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(54) **REFRIGERATOR**

(57) The present invention provides a refrigerator capable of suppressing frost formation in an upper portion of a cooling chamber. The refrigerator 10 comprises: a storage chamber 12; a cooling chamber 115 for accommodating air to be blown to the storage chamber 12; and an evaporator 162 for cooling the air in an interior of the cooling chamber 115. In the refrigerator 10, the evaporator 162 is a finned tube cooler having a heat transfer tube 29 and heat-dissipating fins, an air passage restricting member 30 is disposed between a side wall 32 of the cooling chamber 115 and the evaporator 162 and is in contact with the evaporator 162.

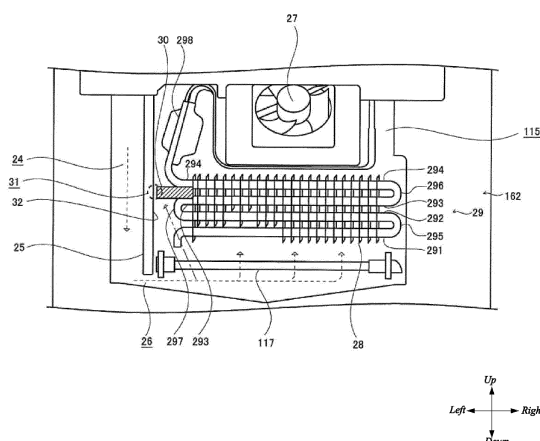


Fig. 3

Description

TECHNICAL FIELD

[0001] The present invention relates to a refrigerator, and particularly to a refrigerator having a defrosting mechanism for defrosting an evaporator.

BACKGROUND

[0002] In ordinary refrigerators, air cooled by an evaporator in a freezing cycle is blown to storage chambers to thereby cool the storage chambers to a desired refrigeration temperature range or freezing temperature range. When the freezing cycle is used constantly for cooling, the evaporator will get frosted. When the frost on the evaporator increases, heat transfer and air supply between the evaporator and air will be hindered. Therefore, in the operation of the refrigerator, a defrosting operation for clearing the frost from the evaporator is performed regularly.

[0003] In the general defrosting operation, a defrosting heater disposed below the evaporator is energized so that the defrosting heater heats up to melt and remove the frost on the evaporator. Here, the evaporator employs a finned tube evaporator disclosed in the following Patent Document 1:

[Patent Document] Japanese patent laid-open JP2012-52747.

[0004] In a refrigerator having the finned tube evaporator, part of air returning from the storage chamber to the cooling chamber sometimes flows to an upper portion of the cooling chamber, thereby forming a large frost block in the upper portion of the cooling chamber. When the large frost block is formed in this region, even though the cooling chamber is heated by the defrost heater in the defrosting operation, the frost block cannot be melted away completely within a predetermined defrosting operation time period, thereby failing to overcome the reduction of the cooling efficiency due to the frosting.

SUMMARY

[0005] The present invention is completed in view of the above situations and aims to provide a refrigerator capable of suppressing frost formation in an upper portion of the cooling chamber.

[0006] An embodiment of the present invention provides a refrigerator, comprising: a storage chamber; a cooling chamber for accommodating air to be blown to the storage chamber; and an evaporator for cooling the air in an interior of the cooling chamber, the evaporator being a finned tube cooler having a heat transfer tube and heat-dissipating fins, an air passage restricting member being disposed between a side wall of the cooling chamber and the evaporator and being in contact with the evaporator. Therefore, in the refrigerator according to the embodiment of the present invention, since the air

passage restricting member is disposed between the side wall of the cooling and the evaporator, the frost formed on the surface of the air passage restricting member blocks the air passage, thereby preventing the cold air from advancing upward via a side of the evaporator in the cooling chamber. Hence, the frosting above the evaporator can be suppressed.

[0007] Preferably, in the refrigerator according to one embodiment of the present invention, the heat transfer pipe has a plurality of linear sections and a plurality of curved sections, the plurality of curved sections connect end portions of vertically-adjacent linear sections, and the air passage restricting member is sandwiched between the adjacent linear sections. Therefore, in the refrigerator according to the embodiment of the present invention, the air passage restricting member is sandwiched by the heat transfer tube, so that the surface of the air passage restricting member is cooled by the heat transfer tube such that the surface of the air passage restricting member is frosted early. Then, the frost grown is used to block the air passage in the interior of the cooling chamber early so that the cold air can be suppressed from advancing upward in the interior of the cooling chamber.

[0008] Preferably, in the refrigerator according to an embodiment of the present invention, the refrigerator further comprises a freezing cycle having the evaporator, and the evaporator is connected to another constituent device in the freezing cycle through a refrigerant pipe; the refrigerant pipe is guided in an upper portion of the cooling chamber, starting from a left end of the topmost linear section; the air passage restricting member is located between a side wall of the cooling chamber and a left end portion of the evaporator. Therefore, in the refrigerator according to the embodiment of the present invention, the air passage restricting member blocks the air passage below the refrigerant pipe, so that the cold air can be prevented from advancing upward to the refrigerant pipe via the side of the evaporator, thereby suppressing the frost formation on the refrigerant pipe.

[0009] Preferably, in the refrigerator according to one embodiment of the present invention, the air passage restricting member is sandwiched between the topmost linear section and another adjacent linear section below the topmost linear section. Therefore, in the refrigerator according to the embodiment of the present invention, frost formed on the surface of the air passage restricting member blocks the air passage, thereby preventing the cold air from advancing upward beyond the uppermost linear section via the side of the evaporator. Therefore, the progress of frost formation above the cooling chamber can be suppressed. Preferably, in the refrigerator according to the embodiment of the present invention, the air passage restricting member is formed of a deformable flexible material, and is sandwiched between the adjacent linear sections while being slightly deformed. Therefore, in the refrigerator according to one embodiment of the present invention, the mounting of the air passage

restricting member is facilitated, the surface of the air passage restricting member can be brought into close contact with the linear sections so that the temperature of the surface of the air passage restricting member can be rapidly lowered to a low temperature, and meanwhile, the air passage restricting member can be mounted firmly in position.

[0010] Preferably, in the refrigerator according to an embodiment of the present invention, the air passage restricting member comprises: a core member; and a surface member covering a surface of the core member, the surface member being made of a material having a higher thermal conductivity than the core member. Therefore, in the refrigerator according to the embodiment of the present invention, the surface of the air passage restricting member is covered with the surface member which is superior in heat conduction, so that the temperature of the surface member in contact with the evaporator rapidly becomes a low temperature, and the frost formed early on the surface of the surface member can be used to block the path of the cold air early.

[0011] Preferably, in the refrigerator according to the embodiment of the present invention, the core member employs a foamed resin, and the surface member employs an aluminum tape or an aluminum foil. Therefore, in the refrigerator according to the embodiment of the present invention, light weight of the air passage restricting member can be pursued for; furthermore, the surface of the air passage restricting member can be brought into good contact with the evaporator, and the temperature of the surface member can be made fall rapidly by virtue of excellent thermal conductivity.

[0012] Preferably, in the refrigerator according to an embodiment of the present invention, the air passage restricting member has a rectangular parallelepiped shape, and an end face of the air passage restricting member is in contact with the heat-dissipating fin. Therefore, in the refrigerator according to an embodiment of the present invention, the end face of the air passage restricting member is brought into surface contact with the heat-dissipating fin, so that the surface of the air passage restricting member can be effectively cooled by the heat-dissipating fin, and the surface of the air passage restricting member is effectively frosted.

[0013] Preferably, in the refrigerator according to an embodiment of the present invention, the refrigerator further comprises a freezing cycle having the evaporator; and the air passage restricting member is formed with an insertion hole running through the air passage restricting member in an up-down direction, and a slot communicating the end face of the air passage restricting member with the insertion hole; the refrigerant pipe of the freezing cycle is arranged in the insertion hole via the slot. Therefore, in the refrigerator according to the embodiment of the present invention, the air passage restricting member can be more firmly mounted to the evaporator by inserting the refrigerant pipe into the insertion hole,, and the air passage restricting member can be

prevented from disengaging from the evaporator during the handling of the evaporator mounted with the air passage restricting member, or during the mounting of the evaporator to the main body of the refrigerator.

[0014] Preferably, in the refrigerator according to an embodiment of the present invention, the refrigerator further comprises: a return air passage through which air returns from the storage chamber to the cooling chamber and which is formed on a side of the cooling chamber; a partition wall for partitioning the return air passage from the cooling chamber; and a return air port formed at a lower end of the partition wall, the air in the return air passage returning through the return air port back to the cooling chamber; wherein the side wall of the cooling chamber is formed by the partition wall, and the air passage restricting member is disposed between the partition wall and the evaporator. Therefore, in the refrigerator according to the embodiment of the present invention, the return air port is formed at the lower end of the return air passage, and the air passage restricting member is disposed between the partition wall and the evaporator. As a result, when the air containing moisture and returned through the return air port passes by the air passage restricting member, frost is actively grown on the surface of the air passage restricting member, thereby preventing the air containing moisture from advancing to the upper portion of the cooling chamber and thereby causing a lot of frost.

[0015] Preferably, in the refrigerator according to one embodiment of the present invention, a clearance is formed between an end portion of the air passage restricting member in a left-right direction and the partition wall. Therefore, in the refrigerator according to the embodiment of the present invention, the clearance is provided in consideration of the manufacturing error, assembling deformation, etc. of the air passage restricting member or the components of the refrigerator, to reduce the difficulty of requirements for the manufacturing error or assembling precision of the air passage restricting member or the components of the refrigerator. Furthermore, the air containing moisture and returned through the air return port can easily advance upward through the clearance, frost actively grows on the surface of the air passage restricting member, the frost is used to block the clearance, thereby preventing the air containing moisture from advancing to the upper portion of the cooling chamber and thereby causing a lot of frost.

[0016] Preferably, in the refrigerator according to an embodiment of the present invention, the refrigerator further comprises a defrost-purpose heating portion which is disposed in the interior of the cooling chamber and below the evaporator. Therefore, in the refrigerator according to the embodiment of the present invention, the arrangement of the air passage restricting member reduces the amount of frost formed in the upper portion of the cooling chamber, and the defrost-purpose heating portion defrosts the lower portion of the cooling chamber, so that most or all of the frost formed in the interior of the

cooling chamber is melted, and the time and energy required for defrosting can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

FIG. 1 is a perspective view of a refrigerator according to an embodiment of the present invention as viewed from the front left side;

FIG. 2 is a side cross-sectional view showing a refrigerator according to an embodiment of the present invention as a whole;

FIG. 3 is a rear view showing an internal structure of a cooling chamber of a refrigerator according to the embodiment of the present invention;

FIG. 4A and FIG. 4B each are a view showing a refrigerator according to an embodiment of the present invention, wherein FIG. 4A is a side view showing a portion provided with an air passage restricting member, and FIG. 4B is a cross-sectional view of a lower portion of the portion provided with the air passage restricting member;

FIG. 5A and FIG. 5B each are a view showing a refrigerator according to an embodiment of the present invention, wherein FIG. 5A is a perspective view showing an air passage restricting member, and FIG. 5B is a cross-sectional view showing the air passage restricting member;

FIG. 6 is a view showing a refrigerator according to an embodiment of the present invention, and is a rear view showing a frosted cooling chamber nearby the air passage restricting member in an initial phase;

FIG. 7A and FIG. 7B each are a view showing a refrigerator according to an embodiment of the present invention, wherein FIG. 7A is a rear view showing a final stage of frost formation in an interior of the cooling chamber, and FIG. 7B is a rear view showing conditions in the interior of the cooling chamber after defrosting;

FIG. 8A and FIG. 8B each are a view showing a refrigerator in a comparative example without an air passage restricting member, wherein FIG. 8A is a rear view showing a final stage of frost formation in an interior of a cooling chamber, and FIG. 8B is a rear view showing conditions in the interior of the cooling chamber after defrosting.

DETAILED DESCRIPTION

[0018] Hereinafter, a refrigerator 10 according to an embodiment of the present invention will be described in detail with reference to figures. In the following depictions, in principle, the same members are denoted by the same reference numerals, and repeated depictions are omitted. Furthermore, in the following depictions, directional terms such as "up", "down", "front", "rear", "left"

and "right" are used properly, wherein "left" and "right" means left and right when the refrigerator 10 is viewed from rear. In addition, in the present embodiment, the refrigerator 10 is exemplarily a refrigerator having a freezing chamber and a refrigeration chamber, but the refrigerator 10 can also employ a refrigerator having a freezing chamber only or having a refrigeration chamber only.

[0019] FIG. 1 is a perspective view of a refrigerator 10 according to an embodiment of the present invention as viewed from the front left side. The refrigerator 10 has a heat-insulating cabinet 11 and storage compartments formed in an interior of the heat-insulating cabinet 11. The storage compartments comprise refrigeration chambers 12 and freezing chambers 13 from top to bottom. Regarding front openings of the refrigeration chambers 12, the refrigeration chamber in an upper layer is closed by a heat-insulating door 18, and the refrigeration chamber in a lower layer is closed by a heat-insulating door 19. Regarding front openings of the freezing chambers 13, the freezing chamber in an upper layer is closed by a heat-insulating door 20, and the freezing chamber in a lower layer is closed by a heat-insulating door 21. The heat-insulating door 18 is a rotary door, and the heat-insulating door 19, the heat-insulating door 20 and the heat-insulating door 21 are draw-type doors.

[0020] FIG. 2 is a side sectional view showing the refrigerator 10 as a whole. The heat-insulating cabinet 11 comprises an outer cabinet 111 made of a steel plate that is bent into a predetermined shape, an inner liner 112 made of a synthetic resin plate and disposed separately inside the outer cabinet 111, and a heat-insulating material 113 filled between the outer cabinet 111 and the inner liner 112.

[0021] A cooling chamber 115 is formed on an inner side of the freezing chamber 13, and the freezing chamber 13 and the cooling chamber 115 are partitioned by a partition plate 17. An evaporator 162 serving as a cooler is arranged in an interior of the cooling chamber 115. Moreover, a compressor chamber 14 is partitioned and formed in a rear portion of a lower end side of the refrigerator 10, and a compressor 161 is disposed in the compressor chamber 14. The evaporator 162 and the compressor 161 form a refrigerant compression type freezing cycle 16. Specifically, the freezing cycle 16 comprises the compressor 161, a condenser (not shown), an expansion unit (not shown), and the evaporator 162. By operating the freezing cycle 16, the evaporator 162 is used to cool the air in the interior of the cooling chamber 115, and a blower 27 is used to blow the cool air to each storage chamber to bring the internal temperature of each storage chamber into a predetermined cooling temperature range. The devices constituting the freezing cycle 16 are connected to each other by a refrigerant pipe formed of a metal pipes such as a copper pipe.

[0022] The blower 27 is disposed above the evaporator 162 in the interior of the cooling chamber 115. The blower 27 is an axial flow blower or a centrifugal blower, and blows the cold air which is in the cooling chamber 115

and cooled by the evaporator 162, toward the refrigeration chamber 12 and the freezing chamber 13.

[0023] A defrost-purpose heating portion 117 is disposed in the interior of the cooling chamber 115 and below the evaporator 162. The defrost-purpose heating portion 117 is a heater that generates heat after being energized.

[0024] An air supply passage 118 is formed upward from the cooling chamber 115. Openings for blowing cold air to the refrigeration chamber 12 are formed in the air supply passage 118. The cold air for cooling the refrigeration chamber 12 is returned to the cooling chamber 115 via a return air passage not shown here. Thereby, the refrigeration chamber 12 is cooled to a predetermined refrigeration temperature range.

[0025] A portion of the blown cold air is blown to the freezing chamber 13 through an opening formed in an upper portion of the partition plate 17, and the cold air for cooling the freezing chamber 13 returns to the cooling chamber 115 through an opening formed in a lower portion of the partition plate 17. Thereby, the freezing chamber 13 is cooled to a predetermined freezing temperature range.

[0026] When the cooling of the refrigeration chamber 12 and the freezing chamber 13 by the freezing cycle 16 lasts, a lot of frost is generated on the evaporator 162 and hinders the heat transfer and airflow of the evaporator 162. Therefore, the evaporator 162 is periodically defrosted. During the defrosting operation, the cooling of the refrigeration chamber 12 and the freezing chamber 13 by the freezing cycle 16 is stopped, the air supply by the blower 27 is stopped, and the air in the interior of the cooling chamber 115 is heated by the defrost-purpose heating portion 117, thereby defrosting the evaporator 162. After the defrosting operation ends, the aforementioned cooling operation of the refrigeration chamber 12 and the freezing chamber 13 is restarted.

[0027] FIG. 3 is a rear view showing an internal structure of the cooling chamber 115.

[0028] The evaporator 162 is a finned tube type evaporator disposed in the interior of the cooling chamber 115. Specifically, the evaporator 162 has a heat transfer tube 29 and heat-dissipating fins 28, and the heat transfer tube 29 runs through an opening formed in the heat-dissipating fins 28. The heat transfer tube 29 is a conduit formed of copper or aluminum having excellent thermal conductivity. The heat-dissipating fins 28 are metal plates made of copper or aluminum having high thermal conductivity, and a plurality of heat-dissipating fins 28 are arranged at substantially equal intervals in the left-right direction. A low-temperature refrigerant circulates inside the heat transfer tube 29, whereby the heat transfer tube 29 and the heat-dissipating fins 28 exchange heat with the air in the interior of the cooling chamber 115. Thereby, the air in the interior of the cooling chamber 115 is cooled.

[0029] The heat transfer tube 29 has a linear section 291, a linear section 292, a linear section 293 and a linear section 294 extending linearly in the left-right direction.

The linear sections 291, 292, 293 and 294 are in the same plane and parallel to one another in the up-down direction.

[0030] A right end portion of the linear section 291 and a right end portion of the linear section 292 are connected by a curved section 295. A left end portion of the linear section 292 and a left end portion of the linear section 293 are connected by a curved section 297. A right end portion of the linear section 293 and a right end portion of the linear section 294 are connected by a curved section 296. Moreover, starting from a left end of the linear section 294, a refrigerant pipe 298 is guided in the upper portion of the cooling chamber 115.

[0031] A return air passage 24 is an air passage through which the air for cooling the refrigeration chamber 12 shown in FIG. 2 returns to the cooling chamber 115. The return air passage 24 is formed on the left side of the cooling chamber 115. The return air passage 24 and the cooling chamber 115 are partitioned by a partition wall 25 having a heat-insulating structure. Here, the partition wall 25 is formed with a side wall 32 located on the left side of the evaporator 162.

[0032] A return air port 26 is an opening that communicates a lower end of the return air passage 24 with the cooling chamber 115.

[0033] The airflow in the interior of the cooling chamber 115 will be described. First, the air for cooling the refrigeration chamber 12 shown in FIG. 2 advances downward in the return air passage 24. The air that has reached the lower end of the return air passage 24 enters the cooling chamber 115 through the return air port 26, and then advances rightward at the bottom of the cooling chamber 115. Thereafter, the air rises inside the cooling chamber 115 as indicated by the dotted line, and exchanges heat with the evaporator 162 and therefore is cooled. In addition, part of the air entering the interior of the cooling chamber 115 through the air return port 26 rises through a gap formed between a left end portion of the evaporator 162 and the side wall 32 as indicated by the dashed-dotted line.

[0034] In the present embodiment, an air passage restricting member 30 is provided between the left end portion of the evaporator 162 and the side wall 32. The air passage restricting member 30 has a substantially rectangular parallelepiped shape, is formed of a deformable flexible material, and a surface portion of the air passage restricting member is excellent in thermal conductivity. A right side portion of the air passage restricting member 30 is inserted into a gap between the heat transfer tubes 29 of the evaporator 162. Furthermore, a clearance 31 is formed between a left end portion of the air passage restricting member 30 and the side wall 32. The clearance 31 is a clearance ensured in consideration of the manufacturing error, assembling deformation, etc. of the air passage restricting member 30 or the components of the refrigerator 10.

[0035] FIG. 4A is a partially enlarged view showing a portion provided with the air passage restricting member

30, and FIG. 4B is a partially enlarged cross-sectional view showing the portion provided with the air passage restricting member 30 as viewed from below.

[0036] Referring to FIG. 4A, a right end portion of the air passage restricting member 30 is inserted between the left end portion of the linear section 293 and the left end portion of the linear section 294. The right end portion of the air passage restricting member 30 is slightly compressed between the linear section 293 and the linear section 294, and thereby the position thereof is fixed. In addition, the right end face of the air passage restricting member 30 is in surface contact with the heat-dissipating fins 28. With such a configuration, the air passage restricting member 30 is in surface contact with the linear sections 293 and 294 as parts of the heat transfer tube 29 and the heat-dissipating fins 28. Therefore, the surface of the air passage restricting member 30 is cooled by the heat exchange with the heat transfer tube 29 and the heat-dissipating fins 28, and the temperature of the surface is lowered.

[0037] Referring to FIG. 4B, an insertion hole 303 and a slot 304 are formed in the air passage restricting member 30. The insertion hole 303 is a through hole that runs through the air passage restricting member 30 in the up-down direction. The slot 304 is a slot for communicating the right end face of the air passage restricting member 30 and the insertion hole 303. The refrigerant pipe 299 is arranged in the insertion hole 303 via the slot 304. The air passage restricting member 30 can be mounted more firmly to the evaporator 162 by inserting the refrigerant pipe 299 into the insertion hole 303. Therefore, the air passage restricting member 30 can be prevented from disengage from the evaporator 162 in the process of conveying the evaporator 162 mounted with the air passage restricting member 30, or in the process of mounting the evaporator 162 to the main body of the refrigerator 10.

[0038] FIG. 5A is a perspective view showing the air passage restricting member, and FIG. 5B is a cross-sectional view showing the air passage restricting member 30. Here, the insertion holes 303 and the slot 304 shown in FIG. 4B are not shown.

[0039] Referring to FIG. 5A, the air passage restricting member 30 has a substantially rectangular parallelepiped shape. The size of the air passage restricting member 30 can vary with the shape of the evaporator 162 shown in FIG. 3, and the size of the cooling chamber 115, and so on. A thickness dimension of the air passage restricting member 30 is set to be slightly larger than a vertical distance dimension between the linear section 293 and the linear section 294.

[0040] Referring to FIG. 5B, the air passage restricting member 30 has a core member 301 and a surface member 302. Here, although the surface member 302 is away from the surface of the core member 301 in the figure, the surface member 302 is, in reality, in close contact with the surface of the core member 301.

[0041] The material of the core member 301 may employ a material that can be easily deformed and light

weighted, for example, employ a foamed resin. By employing the foamed resin or the like as the core member 301, the air passage restricting member 30 can be inserted between the linear section 293 and the linear section 294 while being deformed slightly as shown in FIG. 4A. In addition, a lower surface and an upper surface of the air passage restricting member 30 can be brought into close contact with the linear section 293 and the linear section 294 satisfactorily. Furthermore, the light weight of the air passage restricting member 30 can be pursued.

[0042] The surface member 302 may employ a film material having a better thermal conductivity than the core member 301, for example, employ an aluminum tape or an aluminum foil. The surface of the air passage restricting member 30 is formed by the surface member 302, whereby the temperature of the surface member 302 can be lowered by exchanging heat with the linear section 294, the linear section 293 and the heat-dissipating fins 28.

[0043] FIG. 6 is a rear view showing a frosted cooling chamber 115 in an initial phase of the cooling operation of the freezing cycle 16.

[0044] As stated above, the surface of the air passage restricting member 30 formed of the aluminum foil is in surface contact with the evaporator 162. Therefore, when the low-temperature refrigerant is guided into the evaporator 162 by operating the freezing cycle 16, the surface of the air passage restricting member 30 is also cooled to a low temperature.

[0045] On the other hand, since the refrigeration compartment 12 shown in FIG. 2 is cooled, the air returning to the return air passage 24 contains a lot of moisture evaporated from the foods etc. stored in the refrigeration compartment 12. A portion of the air that descends in the return air passage 24 and is guided through the return air port 26 into the cooling chamber 115 advances in the direction of the clearance 31 as indicated by the dashed-dotted line. The air containing moisture is blown onto the surface of the cooled air passage restricting member 30, whereby the surface of the air passage restricting member 30 is first frosted. Here, frosting is shown with dotted shading. As such, in an early stage of the cooling operation, the surface of the air passage restricting member 30 is first frosted, so the frost in this portion grows earlier than the surrounding area. The clearance 31 is blocked by the frost growing on the air passage restricting member 30.

[0046] FIG. 7A is a rear view showing a final stage of frost formation in the interior of the cooling chamber 115, and FIG. 7B is a rear view showing conditions in the interior of the cooling chamber 115 after defrosting.

[0047] Referring to FIG. 7A, frost occurs as a whole starting from the evaporator 162, the refrigerant pipe 298 and so on. Specifically, a large amount of frost occurs in a lower portion of the evaporator 162, and frost also occurs in an upper portion of the evaporator 162. In the present embodiment, since the clearance 31 is blocked

early by arranging the air passage restricting member 30, frost formation around the refrigerant pipe 298 arranged in the upper portion is suppressed. In addition, frost formation in the entire upper region of the cooling chamber 115 is suppressed.

[0048] As such, the air passage restricting member 30 can enable the surface of the surface member 302 to be actively frosted, and the resultant frost is used to block the clearance 31. When the clearance 31 is blocked, the cold air flowing upward along the clearance 31 is prevented from flowing upward, and flows rightward instead. In this way, frost formation in the upper portion of the cooling chamber 115 can be suppressed.

[0049] When the frosting of the evaporator 162 proceeds, the heat transfer of the evaporator 162 and the air flow in the interior of the cooling chamber 115 are hindered. Therefore, the defrosting operation for melting and removing the frost is performed by energizing the defrost-purpose heating portion 117 to heat the air in the interior of the cooling chamber 115.

[0050] Referring to FIG. 7B, when the defrosting operation ends, most or all of the frost formed in the interior of the cooling chamber 115 is melted and removed. Therefore, the interior of the cooling chamber 115 can be effectively cooled by allowing the low-temperature refrigerant to circulate through the evaporator 162 again. Furthermore, the time and energy required for defrosting can be reduced.

[0051] FIG. 8 is a diagram showing a refrigerator of a comparative example without the air passage restricting member 30, FIG. 8A is a rear view showing a final stage of frost formation in the interior of the cooling chamber 115, and FIG. 8B is a rear view showing conditions in the interior of the cooling chamber 115 after defrosting.

[0052] Referring to FIG. 8A, in a case where there is no air passage restricting member 30 and the clearance 31 is not blocked, a portion of the humid air advances toward the upper side of the cooling chamber 115 as indicated by the dashed-dotted line. Thereby, a large amount of frost is generated along the refrigerant pipe 298 guided above an accommodating rack 15.

[0053] Referring to FIG. 8B, the defrosting operation of heating the air in the interior of the cooling chamber 115 is performed by energizing the defrost-purpose heating portion 117. However, since a very large amount of frost is formed at a position away from the defrost-purpose heating portion 117, namely, the upper portion of the cooling chamber 115, a considerable amount of frost does not melt away and remains nearby the refrigerant pipe 298 or in the upper portion of the cooling chamber 115. When the cooling operation using the freezing cycle 16 is restarted in this state, the frost hinders the heat transfer of the cooling chamber 115, and thereby hinders the air flow in the interior of the cooling chamber 115, thereby causing the reduction of the cooling efficiency. On the other hand, if the time duration of energizing the defrost-purpose heating portion 117 through the defrosting operation is prolonged, all frost can be removed. How-

ever, this causes the problem that more energy, time, cooling efficiency and power consumption are needed for the defrosting.

[0054] According to the present embodiment described above, the following main effects can be achieved.

[0055] Referring to FIG. 3, with the air passage restricting member 30 being disposed between the evaporator 162 of the cooling chamber 115 and the side wall 32 of the cooling chamber 115, the cold air can be prevented from advancing to above the evaporator 162 via the left side of the evaporator 162 in the cooling chamber 115. Therefore, the defrosting above the evaporator 162 can be suppressed.

[0056] Referring to FIG. 4A, the air passage restricting member 30 is sandwiched by the heat transfer tube 29, so that the surface thereof is cooled by the heat transfer tubes 29. Thereby, since the temperature of the surface of the air passage restricting member 30 becomes a low temperature, frosting proceeds efficiently. Then, since the clearance 31 between the evaporator 162 and the side wall 32 of the cooling chamber 115 can be blocked by the formed frost, the cold air can be prevented from advancing to above the evaporator 162 in the cooling chamber 115.

[0057] Referring to FIG. 5, the surface of the air passage restricting member 30 is covered with a surface member 302 such as an aluminum tape having excellent thermal conductivity. As a result, the temperature of the surface member 302 in contact with the evaporator 162 rapidly becomes a low temperature, so the frost effectively formed on the surface of the surface member 302 can be used to block the path through which the cold air advances to above.

[0058] Referring to FIG. 4A, the end face of the air passage restricting members 30 is in surface contact with the heat-dissipating fins 28. Thereby, the surface of the air passage restricting member 30 can be efficiently cooled by the heat-dissipating fins 28, so that the surface of the air passage restricting member 30 can be effectively frosted.

[0059] Referring to FIG. 3, the return air port 26 is formed at the lower end of the return air passage 24, and the clearance 31 is formed between the outer end portion of the air passage restricting member 30 in the width direction and the partition wall 25, whereby the air returned through the return air port 26 and containing moisture easily advances toward the upper portion of the cooling chamber 115 via the clearance 31. Here, since the air passage restricting member 30 is in contact with the evaporator 162, the thermal conductivity in the surface of the air passage restricting member 30 is improved, and frost is actively grown on the surface of the air passage restricting member 30, and the clearance 31 is closed by the frost, thereby preventing the air containing moisture from advancing towards the upper portion of the cooling chamber 115 and thereby causing a lot of frost.

[0060] The present invention is not limited to the above-described embodiments, and additionally, various modifications can be made within a range not departing from the spirit of the present invention. In addition, the aforesaid modes can be combined with each other.

[0061] For example, referring to FIG. 5, the air passage restricting member 30 has a substantially rectangular parallelepiped shape, but the air passage restricting member 30 can employ a shape other than the rectangular parallelepiped shape, such as a cylindrical shape.

[0062] Furthermore, referring to FIG. 3, it is also possible to make the left end portion of the air passage restricting member 30 abut against the side wall 32 to completely block the clearance 31, thereby further suppressing the formation of frost in the upper portion of the cooling chamber 115.

[0063] Hereinafter, the technical idea and its effects that are mastered from the aforesaid present embodiment will be described.

[0064] The refrigerator of the present invention further comprises: a return air passage, which is an air passage through which air returns from the storage chamber to the cooling chamber and which is formed on a side of the cooling chamber; a partition wall for partitioning the return air passage from the cooling chamber; and a return air port which is an opening formed at the lower end of the partition wall, the air in the return air passage returning through the return air port back to the cooling chamber, a clearance being formed between the outer end portion of the air passage restricting member in the width direction and the partition wall. Therefore, in the refrigerator according to the present invention, the return air port is formed at the lower end of the return air passage, and the clearance is formed between the outer end portion of the air passage restricting member in the width direction and the partition wall, so that the air returned through the return air port and containing moisture easily advances toward the upper portion of the cooling chamber via the clearance. In the present invention, since the air passage restricting member is in contact with the evaporator, frost is actively grown on the surface of the air passage restricting member, and the clearance is blocked by the frost, thereby preventing the air containing moisture from advancing to the upper portion of the cooling chamber and thereby causing a lot of frost.

Claims

1. A refrigerator, wherein the refrigerator comprises:
 - a storage chamber;
 - a cooling chamber for accommodating air to be blown to the storage chamber; and
 - an evaporator for cooling the air in an interior of the cooling chamber, the evaporator being a finned tube cooler having a heat transfer tube and heat-dissipating fins,

an air passage restricting member is disposed between a side wall of the cooling chamber and the evaporator and is in contact with the evaporator.

2. The refrigerator according to claim 1, wherein

the heat transfer pipe has a plurality of linear sections and a plurality of curved sections, the plurality of curved sections connecting end portions of vertically-adjacent linear sections, and the air passage restricting member is sandwiched between the adjacent linear sections.

3. The refrigerator according to claim 2, wherein

the refrigerator further comprises a freezing cycle having the evaporator, and the evaporator is connected to another constituent device in the freezing cycle through a refrigerant pipe; the refrigerant pipe is guided in an upper portion of the cooling chamber, starting from a left end of the topmost linear section; the air passage restricting member is located between a side wall of the cooling chamber and a left end portion of the evaporator.

4. The refrigerator according to claim 3, wherein the air passage restricting member is sandwiched between the topmost linear section and another adjacent linear section below the topmost linear section.

5. The refrigerator according to claim 2, wherein the air passage restricting member is formed of a deformable flexible material, and is sandwiched between the adjacent linear sections while being slightly deformed.

6. The refrigerator according to claim 1, wherein the air passage restricting member comprises:

a core member; and
a surface member covering a surface of the core member,
the surface member is made of a material having a higher thermal conductivity than the core member.

7. The refrigerator according to claim 6, wherein the core member employs a foamed resin, and the surface member employs an aluminum tape or an aluminum foil.

8. The refrigerator according to claim 1, wherein the air passage restricting member has a rectangular parallelepiped shape, and an end face of the air passage restricting member is in contact with the heat-

dissipating fin.

9. The refrigerator according to claim 1, wherein

the refrigerator further comprises a freezing cycle having the evaporator;
the air passage restricting member is formed with an insertion hole running through the air passage restricting member in an up-down direction, and a slot communicating an end face of the air passage restricting member with the insertion hole;
the refrigerant pipe of the freezing cycle is arranged in the insertion hole via the slot.

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10. The refrigerator according to claim 1, wherein the refrigerator further comprises:

a return air passage through which air returns from the storage chamber to the cooling chamber and which is formed on a side of the cooling chamber;
a partition wall for partitioning the return air passage from the cooling chamber; and
a return air port formed at a lower end of the partition wall, the air in the return air passage returning through the return air port back to the cooling chamber;
wherein the side wall of the cooling chamber is formed by the partition wall, and the air passage restricting member is disposed between the partition wall and the evaporator.

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11. The refrigerator according to claim 10, wherein

a clearance is formed between an end portion of the air passage restricting member in a left-right direction and the partition wall.

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12. The refrigerator according to claim 1, wherein

the refrigerator further comprises a defrost-purpose heating portion which is disposed in the interior of the cooling chamber and below the evaporator.

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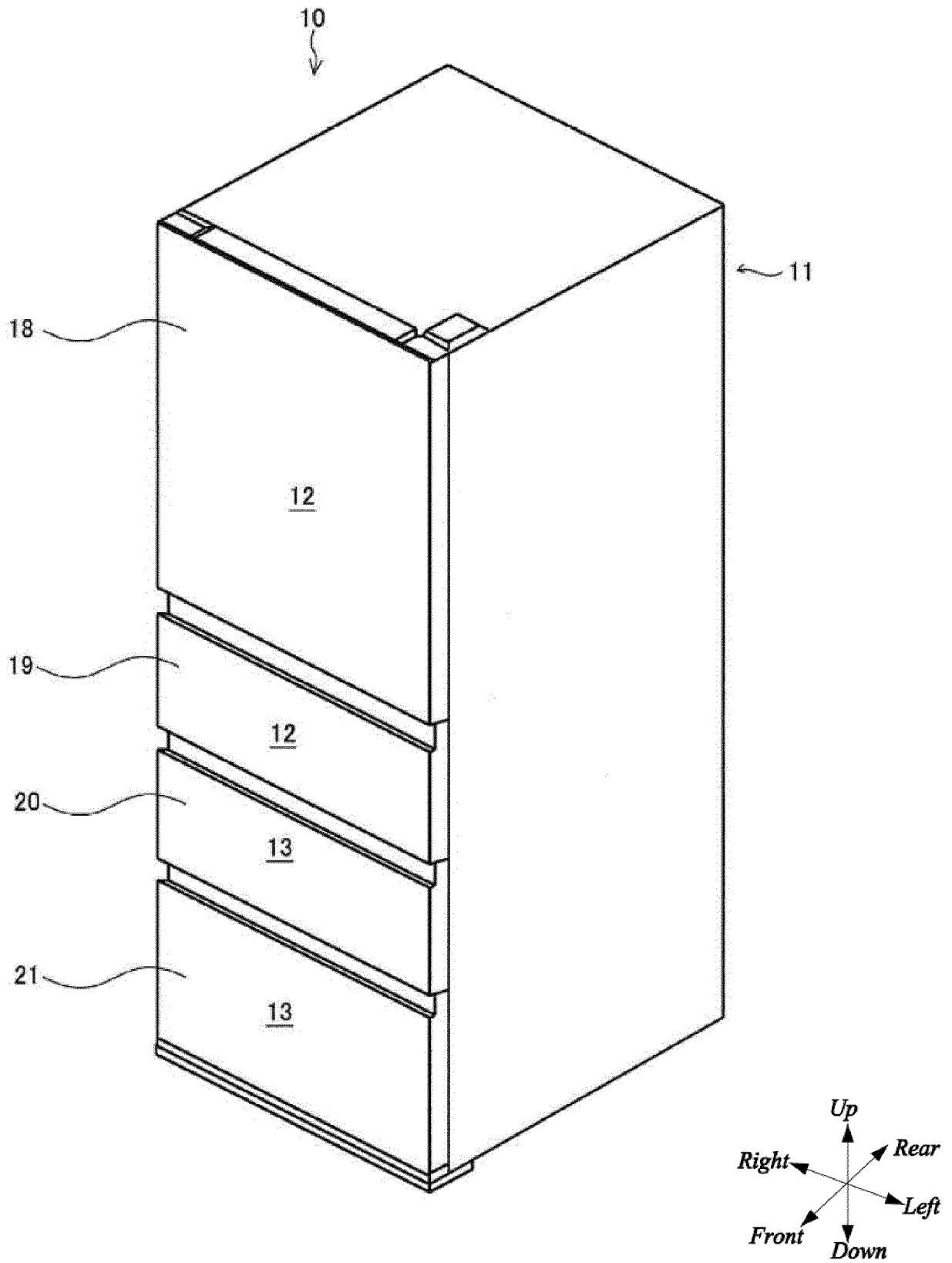


Fig. 1

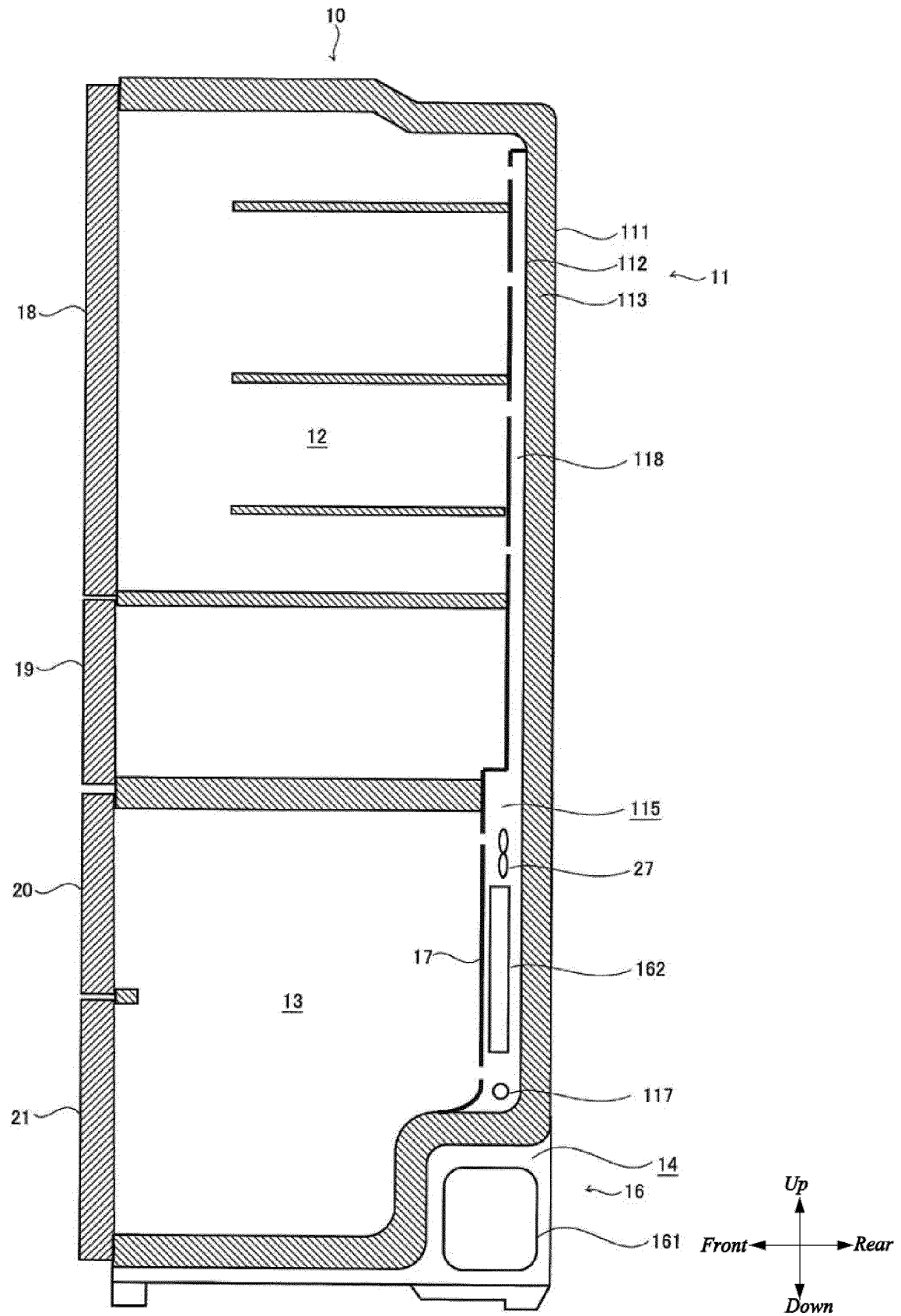


Fig. 2

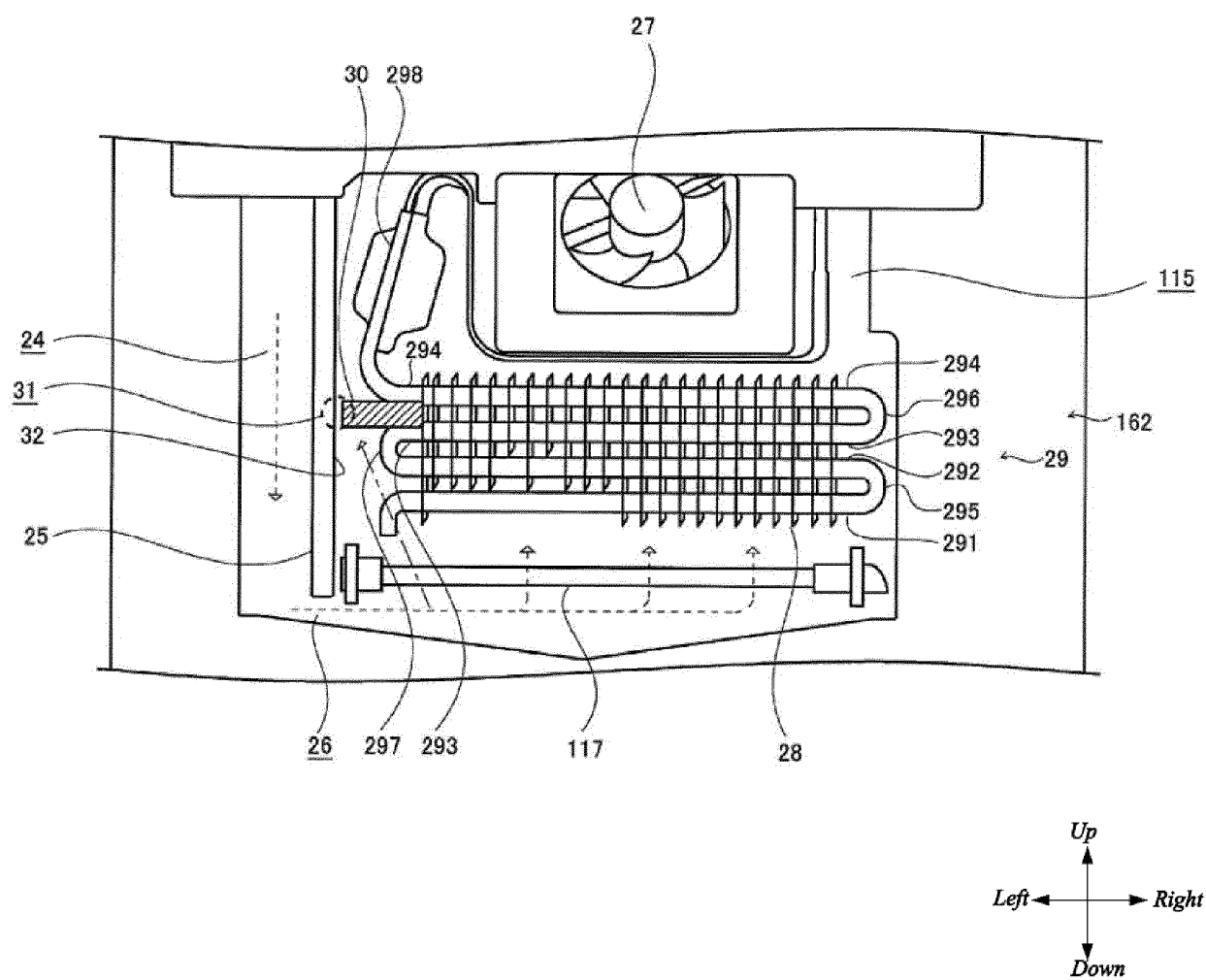


Fig. 3

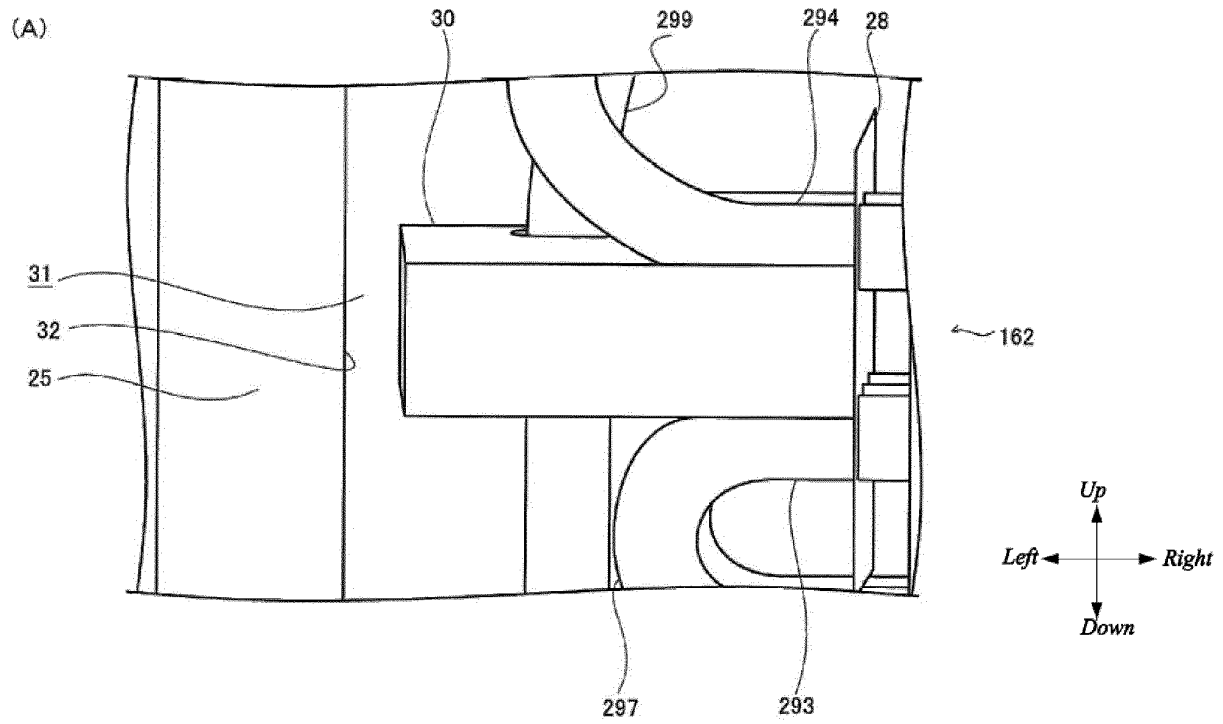


Fig. 4A

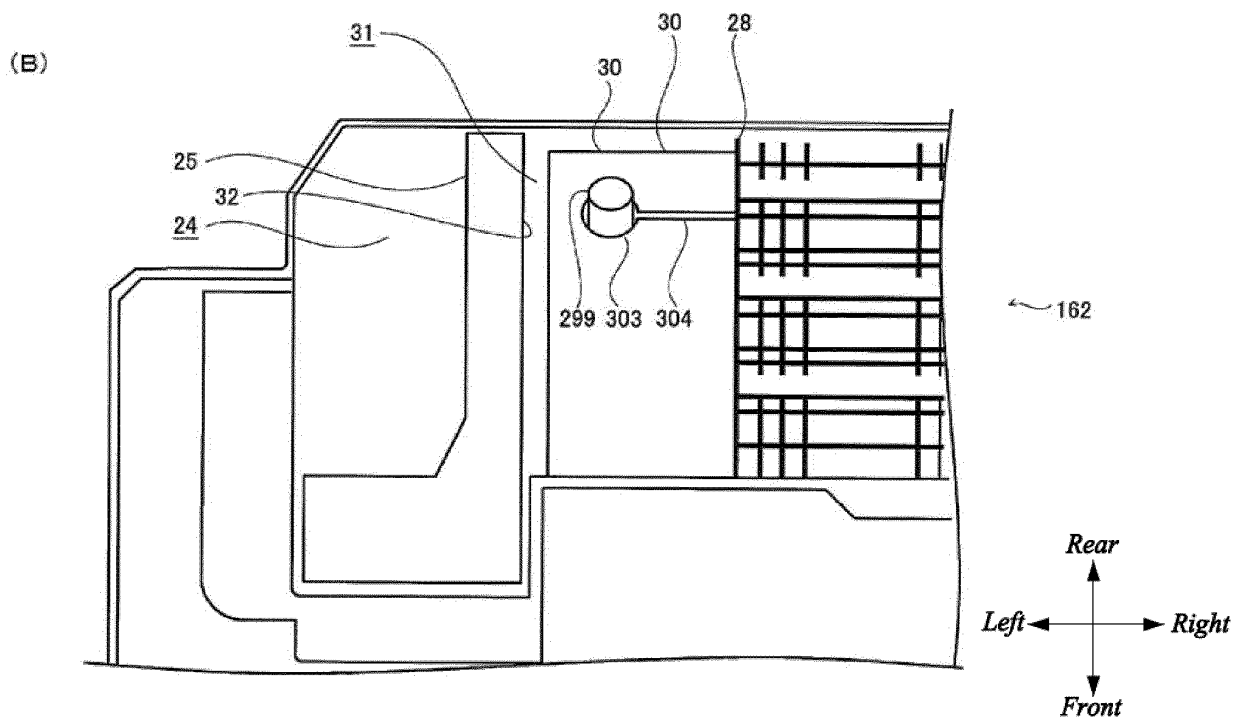


Fig. 4B

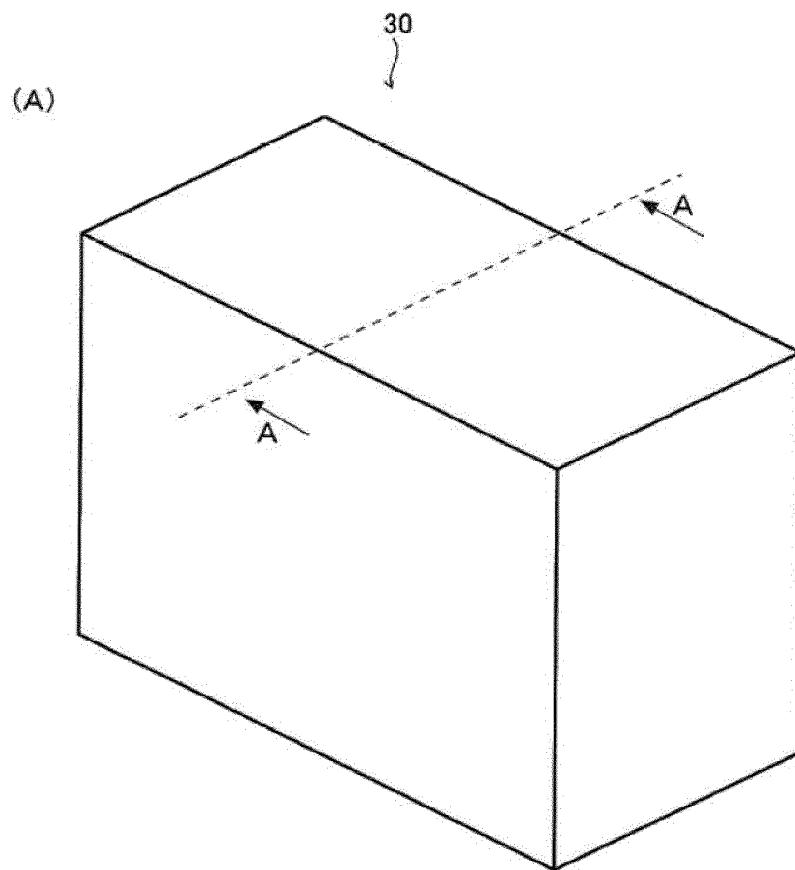


Fig. 5A

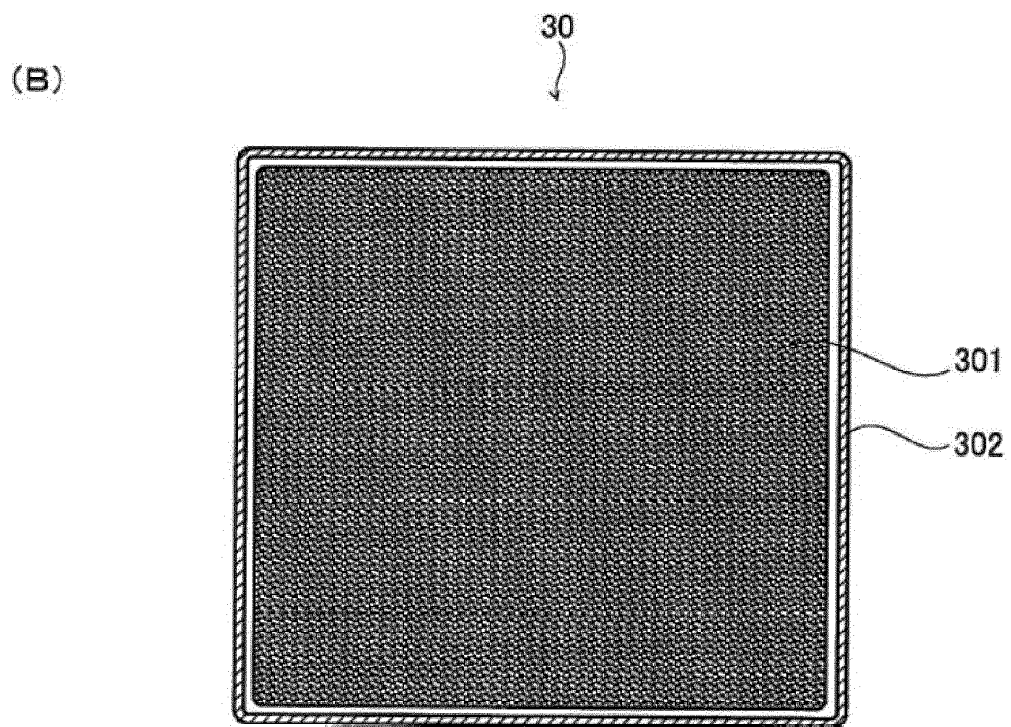


Fig. 5B

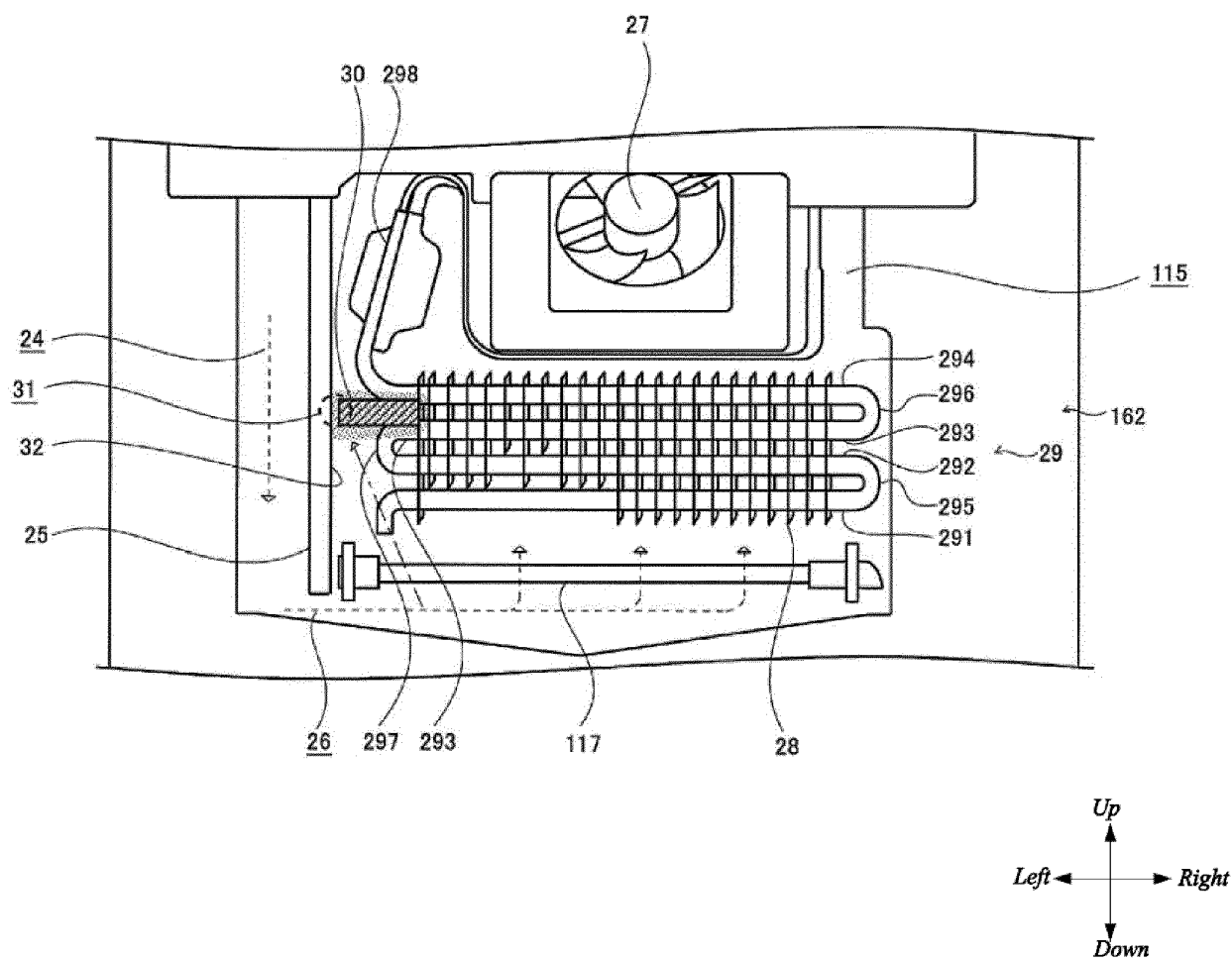


Fig. 6

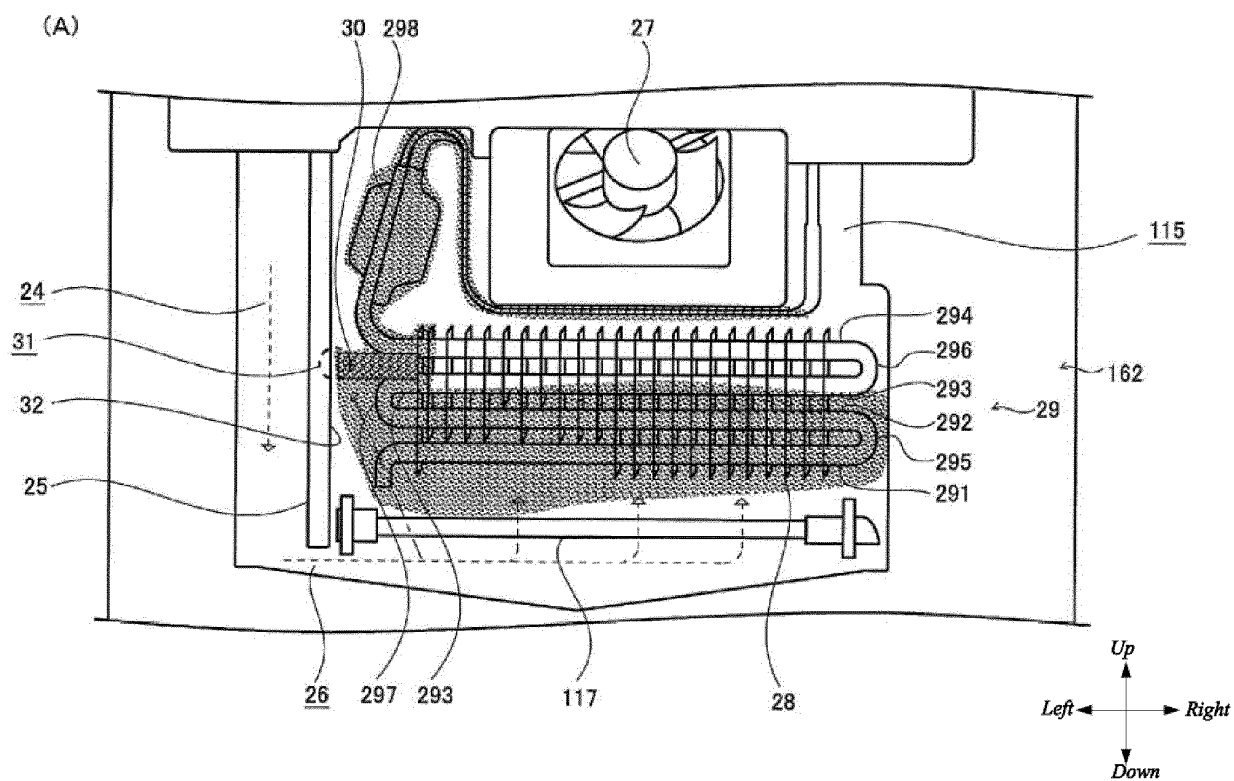


Fig. 7A

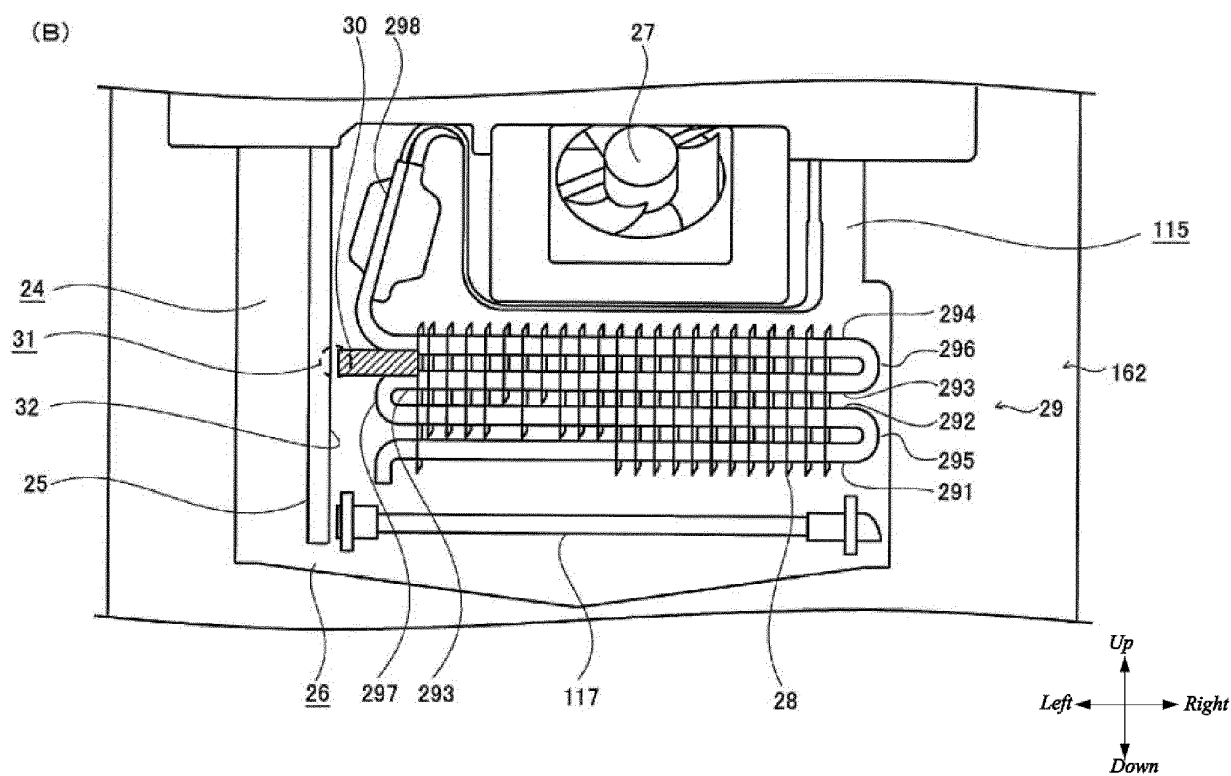


Fig. 7B

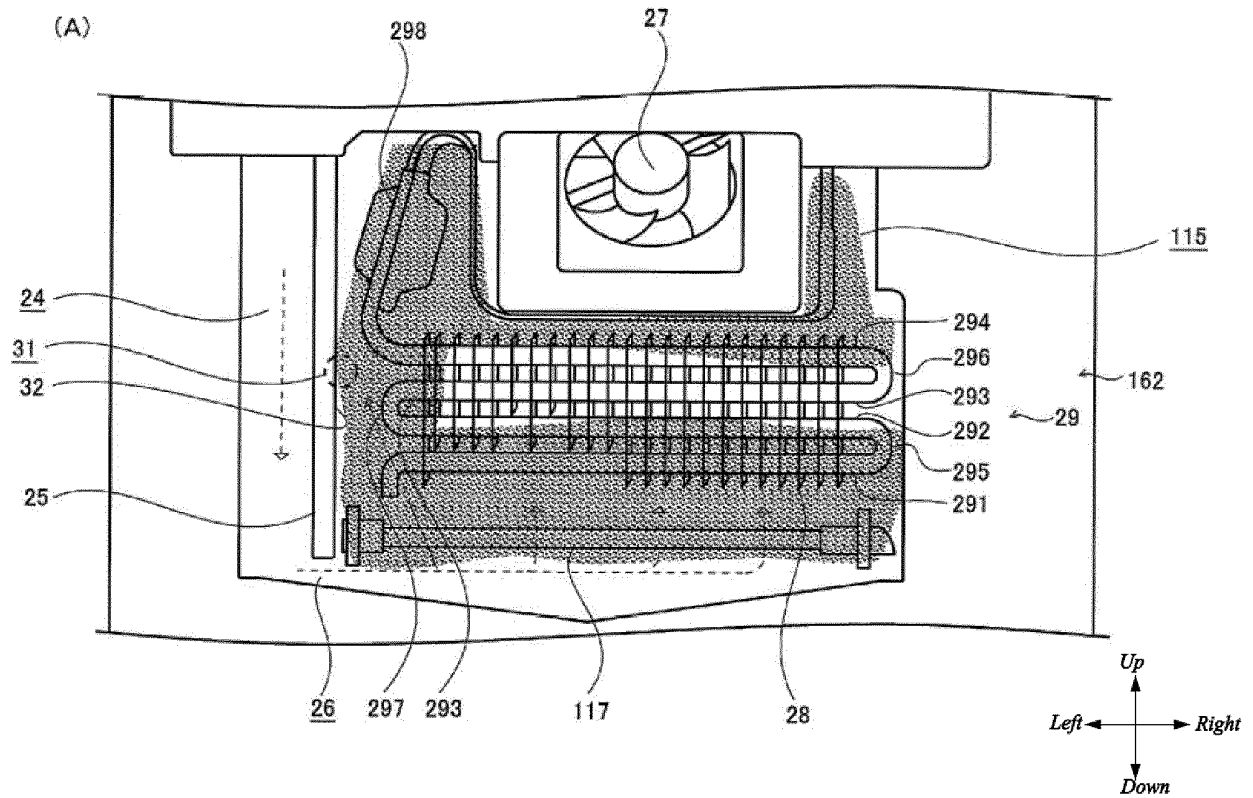


Fig. 8A

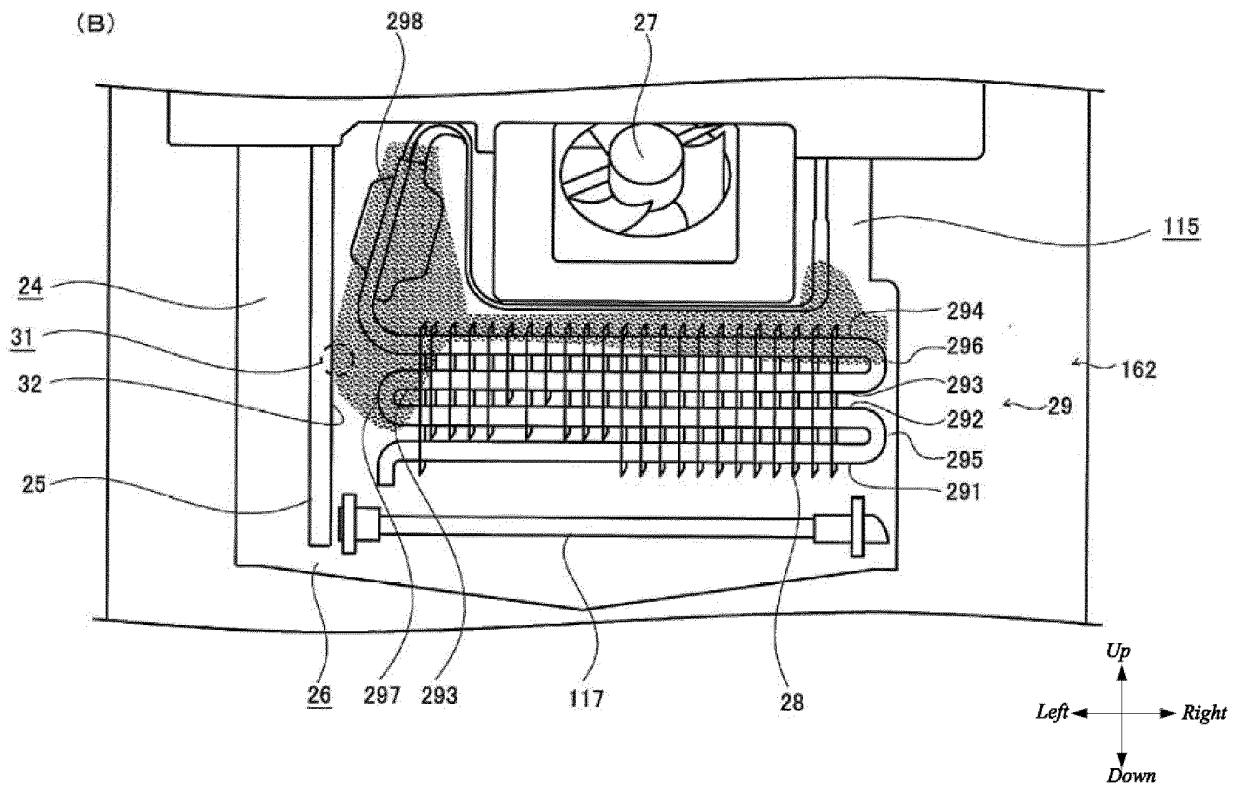


Fig. 8B

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2021/092694

A. CLASSIFICATION OF SUBJECT MATTER F25D 21/04(2006.01)i; F25D 11/00(2006.01)i According to International Patent Classification (IPC) or to both national classification and IPC																					
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) F25D11 F25D17 F25D21 F25D23 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) CNABS, CNTXT, CNKI, DWPI: 蒸发器 风挡管霜 evaporator air wind baffle block+ pipe tube conduit frost																					
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>CN 108195100 A (QINGDAO HAIER CO., LTD.) 22 June 2018 (2018-06-22) description, paragraphs [0024]-[0034] and figures 1-4</td> <td>1, 6-8, 10, 11</td> </tr> <tr> <td>Y</td> <td>CN 108195100 A (QINGDAO HAIER CO., LTD.) 22 June 2018 (2018-06-22) description, paragraphs [0024]-[0034] and figures 1-4</td> <td>2-5, 9, 12</td> </tr> <tr> <td>Y</td> <td>CN 102944094 A (HEFEI HUALING CO., LTD.) 27 February 2013 (2013-02-27) description, paragraphs [0031]-[0040] and figures 1-3</td> <td>2-5, 9, 12</td> </tr> <tr> <td>A</td> <td>CN 110986467 A (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI et al.) 10 April 2020 (2020-04-10) entire document</td> <td>1-12</td> </tr> <tr> <td>A</td> <td>CN 103062960 A (HISENSE (BEIJING) ELECTRICAL APPLIANCE CO., LTD.) 24 April 2013 (2013-04-24) entire document</td> <td>1-12</td> </tr> <tr> <td>A</td> <td>JP 11264631 A (SANYO ELECTRIC CO., LTD.) 28 September 1999 (1999-09-28) entire document</td> <td>1-12</td> </tr> </tbody> </table>	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	CN 108195100 A (QINGDAO HAIER CO., LTD.) 22 June 2018 (2018-06-22) description, paragraphs [0024]-[0034] and figures 1-4	1, 6-8, 10, 11	Y	CN 108195100 A (QINGDAO HAIER CO., LTD.) 22 June 2018 (2018-06-22) description, paragraphs [0024]-[0034] and figures 1-4	2-5, 9, 12	Y	CN 102944094 A (HEFEI HUALING CO., LTD.) 27 February 2013 (2013-02-27) description, paragraphs [0031]-[0040] and figures 1-3	2-5, 9, 12	A	CN 110986467 A (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI et al.) 10 April 2020 (2020-04-10) entire document	1-12	A	CN 103062960 A (HISENSE (BEIJING) ELECTRICAL APPLIANCE CO., LTD.) 24 April 2013 (2013-04-24) entire document	1-12	A	JP 11264631 A (SANYO ELECTRIC CO., LTD.) 28 September 1999 (1999-09-28) entire document	1-12
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Date of the actual completion of the international search 14 July 2021	Date of mailing of the international search report 29 July 2021																				
Name and mailing address of the ISA/CN China National Intellectual Property Administration (ISA/CN) No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088 China Facsimile No. (86-10)62019451	Authorized officer Telephone No.																				

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2021/092694

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CN	108195100	A	22 June 2018		None				
CN	102944094	A	27 February 2013		None				
CN	110986467	A	10 April 2020		None				
CN	103062960	A	24 April 2013		None				
JP	11264631	A	28 September 1999		JP	H11264631	A	28 September 1999	

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REFERENCES CITED IN THE DESCRIPTION

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