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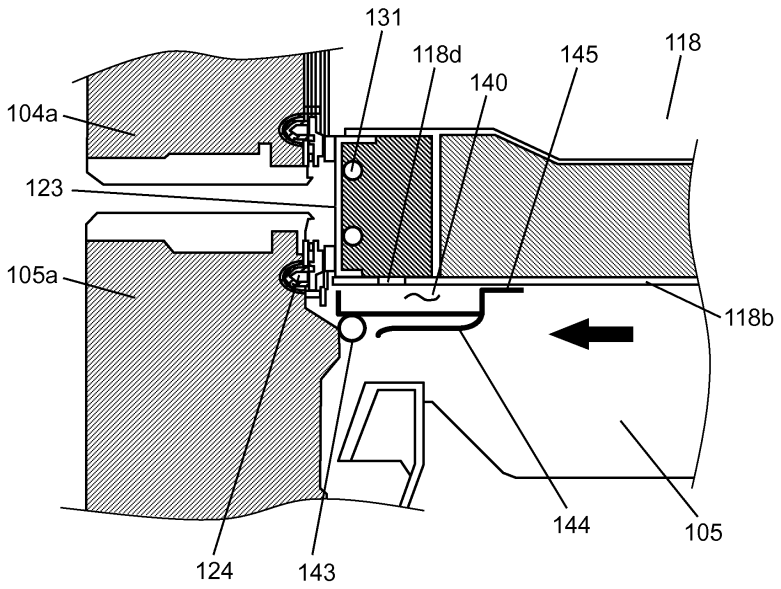
(54) REFRIGERATOR

(57) A refrigerator according to the present invention uses partition wall (118) that divides the interior of a heat-insulating box into a plurality of storage compartments, to which cool air is supplied, and includes openable door (105a) in front of each of the storage compartments. On door (105a), door gasket (124) is provided which is in tight contact with metal receiving member (123) that is provided on the front face facing the doors, of partition wall (118). The storage compartments include storage cases. A configuration such that metal receiving member (123) is heated is provided. Heat exchange suppression space (140) is also provided which suppresses heat exchange between cool air in the associated storage compartment and metal receiving member (123).

FIG. 4



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Description

TECHNICAL FIELD

[0001] The present invention relates to a configuration of a refrigerator that can achieve significant energy savings.

BACKGROUND ART

[0002] FIG. 11 is a cross-sectional view of a basic configuration of a freezing compartment of a conventional refrigerator.

[0003] As shown in FIG. 11, door gasket 12 is provided along the entire perimeter on edges of an inner surface of door 11. Door gasket 12 is in tight contact with metal receiving member 14 that is provided on a front face of partition wall 13, and which serves as a receiving surface for door gasket 12, thereby preventing cool air in freezing compartment 25 from leaking to outside.

[0004] Cool air generated in cooler 15 that is installed in a rear portion of a body is blown by fan 16 out of discharge port 17 on the backside of freezing compartment 25 into freezing compartment 25, and thus chills food stored in freezing compartment 25.

[0005] Then, as indicated by arrows, the cool air that has chilled the food reaches upper front portions of storage cases 18 and 19, and flows through spaces between an inner wall of door 11 and front faces of storage cases 18 and 19. The cool air further flows through a space under the bottom of storage case 19 into return duct 21, and then therefrom returns to cooler 15 for circulation.

[0006] Moreover, heat radiation pipe 23 is disposed in order to prevent the front face of partition wall 13 between freezing compartment 25 and upper storage compartment 22 from being cooled by the cool air that has reached the upper front portion of storage case 18, and thus prevent dew condensation from occurring on the front face of partition wall 13 due to a temperature difference between the interior and the exterior. This heat radiation pipe 23 utilizes a high-temperature refrigerant pipe in a freezing cycle (not shown), and the heat therefrom heats the front face of partition wall 13 to a high temperature. Heating the front face of partition wall 13 to a high temperature prevents dew condensation, but at the same time, causes air in the upper front portion of freezing compartment 25 to be heated, thereby causing cooling efficiency to be reduced.

[0007] In order to prevent this, a mechanism is proposed in which sealing member 24 indicated by the dotted line is provided in a space above storage case 18 in the vicinity of partition wall 13 so that the flow of cool air toward door gasket 12 is closed (see, e.g., PTL 1).

[0008] In the conventional configuration described above, sealing member 24 is provided on partition wall 13 so as to contact with storage case 18 and to close the flow of cool air toward metal receiving member 14 in order to prevent the cool air in freezing compartment 25 from being heated by heat exchange with heated metal receiving member 14. However, deterioration of sealing performance due to, for example, time-related deterioration of sealing member 24 makes sealing member 24 unable to close the cool air any more, and thus the cool air in freezing compartment 25 is heated by heat exchange with metal receiving member 14 in a high temperature. This presents a problem in that cooling efficiency is reduced.

Citation List

Patent Literature

[0009] PTL 1: Unexamined Japanese Patent Publication No. H10-96584

SUMMARY OF THE INVENTION

[0010] A refrigerator according to the present invention uses a partition wall to divide an interior of a heat-insulating box into a plurality of storage compartments, to which cool air is supplied, and includes an openable door in front of each of the storage compartments. On the door, a door gasket is provided which is in tight contact with a metal receiving member that is provided on the front face of the partition wall facing the doors. A configuration such that the metal receiving member is heated is also provided. In addition, a heat exchange suppression space is provided which suppresses heat exchange between cool air in the associated storage compartment and the metal receiving member. The heat exchange suppression space is formed by the partition wall and a sealing member, between the metal receiving member and the associated storage compartment.

[0011] With this configuration, the present invention can suppress heat exchange with the outside, improve cooling efficiency, and thus provide a refrigerator having reduced power consumption.

BRIEF DESCRIPTION OF DRAWINGS

[0012]

FIG. 1 is a front view of a refrigerator according to a first embodiment of the present invention.

FIG. 2 is a vertical cross-sectional view taken along line 2-2 of FIG. 1.

FIG. 3 is an enlarged cross-sectional view of a main portion of the refrigerator according to the first embodiment of the present invention.

FIG. 4 is an enlarged cross-sectional view of a main portion of a refrigerator according to a second embodiment of the present invention.

FIG. 5 is an enlarged cross-sectional view of a main portion of a refrigerator according to a third embodiment of the present invention.

FIG. 6 is a cross-sectional view of a sealing member

of the refrigerator according to the third embodiment of the present invention.

FIG. 7 is an enlarged cross-sectional view of a main portion of the refrigerator according to the third embodiment of the present invention.

FIG. 8 is an enlarged cross-sectional view of a main portion of a refrigerator according to a fourth embodiment of the present invention.

FIG. 9 is an enlarged cross-sectional view of a main portion of a refrigerator according to a fifth embodiment of the present invention.

FIG. 10 is a perspective view of a sealing member of the refrigerator according to the fifth embodiment of the present invention.

FIG. 11 is a cross-sectional view of a freezing compartment of a conventional refrigerator.

DESCRIPTION OF EMBODIMENTS

[0013] Embodiments of the present invention will be described below with reference to the drawings. It should be noted that the present invention is not limited to the embodiments.

FIRST EXEMPLARY EMBODIMENT

[0014] FIG. 1 is a front view of a refrigerator according to a first embodiment of the present invention. FIG. 2 is a cross-sectional view taken along line 2-2 of FIG. 1. FIG. 3 is an enlarged cross-sectional view of a main portion of the refrigerator according to the first embodiment of the present invention.

[0015] In FIGS. 1 and 2, heat-insulating box 101, which is a refrigerator body of refrigerator 100, includes outer box 102 mainly made of steel plates, and inner box 103 molded from resin such as ABS (acrylonitrile butadiene styrene). A space between outer box 102 and inner box 103 of heat-insulating box 101 is foam-filled with foamed heat-insulating material such as rigid urethane foam, and thus is heat-insulated from the ambient environment. In addition, heat-insulating box 101 is divided into a plurality of storage compartments.

[0016] Refrigerating compartment 104 is provided in the top portion as a first storage compartment. Second freezing compartment 105 and ice-making compartment 106 are provided horizontally under refrigerating compartment 104 respectively as a fourth storage compartment and as a fifth storage compartment. First freezing compartment 107 is provided under both second freezing compartment 105 and ice-making compartment 106 as a second storage compartment. Vegetable compartment 108 is provided in the bottom portion as a third storage compartment.

[0017] Refrigerating compartment 104 includes refrigerating compartment right door 104a and refrigerating compartment left door 104b, which are pivoted doors. In refrigerating compartment 104, refrigerating compartment shelf plates 104c and refrigerating compartment case 104d are appropriately disposed, allowing a storage space to be easily organized. The other storage compartments have drawer-type doors. Second freezing compartment case 105b is placed on a frame (not shown) of drawer-type second freezing compartment door 105a of second freezing compartment 105. An ice-making compartment case (not shown) is placed on a frame (not shown) of ice-making compartment door 106a. Upper freezing compartment case 107b and lower freezing compartment case 107c are placed on a frame (not shown) of first freezing compartment door 107a. Upper vegetable compartment case 108b and lower vegetable compartment case 108c are placed on a frame (not shown) of vegetable compartment door 108a.

[0018] Refrigerating compartment 104 is set within a refrigerating temperature range that does not cause freezing for refrigerated storage, that is, usually from 1°C to 5°C. Vegetable compartment 108 is set within a refrigerating temperature range equivalent to that of refrigerating compartment 104, or set within a vegetable temperature range, which is a slightly higher temperature setting than that of refrigerating compartment 104, that is, from 2°C to 7°C. First freezing compartment 107 is set within a freezing temperature range, that is, usually from -22°C to -15°C for frozen storage; however, first freezing compartment 107 may also be set to a lower temperature such as -30°C or -25°C to improve the frozen storage condition.

[0019] Second freezing compartment 105 is set within a freezing temperature range equivalent to that of first freezing compartment 107, or set to a slightly higher temperature setting than that of first freezing compartment 107, that is, from -20°C to -12°C. Ice is made by an automatic icemaker (not shown) provided in an upper portion of the compartment, using water supplied from a water tank (not shown) in refrigerating compartment 104, and the ice is stored in the ice-making compartment case (not shown) of ice-making compartment 106.

[0020] The top surface portion of heat-insulating box 101 has a shape with a stepped recess toward a rear side of the refrigerator, and machine compartment 101a is formed in this stepped recess. Machine compartment 101a accommodates high pressure side components of the freezing cycle such as compressor 109, a dryer (not shown) for removing moisture, and the like. That is, machine compartment 101a, which accommodates compressor 109, is formed intruding into a top rear portion in refrigerating compartment 104.

[0021] Thus, machine compartment 101a is provided in a rear portion of the storage compartment in the top portion of heat-insulating box 101, which is not easily accessible and thus has been a dead space, and compressor 109 is provided in machine compartment 101a. This placement provides the following advantage: the space for machine compartment that has been located in the bottom portion of heat-insulating box 101, which is convenient for users, in a conventional refrigerator, can be advantageously turned into a storage compart-

ment capacity. This can significantly improve storage performance and usability.

[0022] The freezing cycle is formed of a sequence of refrigerant flow paths, sequentially including compressor 109, a condenser, a capillary as a decompressor, and cooler 112. In the freezing cycle, hydrocarbon-based refrigerant such as isobutane is sealed as the refrigerant.

[0023] Compressor 109 is a reciprocating compressor that compresses the refrigerant by its piston reciprocating in the cylinder. When the freezing cycle uses a three-way valve or a changeover valve in heat-insulating box 101, these functional components may be provided in machine compartment 101a.

[0024] In addition, although this embodiment has been described as having a capillary as the decompressor constituting the freezing cycle, a pulse motor-driven electronic expansion valve capable of freely controlling the flow rate of the refrigerant may be used.

[0025] Note that the discussions, in this embodiment, on the core part of the present invention provided below may also be applied to a refrigerator of a type in which a machine compartment is provided in a rear portion of the storage compartment in the bottom portion of heat-insulating box 101, and compressor 109 is provided in the machine compartment, as has been general practice conventionally.

[0026] Cooling compartment 110 that generates cool air is provided on the backside of first freezing compartment 107. Partition member 111 is provided in order to separate storage compartments including second freezing compartment 105, ice-making compartment 106, and first freezing compartment 107 from cooling compartment 110. Cooling compartment 110 includes cooler 112, which exchanges heat with air that has been heated by heat exchange in storage compartments, and thus generates cool air. Partition member 111 includes storage compartment side partition member 111a and cooling compartment side partition member 111b. Cooling compartment side partition member 111b includes ventilator 113. The space between storage compartment side partition member 111a and cooling compartment side partition member 111b forms ventilation duct 111c, which guides cool air forcedly blown out by ventilator 113 to refrigerating compartment 104, to second freezing compartment 105, to ice-making compartment 106, to first freezing compartment 107, and to vegetable compartment 108.

[0027] In addition, radiant heating means 114 made of a glass tube is provided in a space under cooler 112 for defrosting cooler 112 and the periphery thereof regarding frost and/or ice deposited thereon during cooling. Drain pan 115 for receiving defrosting water generated upon defrosting, and drain tube 116 that penetrates from the deepest portion of drain pan 115 to outside the refrigerator, are provided under radiant heating means 114. Evaporating dish 117 is provided outside the refrigerator downstream of drain tube 116.

[0028] Upper discharge port 120 is provided between partition wall 118, which separates refrigerating compartment 104 from the other storage compartments, and the upper end of storage compartment side partition member 111a, and from upper discharge port 120, cool air is discharged into second freezing compartment 105, into ice-making compartment 106, and into first freezing compartment 107 as indicated by the arrows in FIG. 2. The cool air discharged into the storage compartments described above circulates through second freezing compartment case 105b, the ice-making compartment case (not shown), upper freezing compartment case 107b, and lower freezing compartment case 107c, flows through return suction port 125 provided under storage compartment side partition member 111a, and then returns again to cooler 112 for circulation.

[0029] In addition, damper 121 is provided behind partition wall 118. After flowing through damper 121, the cool air branches into refrigerating compartment duct 122 and into a vegetable compartment duct (not shown), and is delivered from respective discharge ports to refrigerating compartment 104 and to vegetable compartment 108.

[0030] In FIG. 3, door gasket 124 is provided along the entire perimeter on edges of an inner surface of second freezing compartment door 105a. Door gasket 124 is in tight contact with metal receiving member 123 that is provided on the front face of partition wall 118, whose outer surfaces are made of resin portions, and which separates refrigerating compartment 104 from second freezing compartment 105, and such tight contact prevents cool air from leaking to the outside. Note that each of refrigerating compartment 104, second freezing compartment 105, ice-making compartment 106, first freezing compartment 107, and vegetable compartment 108 also has a configuration for preventing cool air from leaking to the outside in a similar manner.

[0031] Moreover, heat radiation pipe 131 is disposed in metal receiving member 123 in order to prevent dew condensation from occurring on the outer surface of the associated storage compartment. This heat radiation pipe 131 utilizes a high-temperature refrigerant pipe in the freezing cycle (not shown), the heat from which heats metal receiving member 123.

[0032] Partition wall 118 is formed by vertically mating upper partition plate 118a with lower partition plate 118b. In addition, partition wall 118 is configured such that heat-insulating member 118c is interposed between upper partition plate 118a and lower partition plate 118b, thereby providing heat insulation between storage compartments set within different temperature ranges. Note that heat-insulating member 118c may be provided by filling foamed heat-insulating material, such as rigid urethane foam, which is foam-filled in the space between outer box 102 and inner box 103.

[0033] Heat exchange suppression space 140 provided under metal receiving member 123 is formed by sealing member 141 and a surface of lower partition plate 118b. Lower partition plate 118b includes heat conduction suppress portion 118d, which is a notch opening, in

a part of the constituent surface in heat exchange suppression space 140 covered with sealing member 141.

[0034] Sealing portion 142 of sealing member 141 is disposed so as to contact with a part, on the storage compartment side, of second freezing compartment door 105a of second freezing compartment 105.

[0035] Note that the discussions, in this embodiment, on the core part of the present invention provided below may also be applied to a refrigerator of a type in which all the storage compartments have pivoted doors, and the storage cases are placed in inner box 103. Moreover, heat exchange suppression space 140 need not necessarily be provided on the bottom surface of partition wall 118, but may be provided on the top surface of partition wall 118.

[0036] An operation and function of a refrigerator having such a configuration will now be described.

[0037] Firstly, the flow of cool air in first freezing compartment 107 will be described. Cool air generated by cooler 112 is forcedly blown by ventilator 113, which rotates in conjunction with rotation of a motor (not shown), out of upper discharge port 120 into each of the cases in first freezing compartment 107. The blown-out cool air is blown into the storage case of each of the storage compartments, and thus chills the stored food. The cool air that has chilled the food flows in parallel as indicated by the arrows through a gap space between second freezing compartment 105 and partition wall 118, and through a gap space between second freezing compartment case 105b and upper freezing compartment case 107b in a middle stage, and then merges together. The merged air flow flows through a gap space below lower freezing compartment case 107c, is sucked from suction port 125, and returns to cooler 112. This is the air flow configuration.

[0038] As described above, the cool air is heated through heat exchange with wall surfaces during the circulation through a freezing temperature zone. In particular, cool air in the upper stage undergoes the largest amount of heat exchange in the vicinity of metal receiving member 123 heated by heat radiation pipe 131. However, providing under metal receiving member 123 heat exchange suppression space 140 in which no air circulation occurs, formed by sealing member 141 and a surface of lower partition plate 118b, reduces heat transfer from heat radiation pipe 131 to the surface contacting with the cool air. This can prevent a temperature rise in the surface in contact with the cool air, of partition wall 118, and can suppress heat exchange between partition wall 118 and the cool air. This can suppress heating of the cool air, improve cooling efficiency, and as a result, reduce the power consumption.

[0039] Moreover, since heating of the cool air can be thus suppressed, the cool air circulates while maintaining a low temperature, and thus the temperature distribution can be kept uniform in the entire freezing temperature zone.

[0040] Moreover, sealing member 141, which constitutes heat exchange suppression space 140 provided under metal receiving member 123, includes sealing portion 142, which is disposed so as to contact with a part, on the storage compartment side, of second freezing compartment door 105a of second freezing compartment 105. Thus, door gasket 124 is formed in a position enclosed by both the inner wall of second freezing compartment door 105a and a space in which no air circulation occurs. This can reduce the flow of cool air toward door gasket 124, which is a member facing both the interior and the exterior of the refrigerator, and thus can suppress heat exchange between air inside and air outside the refrigerator.

[0041] Such an effect can also prevent dew condensation from occurring on the surface, of metal receiving member 123, that is in contact with the exterior of the refrigerator due to a large temperature difference between the interior and the exterior after metal receiving member 123 is cooled by heat exchange between metal receiving member 123 and the cool air.

[0042] Furthermore, since lower partition plate 118b includes heat conduction suppress portion 118d, which is a notch opening, in a part of the constituent surface in heat exchange suppression space 140 covered with sealing member 141, heat from metal receiving member 123 is prevented from transferring into the associated storage compartment by heat conduction of lower partition plate 118b. In addition, sealing member 141 prevents heat conduction suppress portion 118d, which is a notch opening, from being visible from the outside, and thereby prevents deterioration of appearance quality. Note that, although heat conduction suppress portion 118d has been described as a notch opening, it may be a portion having a thin plate thickness of the member.

[0043] As described above, a refrigerator according to this embodiment uses partition wall 118 to divide the interior of heat-insulating box 101 into a plurality of storage compartments, to which cool air is supplied, and includes an openable door in front of each of the storage compartments. On the door, a door gasket is provided which is in tight contact with a metal receiving member that is provided on the front face facing the doors, of partition wall 118. Sealing member 141 is also provided which prevents cool air in the associated storage compartment from directly flowing onto door gasket 124, and thus suppresses heat exchange. A configuration such that metal receiving member 123 and door gasket 124 are heated is provided. A heat exchange suppression structure is also provided which suppresses heat exchange between cool air in the associated storage compartment and metal receiving member 123. The heat exchange suppression structure is configured such that heat exchange suppression space 140 formed by sealing member 141 and a surface of lower partition plate 118b is provided between metal receiving member 123 and the associated storage compartment. This configuration can reduce heat transfer from heat radiation pipe 131 to sealing member 141 having a surface in contact with the cool air, prevent a temperature rise in the surface in contact with the cool

air, of partition wall 118, and suppress heat exchange. This can suppress heating of the cool air, improve cooling efficiency, and as a result, reduce the power consumption.

SECOND EXEMPLARY EMBODIMENT

[0044] FIG. 4 is an enlarged view of a main portion of a refrigerator according to a second embodiment of the present invention.

[0045] In FIG. 4, door gasket 124 is provided along the entire perimeter on the edges of the inner surface of second freezing compartment door 105a. Door gasket 124 is in tight contact with metal receiving member 123 that is provided on the front face of partition wall 118, whose outer surfaces are made of resin portions, and which separates refrigerating compartment 104 from second freezing compartment 105, and thus such tight contact prevents cool air from leaking to the outside. Note that each of refrigerating compartment 104, second freezing compartment 105, ice-making compartment 106, first freezing compartment 107, and vegetable compartment 108 also has a configuration for preventing cool air from leaking to the outside in a similar manner.

[0046] Moreover, heat radiation pipe 131 is disposed in metal receiving member 123 in order to prevent dew condensation from occurring on the outer surface of the associated storage compartment. This heat radiation pipe 131 utilizes a high-temperature refrigerant pipe in the freezing cycle (not shown), the heat from which heats metal receiving member 123.

[0047] Partition wall 118 is formed by vertically mating upper partition plate 118a with lower partition plate 118b. In addition, partition wall 118 is configured such that heat-insulating member 118c is interposed between upper partition plate 118a and lower partition plate 118b, thereby providing heat insulation between storage compartments set within different temperature ranges.

[0048] Heat exchange suppression space 140 provided under metal receiving member 123 is formed by sealing member 145 and a surface of lower partition plate 118b. Lower partition plate 118b includes heat conduction suppress portion 118d, which is a notch opening, in a part of the constituent surface in heat exchange suppression space 140 covered with sealing member 145.

[0049] Sealing portion 143 of sealing member 145 is disposed so as to contact with a part, on the storage compartment side, of second freezing compartment door 105a of second freezing compartment 105. In addition, sealing portion 143 alone forms a cylindrical space.

[0050] Moreover, sealing member 145 includes cool air guide 144. Cool air guide 144 has a connection portion on the storage compartment side of the portion constituting heat exchange suppression space 140.

[0051] Sealing portion 143 and cool air guide 144 respectively have different connection portions, and are formed monolithically with sealing member 145.

[0052] An operation and function of a refrigerator having such a configuration will now be described. Note that description of operations and functions similar to those of the first embodiment will be omitted.

[0053] Cool air that has been generated by cooler 112 and has been forcedly blown by ventilator 113 out of upper discharge port 120 undergoes the largest amount of heat exchange in the vicinity of metal receiving member 123 heated by heat radiation pipe 131 during the circulation within freezing temperature zones. Providing under metal receiving member 123 heat exchange suppression space 140 reduces heat transfer from heat radiation pipe 131 to the surface contacting with the cool air. This can prevent a temperature rise in the surface in contact with the cool air, of partition wall 118, and can suppress heat exchange between partition wall 118 and the cool air. This can suppress heating of the cool air, improve cooling efficiency, and as a result, reduce the power consumption.

[0054] Moreover, sealing member 145, which constitutes heat exchange suppression space 140 provided under metal receiving member 123, includes cylindrical sealing portion 143, which is disposed so as to contact with a part, on the storage compartment side, of second freezing compartment door 105a of second freezing compartment 105. Thus, door gasket 124 is formed in a position enclosed by both the inner wall of second freezing compartment door 105a and a space in which no air circulation occurs. This can reduce the flow of cool air toward door gasket 124, which is a member facing both the interior and the exterior of the refrigerator, and thus can suppress heat exchange between air inside and air outside the refrigerator.

[0055] Moreover, cool air guide 144 prevents cool air that has been generated by cooler 112 and has been blown out by ventilator 113 from directly flowing onto the surface constituting heat exchange suppression space 140, of sealing member 145, and thus suppresses heat exchange between the air inside heat exchange suppression space 140 and the cool air. In addition, cool air guide 144 has a downward-curved edge so that the cool air is directed toward the associated storage compartment, and providing a shape that also makes it less likely for the cool air to flow onto sealing portion 143 also improves the heat exchange suppression effect of sealing portion 143.

[0056] Such an effect can also prevent dew condensation from occurring on the surface, of metal receiving member 123, that is in contact with the exterior of the refrigerator due to a large temperature difference between the interior and the exterior after metal receiving member 123 is cooled by heat exchange between metal receiving member 123 and the cool air.

[0057] Since lower partition plate 118b includes heat conduction suppress portion 118d, which is a notch opening, in a part of the constituent surface in heat exchange suppression space 140 covered with sealing member 145, heat from metal receiving member 123 is prevented from transferring into the associated storage compart-

ment by heat conduction of lower partition plate 118b. In addition, sealing member 145 prevents heat conduction suppress portion 118d, which is a notch opening, from being visible from the outside, and thereby prevents deterioration of appearance quality.

[0058] As described above, a refrigerator according to this embodiment uses partition wall 118 to divide the interior of heat-insulating box 101 into a plurality of storage compartments, to which cool air is supplied, and includes an openable door in front of each of the storage compartments. On the door, a door gasket is provided which is in tight contact with a metal receiving member that is provided on a front face facing the doors, of partition wall 118. Sealing member 145 is provided which prevents cool air in the associated storage compartment from directly flowing onto door gasket 124, and thus suppresses heat exchange. A configuration such that metal receiving member 123 and door gasket 124 are heated is provided. A heat exchange suppression structure is also provided which suppresses heat exchange between cool air in the associated storage compartment and metal receiving member 123. The heat exchange suppression structure is configured such that heat exchange suppression space 140 formed by sealing member 145 and a surface of lower partition plate 118b is provided between metal receiving member 123 and the associated storage compartment. This configuration can reduce heat transfer from heat radiation pipe 131 to sealing member 145 having a surface in contact with the cool air, prevent a temperature rise in the surface in contact with the cool air, of partition wall 118, and suppress heat exchange. This can suppress heating of the cool air, improve cooling efficiency, and as a result, reduce the power consumption.

THIRD EXEMPLARY EMBODIMENT

[0059] FIG. 5 is an enlarged detail view of a main portion of a refrigerator according to a third embodiment of the present invention. FIG. 6 is a detail view of a sealing member according to the third embodiment of the present invention. FIG. 7 is an enlarged detail view of a main portion of the refrigerator with the door closed according to the third embodiment of the present invention.

[0060] In FIGS. 5 and 7, heat radiation pipe 131 is disposed in metal receiving member 123 in order to prevent dew condensation from occurring on the outer surface of the associated storage compartment. Metal receiving member 123 is heated by means of the heat from this heat radiation pipe 131. Partition wall 118 is formed by vertically mating upper partition plate 118a with lower partition plate 118b. In addition, partition wall 118 is configured such that heat-insulating member 118c is interposed between upper partition plate 118a and lower partition plate 118b, thereby providing heat insulation between storage compartments set within different temperature ranges.

[0061] Heat exchange suppression space 140 provided under metal receiving member 123 is formed by sealing member 147 and a surface of lower partition plate 118b. Sealing member 147 includes sealing portion 143 that alone forms a cylindrical space, and includes cool air guide 144 that guides the flow direction of the discharged cool air. Sealing portion 143 has a connection portion on the door side of the portion constituting heat exchange suppression space 140, of sealing member 147. Cool air guide 144 has a connection portion on the storage compartment side of the portion constituting heat exchange suppression space 140, with respect to the center in the forward and backward directions of sealing member 147. Sealing portion 143 and cool air guide 144 respectively have different connection portions, and are formed monolithically with sealing member 147. Sealing member 147 is secured by fitting sealing member fixing section 146 into protrusion 118e of lower partition plate 118b. Heat-insulating member 150 is disposed in heat exchange suppression space 140. Heat-insulating member 150 is adhesively secured using the inner surface of sealing member 147 as the adherend surface, which adheres to a foam member using, for example, polyethylene material.

[0062] In FIG. 6, sealing member 147 has gap prevention angle A, which is an acute angle greater than or equal to one degree, between the surface constituting heat exchange suppression space 140 and sealing member fixing section 146 or the surface of lower partition plate 118b. Also, sealing member 147 has droop prevention angle B, which is an acute angle greater than or equal to one degree, between the surface constituting heat exchange suppression space 140 and cool air guide 144.

[0063] An operation and function of a refrigerator having such a configuration will now be described. Note that description of operations and functions similar to those of the first or second embodiment will be omitted.

[0064] Sealing member 147, which constitutes heat exchange suppression space 140 provided under metal receiving member 123, includes cylindrical sealing portion 143. Since this sealing portion 143 is disposed so as to contact with a part, on the storage compartment side, of second freezing compartment door 105a of second freezing compartment 105, door gasket 124 is formed in a position enclosed by both the inner wall of second freezing compartment door 105a and a space in which no air circulation occurs. This configuration can reduce the flow of cool air toward door gasket 124, which is a member facing both the interior and the exterior of the refrigerator, and thus can suppress heat exchange between air inside and air outside the refrigerator.

[0065] Moreover, cool air guide 144 prevents cool air that has been blown out by ventilator 113 from directly flowing onto the surface constituting heat exchange suppression space 140, of sealing member 147, and thus suppresses heat exchange between the air inside heat exchange suppression space 140 and the cool air. In addition, cool air guide 144 has a downward-curved edge so that the cool air is directed toward the associated stor-

age compartment, and providing a shape that also makes it less likely for the cool air to flow onto sealing portion 143 also improves the heat exchange suppression effect of sealing portion 143.

[0066] Furthermore, placement of heat-insulating member 150 inside heat exchange suppression space 140 further improves the heat insulation effect of heat exchange suppression space 140.

[0067] Sealing portion 143 and cool air guide 144 of sealing member 147 are placed spaced apart when second freezing compartment door 105a is open, but upon closure of second freezing compartment door 105a, sealing portion 143 is deformed as shown in FIG. 7, and thus moves toward the storage compartment side. This deformation of sealing portion 143 causes a part of sealing portion 143 and a part of cool air guide 144 to come in contact with each other, thereby forming second heat exchange suppression space 161. Second heat exchange suppression space 161 further reduces the effect of discharged cool air upon heat exchange suppression space 140 since there is no movement of the air inside the space, and thus further improves the heat insulation effect of heat exchange suppression space 140.

[0068] Sealing member 147 has gap prevention angle A, which is an acute angle greater than or equal to one degree, between the surface constituting heat exchange suppression space 140 and sealing member fixing section 146 or the surface of lower partition plate 118b. Accordingly, after sealing member 147 has been attached on partition wall 118, sealing member 147 is deformed about spring section 160, and thus a force is produced so as to move sealing member 147 toward lower partition plate 118b. This can prevent a gap from being generated between sealing member 147 and partition wall 118. Prevention of a gap between sealing member 147 and partition wall 118 ensures appearance quality, and at the same time, ensures that the heat exchange suppression effect of heat exchange suppression space 140 is exerted.

[0069] Also, droop prevention angle B is provided which is an acute angle greater than or equal to one degree, between the surface constituting heat exchange suppression space 140 and cool air guide 144. Thus, cool air guide 144, which is likely to droop due to its own weight, is configured so as to be raised in advance. Therefore, irregularity due to drooping is compensated, and thus contacting with food or the like is prevented in practical use. It is also ensured that the heat exchange suppression effect of second heat exchange suppression space 161 is exerted.

[0070] Note that, although this embodiment has been described in which heat-insulating member 150 is adhesively secured using the inner surface of sealing member 147 as the adherend surface, the surface of partition wall 118 may be used as the adherend surface.

FOURTH EXEMPLARY EMBODIMENT

[0071] FIG. 8 is an enlarged cross-sectional view of a main portion of a refrigerator according to a fourth embodiment of the present invention.

[0072] In FIG. 8, heat radiation pipe 131 is disposed in metal receiving member 123 in order to prevent dew condensation from occurring on the outer surface of the associated storage compartment. Metal receiving member 123 is heated by means of the heat from this heat radiation pipe 131. Partition wall 118 is formed by vertically mating upper partition plate 118a with lower partition plate 118b. In addition, partition wall 118 is configured such that heat-insulating member 118c is interposed between upper partition plate 118a and lower partition plate 118b, thereby providing heat insulation between storage compartments set within different temperature ranges.

[0073] Heat exchange suppression space 140 provided under metal receiving member 123 is formed by sealing member 148, a surface of lower partition plate 118b, and door gasket 124. Sealing portion 142 of sealing member 148 is disposed so as to contact with a part, on the storage compartment side, of second freezing compartment door 105a of second freezing compartment 105.

[0074] Heat exchange suppression space heat-insulating member 150 is disposed in heat exchange suppression space 140. Heat-insulating member 150 is adhesively secured using the inner surface of sealing member 148 as the adherend surface, which adheres to a foam member using, for example, polyethylene material.

[0075] An operation and function of a refrigerator having such a configuration will now be described. Note that description of operations and functions similar to those of any of the first through third embodiments will be omitted.

[0076] Heat exchange suppression space 140, in which heat exchange suppression space heat-insulating member 150 is disposed, is formed by sealing member 148, a surface of lower partition plate 118b, and door gasket 124. Preventing contact between sealing member 148 and door gasket 124 can prevent heat transfer into the associated storage compartment by heat conduction from door gasket 124 to sealing member 148, and thus can further improve the heat insulation effect of heat exchange suppression space 140.

FIFTH EXEMPLARY EMBODIMENT

[0077] FIG. 9 is an enlarged cross-sectional view of a main portion of a refrigerator according to a fifth embodiment of the present invention. FIG. 10 is a perspective view of the sealing member of the refrigerator according to the fifth embodiment of the present invention.

[0078] In FIG. 9, heat radiation pipe 131 is disposed in metal receiving member 123 in order to prevent dew condensation from occurring on the outer surface of the associated storage compartment. Metal receiving member 123 is heated by means of the heat from this heat radi-

ation pipe 131. Partition wall 118 is formed by vertically mating upper partition plate 118a with lower partition plate 118b. In addition, partition wall 118 is configured such that heat-insulating member 118c is interposed between upper partition plate 118a and lower partition plate 118b, thereby providing heat insulation between storage compartments set within different temperature ranges.

[0079] Heat exchange suppression space 140 provided under metal receiving member 123 is formed by sealing member 149 and a surface of lower partition plate 118b. Sealing portion 142 of sealing member 149 is disposed so as to contact with a part, on the storage compartment side, of second freezing compartment door 105a of second freezing compartment 105.

[0080] Heat-insulating member 150 is disposed in heat exchange suppression space 140. Heat-insulating member 150 is adhesively secured using the inner surface of sealing member 149 as the adherend surface, which adheres to a foam member using, for example, polyethylene material.

[0081] Edge cut-out opening 170 is provided in a portion constituting heat exchange suppression space 140, of sealing member 149, and the opening of edge cut-out opening 170 is covered by heat-insulating member 150.

[0082] An operation and function of a refrigerator having such a configuration will now be described. Note that description of operations and functions similar to those of any of the first through fourth embodiments will be omitted.

[0083] Sealing member 149, which constitutes heat exchange suppression space 140 provided under metal receiving member 123, includes sealing portion 142, which is disposed so as to contact with a part, on the storage compartment side, of second freezing compartment door 105a of second freezing compartment 105. Thus, door gasket 124 is formed in a position enclosed by both the inner wall of second freezing compartment door 105a and a space in which no air circulation occurs. This can reduce the flow of cool air toward door gasket 124, which is a member facing both the interior and the exterior of the refrigerator, and thus can suppress heat exchange between air inside and air outside the refrigerator.

[0084] Placement of heat exchange suppression space heat-insulating member 150 inside heat exchange suppression space 140 can improve the heat insulation effect of heat exchange suppression space 140.

[0085] Furthermore, providing edge cut-out opening 170 in a portion constituting heat exchange suppression space 140, of sealing member 149, prevents heat conduction to the associated storage compartment by heat conduction of sealing member 149. Also, covering the opening of edge cut-out opening 170 by heat exchange suppression space heat-insulating member 150 can prevent heat exchange with the interior of heat exchange suppression space 140 via edge cut-out opening 170, and thus can further improve the heat insulation effect of heat exchange suppression space 140.

[0086] The present invention provides a heat-insulating box including an inner box, an outer box, and heat-insulating material filled between the inner box and the outer box, and a partition wall that vertically separates storage compartments set within different temperature ranges within the heat-insulating box. The partition wall divides the interior of the heat-insulating box into a plurality of storage compartments, to which cool air is supplied. An openable door is provided in front of each of the storage compartments. A door gasket is provided which is in tight contact with a metal receiving member that is provided on a front face of the partition wall facing the doors. A sealing member is provided which has a sealing portion that is attached to the partition wall, and that partially closes a gap between a corresponding one of the doors and the partition wall. Moreover, a heat exchange suppression space formed by both the partition wall and the sealing member is provided on the inward side of the corresponding storage compartment with respect to the door gasket, at least either on the top of, or on the bottom of, the metal receiving member. This configuration can suppress, by the space, heat exchange between the metal receiving member in contact with the external air, and the interior of the associated storage compartment, and thus a refrigerator having reduced power consumption can be provided.

[0087] According to the present invention, the sealing member includes a cool air guide. Therefore, the flow of cool air can be guided, heat exchange between the cool air and the sealing member can be suppressed, the effect of the heat exchange suppression space can be improved, and thus a refrigerator having reduced power consumption can be provided.

[0088] According to the present invention, the cool air guide includes a connection portion with the sealing member, on the storage compartment side with respect to the center in the forward and backward directions of the heat exchange suppression space. Therefore, heat exchange between the periphery of the metal receiving member and the cool air guide cooled by the cool air by heat conduction of the sealing member can be reduced, and thus a refrigerator having reduced power consumption can be provided.

[0089] According to the present invention, the sealing portion of the sealing member alone forms a sealing portion independent space, which is a second heat exchange suppression space. Therefore, heat exchange between the periphery of the metal receiving member and the associated storage compartment via the sealing portion can be suppressed by the space, and thus a refrigerator having reduced power consumption can be provided.

[0090] According to the present invention, a heat exchange suppression space heat-insulating member is provided in the heat exchange suppression space of the sealing member. Therefore, heat exchange between the periphery of the metal receiving member and the interior of the associated storage compartment can be sup-

pressed by the heat insulation effect of the heat-insulating member, and thus a refrigerator having reduced power consumption can be provided.

[0091] According to the present invention, the heat-insulating member is adhesively secured to the space side surface of the sealing member in the heat exchange suppression space. Therefore, the heat-insulating member can be installed before the sealing member is attached to the refrigerator body, and thus improvement of work efficiency can be achieved.

[0092] According to the present invention, the basic plane defining the heat exchange suppression space has an angle greater than or equal to one degree with respect to the base attachment face of the sealing member. This can prevent a gap with respect to the partition wall from being generated after attachment of the sealing member, and thus can ensure appearance quality, and at the same time, can ensure that a heat exchange suppression effect is exerted.

[0093] According to the present invention, the cool air guide has an angle greater than or equal to one degree with respect to the basic plane defining the heat exchange suppression space. Thus, prevention of drooping of the cool air guide due to its own weight can prevent the cool air guide from contacting with food or the like in practical use, and at the same time, the heat exchange suppression effect of the heat exchange suppression space can be improved, and thus a refrigerator having reduced power consumption can be provided.

[0094] According to the present invention, securing the sealing member by being fitted into the partition wall can facilitate component attachment works during product assembling, and thus improvement of work efficiency can be achieved.

[0095] According to the present invention, the partition wall includes a heat conduction suppress portion in the heat exchange suppression space formed by both the partition wall and the sealing member. Thus, heat exchange between the periphery of the metal receiving member and the interior of the associated storage compartment via the partition wall can be suppressed, and thus a refrigerator having reduced power consumption can be provided.

INDUSTRIAL APPLICABILITY

[0096] As described above, a refrigerator according to the present invention may also be applied to household or industrial refrigerators, or to vegetable-dedicated storages.

REFERENCE MARKS IN THE DRAWINGS

[0097]

11	door
12	door gasket
13	partition wall
14	metal receiving member
15	cooler
16	fan
17	discharge port
18	storage case
19	storage case
21	return duct
22	upper storage compartment
23	heat radiation pipe
24	sealing member
25	freezing compartment
100	refrigerator
101	heat-insulating box
102	outer box
103	inner box
104	refrigerating compartment
104a	refrigerating compartment right door
104b	refrigerating compartment left door
104c	refrigerating compartment shelf plate
104d	refrigerating compartment case
105	second freezing compartment
105a	second freezing compartment door
105b	second freezing compartment case
106	ice-making compartment
106a	ice-making compartment door
107	first freezing compartment
107a	first freezing compartment door
107b	upper freezing compartment case
107c	lower freezing compartment case
108	vegetable compartment
108a	vegetable compartment door
108b	upper vegetable compartment case
108c	lower vegetable compartment case
109	compressor
110	cooling compartment
111	partition member
111a	storage compartment side partition member
111b	cooling compartment side partition member
111c	ventilation duct
112	cooler
113	ventilator
114	radiant heating means
115	drain pan
116	drain tube
117	evaporating dish
118	partition wall
118a	upper partition plate
118b	lower partition plate
118c	heat-insulating member
118d	heat conduction suppress portion
118e	protrusion
120	upper discharge port
121	damper
122	refrigerating compartment duct
123	metal receiving member
124	door gasket
125	suction port
131	heat radiation pipe

140	heat exchange suppression space
141	sealing member
142	sealing portion
143	sealing portion
144	cool air guide
145	sealing member
146	sealing member fixing section
147	sealing member
148	sealing member
149	sealing member
150	heat-insulating member
160	spring section
161	second heat exchange suppression space
170	edge cut-out opening
A	gap prevention angle
B	droop prevention angle

Claims

1. A refrigerator comprising:

a heat-insulating box including an inner box, an outer box, and a heat-insulating material filled between the inner box and the outer box;
a partition wall that vertically divides an interior of the heat-insulating box into a plurality of storage compartments, to which cool air is supplied;
an openable door provided in front of each of the plurality of storage compartments; and
a door gasket in tight contact with a metal receiving member that is provided on a front face of the partition wall facing the doors,
wherein the refrigerator includes:

a sealing member attached to the partition wall, and having a sealing portion for partially closing a gap between one of the doors and the partition wall, and
a heat exchange suppression space formed by the partition wall and the sealing member on at least one of top and bottom of the metal receiving member at one side of the door gasket facing an inside of one of the plurality of storage compartments.

2. The refrigerator according to claim 1, wherein the sealing member includes a cool air guide.

3. The refrigerator according to claim 2, wherein a connection portion connecting the cool air guide with the sealing member is provided on a storage compartment side with respect to a center of the heat exchange suppression space.

4. The refrigerator according to claim 1 or 2, wherein the sealing portion of the sealing member forms an independent sealing space.

5. The refrigerator according to claim 1 or 2 further comprising a heat-insulating member disposed in the heat exchange suppression space.

6. The refrigerator according to claim 5, wherein the heat exchange suppression space heat-insulating member is adhesively secured to the sealing member.

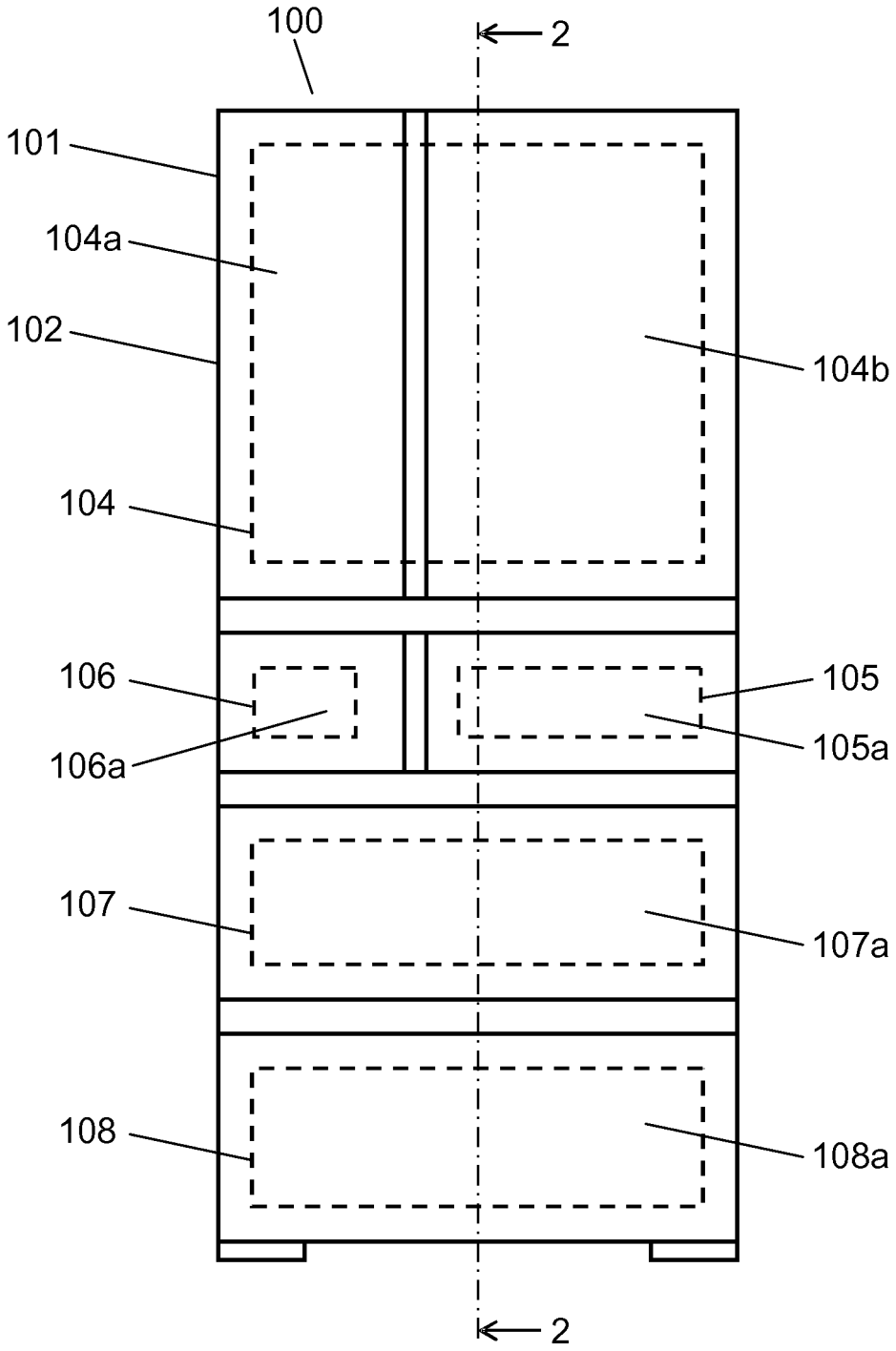
7. The refrigerator according to claim 1 or 2, wherein a basic plane defining the heat exchange suppression space has an angle equal to or greater than one degree with respect to a base attachment face of the sealing member.

8. The refrigerator according to claim 7, wherein the cool air guide has an angle greater than or equal to one degree with respect to the basic plane defining the heat exchange suppression space.

9. The refrigerator according to claim 1 or 2, wherein the sealing member is secured by being fitted into the partition wall.

10. The refrigerator according to claim 1 or 2, wherein the partition wall includes a heat conduction suppress portion in the heat exchange suppression space formed by both the partition wall and the sealing member.

FIG. 1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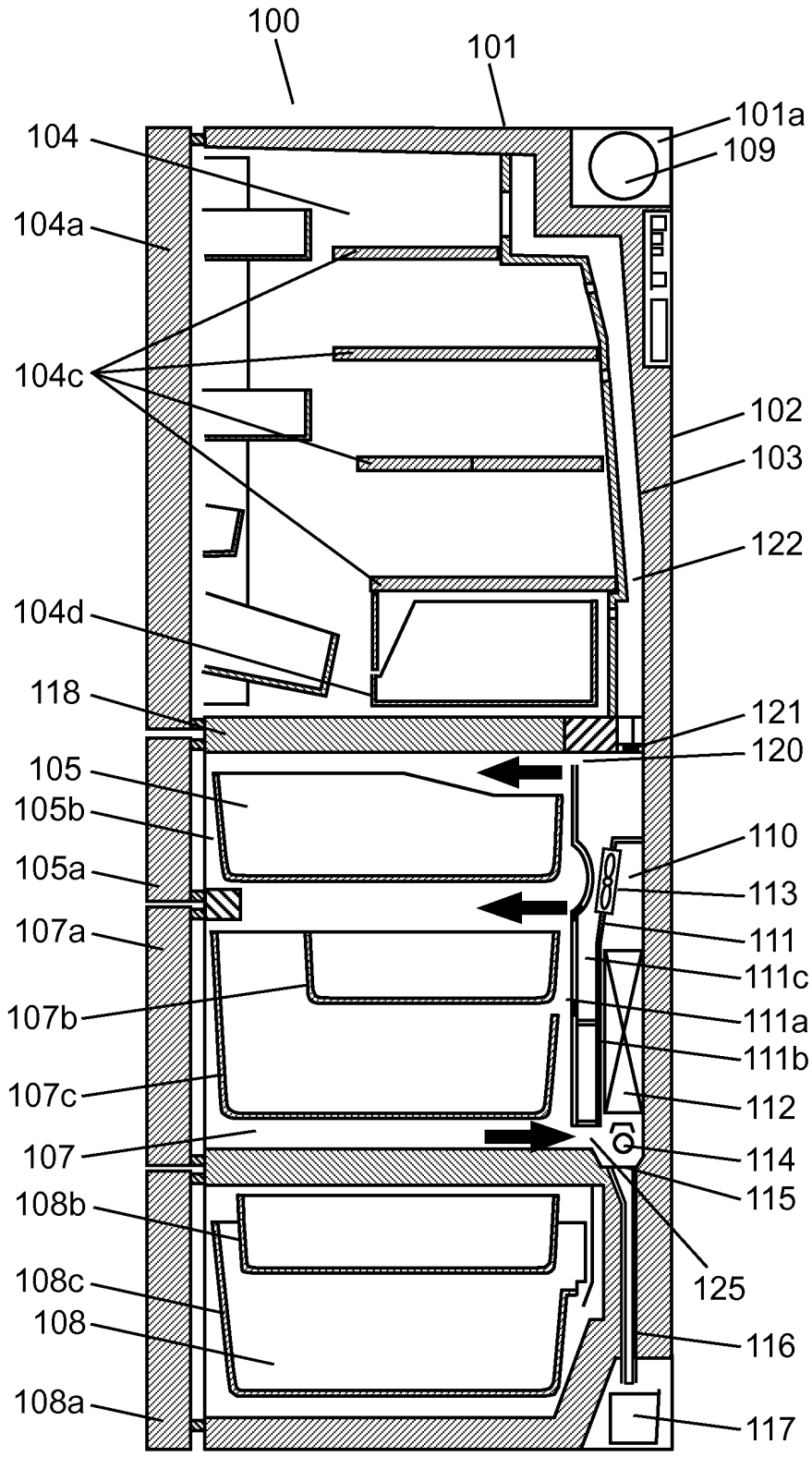
108a
2

FIG. 2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108a
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FIG. 3

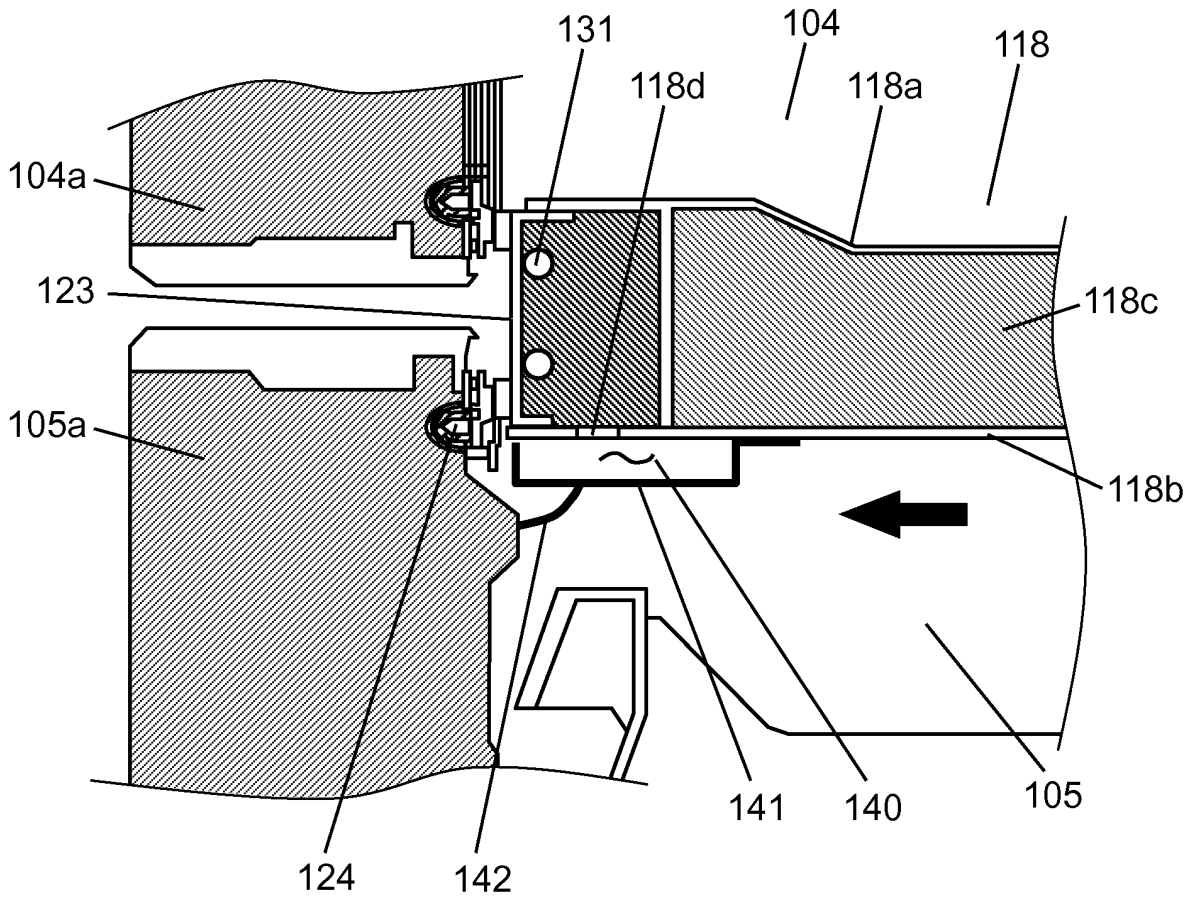
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FIG. 4

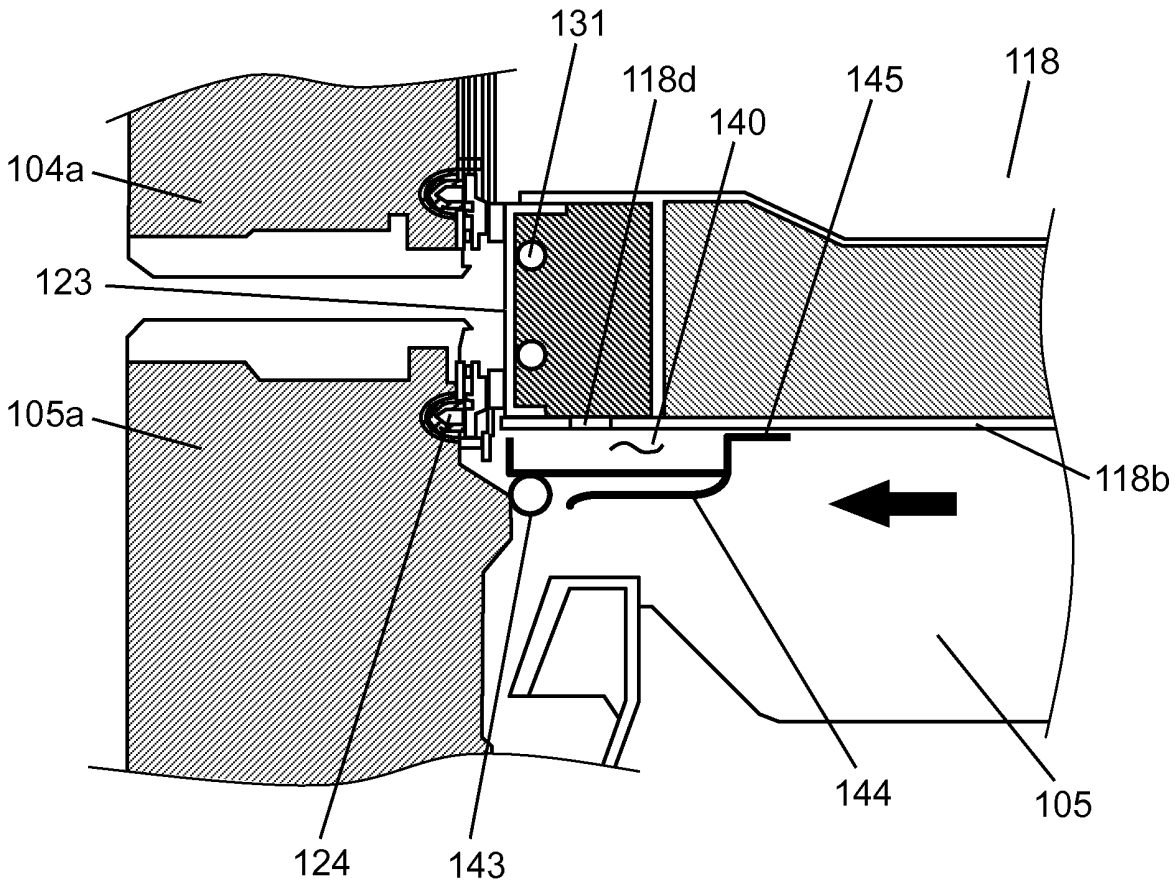

FIG. 5

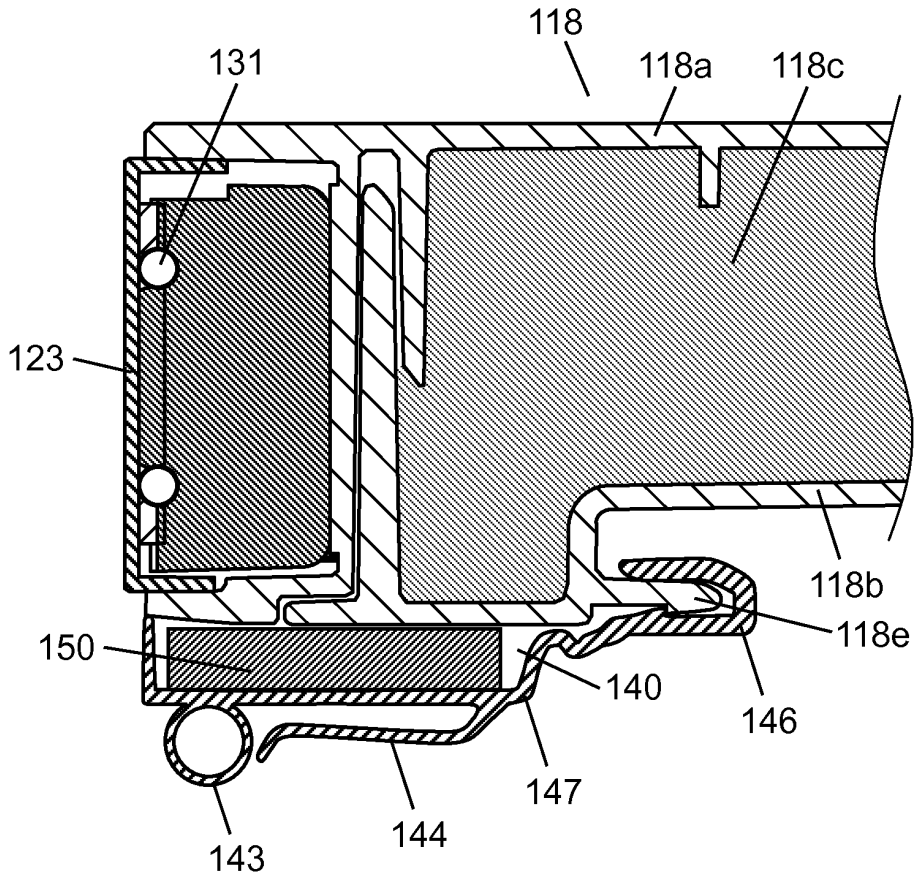
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FIG. 6

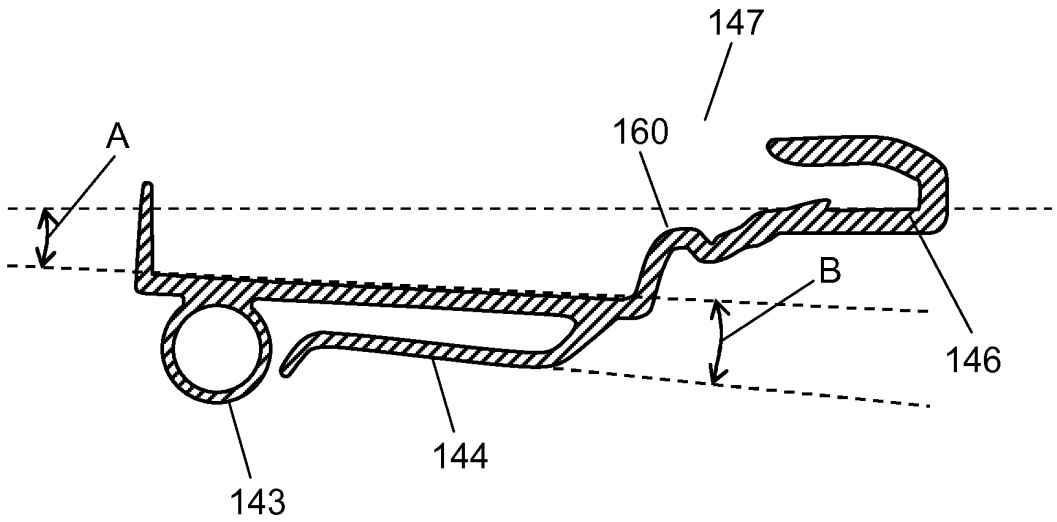

147
A
160
B
146
144
143

FIG. 7

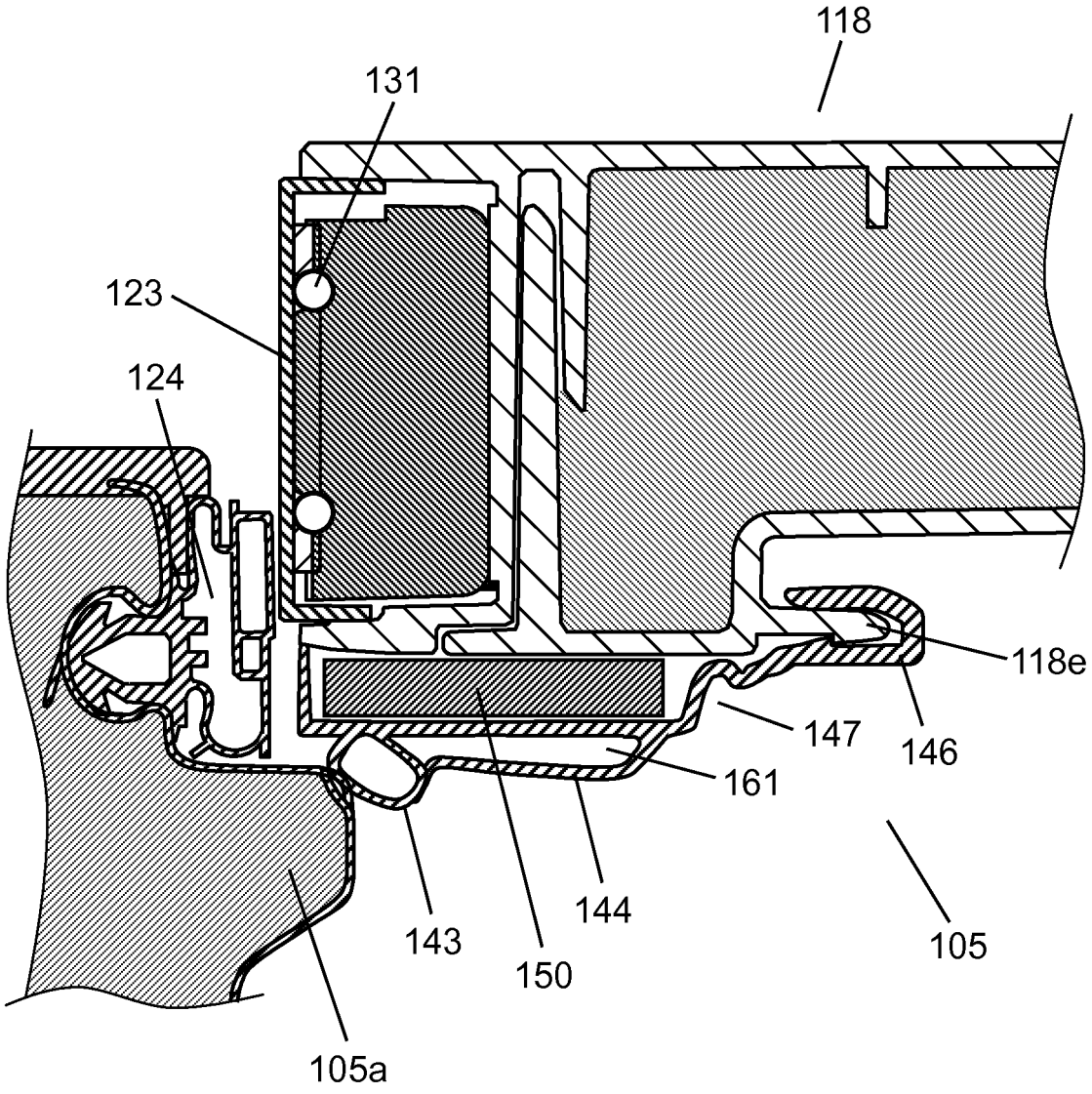


FIG. 8

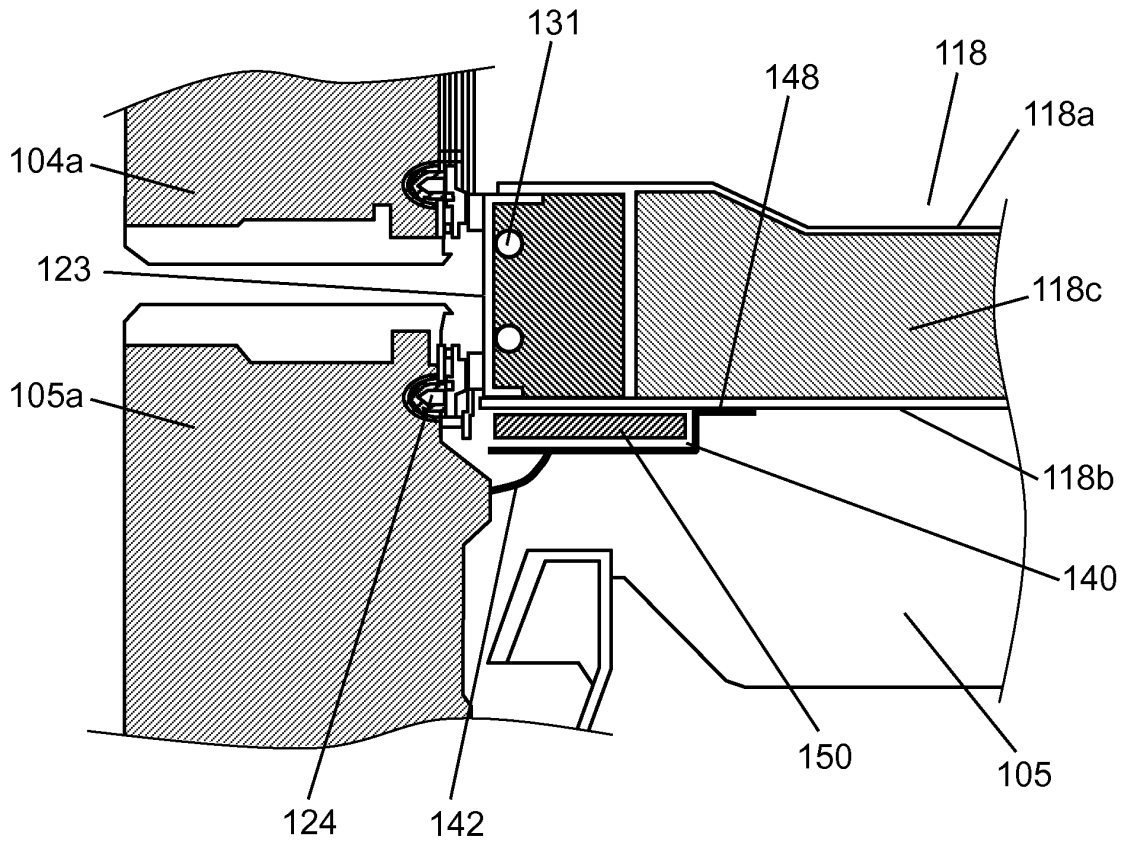
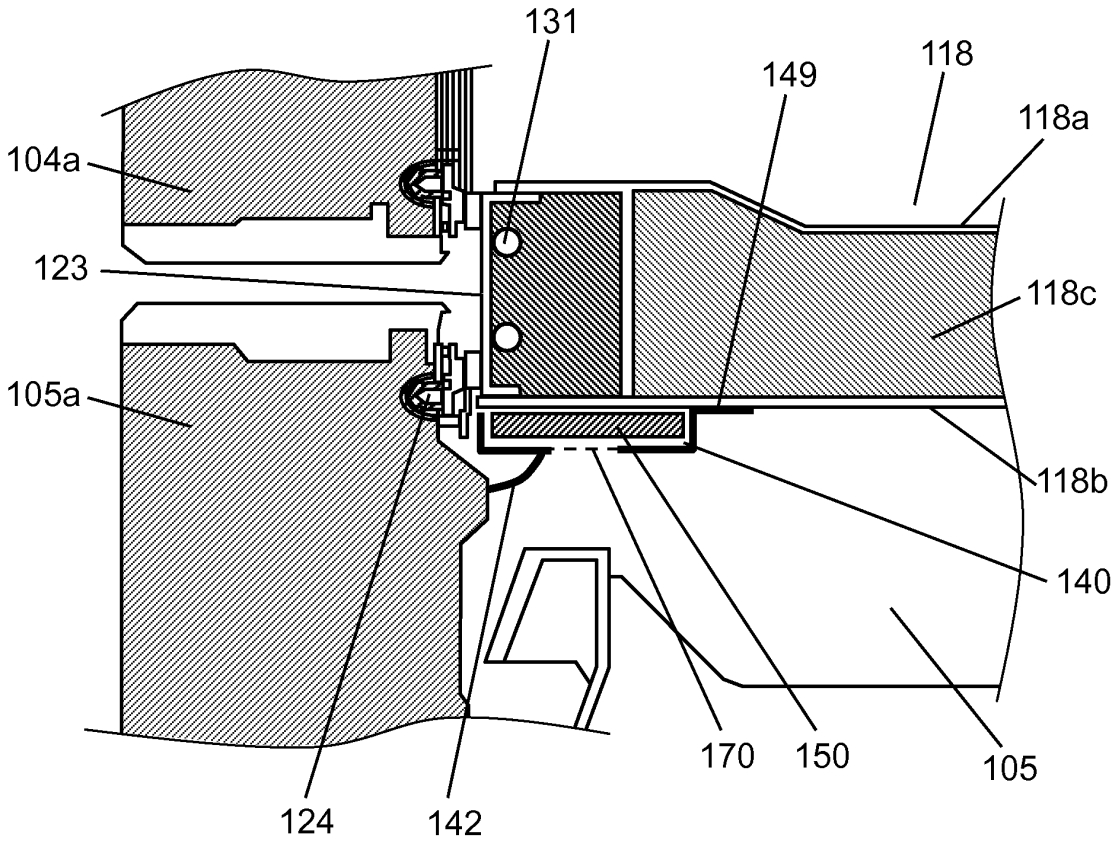


FIG. 9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118b
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142

FIG. 10

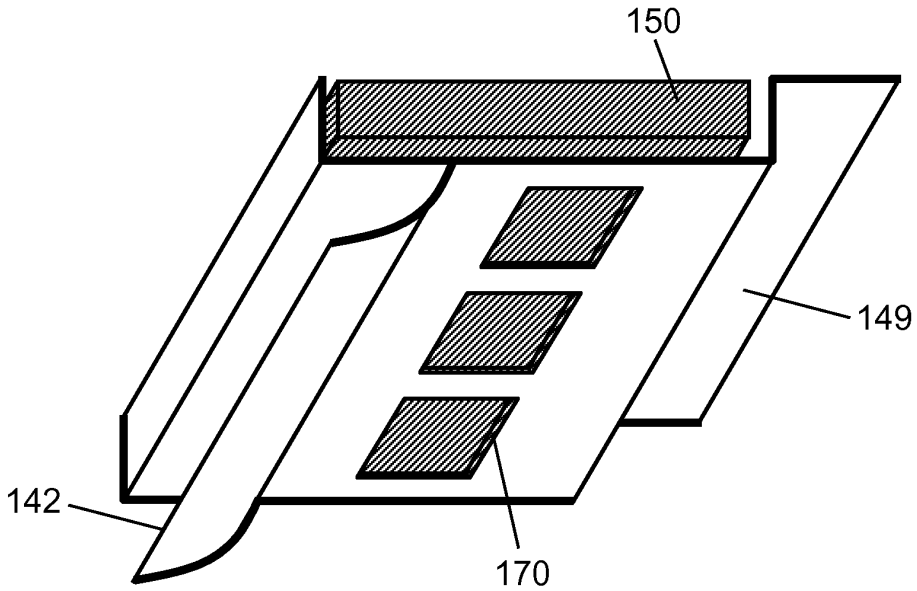
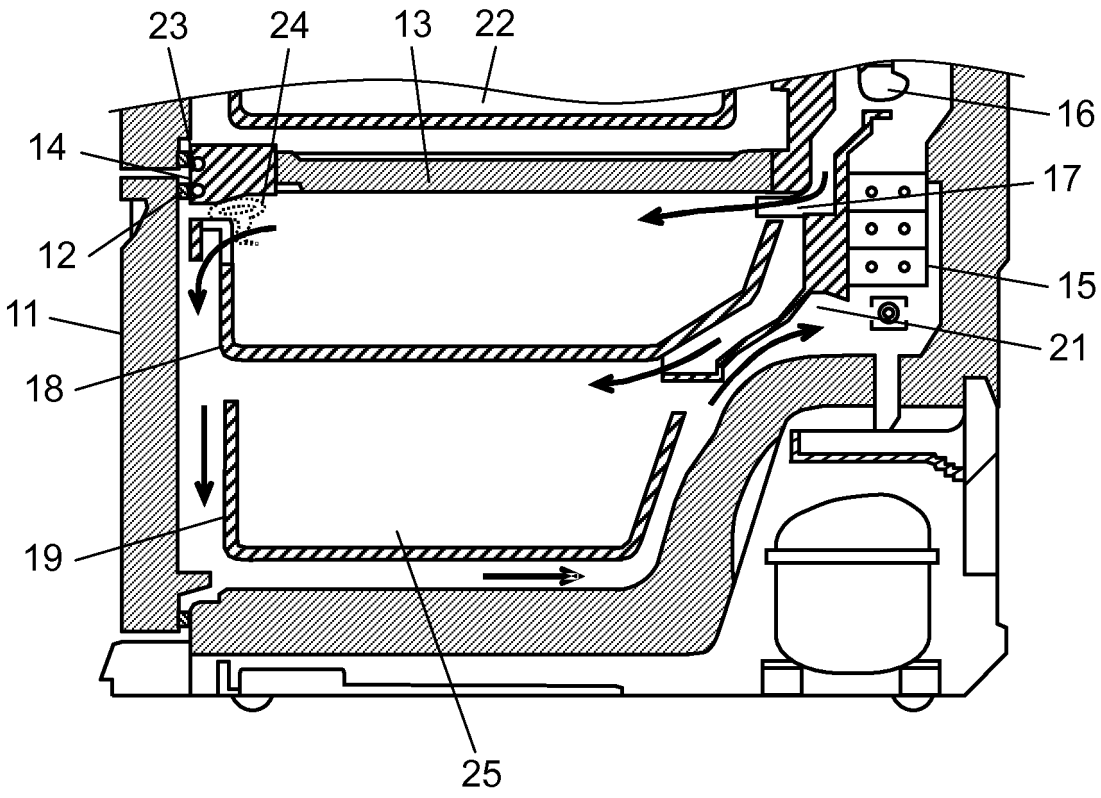

150
149
142
170

FIG. 11



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/007398

A. CLASSIFICATION OF SUBJECT MATTER
F25D23/06(2006.01)i, *F25D23/02*(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)
F25D23/06, F25D23/02

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 1996-2013
Kokai Jitsuyo Shinan Koho 1971-2013 Toroku Jitsuyo Shinan Koho 1994-2013

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	WO 2011/036872 A1 (Panasonic Corp.), 31 March 2011 (31.03.2011), entire text; all drawings (particularly, paragraphs [0113] to [0125]; fig. 15 to 17) & JP 2011-220663 A & CN 102472561 A	1-10
Y	JP 2001-280834 A (Toshiba Corp.), 10 October 2001 (10.10.2001), entire text; all drawings (particularly, paragraphs [0028] to [0037], [0043] to [0049]; fig. 1 to 8) (Family: none)	1-10

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

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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
30 January, 2013 (30.01.13)	12 February, 2013 (12.02.13)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/007398

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2002-22351 A (Toshiba Corp.), 23 January 2002 (23.01.2002), entire text; all drawings (particularly, paragraphs [0027] to [0028]; fig. 1, 3, 4) (Family: none)	2,9
Y	JP 10-96584 A (Mitsubishi Electric Corp.), 14 April 1998 (14.04.1998), entire text; all drawings (particularly, fig. 4 to 13) (Family: none)	4
Y	JP 2005-315547 A (Toshiba Corp.), 10 November 2005 (10.11.2005), entire text; all drawings (particularly, paragraphs [0022] to [0025]; fig. 3) (Family: none)	5
Y	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 72031/1992(Laid-open No. 35887/1994) (Hoshizaki Electric Co., Ltd.), 13 May 1994 (13.05.1994), entire text; all drawings (particularly, paragraph [0007]) (Family: none)	10
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 109550/1985(Laid-open No. 19589/1987) (Hoshizaki Electric Co., Ltd.), 05 February 1987 (05.02.1987), entire text; all drawings (particularly, fig. 4 to 6) (Family: none)	7,8

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H1096584 B **[0009]**