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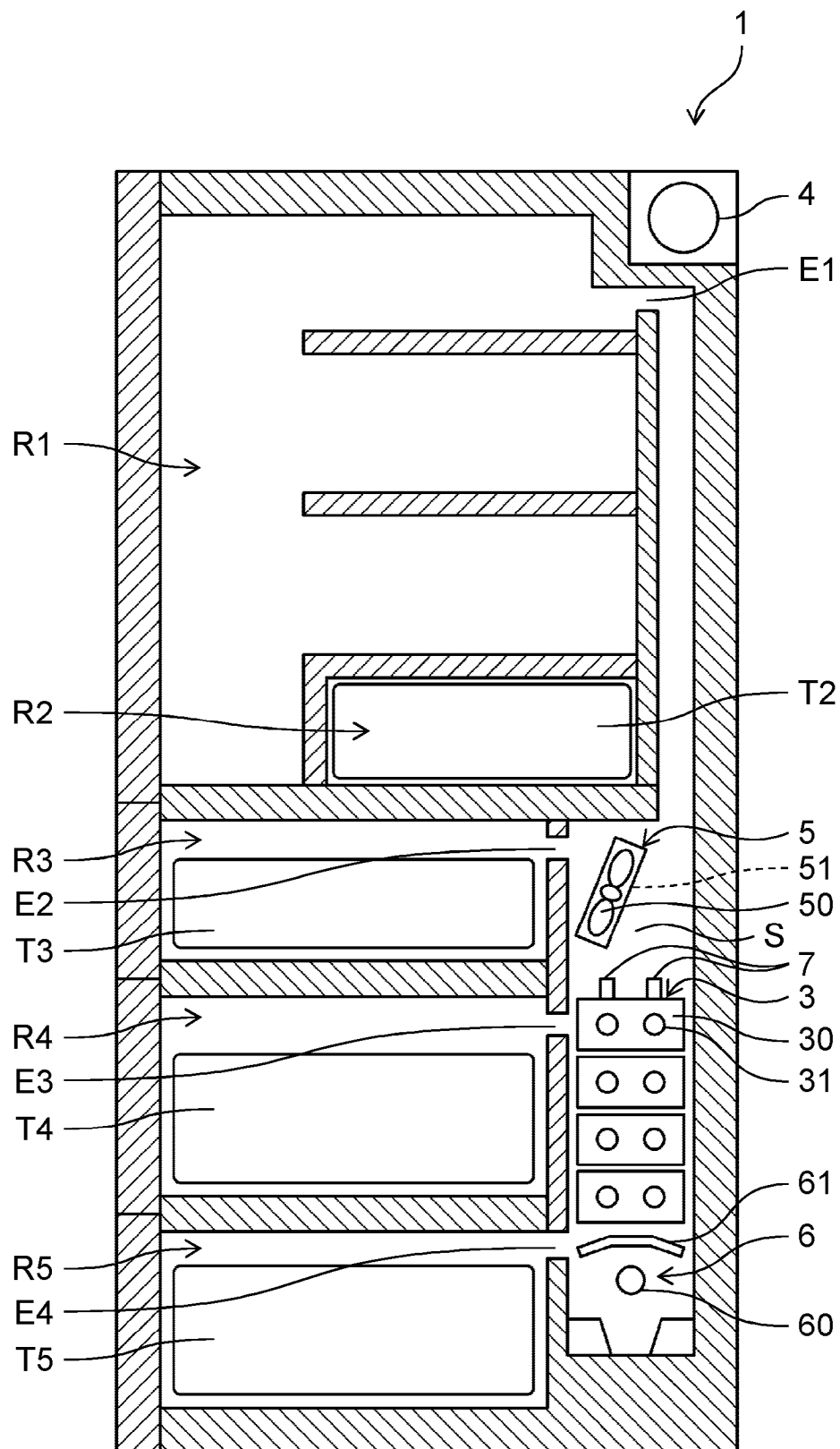
(54) **REFRIGERATING DEVICE**

(57) A refrigerating device refrigerates or freezes an object. The refrigerating device includes heat exchanger (3) through which a refrigerant flows and which cools air by exchanging heat between the refrigerant and the air upon contact with the air, supply member (7) that is disposed on or above heat exchanger (3), the supply member (7) holding an additive for reducing a contact angle of moisture in the air on a surface of heat exchanger

(3), the moisture adhering to the surface of heat exchanger (3), and air blowing mechanism (5) that is disposed above supply member (7) to blow air that passes through heat exchanger (3) and supply member (7). When supply member (7) comes into contact with moisture, the supply member (7) supplies the additive to the surface of heat exchanger (3).

EP 4 682 449 A1

FIG. 1



Description

effect can be obtained.

TECHNICAL FIELD

BRIEF DESCRIPTION OF THE DRAWINGS

[0001] The present disclosure relates to a refrigerating device, and more particularly to a technique for improving drainage properties of a heat exchanger included in the refrigerating device.

5 **[0008]**

Fig. 1 is a schematic diagram of a refrigerating device according to a first exemplary embodiment.

BACKGROUND ART

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Fig. 2 is a perspective view of a part of a heat exchanger, and a supply member in Fig. 1.

[0002] As disclosed in PTL 1, there is known a refrigerating device that reduces the amount of frosting of a heat exchanger as an evaporator to suppress deterioration in cooling efficiency. The evaporator has a coating that facilitates scattering or dropping of condensed water generated on a surface from the surface.

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Fig. 3 is a partial view of the heat exchanger and the supply member in Fig. 1 as viewed in a longitudinal direction of a refrigerant pipe.

Citation List

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Fig. 4 is a diagram schematically illustrating an internal structure of the supply member in Fig. 1.

Patent Literature

[0003] PTL 1: Unexamined Japanese Patent Publication No. 2013-120047

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Fig. 5 is an enlarged view of a heater and a heater cover in Fig. 1.

SUMMARY OF THE INVENTION

[0004] Unfortunately, the refrigerating device described in PTL 1 has deterioration in drainage effect on the surface of the heat exchanger due to degradation of the film with elapse of a use period. Consequently, deterioration in cooling efficiency is less likely to be suppressed, so that stable cooling effect cannot be obtained.

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Fig. 6A is a diagram illustrating moisture and frost adhering to a fin of a conventional heat exchanger.

[0005] Thus, it is an object of the present disclosure to suppress deterioration in cooling efficiency due to deterioration in drainage effect on a surface of a heat exchanger with elapse of a use period in a refrigerating device, thereby obtaining stable cooling effect.

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Fig. 6B is a diagram illustrating moisture and frost adhering to the fin of the conventional heat exchanger.

[0006] A refrigerating device according to one aspect of the present disclosure refrigerates or freezes an object. The refrigerating device includes a heat exchanger through which a refrigerant flows and which cools air by exchanging heat between the refrigerant and the air upon contact with the air, a supply member that is disposed on or above the heat exchanger, the supply member holding an additive for reducing a contact angle of moisture in the air on a surface of the heat exchanger, the moisture adhering to the surface of the heat exchanger, and an air blowing mechanism that is disposed above the supply member to blow air that passes through the heat exchanger and the supply member. When the supply member comes into contact with moisture, the supply member supplies the additive to the surface of the heat exchanger.

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Fig. 6C is a diagram illustrating moisture and frost adhering to the fin of the conventional heat exchanger.

[0007] The refrigerating device according to the one aspect of the present disclosure enables suppressing deterioration in cooling efficiency due to deterioration in drainage effect on the surface of the heat exchanger with elapse of a use period. Consequently, stable cooling

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Fig. 7A is a cross-sectional view illustrating a state in which moisture adhering to a fin of the heat exchanger of Fig. 1 is drained.

Fig. 7B is a cross-sectional view illustrating a state in which moisture adhering to the fin of the heat exchanger of Fig. 1 is drained.

Fig. 7C is a cross-sectional view illustrating a state in which moisture adhering to the fin of the heat exchanger of Fig. 1 is drained.

Fig. 8 is a diagram illustrating a heater cover according to a first modification.

Fig. 9 is a diagram illustrating a heater cover according to a second modification.

Fig. 10 is a diagram illustrating a heater cover according to a third modification.

Fig. 11 is a diagram illustrating a heater cover according to a fourth modification.

Fig. 12 is a diagram illustrating a heater cover ac-

cording to a fifth modification.

Fig. 13 is a diagram illustrating a heater cover according to a sixth modification.

Fig. 14 is a schematic diagram of a refrigerating device according to a second exemplary embodiment.

DESCRIPTION OF EMBODIMENT

(First exemplary embodiment)

[0009] Fig. 1 is a schematic diagram of refrigerating device 1 according to a first exemplary embodiment. Refrigerating device 1 illustrated in Fig. 1 refrigerates or freezes an object. Refrigerating device 1 of the present exemplary embodiment includes a plurality of storage chambers R1 to R5 including a refrigerating chamber, an ice making chamber, a switching chamber, a freezing chamber, and a vegetable chamber, for example. Storage chambers R1 to R5 of the present exemplary embodiment are respectively provided with trays T2 to T5, for example. Refrigerating device 1 also includes heat exchanger (referred to also as an evaporator or a cooler) 3 in which a refrigerant flows and which cools air by exchanging heat between the refrigerant and the air upon contact with the air, compressor 4 that compresses the refrigerant that has passed through the heat exchanger 3, air blowing mechanism 5 that causes the air inside refrigerating device 1 to circulate, and heating mechanism 6 that heats the air at a predetermined timing, the air having contact with heat exchanger 3. Refrigerating device 1 further includes supply member 7 disposed with respect to heat exchanger 3. Components 3 to 7 of refrigerating device 1 are disposed in inner space S of refrigerating device 1. Refrigerating device 1 includes a plurality of communication passages E1 to E4 that allow air to flow between inner space S and storage chambers R1 to R5. Refrigerating device 1 may have only one of a freezing function or a refrigerating function. Refrigerating device 1 may be a refrigerator mainly having the refrigerating function.

[0010] Heat exchanger 3 of the present exemplary embodiment is a fin-and-tube type having a plurality of fins 30 in contact with air containing moisture, and at least one refrigerant pipe 31 that is connected to the plurality of fins 30 and through which a refrigerant internally flows. Refrigerant pipe 31 is directly or indirectly connected to fin 30. A part of refrigerant pipe 31 is preferably disposed in thermal contact with at least fin 30. Heat exchanger 3 cools air by exchanging heat between the air and the refrigerant using the plurality of fins 30. The plurality of fins 30 extends in a vertical direction and are disposed at intervals in a horizontal direction, for example. Fin 30 contains a metal such as aluminum excellent in thermal conductivity, for example. Fin 30 is not limited to the material above.

[0011] Compressor 4 is connected to heat exchanger 3 using a refrigerant flow channel. The refrigerant circulates between heat exchanger 3 and compressor 4 through the refrigerant flow channel. Air blowing mechanism 5 blows air so that the air passes through heat exchanger 3 and supply member 7. Air blowing mechanism 5 blows air toward each of storage chambers R1 to R5. Air blowing mechanism 5 is disposed above supply member 7. Air blowing mechanism 5 of the present exemplary embodiment includes fan 50 and drive source 51 of fan 50.

[0012] Heating mechanism 6 heats air to melt frost adhering to a surface of heat exchanger 3 for defrosting. In other words, refrigerating device 1 includes heating mechanism 6 as a defrosting mechanism. Heating mechanism 6 includes heater 60 that is disposed below heat exchanger 3 to heat air in contact with heat exchanger 3, and heater cover 61 that is disposed between heat exchanger 3 and heater 60 to cover heater 60. When heating mechanism 6 is driven as the defrosting mechanism, air blowing mechanism 5 is not driven in the present exemplary embodiment, for example.

[0013] Supply member 7 is disposed on or above heat exchanger 3. Supply member 7 holds additive 70 to be described later. Additive 70 is supplied from supply member 7 to the surface of heat exchanger 3. This additive 70 reduces a contact angle of moisture in the air, the moisture adhering to the surface of heat exchanger 3, on the surface of heat exchanger 3. Consequently, when frost adhering to the surface of heat exchanger 3 including fins 30 is defrosted, supply member 7 reduces a thickness of a water film formed on the surface by melting of the frost, thereby improving drainage effect. In the present exemplary embodiment, supply member 7 supplies additive 70 to the moisture adhering to the surface by free fall. Supply member 7 releases additive 70 in a sustained way to the moisture adhering to the surface. "Release in a sustained way" as used herein refers to continuous release of additive 70 containing a non-ionized surfactant with elapse of time without releasing all of additive 70 at once. When coming into contact with moisture in the air, supply member 7 releases additive 70 to the outside together with the moisture while dispersing additive 70 in the moisture. Supply member 7 of the present exemplary embodiment is in contact with an upper surface of heat exchanger 3, for example. Supply member 7 may be in contact with a surface of heat exchanger 3 other than the upper surface or may be separated from heat exchanger 3.

[0014] Fig. 2 is a perspective view of a part of heat exchanger 3, and supply member 7 in Fig. 1. Fig. 3 is a partial view of heat exchanger 3 and supply member 7 in Fig. 1 as viewed in a longitudinal direction of refrigerant pipe 31. Fig. 3 illustrates a plurality of vertical lines X passing through respective ends of refrigerant pipe 31 in a radial direction at a connection position between fin 30 and refrigerant pipe 31. As illustrated in Figs. 2 and 3, supply member 7 has an elongated shape extending in

the longitudinal direction of refrigerant pipe 31. When viewed in the vertical direction, at least a part of supply member 7 in a width direction is disposed overlap refrigerant pipe 31 inside both ends of the plurality of fins 30 in the width direction. This configuration prevents a flow of air circulating around heat exchanger 3 by passing through between adjacent fins 30 from being obstructed by supply member 7. Consequently, pressure loss of the air circulating around heat exchanger 3 can be prevented from increasing. Thus, excellent heat exchange efficiency can be obtained.

[0015] As illustrated in Fig. 3, the whole of supply member 7 is disposed overlapping refrigerant pipe 31 as viewed in the vertical direction in the present exemplary embodiment, for example. When viewed in the longitudinal direction of supply member 7, supply member 7 has a maximum dimension in the vertical direction larger than a maximum dimension in the horizontal direction. This configuration enables supply member 7 to hold abundant additives 70 by increasing an internal volume of supply member 7 while further preventing supply member 7 from obstructing a flow of air circulating around heat exchanger 3. Thus, additives 70 can be supplied from supply member 7 to the surface of heat exchanger 3 over a long period of time.

[0016] Supply member 7 is disposed in refrigerating device 1 in a detachable manner. Consequently, supply member 7 can be easily replaced in the present exemplary embodiment. Alternatively, refrigerating device 1 may include a holder for holding supply member 7.

[0017] Fig. 4 is a diagram schematically illustrating an internal structure of supply member 7 in Fig. 1. As illustrated in Fig. 4, supply member 7 includes holder 71 that holds additive 70, and support 72 that supports holder 71. Supply member 7 of the present exemplary embodiment includes support 72 supporting a plurality of holders 71 that are dispersedly disposed in support 72. Additive 70 contains a surfactant. Supply member 7 mainly includes the surfactant contained in additive 70, holder 71, and support 72.

[0018] Holder 71 is a spherical particle, for example. Holder 71 of the present exemplary embodiment contains at least one of glass, activated carbon, zeolite, amorphous silica, or porous concrete. Among them, glass such as porous glass is preferable, and amorphous silica is more preferable, for example. Holder 71 of another example contains an inorganic component. Holder 71 of the present exemplary embodiment includes a plurality of porous bodies dispersed in support 72. Using the porous bodies enables holder 71 to hold abundant additives 70 inside many pores of the porous bodies. Each porous body is a porous particle, for example. In other words, holder 71 includes a plurality of porous particles dispersed in a water-insoluble resin contained in support 72 described later, for example.

[0019] Holder 71 has an outer diameter, the amount of oil absorption, a pore diameter, and a specific surface area, and a weight ratio M1/M2 of weight M1 of holder 71

to weight M2 of support 72, which are appropriately set based on sustained-release performance of additive 70 required for supply member 7, for example. When holder 71 is a spherical particle, holder 71 has an outer diameter that is a particle diameter with a value in a range from 1 μm to 10 μm inclusive, for example. Although examples of holder 71 being a spherical particle include the functional filler "Sunsphere" series manufactured by AGC Si-Tech Co., Ltd., holder 71 is not limited thereto.

[0020] Holder 71 has the amount of oil absorption in accordance with JIS K 5101-13-1:2004, the amount being a value in a range from 200 ml/100 g to 600 ml/100 g inclusive (such as 400 ml/100 g), for example. Holder 71 has the pore diameter with a value in a range from 0.5 nm to 20 nm inclusive (such as 11 nm), for example. Holder 71 has the specific surface area with a value in a range from 400 m^2/g to 900 m^2/g inclusive (such as 700 m^2/g). The weight ratio M1/M2 has a value of 0.27 or more, for example.

[0021] Here, increase in weight M1 enables increasing the amount of holding of an additive of supply member 7, for example. Consequently, allowing moisture to permeate a contact part between corresponding holders 71 of supply member 7 from the outside enables additive 70 held by holder 71 located at the back of the inside of supply member 7 to be easily and in a sustained way released into the moisture without waste through the contact part. When the weight ratio M1/M2 has a value of 0.27 or more, an effect as described above is favorably obtained. For example, the weight ratio M1/M2 having a value set in a range from 0.27 to 1.00 inclusive enables a shape of supply member 7 to be easily maintained. When holder 71 is reduced in surface area to prevent additive 70 from being excessively released from supply member 7 at once, for example, the weight ratio M1/M2 may be set to a value in a range of 1.00 or more.

[0022] Support 72 of the present exemplary embodiment holds holder 71 to enable additive 70 to come into contact with external moisture. Support 72 contains a water-insoluble resin, for example. Examples of the water-insoluble resin include any resin material having water-insolubility. The water-insoluble resin is a main component of support 72, for example. In other words, the water-insoluble resin is a base material resin of supply member 7. The water-insoluble resin is at least one of polyethylene, polypropylene, polyamide, polyethylene terephthalate, polybutylene terephthalate, or acrylic-modified polyethylene, for example.

[0023] Holders 71 are in contact with each other inside support 72. A gap through which moisture can pass exists in a part of interfaces between holders 71 and support 72. This configuration allows moisture to penetrate into the gap from a surface of supply member 7 when moisture comes into contact with supply member 7 from the outside. The moisture penetrates to each holder 71 inside supply member 7 through the contact part between corresponding holders 71.

[0024] Additive 70 is added from holder 71 to moisture

in air circulating through the inside of refrigerating device 1. Additive 70 is supplied to the surface of heat exchanger 3 together with moisture. Additive 70 modifies the moisture. Additive 70 of the present exemplary embodiment contains a nonionic surfactant as a surfactant. Additive 70 reduces surface tension of moisture adhering to the surface of heat exchanger 3, thereby reducing a contact angle of the moisture on the surface of heat exchanger 3. Consequently, additive 70 allows a thin liquid film to be formed on the surface of heat exchanger 3. In other words, additive 70 improves wettability of the surface of heat exchanger 3.

[0025] As the nonionic surfactant, an oxyalkylene alkyl ether surfactant is suitable, for example. Although at least one of polyoxyethylene propylene alkyl ether, polyoxyethylene alkyl ether, polyoxyethylene alkylphenyl ether, or polyoxyethylene polyoxypropylene glycol can be exemplified as the oxyalkylene alkyl ether surfactant, the oxyalkylene alkyl ether surfactant not limited thereto.

[0026] The nonionic surfactant has a contact angle of less than or equal to 90° on the water-insoluble resin contained in support 72. Thus, the nonionic surfactant and the water-insoluble resin have good affinity. When the nonionic surfactant and the water-insoluble resin are kneaded during manufacturing of supply member 7, the nonionic surfactant can be easily blended into the water-insoluble resin. Thus, supply member 7 can be easily molded.

[0027] Additive 70 may contain other components within a range in which a concentration of the surfactant is appropriately maintained. Examples of the other components include a water-soluble organic solvent. Examples of an organic solvent include alcohols, ketones, and ethers. Examples of lower alcohol include ethanol, propanol, isopropyl alcohol, and butanol. Additive 70 of the present exemplary embodiment contains only the nonionic surfactant, for example.

[0028] When supply member 7 comes into contact with moisture in air, additive 70 is released in the sustained way from holder 71 to the surface of heat exchanger 3. Supply member 7 of the present exemplary embodiment releases additive 70 in the sustained way from holder 71 so that additive 70 is supplied to the surface of heat exchanger 3 over a predetermined period (such as a period of several months to several years).

[0029] When supply member 7 comes into contact with moisture in air, additive 70 is supplied to the surface of heat exchanger 3 together with the moisture from holder 71 positioned in a surface layer of supply member 7. Consequently, a concentration of additive 70 in holder 71 in the surface layer decreases. Then, the surface layer becomes a deficient layer in which additive 70 is deficient. After that, additive 70 moves from holder 71 positioned inside supply member 7 toward holder 71 positioned in the surface layer of supply member 7, and thus increasing the concentration of additive 70 in holder 71 in the surface layer. Additive 70 held by holder 71 in the surface layer is supplied again to the surface of heat exchanger 3

together with moisture. This repetition allows additive 70 to be supplied (added) little by little to moisture from supply member 7.

[0030] As another example, supply member 7 may have configurations below. The nonionic surfactant includes an oxyalkylene alkyl ether surfactant. Holder 71 includes a porous glass spherical particle having a pore diameter of 11 nm and a pore volume of 2 mL/g. Support 72 contains an acrylic-modified polyethylene resin (EMMA) ("Acryft" manufactured by Sumitomo Chemical Co., Ltd.) as a water-insoluble resin. The supply member 7 contains the nonionic surfactant, holder 71, and support 72 at a weight percentage of 56%, 22%, and 22%, respectively, for example. Supply member 7 has a total weight of 0.5 g, for example.

[0031] Next, a method for manufacturing supply member 7 will be exemplified. Additive 70, holder 71, and support 72 are heated and kneaded to manufacture a resin composition. These heating and kneading are performed using a twin-screw extrusion kneader under a heating condition in a temperature range from 70°C to 180°C inclusive, for example. Then, a resin composition in the form of a strand is manufactured, for example. When the strand is cut, a pellet is obtained. When injection molding is performed using the pellets, supply member 7 having a desired shape is obtained. Besides a cylindrical shape as described above, supply member 7 may have a plate shape, a strip shape, a rectangular parallelepiped shape, a cubic shape, a spherical shape, or an elliptical shape, for example.

[0032] Fig. 5 is an enlarged view of heater 60 and heater cover 61 in Fig. 1. Fig. 5 shows a direction perpendicular to the paper surface that is a longitudinal direction of heater 60. Heater 60 has an elongated shape, for example. Heater cover 61 is a plate body extending in the longitudinal direction of heater 60. Heater 60 is entirely covered with heater cover 61 when viewed in the vertical direction. Heater cover 61 of the present exemplary embodiment includes at least any one of a protruding region and an end region, the protruding region being disposed at a position other than a region overlapping heater 60 in the vertical direction and including a protrusion protruding downward from an uppermost position of heater cover 61, the end region being disposed at a position other than the region overlapping heater 60 and including an end positioned below the uppermost position of heater cover 61.

[0033] Heater cover 61 includes a pair of end regions 61a, 61b disposed on both sides across heater 60 in the horizontal direction when viewed from the longitudinal direction of heater 60, for example. End regions 61a, 61b include ends 61c, 61d, respectively. Ends 61c, 61d of the present exemplary embodiment are located above the uppermost position of heater 60, but may be located below the uppermost position. Ends 61c, 61d extend in the longitudinal direction of heater 60. When viewed in the longitudinal direction of heater 60, central region 61e sandwiched between the pair of end regions 61a, 61b of

heater cover 61 extends in the horizontal direction. When viewed in the longitudinal direction of the heater 60, end regions 61a, 61b extend obliquely downward from respective ends in the horizontal direction of central region 61e.

[0034] When drainage water from heat exchanger 3 falls on heater cover 61, a thin water film is formed on an upper surface of heater cover 61 as in a surface of fin 30 by moisture modified by additive 70. Consequently, heater cover 61 can be improved in drainage effect. Heater cover 61 includes end regions 61a, 61b, so that even when the drainage water from heat exchanger 3 falls on heater cover 61, moisture dropped from heater cover 61 can be dropped downward from ends 61c, 61d of end regions 61a, 61b without being brought into contact with heater 60. When viewed in the longitudinal direction of heater 60, end regions 61a, 61b extend obliquely downward from respective ends of central region 61e in the horizontal direction. Thus, moisture is less likely to remain on the upper surface of heater cover 61, and can be quickly drained from heater cover 61.

[0035] This configuration enables suppressing heat loss caused by wasteful heating or evaporation of moisture adhering to the upper surface of heater cover 61 during defrosting, for example. Thus, heater 60 can be stably driven by preventing driving of heater 60 from being hindered by moisture. Additionally, the amount of power consumption of heating mechanism 6 can be suppressed, and thus contributing to energy saving effect of refrigerating device 1. Thus, stable drainage effect and defrosting effect of refrigerating device 1 can be obtained. Heater cover 61 may have a horizontally asymmetric shape when viewed in the longitudinal direction of heater 60. Heater cover 61 may have an inclination in the width direction, the inclination increasing toward its each end in the width direction when viewed from the longitudinal direction of heater 60.

[0036] Here, Figs. 6A to 6C are each diagrams illustrating moisture and frost adhering to the fin of the conventional heat exchanger. During operation of the refrigerating device, air inside the refrigerating device circulates around the heat exchanger to exchange heat with the refrigerant, thereby becoming cool air. The cool air is fed to each storage chamber of the refrigerating device to refrigerate or freeze an object. At this time, air containing moisture comes into contact with the heat exchanger, so that moisture in the air adheres to a surface of a fin or the like of the heat exchanger (Fig. 6A). This moisture becomes frost and accumulates on the surface of heat exchanger 3. When a drive period of the refrigerating device reaches a predetermined period, the defrosting mechanism of the refrigerating device operates to defrost the surface of the heat exchanger, for example. However, slight frost and moisture remain (Fig. 6B). The remaining moisture is frozen by re-cooling. Consequently, the conventional refrigerating device has frost that accumulates on the surface of the heat exchanger (Fig. 6C) due to defrosting and re-cooling that are repeatedly performed.

[0037] Figs. 7A to 7C are each diagrams illustrating a state in which moisture adhering to fin 30 of heat exchanger 3 in Fig. 1 is drained. Refrigerating device 1 causes moisture in air to come into contact with supply member 7 and penetrate into supply member 7. Additive 70 held by holder 71 of supply member 7 is added to the moisture. The moisture containing additive 70 falls from supply member 7 by free fall and adheres to the surface of heat exchanger 3 (Fig. 7A). Although a waterdrop adhering to the surface of heat exchanger 3 has a size in a range of less than or equal to 10 μm for example, the size is not limited thereto. The moisture adhering to the surface of heat exchanger 3 is frozen to become frost.

[0038] When a drive period of refrigerating device 1 reaches a predetermined period, heating mechanism 6 is operated, and air heated by heating mechanism 6 comes into contact with the surface of heat exchanger 3, for example. Consequently, frost adhering to the surface of heat exchanger 3 melts. The frost having melted becomes moisture containing additive 70. Additive 70 reduces a contact angle of the moisture on the surface of heat exchanger 3, so that surface tension of the moisture is reduced to improve wettability of the surface of heat exchanger 3. Consequently, a thin water film is formed on the surface of heat exchanger 3. This thin water film easily evaporates or easily slips off the surface of heat exchanger 3. Additionally, water films adjacent to each other easily slip off the surface of heat exchanger 3 by being joined to each other. As a result, heat exchanger 3 is improved in drainage effect and defrosting effect (Fig. 7B). Consequently, when the refrigerating device 1 is driven for re-cooling after defrosting, the amount of residual moisture on the surface of heat exchanger 3 is significantly reduced (Fig. 7C). Thus, even when refrigerating device 1 is driven to repeatedly perform defrosting and re-cooling, frost is prevented from accumulating on the surface of heat exchanger 3.

[0039] As described above, the present exemplary embodiment allows additive 70 to be supplied from supply member 7 to the surface of heat exchanger 3. Consequently, a contact angle of moisture on the surface of heat exchanger 3 is reduced to form a thin water film on the surface. Thus, evaporation of moisture is promoted, and droplets of moisture adjacent to each other are joined to easily slip off the surface. As a result, the drainage effect and the defrosting effect from the surface of heat exchanger 3 are improved. This improvement enables heat exchanger 3 to be driven with excellent heat exchange efficiency. Then, not only the amount of power consumption and defrosting time for defrosting of heat exchanger 3, but also the amount of power consumption and a re-cooling period for re-cooling after defrosting, can be reduced. As a result, defrosting efficiency and re-cooling efficiency can be improved. This improvement contributes to the energy saving effect of refrigerating device 1. This improvement also prevents refrigerating and freezing objects stored in storage chambers R1 to R5 from increasing in temperature during defrosting. Thus,

the objects can be stored with high quality for a long period of time.

[0040] Here, the drainage effect according to the present exemplary embodiment is obtained by modifying moisture so that additive 70 of supply member 7 reduces a contact angle of the moisture unlike a coating formed on a surface of a conventional heat exchanger, for example. For this reason, the drainage effect is not deteriorated by elapse of a use period of refrigerating device 1. Thus, stable cooling effect can be obtained in refrigerating device 1.

[0041] In the present exemplary embodiment, supply member 7 is disposed on or above heat exchanger 3, and air blowing mechanism 5 is disposed above supply member 7. This configuration allows additive 70 held by supply member 7 to be supplied to heat exchanger 3 by mainly free fall. For this reason, additive 70 is less likely to adhere to air blowing mechanism 5. Thus, preventing additive 70 from adhering to air blowing mechanism 5 enables air blowing mechanism 5 to be stably driven. In the present exemplary embodiment, air blowing mechanism 5 circulates air around heat exchanger 3 upward through inner space S from a lower side of refrigerating device 1. Thus, when the air is fed to each of the storage chambers R1 to R5, additive 70 is less likely to enter each of storage chambers R1 to R5 together with the air. Hereinafter, each modification of the heater cover of the present exemplary embodiment will be described focusing on a difference from heater cover 61.

(Modifications)

[0042] Fig. 8 is a diagram illustrating heater cover 62 according to a first modification. Heater cover 62 illustrated in Fig. 8 includes central region 62e where a part vertically overlapping heater 60 protrudes upward and bends, and a pair of end regions 62a, 62b. End regions 62a, 62b include ends 62c, 62d, respectively. Heater cover 62 extends linearly from the center in the width direction to each of ends 62c, 62d. Heater cover 62 has effect as in heater cover 61.

[0043] Fig. 9 is a diagram illustrating heater cover 63 according to a second modification. Heater cover 63 illustrated in Fig. 9 includes central region 63e where a part vertically overlapping heater 60 protrudes upward and bends, and a pair of end regions 63a, 63b. End regions 63a, 63b include ends 63c, 63d, respectively. Heater cover 63 has effect as in heater cover 61.

[0044] Fig. 10 is a diagram illustrating heater cover 64 according to a third modification. Heater cover 64 illustrated in Fig. 10 includes a pair of protruding regions 64a, 64b. Protruding regions 64a, 64b include protrusions 64c, 64d, respectively. Central region 64e sandwiched between the pair of protruding regions 64a, 64b of heater cover 64 extends in the horizontal direction.

[0045] Heater cover 64 includes the pair of protruding regions 64a, 64b each disposed at a position other than a region overlapping heater 60 in the vertical direction, and

thus suppressing heat loss caused by wasteful heating or evaporation of moisture adhering to heater cover 64 using heater 60. Heater cover 64 has an upper surface inclined from one side to the other side in the longitudinal direction of heater 60, for example. This inclination enables moisture adhering to the pair of protruding regions 64a, 64b to easily fall from heater cover 64.

[0046] Fig. 11 is a diagram illustrating heater cover 65 according to a fourth modification. Heater cover 65 illustrated in Fig. 11 includes central region 65e where a part vertically overlapping heater 60 protrudes upward and bends, and a pair of protruding regions 65a, 65b. Protruding regions 65a, 65b include protrusions 65c, 65d, respectively. Heater cover 65 has an upper surface inclined from one side to the other side in the longitudinal direction of heater 60, for example. Heater cover 65 has effect as in heater cover 64.

[0047] Fig. 12 is a diagram illustrating heater cover 66 according to a fifth modification. Heater cover 66 illustrated in Fig. 12 includes a pair of end regions 66a, 66b. End regions 66a, 66b include ends 66c, 66d, respectively. Heater cover 66 extends in an arch shape that gently swells upward from one of ends 66c, 66d to the other. Heater cover 66 has effect as in heater cover 61.

[0048] Fig. 13 is a diagram illustrating heater cover 67 according to a sixth modification. Heater cover 67 illustrated in Fig. 13 includes central region 67e where a part vertically overlapping heater 60 protrudes downward and bends, and a pair of protruding regions 67a, 67b. Protruding regions 67a, 67b include protrusions 67c, 67d, respectively. Heater cover 67 has an upper surface inclined from one side to the other side in the longitudinal direction of heater 60, for example. Heater cover 67 has effect as in heater cover 64.

[0049] The heater cover of the present disclosure preferably includes at least any one of the protruding region or the end region, for example. Thus, a plurality of structures can be used as the structure of the heater cover. Any of heater covers 62 to 67 described in the first to sixth modifications are configured such that when water drained from the surface of heat exchanger 3 comes into contact with each of heater covers 62 to 67, a waterdrop falling from corresponding one of heater covers 62 to 67 falls downward from the protrusion of the protruding region or the end of the end region. The protrusion and the end are each disposed at a position without overlapping the heater in the vertical direction. This configuration prevents water from coming into contact with the heater. As a result, the heater can be stably driven. As with heater covers 64, 65, 67, the heater cover of the present disclosure may be configured to facilitate falling of moisture from the heater cover by inclining an upper surface of the heater cover from one side to the other side in the longitudinal direction of the heater within a range in which unnecessary retention of water on the upper surface can be suppressed. Hereinafter, a second exemplary embodiment will be described focusing on differences from the first exemplary embodiment.

(Second exemplary embodiment)

[0050] Fig. 14 is a schematic diagram of refrigerating device 101 according to a second exemplary embodiment. Refrigerating device 101 includes a plurality of storage chambers R1 to R5 including at least any one of an ice-making chamber, a freezing chamber, a switching chamber, and a vegetable chamber, for example. Refrigerating device 101 also includes: first heat exchanger 103 that exchanges heat to generate cool air to be fed to a storage chamber belonging to a predetermined first group (such as storage chambers R3 to R5) among storage chambers R1 to R5; first air blowing mechanism 105 that blows cool air from first heat exchanger 103 toward storage chambers R3 to R5 of the first group; heating mechanism 106 that defrosts first heat exchanger 103; and first supply member 107 disposed for first heat exchanger 103. Refrigerating device 101 also includes inner space S1 in which first heat exchanger 103 and heating mechanism 106 are disposed, and communication passages E5 to E7 that allows air to flow between inner space S1 and storage chambers R3 to R5.

[0051] Refrigerating device 101 also includes: second heat exchanger 113 that exchanges heat to generate cool air to be fed to a storage chamber of a second group (such as storage chambers R1, R2) other than the first group among storage chambers R1 to R5; second air blowing mechanism 115 that blows cool air from second heat exchanger 113 toward storage chambers R1, R2 of the second group; and second supply member 117 disposed for second heat exchanger 113. Refrigerating device 101 further includes inner space S2 in which second heat exchanger 113 is disposed, and communication passages E8 to E11 that allow air to flow between inner space S2 and storage chambers R1, R2. In the present exemplary embodiment, first heat exchanger 103 serves as a freezing heat exchanger, and second heat exchanger 113 serves as a refrigerating heat exchanger, for example.

[0052] Heating mechanism 106 has a configuration similar to that of heating mechanism 6 of the first exemplary embodiment. Supply member 107, 117 have a configuration similar to that of supply member 7 of the first exemplary embodiment. Second heat exchanger 113 is provided with no heating mechanism. Second air blowing mechanism 115 defrosts second heat exchanger 113 by circulating air to second heat exchanger 113. That is, second air blowing mechanism 115 also serves as a part of a defrosting mechanism of refrigerating device 101.

[0053] First supply member 107 is disposed on or above first heat exchanger 103. First air blowing mechanism 105 is disposed above first supply member 107. Second supply member 117 is disposed on or above second heat exchanger 113. Second air blowing mechanism 115 is disposed above second supply member 117. Not only first supply member 107 is disposed with respect to first heat exchanger 103, but also second supply member 117 is disposed with respect to second

heat exchanger 113 in a similar manner to that in which supply member 7 is disposed with respect to heat exchanger 3 of the first exemplary embodiment. As with refrigerating device 101, the refrigerating device of the present disclosure may include two heat exchangers for refrigerating chamber use and freezing chamber use, for example.

[0054] When refrigerating device 101 is driven, additive 70 held by second supply member 117 is supplied to a surface of second heat exchanger 113. When second heat exchanger 113 is defrosted in refrigerating device 101, second air blowing mechanism 115 is driven. Then, refrigerating device 101 allows air discharged from storage chambers R1 and R2 and air around second heat exchanger 113 in inner space S1 to circulate through communication passages E8 to E11. In this state, the surface of second heat exchanger 113 is defrosted using circulation of the air and a temperature difference between the air discharged from storage chambers R1 and R2 and the air around second heat exchanger 113, for example. The surface of second heat exchanger 113 then has a thin water film formed due to additive 70 contained in the moisture generated by melting of frost, so that drainage is promoted. Consequently, drainage effect and defrosting effect on the surface of second heat exchanger 113 are improved.

[0055] Second supply member 117 is disposed on or above second heat exchanger 113, and second air blowing mechanism 115 is disposed above second supply member 117. This placement allows additive 70 held by second supply member 117 to be appropriately supplied to the surface of second heat exchanger 113 by free fall even when second air blowing mechanism 115 is driven during defrosting of second heat exchanger 113. Thus, even when air circulates upward from second heat exchanger 113 toward second air blowing mechanism 115 in inner space S1 of refrigerating device 101, for example, additive 70 discharged from second supply member 117 is prevented from coming into contact with second air blowing mechanism 115. Consequently, second air blowing mechanism 115 can be stably driven. Additionally, additive 70 of second supply member 117 is prevented from entering storage chambers R1 and R2 together with air by driving of second air blowing mechanism 115.

[0056] When refrigerating device 101 is driven, additive 70 of first supply member 107 is supplied to a surface of first heat exchanger 103. When first heat exchanger 103 is defrosted in refrigerating device 101, heating mechanism 106 is driven while first air blowing mechanism 105 is stopped, as in refrigerating device 1 according to the first exemplary embodiment. Consequently, air heated by heating mechanism 106 in inner space S1 comes into contact with the surface of first heat exchanger 103. The surface of first heat exchanger 103 then has a thin water film formed due to additive 70 contained in the moisture generated by melting of frost, so that drainage is promoted. Thus, first heat exchanger 103 is defrosted as with heat exchanger 3.

[0057] As described above, the satisfactory drainage effect and defrosting effect are achieved also in refrigerating device 101 as in refrigerating device 1. Thus, refrigerating device 101 enables suppressing deterioration in cooling efficiency due to deterioration in drainage effect on the surface of heat exchanger 103, 113 with elapse of a use period. As a result, stable cooling effect can be obtained.

(Disclosure Item)

[0058] Each of items below is a disclosure of a preferred exemplary embodiment.

[Item 1]

[0059] A refrigerating device that refrigerates or freezes an object, the refrigerating device including:

a heat exchanger through which a refrigerant flows and which cools air by exchanging heat between the refrigerant and the air upon contact with the air; a supply member that is disposed on or above the heat exchanger, the supply member holding an additive for reducing a contact angle of moisture in the air on a surface of the heat exchanger, the moisture adhering to the surface of the heat exchanger; and an air blowing mechanism that is disposed above the supply member to blow air that passes through the heat exchanger and the supply member, wherein when the supply member comes into contact with moisture, the supply member supplies the additive to the surface of the heat exchanger.

[0060] The configuration allows the additive to be supplied from the supply member to the surface of the heat exchanger. Consequently, a contact angle of moisture on the surface of the heat exchanger is reduced to form a thin water film on the surface. Thus, evaporation of moisture is promoted, and droplets of moisture adjacent to each other are joined to easily slip off the surface. As a result, the drainage effect from the surface of the heat exchanger is improved. This improvement enables the heat exchanger to be driven with excellent heat exchange efficiency. Then, not only the amount of power consumption and defrosting time for defrosting of the heat exchanger, but also the amount of power consumption and a re-cooling period for re-cooling after defrosting, can be reduced. As a result, defrosting efficiency and re-cooling efficiency can be improved. This improvement contributes to energy saving effect of the refrigerating device. This improvement also prevents refrigerating and freezing objects stored in respective storage chambers of the refrigerating device from increasing in temperature during defrosting, for example. Thus, the objects can be stored with high quality for a long period of time.

[0061] Here, the drainage effect according to the configuration above is obtained by modifying moisture so

that the additive of the supply member reduces a contact angle of the moisture unlike a coating formed on a surface of a conventional heat exchanger, for example. For this reason, the drainage effect is not deteriorated by elapse of a use period of the refrigerating device. Thus, stable cooling effect can be obtained in the refrigerating device.

[0062] In the configuration above, the supply member is disposed on or above the heat exchanger, and the air blowing mechanism is disposed above the supply member. This configuration allows the additive held by the supply member to be supplied to the heat exchanger by mainly free fall. For this reason, the additive is less likely to adhere to the air blowing mechanism. Thus, preventing the additive from adhering to the air blowing mechanism enables the air blowing mechanism to be stably driven. Even when the air blowing mechanism circulates air around the heat exchanger upward from the lower side of the refrigerating device to feed the air to each storage chamber of the refrigerating device, for example, the additive can be less likely to be mixed in the air and enter each storage chamber.

[Item 2]

[0063] The refrigerating device described in item 1, in which the supply member is in contact with an upper surface of the heat exchanger.

[0064] The configuration above enables facilitating supply of the additive to the heat exchanger from the supply member by free fall by shortening a vertical distance between the supply member and the heat exchanger. This configuration enables the additive to be efficiently diffused and supplied to the heat exchanger. Thus, the drainage effect and the defrosting effect from the surface of the heat exchanger can be promoted. As a result, excellent heat exchange efficiency is obtained. Eliminating a space between the supply member and the heat exchanger reduces the refrigerating device in size to have a compact size.

[Item 3]

[0065] The refrigerating device described in item 1 or 2, in which the heat exchanger includes:

a plurality of fins disposed at intervals in a horizontal direction; and at least one refrigerant pipe that is connected to the plurality of fins and through which the refrigerant flows, the supply member has an elongated shape extending in a longitudinal direction of the refrigerant pipe, and the supply member is disposed with at least a part in a width direction, the part overlapping the refrigerant pipe inside both ends of the plurality of fins in the width direction when viewed in a vertical direction.

[0066] The configuration above enables a contact angle of moisture on a surface of each of the plurality of fins of the heat exchanger to be reduced due to the additive supplied from the supply member even when air around the heat exchanger exchanges heat with the refrigerant flowing inside the refrigerant pipe to cause the moisture to adhere to the surface of each of the plurality of fins to form frost. As a result, the drainage effect and the defrosting effect from the plurality of fins can be improved.

[Item 4]

[0067] The refrigerating device described in item 3, in which the whole of the supply member is disposed overlapping the refrigerant pipe as viewed in the vertical direction.

[0068] The configuration above enables preventing a flow of air circulating around the heat exchanger from being obstructed by the supply member. Consequently, air inside the refrigerating device can be likely to be circulated in a desired direction. Additionally, pressure loss of the air circulating around the heat exchanger can be prevented from increasing. As a result, excellent heat exchange efficiency is obtained.

[Item 5]

[0069] The refrigerating device described in any one of items 1 to 4, in which the supply member has a maximum dimension in the vertical direction larger than a maximum dimension in the horizontal direction when viewed in a longitudinal direction of the supply member.

[0070] The configuration above enables the supply member to hold abundant additives by increasing an internal volume of the supply member while further preventing the supply member from obstructing a flow of air circulating around the heat exchanger. Thus, the additives can be supplied from the supply member to the surface of the heat exchanger over a long period of time.

[Item 6]

[0071] The refrigerating device described in any one of items 1 to 5, further including:

a heater disposed below the heat exchanger and configured to heat air in contact with the heat exchanger; and
a heater cover disposed between the heat exchanger and the heater to cover the heater, in which the heater cover includes at least any one of a protruding region and an end region, the protruding region being disposed at a position other than a region overlapping the heater in the vertical direction and including a protrusion protruding downward from an uppermost position of the heater cover, the end region being disposed at a position other than the region overlapping the heater and including

an end positioned below the uppermost position of the heater cover.

[0072] The configuration above enables moisture dropped from the heater cover to be prevented from coming into contact with the heater even when drainage water from the surface of the heat exchanger falls on the heater cover due to the protruding region or the end region provided in the heater cover. Additionally, heat loss can be suppressed, the heat loss being caused by wasteful heating or evaporation of moisture adhering to the heater cover, which is caused by the heater. When the heater cover includes the end region, moisture adhering to the heater cover can be dropped downward from the end of the end region. Consequently, the heater can be stably driven by preventing driving of the heater from being hindered by moisture. Thus, stable defrosting effect can be obtained by the heater.

[Item 7]

[0073] The refrigerating device described in item 6, in which

the heater has an elongated shape, the heater cover is a plate body, and the protrusion of the protruding region or the end of the end region extends in a longitudinal direction of the heater.

[0074] The configuration above enables air inside the refrigerating device to be efficiently heated during defrosting using the heater due to the heater formed in the elongated shape. The heater cover formed of the plate body enables the heater cover to be easily formed in a desired shape. The protrusion of the protruding region or the end of the end region extends in the longitudinal direction of the heater, so that moisture can be satisfactorily prevented from coming into contact with the heater by using the protrusion or the end extending in the longitudinal direction of the heater even when drainage water from the heat exchanger falls onto the heater cover.

[Item 8]

[0075] The refrigerating device described in any one of items 1 to 7, in which the supply member includes:

the additive containing a nonionic surfactant; a holder that holds the additive; and a support that supports the holder to enable the additive to come into contact with external moisture, and
the supply member supplies the additive in a sustained way from the holder to the external moisture.

[0076] The configuration above enables improving

wettability of a surface of the heat exchanger and facilitating further decrease in a contact angle of moisture formed on the surface of the heat exchanger by supplying the additive containing the nonionic surfactant from the holder to the surface of the heat exchanger, for example. Consequently, a thin water film can be formed on the surface, and a drying rate of the surface can be stably improved. The additive is held in the holder and the holder is supported by the support, so that supply of the additive to the surface can be further facilitated while a position of the holder in the supply member is stably maintained.

[Item 9]

[0077] The refrigerating device described in item 8, in which the holder is a porous body containing at least one of glass, activated carbon, zeolite, amorphous silica, or porous concrete.

[0078] The configuration above enables the additive to be held inside many pores of the holder because the holder is a porous body. Consequently, the amount of holding of an additive of the holder can be increased. Additionally, a range of material selection of the holder is expanded, so that a degree of freedom in designing the holder can be improved.

[Item 10]

[0079] The refrigerating device described in item 8 or 9, in which the nonionic surfactant is an oxyalkylene alkyl ether surfactant.

[0080] The configuration above enables further improving wettability of the surface of the heat exchanger by using the oxyalkylene alkyl ether surfactant as the nonionic surfactant. Thus, the drainage effect and the defrosting effect of the refrigerating device can be further improved.

[Item 11]

[0081] The refrigerating device described in any one of items 8 to 10, in which

the support contains a water-insoluble resin, and
the holder contains a plurality of porous particles
dispersed in the water-insoluble resin.

[0082] The configuration above enables facilitating formation of a circulation path of the additive between the support and the holder by using the support containing the water-insoluble resin. Additionally, abundant additives can be retained inside the pores of the plurality of porous particles. When a plurality of porous particles identical in shape and particle size is used, for example, the amount of the additive retained in each porous particle can be increased and uniformized. Consequently, the additive can be stably supplied from the supply member to the surface of the heat exchanger for a long

period of time.

[Item 12]

5 **[0083]** The refrigerating device described in any one of items 8 to 11, in which the holder has a specific surface area in a range from 400 m²/g to 900 m²/g inclusive.

10 **[0084]** The configuration above enables the specific surface area of the holder to be highly increased. Consequently, the holder can hold abundant additives by causing the additives to adhere to a wide surface. Thus, the nonionic surfactant can be easily supplied from the supply member to the surface of the heat exchanger for a long period of time.

15 **[0085]** The present disclosure is not limited to the above exemplary embodiments and the above modifications, and configurations and methods thereof can be changed, added, combined, or deleted without departing from the gist of the present disclosure. The type of heat exchanger 3, 103, 113 provided in refrigerating device 1, 101 is not limited to the fin-and-tube type, and other types such as a microchannel type (flat pipe type) may be used. The microchannel type (flat pipe type) enables further improving heat exchange efficiency by reducing a contact angle of moisture adhering to the surface of the heat exchanger on the surface to efficiently form a thin water film on the surface, for example.

REFERENCE MARKS IN THE DRAWINGS

[0086]

1, 101: refrigerating device
3: heat exchanger
5: air blowing mechanism
7: supply member
30: fin
31: refrigerant pipe
60: heater
40 61 to 67: heater cover
61c, 61d, 62c, 62d, 63c, 63d, 66c, 66d: end
61a, 61b, 62a, 62b, 63a, 63b, 66a, 66b: end region
64c, 64d, 65c, 65d, 67c, 67d: protrusion
64a, 64b, 65a, 65b, 67a, 67b: protruding region
45 70: additive
71: holder
72: support
103: first heat exchanger (heat exchanger)
105: first air blowing mechanism (air blowing mechanism)
50 107: first supply member (supply member)
113: second heat exchanger (heat exchanger)
115: second air blowing mechanism (air blowing mechanism)
55 117: second supply member (supply member)

Claims

1. A refrigerating device that refrigerates or freezes an object, the refrigerating device comprising:

a heat exchanger through which a refrigerant flows and which cools air by exchanging heat between the refrigerant and the air upon contact with the air;

a supply member that is disposed on or above the heat exchanger, the supply member holding an additive for reducing a contact angle of moisture in the air on a surface of the heat exchanger, the moisture adhering to the surface of the heat exchanger; and

an air blowing mechanism that is disposed above the supply member to blow air that passes through the heat exchanger and the supply member, wherein when the supply member comes into contact with moisture, the supply member supplies the additive to the surface of the heat exchanger.

2. The refrigerating device according to Claim 1, wherein the supply member is in contact with an upper surface of the heat exchanger.

3. The refrigerating device according to Claim 1, wherein the heat exchanger includes:

a plurality of fins disposed at intervals in a horizontal direction; and

at least one refrigerant pipe that is connected to the plurality of fins and through which the refrigerant flows,

the supply member has an elongated shape extending in a longitudinal direction of the refrigerant pipe, and

the supply member is disposed with at least a part in a width direction, the part overlapping the refrigerant pipe inside both ends of the plurality of fins in the width direction when viewed in a vertical direction.

4. The refrigerating device according to Claim 3, wherein a whole of the supply member is disposed overlapping the refrigerant pipe as viewed in the vertical direction.

5. The refrigerating device according to Claim 4, in which the supply member has a maximum dimension in the vertical direction larger than a maximum dimension in the horizontal direction when viewed in a longitudinal direction of the supply member.

6. The refrigerating device according to Claim 1, further

comprising:

a heater disposed below the heat exchanger and configured to heat air in contact with the heat exchanger; and

a heater cover disposed between the heat exchanger and the heater to cover the heater, wherein the heater cover includes at least any one of a protruding region and an end region, the protruding region being disposed at a position other than a region overlapping the heater in the vertical direction and including a protrusion protruding downward from an uppermost position of the heater cover, the end region being disposed at a position other than the region overlapping the heater and including an end positioned below the uppermost position of the heater cover.

7. The refrigerating device according to Claim 6, wherein

the heater has an elongated shape, the heater cover is a plate body, and the protrusion of the protruding region or the end of the end region extends in a longitudinal direction of the heater.

8. The refrigerating device according to any one of Claims 1 to 7, wherein the supply member includes:

the additive containing a nonionic surfactant; a holder that holds the additive; and a support that supports the holder to enable the additive to come into contact with external moisture, and the supply member supplies the additive from the holder to the external moisture.

9. The refrigerating device according to Claim 8, wherein the holder is a porous body containing at least one of glass, activated carbon, zeolite, amorphous silica, or porous concrete.

10. The refrigerating device according to Claim 8, wherein the nonionic surfactant is an oxyalkylene alkyl ether surfactant.

11. The refrigerating device according to Claim 8, wherein

the support contains a water-insoluble resin, and the holder contains a plurality of porous particles dispersed in the water-insoluble resin.

12. The refrigerating device according to Claim 8, wherein the holder has a specific surface area in a

range from 400 m²/g to 900 m²/g inclusive.

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FIG. 1

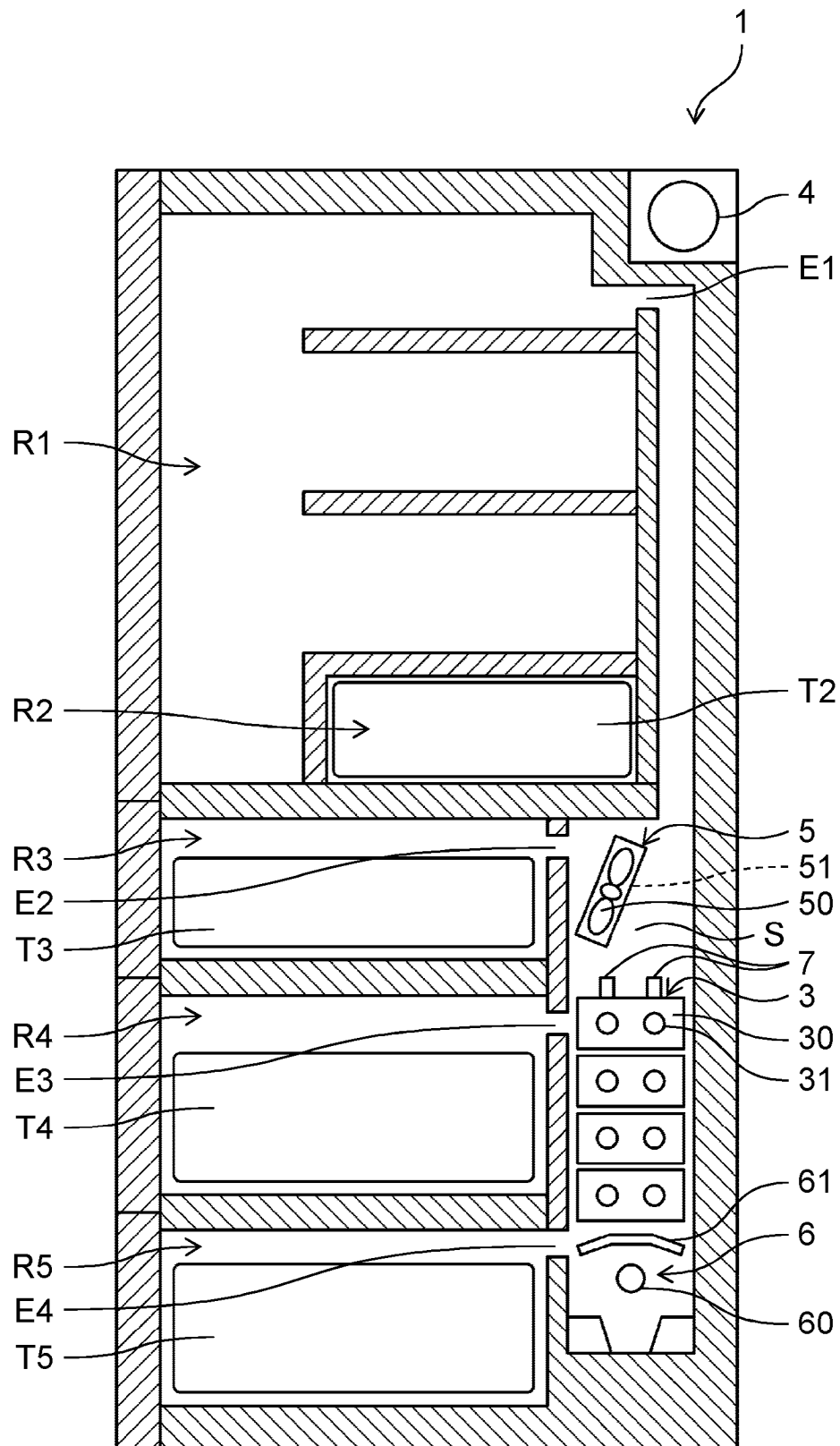


FIG. 2

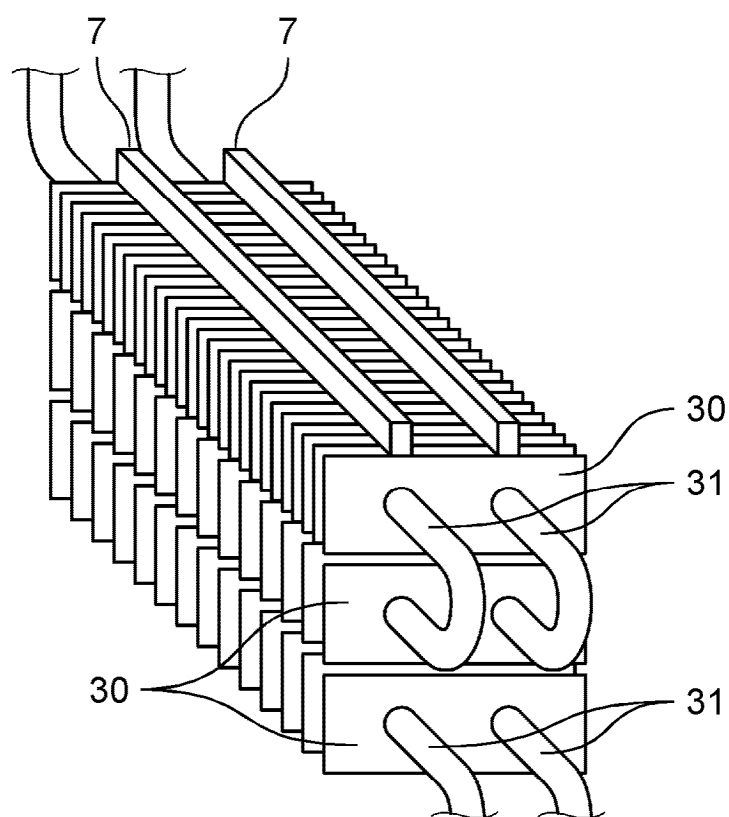


FIG. 3

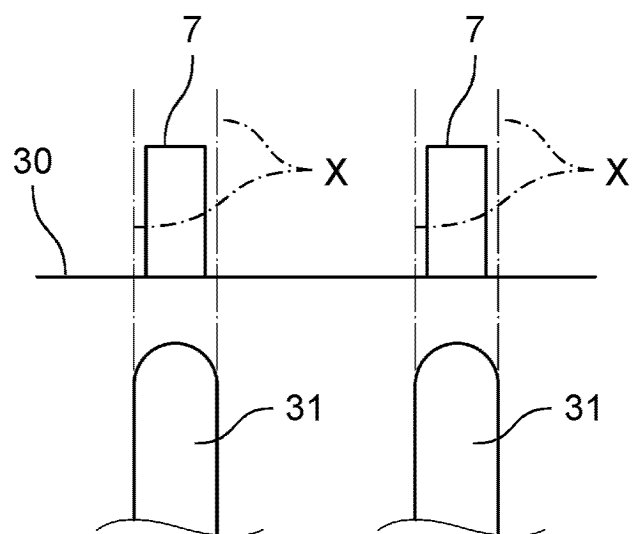


FIG. 4

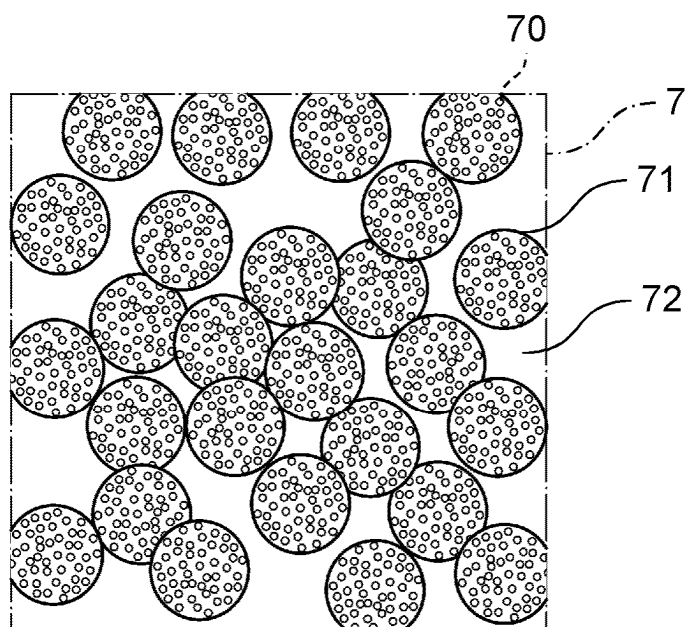


FIG. 5

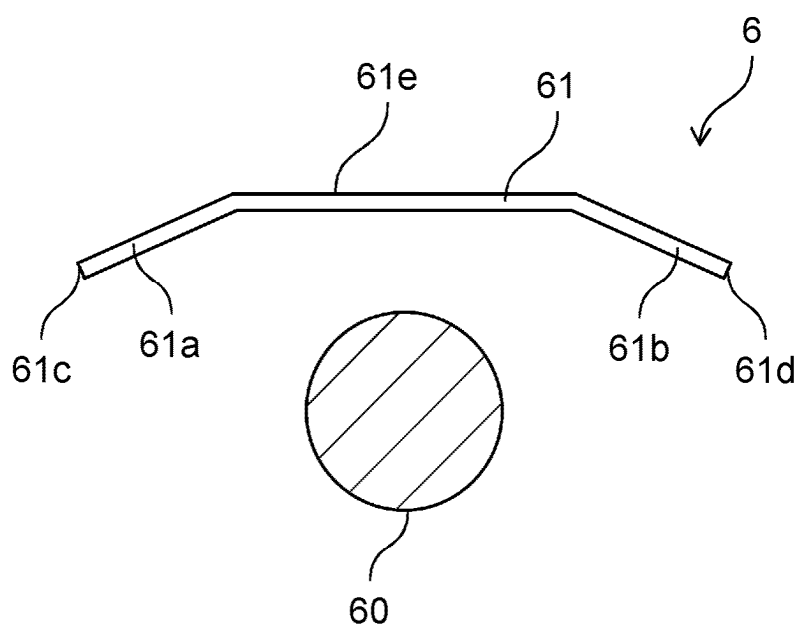


FIG. 6A

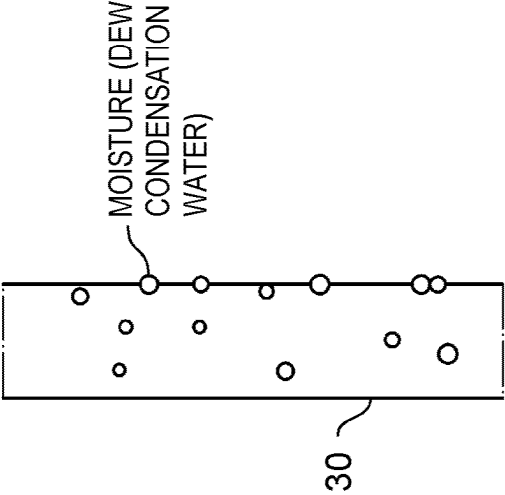


FIG. 6B

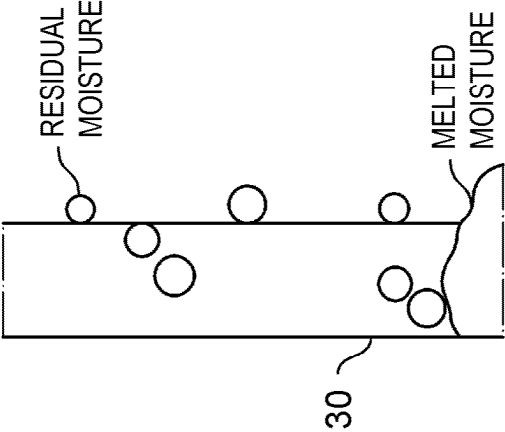


FIG. 6C

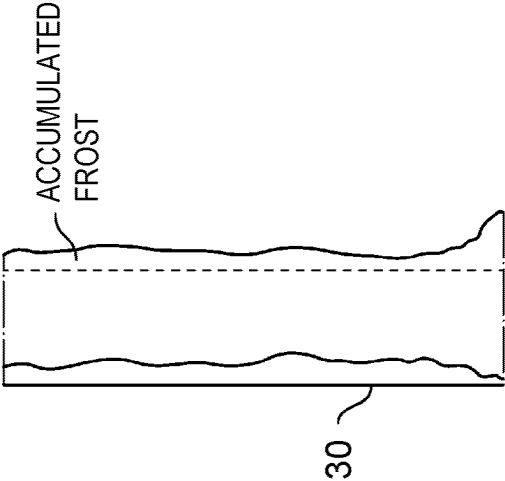


FIG. 7A

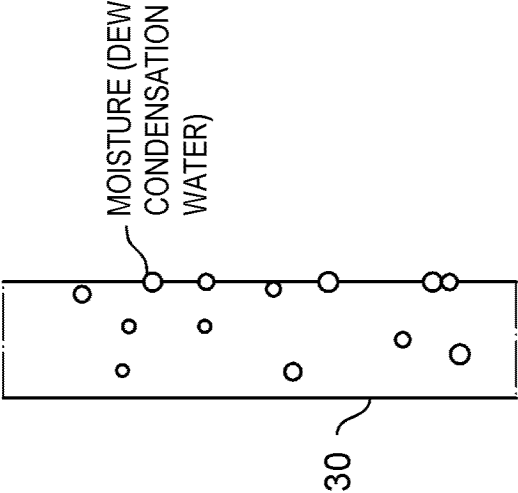


FIG. 7B

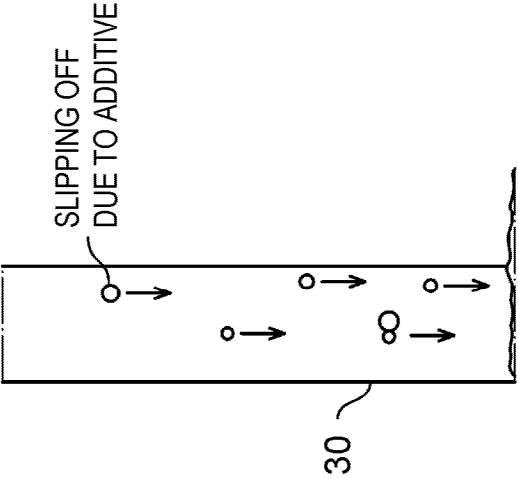


FIG. 7C

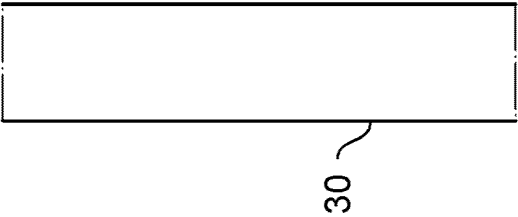


FIG. 8

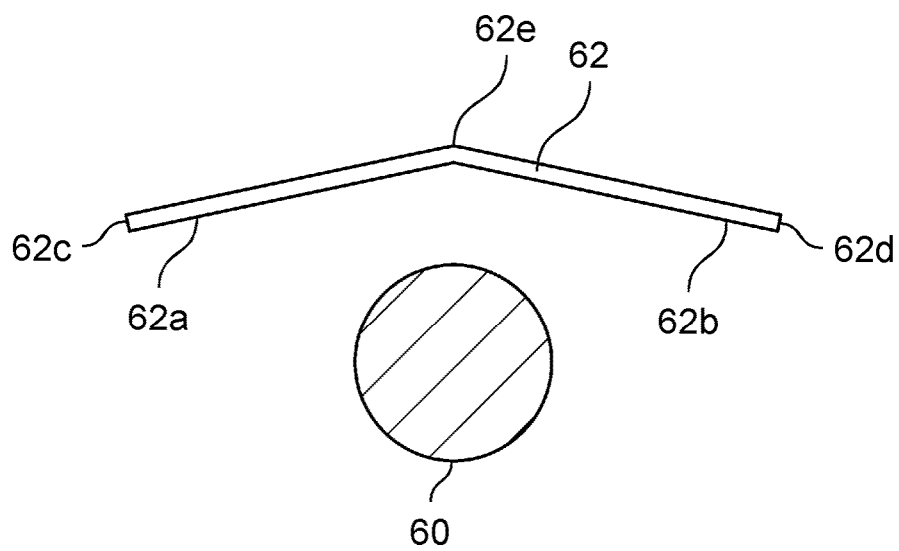


FIG. 9

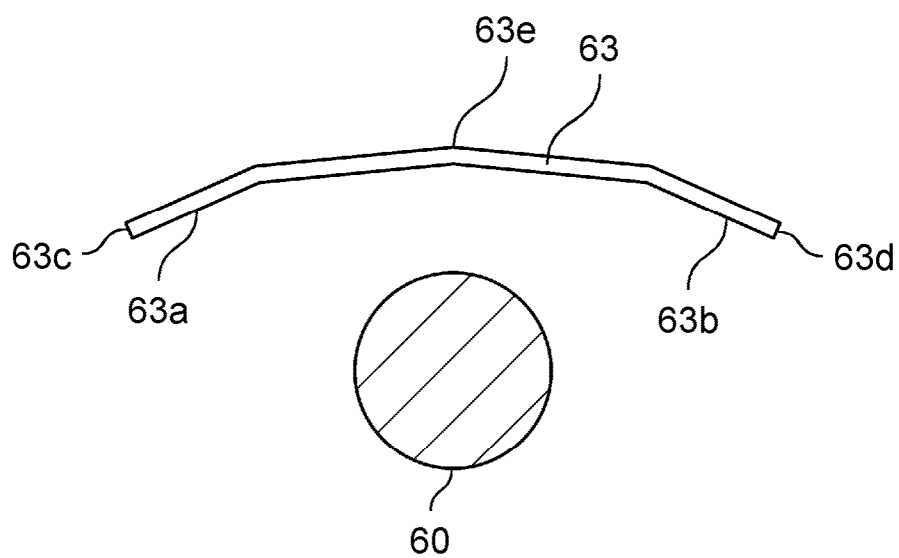


FIG. 10

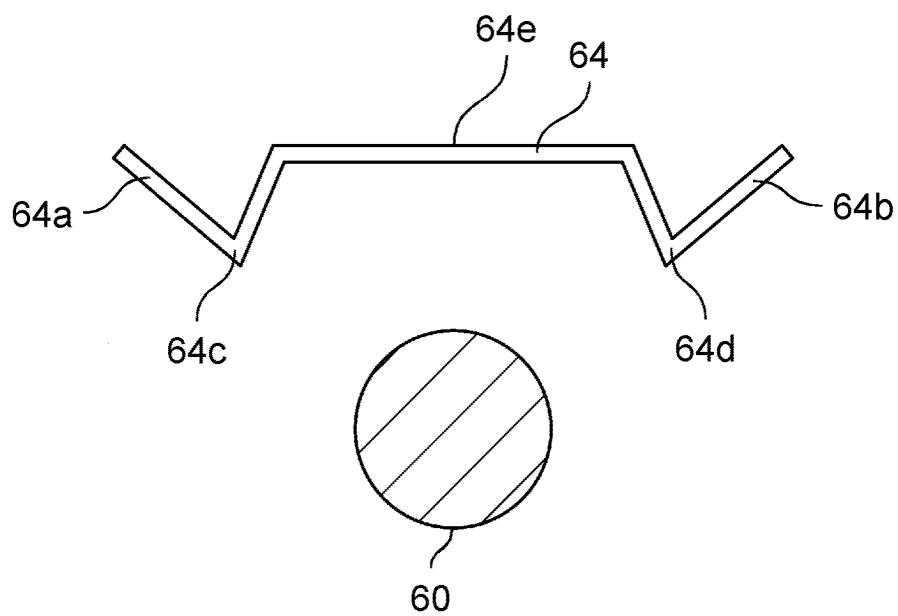


FIG. 11

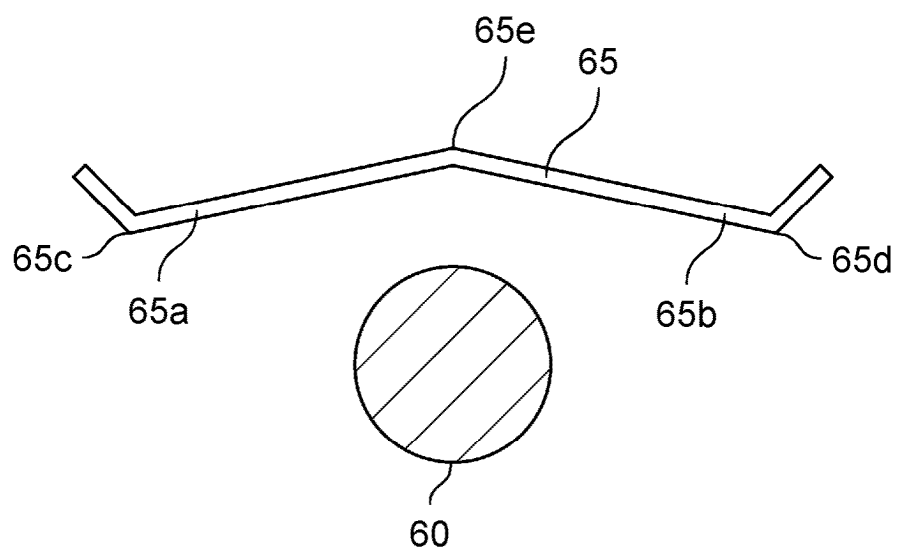


FIG. 12

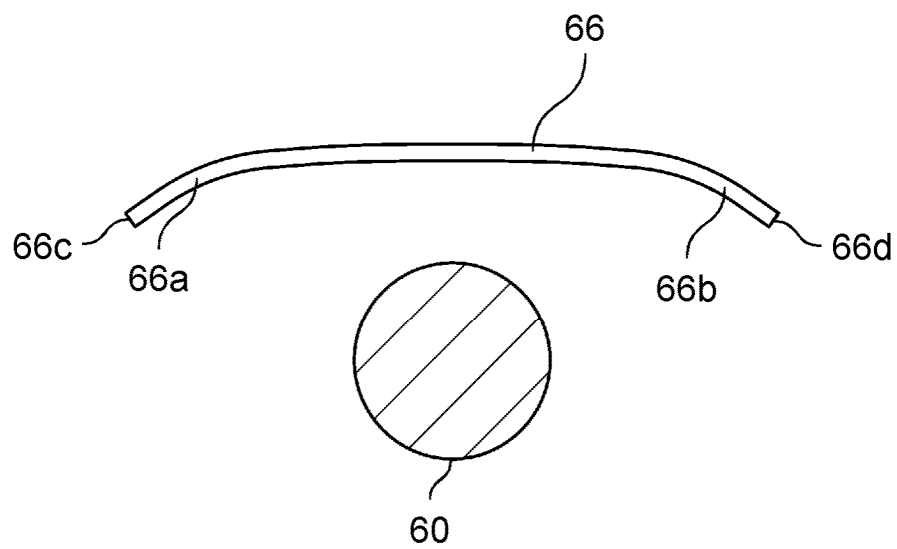


FIG. 13

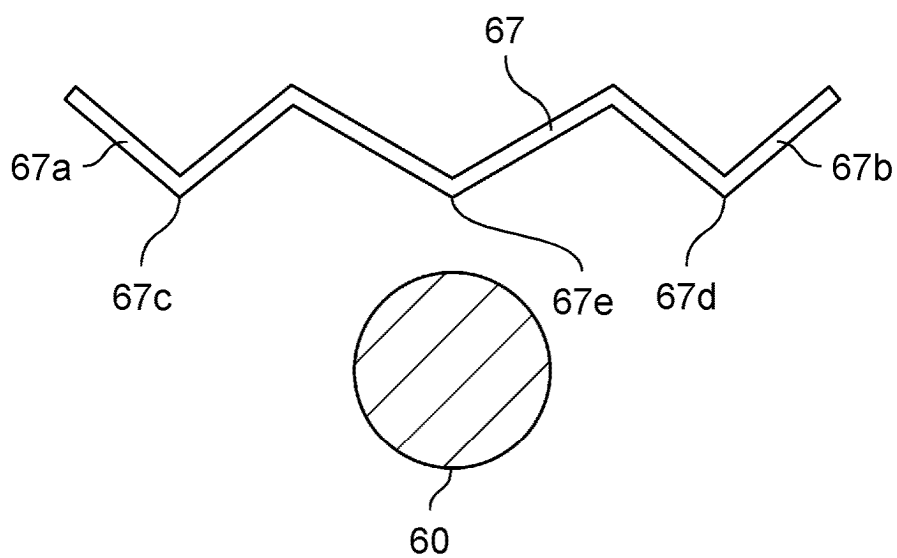
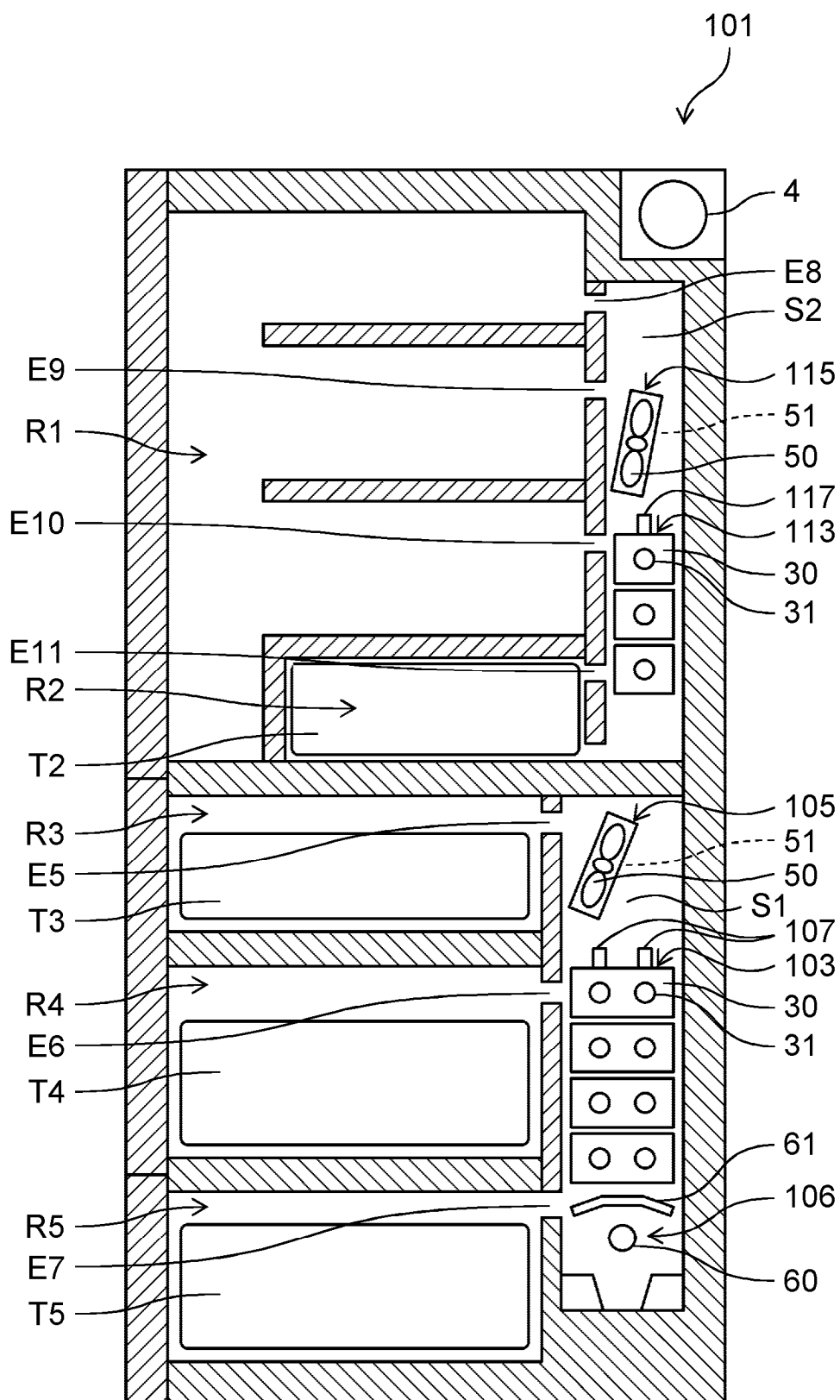


FIG. 14



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2024/003942

A. CLASSIFICATION OF SUBJECT MATTER

F25D 21/14(2006.01)i; **F25B 39/02**(2006.01)i; **F25D 21/04**(2006.01)i; **F25D 21/08**(2006.01)i; **F28F 17/00**(2006.01)i
FI: F25D21/14 Z; F25B39/02 J; F25B39/02 V; F25D21/04 D; F25D21/08 E; F28F17/00 501A

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)

F25D21/00-21/14; F25B39/02; F25B47/00-47/02; F28F17/00; F24F11/41-11/43

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

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2024
Registered utility model specifications of Japan 1996-2024
Published registered utility model applications of Japan 1994-2024

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2020/166308 A1 (PANASONIC INTELLECTUAL PROPERTY MANAGEMENT CO., LTD.) 20 August 2020 (2020-08-20) paragraphs [0036]-[0043], [0064], fig. 1-2	1-3, 6-12
Y	JP 2022-067041 A (PANASONIC INTELLECTUAL PROPERTY MANAGEMENT CO., LTD.) 02 May 2022 (2022-05-02) paragraphs [0022]-[0032], [0041], fig. 1-3	1-3, 6-12
A		4-5
Y	JP 9-105575 A (SHARP KABUSHIKI KAISHA) 22 April 1997 (1997-04-22) paragraphs [0017], [0025]-[0028], fig. 1-10	6-12

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

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“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

27 March 2024

Date of mailing of the international search report

09 April 2024

Name and mailing address of the ISA/JP

**Japan Patent Office (ISA/JP)
3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915
Japan**

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2024/003942

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Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
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