(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 312 244 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
20.04.2011 Bulletin 2011/16

(21) Application number: **09794264.3**

(22) Date of filing: **04.06.2009**

(51) Int Cl.:
F25D 21/14 *(2006.01)*

(86) International application number:
PCT/JP2009/060243

(87) International publication number:
WO 2010/004817 (14.01.2010 Gazette 2010/02)

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK TR
Designated Extension States:
AL BA RS

(30) Priority: **09.07.2008 JP 2008179367**

(71) Applicant: **Hoshizaki Denki Kabushiki Kaisha**
Aichi 470-1194 (JP)

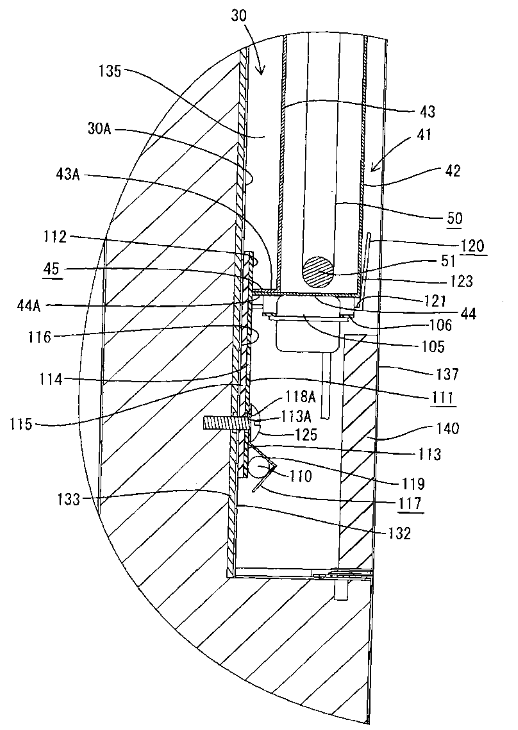
(72) Inventors:
- **HIRAKI Daisuke**
  Toyoake-shi
  Aichi 470-1194 (JP)
- **SUGIYAMA Etsuo**
  Toyoake-shi
  Aichi 470-1194 (JP)
- **KATO Kiyoshi**
  Toyoake-shi
  Aichi 470-1194 (JP)
- **NISHIO Masayuki**
  Toyoake-shi
  Aichi 470-1194 (JP)

(74) Representative: **Müller-Boré & Partner**
Patentanwälte
Grafinger Straße 2
81671 München (DE)

(54) DRAINAGE WATER EVAPORATOR FOR COOLING STORAGE

(57) A thermostat 105 is provided on an outer surface of a bottom plate 44 of an evaporation tank 41 so as to be in contact directly therewith. A heat exchanger plate 111 is provided on a back wall 30A of a recess 30 of a refrigerator body 10 with having a heat insulating sheet 115 therebetween. A heat transferring surface 112 of the heat exchanger plate 111 is positioned to face a rear side of a horizontal portion of an evaporation heater 50. A contact plate 45 extending from the bottom plate 44 of the evaporation tank 41 is in line contact with the heat receiving surface 112. A temperature fuse 110 is held by a fuse holder 117 to be closely contacted to a mounting surface 113 at a lower part of the heat exchanger plate 111. Heat of the evaporation tank 41 is lowered and transferred to the mounting surface 113 of the heat exchanger plate 111. Therefore, even if the temperature of the evaporation tank 41 rises to a predetermined level at which the temperature fuse 110 should be turned off, the temperature of the mounting surface 113 of the heat exchanger plate 111 remains a level lower than the predetermined level.

FIG.10



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Description

TECHNICAL FIELD

[0001] The present invention relates to a discharge water evaporating device for a cooling storage that stores and evaporates discharged water such as defrosted water.

BACKGROUND ART

[0002] A cooling storage of this kind described in Patent Document 1 is known. In the cooling storage, a cooler is provided on a ceiling of a refrigerator body of the cooling storage and a drain pan is provided below the cooler to receive defrosted water. A discharge tube connected to the drain pan penetrates through a wall of the refrigerator body to extend outwardly from a rear surface of the refrigerator body. An evaporation tank provided with a drop-in heater (sheathed heater) is provided below the extended tube. If a defrosting operation is started, the defrosted water is received by the drain pan and dropped in the evaporation tank from the discharge tube and stored therein. The stored water is heated by the heater to be evaporated and discharged.

[0003] Such a discharge water evaporating device has a boil-dry protection mechanism. In the above conventional art, a thermostat of a liquid expansion type is directly provided on an upper surface of the sheathed heater. If the discharged water is further evaporated and the surface of the heater where the thermostat is provided is exposed from the stored water, the temperature of the surface of the heater increases rapidly. If the temperature increases to a predetermined level, the thermostat detects that the temperature reaches the predetermined temperature and is turned off and current supply to the heater is stopped. Then, if the temperature of the surface of the heater drops to a predetermined level or lower, the thermostat is turned on and this makes possible the current supply to the heater.

[Patent Document 1] Japanese Unexamined Patent Publication No. 2008-8533

DISCLOSURE OF THE INVENTION

(Problem to Be Solved by the Invention)

[0004] However, in the above-described boil-dry protection mechanism, discharged water is repeatedly stored and evaporated in the evaporation tank. This makes a water surface of the discharged water to be raised and lowered repeatedly with passing by a contact surface of a thermostatic part of the thermostat and the heater. This may cause bimetallic corrosion.

A temperature fuse may be provided as compensation for the thermostat in trouble. In the above conventional example, a temperature fuse is provided on a cover plate covering an upper opening of the evaporation tank. If the temperature detected by the temperature fuse reaches a predetermined level, the temperature fuse is blown out by fusing and current supply to the heater is stopped.

[0005] The temperature fuse should not be operated (turned off) before the thermostat is turned off. That is, the temperature at which the temperature fuse is turned off should be a predetermined temperature value higher than the appropriate operation temperature of the thermostat. If the temperature fuse is provided on the cover plate of the evaporation tank as described above, the temperature of the portion of the cover plate where the temperature fuse is provided is supposed to rise to approximately 110°C when the thermostat is turned off. Therefore, the temperature at which the temperature fuse is turned off should be set to a temperature that is a predetermined temperature value higher than 110°C.

Therefore, the temperature fuse is repeatedly exposed to a high temperature of approximately 110°C while the thermostat is normally operating. If this exposure is repeated for several times, the temperature fuse may be deteriorated and this may cause an erroneous operation such as fusing at a temperature lower than the appropriate operation temperature.

The present invention was made in view of the foregoing circumstances, and an object thereof is to prevent deterioration of a heater and provide a protection member that is appropriately operated for a long period.

(Means for Solving the Problem)

[0006] A discharge water evaporating device for a cooling storage includes an evaporation tank for storing discharged water including defrosted water on a side surface of a storage body, and current is supplied to a heater provided in a bottom portion of the evaporation tank to heat and evaporate the discharge water. The discharge water evaporating device for a cooling storage further includes a heating controller, a heat exchanger plate and a protection member. The heating controller is provided on an outer surface of the evaporation tank and controls on and off of a current supply path to the heater according to detected temperature. The heat exchanger plate is provided in adjacent to the evaporation tank and configured to transfer heat from the evaporation tank. The protection member is provided on the heat exchanger plate and disconnects the current supply path according to the detected temperature.

[0007] If the temperature of the portion of the evaporation tank where the heating controller is provided exceeds a predetermined level according to decreasing of the water amount in the evaporation tank due to the evaporation of discharge water, current supply to the heater is stopped by a function of the heating controller. If the temperature of the portion of the evaporation tank where the heating controller is provided becomes lower than the predetermined level, the current supply to the heater is made possible. The heating controller is provided on an outer surface of the evaporation tank. This prevents the heater from being deteriorated due to corrosion unlike the conventional case that the heating controller is provided directly on the heater that is immersed in discharge water.

[0008] The protection member is provided as compensation for the heat controller in trouble. Especially the protection member is provided on the heat exchanger plate in adjacent to the evaporation tank and configured to transfer heat from the evaporation tank.

An arrangement configuration provided with such a protection member that is normally used is as follows. The protection member is provided on an outer surface of the evaporation tank next to the heating controller. Because of the function of the protection member, the operation temperature of the protection member (at which the protection member is turned off) is required to be a predetermined temperature amount higher than the operation temperature of the heating controller (at which the heating controller is turned off) . However, in the evaporation tank provided with a drop-in heater that has the heating controller on its outer surface, the operation temperature (turning-off temperature) of the heating controller is appropriately set to approximately 110°C that is higher than 100°C. Therefore, the operation temperature (turning-off temperature) of the protection member is higher than 110°C. This makes the protection member to be repeatedly exposed to high temperature of approximately 110°C while the heating controller is normally operated. This may deteriorate the protection member earlier.

[0009] According to the present invention, the heat exchanger plate on which the protection member is provided is separately provided in adjacent to the evaporation tank. Heat of the evaporation tank is not directly transferred to the heat exchanger plate but indirectly transferred mainly by heat radiation. The protection member is provided on the heat exchanger plate. With this configuration, the heat of the evaporation tank is substantially lowered and transferred to the heat exchanger plate. Therefore, if current is continuously supplied to the heater in case of some trouble in the heating controller and the temperature of the evaporation tank is raised to the level at which the protection member should be turned off, the temperature increase of the heat exchanger plate stops at the temperature lower than the temperature at which the protection member should be turned off. Therefore, since the protection member having the operation temperature (turning-off temperature) that is lower than the temperature at which the protection should be turned off is provided, the protection member is appropriately operated. Since the temperature of the heat exchanger plate is controlled to be lower than that of the evaporation tank, the protection member is suppressed from being exposed to high temperature and the protection member is prevented from being deteriorated.

[0010] If it is only aimed to prevent deterioration of the protection member, the heat from the evaporation tank is further released to be lowered and maintain the heat exchanger plate to have lower temperature. However, if the temperature of the exchanger plate becomes too lowered and accordingly the operation temperature (turning-off temperature) of the protection member also becomes too lowered, the following problems may be occurred. For example, due to the function or the installation environment of the cooling storage, the protection member may be erroneously turned off if warm wind blows momentarily to the area near the protection member. Therefore, there are limitations to lower the operation temperature of the heat exchanger plate.

[0011] Based on such consideration, it is preferable that the protection member detects temperature in a portion which has temperature lower than the evaporation tank, and also the operation temperature (turning-off temperature) of the protection member is preferably set to be appropriately high to prevent erroneous operations. According to the present invention, the protection member is provided on the heat exchanger plate that is provided in adjacent to the evaporation tank so as to transfer heat from the evaporation tank. With this configuration, heat is substantially indirectly transferred from the evaporation tank to the heat exchanger plate and heat of the evaporation tank is lowered and transferred. This maintains the temperature of the heat exchanger plate lower than the evaporation tank. The arrangement position of the heat exchanger plate such as a distance from the evaporation tank or partial contact with the evaporation tank may be adjusted or conductivity of the heat exchanger plate may be changed to control the heat releasing degree of heat transferred from the evaporation tank. This makes possible to set the operation temperature of the protection member to be a high level. Therefore, this prevents deterioration of the protection member and erroneous operation due to the surrounding temperature. Accordingly, the protection member is operated appropriately for a long period.

[0012] The discharge water evaporating device for a cooling storage of the present invention may have a following structure.

(1) The heating controller may be provided on an outer surface of a bottom portion of the evaporation tank, and the heat exchanger plate may be provided on a side surface of the storage body.
(2) Heat may be transferred from the evaporation tank to the heat exchanger plate by heat radiation.
(3) An end of the bottom portion of the evaporation tank may be in line contact with the heat exchanger plate, and heat may be transferred from the evaporation tank to the heat exchanger plate by heat transfer.

[0013] (4) The heat exchanger plate may be provided such that an upper end portion of the heat exchanger plate corresponds to the heater in the evaporation tank, and the protection member may be provided on a lower end portion of the heat exchanger plate.

[0014] (5) A plurality of openings may be formed on a middle height portion of the heat exchanger plate. Since the lower end portion of the heat exchanger plate extends below the bottom surface of the evaporation tank, the lower end portion is easier to be influenced by the surrounding temperature. For example, if the surrounding temperature is high, the temperature of the lower end portion is raised quickly, the protection member may be erroneously operated. According to this configuration, the openings are formed in the heat exchanger plate. This suppresses the heat transfer efficiency from the upper end portion to the lower end portion. Accordingly, the temperature of the lower end portion of the heat exchanger plate is prevented from increasing too quickly. As a result, the protection member is prevented from being operated at an inappropriate timing.

[0015] (6) A heat insulating member may be provided on a rear surface of the heat exchanger plate. If the surrounding temperature is low, the temperature of the storage body becomes lowered. This may delay temperature increase of the heat exchanger plate and delay the operation timing of the protection member. According to this configuration, the heat insulating member is provided, and this suppresses that the low temperature of the storage body influences the heat exchanger plate. Accordingly, the temperature of the heat exchanger plate is increased appropriately, and this makes the protection member to be operated at an appropriate timing.

[0016] (7) A cover may be provided on a side surface of the storage body to cover a surface of the evaporation tank, and a heat insulating member may be provided on a rear side of the cover corresponding to the heating controller. This stabilizes the temperature of the portion where the heating controller is provided regardless of temperature change in the surroundings of the installation position of the refrigerator. Therefore, the heating controller is operated at an appropriate timing.

(Effect of the Invention)

[0017] According to the present invention, deterioration of the heater is prevented and the protection member is appropriately operated for a long period.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

FIG. 1 is a cross-sectional view illustrating a part of a refrigerator near an evaporating device according to a first embodiment of the present invention;
FIG. 2 is a perspective view partially illustrating a mechanical chamber of the refrigerator seen from a rear side from which a rear panel and a cover are removed;
FIG. 3 is an exploded perspective view partially illustrating the mechanical chamber seen from the rear side of the refrigerator;
FIG. 4 is a partially cut-away rear view illustrating the rear side of the refrigerator from which the rear panel and the cover are removed;
FIG. 5 is an exploded perspective view illustrating a duct;
FIG. 6 is a perspective view illustrating an evaporating device;
FIG. 7 is an enlarged rear view partially illustrating a configuration of an extended discharge tube;
FGI. 8 is a rear view illustrating an arrangement configuration of a thermostat and a temperature fuse;
FIG. 9 is an exploded perspective view illustrating an attachment configuration of the temperature fuse; and
FIG. 10 is a cross-sectional view illustrating an arrangement configuration of the thermostat and the temperature fuse.

Explanation of Reference Symbols

[0019] 10: Refrigerator body (Storage body), 10A: Rear surface (of refrigerator body 10), 30: Recess, 30A: Back wall, 40: Evaporating device, 41: Evaporation tank, 44: Bottom plate (of evaporation tank 41), 45: Contact plate, 50: Evaporation heater, 105: Thermostat (Heating controller), 110: Temperature fuse (Protection member), 111: Heat exchanger plate, 112: Heat receiving surface, 113: Mounting surface, 114: Opening, 115: Heat insulating sheet (Heat insulating member), 117: Fuse holder, 137: Cover, 140: heat insulating member

BEST MODE FOR CARRYING OUT THE INVENTION

<Embodiment>

[0020] A first embodiment of the present invention will be explained with reference to FIGS. 1 through 10. In this embodiment, a commercial-use upright refrigerator is used as an example.
In FIGS. 1 and 2, a refrigerator body 10 is an insulated casing having an opening on the front. The inside of the body is a refrigeration compartment 11, and an insulating door 12 is assembled covering the opening of the refrigeration compartment 11 so as to be swingably openable and closable. Panels are installed on the top surface of the refrigerator body 10 so as to form a mechanical chamber 14 and a freezer 15 is provided therein. The freezer 15 is provided with a compressor 16, a condenser 17 of an air-cooled type having a condenser fan 17A and they are mounted on a heat insulating unit base 18 as a unit. The unit base 18 is mounted so as to cover an opening 19 in a ceiling of the refrigeration compartment 11.

[0021] A drain pan 20 that also functions as an air duct is provided such that a bottom surface of the drain pan 20 extends at a downslope angle toward a rear side (right side in FIG. 1) below the opening 19 in the ceiling of the refrigeration compartment 11. A cooling chamber 21 is formed above the drain pan 20. An air suction port 22 is provided in a front side area of the cooling chamber 21 and an air outlet 23 is provided in a rear side area of the cooling chamber 21.

A cooler 25 and an internal fan 26 facing the air suction port 22 are provided in the cooling chamber 21. The cooler 25 is connected to the freezer 15 by refrigerant circulation and form a known freezing cycle.

[0022] Cooling operation is performed by driving the freezer 15 (compressor 16) and the internal fan 26. Air in the refrigeration compartment 11 is sucked into the cooling chamber 21 through an air suction port 22 by the internal fan 26. The air flows into the cooler 25 and cools down by heat exchange. As a result, cold air is generated. The cold air is blown out from the air outlet 23 along the rear surface of the refrigeration compartment 11. The inside of the refrigeration compartment 11 is cooled down with cold air supplied and circulated in the refrigeration compartment 11.

The condenser fan 17A is driven by driving the compressor 16. Outer air is sucked into the freezer 15 through an air suction port (not shown) formed in a front panel 14A of the mechanical chamber 14 by the condenser fan 17A. The air passes through the condenser 17 and the compressor 16 and cools down. Exhaust heat used for cooling is discharged from discharge outlet 28 formed in a rear panel 14B (FIG. 3) or a ceiling panel 14C of the mechanical chamber 14 toward a rear side.

[0023] Further, defrosting operation is performed as necessary to remove frost in the cooler 25 and other parts. To perform this operation, the cooler 25 includes a defrosting heater (not shown) and the defrosting heater is energized to heat the cooler 25. The melted defrosted water is received by the drain pan 20 and is guided to and stored in the evaporating device 40 provided at the rear surface 10A side of the refrigerator body 10. The stored water is further heated by the evaporating device 40 to be forcibly evaporated and discharged.

[0024] Next, an arrangement configuration of the evaporating device 40 will be explained.

A recess 30 is formed in an upper portion on the rear surface 10A of the refrigerator body 10 so as to be recessed from the rear surface 10A. The evaporating device 40 is provided in the recess 30 at the lower side of the mechanical chamber 14 on the rear surface side.

A configuration for discharging defrosted water received in the drain pan will be explained. A drain pipe 32 extends from a rear end of the drain pan 20 to be sloped so that its distal end directs downwardly. A discharge cylinder body 33 made of synthetic resin is embedded in a back wall 30A of the recess 30 corresponding to the distal end of the drain pipe 32. A discharge pipe 34 extends from an outer lower end of the discharge cylinder body 33. The discharge pipe 34 is formed in a short cylindrical shape opening upwardly and extends at a downslope angle having inclination steeper than the drain pipe 32. The distal end surface of the discharge pipe 34 is formed to be sloped steeply so that an upper portion of the discharge pipe 34 is shorter than a lower portion.

[0025] As illustrated in FIG. 4, the discharge pipe 34 of the discharge cylinder body 33 is provided in an upper portion from a middle height on the back wall 30A of the recess 30 and in a rightward portion from a middle width with rear view so as to extend in the recess 30 (toward outside of the refrigerator). As illustrated in FIG. 1, the extending length of the discharge pipe 34 from the end of the discharge cylinder body 33 is slightly greater than 1/3 of the depth of the recess 30. The distal end of the drain pipe 32 is inserted in the discharge cylinder body 33 to extend near the basal end of the discharge pipe 34.

[0026] A general construction of the evaporating device 40 will be explained with reference to FIGS. 1 and 3. An evaporation tank 41 is provided below the extended portion of the discharge pipe 34 in the recess 30. The evaporation tank 41 stores defrosted water and forcibly evaporates the defrosted water by an evaporation heater 50. A duct 70 is mounted above the evaporation tank 41. The duct 70 guides steam generated in the evaporation tank 41 upwardly. A cover 137 is provided to cover a rear opening of the recess 30 so as to be on the substantially same plane as the rear panel 14B of the mechanical chamber 14.

[0027] The evaporation tank 41 is formed by assembling two metal panels 42, 43 such as stainless steel plates as illustrated in FIG. 10. The evaporation tank 41 has a box shape that is substantially flat and horizontally long and opens upwardly. Specifically, the evaporation tank 41 has a width slightly smaller than that of the recess 30, a depth slightly greater than half a width of the recess 30 and a height slightly smaller than half a height of the recess 30. As illustrated in FIG. 10, the contact plate 45 integrally extends from an inner edge of the bottom plate 44 of the evaporation tank 41 so that the extending length is approximately 1/3 of the depth of the evaporation tank 41. Specifically, the contact plate 45 includes an extended portion 44A horizontally extending from the bottom plate 44 and a flange 43A bent at a right angle at a lower end of the inner panel 43. The extended portion 44A and the flange 43A are laminated with each other to form the contact plate 45.

[0028] An attachment plate 47 is formed at an upper edge of the inner panel 43 of the evaporation tank 41. The attachment plate 47 extends from the inner panel 43 by a depth approximately corresponding to the extending length of the contact plate 45 and then extends upwardly by a predetermined height. A fitting portion 48 is formed on an upper edge of the attachment plate 47 in a rightward portion from a middle width of the attachment plate 47 with rear view. The fitting portion 48 is formed by cutting a part of the attachment plate 47 away. The discharge pipe 34 is fitted in the fitting portion 48.

The evaporation tank 41 and the attachment plate 47 are fixed to the back wall 30A by screws 49 at the left and right sides of the attachment plate 47. In fixing the evaporation tank 41 and the attachment plate 47, the evaporation tank 41 is placed in a lower portion from a middle portion of the back wall 30A of the recess 30 and the attachment plate 47 is placed on the back wall 30A so that the discharge pipe 34 is fitted in the fitting portion 48. A bottom portion of the evaporation tank 41 is supported by receivers 120 that will be explained later.

[0029] A drop-in evaporation heater 50 that is a sheathed heater is provided in the evaporation tank 41. The sheathed heater is basically configured by inserting a coiled heating wire through a metal pipe being filled with insulating powder. The evaporation heater 50 of this embodiment is, as illustrated in FIG. 3, formed by bending an elongated pipe in a U-shape. The evaporation heater 50 includes a horizontal portion 51 and vertical portions 52 each of which is lifted vertically from each end of the horizontal portion 51. The horizontal portion 51 has a length slightly shorter than the width of the evaporation tank 41. The vertical portion 52 has a length substantially same as the depth of the evaporation tank 41.

In this embodiment, only the horizontal portion 51 generates heat and the vertical portions 52 do not generate heat. Therefore, in the vertical portions 52, the heating wire is removed or the metal pipe is replaced with a pipe that is not thermally conductive.

A lead wire 53 is connected to an upper end of each vertical portion 52 and extends therefrom. The connection portion is molded with a resin to form an attachment portion 54.

[0030] The duct 70 is mounted on the upper opening 41A of the evaporation tank 41 so as to be shifted leftward with respect to the middle width with rear view. Accordingly, the duct 70 is communicated with the evaporation tank 41. The opening portions on the left and right sides of the duct 70 are closed by covers 56A, 56B respectively. The evaporation heater 50 is inserted in the evaporation tank 41 with each attachment portion 54 being attached to the corresponding cover 56A, 56B.

Each cover 56A, 56B is, as illustrated in FIG. 6, formed by bending a metal plate to have an angle. The right cover 56B is longer than (approximately twice as) the left cover 56A corresponding to the size of the opening area on the right and left sides.

[0031] Each cover 56A, 56B is mounted on the opening 41A so that each side plate 57 is overlapped with an upper end portion of the surface panel 42 of the evaporation tank 41 and each upper plate 58 covers the opening 41A. An extended portion 59 extends outwardly from the upper plate 58 of the right cover 56B. A support plate 60 extends rightward from the right edge of the opening 41A of the evaporation tank 41. The extended portion 59 is fixed to the support plate 60 by a screw. An attachment plate 61 is lifted up from an inner edge of the upper plate 58. The attachment plate 61 is overlapped with the attachment plate 47 of the evaporation tank 41 and they are fixed to the back wall 30A by the screw 49. An extended portion 59 extends outwardly from the upper plate 58 of the left cover 56A. A support plate 60 extends leftward from the left edge of the opening 41A of the evaporation tank 41. The extended portion 59 is fixed to the support plate 60 by a screw.

[0032] The right attachment portion 54 of the evaporation heater 50 is put in a position on the upper plate 58 of the right cover 56B slightly inner from a right side plate 63B of the evaporation tank 41. The left attachment portion 54 is put in a position on the upper plate 58 of the left cover 56A slightly inner from a left side plate 63A. In such a state, the evaporation heater 50 is inserted in the evaporation tank 41. In this state, as illustrated in FIG. 10, the evaporation heater 50 is positioned in a middle portion with respect to the depth of the evaporation tank 41, and each of the vertical portions 52 is separated from the corresponding side plate 63A, 63B by a predetermined distance and the horizontal portion 51 is placed with a small distance from the bottom plate 44 of the evaporation tank 41. A support bracket 65 is provided corresponding to an upper portion of each side plate 63A, 63B of the evaporation tank 41. The upper portion of each vertical portion 52 of the evaporation heater 50 is fitted in the corresponding support bracket 65. This prevents a position gap of the evaporation heater 50 in the evaporation tank 41.

[0033] The duct 70 will be explained. The duct 70 is, as illustrated in FIG. 5, formed by assembling metal surface plates 71, 72 to have a flat and horizontally long and quadrangular tubular shape and have upper and lower sides open. Specifically, a mounting plate 73 is formed by bending an upper end of the surface plate 72 vertically and inwardly. Attachment surfaces 74A, 74B extend from the right and left ends of the surface plates 72 respectively at a substantially middle height. A fitting portion 75 is formed at a right lower corner of the surface plate 72 with rear view. The discharge tube 34 is fitted in the fitting portion 75.

[0034] Side plates 77A, 77B are integrally formed with the surface plate 71 by bending the surface plate 71 at the right and left sides vertically and inwardly. As a whole, the surface plate 71 is formed to have a height greater than the surface plate 72 by a predetermined height amount. The surface plate 71 is assembled to the surface plate 72 so as to oppose to each other so that an upper edge of the surface plate 71 extends slightly from an upper edge of the surface plate 72 and a lower edge of the surface plate 71 extends greatly from a lower edge of the surface plate 72. A cutaway portion 78 is formed at a lower edge of each side plate 77A, 77B so as to be a same level as the lower edge of the surface plate 72. An attachment plate 79 is formed by bending the right side plate 77B vertically and rightward at a portion of the right side plate 77B ranging from a middle portion to the lower edge of the inner side of the right side plate 77B. The surface plate 71 is assembled to the surface plate 72 to be opposed to each other so that the right attachment plate 79 is overlapped with the right attachment surface 74B of the surface plate 72 and an inner side edge of the left side plate 77A comes in contact with the basal portion of the left attachment surface 74A of the surface plate 72 to maintain the above-described vertical positional relation. Thus assembled duct 70 has substantially same depth and height as the evaporation tank 41 and has a width smaller than the evaporation tank 41.

[0035] An attachment plate 81 has a step and extends along an entire width of the surface plate 71. An upper portion of the attachment plate 81 is fixed to the lower end of the surface plate 71 by screws, as illustrated in FIG. 6. The lower end of the duct 70 is inserted in a predetermined area of the opening 41A of the evaporation tank 41 so that the discharge tube 34 is fitted in the fitting portion 75 of the surface plate 72 and the upper end of the surface panel 42 of the evaporation duct 70 is held between the lower portions of the attachment plate 81 and the surface plate 71. When a step 82 of the attachment plate 81 comes in contact with the upper edge of the surface panel 42 and the upper edge of the cutaway portion 78 of each side plate 77A, 77B comes in contact with an extended surface 47A (FIG. 3) extending from a lower end of the attachment plate 47, the insertion of the duct 70 is stopped. In this state, as illustrated in FIG. 4, the left attachment surface 74A with rear view is placed on the back wall 30A of the recess 30 and fixed thereto by the screw 83. The lower portion of the attachment plate 79 comes in contact with the attachment plate 47 of the evaporation tank 41 and the overlapped portion of the right attachment surface 74B and attachment plate 79 comes in contact with the back wall 30A of the recess 30 and they are fixed together by the screw 83. The upper portion of the duct 70 extends to a lower space of the mechanical chamber 14 at the rear side and reaches the upper surface of the unit base 18 having the freezer 15 thereon.

[0036] When the duct 70 is mounted in a predetermined position in the opening 41A of the evaporation tank 41, the discharge pipe 34 extends into the duct 70 at the right lower corner with rear view as illustrated in FIG. 4. Steam rising from the evaporation tank 41 is prevented from flowing into the discharge pipe 34 as follows.

A receiving plate 85 is integrally formed with the right cover 56B that covers the right opening area of the opening 41A of the evaporation tank 41. Specifically, as illustrated in FIG. 7, an upper plate 58 extends from the cover 56B and a short vertical plate 86 extends downwardly from an end of the upper plate 58 over its entire width. The receiving plate 85 is formed by bending at the lower end of the vertical plate 86 so as to extend leftward over its entire width. The receiving plate 85 is formed such that its distal end is lower than its basal end (inclination angle is approximately ten degrees). When the right cover 56B is put in the predetermined position, the vertical plate 86 is provided to overlap an outer side of a lower end portion of the right side plate 77B that is inserted in the evaporation tank 41. Then, the receiving plate 85 extends from the lower end of the right side plate 77B leftward under the discharge pipe 34 so that the distal end is lower than the basal end.

[0037] A defining plate 90 is provided on the left side of the extended discharge pipe 34 in the duct 70. The defining plate 90 has a width corresponding to a distance between the surface plates 71 and 72 and a length greater than the height of the surface plate 72 and smaller than the height of the surface plate 71. The defining plate 90 has an attachment plate 91A close to the surface plate 72. The attachment plate 91A is formed by bending the defining plate 90 vertically leftward with rear view. The defining plate 90 has an attachment plate 91B close to the surface plate 71. The attachment plate 91B is formed over an entire length of the defining plate 90 and by bending the defining plate 90 vertically rightward. Screw holes 92 are formed at upper and lower ends of the attachment plate 91B. A cutaway portion 93 is formed at the lower end of the defining plate 90 like the one 78 formed on each side plate 77A, 77B.

[0038] When the defining plate 90 is mounted in the duct 70, it is positioned vertically at the left side of the fitting portion 75 on the surface plate 72 of the duct 70. In this state, the attachment plate 91A comes in contact with the surface plate 72 over an entire height of the surface plate 72 and fixed thereto by welding. Then, if the surface plate 71 is assembled to the surface plate 72 to be opposed thereto, the attachment plate 91B comes in contact with the inner surface of the surface plate 71 ranging over substantially an entire height of the surface plate 71 keeping a free area near the upper end of the surface plate 71. Screws 95 are screwed in the screw holes 92 in the attachment plate 91B passing through the insertion holes 94 in the surface plate 71 so that the duct 70 and the defining plate 90 are assembled together. When the duct 70 is mounted in the opening 41A of the evaporation tank 41, the cutaway portion 93 of the defining plate 90 comes in contact with the extended surface 47A formed at the lower end of the attachment plate 47 provided on the inner side of the evaporation tank 41.

The length of the receiving plate 85 extending from the cover 56B is set to be a predetermined length greater than a distance between the defining plate 90 provided in the duct 70 and the right side plate 77B of the duct 70.

[0039] When the duct 70 is mounted in a predetermined position in the opening 41A of the evaporation tank 41, as illustrated in FIG. 4, the defining plate 90 is positioned at the left side of the extended discharge pipe 34 with rear view so as to extend over the entire height of the surface plate 72 of the duct 70, that is, an entire height of the opposing portion of the surface plates 71 and 72. Accordingly, an inner space in the duct 70 is defined in left and right spaces.

The lower predetermined portion of the defining plate 90 enters the opening 41A of the evaporation tank 41. In this state, as illustrated in FIG. 7, the receiving plate 85 extends from the right cover 56B so that its distal end is lower than its basal end and extends further leftward over the defining plate 90 by a predetermined distance a. The lower end of the defining plate 90 is positioned close to the upper surface of the extended receiving plate 85 so as to have a predetermined clearance b therebetween.

The surface plate 71, the right side plate 77B, the defining plate 90 and the receiving plate 85 form a surrounded space 96. An outlet port 97 is formed by a clearance between the lower end of the defining plate 90 and the upper surface of the extended receiving plate 85.

[0040] An exhaust box 100 is provided on the upper opening of the duct 70. The exhaust box 100 is formed in a box opening at its lower side so as to closely cover the upper opening of the duct 70. A plurality of slits 101 are formed on the upper surface and two opposing surfaces of the exhaust box 100 in the longitudinal direction at regular intervals. The exhaust box 100 has an attachment plate 102 at the lower end of the surface on the side of the surface plate 72 so as to be bent inwardly and vertically.

The lower end part of the exhaust box 100 is pressed to be fitted in the upper opening of the duct 70 and stops when the attachment plate 102 comes in contact with the mounting plate 73 of the duct 70. In this state, the attachment plate 102 is fixed to the mounting plate 73 by screws (not shown) and the lower part of the exhaust box 100 is fixed by a screw 103. Accordingly, the exhaust box 100 is fixed to the duct 70 with covering the upper opening of the duct 70.

[0041] Power is supplied to the evaporation heater 50 disposed in the evaporation tank 41 from a commercial power source, for example, and the evaporation heater 50 generates heat. On the current supply path of the evaporation heater 50, a thermostat 105 and a temperature fuse 110 are provided. The thermostat 105 functions as a heating controller and the temperature fuse 110 functions as a protection member. The thermostat 105 is provided for boil-dry protection and the switch of the thermostat 105 is opened and closed according to detection temperature of the position where the thermostat 105 is provided to control on and off of the current supply path. The temperature fuse 110 is provided as compensation for the thermostat 105 in trouble to be blown out by fusing and disconnect the current supply path when the detection temperature reaches predetermined temperature. The temperature fuse 110 is not blown out as long as the thermostat 105 is normally operated.

[0042] The arrangement configuration of the thermostat 105 and the temperature fuse 110 will be explained with reference to FIGS. 8 to 10.

The thermostat 105 is provided in a position so as to directly detect the temperature of the evaporation tank 41. Specifically, the thermostat 105 is provided in a middle position in a width direction on an outer surface of the bottom plate 44 of the evaporation tank 41 so as to be directly contacted to thereto by a bracket 106. The temperature of the evaporation tank 41 provided with this kind of drop-in evaporation heater 50 does not exceed 100°C while the evaporation heater 50 executes water evaporation with being immersed in the stored water. However, if the water is further evaporated and the evaporation heater 50 is exposed from the stored water, the evaporation tank 41, especially the bottom portion including the bottom plate 44, has rapidly increasing temperature. The thermostat 105 is turned off when detecting a predetermined temperature greater than 100°C. In this state, it is considered that the remaining amount of water in the evaporation tank 41 is small and the current supply to the evaporation heater 50 is stopped. The predetermined temperature at which the thermostat 105 is turned off is preferably set to 106°C to 114°C. In this embodiment, the predetermined temperature is set to 110°C.

If the detection temperature detected by the thermostat 105 is lowered to be the predetermined temperature, the thermostat 105 is turned on and the current supply to the evaporation heater 50 becomes possible.

[0043] To prevent the temperature fuse 110 from being deteriorated due to exposure to high temperature and prevent that the temperature fuse 110 causes an erroneous operation that the temperature fuse 110 is inappropriately turned off, the temperature fuse 110 is mounted in a position that transmits heat of the bottom portion of the evaporation tank 41 to the temperature fuse 110 with the heat temperature being lowered to some extent.

Specifically, the temperature fuse 110 is provided on a heat exchanger plate 111. The heat exchanger plate 111 is made of a metal plate that is appropriately good in thermal conductivity. For example, stainless steel (SUS430) having thermal conductivity κ of 0.261 [100°C, * 10^2 W/(m · K)].

[0044] The heat exchanger plate 111 is formed in substantially a square with front view and has a heat receiving surface 112 at its upper part and a mounting surface 113 for the temperature fuse 110 at its lower part. Five openings 114 of elongated slits are provided in a zigzag in three rows in an area between the heat receiving surface 112 and the mounting surface 113. Specifically, two openings 114 lie in a horizontal line in the upper and lower rows and one opening 114 is formed in a middle row. The openings 114 suppress the heat transfer efficiency from the heat receiving surface 112 to the mounting surface 113. Insertion holes (not shown) for receiving screws 114A are formed at left and right sides of the middle opening 114.

[0045] The temperature fuse 110 is provided on the mounting surface 113 of the heat exchanger plate 111 and a fuse holder 117 is also provided thereon. The fuse holder 117 is made of a metal plate having elasticity such as stainless steel plate and has a width smaller than the mounting surface 113. The fuse holder 117 has a flat attachment surface 118 at the upper side and a pressure portion 119 having an angle section at the lower side. Insertion holes 118A, 113A for receiving a screw 125 are formed at a middle portion of the attachment surface 118 and a corresponding position on the mounting surface 113 of the heat exchanger plate 111.

When the temperature fuse 110 is put in an inner space of the pressure portion 119 of the fuse holder 117 and the attachment surface 118 is fixed to the mounting surface 113, the temperature fuse 110 is elastically pressed against the mounting surface 113 by the pressure portion 119 to be closely provided between the fuse holder 117 and the mounting surface 113.

[0046] The heat exchanger plate 111 is, as illustrated in FIG. 4, provided at a width center portion of the lower end of the back wall 30A of the recess 30 in the refrigerator body 10. Specifically, as illustrated in FIG. 10, the heat exchanger plate 111 is provided so that the heat receiving surface 112 faces the horizontal portion 51 (that generates heat) of the evaporation heater 50 provided in the evaporation tank 41.

The heat exchanger plate 111 is placed on a predetermined surface 116 on the back wall 30A of the recess 30 via a heat insulating sheet 115. The heat insulating sheet 115 is made of, for example, a silicone sponge and provided over an entire rear surface of the heat exchanger plate 111. The heat exchanger plate 111 is provided on the surface 116 of the back wall 30a in the recess 30 with having the heat insulating sheet 115 therebetween. The screw 114A is inserted through each insertion hole close to the openings 114 to be penetrated through the heat insulating sheet 115 and screwed into the corresponding screw hole formed in the surface 116. This fixes the heat exchanger plate 111 and the heat insulating sheet 115 to the back wall 30A.

[0047] The temperature fuse 110 is put in the inner space of the pressure portion 119 of the fuse holder 117 and the attachment surface 118 of the fuse holder 117 comes in contact with the mounting surface 113. In this state, the screw 125 is inserted through the insertion hole 118A of the attachment surface 118 and the insertion hole 113A of the mounting surface 113 to be penetrated through the heat insulating sheet 115 and screwed into the corresponding screw hole formed in the surface 116. Accordingly, the fuse holder 117 is fixed to the heat exchanger plate 111. This maintains close contact of the temperature fuse 110 and the mounting surface 113.

If the refrigerator body 10 is cooled down by low surrounding temperature of the installation place of the refrigerator, for example, the heat insulating sheet 115 suppresses the coldness from being transferred to the heat exchanger plate 111.

[0048] Thus, the heat exchanger plate 111 to which the temperature fuse 110 is mounted is provided on the surface 116 of the back wall 30A in the recess 30. Thereafter, the evaporation tank 41 is attached to the back wall 30A. The attachment plate 47 provided at the upper end of the evaporation tank 41 is fixed to the back wall 30A by the screw 49 to fix the evaporation tank 41 to the back wall 30A and the bottom portion of the evaporation tank 41 is supported by the receivers 120.

The receiver 120 is made of an elastic metal plate such as a stainless steel plate and formed by bending a flat plate into a crank. Two receivers 120 are provided and each of the receivers 120 has a substantially flat base portion 121, an attachment portion 122 bent downwardly from an end of the base portion 121 and a pressure portion 123 lifting up from another end of the base portion 121. An insertion hole for receiving a screw 124 is formed in the attachment portion 122 of the receiver 120. A length (depth) of the base portion 121 is set to be slightly smaller than a total length (depth) of the bottom plate 44 including the contact plate 45 of the evaporation tank 41 and a thickness of the heat exchanger plate 111 and the heat insulating sheet 115.

[0049] The evaporation tank 41 is disposed so that the distal end of the contact plate 45 corresponds to the heat receiving surface 112 of the heat exchanger plate 111, and then, the attachment plate 47 is fixed to the back wall 30A by the screw 49. Thereafter, as illustrated in FIG. 8, the receiver 120 is provided on either side of the heat exchanger plate 111 and each pressure portion 123 is put in contact with the lower end of the surface panel 42 of the evaporation tank 41. In this state, each attachment portion 122 is put in contact with the back wall 30a and the screw 124 passes through the insertion hole of each attachment portion 122 to be screwed into the corresponding screw hole formed in the back wall 30A and fixed to the back wall 30A. In this state, as illustrated in FIG. 10, the pressure portion 123 of each receiver 120 elastically presses the lower corner of the evaporation tank 41. This presses the distal end of the contact plate 45 against the mounting surface 113 of the heat exchanger plate 111.

[0050] The heat exchanger plate 111 and the evaporation tank 41 are provided in the recess 30 as described above. In such a state, the bottom portion of the evaporation tank 41 corresponds to the heat receiving surface 112 of the heat exchanger plate 111 with having a predetermined distance therebetween, and the distal end of the contact plate 45 is in line contact with the heat receiving surface 112. Therefore, if current is supplied to the evaporation heater 50 and heat is generated, the evaporation tank 41 is heated. However, heat of the bottom portion of the evaporation tank 41 is transferred to the heat receiving surface 112 of the heat exchanger plate 111 by radiation. Due to the line contact of the contact plate 45 and the heat receiving surface 112 of the heat exchanger plate 111, the heat of the bottom portion of the evaporation tank 41 is slightly transferred to the heat receiving surface 112.

The heat of the bottom portion of the evaporation tank 41 is indirectly transferred to the heat receiving surface 112 of the heat exchanger plate 111 due to the heat radiation and the slight heat transfer. Thus, the heat of the evaporation tank 41 is substantially released and transferred to the heat receiving surface 112. The heat received by the heat receiving surface 112 is transferred to the mounting surface 113 where the temperature fuse 110 is provided by heat transfer. Since the heat transfer efficiency is suppressed by the openings 114 formed between the surfaces 112 and 113, the heat is further released and the mounting surface 113 is heated by low heat.

[0051] In this embodiment, the thermostat 105 is turned off at 110°C. That is, the thermostat 105 is turned off when the temperature of an outer bottom surface of the bottom plate 44 of the evaporation tank 41 becomes 110°C. The temperature fuse 110 is provided as compensation for the thermostat 105 in trouble and should not be turned off before the thermostat 105 is turned off. For example, if the temperature fuse 110 is provided on the outer bottom surface of the bottom plate 44 of the evaporation tank 41 next to the thermostat 105, the temperature at which the temperature fuse 110 is turned off is appropriately set to be approximately 130°C that is higher than the temperature at which the thermostat 105 is turned off by about 20K.

[0052] In this embodiment, the position where the temperature fuse 110 is located is considered so that the temperature fuse 110 is appropriately operated at a possible low temperature. As described above, the temperature fuse 110 is provided on the mounting surface 113 of the heat exchanger plate 111 to which the heat of the bottom portion of the evaporation tank 41 is lowered and transferred. When the temperature of the outer bottom surface of the bottom plate 44 is 130°C that is appropriately set for turning off the temperature fuse 110 provided on the mounting surface 113, the temperature of the mounting surface 113 of the heat exchanger plate 111 is actually measured. The measured temperature is approximately 94°C.

Therefore, the temperature fuse 110 provided on the mounting surface 113 has an operation temperature (the temperature at which the temperature fuse 110 is turned off) of 94°C. In other words, when the temperature fuse 110 provided on the mounting surface 113 of the heat exchanger plate 111 is turned off, the temperature of the outer bottom surface of the bottom plate 44 is raised to approximately 130°C.

Since the temperature fuse 110 is turned off at 94°C, it is prevented from being turned off unnecessarily due to momentarily-blowing warm wind in the area of the temperature fuse 110.

[0053] An L-shaped electric line guide 130 is provided on the back wall 30A of the recess 30 so as to extend along the lower left end and the left side with rear view. Lead lines from the thermostat 105 and the temperature fuse 110 pass trough the electric line guide 130 and extend to the mechanical chamber 14.

A heat insulating plate 133 is provided on an exterior plate 132 forming the back wall 30A of the recess 30. This makes heat of the evaporation tank 41 or the heat exchanger plate 111 difficult to be transferred to the inside of the refrigerator. A space is formed between the surface of the evaporation tank 41 facing the back wall 30A and the back wall 30A to form a heat insulating barrier 135. This achieves an improved heat insulating effect.

[0054] As partially described above, the cover 137 is provided on a rear opening of the recess 30 to be on the substantially same plane as the rear panel 14B of the mechanical chamber 14. As illustrated in FIG. 3, an upper plate 138 (only the right side with rear view is illustrated) covering each of the right and left ends of the duct 70 in the upper opening of the recess 30 extends from the upper edge of the cover 137. A plurality of exhaust openings 139 for releasing heat air inside are formed in the upper surface of the cover 137.

As illustrated in FIG. 10, a thick heat insulating member 140 is provided on a lower inner surface of the cover 137 corresponding to the thermostat 105. The heat insulating member 140 stabilizes the temperature of the portion where the thermostat 105 is provided regardless of temperature change in the surroundings of the installation position of the refrigerator.

An operation of the present embodiment will be explained.

[0055] When the defrosting operation is performed while the refrigerator is running, defrosted water from the cooler 25 is received by the drain pan 20. Then, the defrosted water flows from the drain pan 20 through the drain pipe 32 and the discharge pipe 34 of the discharge cylinder body 33 and dropped from the distal end of the discharge pipe 34. As illustrated in FIG. 4, the receiving plate 85 is provided right below the drain pipe 34 so that its distal end is lower than its basal end. Therefore, the defrosted water dropped from the drain pipe 34 is received by the receiving plate 85 and dropped from the distal end of the receiving plate 85 into the evaporation tank 41 and stored in the bottom portion of the evaporation tank 41 as illustrated by an arrow w in FIG. 4.

[0056] In this state, a current is supplied to the evaporation heater 50 to heat the water (defrosted water) stored in the evaporation tank 41. Accordingly, the water is forcibly evaporated and steam is generated and rises into the duct 70 that is provided on the upper surface of the evaporation tank 41 so as to communicate therewith. Since the discharge pipe 33 extends into the duct 70, the steam rising in the duct 70 may flows into the cooling chamber 21 from the discharge pipe 34. However, the receiving plate 85 is provided below the discharge pipe 34 so as to extend leftward at a downslope angle from the right cover 56B. Further, the defining plate 90 is provided at the left side of the discharge pipe 33 extending in the duct 70 so that its lower end extends close to the upper surface of the receiving plate 85. The lower end of the defining plate 90 corresponds to the position on the upper surface of the receiving plate 85 close to the basal end of the receiving plate 85 from the distal end by a predetermined distance. The lower end of the defining plate 90 and the upper surface of the receiving plate 85 have a distance b therebetween.

[0057] Therefore, the steam rising from the evaporation tank 41 toward the discharge pipe 34 is prevented from moving toward the discharge pipe 34 by the receiving plate 85 and the steam is guided by the receiving plate 85 to be forcibly moved to the left side of the defining plate 90 as illustrated by arrows v in FIG. 4. Especially as described above, the extended distal end of the receiving plate 85 extends leftward from the lower end of the defining plate 90 by the predetermined distance a, and the distance b generated as the outlet port 97 is quite small. This suppresses the amount of steam flowing through the outlet port 97 to be minimum.

Therefore, the stream rising from the evaporation tank 41 toward the discharge pipe 34 rises in the left area in the duct 70 from the defining plate 90 with the steam rising from the left area in the evaporation tank 41, and passes through the slits 101 of the discharge box 100 to be dispersed and discharged upwardly. This surely prevents backward flow of the steam into the discharge pipe 34.

[0058] When the defrosting operation is completed, the cooling operation is restarted. At this time, the condenser fan 17A is operated and external air for cooling is suctioned from the front side of the refrigerator to cool down the condenser 17 and the compressor 16. The exhaust heat used for the cooling is discharged from the discharge outlet 28 of the mechanical chamber 14 mainly toward the rear side of the refrigerator. Therefore, the steam discharged upwardly from the exhaust box 100 of the duct 70 is dispersed to have a lower density by the exhaust heat. This prevents that a great amount of steam is intensively discharged to a wall of a kitchen that is located near the refrigerator to cause dew condensation.

[0059] If the defrosted water is further evaporated and the water level of the stored water is lowered gradually, the horizontal portion 51 of the thermostat 105 is exposed from the water stored in the evaporation tank 41. This rapidly raises the temperature of the evaporation tank 41, especially the bottom portion thereof. If the thermostat 105 disposed on the outer bottom surface of the bottom plate 44 detects the predetermined temperature (110°C), the thermostat 105 is turned off. This is considered that the remaining amount of the water in the evaporation tank 41 is small and the current supply to the evaporation heater 50 is stopped to stop heat generation. This prevents no-water burning.

The heat generation by the evaporation heater 50 is stopped to lower the temperature of the evaporation tank 41. If the thermostat 105 detects the predetermined temperature that is lower than 110°C by approximately 20K, the thermostat 105 is turned on again to make the current supply to the evaporation heater 50 to be possible.

[0060] The thermostat 105 may not be normally operated (turned off) because of some trouble. In such a case, the current is continuously supplied to the evaporation heater 50 and the temperature of the evaporation tank 41 is further raised. For example, if the temperature of the outer bottom surface of the bottom plate 44 is raised to approximately 130°C that is higher than the predetermined temperature of 110°C, the temperature of the mounting surface 113 of the heat exchanger plate 111, to which the heat of the bottom portion of the evaporation tank 41 is transferred with lowered, is raised to approximately 94°C that is the operation temperature of the temperature fuse 110. If the temperature fuse 110 disposed on the mounting surface 113 detects the temperature of 94°C, it is turned off and this forcibly stops current supply to the evaporation heater 50 and heat generation. This prevents the temperature of the evaporation tank 41 from excessively increasing.

Since the temperature at which the temperature fuse 110 is turned off is 94°C that is quite higher than room temperature, the temperature fuse 110 is prevented from being turned off unnecessarily due to momentarily-blowing warm wind in the area of the temperature fuse 110.

[0061] As is explained above, according to the present embodiment, the following effects are obtained.

The thermostat 105 for boil-dry protection is provided on the outer surface of the bottom plate 44 of the evaporation tank 41. Therefore, unlike the thermostat 105 directly disposed on the heater that is immersed in the stored water according to the conventional art, the evaporation heater 50 is prevented from being deteriorated due to corrosion.

[0062] The arrangement configuration of the temperature fuse 110 that is provided as compensation for the thermostat 105 in trouble is as follows. The heat of the evaporation tank 41 is not directly transferred to the temperature fuse 110. The heat exchanger plate 111 is provided on the surface of the back wall 30A of the recess 30 corresponding to the bottom portion of the evaporation tank 31. The heat exchanger plate 111 indirectly transfers the heat by the heat radiation and the slight heat transfer. The temperature fuse 110 is provided on the mounting surface 113 of the heat exchanger plate 111.

This configuration makes the heat of the evaporation tank 41 is substantially released and transferred to the heat exchanger plate 111. If the current is continuously supplied to the evaporation heater 50 because of some trouble of the thermostat 105 and the temperature of the evaporation tank 41 is raised to the temperature at which the temperature fuse 110 should be turned off (for example approximately 130°C), the mounting surface 113 of the heat exchanger plate 111 is maintained at the temperature lower than 130°C (for example, 94°C). Therefore, since the temperature fuse 110 has the operation temperature (at which the temperature fuse 110 is turned off) that is 94°C, it is operated at an appropriate timing.

[0063] Since the temperature of the heat exchanger plate 111 is maintained at the temperature lower than that of the evaporation tank 41, the temperature fuse 110 is prevented from being exposed in high heat and deteriorated. Also, since the operation temperature of the temperature fuse 110 is set to 94°C that is lower than that of the evaporation tank 41 and also quite higher than the room temperature, the temperature fuse 110 is prevented from being turned off unnecessarily due to momentarily-blowing warm wind in the area of the temperature fuse 110.

Accordingly, the deterioration of the temperature fuse 110 is prevented and an erroneous operation of the temperature fuse 110 due to the surrounding temperature is prevented from occurring. Also, the temperature fuse 110 is appropriately operated for a long period.

[0064] The heat exchanger plate 111 is provided so that the heat receiving surface 112 at the upper portion corresponds to the horizontal portion 51 (heat generating portion) of the evaporation heater 50 in the evaporation

tank 41. Accordingly, the temperature of the heat exchanger plate 111 is relatively effectively raised.
Since the mounting surface 113 at the lower portion of the heat exchanger plate 111 extends below the bottom plate 44 of the evaporation tank 41, the mounting surface 113 is easier to be influenced by the surrounding temperature. For example, if the surrounding temperature is high, the temperature of the mounting surface 113 is raised quickly, the temperature fuse 110 may be erroneously operated. According to this embodiment, the openings 114 are formed in the heat exchanger plate 111. This suppresses the heat transfer efficiency from the heat receiving surface 112 to the mounting surface 113. Accordingly, the temperature of the mounting surface 113 of the heat exchanger plate 111 is prevented from increasing too quickly. As a result, the temperature fuse 110 is prevented from being operated at an inappropriate timing.

[0065] If the surrounding temperature is low, the temperature of the refrigerator body 10 becomes lowered. This may delay temperature increase of the heat exchanger plate 111 and delay the operation (turning off) timing of the temperature fuse 110. According to the present embodiment, the heat insulating sheet 115 is provided on the rear side of the heat exchanger plate 111. This suppresses that the low temperature of the refrigerator body 10 influences the heat exchanger plate 111. Accordingly, the temperature of the heat exchanger plate 111 is increased appropriately, and this makes the temperature fuse 110 to be operated at an appropriate timing. The heat insulating member 140 is provided to correspond to the thermostat 105. This stabilizes the temperature of the portion where the thermostat 105 is provided regardless of temperature change in the surroundings of the installation position of the refrigerator. Therefore, the thermostat 105 is operated at an appropriate timing.

<Other Embodiments>

[0066] The present invention is not limited to the embodiment as explained above with reference to the drawing. For example, the following embodiments are included within the scope of the present invention. Furthermore, further various configurations other than the following embodiments are also possible within the scope and spirit of the invention.

(1) The thermostat is not necessarily provided on the outer surface of the bottom plate of the evaporation tank but may be provided in any position on the outer surface of the bottom portion of the evaporation tank such as the bottom portion on the surface plate of the evaporation tank.

(2) The thermostat may be turned on and off to correspondingly supply current and stop current supply to the evaporation heater repeatedly.

(3) The heating controller is not limited to the thermostat but may be a member that actually measures a temperature value. In such a case, the evaporation heater may be controlled to be turned off when the measured value reaches a predetermined temperature.

[0067]

(4) In the above embodiment, the heat exchanger plate on which the temperature fuse is provided is provided on the rear surface of the refrigerator body (the back wall of the recess). However, the heat exchanger plate may be provided in any other portion as long as it receives heat substantially indirectly from the evaporation tank. For example, the heat exchanger plate may be engaged to and hang from the evaporation tank.

(5) The openings may not necessarily be provided according to the heat conductivity of the material of the heat exchanger plate.

(6) The operation temperatures (turning-off temperature) of the thermostat and the temperature fuse described in the above embodiment are only the examples, and may be set arbitrarily.

(7) The evaporating device is not necessarily provided on the rear side of the refrigerator as is described in the above embodiment but may be provided on a left or right side of the refrigerator.

(8) The exhaust water to be evaporated may include general exhaust water generated in the refrigerator including defrosted water.

Claims

1. A discharge water evaporating device for a cooling storage in which an evaporation tank for storing discharged water including defrosted water is provided on a side surface of a storage body, and current is supplied to a heater provided in a bottom portion of the evaporation tank to heat and evaporate the discharge water, **characterized by**:

a heating controller that is provided on an outer surface of the evaporation tank and controls on and off of a current supply path to the heater according to detected temperature;
a heat exchanger plate that is provided in adjacent to the evaporation tank and configured to transfer heat from the evaporation tank; and
a protection member that is provided on the heat exchanger plate and disconnects the current supply path according to the detected temperature.

2. The discharge water evaporating device for a cooling storage according to claim 1, wherein the heating controller is provided on an outer surface of a bottom portion of the evaporation tank, and the heat exchanger plate is provided on a side surface of the storage body.

3. The discharge water evaporating device for a cooling storage according to claim 1 or 2, heat is transferred from the evaporation tank to the heat exchanger plate by heat radiation.

4. The discharge water evaporating device for a cooling storage according to claim 3, wherein an end of the bottom portion of the evaporation tank is in line contact with the heat exchanger plate, and heat is transferred from the evaporation tank to the heat exchanger plate by heat transfer.

5. The discharge water evaporating device for a cooling storage according to any one of claims 2 to 4, wherein the heat exchanger plate is provided such that an upper end portion of the heat exchanger plate corresponds to the heater in the evaporation tank, and the protection member is provided on a lower end portion of the heat exchanger plate.

6. The discharge water evaporating device for a cooling storage according to claim 5, wherein a plurality of openings are formed on a middle height portion of the heat exchanger plate.

7. The discharge water evaporating device for a cooling storage according to any one of claims 2 to 6, wherein a heat insulating member is provided on a rear surface of the heat exchanger plate.

8. The discharge water evaporating device for a cooling storage according to any one of claims 1 to 7, wherein a cover is provided on a side surface of the storage body to cover a surface of the evaporation tank, and a heat insulating member is provided on a rear side of the cover corresponding to the heating controller.

FIG.1

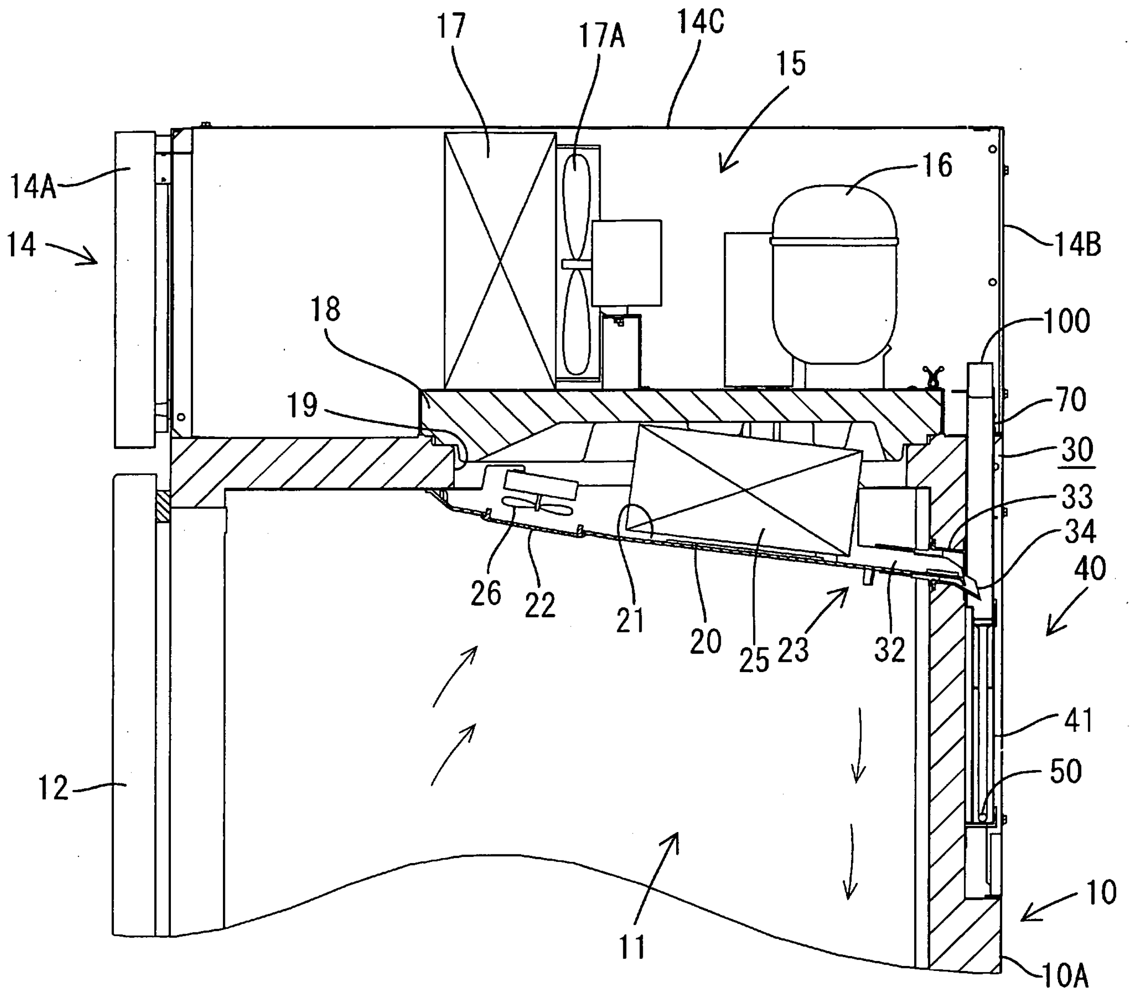
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FIG.2

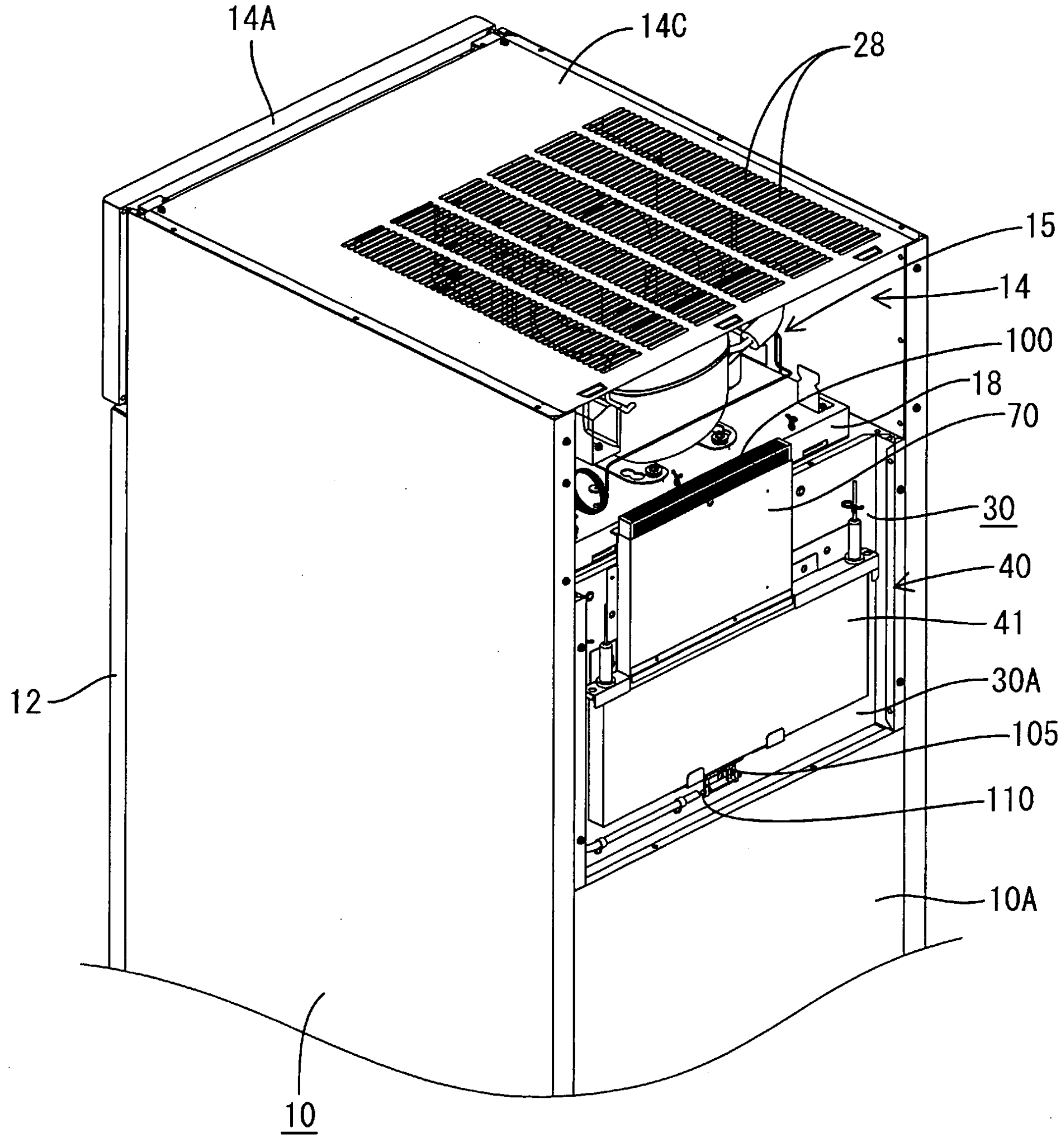

FIG.3

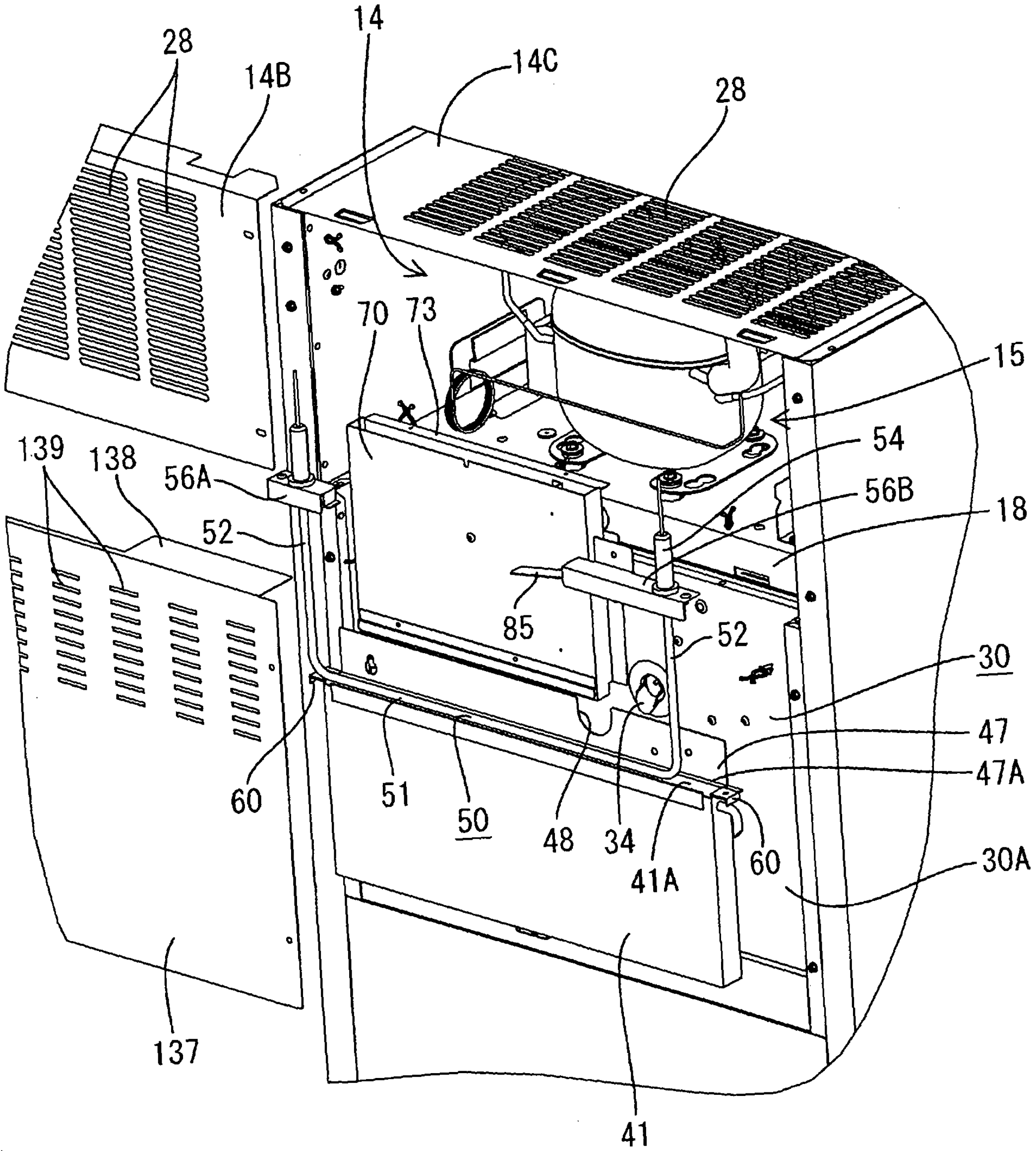
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FIG.4

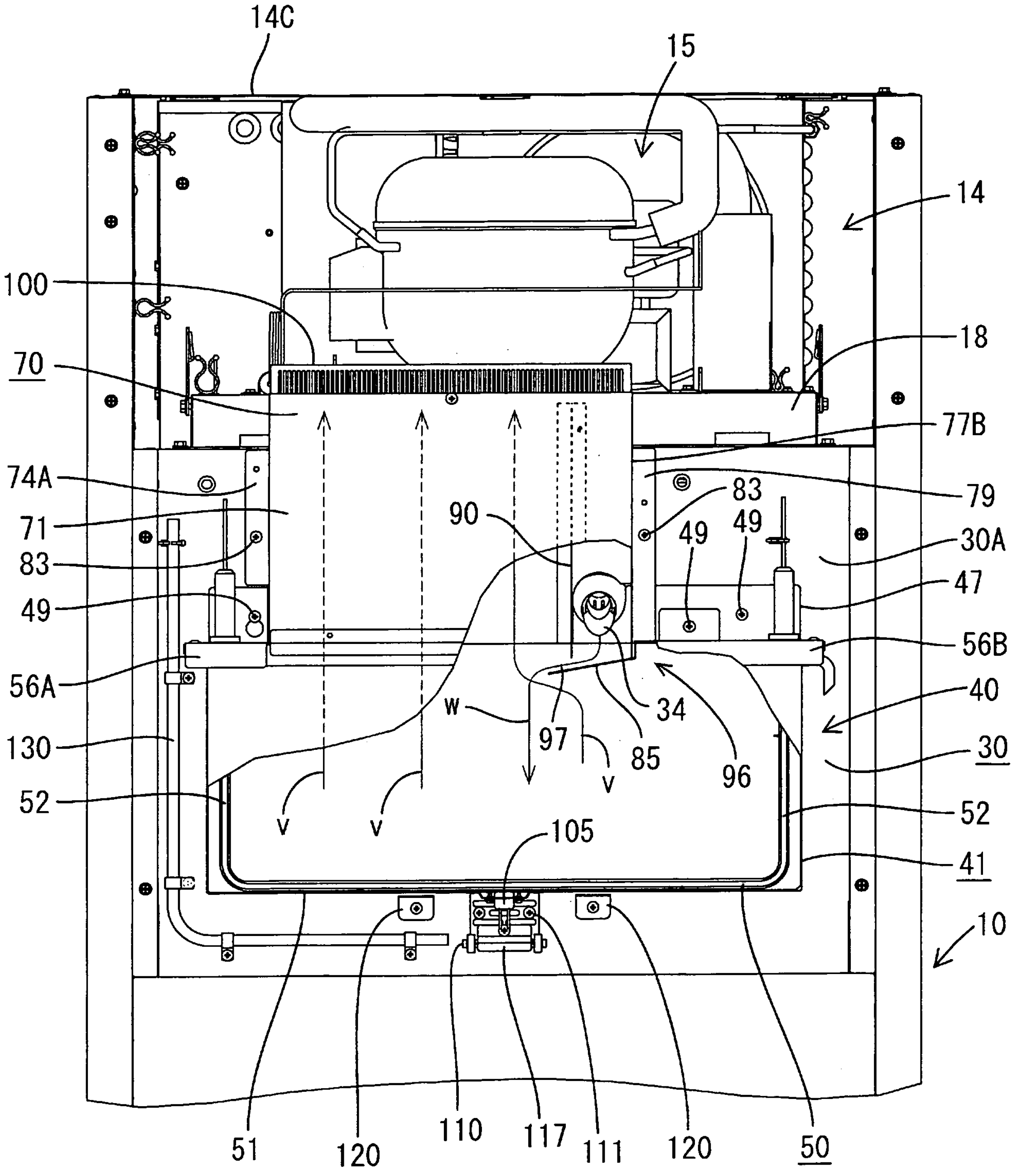
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FIG.5

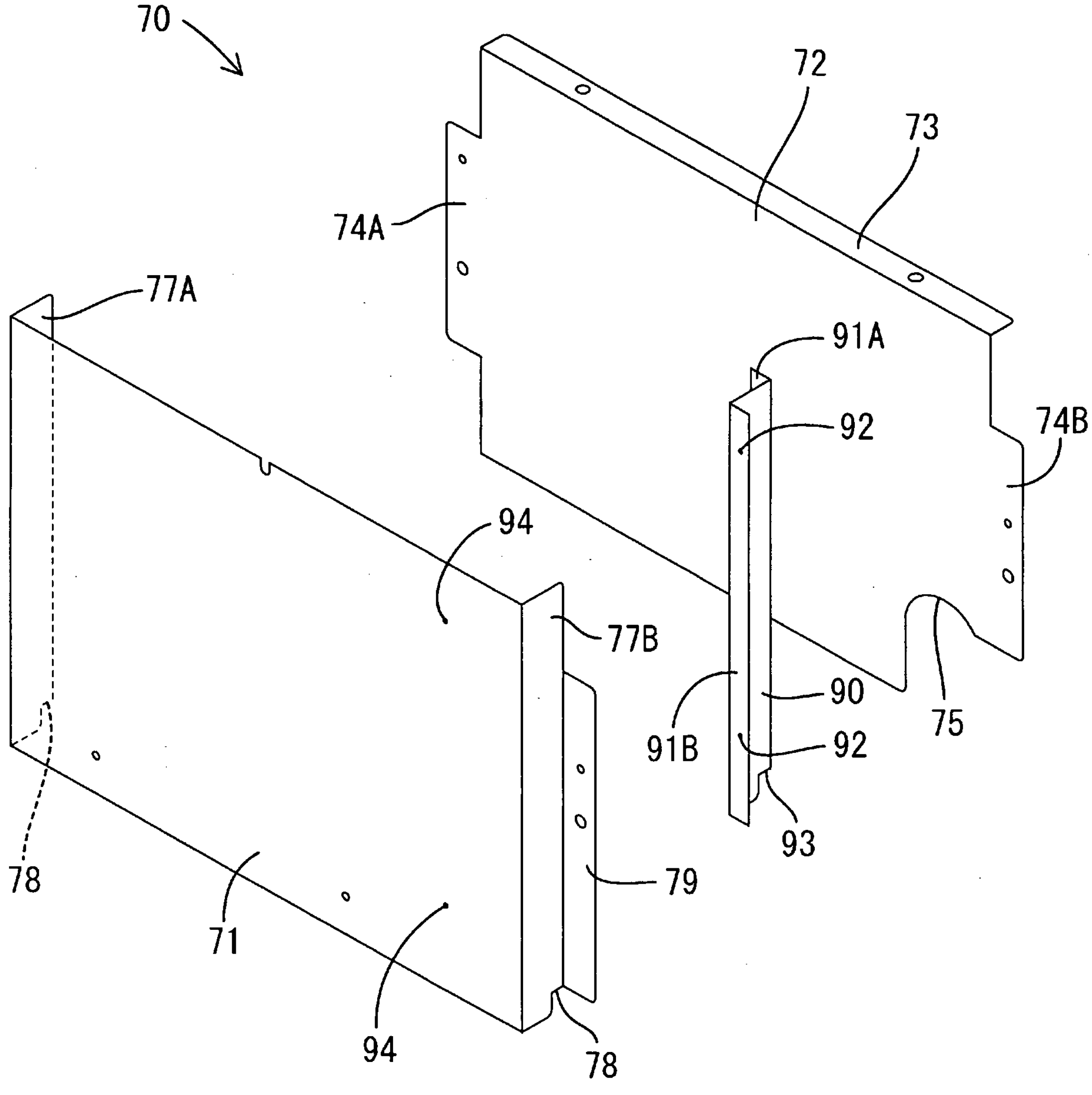

FIG.6

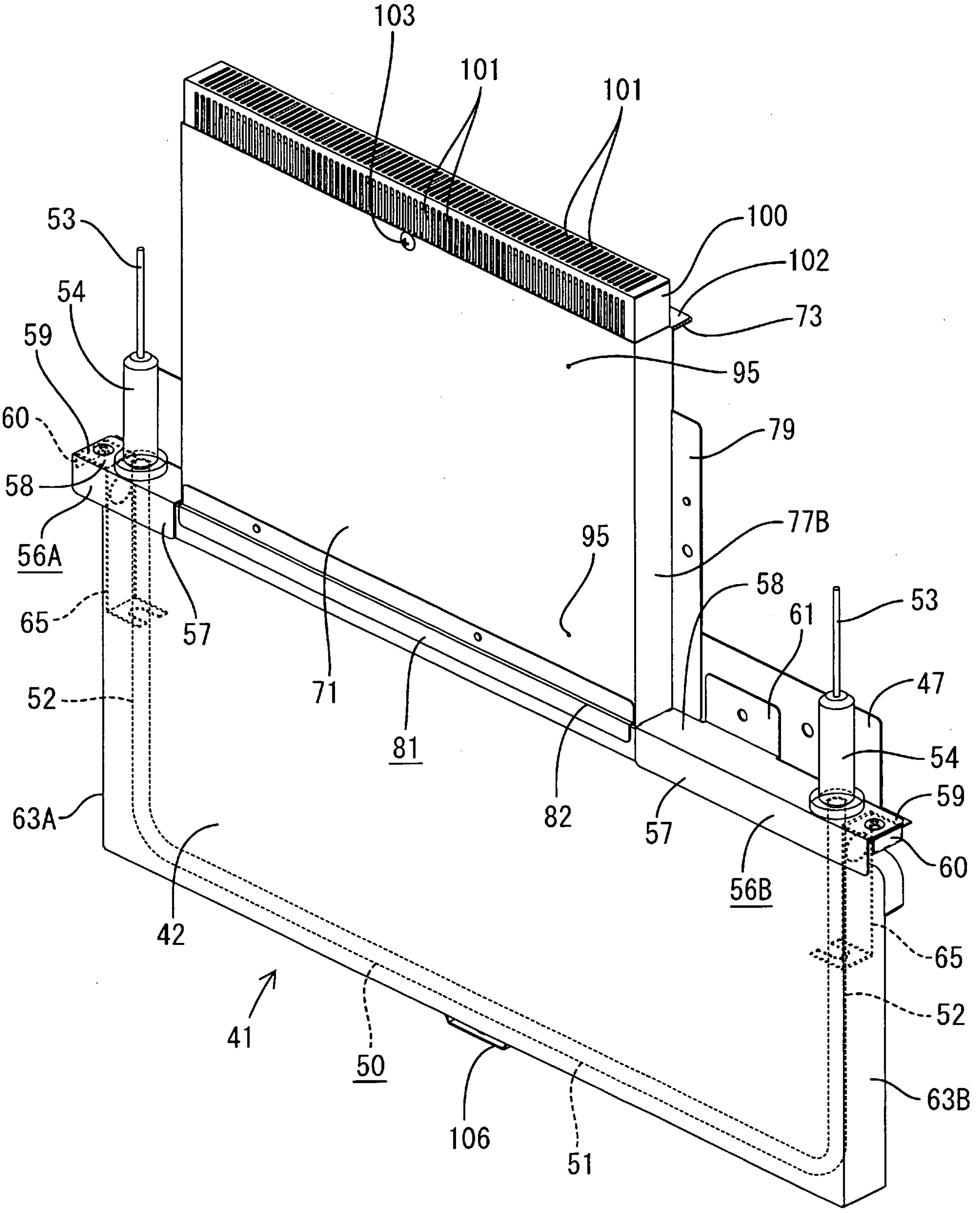
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FIG.7

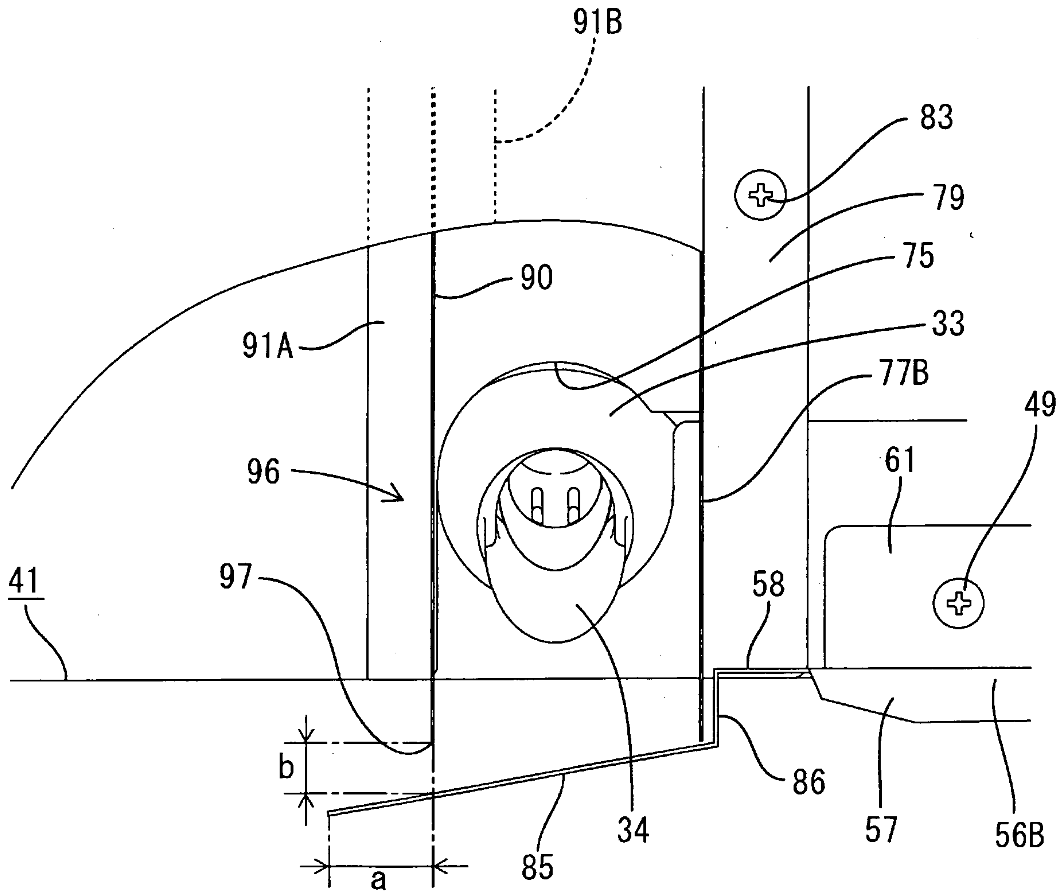
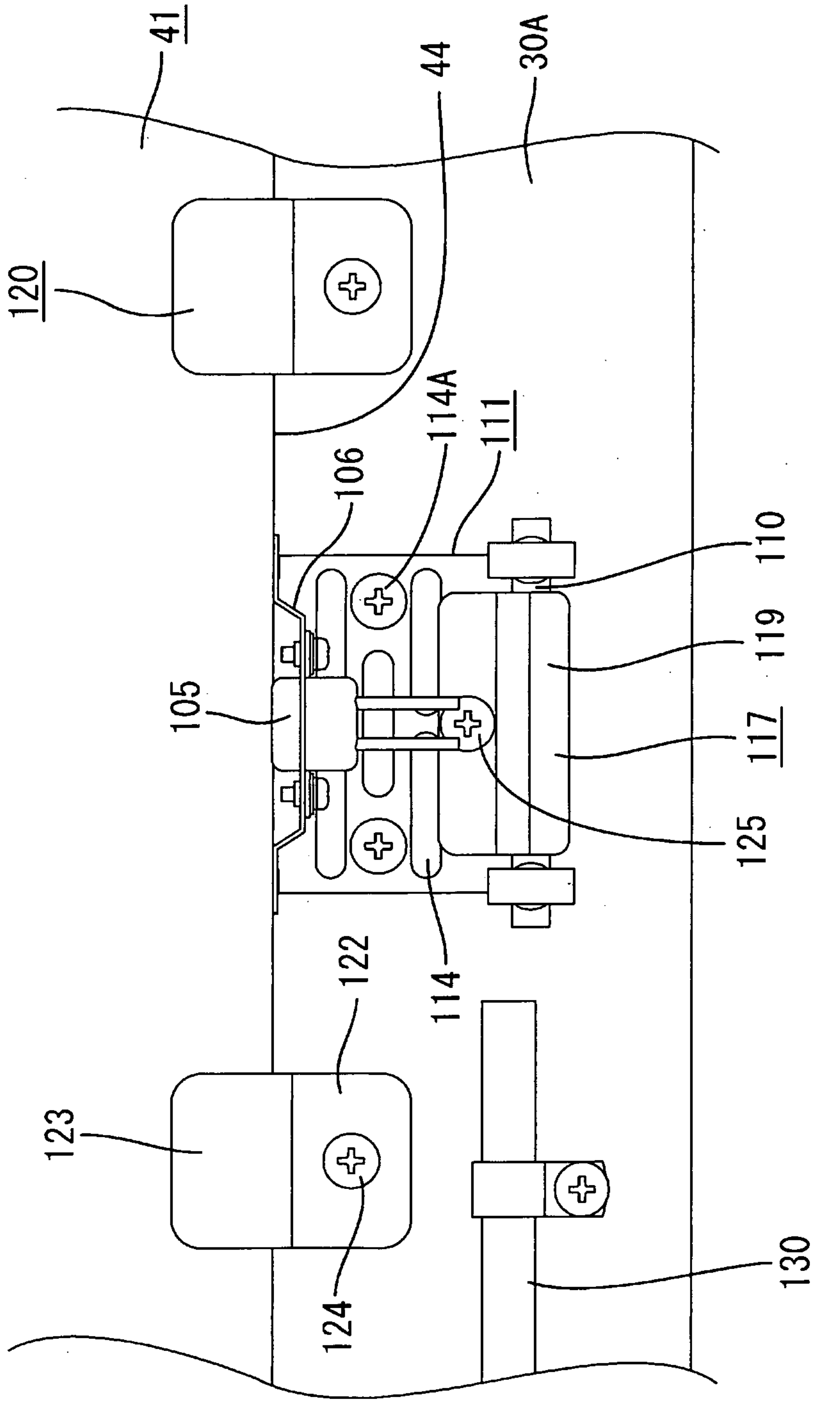


FIG.8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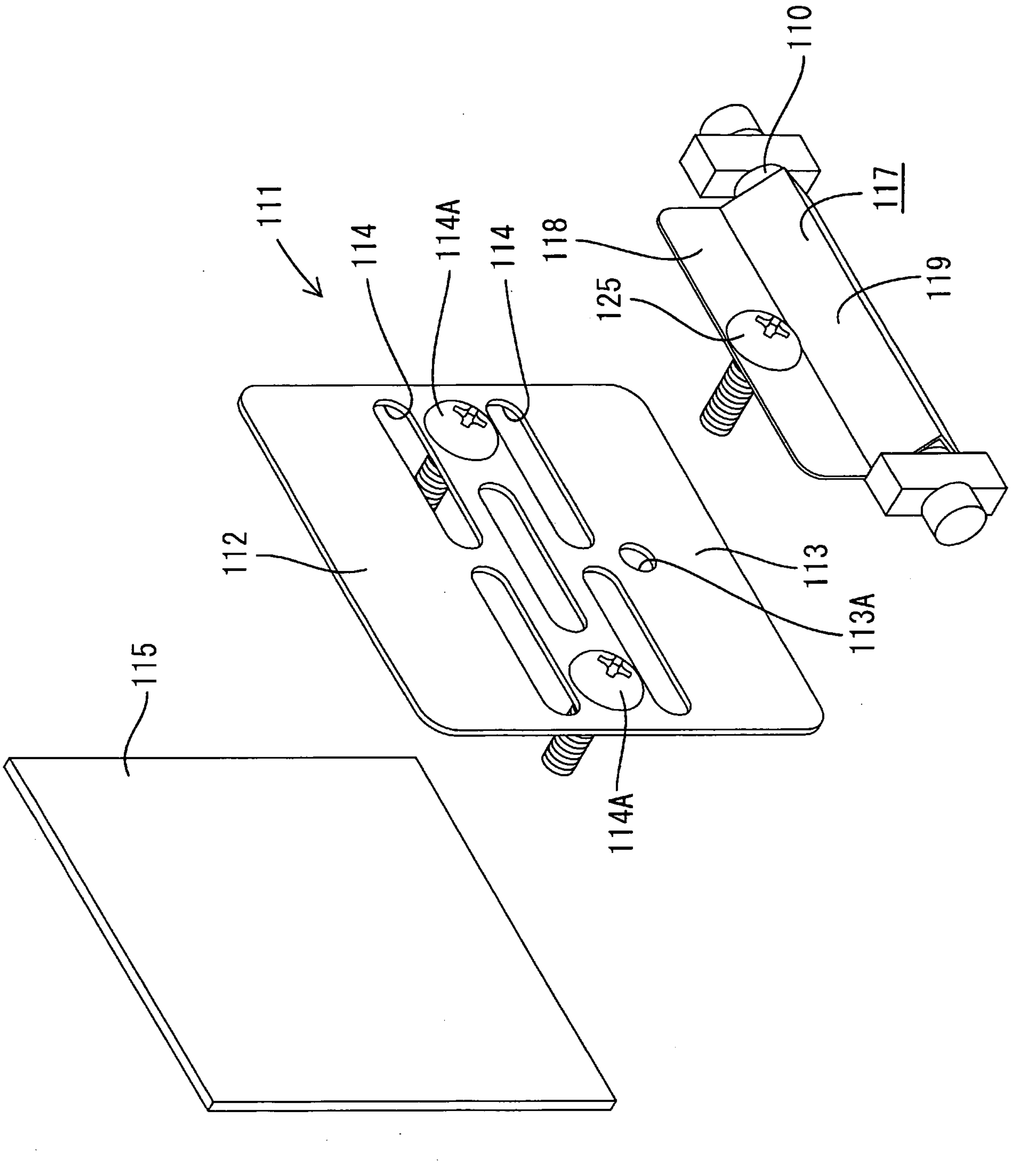
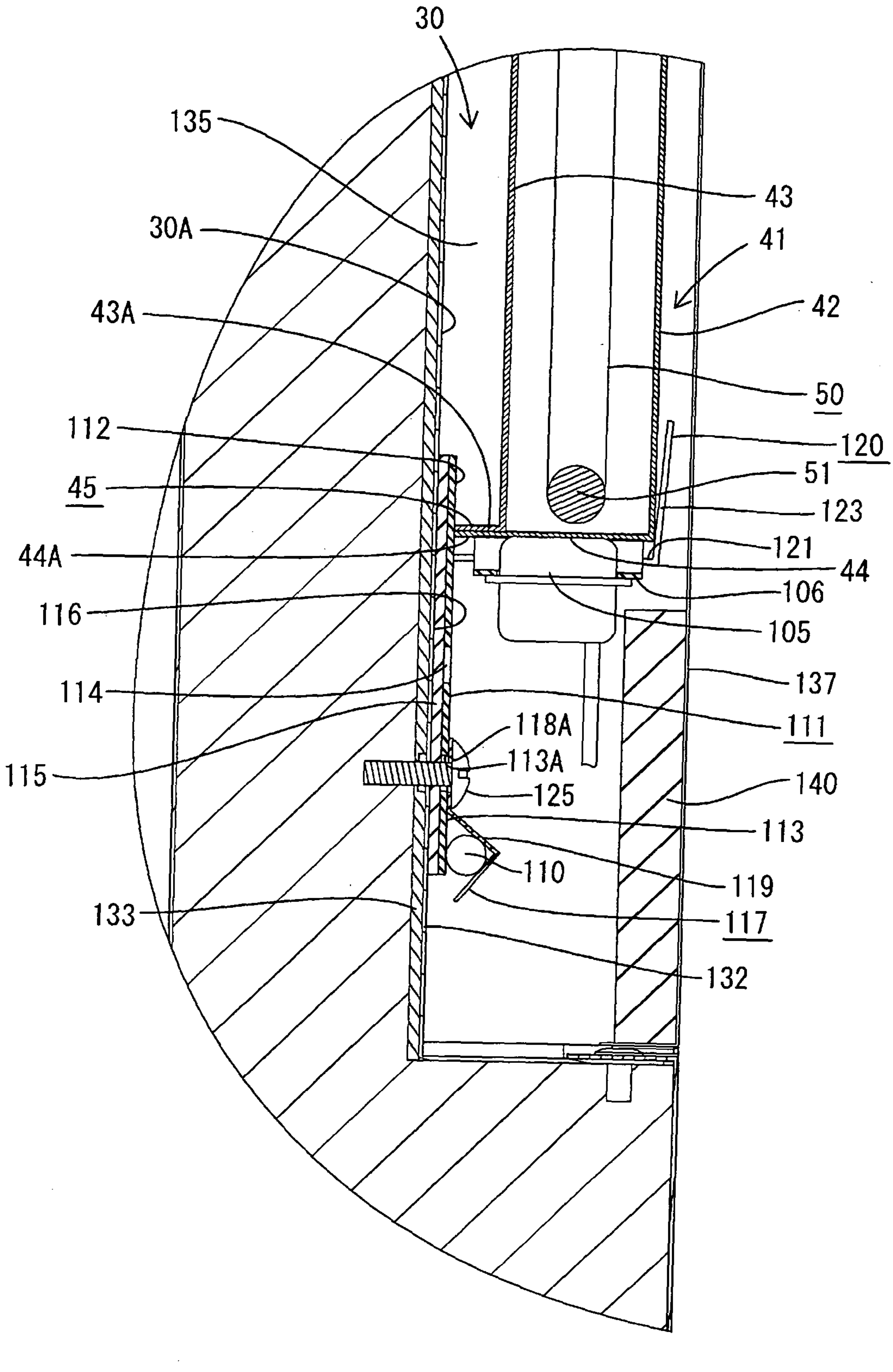


FIG.9

FIG.10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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/060243

A. CLASSIFICATION OF SUBJECT MATTER
F25D21/14(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F25D21/14

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	1996-2009
Kokai Jitsuyo Shinan Koho	1971-2009	Toroku Jitsuyo Shinan Koho	1994-2009

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2007-107759 A (Hoshizaki Electric Co., Ltd.), 26 April, 2007 (26.04.07), Claims; Par. Nos. [0001] to [0027]; Figs. 1 to 5 (Family: none)	1-8
Y	JP 2007-240086 A (Hoshizaki Electric Co., Ltd.), 20 September, 2007 (20.09.07), Claims; Par. Nos. [0001] to [0038]; Figs. 1 to 8 (Family: none)	1-8

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

* Special categories of cited documents:
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Date of the actual completion of the international search	Date of mailing of the international search report
04 August, 2009 (04.08.09)	18 August, 2009 (18.08.09)

Name and mailing address of the ISA/	Authorized officer
Japanese Patent Office	
Facsimile No.	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/060243

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	JP 63-318429 A (Ikeno Sangyo Kabushiki Kaisha), 27 December, 1988 (27.12.88), Claims & US 4820903 A	7-8
Y	JP 2003-240333 A (Bridgestone Corp.), 27 August, 2003 (27.08.03), Claim 4 (Family: none)	7-8
A	JP 2008-8533 A (Hoshizaki Electric Co., Ltd.), 17 January, 2008 (17.01.08), Full text; all drawings (Family: none)	1-8

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2008008533 A **[0003]**