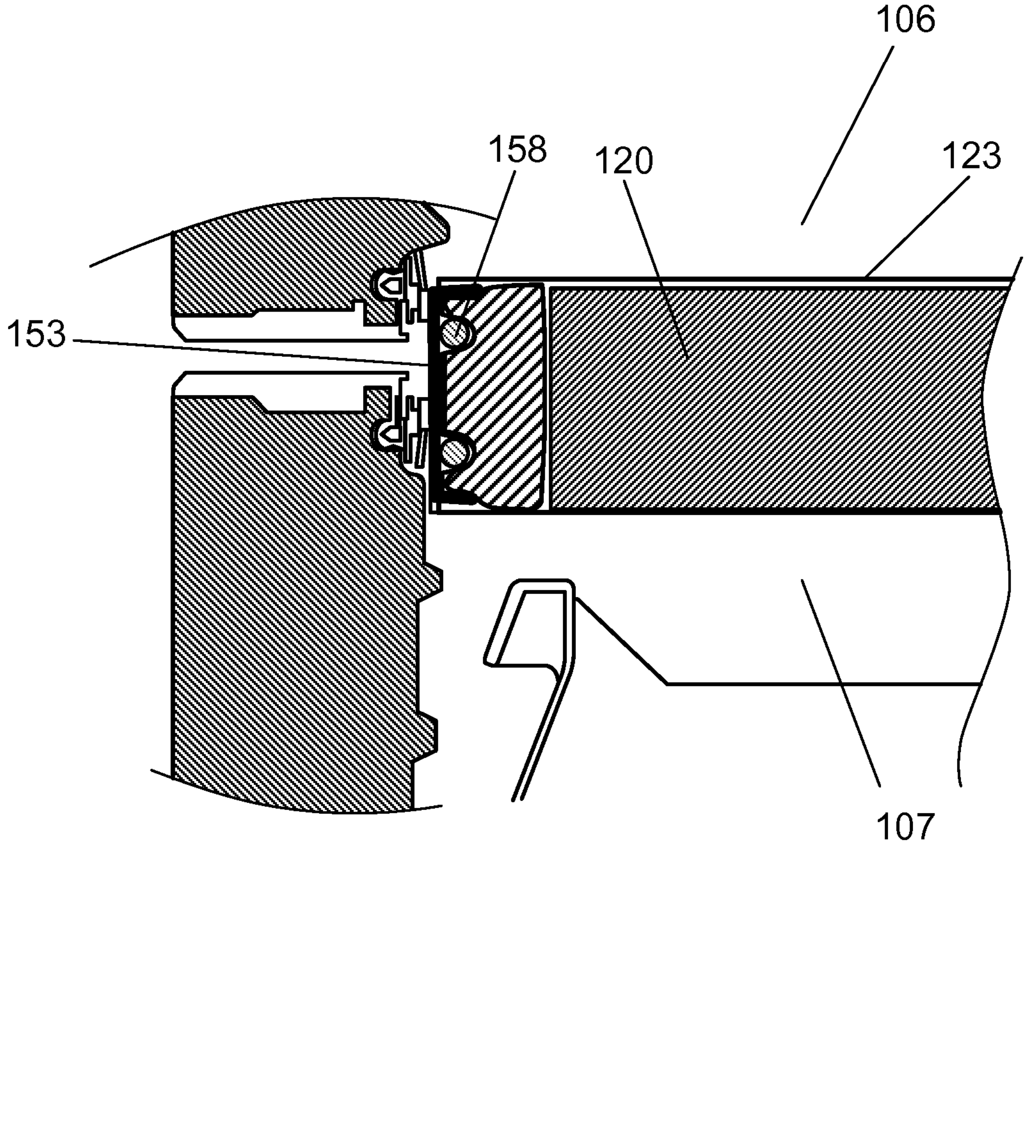

FIG. 10

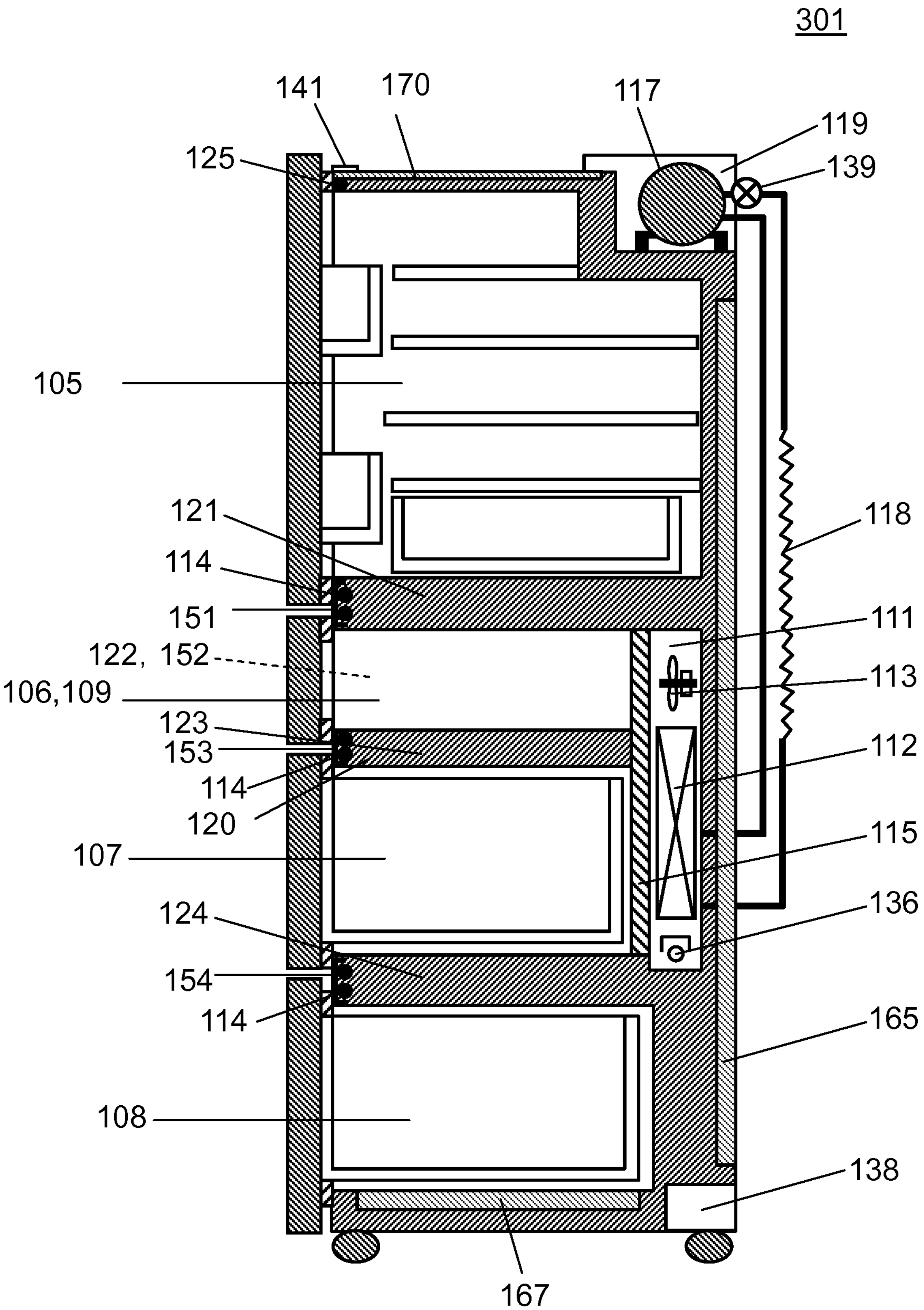
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FIG. 11

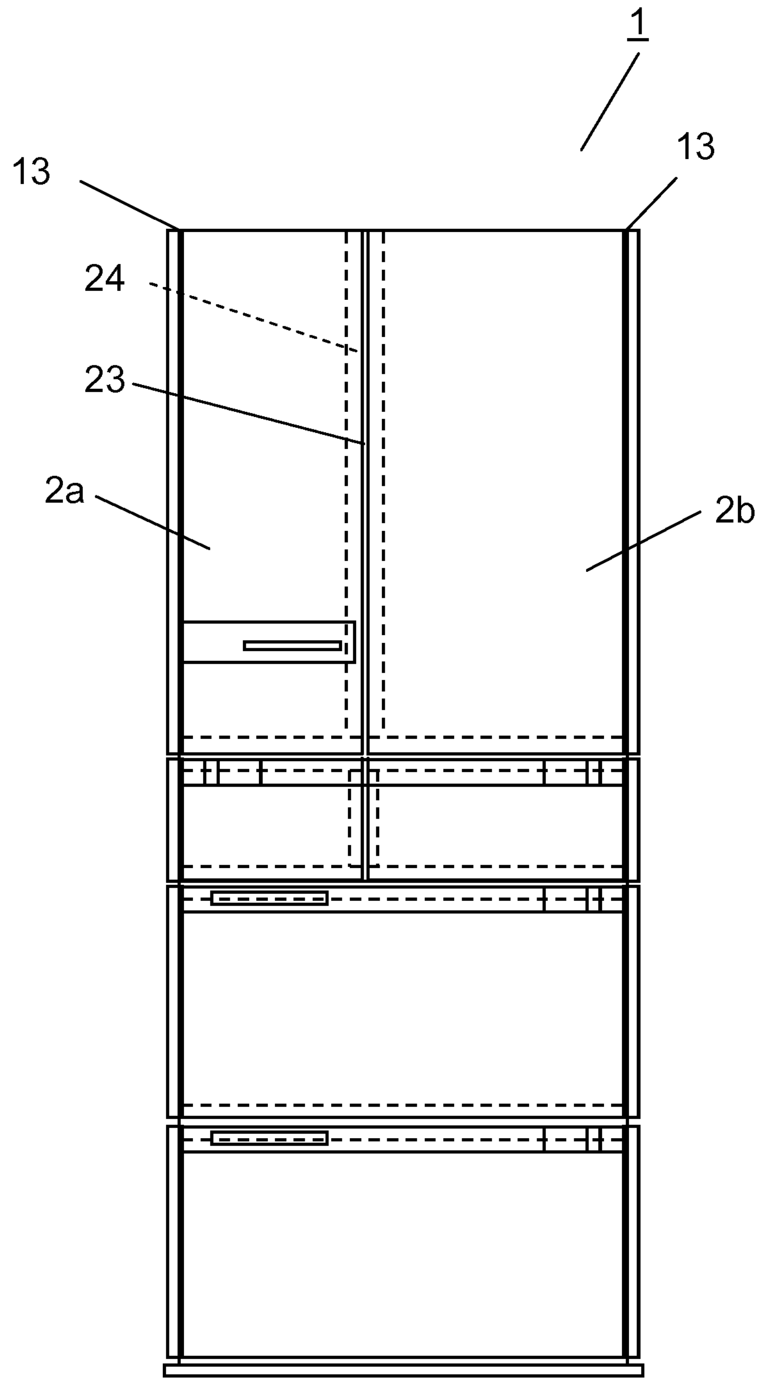
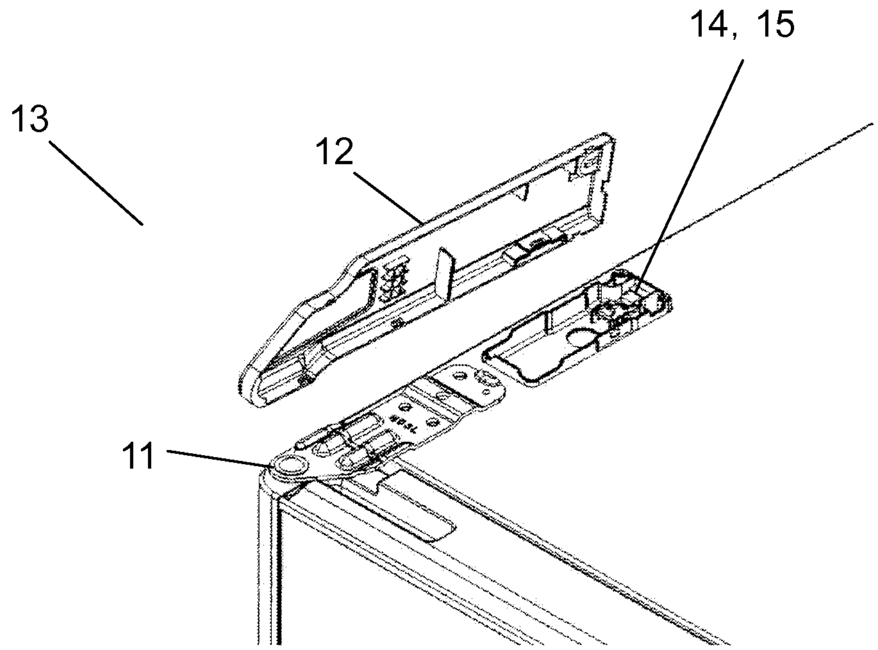


FIG. 12



INTERNATIONAL SEARCH REPORT

International application No. PCT/JP2016/003601

A. CLASSIFICATION OF SUBJECT MATTER

F25D21/04(2006.01)i, *F25D29/00*(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F25D21/04, F25D29/00

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2016
Kokai Jitsuyo Shinan Koho	1971-2016	Toroku Jitsuyo Shinan Koho	1994-2016

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2013-072595 A (Hitachi Appliances, Inc.), 22 April 2013 (22.04.2013), paragraphs [0012] to [0055], [0094] to [0105]; fig. 1 to 3, 10 to 12 & CN 103033013 A	1-4,6-8 5
Y A	JP 2015-010780 A (Toshiba Corp.), 19 January 2015 (19.01.2015), paragraphs [0009] to [0023]; fig. 1 to 3 & CN 104251585 A & KR 10-2015-0002484 A	1-4,6-8 5
Y A	JP 2011-102781 A (Nissan Motor Co., Ltd.), 26 May 2011 (26.05.2011), paragraph [0015]; fig. 1 to 2 (Family: none)	3-4,6-8 5

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

* Special categories of cited documents:
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 October 2016 (18.10.16)	01 November 2016 (01.11.16)

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2013072595 A **[0010]**