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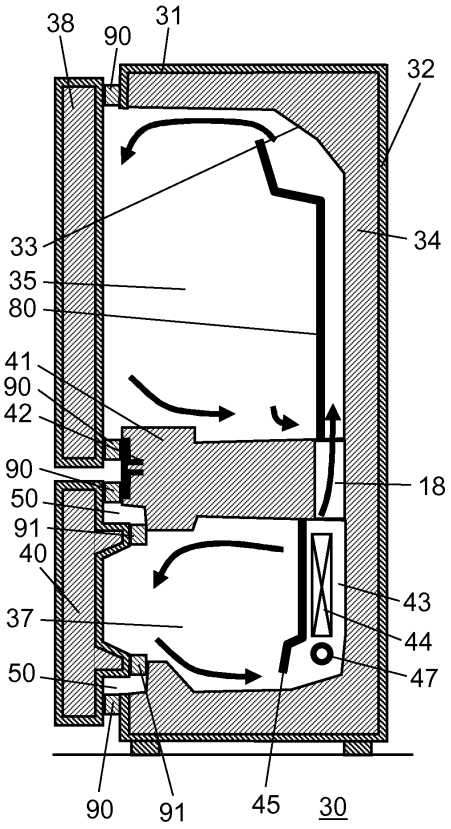
(54) REFRIGERATOR

(57) Refrigerator (30) includes heat-insulating box body (31) formed from inner box (33), outer box (32), and a heat-insulating material filled between inner box (33) and outer box (32), and a storage compartment provided in heat-insulating box body (31). In addition, refrigerator (30) includes partition wall (41) vertically partitioning the storage compartment, an openable door provided on an opening of the storage compartment, and metal receiving member (42) provided at the door side of partition wall (41). Refrigerator (30) further includes door gasket (90) in close-contact with metal receiving member (42), and independent opening-side space (50) provided in a front opening of the storage compartment and separated from a space inside the storage compartment.

FIG. 1A



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Description

TECHNICAL FIELD

[0001] The present invention relates to a refrigerator, and more particularly to a structure for preventing dew condensation on a peripheral edge of a front opening of a refrigerator.

BACKGROUND ART

[0002] A description will be made of conventional refrigerator 100.

[0003] FIG. 9 is a cross-sectional view showing a basic structure of freezing compartment 125 of conventional refrigerator 100, FIG. 10 is a perspective view showing a configuration of a refrigeration cycle piping of conventional refrigerator 100, and FIG. 11 shows a cross-sectional structure of a portion where partition wall 113 and door 111 of conventional refrigerator 100 are connected with each other.

[0004] As shown in FIGS. 9 and 11, door gasket 112 is provided at a peripheral edge portion of an inner surface of door 111 over an entire periphery. A front surface of partition wall 113 is provided with metal receiving member 114. Metal receiving member 114 forming a receiving surface of door gasket 112 is brought into close-contact with door gasket 112 to prevent cool air from leaking outside.

[0005] Cooler 115 is installed in a rear portion of main body 131. Cool air generated by cooler 115 is blown out from discharge port 117 of a rear surface side of freezing compartment 125 into the refrigerator by fan 116 to cool foods stored therein.

[0006] Cool air that cools the foods circulates as shown by arrows in FIG. 9. Specifically, the cool air flows from the rear surface side of freezing compartment 125 to front upper portions of storage cases 118, 119, and downwardly passes through a space between an inner wall of door 111 and front surfaces of storage cases 118, 119. The cool air, then, passes through a space between a bottom surface of lower storage case 119 and a bottom wall of freezing compartment 125 to return from return duct 121 to cooler 115.

[0007] In this type of configuration, a front surface of partition wall 113 formed between freezing compartment 125 and upper storage compartment 122 is cooled by the cool air that has reached the front upper portion of storage case 118. Heat radiation pipe 123 is disposed in order to prevent dew condensation on a front surface of cooled partition wall 113 due to a temperature difference between inside and outside. Heat radiation pipe 123 uses a high temperature refrigerant pipe in a refrigeration cycle (not shown).

[0008] The front surface of partition wall 113 is heated to a high temperature by heat of heat radiation pipe 123. This can prevent dew condensation on metal receiving member 114 of partition wall 113. However, this type of configuration has a disadvantage in that cooling efficiency is lowered, because air above a front side of freezing compartment 125 is also heated.

[0009] In order to prevent the cooling efficiency from being lowered, there is proposed a mechanism in which sealing member 124 shown with a dotted line in FIG. 9 is provided in a space portion above a front side of storage case 118 which is near partition wall 113 to block the flow of cool air to the door gasket 112 side (e.g., refer to PTL 1).

[0010] In such a conventional configuration, as shown in FIG. 11, both of upper and lower end portions of metal receiving member 114 are extended to an inner side (rear side) of a storage compartment, such as freezing compartment 125, from a viewpoint of securing strength. The extended portion is proximate to heat-insulating material 113a, but is not in contact with heat-insulating material 113a in consideration with insertion workability, or for a structural reason. A gap is generated between the extended portion and heat-insulating material 113a.

[0011] Accordingly, part of heat radiation from heat radiation pipe 123 is likely to enter, as a heat load, into an inside of the storage compartment such as freezing compartment 125 through both of the upper and lower end portions of metal receiving member 114. This may lead to lowering of cooling system efficiency.

Citation List

Patent Literature

[0012] PTL 1: Unexamined Japanese Patent Publication No. H10-96584

SUMMARY OF THE INVENTION

[0013] The present invention has been made in view of the problems described above, and provides a refrigerator which is less likely to produce dew condensation on a surface of a metal receiving member without lowering cooling system efficiency.

[0014] The refrigerator according to the present invention includes a heat-insulating box body formed from an inner box, an outer box, and a heat-insulating material filled between the inner box and the outer box, and a storage compartment provided in the heat-insulating box body. The refrigerator also includes a partition wall vertically partitioning the storage compartment, an openable door provided on an opening of the storage compartment, and a metal receiving member provided on the partition wall at one side facing the door. The refrigerator further includes a door gasket in close-contact with the metal receiving member, and an independent opening-side space separated from a space inside the storage compartment at a front opening of the storage compartment.

[0015] Accordingly, since the front opening of the storage compartment includes the independent opening-side space separated from the space inside the storage compartment, the independent opening-side space can suppress heat leakage of the storage compartment. Further, cooling of the metal receiving member provided at a door-side front surface portion of the partition wall can be suppressed, to thereby suppress dew condensation. Thus, it is possible to provide a refrigerator which is less likely to generate dew condensation on the surface of the metal receiving member without lowering cooling system efficiency.

BRIEF DESCRIPTION OF DRAWINGS

[0016]

FIG. 1A is a cross-sectional view showing an internal structure of a refrigerator, as viewed from a side, according to a first embodiment of the present invention.

FIG. 1B is a front view showing a structure of the refrigerator, as viewed from a front, according to the first embodiment of the present invention.

FIG. 2 is a front view schematically showing a configuration in the vicinity of a cooling compartment of the refrigerator according to the first embodiment of the present invention.

FIG. 3 is an exploded perspective view of a refrigerating compartment duct device of the refrigerator according to the first embodiment of the present invention.

FIG. 4 shows a flow of cool air inside a refrigerating compartment in the refrigerator according to the first embodiment of the present invention.

FIG. 5A is a perspective view for schematically illustrating an arrangement of a heat radiation pipe of the refrigerator according to the first embodiment of the present invention.

FIG. 5B is a perspective view for schematically illustrating the arrangement of the heat radiation pipe of the refrigerator according to the first embodiment of the present invention.

FIG. 5C is a perspective view for schematically illustrating a heat radiation piping arrangement of a refrigerator according to a second embodiment of the present invention.

FIG. 5D is a perspective view for schematically illustrating the heat radiation piping arrangement of the refrigerator according to the second embodiment of the present invention.

FIG. 6A is a front view showing a structure of a refrigerator according to a third embodiment of the present invention.

FIG. 6B is a cross-sectional view showing an internal structure of the refrigerator, as viewed from a side, according to the third embodiment of the present invention.

FIG. 7A is a front view showing a structure of a refrigerator according to a fourth embodiment of the present invention.

FIG. 7B is a cross-sectional view showing an internal structure of the refrigerator, as viewed from a side, according to the fourth embodiment of the present invention.

FIG. 7C is a perspective view schematically showing a heat radiation piping arrangement of the refrigerator according to the fourth embodiment of the present invention.

FIG. 7D is a perspective view schematically showing the heat radiation piping arrangement of the refrigerator according to the fourth embodiment of the present invention.

FIG. 8A is a front view showing a structure of a refrigerator according to a fifth embodiment of the present invention.

FIG. 8B is a cross-sectional view showing an internal structure of the refrigerator, as viewed from a side, according to the fifth embodiment of the present invention.

FIG. 9 is a cross-sectional view showing a basic structure of a freezing compartment of a conventional refrigerator.

FIG. 10 is a perspective view showing a configuration of a refrigeration cycle piping of the conventional refrigerator.

FIG. 11 shows a cross-sectional structure of a portion where a partition wall and a door of the conventional refrigerator connect with each other.

DESCRIPTION OF EMBODIMENTS

[0017] Hereinafter, descriptions will be made of embodiments of the present invention with reference to the drawings. Note that the present invention is not limited by the below-described embodiments.

FIRST EXEMPLARY EMBODIMENT

[0018] A description will be made of refrigerator 30 according to a first embodiment of the present invention.

[0019] FIG. 1A is a cross-sectional view showing an internal structure of refrigerator 30, as viewed from a side, according to the first embodiment of the present invention, and FIG. 1B is a front view showing a structure of refrigerator 30, as viewed from a front. In FIG. 1B, illustrations of doors, gaskets, and the like are omitted. Arrows in the drawings show circulation paths of cool air.

[0020] Refrigerator 30 includes heat-insulating box body 31, refrigerating compartment 35 and freezing compartment 37 serving as storage compartments, partition wall 41, refrigerating compartment door 38 and freezing compartment door 40 serving as doors, metal receiving member 42, door gasket 90, and independent opening-side space 50.

[0021] Heat-insulating box body 31 is formed from inner box 33, outer box 32, and a heat-insulating material filled between inner box 33 and outer box 32.

[0022] The storage compartment is provided in heat-insulating box body 31. Partition wall 41 vertically partitions the storage compartment. A door is openably provided on a front opening of the storage compartment. Metal receiving member 42 is provided at the door-side front surface portion of partition wall 41.

[0023] Door gasket 90 is in close-contact with metal receiving member 42. Independent opening-side space 50 is provided in the front opening of the storage compartment, being separated from a space inside the storage compartment.

[0024] With this arrangement, independent opening-side space 50 can suppress heat leakage of the storage compartment, and can thereby suppress cooling of metal receiving member 42 provided at a door-side front surface portion of partition wall 41 to suppress dew condensation.

[0025] As shown in FIGS. 1A and 1B, heat-insulating box body 31 of refrigerator 30 is configured by outer box 32 mainly made of steel plate, and inner box 33 molded by resin such as ABS.

[0026] An inside of heat-insulating box body 31 is filled with heat-insulating foam material 34 serving as a heat-insulating material made of, for example, rigid urethane foam and the like. The inside of heat-insulating box body 31 is thermally insulated from ambient temperature, and is divided into a plurality of storage compartments.

[0027] Refrigerating compartment 35 is arranged at an upper portion of heat-insulating box body 31, and freezing compartment 37 is arranged at a lower portion thereof.

[0028] Refrigerating compartment door 38 and freezing compartment door 40 are pivotally supported openably and closably by the respective front opening of refrigerating compartment 35 and freezing compartment 37.

[0029] Refrigerating compartment 35 serves as a storage compartment for refrigerated storage, generally being set within a range of 1°C to 5°C with a non-freezing temperature as a lower limit, while freezing compartment 37 serves as a storage compartment being set within a freezing temperature range. While freezing compartment 37 is generally set within a range of -22°C to -15°C for frozen storage, there may be a case where freezing compartment 37 is set at a lower temperature of, for example, -30°C or -25°C for enhancing a frozen storage state.

[0030] Refrigerating compartment 35 and freezing compartment 37 are vertically partitioned by partition wall 41. Door gasket 90 is provided at respective peripheral edge portions of inner surfaces of refrigerating compartment door 38 and freezing compartment door 40 over entire peripheries thereof. A front surface side of outer box 32 and metal receiving member 42 provided at a door-side front surface portion of partition wall 41 are brought into close-contact with the doors (refrigerating compartment door 38 and freezing compartment door 40) by door gasket 90 to prevent cool air from leaking outside.

[0031] In addition, front sealing member 91 is disposed on an inner side of door gasket 90 of an inner surface of freezing compartment door 40 so as to contact with a wall surface of inner box 33, partition wall 41, and the like inside the storage compartment. Independent opening-side space 50, which is a space separated from both of a storage compartment space of freezing compartment 37 and the outside, is provided between door gasket 90 and front sealing member 91. As shown in FIG. 1B, independent opening-side space 50 is formed at a peripheral edge portion of an inner side of freezing compartment door 40 so as to surround front sealing member 91, as viewed from the front.

[0032] As shown in FIG. 1A, a rear surface of freezing compartment 37 is provided with cooling compartment 43 for generating cool air, and cooler 44 is disposed inside cooling compartment 43. Cooling compartment 43 is partitioned from freezing compartment 37 by coil cover 45 in a heat-insulating manner.

[0033] FIG. 2 is a front view schematically showing a configuration in the vicinity of cooling compartment 43 of refrigerator 30 according to the first embodiment of the present invention.

[0034] As shown in FIG. 2, fan 46 that forcibly blows the generated cool air is arranged at an upper side of cooler 44. Defrost heater 47 that removes frost and ice adhered to cooler 44 is provided at a lower side of cooler 44. Defrost heater 47 is, for example, a glass tube heater made of glass. In particular, in the case of using a hydrocarbon refrigerant gas as a refrigerant, a double glass tube heater formed with double glass tubes is used for preventing explosion.

[0035] Coil cover 45 is formed with a panel made of resin, and an insulated coil cover formed with a heat-insulating material such as a styrene material.

[0036] Coil cover 45 is provided with cool air return passage 71, which is provided at a side of cooler 44 and formed

so as to be partitioned from cooler 44 by partition member 75 and a rear surface wall of cooling compartment 43. The cool air that passed through a refrigerating-compartment feedback communication port of partition wall 41 is introduced into cool air return passage 71.

[0037] FIG. 3 is an exploded perspective view of refrigerating-compartment duct device 80 of refrigerator 30 according to the first embodiment of the present invention.

[0038] Refrigerating-compartment duct device 80 is arranged at a rear surface of refrigerating compartment 35. An air flow path of refrigerating compartment 35 is formed from refrigerating-compartment duct device 80 and inner box 33. In addition, a lower end of refrigerating-compartment duct device 80 is coupled with partition wall 41, and refrigerating-compartment discharge cool air from cooling compartment 43 and return cool air from refrigerating compartment 35 are circulated to control a temperature of refrigerating compartment 35 within a refrigeration temperature range.

[0039] Refrigerating-compartment duct device 80 is formed from refrigerating-compartment duct member 81 formed of styrene foam and refrigerating-compartment duct panel 86 made of resin which covers a front surface of refrigerating-compartment duct member 81. Sealing foam member 82 is attached to a sealing portion on an inner side of refrigerating-compartment duct device 80.

[0040] FIG. 4 shows a flow of cool air inside refrigerating compartment 35 in refrigerator 30 according to the first embodiment of the present invention.

[0041] Refrigerating-compartment duct device 80 is attached to the rear surface of refrigerating compartment 35. Cool air 11 passing through refrigerating-compartment air supply duct 48 to be discharged from a discharge port of refrigerating compartment 35 circulates inside refrigerating compartment 35. Then, after having circulated inside refrigerating compartment 35, cool air 12 passes from a return port provided in a lower rear surface of refrigerating compartment 35 through refrigerating-compartment feedback duct 51 to return to cooler 44.

[0042] FIGS. 5A and 5B are perspective views each schematically illustrating an arrangement of heat radiation pipe 49 of refrigerator 30 according to the first embodiment of the present invention.

[0043] As shown in FIGS. 5A and 5B, heat radiation pipe 49 serving as a heater is disposed near metal receiving member 42, in order to prevent dew condensation on an outer side surface of the storage compartment when an external air temperature is high or the like. Heat radiation pipe 49 uses a high temperature refrigerant pipe in a refrigeration cycle (not shown), and metal receiving member 42 is heated to a high temperature by the heat thereof.

[0044] Heat radiation pipe 49 is brought into contact with and fixed to metal receiving member 42 and a front surface portion of outer box 32 at an opening front (peripheral edge portion of an opening) side of freezing compartment 37.

[0045] In addition, refrigerator 30 according to this embodiment is provided with second heat radiation pipe 93. Second heat radiation pipe 93 is fixed so as to be selectively brought into contact with metal receiving member 42. Specifically, second heat radiation pipe 93 is in contact with metal receiving member 42, but is not in contact with the front surface portion of outer box 32.

[0046] A description is made of operations and effects of refrigerator 30 configured as described above.

[0047] Part of the cool air generated by cooler 44 of cooling compartment 43 is forcibly blown into freezing compartment 37 on a front side by fan 46. Freezing compartment 37 is cooled by the cool air discharged from a discharge port of coil cover 45.

[0048] The cool air that circulated inside freezing compartment 37 is guided to a lower portion of cooler 44 via a return port opened in a lower portion of coil cover 45 to be heat-exchanged in cooler 44. Then, fresh cool air is repeatedly circulated by fan 46. With this arrangement, an inside of freezing compartment 37 is cooled to a suitable temperature by control using a freezing-compartment temperature sensor.

[0049] On the other hand, cool air discharged to an upper side of fan 46 passes from a cool air discharge port of coil cover 45 through communication hole 18 of partition wall 41 to be guided to refrigerating-compartment duct device 80. Then, when a refrigerating-compartment temperature sensor determines that the inside temperature is equal to or higher than a preset temperature, a damper is opened, and cool air is discharged from the discharge port of refrigerating compartment 35 through refrigerating-compartment air supply duct 48 to cool an inside thereof.

[0050] The cool air that circulated inside refrigerating compartment 35 is guided to the return port. Air containing moisture included in air inside refrigerating compartment 35 and stored items passes through refrigerating-compartment feedback duct 51 of refrigerating-compartment duct device 80 to be introduced into cool air return passage 71 which is formed from coil cover 45 and the rear surface wall of cooling compartment 43. Air introduced into cool air return passage 71 is guided from cool air feedback port 77 to the lower portion of cooler 44 to be heat-exchanged in cooler 44, and then, fresh cool air is forcibly blown again by fan 46.

[0051] As described above, in refrigerator 30 according to this embodiment, cool air is forcibly blown by fan 46 to refrigerating-compartment air supply duct 48 communicating with cooler 44, and passes through refrigerating-compartment air supply duct 48 inside refrigerating-compartment duct device 80 to be discharged to refrigerating compartment 35. In addition, opening and closing of the damper is controlled based on the refrigerating-compartment temperature sensor. With this arrangement, even if refrigerating compartment 35 is located in a position distant from cooler 44, the temperature inside refrigerating compartment 35 can be controlled to the preset temperature.

[0052] Further, cooling of refrigerating compartment 35 is also performed by a discharge opening and the like in refrigerating-compartment duct member 81, by using the cool air generated from a side surface side and an upper surface.

[0053] Independent opening-side space 50 formed from door gasket 90 and front sealing member 91 is a space separated from both of the storage compartment space of freezing compartment 37 and the outside. With this arrangement, metal receiving member 42 and the front surface portion of outer box 32 at the opening front side of freezing compartment 37 are suppressed from being directly cooled by cool air of freezing compartment 37. Therefore, this can suppress occurrence of dew condensation on metal receiving member 42 and the front surface portion of outer box 32 at the opening front side of freezing compartment 37.

[0054] Meanwhile, as compared to metal receiving member 42, the front surface portion of outer box 32 at the opening front side of freezing compartment 37 is less likely to be affected by the cool air inside the storage compartment. Thus, a heat amount required to suppress occurrence of dew condensation is small.

[0055] As shown in FIGS. 5A and 5B, in refrigerator 30 according to this embodiment, refrigerant circulation of heat radiation pipe 49 can be switched to that of second heat radiation pipe 93, by using switching valve 92. For example, heat radiation pipe 49 is used at the time of occurrence of large amount of dew condensation, whereas heat radiation pipe 49 can be switched to second heat radiation pipe 93 at the time of occurrence of less amount of dew condensation. With this arrangement, heat amount is obtained for suppressing occurrence of dew condensation on the front surface portion of outer box 32 at the opening front side of freezing compartment 37, where an influence of the temperature inside the storage compartment is relatively small. At same time, independent opening-side space 50 can suppress heat leakage from the front surface portion of outer box 32 at the opening front side of freezing compartment 37 into the storage compartment.

[0056] Note that the switching function of the heat radiation pipe described above is not essential. Even if this switching function is not provided, the occurrence of dew condensation on metal receiving member 42 and the front surface portion of outer box 32 at the opening front side of freezing compartment 37 can be effectively suppressed.

SECOND EXEMPLARY EMBODIMENT

[0057] Next, a description will be made of refrigerator 20 according to a second embodiment of the present invention.

[0058] FIGS. 5C and 5D are perspective views each schematically illustrating a heat radiation piping arrangement of refrigerator 20 according to the second embodiment of the present invention.

[0059] Since a configuration of refrigerator 20 of this embodiment is common with that of refrigerator 30 described in the first embodiment, a description of common parts is omitted.

[0060] As shown in FIGS. 5C and 5D, in addition to heat radiation pipe 49, refrigerator 20 is provided with bypass pipe 94. Similarly to refrigerator 30 described in the first embodiment, heat radiation pipe 49 is brought into contact with and fixed to metal receiving member 42 and the front surface portion of outer box 32 at the opening front side of freezing compartment 37. On the other hand, bypass pipe 94 is not in contact with metal receiving member 42 or the front surface portion of outer box 32. Switching valve 92 conducts switching of refrigerants of heat radiation pipe 49 and bypass pipe 94, in the same manner as the first embodiment.

[0061] A description is made of the operations and effects of refrigerator 20 configured as described above.

[0062] Natural convection occurs inside independent opening-side space 50 which is an independent space different from the storage compartment. Specifically, air cooled by discharge cool air of freezing compartment 37 descends inside independent opening-side space 50.

[0063] Particularly, when cooling inside freezing compartment 37 is not conducted, that is, when cool air is not discharged into freezing compartment 37, a temperature distribution inside freezing compartment 37 is not uniform. Therefore, due to the natural convection, a temperature distribution inside independent opening-side space 50 becomes further non-uniform. When a low-temperature air inside independent opening-side space 50 descends, a temperature in the vicinity of metal receiving member 42 rises, so that a speed at which metal receiving member 42 is cooled is reduced. Accordingly, heat amount required for maintaining a temperature which prevents occurrence of dew condensation on metal receiving member 42 is reduced. In other words, heat amount of heat radiation pipe 49 required for maintaining a temperature which prevents occurrence of dew condensation on metal receiving member 42 is reduced.

[0064] For the reason described above, in this embodiment, as shown in FIGS. 5C and 5D, temperature control is conducted by using switching valve 92 with which refrigerant circulation is switched between heat radiation pipe 49 and bypass pipe 94 bypassing a periphery of an opening front of the storage compartment. From a viewpoint of prevention of dew condensation, when neither of the front surface portion of outer box 32 nor metal receiving member 42 is required to be heated, switching valve 92 can be switched to bypass pipe 94. Accordingly, this can effectively suppress heat leakage into the storage compartment from both side surfaces of an opening front of freezing compartment 37 and metal receiving member 42.

THIRD EXEMPLARY EMBODIMENT

[0065] Next, a description will be made of refrigerator 16 according to a third embodiment of the present invention.

[0066] FIG. 6A is a front view showing a structure of refrigerator 16 according to the third embodiment of the present invention, and FIG. 6B is a cross-sectional view showing an internal structure of refrigerator 16 as viewed from a side. In FIG. 6A, illustrations of the doors, the gaskets, and the like are omitted. Arrows in the drawings show circulation paths of cool air.

[0067] As shown in FIGS. 6A and 6B, in refrigerator 16, refrigerating compartment 35 and freezing compartment 37 are vertically partitioned by partition wall 41. Door gasket 90 is provided at the respective peripheral edge portions of the inner surfaces of refrigerating compartment door 38 and freezing compartment door 40 over the entire peripheries thereof. The front surface side of outer box 32 and metal receiving member 42 provided at the door-side front surface portion of partition wall 41 are brought into close-contact with the doors (refrigerating compartment door 38 and freezing compartment door 40) by door gasket 90 to prevent cool air from leaking outside.

[0068] In addition, front sealing member 91 is disposed on the inner side of door gasket 90 of the inner surface of freezing compartment door 40 so as to contact with the wall surface of inner box 33, partition wall 41, and the like inside the storage compartment. Independent opening-side space 50, which is the space separated from both of the storage compartment space of freezing compartment 37 and the outside, is provided between door gasket 90 and front sealing member 91. As shown in FIG. 6A, independent opening-side space 50 is formed at the peripheral edge portion of the inner side of freezing compartment door 40 so as to surround front sealing member 91, as viewed from a front. The above configuration is common with that of refrigerator 30 described in the first embodiment.

[0069] Independent opening-side space 50 of refrigerator 16 according to this embodiment is partially communicated with the storage compartment space via space communication inlet air flow path 95 communicating with refrigerating compartment 35 and space communication outlet air flow path 96 communicating with a periphery of cooling compartment 43. Space communication inlet air flow path 95 and space communication outlet air flow path 96 are spaces which are heat-insulated with the storage compartment by heat-insulating materials such as heat-insulating foam material 34 and partition wall 41. As shown in FIG. 6A, space communication inlet air flow path 95 is provided in both sides of a lower portion of inner case 33 in refrigerating compartment 35.

[0070] A description is made of the operations and effects of refrigerator 16 configured as described above.

[0071] As described in the first embodiment, also in this embodiment, part of the cool air generated by cooler 44 of cooling compartment 43 is forcibly blown into freezing compartment 37 on the front side by fan 46. Freezing compartment 37 is cooled by the cool air discharged from the discharge port of coil cover 45.

[0072] The cool air that circulated inside freezing compartment 37 is guided to the lower portion of cooler 44 via the return port opened in the lower portion of coil cover 45 to be heat-exchanged by cooler 44. Then again, fresh cool air is repeatedly circulated by fan 46. With this arrangement, the inside of freezing compartment 37 is cooled to the suitable temperature by control using the freezing-compartment temperature sensor.

[0073] On the other hand, cool air discharged to the upper side of fan 46 passes from the cool air discharge port of coil cover 45 through communication hole 18 of partition wall 41 to be guided to refrigerating-compartment duct device 80. Then, when the refrigerating-compartment temperature sensor determines that an inside temperature is equal to or higher than the preset temperature, the damper is opened, and cool air is discharged from the discharge port of refrigerating compartment 35 through refrigerating-compartment air supply duct 48 to cool the inside thereof.

[0074] The cool air that circulated inside refrigerating compartment 35 is branched to be guided to the return port and space communication inlet air flow path 95. There are two different paths for return cool air. In one of the paths, air having a temperature equal to that inside refrigerating compartment 35 passes through refrigerating-compartment feedback duct 51, and then through cool air return passage 71 to be guided from cool air feedback port 77 to the lower portion of cooler 44. In the other path, air passes through space communication inlet air flow path 95, and through independent opening-side space 50, and then passes through space communication outlet air flow path 96 to be guided from cool air feedback port 77 to the lower portion of cooler 44. In either path, the cool air returned to the lower portion of cooler 44 is heat-exchanged in cooler 44, so that fresh cool air is forcibly blown again by fan 46.

[0075] As described above, in this embodiment, the return cool air from refrigerating compartment 35 is circulated in independent opening-side space 50. With this arrangement, metal receiving member 42 is suppressed from being directly cooled by the cool air of freezing compartment 37, and a temperature inside independent opening-side space 50 can be maintained at the refrigeration temperature range higher than the freezing temperature range. Accordingly, it is possible to suppress occurrence of dew condensation on metal receiving member 42 and the front surface portion of outer box 32 at the opening front side of freezing compartment 37.

[0076] Further, heat leakage into the storage compartment can be suppressed by also using means of temperature control by switching of heat radiation pipe 49, described with reference to FIGS. 5A to 5D in the first embodiment and the second embodiment.

[0077] In this embodiment, the description has been made with reference to an example in which cool air having the

refrigeration temperature range of refrigerating compartment 35 is circulated in independent opening-side space 50. With this arrangement, the temperature inside independent opening-side space 50 can be maintained at the refrigeration temperature range, and a temperature in the vicinity of metal receiving member 42 can be effectively raised by using the cool air of refrigerating compartment 35. However, the present invention is not limited to this example. Air having a higher temperature range than that of the storage compartment may be circulated inside independent opening-side space 50, so that dew condensation can be reduced by raising the temperature in the vicinity of metal receiving member 42.

FOURTH EXEMPLARY EMBODIMENT

[0078] Next, a description will be made of refrigerator 60 according to a forth embodiment of the present invention.

[0079] FIG. 7A is a front view showing a structure of refrigerator 60 according to the forth embodiment of the present invention, FIG. 7B is a cross-sectional view showing an internal structure of refrigerator 60, as viewed from a side, and FIGS. 7C and 7D are perspective views each schematically showing a heat radiation piping arrangement of refrigerator 60. In FIG. 7A, illustrations of the doors, the gaskets, and the like are omitted. Arrows of solid lines in the drawings show circulation paths of cool air.

[0080] As shown in FIGS. 7A and 7B, refrigerator 60 is vertically partitioned into refrigerating compartment 35 and freezing compartment 37 by partition wall 41. Door gasket 90 is provided at the respective peripheral edge portions of the inner surfaces of refrigerating compartment door 38 and freezing compartment door 40 over the entire peripheries thereof. The front surface side of outer box 32 and metal receiving member 42 provided at the door-side front surface portion of partition wall 41 are brought into close-contact with the doors (refrigerating compartment door 38 and freezing compartment door 40) by door gasket 90 to prevent cool air from leaking outside.

[0081] In addition, front sealing member 91 is disposed on the inner side of door gasket 90 of the inner surface of freezing compartment door 40 so as to contact with the wall surface of inner box 33, partition wall 41, and the like inside the storage compartment. Independent opening-side space 50, which is the space separated from both of the storage compartment space of freezing compartment 37 and the outside, is provided between door gasket 90 and front sealing member 91. As shown in FIG. 7A, independent opening-side space 50 is formed at the peripheral edge portion of the inner side of freezing compartment door 40 so as to surround front sealing member 91, as viewed from a front. The above configuration is common with that of refrigerator 30 described in the first embodiment.

[0082] In refrigerator 60 according to this embodiment, lower side heat source member 97 for generating heat at a temperature equal to or higher than the external air temperature is disposed along a lower side periphery of independent opening-side space 50.

[0083] Further, in this embodiment, independent opening-side space 50 is described as the space which is provided in the peripheral edge of the front opening of the storage compartment, and at least one of left and right portions of independent opening-side space 50 is communicated from an upper side to a lower side thereof.

[0084] With this arrangement, air having relatively high temperature rises and air having relatively low temperature descends in independent opening-side space 50, so that the temperature in the periphery of metal receiving member 42 can be effectively raised. However, the present invention is not limited to this example. For example, both of the left and right sides of independent opening-side space 50 may be a space which is not communicated from the upper side to the lower side.

[0085] A description is made of the operations and effects of refrigerator 60 configured as described above.

[0086] Lower side heat source member 97 conducts heat to a bottom metal member (not shown) having functions of securing strength of a bottom portion and constituting a close-contact surface of door gasket 90 in the same manner as metal receiving member 42, to transfer heat into independent opening-side space 50.

[0087] A heat of lower side heat source member 97 transferred into independent opening-side space 50 warms air inside independent opening-side space 50. The warmed air rises inside independent opening-side space 50 by natural convection (dotted line arrows in FIG. 7A). The rising warmed air rises to the vicinity of metal receiving member 42 inside independent opening-side space 50. This can suppress occurrence of dew condensation on metal receiving member 42 and the front surface portion of outer box 32 at the opening front side of freezing compartment 37.

[0088] Control of optimum heat amount is conducted with respect to lower side heat source member 97 so as to maintain a temperature equal to or higher than a temperature required for suppressing occurrence of dew condensation on metal receiving member 42 and the front surface portion of outer box 32 at the opening front side of freezing compartment 37.

[0089] In addition, heat leakage into the storage compartment can be suppressed by combinedly using means of the temperature control by switching of heat radiation pipe 49, described with reference to FIGS. 5A to 5D.

[0090] Further, as shown in FIGS. 7C and 7D, bottom portion heat radiation pipe 98 is provided to a bottom member which constitutes a bottom portion of heat-insulating box body 31. By using bottom portion heat radiation pipe 98 as lower side heat source member 97, heat radiation can be effectively used.

[0091] Note that, if it is difficult to prevent dew condensation on both sides of the front surface portion of freezing

compartment 37 and metal receiving member 42 only with the heat amount of lower side heat source member 97, it is possible to combinedly use heat radiation pipe 49. In such a case, temperature control is conducted by switching refrigerant circulation between bottom portion heat radiation pipe 98 and heat radiation pipe 49 (or combinedly using both thereof) by using switching valve 92. With this arrangement, it is possible to prevent dew condensation on the both sides of the front surface portion of freezing compartment 37 and metal receiving member 42, while suppressing heat leakage to a minimum from heat radiation pipe 49 on both sides of freezing compartment 37 and metal receiving member 42 to the storage compartment.

FIFTH EXEMPLARY EMBODIMENT

[0092] Next, a description will be made of refrigerator 17 according to a fifth embodiment of the present invention.

[0093] FIG. 8A is a front view showing a structure of refrigerator 17 according to the fifth embodiment of the present invention, and FIG. 8B is a cross-sectional view showing an internal structure of refrigerator 17, as viewed from a side. In FIG. 8A, illustrations of the doors, the gaskets, and the like are omitted. Arrows in the drawings show circulation paths of cool air.

[0094] As shown in FIGS. 8A and 8B, refrigerator 17 is vertically partitioned into refrigerating compartment 35 and freezing compartment 37 by partition wall 41. Door gasket 90 is provided at the respective peripheral edge portions of the inner surfaces of refrigerating compartment door 38 and freezing compartment door 40 over the entire peripheries thereof. The front surface side of outer box 32 and metal receiving member 42 provided at the door-side front surface portion of partition wall 41 are brought into close-contact with the doors (refrigerating compartment door 38 and freezing compartment door 40) by door gasket 90 to prevent the cool air from leaking outside.

[0095] In addition, front sealing member 91 is disposed on the inner side of door gasket 90 of the inner surface of freezing compartment door 40 so as to contact with the wall surface of inner box 33, partition wall 41, and the like inside the storage compartment. Independent opening-side space 50, which is the space separated from both of the storage compartment space of freezing compartment 37 and the outside, is provided between door gasket 90 and front sealing member 91. As shown in FIG. 8A, independent opening-side space 50 is formed at the peripheral edge portion of the inner side of freezing compartment door 40 so as to surround front sealing member 91, as viewed from a front. The above configuration is common with that of refrigerator 30 described in the first embodiment.

[0096] Refrigerator 17 according to this embodiment has three or more storage compartments. In the example shown in FIGS. 8A and 8B, refrigerator 17 is provided with third storage compartment 13. In addition, freezing compartment 37 and third storage compartment 13 are vertically partitioned by second partition wall 99. Door gasket 90 is also provided at a peripheral edge portion of an inner surface of third storage compartment door 14 over an entire periphery thereof. The front surface side of outer box 32 and metal receiving member 42 provided at a door-side front surface portion of second partition wall 99 are brought into close-contact with third storage compartment door 14 by door gasket 90 to prevent the cool air from leaking outside.

[0097] A description is made of the operations and effects of refrigerator 17 configured as described above.

[0098] Part of the cool air generated by cooler 44 of cooling compartment 43 is forcibly blown into freezing compartment 37 at the front side by fan 46. Freezing compartment 37 is cooled by cool air discharged from the discharge port of coil cover 45.

[0099] The cool air that circulated inside freezing compartment 37 is guided to the lower portion of cooler 44 via the return port opened in the lower portion of coil cover 45 to be heat-exchanged by cooler 44. Then again, fresh cool air is repeatedly circulated by fan 46. With this arrangement, the inside of freezing compartment 37 is cooled to a suitable temperature by control using the freezing-compartment temperature sensor.

[0100] In third storage compartment 13, similarly, the cool air generated by cooler 44 of cooling compartment 43 passes through third storage compartment duct 15 to cool an inside of third storage compartment 13. Then, the cool air is guided to the lower portion of cooler 44 via the return port opened in the lower portion of coil cover 45 to be heat-exchanged by cooler 44, and again, fresh cool air is repeatedly circulated by fan 46.

[0101] In this embodiment, similarly to other embodiments, it is also possible to perform heating using heat radiation pipe 49, and switching control of refrigerant circulation between heat radiation pipe 49 and another heat radiation pipe by using switching valve 92.

[0102] In refrigerator 17 having three or more storage compartments, it is possible to suppress occurrence of dew condensation on metal receiving member 42 and the front surface portion of outer box 32 at the opening front side of freezing compartment 37.

[0103] In each of the embodiments, the description has been made with reference to the example in which front sealing member 91 is provided at the inner surfaces of the doors of the refrigerator so as to contact with the wall surface inside the storage compartments, and independent opening-side space 50 is formed between front sealing member 91 and door gasket 90. In this case, although independent opening-side space 50 can be realized with a simple configuration, the present invention is not limited to this example. Independent opening-side space 50 can also be formed between

door gasket 90 and the other member, or can also be formed using the other member.

[0104] In addition, in each of the embodiments, the description has been made with reference to the example in which independent opening-side space 50 is provided in the front surface opening of freezing compartment 37 serving as a storage compartment which temperature is set at the freezing temperature range. In this case, it is possible to enhance a suppression effect of heat leakage from the inside of the storage compartment at the freezing temperature range, and suppress occurrence of dew condensation of metal receiving member 42. However, the present invention is not limited to this example. As long as it is a storage compartment having a temperature range at which dew condensation occurs on metal receiving member 42 provided at the door-side front surface portion of partition wall 41 and the front surface portion of outer box 32, independent opening-side space 50 can be provided to reduce dew condensation, and the storage compartment can be applied to the present invention.

[0105] Further, in each of the embodiments, the example has been shown in which heat radiation pipe 49 serving as a heater is provided near independent opening-side space 50. With this arrangement, the temperature inside independent opening-side space 50 can be reliably raised. However, the present invention is not limited to this example. Even if the vicinity of independent opening-side space 50 is heated by using other heating means, a similar effect of preventing dew condensation can be obtained.

INDUSTRIAL APPLICABILITY

[0106] As described above, according to the present invention, it is possible to provide a refrigerator which is less likely to generate dew condensation on a front surface of a metal receiving member without lowering cooling system efficiency. Thus, the present invention is useful, since it is applicable to all types of refrigerators and the like having a cooling function.

REFERENCE MARKS IN THE DRAWINGS

[0107]

11, 12	cool air
13	third storage compartment
14	third storage compartment door
15	third storage compartment duct
16, 17, 20, 30, 60	refrigerator
18	communicating hole
31	heat-insulating box body
32	outer box
33	inner box
34	heat-insulating foam material
35	refrigerating compartment
37	freezing compartment
38	refrigerating compartment door
40	freezing compartment door
41	partition wall
42	metal receiving member
43	cooling compartment
44	cooler
45	coil cover
46	fan
47	defrost heater
48	refrigerating-compartment air supply duct
49	heat radiation pipe
50	independent opening-side space
51	refrigerating-compartment feedback duct
71	cool air return passage
75	partition member
80	refrigerating-compartment duct device
81	refrigerating-compartment duct member
82	sealing foam member
86	refrigerating-compartment duct panel

90	door gasket
91	front sealing member
92	switching valve
93	second heat radiation pipe
94	bypass pipe
95	space communication inlet air flow path
96	space communication outlet air flow path
97	lower side heat source member
98	bottom portion heat radiation pipe
99	second partition wall

Claims

1. A refrigerator comprising:

a heat-insulating box body formed from an inner box, an outer box, and a heat-insulating material filled between the inner box and the outer box;
a storage compartment provided in the heat-insulating box body;
a partition wall vertically partitioning the storage compartment;
an openable door provided on a front opening of the storage compartment;
a metal receiving member provided on the partition wall at one side facing the door;
a door gasket in close-contact with the metal receiving member; and
an independent opening-side space provided in the front opening of the storage compartment, and isolated from a space inside the storage compartment.

2. The refrigerator according to claim 1 further comprising a front sealing member provided on an inner surface of the door in a manner to contact with a wall surface inside the storage compartment,
wherein the independent opening-side space is formed between the front sealing member and the door gasket.

3. The refrigerator according to claim 2, wherein
the independent opening-side space is provided along a periphery of the front opening of the storage compartment, and
at least one of left and right portions of the independent opening-side space is communicated from an upper side to a lower side.

4. The refrigerator according to claim 2, wherein the independent opening-side space is provided in the front opening of the storage compartment in which a temperature is set within a freezing temperature range.

5. The refrigerator according to claim 4, wherein cool air in a temperature range higher than a freezing temperature range is circulated inside the independent opening-side space.

6. The refrigerator according to any one of claims 1 to 5, further comprising a heater near the independent opening-side space.

FIG. 1A

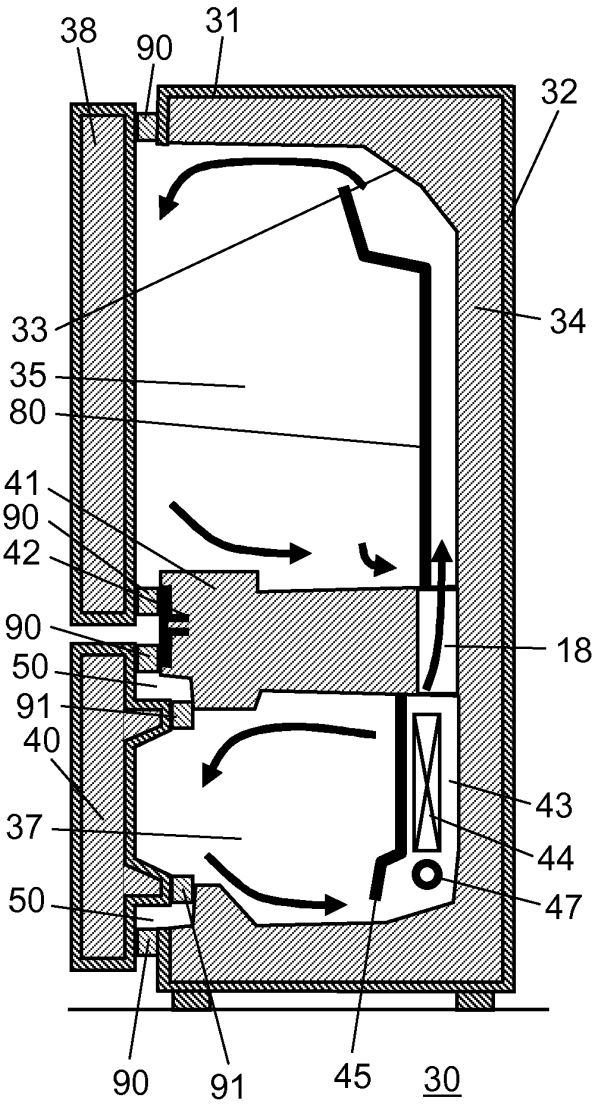
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FIG. 1B

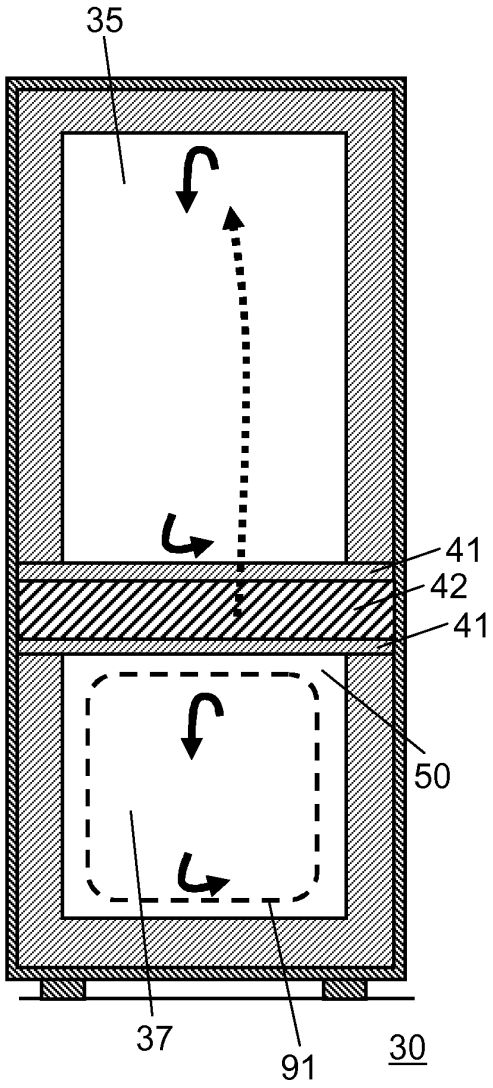
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FIG. 2

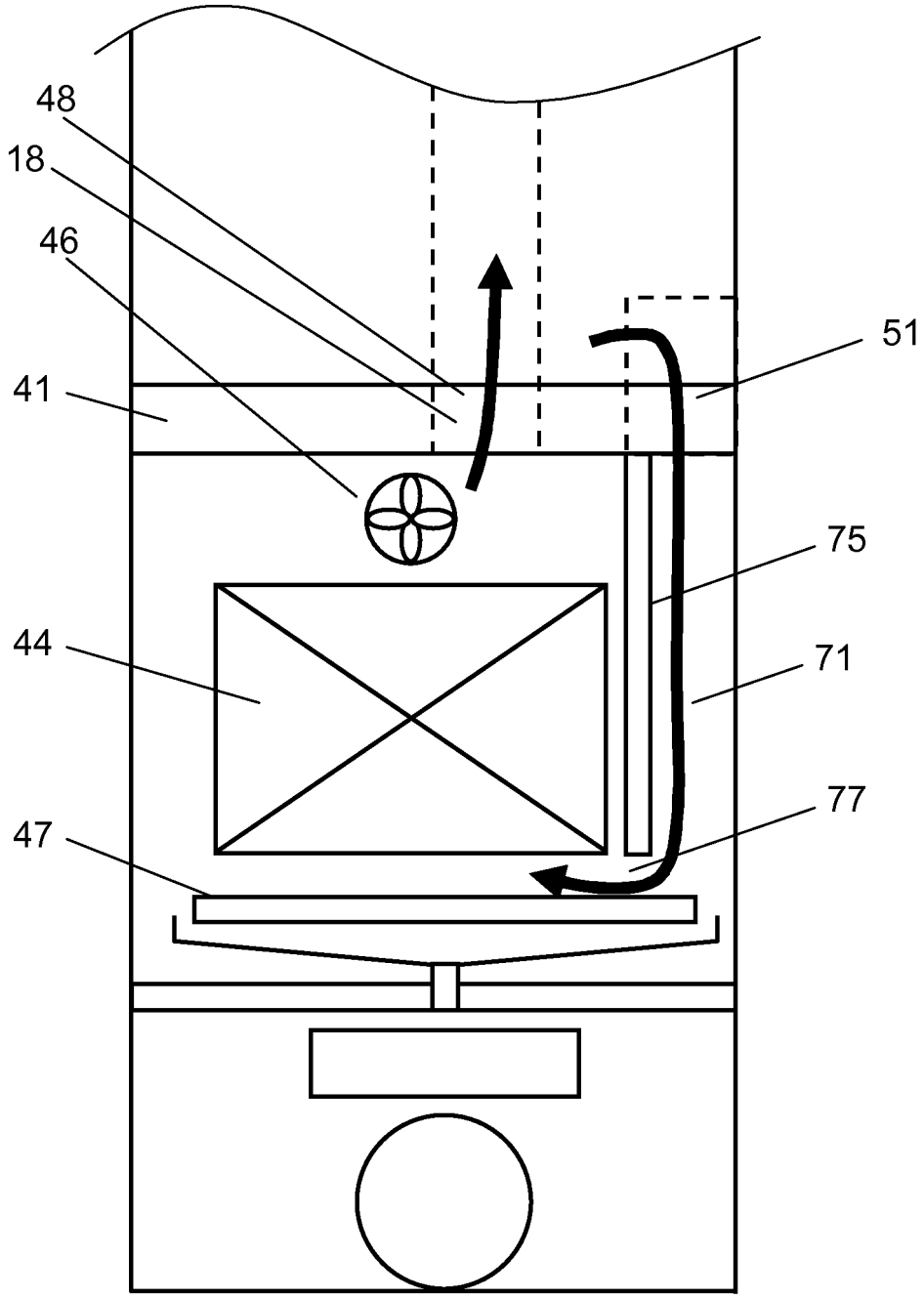

FIG. 3

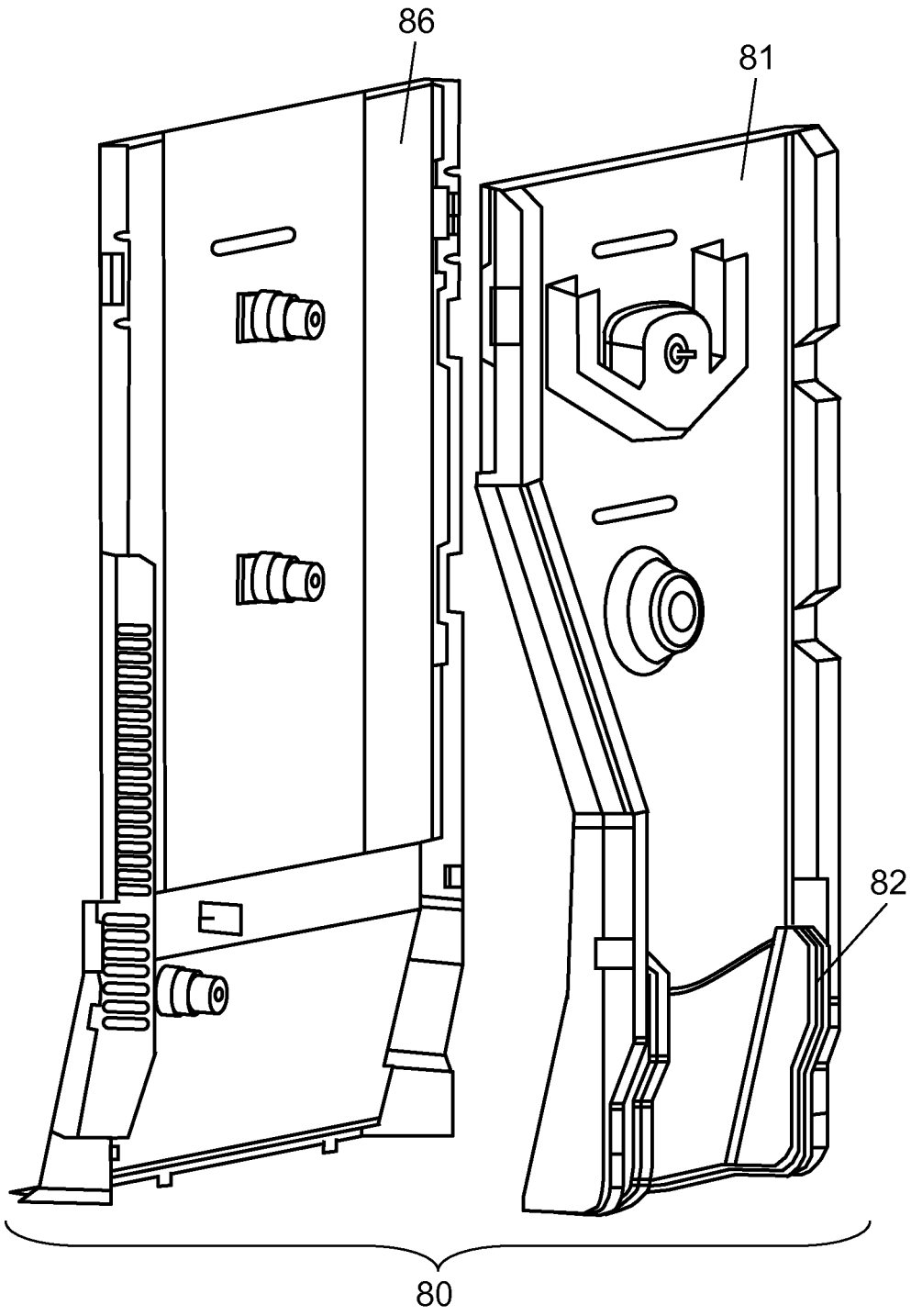

FIG. 4

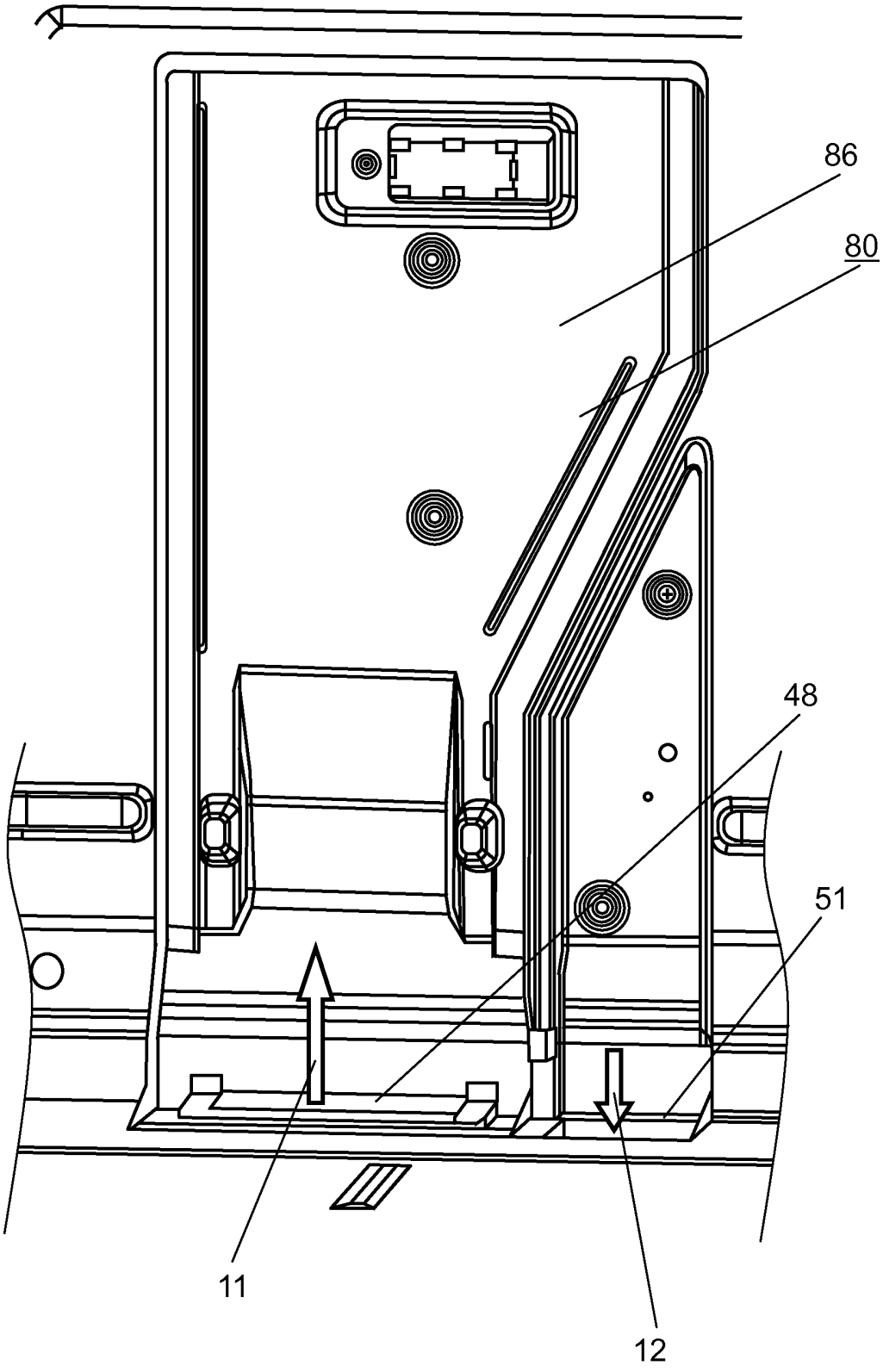

FIG. 5A

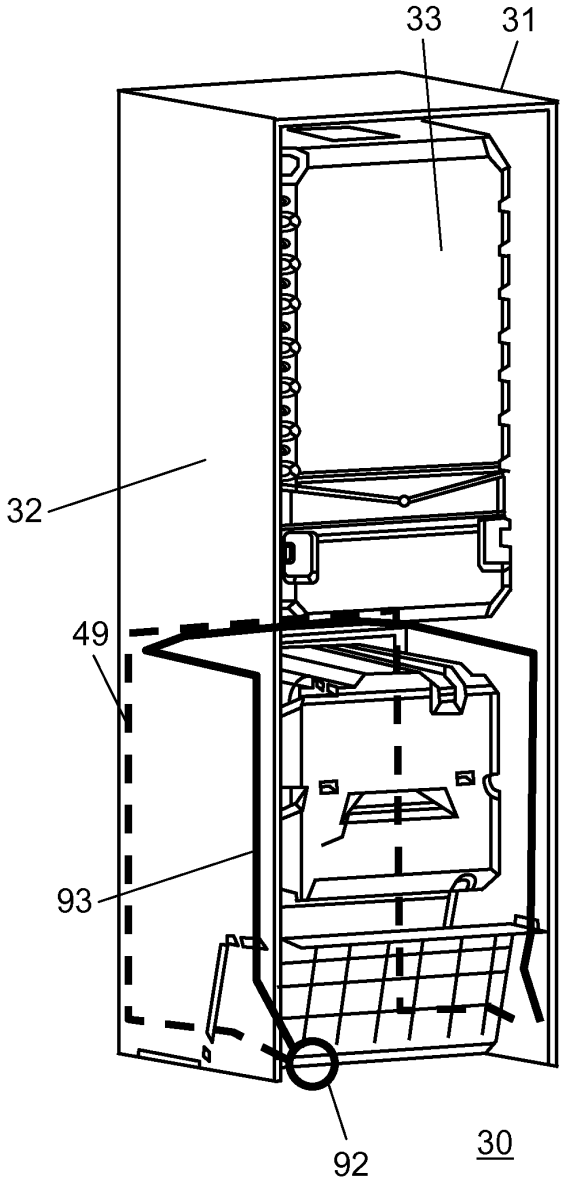

FIG. 5B

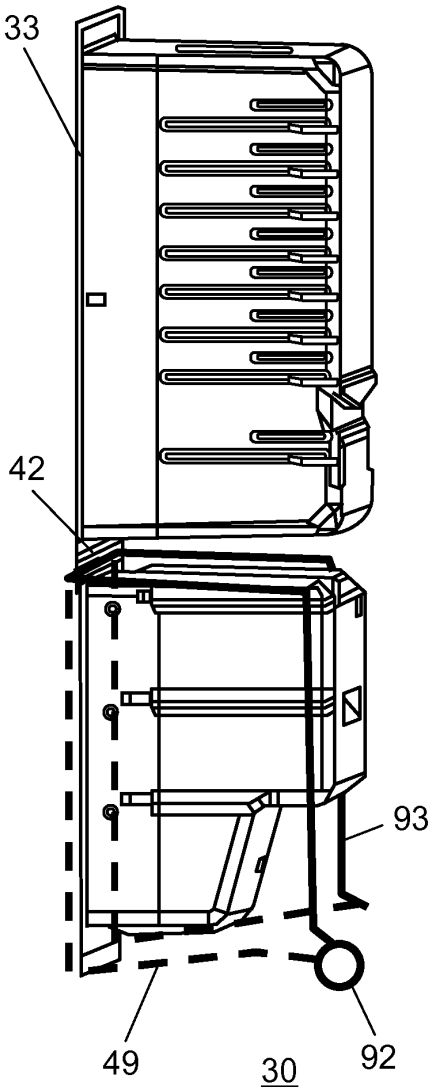

FIG. 5C

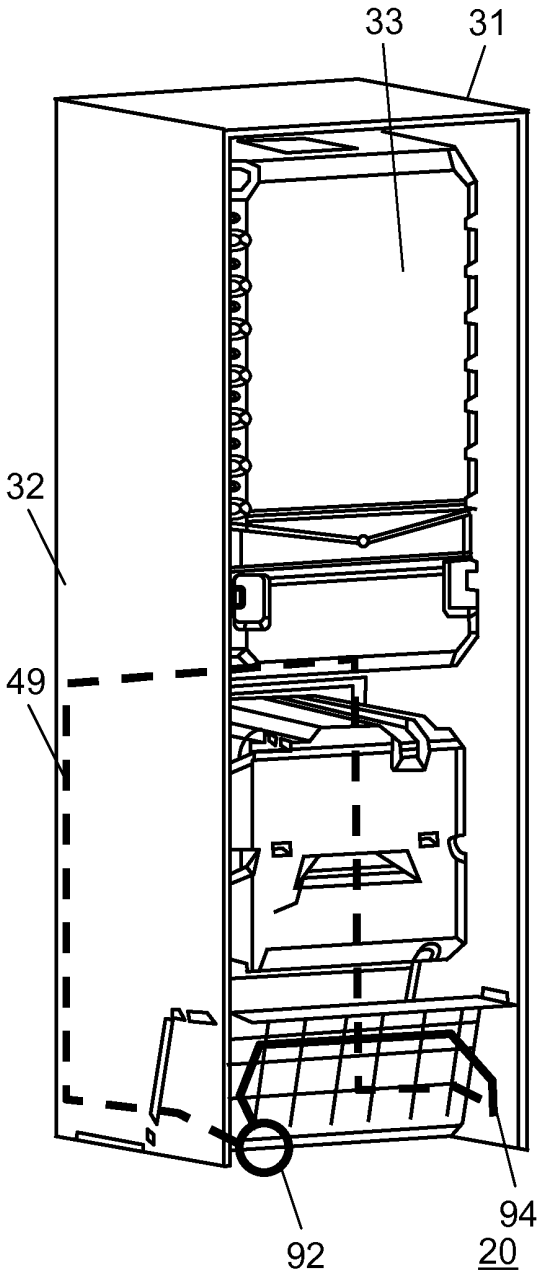

FIG. 5D

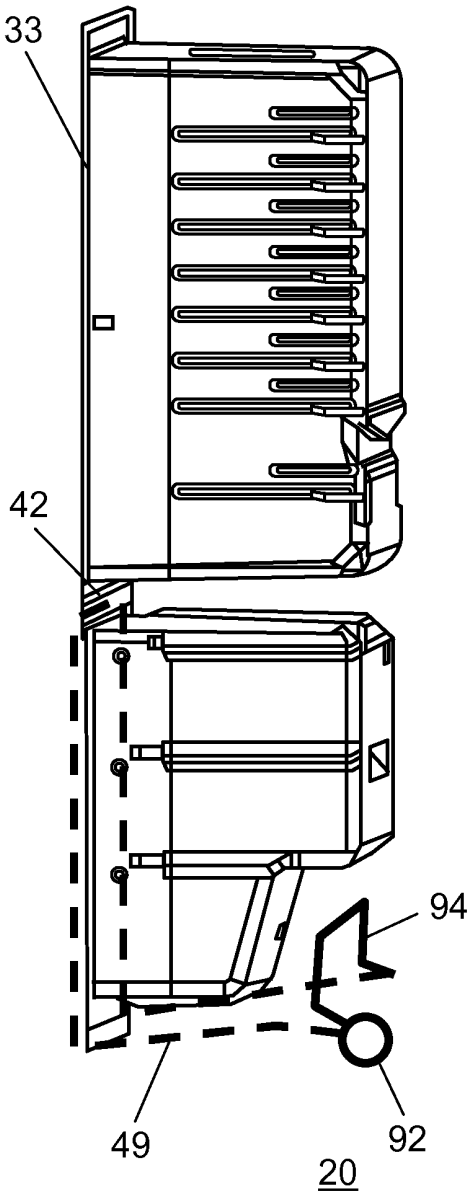

FIG. 6A

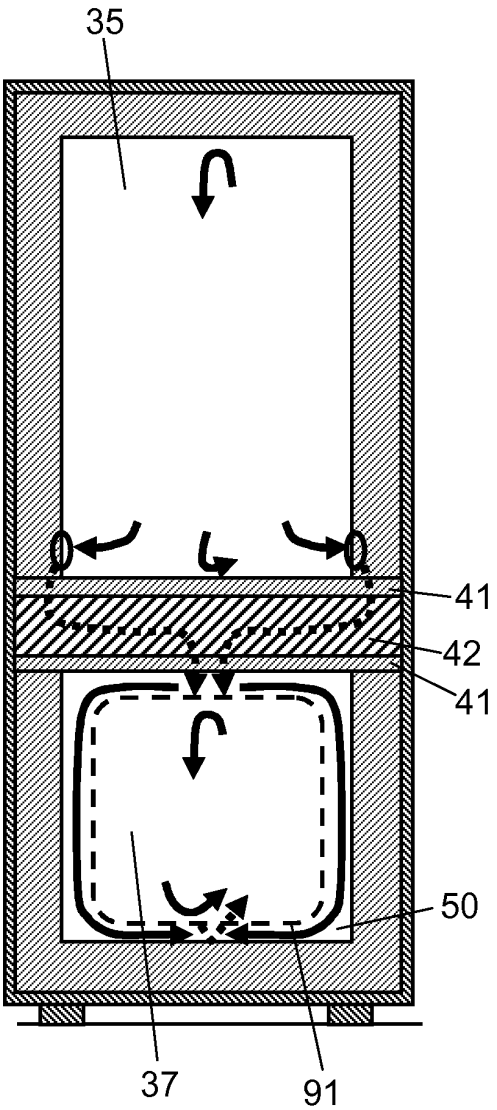
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FIG. 6B

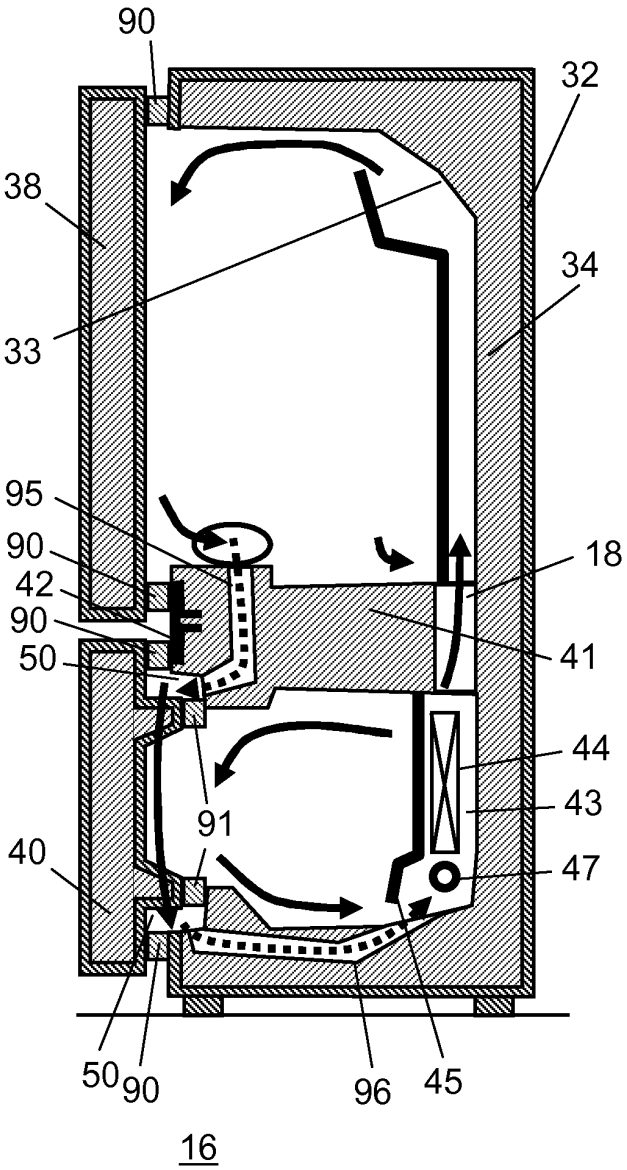
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FIG. 7A

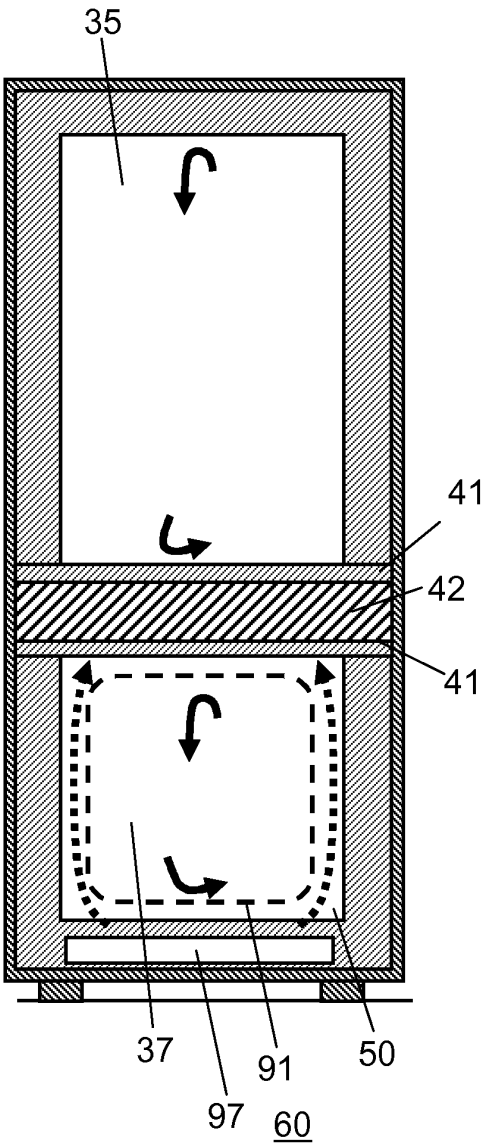
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FIG. 7B

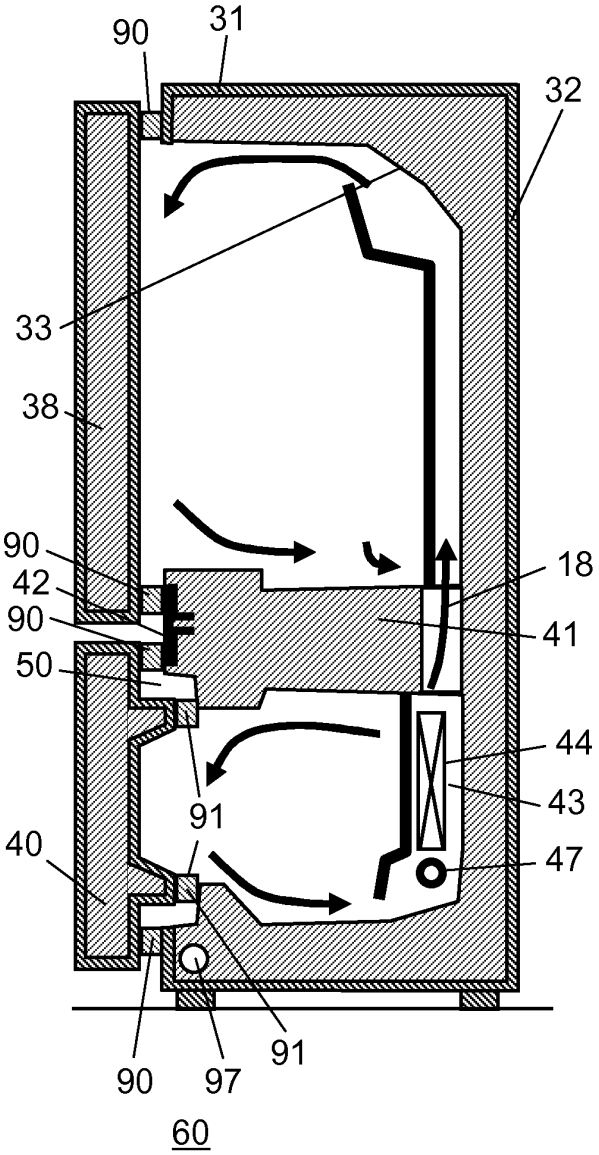
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FIG. 7C

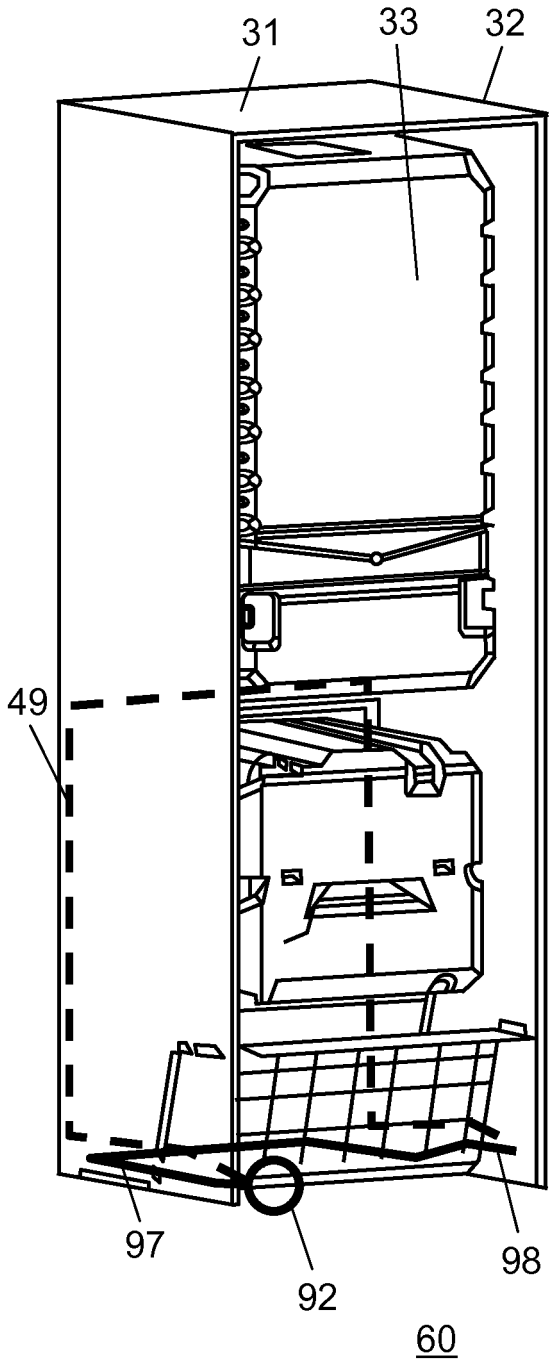

FIG. 7D

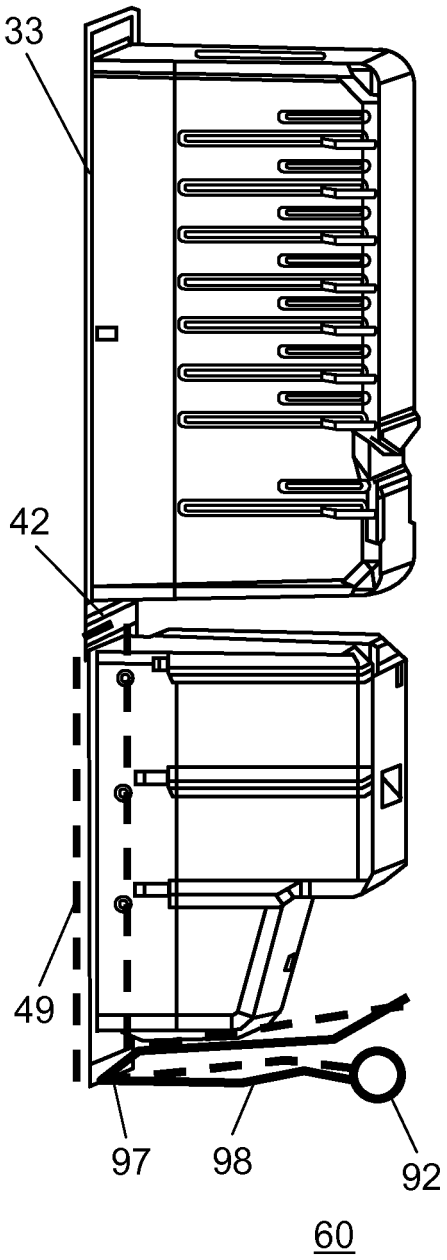

FIG. 8A

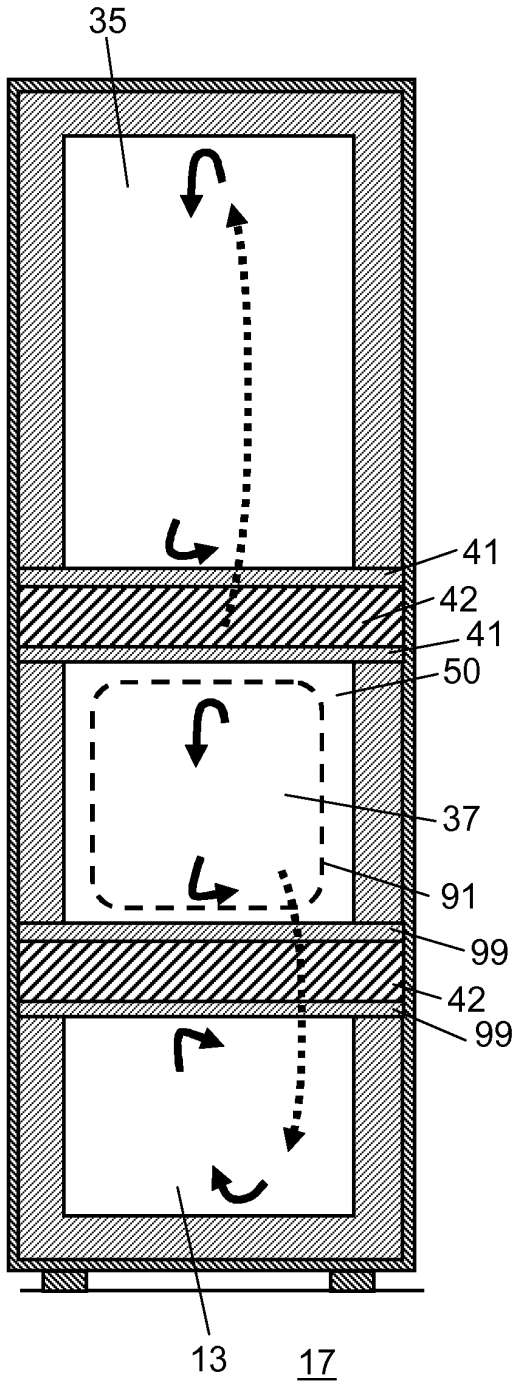
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FIG. 8B

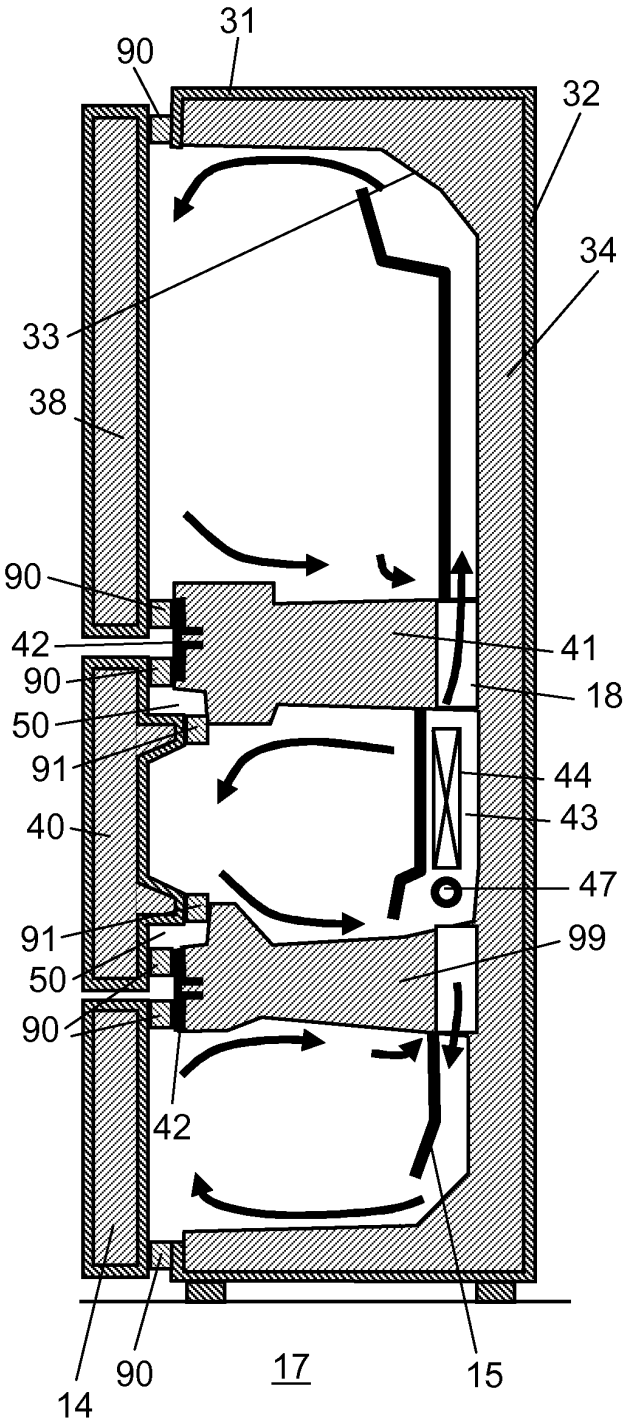
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FIG. 9

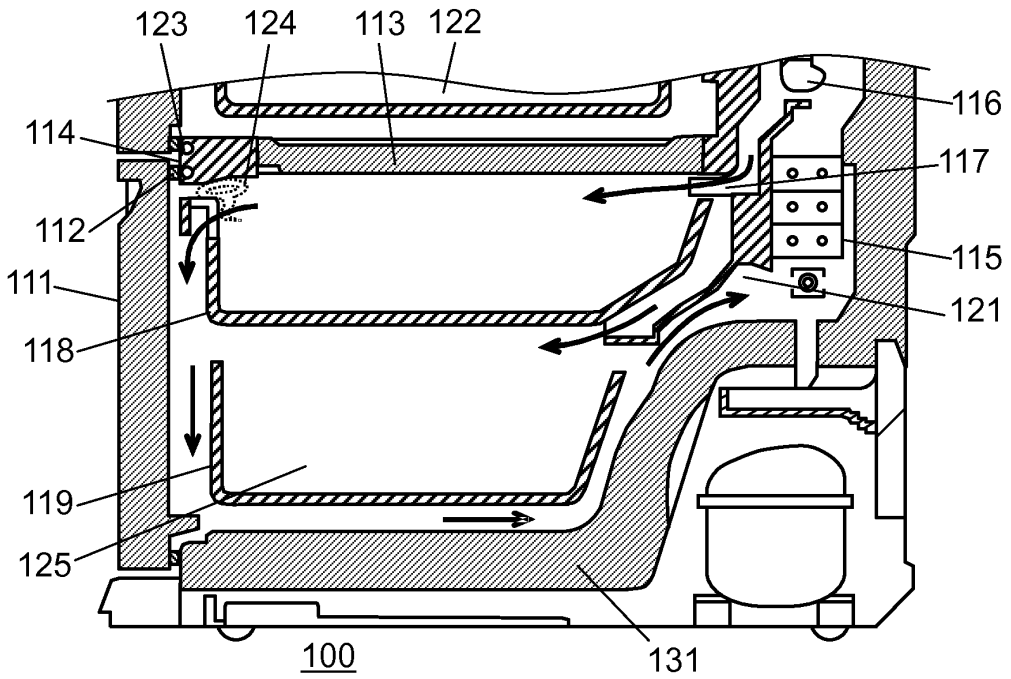
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FIG. 10

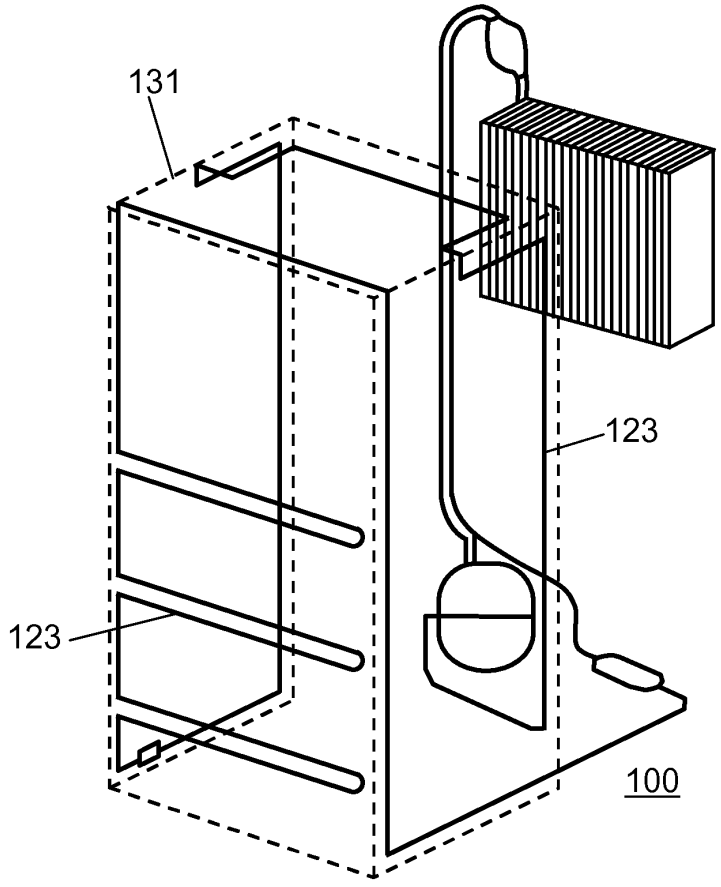
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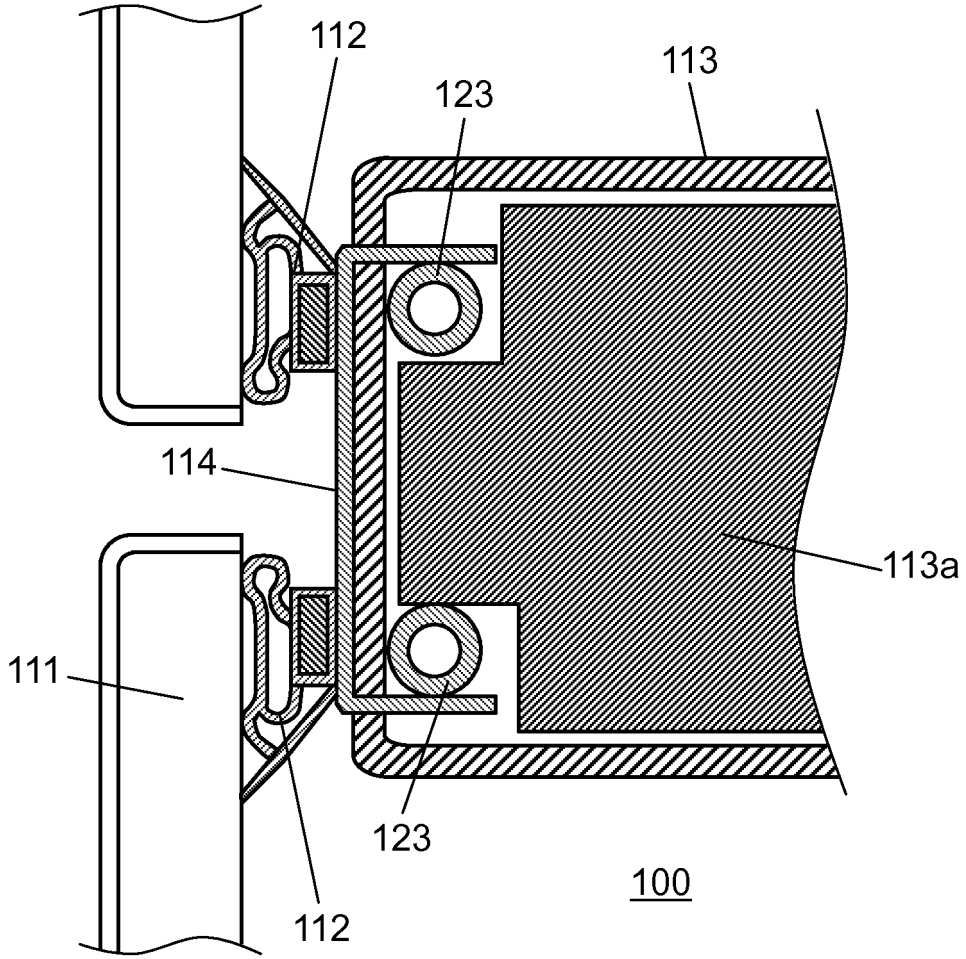
FIG. 11



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/003876

A. CLASSIFICATION OF SUBJECT MATTER
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)
F25D23/02

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	1996-2012
Kokai Jitsuyo Shinan Koho	1971-2012	Toroku Jitsuyo Shinan Koho	1994-2012

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.
X Y	JP 2000-154968 A (Sharp Corp.), 06 June 2000 (06.06.2000), entire text; all drawings (particularly, paragraphs [0029], [0032], [0033]; fig. 3) (Family: none)	1,2,4 3,5
X Y	JP 2002-22351 A (Toshiba Corp.), 23 January 2002 (23.01.2002), entire text; all drawings (particularly, paragraphs [0002], [0003], [0031], [0032]; fig. 1, 6) (Family: none)	1,2,4,6 3,5

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

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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search 19 July, 2012 (19.07.12)	Date of mailing of the international search report 31 July, 2012 (31.07.12)
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/JP2012/003876

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 2001-41642 A (Matsushita Refrigeration Co.), 16 February 2001 (16.02.2001), entire text; all drawings (particularly, claim 1; paragraphs [0031], [0032], [0040], [0046]; fig. 2, 4) (Family: none)	1,2,4,6 3,5
Y	JP 2002-22349 A (Toshiba Corp.), 23 January 2002 (23.01.2002), entire text; all drawings (particularly, paragraphs [0020] to [0022]; fig. 1 to 4) (Family: none)	3
Y	JP 2011-38670 A (Mitsubishi Electric Corp.), 24 February 2011 (24.02.2011), entire text; all drawings (particularly, paragraphs [0020] to [0025], [0035]; fig. 2 to 7) (Family: none)	5

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H1096584 B **[0012]**