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(54) **ICE MAKER**

(57) An ice maker (1) is provided which may make ice efficiently with a simple structure and is easy to disassemble from and assemble to a refrigerator. An ice maker (1) disposed inside a refrigerator (100) is provided, including: a cooling part (50) having a cooling pipe (40) where cold air passing through an evaporator (140) of the refrigerator flows, a heat sink (10) disposed in the cooling pipe (40) and having a plurality of cooling fins (12), and a metal plate (20) mounted to allow a metal rod-like member (24) to extend downwards from a base end portion to a tip portion, the rod-like member (24) being cooled by the heat sink (10); and a liquid container (60) capable of storing liquid, a predetermined region of the rod-like member (24) from the tip portion being immersed in the liquid contained in the liquid container (60), and ice being generated around the rod-like member (24) cooled by the heat sink (10).

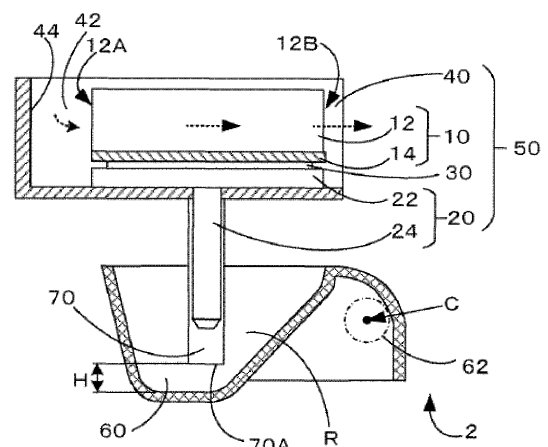


Fig.4

Description

TECHNICAL FIELD

[0001] The present invention relates to an ice maker freezing liquid to produce ice, and in particular, to an ice maker disposed inside a refrigerator.

BACKGROUND

[0002] Among ice makers freezing liquid to produce ice, an ice maker is proposed in which a cooling protrusion is cooled using a refrigerant of a cooling system of a refrigerator, and the cooling protrusion is immersed in liquid in a tray to make ice (for example, refer to patent document 1-Japanese publication No. 2004-150785). In the invention described in patent document 1, the ice may be made efficiently due to production of the ice around the cooling protrusion immersed in the liquid in the tray.

[0003] However, since the ice maker described in patent document 1 is required to be connected with piping of the cooling system of the refrigerator, a structure becomes complicated, and the ice maker cannot be easily disassembled and assembled.

SUMMARY

[0004] Therefore, an object of the present invention is to solve the above problem and provide an ice maker which may make ice efficiently with a simple structure and is easy to disassemble from and assemble to a refrigerator.

[0005] The ice maker according to the present invention is configured as an ice maker disposed inside a refrigerator, the ice maker includes a cooling part and a liquid container for storing liquid, and the cooling part includes:

a cooling pipe through which cold air passing through an evaporator of the refrigerator flows;
a heat sink having a plurality of cooling fins disposed in the cooling pipe; and
a metal plate connected with a rod-like member made of metal, the rod-like member extending from a base end portion downwards to a tip portion; wherein the rod-like member is cooled by the heat sink,
a predetermined region of the rod-like member from the tip portion is immersed in the liquid contained in the liquid container, and ice is generated around the rod-like member due to cooling by the heat sink.

[0006] According to the present invention, the heat sink with the cooling fins may be cooled using the cold air passing through the evaporator of the refrigerator, thereby generating the ice around the rod-like member cooled by the heat sink. Therefore, the ice may be produced

efficiently while a simple structure is realized. Furthermore, since the ice maker is not connected with the piping, or the like, of the refrigerator, the ice maker may be easily disassembled and assembled.

[0007] Furthermore, in the present invention, the cold air flowing into the cooling pipe flows in a direction intersecting with an extending direction of the cooling fin along an inner wall of the cooling pipe on a side of one end portion of the cooling fin, and meanwhile, part of the cold air flows between the cooling fins.

[0008] According to the present invention, the cold air flows in the direction intersecting with the extending direction of the cooling fin along the inner wall of the cooling pipe on the side of one end portion of the cooling fin, and meanwhile, part of the cold air flows between the cooling fins. Thus, the cold air may evenly flow into the cooling fins, so as to equally cool the whole heat sink. Therefore, the metal plate cooled by the heat sink is also equally cooled, such that cooling temperatures of the rod-like members may be consistent. According to the above description, the ice generated around the rod-like members may have consistent sizes.

[0009] The flow direction of the cold air and the extending direction of the cooling fin which intersect with each other may be roughly orthogonal or have other angles.

[0010] Furthermore, in the present invention, the cold air flowing between the cooling fins flows from the other end portion of the cooling fin to an interior of the refrigerator.

[0011] According to the present invention, the cold air flowing between the cooling fins to cool the heat sink flows inside the refrigerator, so as to cool food, or the like, stored inside the refrigerator and meanwhile return to a lower side of the evaporator. Thus, efficient ice making by the ice maker and an efficient cooling cycle of the refrigerator may be realized.

[0012] Furthermore, the ice maker according to the present invention includes:

a liquid supply portion for supplying liquid to the liquid container;
a liquid removing portion for removing at least a part of the liquid remaining in the liquid container from the liquid container; and
a control portion for controlling the liquid supply portion and the liquid removing portion, wherein with control of the control portion, an ice making process is repeated many times, and the ice making process includes:

a liquid supply procedure of supplying liquid to the liquid container by the liquid supply portion; after the liquid supply procedure, maintaining an ice making procedure within a preset time, in which the rod-like member is cooled by the heat sink, and the predetermined region of the rod-like member from the tip portion is immersed in the liquid stored in the liquid container; and

a liquid removing procedure of removing liquid around the generated ice by the liquid removing portion after the ice making procedure.

[0013] According to the present invention, the ice making process including the liquid supply procedure, the ice making procedure and the liquid removing procedure is repeated many times, such that transparent ice frozen by frequently and newly supplied liquid with fewer impurities may be produced in a short time.

[0014] Furthermore, the ice maker according to the present invention further includes:

a heater in contact with the metal plate; and
a moving mechanism for moving the cooling part and the liquid container relatively, and
with the control of the control portion,
after the ice making process is repeated many times, the following procedures are performed:

a moving procedure of moving, by the moving mechanism, the cooling part and the liquid container relatively, such that the liquid container is not located at a lower side of the rod-like member; and
an ice release procedure of heating, by the heater, the metal plate to release the ice generated around the rod-like member from the rod-like member.

[0015] According to the present invention, when the liquid container is not located on the lower side of the rod-like member, a temperature of the rod-like member may be rapidly increased by the heater to release the ice. Thus, a short ice making cycle may be realized reliably.

Effects of invention

[0016] As mentioned above, the present invention may provide the ice maker which may make the ice efficiently with the simple structure and is easy to disassemble from and assemble to the refrigerator.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

FIG 1 is a perspective exploded view of an ice maker according to an embodiment of the present invention.

FIG 2 is a perspective view of an ice maker according to an embodiment of the present invention.

FIG 3 is a planar view of an ice maker according to an embodiment of the present invention.

FIG 4 is a sectional view taken along A-A of FIG 3, particularly a side sectional view schematically showing a configuration of a cooling part, a liquid

container and a liquid supply and removal pipe.

FIG 5 is a block diagram showing a control structure of an ice maker according to an embodiment of the present invention.

FIG 6 is a side sectional view schematically showing a refrigerator including an ice maker according to an embodiment of the present invention.

FIGS. 7(a) and 7(b) are planar views schematically showing variants of a configuration of a heat sink 10 in a cooling pipe 40.

FIG 8A is a side sectional view schematically showing a liquid supply procedure implemented by an ice maker according to an embodiment of the present invention.

FIG 8B is a side sectional view schematically showing an ice making procedure implemented by an ice maker according to an embodiment of the present invention.

FIG 8C is a side sectional view schematically showing a liquid removing procedure implemented by an ice maker according to an embodiment of the present invention.

FIG 8D is a side sectional view schematically showing an escape procedure implemented by an ice maker according to an embodiment of the present invention.

FIG 8E is a side sectional view schematically showing an ice release procedure implemented by an ice maker according to an embodiment of the present invention.

FIG 9 is an exemplary flow chart showing control processing of an ice making process shown in FIGS. 8A to 8E.

FIGS. 10(a) and 10(b) are images (photos) showing ice produced by a trial ice maker.

DETAILED DESCRIPTION

[0018] Embodiments for implementing the present invention are described below with reference to accompanying drawings. Furthermore, an ice maker and a refrigerator described below are used to embody the technical idea of the present invention, and the invention will not be limited to the following content as long as there is no specific description. In the drawings, members with the same functions are sometimes marked with the same symbols. In order to clarify the description, the sizes, positional relationships, or the like, of the members shown in each drawing are sometimes shown in an exaggerated manner. In the following description and drawings, an up-down direction is envisaged to be shown in a case where the ice maker and the refrigerator are arranged on a horizontal plane.

(Ice maker according to embodiment)

[0019] FIG 1 is a perspective exploded view of an ice maker according to an embodiment of the present inven-

tion. FIG 2 is a perspective view of an ice maker according to an embodiment of the present invention. FIG 3 is a planar view of an ice maker according to an embodiment of the present invention. FIG 4 is a sectional view taken along A-A of FIG 3, particularly a side sectional view schematically showing a configuration of a cooling part, a liquid container and a liquid supply and removal pipe. FIG 5 is a block diagram showing a control structure of an ice maker according to an embodiment of the present invention. FIG 6 is a side sectional view schematically showing a refrigerator including an ice maker according to an embodiment of the present invention.

[0020] First, an overview of the ice maker 2 according to an embodiment of the present invention will be described with reference to FIGS. 1 to 6.

[0021] The ice maker 2 includes: the cooling part 50 which may freeze liquid to generate ice, the liquid container 60 which may store liquid, a moving mechanism 80 which rotates and moves the liquid container 60, a liquid supply portion 72 which supplies liquid to the liquid container 50, and a liquid removing portion 74 which removes the liquid in the liquid container 60. FIGS. 1 to 4 show the liquid supply and removal pipe 70 which actually supplies liquid to and removes liquid from the liquid container 60. The liquid supply and removal pipe 70 is a member which realizes functions of both the liquid supply portion 72 and the liquid removing portion 74.

[0022] As an example shown in FIG 6, the ice maker 2 according to the present embodiment is disposed inside the refrigerator 100 and supplied with cold air generated by a cooling system 150 of the refrigerator 100. The ice maker 2 further includes a control portion 90 which controls structural apparatuses of the ice maker 2 (refer to FIG 5). Any liquid including drinking water may be used as the liquid frozen to produce the ice.

<Cooling part>

[0023] The cooling part 50 includes a heat sink 10, a Peltier element 30 and a metal plate 20 in sequence from an upper side to a lower side. Further, the cooling part 50 is further equipped with a cooling pipe 40, the heat sink 10 is arranged in the cooling pipe 40, and the heat sink 10 is cooled by the cold air flowing in the cooling pipe 40.

[0024] The heat sink 10 has a structure in which a plurality of cooling fins 12 are vertically arranged on a base plate 14, and the plurality of cooling fins 12 are arranged at predetermined intervals, and are roughly parallel to each other. In the metal plate 20, a plurality of rod-like members 24 are connected to a lower side surface of a plate-shaped base 22. The Peltier element 30 is disposed between the heat sink 10 and the metal plate 20, and has an upper surface in contact with a lower surface of the heat sink (base plate 14) 10, and a lower surface in contact with an upper surface of the metal plate (base 22).

[0025] As described later, the cold air generated by the cooling system 150 of the refrigerator 100 flows in the

cooling pipe 40 and flows between the cooling fins 12 of the heat sink 10 disposed in the cooling pipe 40, thus cooling the heat sink 10. With heat conduction, the cooled heat sink 10 cools the metal plate 20 via the Peltier element 30, and the rod-like member 24 of the metal plate 20 is cooled to a temperature below a freezing point. At this point, when a part of the rod-like member 24 is immersed in the liquid contained in the liquid container 60, ice is generated around the rod-like member 24.

[0026] A side of the Peltier element 30 in contact with the metal plate 20 serves as a heat release side, such that the metal plate 20 may be heated to separate the ice generated around the rod-like member 24 from the rod-like member 24. That is, the metal plate 20 may function as a heater. On the other hand, the side in contact with the metal plate 20 serves as a heat absorption side, and thus, in addition to cooling by the heat sink 10, the metal plate 20 is cooled by the Peltier element 30, thus further reducing the temperature of the rod-like member 24 of the metal plate 20.

[Heat sink]

[0027] The heat sink 10 is made of metal with a high thermal conductivity, such as aluminum and copper. The base plate 14 is configured as a plate-shaped member with a roughly rectangular planar shape. The cooling fin 12 is also configured as a plate-shaped member with a roughly rectangular planar shape. The cooling fins 12 are vertically arranged roughly perpendicular to the base plate 14, and are roughly parallel to each other. Therefore, the plurality of cooling fins 12 have a roughly rectangular planar shape.

[Metal plate]

[0028] The metal plate 20 is made of metal with a high thermal conductivity, such as aluminum and copper. The metal plate 20 has the flat-plate-shaped base 22 and the plurality of metal rod-like members 24 mounted to the base 22. The rod-like member 24 is mounted on a lower surface of the base 22, so as to extend downwards from a base end portion to a tip portion.

[0029] FIG 1 shows a case where six rod-like members 24 are mounted in the base 22. The rod-like member 24 has a circular section shape which may be exemplified to have an outer diameter of about 5-20mm and a length of about 30-80mm. The planar shape of the base 22 is determined by a size of the rod-like member 24 and a number of the mounted rod-like members. The heat sink 10 also has an almost same planar shape as the base 22 of the metal plate 20. As planar sizes of the heat sink 10 and the base 22 of the metal plate 20, vertical and horizontal sizes may be exemplified to about 40-400mm. A thickness of the base 22 may be exemplified to about 2-10mm.

[0030] An external thread is provided on the base end portion side of the rod-like member 24 of the metal plate

20 in the present embodiment, and is in threaded connection with an internal thread formed in a hole portion provided in the base 22. With such a structure, the rod-like member 24 may be easily replaced and mounted. The rod-like member 24 in the present embodiment has the circular section shape, but the present invention is not limited thereto, and the rod-like member may be substituted by a rod-like member having a section of a polygonal shape, a star shape, a heart shape, or any shape. Furthermore, the rod-like member 24 may also be joined with the base 22 by welding or soldering. A solid rod-like member 24 is preferred in view of a cooling effect of the rod-like member 24, but a hollow rod-like member 24 may also be adopted in view of machinability, or the like.

[Peltier element]

[0031] The Peltier element 30 is configured as an element utilizing a Peltier effect, and the Peltier effect means that when two different kinds of metal or semiconductors are joined and a current flows, absorption/release of heat occurs at the junction. When the current is applied to the Peltier element 30 in a predetermined direction, one surface becomes the heat absorption side and the other surface becomes the heat release side. Then, when the current is applied to the Peltier element 30 in an opposite direction, the surface becoming the heat absorption side and the surface becoming the heat release side are reversed. In the present embodiment, any known Peltier element may be used.

[0032] A width and a depth of the Peltier element 30 in the present embodiment may be exemplified to about 20-100mm, and a thickness thereof may be exemplified to about 2-20mm. Plural Peltier elements 30 may also be disposed according to a size of the heat sink 10 or the metal plate 20. The present embodiment shows a case where three Peltier elements 30 are disposed between the heat sink 10 and the metal plate 20.

[0033] However, the present invention is not limited to the case where the Peltier element 30 is used as a heater, and a heater only having a function of heating the rod-like member 24 to release the ice may also be used. Such a heater may be exemplified as a wire heater, a positive temperature coefficient (PTC) heater, or a ceramic heater. In the case of using such a heater, the heater may be provided between the metal plate 20 and the heat sink 10, and the heater may also be provided on a lower surface side of the metal plate 20.

[Fixed structure of heat sink, Peltier element and metal plate]

[0034] The following fixed structure is provided: two surfaces of the Peltier element 30 are closely attached to the lower surface of the heat sink 10 and the upper surface of the metal plate 20. For example, the heat sink 10 and the metal plate 20 configured to clamp the Peltier element 30 may be fixed to each other using connecting

members, such as a bolt and a nut. A bolt shaft of the bolt is subjected to tensile stress by fastening, such that the lower surface of the heat sink 10 may be closely attached to the upper surface of the Peltier element 30, and the lower surface of the Peltier element 30 may be closely attached to the upper surface of the metal plate 20.

[0035] However, the present invention is not limited to this fixing mode, and any other fixing mode may be used to form the fixing structure of the cooling part 50.

[Cooling pipe]

[0036] The cooling pipe 40 is made of a resin material, for example. The cooling pipe 40 has a bottom surface portion and three side wall portions which are vertically arranged in a manner of surrounding the bottom surface portion, and one side is opened. Furthermore, an inflow opening 40A into which the cold air flows is formed in one side wall portion. The inflow opening 40A has an inflow path in an outward expansion form. A slit-shaped opening is formed in the bottom surface portion of the cooling pipe 40, and through the opening, the rod-like member 24 of the metal plate 20 protrudes downwards from the cooling pipe 40. Then, the heat sink 10, the Peltier element 30 and the base 22 of the metal plate 20 are disposed inside the cooling pipe 40 enclosed by the three side wall portions.

[0037] Four circular holes are further formed in the bottom surface portion of the cooling pipe 40, a pin 46 with a head is inserted into the hole from a lower side, and a tip portion of the pin 46 is mounted on the refrigerator 100 side. Thus, the cooling part 50 may be integrally mounted in the refrigerator 100. The cooling part 50 is not connected with the refrigerator 100 side through piping, or the like, and therefore, the cooling part 50 may be easily mounted to and removed from the refrigerator 100 by disassembly and assembly of the pin 46.

[0038] Next, flow of the cold air in the cooling pipe 40 is described with reference to FIGS. 3 and 4. In FIGS. 3 and 4, the flow of the air is schematically shown with the dotted arrow. The cold air passing through an evaporator 140 of the cooling system 150 of the refrigerator 100 flows into the cooling pipe 40 through the inflow opening 40A. A certain distance exists between an end portion 12A of the cooling fin 12 and an inner wall 44 of the cooling pipe 40, so as to form a flow path 42 for the cold air to flow. An extending direction of the flow path 42 is approximately orthogonal to an extending direction of the cooling fin 12. Furthermore, the other end portion 12B of the cooling fin 12 is disposed on the opened side surface of the cooling pipe 40. That is, the other end portion 12B of the cooling fin 12 is opened into the refrigerator 100.

[0039] The cold air flowing into the cooling pipe 40 flows in a direction roughly orthogonal to the extending direction of the cooling fin 12 along the inner wall 44 of the cooling pipe 40 on a side of the end portion 12A of the cooling fin, and meanwhile, part of the cold air flows

between the cooling fins 12. The cold air flowing between the cooling fins 12 flows from the other end portion 12B of the cooling fin 12 to an interior of the refrigerator 100.

[0040] As mentioned above, the cold air passing through the evaporator 140 of the refrigerator 100 enters positions between the cooling fins 12 to cool the heat sink 10, such that the ice may be generated around the rod-like member 24 of the metal plate 20 cooled by the heat sink 10. Therefore, the ice may be produced efficiently while a simple structure is realized. Furthermore, since the ice maker 2 is not connected with the piping, or the like, of the refrigerator 100, the ice maker 2 may be easily disassembled and assembled. Thus, the ice maker 2 which may make the ice efficiently with the simple structure and is easy to disassemble from and assemble to the refrigerator 100 may be provided.

[0041] In particular, since the cold air flows along the inner wall 44 of the cooling pipe 40, and meanwhile, part of the cold air flows between the cooling fins 12, the cold air may evenly flow into the cooling fins 12. Thus, the whole heat sink 10 is cooled equally, and the metal plate 20 cooled by the cooling fin 12 is also equally cooled, such that cooling temperatures of the rod-like members 24 may be consistent. Therefore, the ice generated around the rod-like members 24 may have consistent sizes.

[0042] Furthermore, the cold air flowing between the cooling fins 12 to cool the heat sink 10 flows inside the refrigerator 100, so as to cool food, or the like, stored inside the refrigerator and meanwhile to return to a lower side of the evaporator 140 of the refrigerator 100. Thus, efficient ice making by the ice maker 2 and an efficient cooling cycle of the refrigerator 100 may be realized.

<Liquid container>

[0043] The liquid container 60 is made of a resin material having elasticity, for example. The liquid container 60 has a liquid storage region R enclosed by a bottom surface portion and side wall portions erected from the bottom surface portion. An opening is formed in an upper portion of the liquid storage region R. The rod-like member 24 of the metal plate 20 is inserted into the liquid storage region R through the opening, and a predetermined region of the rod-like member 24 from the tip portion is disposed in the liquid storage region R.

[0044] In the ice maker 2 according to the present embodiment, the metal rod-like member 24 is cooled to a temperature below the freezing point by the heat sink 10, and the heat sink 10 is cooled by the cold air. Since the predetermined region of the rod-like member 24 from the tip portion is disposed within the liquid storage region R of the liquid container 60, the ice may be generated around a part of the rod-like member 24 immersed in the liquid. The predetermined region may be exemplified to be about 8-40mm from the tip portion of the rod-like member 24.

[0045] Further, in the case of including the Peltier ele-

ment 30, cooling is performed by the Peltier element 30 in addition to the heat sink 10, and therefore, the cooling may be performed at a lower temperature, and the ice may be generated around the rod-like member 24 of the metal plate 20 in a short time.

[0046] In the present embodiment, six rod-like members 24 are arranged substantially linearly, and the liquid storage region R is also elongated along the rod-like members. As shown in FIG 4, the bottom surface portion forming a bottom surface of the liquid storage region R and the side wall portion forming a side surface are connected via a smooth curve portion, the opening is formed in the upper portion, and FIG 4 shows a cross portion substantially orthogonal to the extending direction of the liquid storage region R.

[0047] As shown in FIG 4, a shaft portion 62 extending in the extending direction of the liquid storage region R is provided in a region on a lateral side of the liquid storage region R. As shown in FIG 2, one end portion of the shaft portion 62 of the liquid container 60 is connected with a driving shaft of the moving mechanism 80 described later. On the other hand, the other end portion of the shaft portion 62 of the liquid container 60 is supported, in a free rotation manner, at a bearing portion 82 provided on a frame portion 84 of the ice maker 2. With this structure, the liquid container 60 may be rotated about a center point C of the shaft portion 62. That is, the liquid container 60 may be rotated around the point C located in an end region of the liquid container 60 by a driving force of the moving mechanism 80.

<Moving mechanism>

[0048] The moving mechanism 80 is configured to rotate the liquid container 60. When a driving motor of the moving mechanism 80 is started and the driving shaft is rotated, the liquid container 60 is rotated about the point C. The moving mechanism 80 may rotate the liquid container 60 clockwise/counterclockwise by the driving force of the driving motor, for example (refer to the two arrows in FIG 4).

[0049] The position of the liquid container 60 shown in FIG 4 is referred to as an ice making position. In a case where the liquid container 60 is at the ice making position, the opening of the liquid container 60 faces upwards, such that the liquid may be stored in the liquid storage region R, and the predetermined region of the rod-like member 24 of the metal plate 20 from the tip portion is disposed in the liquid storage region R through the opening.

[0050] The moving mechanism 80 may rotate the liquid container 60 from the ice making position around the point C until the liquid container 60 is not located on a lower side of the rod-like member 24 of the metal plate 20 (refer to FIGS. 8C and 8D). The position of the liquid container 60 is referred to as an escape position. A rotation angle of the liquid container 60 between the ice making position and the escape position varies depend-

ing mainly on a positional relationship between the rod-like member 24 of the metal plate 20 and the liquid container 60, and a position of the point C as a rotation center, but a range from 70 degrees to 120 degrees is considered to be proper.

<Liquid supply portion/liquid removing portion>

[0051] In the present embodiment, there exists a mechanism serving as both the liquid supply portion 72 and the liquid removing portion 74, the liquid supply portion 72 supplies liquid to the liquid container 60, and the liquid removing portion 74 discharges liquid from the liquid container 60. The mechanism serving as both the liquid supply portion 72 and the liquid removing portion 74 mainly includes a storage container for storing liquid, a liquid supply and removal pump which may reverse a suction direction and a discharge direction, a liquid supply and removal pipe 70, and a liquid supply and removal flow path connecting the storage container, the liquid supply and removal pump and the liquid supply and removal pipe. By the mechanism serving as both the liquid supply portion 72 and the liquid removing portion 74, a number of components is reduced, and in particular, only the liquid supply and removal pipe 70 is inserted into the liquid container 60, thus saving a space around the liquid container 60.

[0052] The liquid supply and removal pipe 70 is disposed outside the cooling pipe 40 to prevent the liquid flowing in the liquid supply and removal pipe 70 from freezing.

[0053] When the liquid supply and removal pump is driven to a liquid supply side with control of the control portion 90 described later, the liquid in the storage container flows from the liquid supply and removal pump to the liquid supply and removal pipe 70 through the liquid supply and removal flow path, and flows into the liquid container 60 from a front-end opening 70A of the liquid supply and removal pipe 70.

[0054] When the liquid supply and removal pump is driven to a liquid removal side with the control of the control portion 90, the liquid in the liquid container 60 is sucked from the front-end opening 70A of the liquid supply and removal pipe 70, flows in the liquid supply and removal pump through the liquid supply and removal flow path from the liquid supply and removal pipe 70, and flows into the storage container. At this point, preferably, the returned liquid passes through a filter before flowing into the storage container. An increase in a concentration of soluble or insoluble substances in the liquid in the storage container may be suppressed by a filtering function of the filter, thereby producing high-quality ice.

[0055] However, the mechanism serving as both the liquid supply portion 72 and the liquid removing portion 74 is an example, and each liquid supply portion 72 and each liquid removing portion 74 may also be equipped with a separate liquid supply pump and a separate liquid removing pump, as well as a separate liquid supply pipe

and a separate liquid removing pipe.

[0056] In either case, the liquid container 60 may store liquid in the ice making position and have the opening in the upper portion. Therefore, since only a front-end region of the liquid supply and removal pipe 70 (or a liquid supply pipe and a liquid removing pipe) is inserted into the liquid container 60 from an open portion in the upper portion, interference between members may be easily prevented when the liquid container 60 rotates. However, as is evident from FIG 4, the front-end opening 70A of the liquid supply and removal pipe 70 is disposed at a height H from the bottom surface of the liquid container 60, and therefore, even when the liquid supply and removal pump is driven to the liquid removing side, liquid remains in a region with the height H from the bottom surface.

[0057] All the liquid in the liquid container 60 may be assumed to be discharged in a case where a liquid supply and removal opening is provided in a bottom of the liquid container 60. However, the following problem may be generated: when the liquid container 60 is rotated, interference with other members increases, and processing of a liquid supply and removal hose becomes complicated.

(Control portion)

[0058] Next, the control structure of the ice maker 2 according to the present embodiment including the control portion 90 is described with reference to FIG 5.

[0059] The control portion 90 may form a temperature difference between the two surfaces by controlling a direction and a magnitude of the current supplied to the Peltier element 30, such that one surface becomes the heat absorption side and the other surface becomes the heat release side.

[0060] The control portion 90 may rotate the liquid container 60 with driving control of the motor of the moving mechanism 80, so as to rotate the liquid container between the ice making position and the escape position.

[0061] The control portion 90 may control the liquid supply and removal pump functioning as the liquid supply portion 72 to drive the liquid supply and removal pump to the liquid supply side, so as to supply liquid to the liquid container 60. Similarly, the control portion 90 may control the liquid supply and removal pump functioning as the liquid removing portion 74 to drive the liquid supply and removal pump to the liquid removing side, so as to return the liquid in the liquid container 60 to the storage container.

(Refrigerator in embodiment of present invention)

[0062] Next, the refrigerator 100 provided therein with the ice maker 2 according to the present embodiment is described with reference to FIG 6. In FIG 6, the flow of the air is shown by the dotted arrow, and flow of a refrigerant is shown by the single dot and dash arrow.

[0063] The refrigerator 100 includes a freezing chamber 102A and a refrigerating chamber 102B. Inlet side flow paths 104A, 104B partitioned by a partition 106 are provided on back sides of the freezing chamber 102A and the refrigerating chamber 102B. An example shown in FIG 6 shows a case where the ice maker 2 is disposed in the freezing chamber 102A. However, the present invention is not limited thereto, and the ice maker 2 may sometimes be disposed in the refrigerating chamber 102B.

[0064] The evaporator 140 is disposed in the inlet side flow path 104A on the freezing chamber 102A side, and a fan 170 is disposed above the evaporator. A compressor 110 communicated with the evaporator 140 is disposed in a machine chamber outside the back side of the freezing chamber 102A. The following cycle is repeated: the refrigerant (gas) compressed by the compressor 110 is liquefied by a condenser 120, and decompressed when passing through a capillary tube, a boiling point drops, and the refrigerant passes through a dryer 130, and flows into the evaporator 140; then, the refrigerant absorbs heat of the air inside the refrigerator in the evaporator 140 to vaporize, and the vaporized refrigerant is compressed again by the compressor 110. As mentioned above, the cooling system 150 of the refrigerator for communicating the compressor 110, the condenser 120, the dryer 130 and the evaporator 140 is constructed.

[0065] When the compressor 110 and the fan 170 are driven, the air flows, and the cold air passing through the evaporator 140 flows from an opening 106A provided in the partition 106 into the inflow opening 40A of the cooling pipe 40 of the ice maker 2. Along with the opening 106A, a blowing outlet which allows the cold air passing through the evaporator 140 to flow directly into the freezing chamber 102A is provided in the partition 106.

[0066] The cold air flowing into the cooling pipe 40 enters the positions between the cooling fins 12 and flows out of the ice maker 2. The cold air flowing out of the ice maker 2 circulates in the freezing chamber 102A and returns to the lower side of the evaporator 140 in the inlet side flow path 104A again. The flow of the air may cool the food, or the like, stored in the freezing chamber 102A together with the cooling for ice making in the ice maker 2.

(Variant of configuration of heat sink in cooling pipe)

[0067] FIG 7 is a planar view schematically showing a variant of a configuration of the heat sink 10 in the cooling pipe 40. The flow of the air is shown with the dotted arrow. Next, the variant of the configuration of the heat sink 10 in the cooling pipe 40 is described with reference to FIG 7.

[0068] In the above embodiment, the flow path 42 is set to allow a flow direction of the cold air flowing into the cooling pipe 40 to be approximately orthogonal to the extending direction of the cooling fin 12. However, in an example shown in FIG 7(a), the air flows in a direction forming a non-right angle relative to the extending direction of the cooling fin 12. In FIG 7(a), the flow direction

of the cold air flowing into the cooling pipe 40 is changed at an obtuse angle, and the cold air flows between the cooling fins 12. That is, the cold air flowing into the cooling pipe 40 flows in a direction intersecting with the extending direction of the cooling fin 12 along the inner wall 44 of the cooling pipe 40 on a side of the end portion 12A of the cooling fin 12, and meanwhile, part of the cold air flows between the cooling fins 12.

[0069] In an example shown in FIG 7(b), the heat sink 10 is configured to allow the flow direction of the cold air flowing into the cooling pipe 40 to be almost parallel to the extending direction of the cooling fin 12. In this case, preferably, a rectification plate 48 is configured to allow amounts of the cold air flowing to the cooling fins 12 to become equal.

(Control processing)

[0070] FIG 8A is a side sectional view schematically showing a liquid supply procedure implemented by the ice maker 2 according to an embodiment of the present invention, FIG 8B is a side sectional view schematically showing an ice making procedure, FIG 8C is a side sectional view schematically showing a liquid removing procedure, FIG 8D is a side sectional view schematically showing an escape procedure, and FIG 8E is a side sectional view schematically showing an ice release procedure. FIG 9 is a flow chart showing control processing of an ice making process shown in FIGS. 8A to 8E. FIG 9 shows control processing in the case of including the Peltier element 30. Next, the control processing performed by the control portion 90 is described with reference to FIGS. 8A to 8E and 9.

(Ice making process)

[0071] The description is given with the following situation as an example: the liquid container 60 is at the ice making position, and the ice making process starts from an initial state where no liquid is stored in the liquid container 60. FIGS. 8A to 8C show a case where the ice making process is repeated many times with the control of the control portion 90; the ice making process includes the following procedures: a liquid supply procedure of supplying liquid to the liquid container 60 by the liquid supply portion 72; an ice making procedure of maintaining a state where the predetermined region of the rod-like member 24 cooled by the heat sink 10 from the tip portion is immersed in the liquid stored in the liquid container 60 within a specified time after the liquid supply procedure; and a liquid removing procedure of removing liquid around the generated ice by the liquid removing portion 74 after the ice making procedure.

[0072] Furthermore, FIGS. 8D and 8E show the following procedures after the ice making process is repeated many times: a moving procedure of moving, by the moving mechanism 80, the cooling part 50 and the liquid container 60 relatively, such that the liquid container 60 is

not located at the lower side of the rod-like member 24; and an ice release procedure of heating, by the heater (for example, the Peltier element) 30, the metal plate 20 to release the ice generated around the rod-like member 24 from the rod-like member.

<Liquid supply procedure (refer to FIG 8A)>

[0073] The liquid supply portion 72 supplies liquid to the liquid container 60 with the opening in the upper portion at the ice making position. Specifically, with the control of the control portion 90, the driving motor of the liquid supply and removal pump of the liquid supply portion 72 is driven to a liquid supply direction (refer to step S2 in FIG 9). Thus, the liquid supply and removal pump sucks the liquid in the storage container and supplies the liquid to the liquid container 60 through the liquid supply and removal flow path and the liquid supply and removal pipe 70. When a liquid height in the liquid container 60 is determined to reach a specified height based on a signal from a liquid level sensor or timing of a timer, the control portion 90 stops operation of the liquid supply and removal pump. Steps S4 and S6 in FIG 9 show the control processing of stopping the operation of the liquid supply and removal pump when a liquid level reaches a liquid level H for ice making. With the liquid supply procedure, the state where the predetermined region L of the rod-like member 24 of the metal plate 20 from the tip portion is immersed in the liquid in the liquid container 60 is realized.

<Ice making procedure (refer to FIG 8B)>

[0074] After the above liquid supply procedure, the ice making procedure is performed in which the predetermined region L of the rod-like member 24 of the metal plate 20 at an ice making temperature from the tip portion gets into the state of being immersed in the liquid contained in the liquid container 60 within the specified time. Specifically, the heat sink 10 is cooled using the cold air passing through the evaporator 140 of the refrigerator 100, and with the cooling of the heat sink 10, the rod-like member 24 of the metal plate 20 reaches the ice making temperature below the freezing point. Furthermore, when the Peltier element 30 is included, the Peltier element 30 is supplied with power with the control of the control portion 90 to allow a side of the Peltier element 30 in contact with the heat sink 10 to become the heat release side and a side in contact with the metal plate 20 to become the heat absorption side; in this way (refer to step S8 in FIG 9), the ice may be generated around the rod-like member 24 of the metal plate 20 in a short time.

[0075] Then, when the specified time T is determined to elapse by the timing of the timer, the ice making procedure is ended. As shown in FIG 8B, the ice may be generated from a tip of the rod-like member 24 of the metal plate 20 to cover the predetermined region L, such that the ice G covering a surrounding region may be pro-

duced. The specified time T may be set to different values according to whether Peltier element 30 is provided. When the Peltier element 30 is provided, the control portion 90 stops the power supply to the Peltier element 30 (refer to steps S10 and S12 in FIG 9).

<Liquid removing procedure (refer to FIG 8C)>

[0076] After the ice making procedure, the liquid removing portion 74 removes the liquid remaining in the liquid container 60 with the control of the control portion 90. Specifically, the liquid supply and removal pump is driven to a liquid removing direction with the control of the control portion 90 (refer to step S14 in FIG 9). Thus, the liquid supply and removal pump sucks out the liquid in the liquid container 60 through the liquid supply and removal pipe 70 and the liquid supply and removal flow path to return the liquid to the storage container. At this point, the liquid returned to the storage container flows into the storage container after filtered by the filter, and the filter is disposed at a return path inlet of the storage container. Steps S16 and S 18 in FIG 9 show the control processing of stopping the operation of the liquid supply and removal pump when the liquid level reaches a liquid level L when the liquid removal is completed.

[0077] As described above, since the front-end opening 70A of the liquid supply and removal pipe 70 is disposed at the height H from the bottom surface of the liquid container 60, liquid remains at least in the region with the height H from the bottom surface. However, since a position of a lower end of the liquid supply and removal pipe 70 is much lower than a position of a lower end of the rod-like member 24, the liquid around the ice generated around the rod-like member 24 may be removed. Thus, a first ice making process is ended and the liquid supply procedure of a second ice making process is started (refer to the judgment of No in step S20 in FIG 9). In this case, fresh liquid with fewer impurities is loaded around the ice generated around the rod-like member 24 to generate ice on a surface thereof. Therefore, ice with lower turbidity and high transparency may be obtained.

[0078] As mentioned above, the ice making process is repeated many times (N times in the flow chart of FIG 9) by the control portion 90; the ice making process includes the following procedures: the liquid supply procedure of supplying liquid to the liquid container 60 by the liquid supply portion 72; the ice making procedure of maintaining the state where the predetermined region of the rod-like member 24 cooled by the heat sink 10 from the tip portion is immersed in the liquid stored in the liquid container 60 within the specified time after the liquid supply procedure; and the liquid removing procedure of removing liquid around the generated ice by the liquid removing portion 74 after the ice making procedure. The size of the produced ice may be adjusted by adjusting a number of times the ice making process is repeated. Thus, transparent ice frozen by frequently and newly supplied liquid with fewer impurities may be produced in a short time.

<Escape procedure (refer to FIG 8D)>

[0079] When the specified size of ice is generated around the rod-like member 24 after the above ice making process is performed many times, the ice making process is ended and transferred to the escape procedure.

[0080] With the control of the control portion 90, the moving mechanism 80 rotates the liquid container 60 from the ice making position to the escape position where the liquid container 60 is not located on the lower side of the rod-like member 24 of the metal plate 20. By driving by the driving motor of the moving mechanism 80, the liquid container 60 is rotated from the ice making position to the escape position with a range of 70 degrees to 120 degrees (refer to step S22 in FIG 9). With such a rotation angle, even when the generated ice G falls from the rod-like member 24 of the metal plate 20 in the ice release procedure described later, there is no concern about interference with the liquid container 60.

[0081] In a case shown in FIG 8D, the residual liquid in the liquid container 60 may be discharged by a drainage unit 64. The discharged liquid passes through the filter, or the like, such that the liquid may be reused as the liquid supplied to the liquid container 60.

<Ice release procedure (refer to FIG 8E)>

[0082] After the escape procedure, with the control of the control portion 90, the rod-like member 24 of the metal plate 20 is changed to an ice release temperature, and the ice G generated around the rod-like member falls from the rod-like member 24. The falling ice G is stored in an ice storage container 66 disposed below.

[0083] In order to change the rod-like member 24 of the metal plate 20 to the ice release temperature, the Peltier element 30 is powered on when the Peltier element 30 is provided, such that the side in contact with the surface of the heat sink 10 becomes the heat absorption side and the side in contact with the surface of the metal plate 20 becomes the heat release side, thus rapidly increasing the temperature of the rod-like member 24 of the metal plate 20 to the ice release temperature (refer to step S24 in FIG 9). In a case of using a heater other than the Peltier element 30, the temperature of the rod-like member 24 of the metal plate 20 may be increased to the ice release temperature by supplying power to the heater. Steps S26 and S28 in FIG 9 show the control processing of stopping the energization of the Peltier element 30 after a specified time, and the specified time is sufficient for all the generated ice G to fall from the rod-like member 24.

[0084] As mentioned above, the following procedures are performed after the ice making process is repeated many times: the moving procedure of moving, by the moving mechanism 80, the cooling part 50 and the liquid container 60 relatively, such that the liquid container 60 is not present at the lower side of the rod-like member 24; and the ice release procedure of heating, by the heat-

er (for example, the Peltier element), the metal plate 20 to release the ice generated around the rod-like member 24 from the rod-like member 24. Therefore, when the liquid container 60 is not located on the lower side of the rod-like member 24, the temperature of the rod-like member 24 may be rapidly increased by the heater (for example, the Peltier element) 30 to release the ice. Thus, a short ice making cycle may be realized reliably.

10 (Test result)

[0085] Actual trial operation is performed on the ice maker 2 to carry out the above ice making process, such that the ice as shown in (a) and (b) in FIG 10 may be produced. An ice making time in a single ice making procedure is about 1 minute, and after plural ice making processes, as well as the escape and ice release procedures, the ice as shown in FIG 10 may be produced in the required time of about 35 minutes as a whole.

[0086] While the embodiment and implementation form of the present invention are described, the disclosure may vary in details of the structure, and combinations of elements, changes of sequences, or the like, in the embodiment and implementation form may be realized without departing from the claimed scope and idea of the present invention.

Claims

1. An ice maker disposed inside a refrigerator, comprising:

a cooling part and a liquid container for storing liquid;
the cooling part comprising:

a cooling pipe through which cold air passing through an evaporator of the refrigerator flows;

a heat sink having a plurality of cooling fins disposed in the cooling pipe; and

a metal plate connected with a rod-like member made of metal, the rod-like member extending from a base end portion downwards to a tip portion of the metal plate;

wherein the rod-like member is cooled by the heat sink,

a predetermined region of the rod-like member from the tip portion is immersed in the liquid contained in the liquid container, and ice is generated around the rod-like member due to cooling by the heat sink plate.

2. The ice maker according to claim 1, wherein the cold air flowing into the cooling pipe flows in a direction intersecting with an extending direction of the cooling

fin along an inner wall of the cooling pipe on a side of one end portion of the cooling fin, and meanwhile, part of the cold air flows between the cooling fins.

3. The ice maker according to claim 1, wherein the cold air flowing between the cooling fins flows from the other end portion of the cooling fin to an interior of the refrigerator.

4. The ice maker according to claim 1, comprising:

a liquid supply portion for supplying liquid to the liquid container;

a liquid removing portion for removing at least a part of the liquid remaining in the liquid container from the liquid container; and

a control portion for controlling the liquid supply portion and the liquid removing portion, wherein with control of the control portion, an ice making process is repeated many times, and the ice making process comprises:

a liquid supply procedure of supplying liquid to the liquid container by the liquid supply portion;

after the liquid supply procedure, maintaining an ice making procedure within a preset time, in which the rod-like member is cooled by the heat sink, and the predetermined region of the rod-like member from the tip portion is immersed in the liquid stored in the liquid container; and

a liquid removing procedure of removing liquid around the generated ice by the liquid removing portion after the ice making procedure.

5. The ice maker according to claim 4, further comprising:

a heater in contact with the metal plate; and a moving mechanism for moving the cooling part and the liquid container relatively, and wherein with the control of the control portion, after the ice making process is repeated many times, the following procedures are further performed:

a moving procedure of moving, by the moving mechanism, the cooling part and the liquid container relatively, such that the liquid container is not located at a lower side of the rod-like member; and

an ice release procedure of heating, by the heater, the metal plate to release the ice generated around the rod-like member from the rod-like member.

6. The ice maker according to claim 4, wherein a mechanism serving as both the liquid supply portion and the liquid removing portion is provided and comprises a storage container for storing liquid, a liquid supply and removal pump which may reverse a suction direction and a discharge direction, and a liquid supply and removal pipe, and the liquid supply and removal pipe is inserted into the liquid container from an opening in an upper portion of the liquid container.

7. The ice maker according to claim 1, wherein a slit-shaped opening is formed in a bottom surface portion of the cooling pipe, and through the opening, the rod-like member of the metal plate protrudes downwards from the cooling pipe, and the heat sink and a base of the metal plate are disposed inside the cooling pipe enclosed by 3 side wall portions.

8. The ice maker according to claim 1, wherein the cooling pipe has the bottom surface portion and the 3 side wall portions vertically arranged in a manner of surrounding the bottom surface portion, one side wall portion has an opening as an inflow opening of the cold air, a side without the side wall portion serves as an outflow opening of the cold air, and the inflow opening has an inflow path in an outward expansion form.

9. The ice maker according to claim 1, further comprising: a Peltier element disposed between the heat sink and the metal plate, wherein two surfaces of the Peltier element are closely attached to a lower surface of the heat sink and an upper surface of the metal plate, so as to cool the heat sink and raise a temperature of the rod-like member of the metal plate.

10. The ice maker according to claim 5, wherein the liquid container has a liquid storage region; in a region on a lateral side of the liquid storage region, a shaft portion extending along an extending direction of the liquid storage region is provided, one end portion of the shaft portion of the liquid container is connected to a driving shaft of the moving mechanism, the other end portion of the shaft portion of the liquid container is supported at a bearing portion provided at a frame portion of the ice maker in a free rotation manner, and a driving force of the moving mechanism is used to rotate the liquid container.

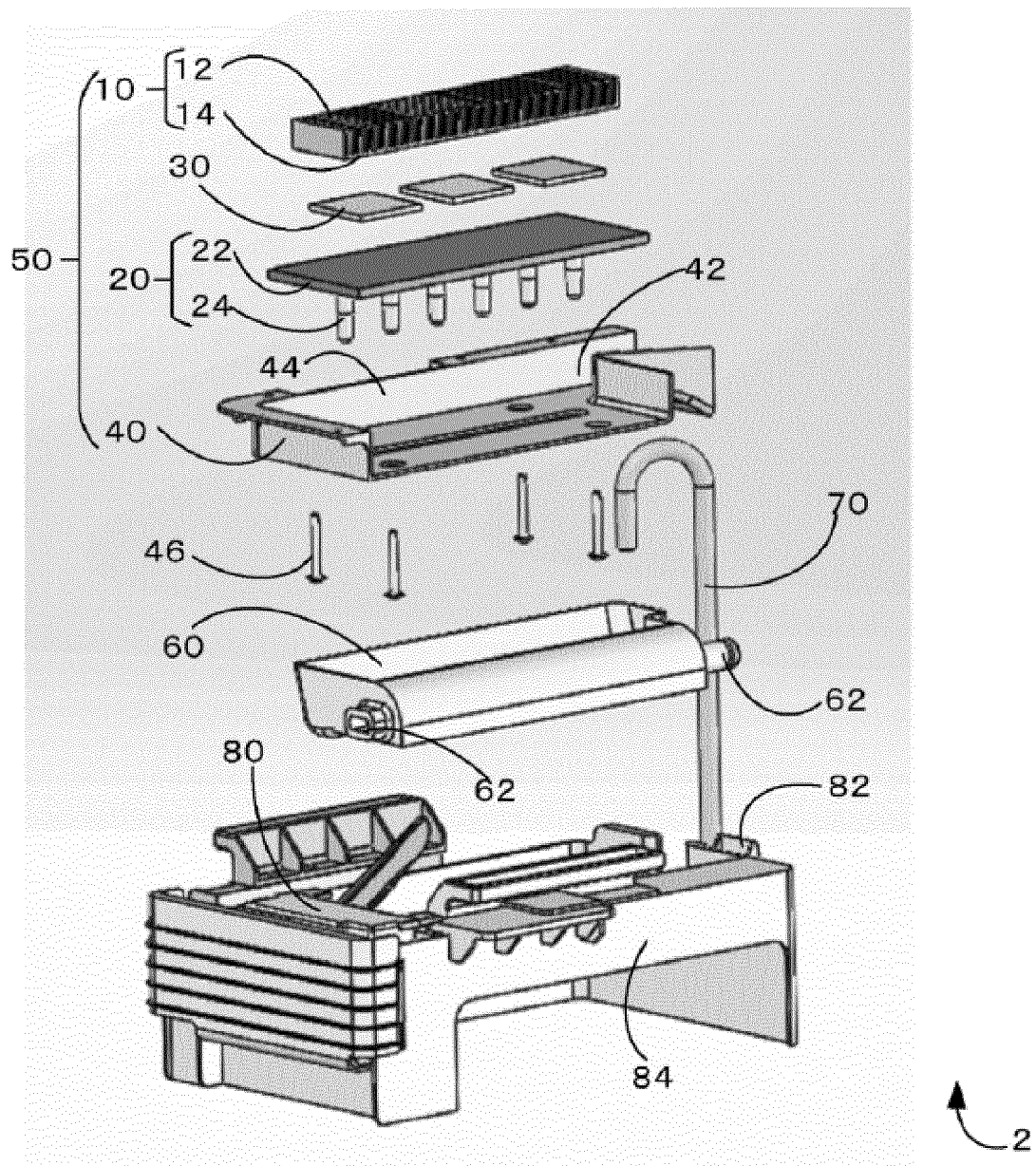


Fig.1

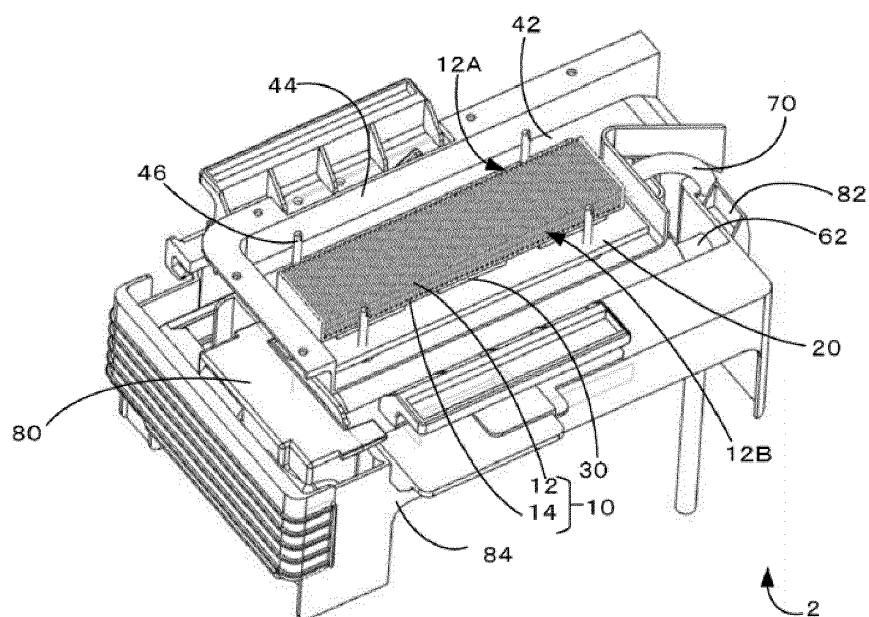


Fig.2

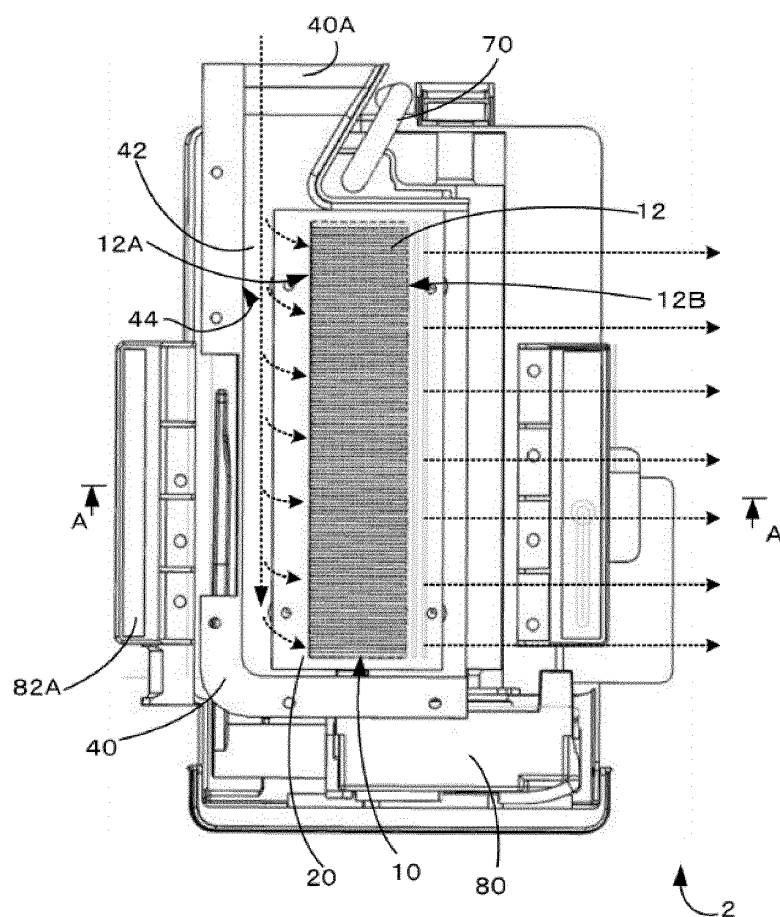


Fig.3

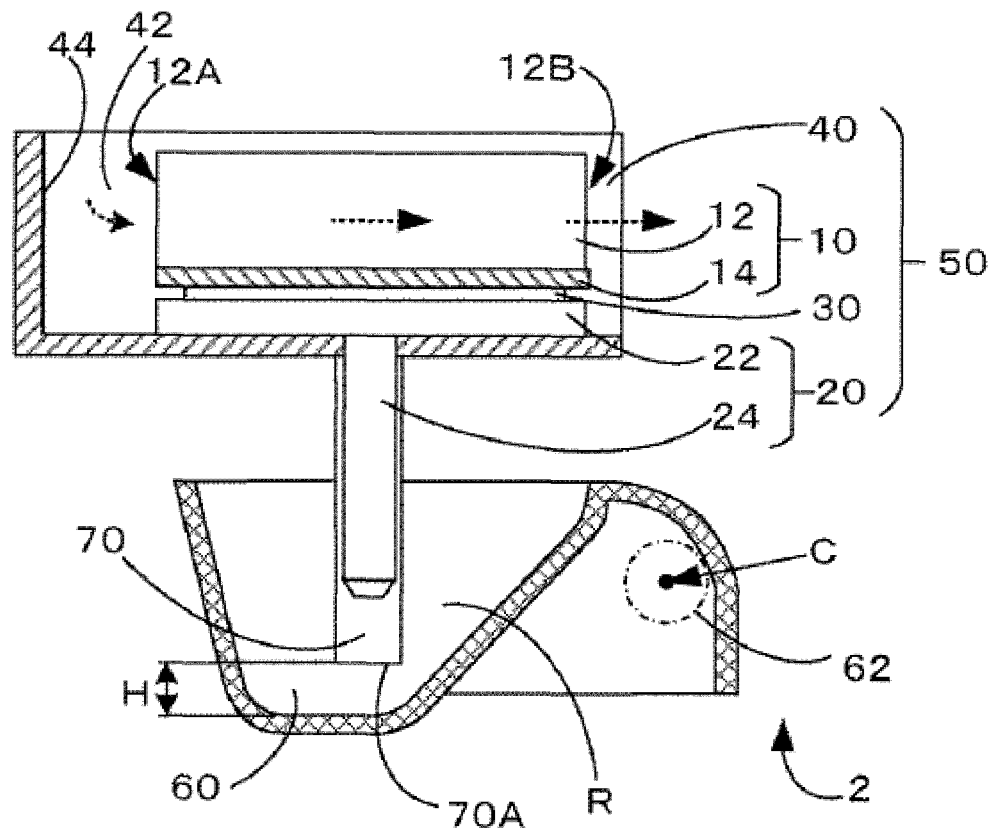


Fig.4

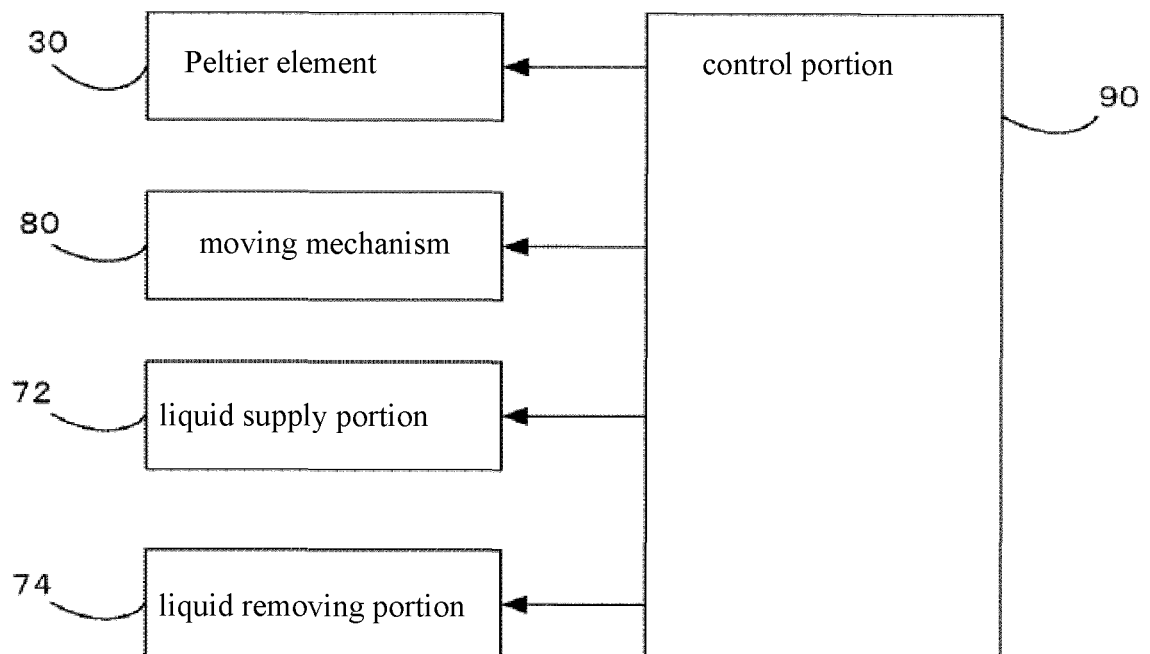


Fig.5

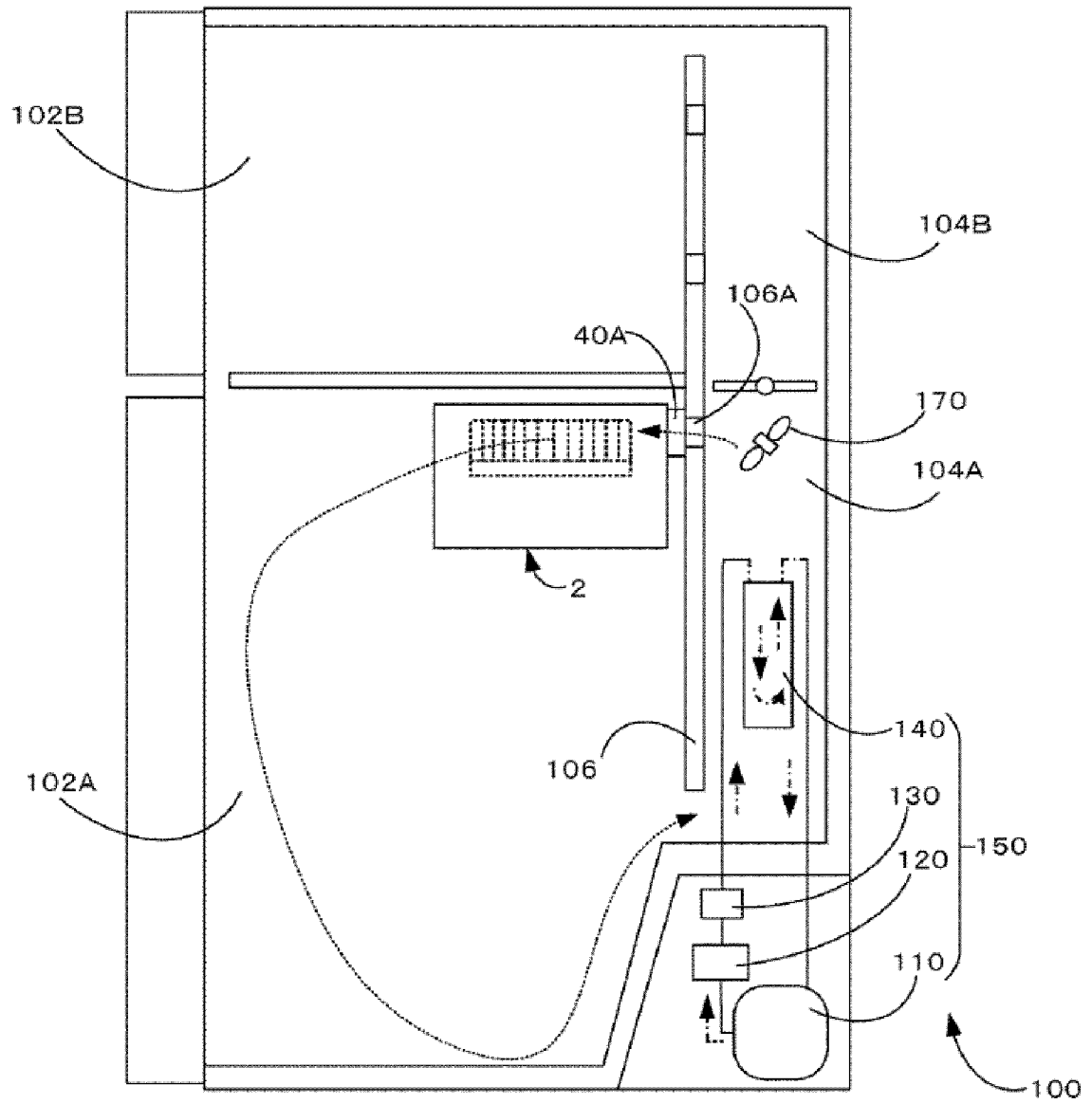


Fig.6

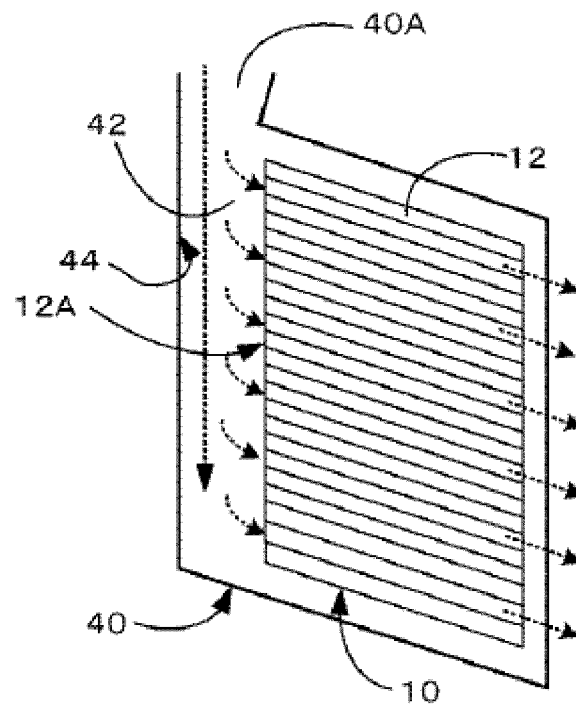


Fig.7 (a)

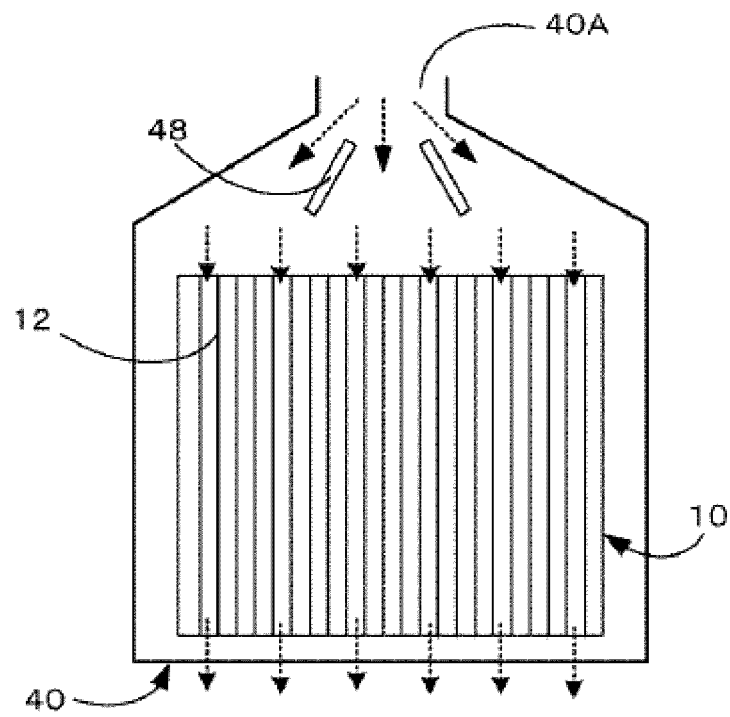


Fig.7 (b)

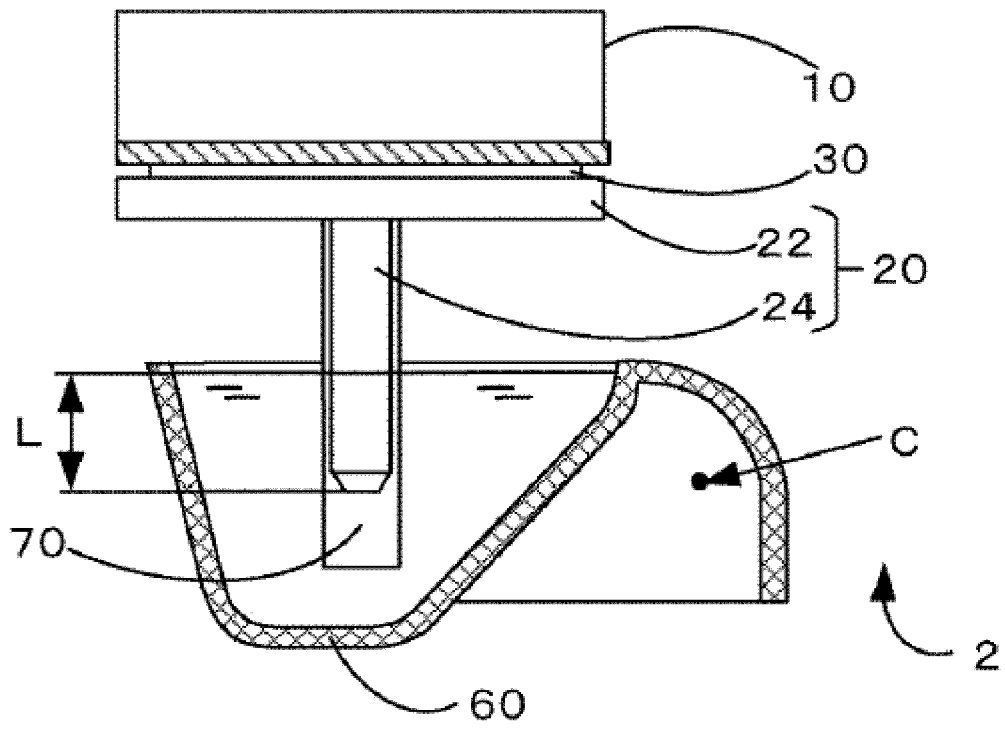


Fig.8A

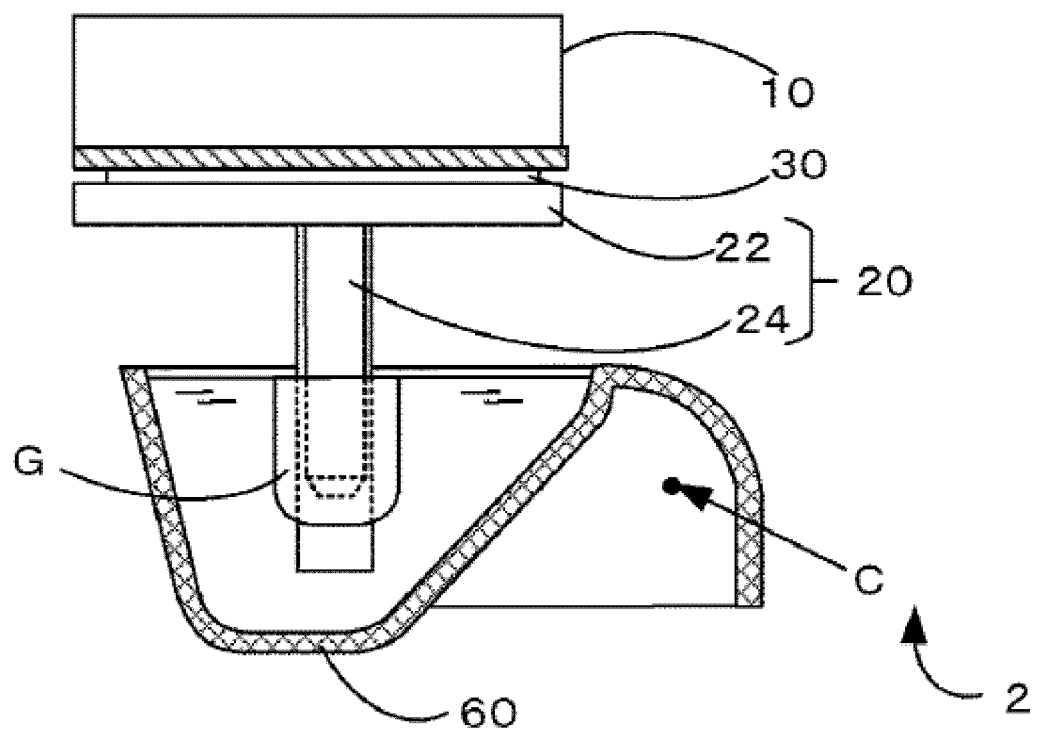


Fig.8B

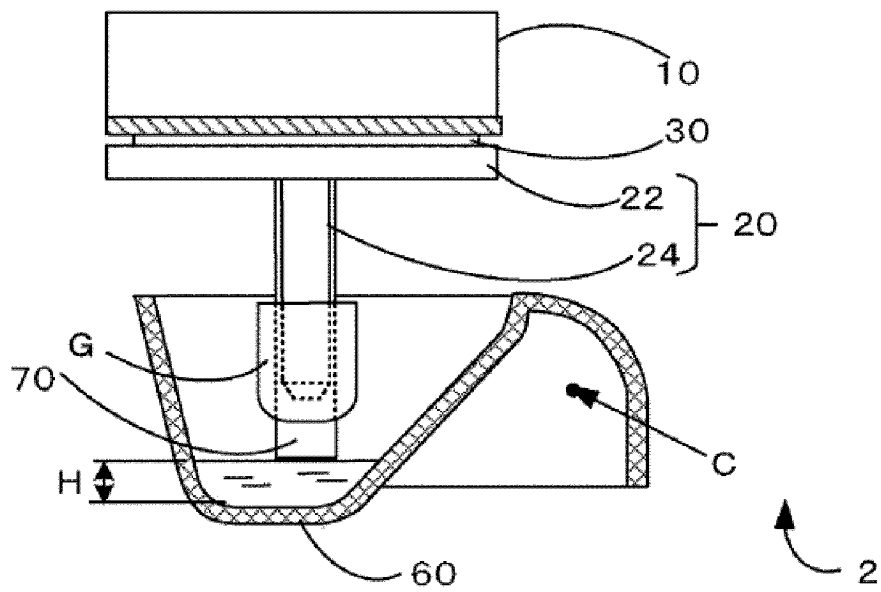


Fig. 8C

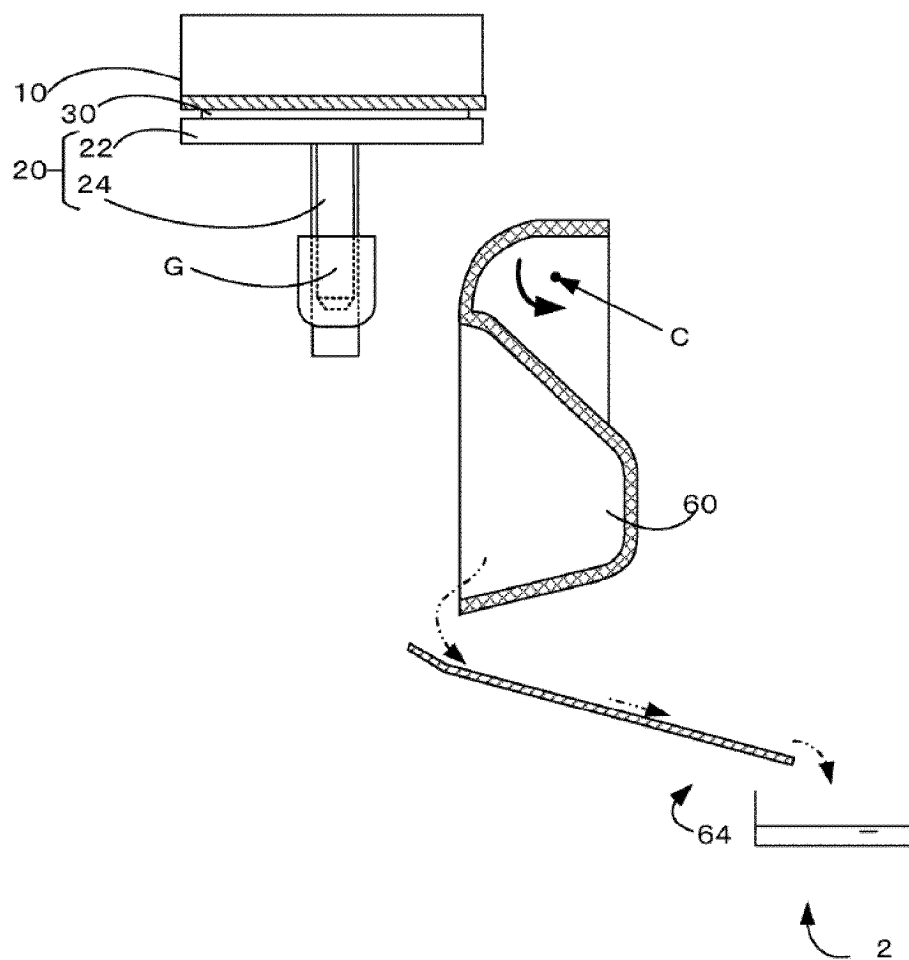


Fig. 8D

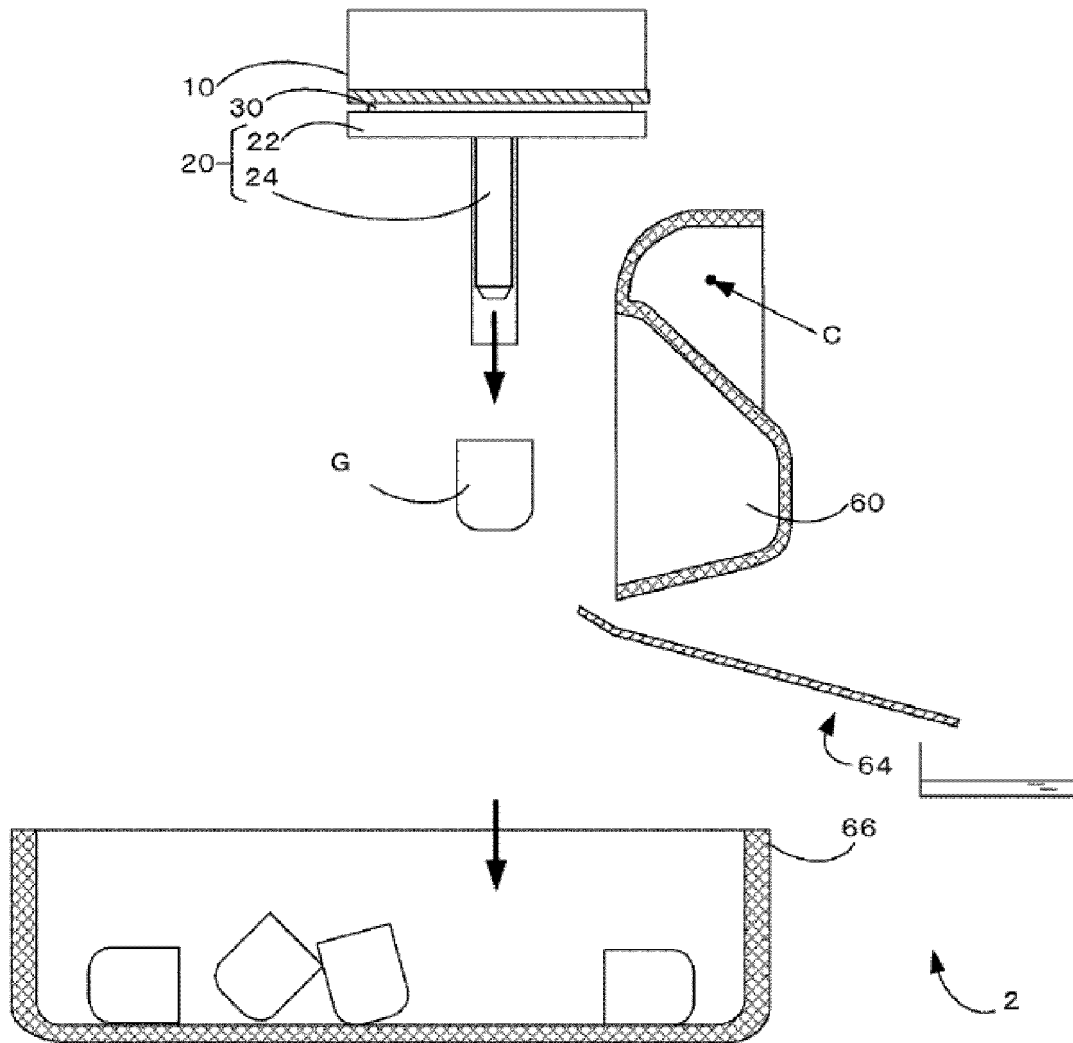


Fig.8E

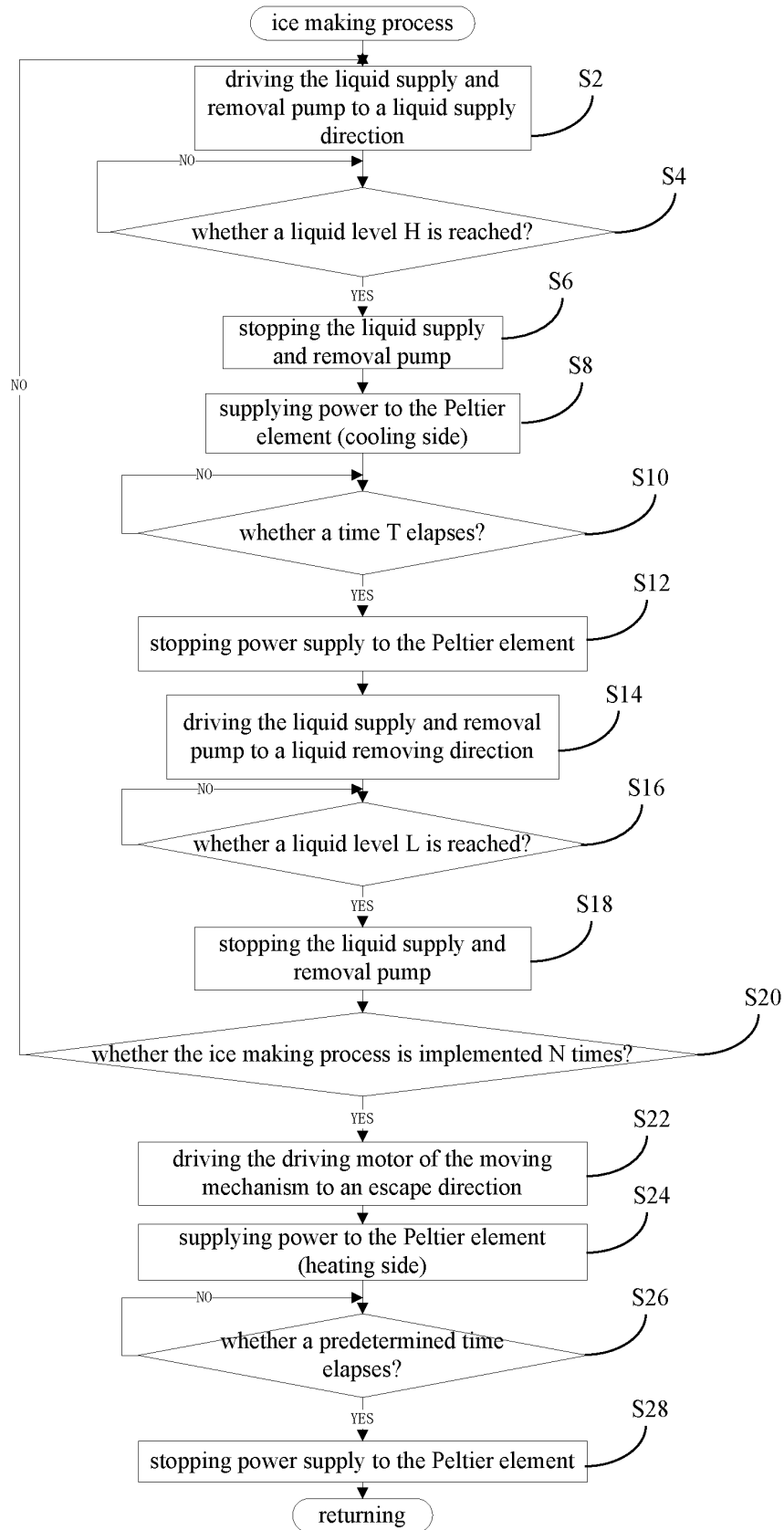


Fig.9

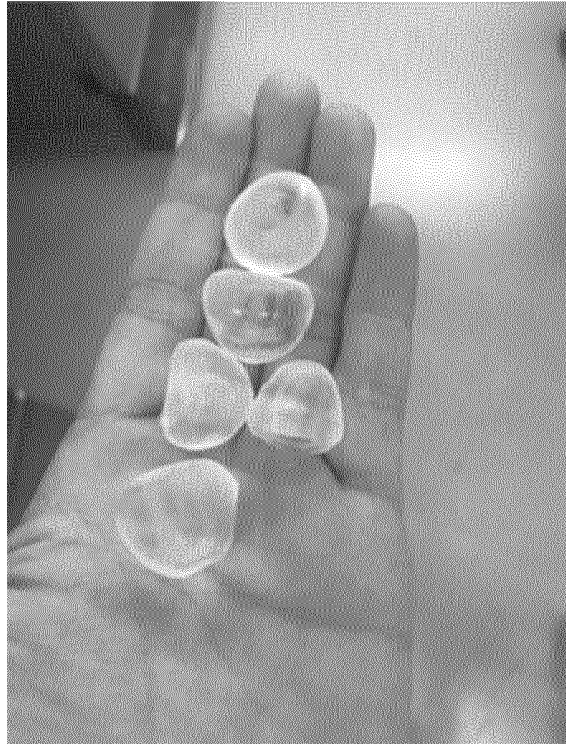


Fig.10 (a)



Fig.10 (b)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2021/114175

A. CLASSIFICATION OF SUBJECT MATTER

F25C 1/12(2006.01)i; F25B 21/04(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)

F25C: F25B

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

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

CNABS, CNTXT, SIPOABS, DWPL, 中国期刊网全文数据库, Patentics; 海尔电冰箱, AQUA株式会社, 制冰, 帕耳帖, 帕耳帖, 珀耳帖, 珀耳帖, 帕耳贴, 帕尔贴, 珀耳贴, 珀尔贴, 热电, 冷气, 冷空气, 通道, 流道, 轴, 转动, ice, maker, makign, peltier, thermoelectric+, rotat+, rotar+, pivot

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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

* "A"	Special categories of cited documents: document defining the general state of the art which is not considered to be of particular relevance	"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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"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"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
"O"	document referring to an oral disclosure, use, exhibition or other means	
"P"	document published prior to the international filing date but later than the priority date claimed	"G" document member of the same patent family

Date of the actual completion of the international search

03 November 2021

Date of mailing of the international search report

25 November 2021

Name and mailing address of the ISA/CN

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Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2021/114175

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Form PCT/ISA/210 (second sheet) (January 2015)

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Information on patent family members

International application No.

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