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(54) **ICE MAKER AND REFRIGERATOR HAVING SAME**

(57) An ice maker and a refrigerator having same. The ice maker comprises: a cooling part (40) having a heat dissipation device (10) and a metal piece (20); a liquid container (50) configured to store liquid; a liquid supply part (72) configured to supply liquid to the liquid container (50); a moving mechanism (60) configured to rotate and move the liquid container (50); and a control part (90). The metal piece (20) is mounted, so that a rod-shaped component (24) made of metal extends downward from a base end to the tip, and the rod-shaped component (24) is cooled by means of the heat dissipation device (10). The ice-making process is repeated multiple times under the control of the control part (90), and the following steps are carried out in the ice-making process: a liquid supply step, an ice making step, an avoidance step, a deicing step, and a recovering step. The ice maker is high in cooling efficiency, and can make ice within a short period of time.

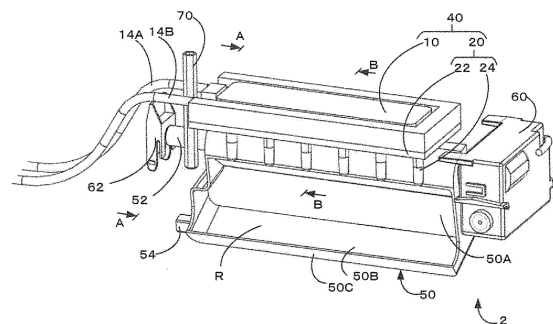


FIG. 1A

Description

TECHNICAL FIELD

[0001] The present invention relates to an ice maker for freezing liquid to produce ice and a refrigerator having the same.

BACKGROUND

[0002] In an ice maker for freezing liquid to produce ice, a cooling protrusion immersed in liquid inside a tray is cooled using a refrigerant of a cooling system of a refrigerator to make ice (for example, refer to patent document 1).

(Prior art document)

(Patent document)

[0003] Patent document 1: Japanese patent No. 2004-150785.

[0004] However, in the ice maker described in patent document 1, liquid remaining in the tray other than the liquid frozen around the cooling protrusion is discharged. Therefore, since new uncooled liquid is supplied to the tray when a new ice making operation is performed, a cooling efficiency is low and an ice making cycle becomes longer.

[0005] In view of this, the existing ice maker and refrigerator are necessary to be improved to solve the above-mentioned problem.

SUMMARY

[0006] An object of the present invention is to provide an ice maker and a refrigerator having the same, which have a high cooling efficiency and can make ice in a short time.

[0007] The present invention is directed to an ice maker comprising a cooling part, a liquid container capable of storing liquid, a liquid supply part which supplies liquid to the liquid container, a moving mechanism which rotates the liquid container and a control part. The cooling part has a heat dissipation device having a flow passage for a refrigerant to flow through and a metal piece mounted such that a rod-shaped component extends downwards from a base end portion to a tip portion, and the rod-shaped component is cooled by the heat dissipation device. The control part controls a temperature of the rod-shaped component, an operation of the liquid supply part, and an operation of the moving mechanism.

[0008] An ice making process is repeated a plurality of times under control of the control part, in which the following steps are performed:

a liquid supply step in which the liquid supply part supplies liquid to the liquid container which has an

opening in an upper portion when being at an ice making position;

an ice making step which is after the liquid supply step and in which an ice making temperature is reached after a predetermined time, and the following state is achieved: a predetermined range from the tip portion of the rod-shaped component at the ice making temperature is immersed in liquid contained in the liquid container;

an escape step which is after the ice making step and in which while remaining liquid is still stored in the liquid container, the moving mechanism rotates the liquid container from the ice making position to an escape position where the liquid container is not located below the rod-shaped component;

an ice release step which is after the escape step and in which the rod-shaped component is changed to an ice release temperature, such that ice generated around the rod-shaped component falls from the rod-shaped component; and

a recovery step which is after the ice release step and in which the moving mechanism rotates the liquid container from the escape position to the ice making position when the remaining liquid is still stored in the liquid container;

the liquid container has a structure capable of containing a predetermined amount of liquid in the escape position.

[0009] As such, since liquid remaining in a liquid container in an ice making step of a previous ice making process can be used in the ice making step of a next ice making process, the ice can be made using the low-temperature liquid cooled in the previous ice making process. Thus, the ice maker which has the high cooling efficiency and can make the ice in a short time can be provided.

[0010] Further, the ice maker further comprises a liquid removing part for removing the liquid remaining in the liquid container; under the control of the control part, after the ice making step, the escape step is performed after the liquid removing step is performed; in the liquid removing step, the liquid removing part removes a part of the liquid remaining in the liquid container, such that an amount of the liquid remaining in the liquid container is reduced to be less than the predetermined amount.

[0011] As such, since an amount of the liquid remaining in the liquid container can be reduced to be less than a predetermined amount by a liquid removing part, the liquid container can be reliably rotated to an escape position while the remaining liquid is still stored in the liquid container.

[0012] Further, after the plurality of ice making processes are repeated, the following steps are performed under the control of the control part:

a remaining liquid freezing step in which the remaining liquid remaining in the liquid container at the ice making position or the escape position is placed in

a freezing environment and frozen; and a remaining liquid ice release step which is after the remaining liquid freezing step and in which the moving mechanism further rotates the liquid container in a state where a part of the liquid container having elasticity is restrained, so as to twist the liquid container to drop the frozen remaining liquid from the liquid container.

[0013] As such, the remaining liquid does not flow out of the liquid container after a series of ice making processes is completed. Since a freezing operation can be performed and the ice can be released from the liquid container, an efficient ice making cycle can be realized.

[0014] Further, the ice maker further comprises a semiconductor chilling plate provided between the heat dissipation device and the metal piece, one side surface of the semiconductor chilling plate is in contact with a surface of the heat dissipation device, and the other side surface thereof is in contact with a surface of the metal piece opposite to the surface on which the rod-shaped component is mounted;

in the ice making step, the semiconductor chilling plate is supplied with power, such that the side of the semiconductor chilling plate in contact with the heat dissipation device becomes a heat release side, and the side in contact with the metal piece becomes a heat absorption side, so as to further cool the rod-shaped component at the ice making temperature; and

in the ice release step, the semiconductor chilling plate is supplied with power, such that the side of the semiconductor chilling plate in contact with the heat dissipation device becomes the heat absorption side, and the side in contact with the metal piece becomes the heat release side, so as to change the rod-shaped component to the ice release temperature.

[0015] As such, since heat is absorbed from the side of a metal piece having a rod-shaped component by a semiconductor chilling plate and radiated to the heat dissipation device side, a cooling operation is performed by the semiconductor chilling plate in addition to a heat dissipation device having a flow passage for a refrigerant to flow, and a temperature of the rod-shaped component of the metal piece can be lower than a temperature in a case of using only the refrigerant. Thus, the ice can be generated around the rod-shaped component of the metal piece in a short time. Further, by reversing a direction of a current applied to the semiconductor chilling plate, the temperature of the rod-shaped component can be rapidly increased to realize ice release. Thus, a short ice making cycle can be realized reliably.

[0016] Further, in the ice release step, with an end region of the liquid container as a rotation center, the liquid container is rotated by 70 to 120 degrees from the ice

making position to the escape position; the liquid container is provided with a rib, the rib is connected with a side wall forming the liquid container and partially covers the opening in the upper portion, and in the escape position, the predetermined amount of liquid is caught in the liquid container by the rib.

[0017] As such, by providing a rib partially covering an opening in an upper portion at the liquid container, a simple structure can be realized and a predetermined amount of liquid can be reliably stored in the liquid container in the escape position.

[0018] The present invention is directed to a refrigerator comprising the ice maker, a refrigerant branched from a cooling system for cooling an interior of the refrigerator being supplied to the heat dissipation device of the ice maker.

[0019] As such, the refrigerator has a high cooling efficiency and can make the ice in a short time.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020]

FIG. 1A is a perspective view of an ice maker according to one embodiment of the present invention. FIG. 1B is a view of the ice maker shown in FIG. 1A from another perspective.

FIG. 2 is a side view as viewed along arrow A-A in FIG. 1A.

FIG. 3 is a sectional view taken along arrow B-B in FIG. 1A, and is a side sectional view of the ice maker according to the present invention.

FIG. 4 is a same sectional view as FIG. 3, and is a side sectional view of a variant of the ice maker according to the present invention.

FIG. 5 is a view of a planar shape of a heat dissipation device and a cooling system connected to the heat dissipation device in the present invention.

FIG. 6 is a block diagram of a control structure of the ice maker according to the present invention.

FIG. 7A is a side sectional view of a liquid supply step implemented in the ice maker according to the present invention.

FIG. 7B is a side sectional view of an ice release step implemented in the ice maker according to the present invention.

FIG. 7C is a side sectional view of a liquid removing step implemented in the ice maker according to the present invention.

FIG. 7D is a side sectional view of an escaping step implemented in the ice maker according to the present invention.

FIG. 7E is a side sectional view of the ice release step implemented in the ice maker according to the present invention.

FIG. 7F is a side sectional view of a recovery step implemented in the ice maker according to the present invention.

FIG. 7G is a side sectional view of a liquid supply step in a next ice making process performed in the ice maker according to the present invention.

FIG. 8A is a side sectional view of a remaining liquid freezing step implemented in the ice maker according to the present invention.

FIG. 8B is a side sectional view when a liquid container is twisted in a remaining liquid ice release step implemented in the ice maker according to the present invention.

FIG. 8C is a side sectional view when frozen remaining liquid falls from the liquid container in the remaining liquid ice release step implemented in the ice maker according to the present invention.

FIG. 9 is a side sectional view of a refrigerator according to the present invention.

Reference numerals

[0021]

2: ice maker
 10: heat dissipation device
 12: flow passage
 14A, 14B: connecting pipe
 20: metal piece
 22: base
 24: rod-shaped component
 24A: base end portion
 24B: tip portion
 30: semiconductor chilling plate
 40: cooling part
 50: liquid container
 50A: bottom wall
 50B: side wall
 50C: rib
 52: shaft portion
 54: protrusion
 56: ice storage container
 60: moving mechanism
 62: bearing portion
 70: liquid supply/removing pipe
 72: liquid supply part
 72A: tip opening
 74: liquid removing part
 80: cooling system
 82: compressor
 84: condenser
 86: dryer
 90: control part
 100: refrigerator
 102A: freezing chamber
 102B: refrigerating chamber
 104A, B: inlet side flow passage
 106: partition
 106A: blow-out port
 110: compressor
 120: condenser

130: dryer
 140: evaporator
 150: cooling system
 160: three-way valve
 170: fan
 180: damper

DETAILED DESCRIPTION

[0022] In order to make the objects, technical solutions and advantages of the present invention more apparent, the present invention will be described in detail with reference to the accompanying drawings and specific embodiments.

[0023] Hereinafter, the embodiment of the present invention will be described in detail based on the accompanying drawings. In addition, a device described below serves as a device for embodying the technical idea of the present invention, and the present invention is not limited to the following content unless otherwise specified. In order to clarify the description, the sizes, positional relationships, or the like, of elements in each drawing can be exaggeratedly shown. In the specification and the accompanying drawings, the up-down direction is shown assuming a refrigerator provided on the floor.

(One embodiment of ice maker)

[0024] FIG. 1A is a perspective view of an ice maker 2 according to the present invention. FIG. 1B is a perspective view of the ice maker 2 according to the present invention from another perspective. FIG. 2 is a side view as viewed along arrow A-A in FIG. 1A. FIG. 3 is a sectional view taken along arrow B-B in FIG. 1A, and is a side sectional view showing the ice maker according to the present invention. FIG. 4 is a same sectional view as FIG. 3, and is a side sectional view showing a variant of the ice maker according to the present invention. FIG. 5 is a view of a planar shape of a heat dissipation device and a cooling system connected to the heat dissipation device in the present invention. FIG. 6 is a block diagram of a control structure of the ice maker according to the present invention. First, an overview of the ice maker 2 according to the present invention will be described with reference to FIGS. 1A, 1B, 2, 3, 4, 5, and 6.

[0025] The ice maker 2 includes: a cooling part 40 which can freeze liquid to generate ice, a liquid container 50 which can store liquid, a moving mechanism 60 which rotates and moves the liquid container 50, a liquid supply part 72 which supplies liquid to the liquid container 50, and a liquid removing part 74 which removes the liquid in the liquid container 50. FIGS. 1A and 1B show a liquid supply/removing pipe 70 which actually supplies the liquid to the liquid container 50 and removes the liquid from the liquid container 50. The liquid supply/removing pipe 70 is configured as a member which achieves the functions of both the liquid supply part 72 and the liquid removing part 74. In the present embodiment, the ice maker

2 is configured as a separate ice maker, and includes a cooling system 80 for supplying a refrigerant to the cooling part 40. However, the present invention is not limited thereto, and as will be described later, the ice maker can also be incorporated into a refrigerator and supplied with the refrigerant from a cooling system of the refrigerator. The ice maker 2 further includes a control part 90 for controlling constituent devices of the ice maker 2. Any liquid, such as drinking water, can be used as the liquid to be frozen to produce ice.

<Cooling part>

[0026] According to the embodiment shown in FIG. 3 and the variant shown in FIG. 4, constituent components of the cooling part 40 can be different.

[One embodiment]

[0027] In the embodiment shown in FIG. 3, the cooling part 40 includes a heat dissipation device 10 and a metal piece 20 from top to bottom, and a lower surface of the heat dissipation device 10 is joined to an upper surface of the metal piece 20. A plurality of rod-shaped components 24 are mounted to a lower side surface of a plate-like base 22 of the metal piece 20.

[Variant]

[0028] In the variant shown in FIG. 4, the cooling part 40 includes, in sequence from top to bottom, a heat dissipation device 10, a semiconductor chilling plate 30 and a metal piece 20. A plurality of rod-shaped components 24 are mounted to a lower side surface of a plate-like base 22 of the metal piece 20. The semiconductor chilling plate 30 is provided between the heat dissipation device 10 and the metal piece 20, such that one side surface (upper surface) thereof is in contact with a surface (lower surface) of the heat dissipation device 10 and the other side surface (lower surface) thereof is in contact with a surface (upper surface) of the metal piece 20 opposite to the surface on which the rod-shaped component 24 is mounted.

[Heat dissipation device]

[0029] The heat dissipation device 10 has a flat plate shape and is made of metal having a high thermal conductivity, such as aluminum and copper. The heat dissipation device 10 is provided therein with a flow passage 12 in which a liquid or mist refrigerant flows. In FIG. 5, the flow of the refrigerant is shown by a dotted arrow. In FIG. 5, the substantially M-shaped flow passage 12 having three folded portions is shown in a plan view, but the present invention is not limited thereto. Depending on a size of the heat dissipation device 10, a flow passage having one folded portion or a flow passage having more than three folded portions can also be used. Connecting

pipes 14A, 14B are mounted to both ends of the flow passage 12. The heat dissipation device 10 can have the following exemplary structure: a groove-shaped flow passage is formed in the metal piece, or a cooling pipe as a flow passage is joined to a metal sheet. In the latter case, the cooling pipe can be joined to one side of the metal sheet, or the metal sheet can be joined to cover a periphery of the cooling pipe. The cooling pipe and the metal sheet are preferably in surface contact in view of heat conduction. For example, the metal sheet can have a thickness of about 1 to 20 mm. The heat dissipation device 10 has a same planar size as the metal piece 20 described later.

[0030] In the cooling system 80 in the present embodiment, high-pressure refrigerant gas compressed by a compressor 82 releases heat and turns back into liquid in a condenser 84, is decompressed to lower a boiling point while passing through a capillary tube, and enters the flow passage 12 of the heat dissipation device 10 from the connecting pipe 14A via a dryer 86. While passing through the flow passage 12, the liquid or mist refrigerant absorbs heat from the surroundings and evaporates. The vaporized refrigerant returns from the connecting pipe 14B to the compressor 82 via a pipeline of the cooling system 80, and the re-compressed cycle is repeated. With such a cooling cycle, the heat dissipation device 10 can be cooled to a temperature below a freezing point.

[Metal piece]

[0031] The metal piece 20 is formed of metal having a high thermal conductivity, such as aluminum and copper. The metal piece 20 includes the flat-plate-shaped base 22 and the plurality of rod-shaped components 24 mounted to the base 22. The rod-shaped component 24 is mounted on the lower surface of the base 22, so as to extend downwards from a base end portion 24A to a tip portion 24B.

[0032] FIGS. 1A and 1B show a case where six rod-shaped components 24 are mounted to the base 22. The rod-shaped component 24 can have a circular cross-section shape with an outer diameter of about 5 to 20 mm and a length of about 30 to 80 mm. The planar shape of the base 22 is determined by a size of the rod-shaped component 24 and a number of the rod-shaped component to be mounted. The heat dissipation device 10 also has a substantially same planar shape as the base 22 of the metal piece 20. The planar sizes of the heat dissipation device 10 and the base 22 of the metal piece 20 can include longitudinal and transverse sizes of about 40 to 400 mm. The base 22 can have a thickness of about 2 to 10 mm.

[0033] In the present embodiment, a male thread is provided on the base end portion 24A side of the rod-shaped component 24 of the metal piece 20, so as to be connected with a female thread formed in a hole portion provided in the base 22. With such a structure, the rod-

shaped component 24 can be easily replaced and mounted. Although the rod-shaped component 24 in the present embodiment has the circular cross-section shape, the present invention is not limited thereto, and the rod-shaped component can be substituted by a rod-shaped component having a polygonal shape, a star shape, a heart shape, or any cross-section shape. In addition, the rod-shaped component 24 can also be joined to the base 22 by a welding or soldering operation. A solid rod-shaped component 24 is preferred in view of a cooling effect of the rod-shaped component 24, but a hollow rod-shaped component 24 can also be employed in view of workability, or the like.

[Semiconductor chilling plate]

[0034] The semiconductor chilling plate 30 is configured as an element utilizing the peltier effect, and 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 flows in a predetermined direction with respect to the semiconductor chilling plate 30, one side surface becomes a heat absorption side, and the other side surface becomes a heat release side. Moreover, when the current flows in a reverse direction with respect to the semiconductor chilling plate 30, the surface becoming the heat absorption side and the surface becoming the heat release side are reversed. In the present embodiment, any known semiconductor chilling plate can be used. The semiconductor chilling plate 30 in the present embodiment has width and depth sizes of about 20 to 100 mm and a thickness of about 2 to 20 mm. In addition, a plurality of semiconductor chilling plates 30 can be provided in accordance with the size of the heat dissipation device 1 and the metal piece 20.

[Fixing structure of cooling part]

[0035] In a case where the semiconductor chilling plate 30 is not provided, fixation can be realized using a fastening member, such as a bolt and a nut, such that the lower surface of the heat dissipation device 10 is closely attached to the upper surface of the metal piece 20. On the other hand, in a case where the semiconductor chilling plate 30 is provided, the following fixing structure is provided: two sides of the semiconductor chilling plate 30 are closely attached to the lower surface of the heat dissipation device 10 and the upper surface of the metal piece 20. For example, the heat dissipation device 10 and the metal piece 20 which are provided to sandwich the semiconductor chilling plate 30 can be fixed to each other with a fastening member, such as a bolt and a nut. A bolt shaft is subjected to tensile stress by a fastening operation, such that the lower surface of the heat dissipation device 10 can be closely attached to an upper surface of the semiconductor chilling plate 30, and a lower surface of the semiconductor chilling plate 30 can be closely attached to the upper surface of the metal piece

20. However, the present invention is not limited to this fixing method, and the fixing structure of the cooling part 40 can be formed by any other fixing means.

5 <Liquid container>

[0036] The liquid container 50 is made of a resin material having elasticity. The liquid container 50 includes a liquid storage region R enclosed by a bottom wall 50A and a side wall 50B erected from the bottom wall 50A. An opening is formed in an upper portion of the liquid storage region R. The rod-shaped component 24 of the metal piece 20 is inserted into the liquid storage region R through the opening, such that a predetermined range from the tip portion 24B of the rod-shaped component 24 is provided in the liquid storage region R.

[0037] In the ice maker 2 according to the present embodiment, the rod-shaped component 24 is lowered to a temperature below the freezing point by the cooling effect of the heat dissipation device 10 cooled by the refrigerant. Since the predetermined range from the tip portion 24B of the rod-shaped component 24 is provided within the liquid storage region R of the liquid container 50, ice can be generated around a portion of the rod-shaped component 24 immersed in the liquid. The predetermined range from the tip portion 24B of the rod-shaped component 24 can be about 8 mm to 40 mm. Further, in the case of including the semiconductor chilling plate 30, since the cooling operation is performed by the semiconductor chilling plate 30 in addition to the heat dissipation device 10, the cooling operation can be performed at a lower temperature, and the ice can be generated around the rod-shaped component 24 of the metal piece 20 in a short time.

[0038] In the present embodiment, six rod-shaped components 24 are arranged substantially linearly, and the liquid storage region R is also elongated along a substantially straight line. As shown in FIGS. 3 and 4 which show a cross section substantially orthogonal to the extending direction of the liquid storage region R, the bottom wall 50A forming a bottom surface of the liquid storage region R and the side wall 50B forming a side surface are connected via a smooth curve portion, and the opening is formed in the upper portion. Further, the liquid container 50 is provided with a rib 50C which is connected with the side wall 50B forming the liquid container 50 and partially covers the opening in the upper portion.

[0039] In the side view shown in FIG. 2, a shaft portion 52 extending in the extending direction of the liquid storage region R is provided in a region on the side surface of the liquid storage region R. As shown in FIGS. 1A and 1B, one end portion of the shaft portion 52 of the liquid container 50 is coupled with a driving shaft of the moving mechanism 60 described later. On the other hand, the other end portion of the shaft portion 52 of the liquid container 50 is supported, in a free rotation manner, at a bearing portion 62 provided on a frame portion of the ice maker 2. With this structure, the liquid container 50 can

be rotated about a center point C of the shaft portion 52. That is, the liquid container 50 can be rotated around the center point C located in an end region of the liquid container 50 by a driving force of the moving mechanism 60. Further, the liquid container 50 is provided with a protrusion 54. As will be described later, in a state where the protrusion 54 abuts against the frame portion of the ice maker 2, the liquid container 50 is rotated by the moving mechanism 60, the liquid container 50 having elasticity can be twisted, and the ice in the liquid container 50 can be dropped.

<Moving mechanism>

[0040] The moving mechanism 60 is set to rotate the liquid container 50. When a driving motor of the moving mechanism 60 is started and the driving shaft is rotated, the liquid container 50 is rotated about the center point C. The moving mechanism 60 can rotate the liquid container 50 clockwise/counterclockwise by the driving force of the driving motor, for example (refer to the double-headed arrow in FIG. 1B).

[0041] The position of the liquid container 50 shown in FIGS. 3 and 4 is referred to as an ice making position. In a case where the liquid container 50 is at the ice making position, the opening of the liquid container 50 faces upwards, such that the liquid can be stored in the liquid storage region R, and the predetermined range of the rod-shaped component 24 of the metal piece 20 from the tip portion 24B is provided in the liquid storage region R through the opening. The moving mechanism 60 rotates the liquid container 50 from the ice making position around the center point C (as shown in FIG. 2) until the liquid container 50 is not located below the rod-shaped component 24 of the metal piece 20, and the position of the liquid container 50 at this point is referred to as an escape position. A rotation angle of the liquid container 50 between the ice making position and the escape position differs depending mainly on a positional relationship between the rod-shaped component 24 of the metal piece 20 and the liquid container 50, and a position of the center point C as a rotation center, but preferably ranges from 70 degrees to 120 degrees.

[0042] The moving mechanism 60 can also rotate the liquid container 50 from the ice making position around the center point C over the escape position to a position where the opening of the liquid container 50 faces downwards (as described later, and a shown in FIGS. 8B and 8C). In this case, the protrusion 54 provided outside the liquid container 50 abuts against the frame portion of the ice maker 2, and in this state, the liquid container 50 is further rotated by the moving mechanism 60, such that the liquid container 50 having the elasticity is twisted, and the ice frozen near the bottom wall 50A of the liquid container 50 can be released.

<Liquid supply part/liquid removing part>

[0043] In the present embodiment, the ice maker further includes a mechanism of the liquid supply part 72 which supplies the liquid into the liquid container 50 and the liquid removing part 74 which discharges the liquid from the liquid container 50. The liquid supply part 72 and the liquid removing part 74 mainly include a storage container for storing liquid, a liquid supply/removing pump capable of reversing a suction direction and a discharge direction, a liquid supply/removing pipe 70, and a liquid supply/removing flow passage connecting these parts. The liquid supply part 72 and the liquid removing part 74 reduce a number of parts, and in particular, only the liquid supply/removing pipe 70 is inserted into the liquid container 50, thus saving a space around the liquid container 50.

[0044] When the liquid supply/removing pump is driven to the liquid supply side under control of the control part 90, the liquid in the storage container flows from a liquid supply/discharge pump to the liquid supply/removing pipe 70 through the liquid supply/removing flow passage, and flows into the liquid container 50 from a tip opening 70A of the liquid supply/removing pipe 70. When the liquid supply/removing pump is driven to the liquid removing side under the control of the control part 90, the liquid in the liquid container 50 is sucked from the tip opening 70A of the liquid supply/removing pipe 70, flows through the liquid supply/discharge pump from the liquid supply/removing pipe 70 via the liquid supply/removing flow passage, 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 can be suppressed by a filtering function of the filter, thereby producing high-quality ice. However, the liquid supply part 72 and the liquid removing part 74 only serve as one example, and each of the liquid supply part 72 and the liquid removing part 74 can also include a liquid supply pump, a liquid removing pump, a liquid supply pipe and a liquid removing pipe.

[0045] In either case, the liquid container 50 can store liquid in the ice making position and have the opening in the upper portion. Thus, a tip region of the liquid supply/removing pipe 70 (or a liquid supply pipe and a liquid removing pipe) is simply inserted into the liquid container 50 from the opening in the upper portion, thus easily preventing interference between members when the liquid container 50 rotates. However, as shown in FIGS. 3 and 4, the tip opening 70A of the liquid supply/removing pipe 70 is provided at a height H from the bottom surface of the liquid container 50, and therefore, even when the liquid supply/removing pump is driven to the liquid removing side, the liquid in the region with the height H on the bottom surface remains. All the liquid in the liquid container 50 can be assumed to be discharged in a case where a liquid supply/removing port is provided in the bottom of the liquid container 50. However, when the

liquid container 50 is rotated, interference with other members increases, and a processing operation of a liquid supply/removing hose becomes complicated.

[0046] Next, the control structure of the ice maker 2 including the control part 90 will be described with reference to FIG. 6. Here, a control structure including the semiconductor chilling plate 30 will be described as an example. By controlling the driving action of the motor of the moving mechanism 60 by the control part 90, the liquid container 50 can be rotated between the ice making position and the escape position, and meanwhile, the liquid container 50 can be twisted to release the ice.

[0047] The liquid can be supplied to the liquid container 50 by the control part 90 controlling and driving the liquid supply/removing pump as the liquid supply part 72 to the liquid supply side. Similarly, the liquid in the liquid container 50 can be returned to the storage container by the control part 90 controlling and driving the liquid supply/removing pump as the liquid removing part 74 to the liquid removing side. Further, in the case of including the semiconductor chilling plate 30, a temperature difference can be formed between the two surfaces by the control part 90 controlling a direction and a magnitude of power supplied to the semiconductor chilling plate 30, such that one side surface becomes the heat absorption side and the other side surface becomes the heat release side.

[0048] As described above, the ice maker 2 according to the present embodiment includes: the cooling part 40 having the heat dissipation device 10 having the flow passage 12 for the refrigerant to flow through, and the metal piece 20 mounted such that the rod-shaped component 24 extends downwards from the base end portion 24A to the tip portion 24B; the liquid container 50 capable of storing the liquid; the liquid supply part 72 which supplies the liquid to the liquid container 50 at the ice making position; the moving mechanism 60 which rotates the liquid container 50 between the ice making position and the escape position; and the control part 90, such that the predetermined range from the tip portion 24B of the rod-shaped component 24 is provided in the liquid storage region of the liquid container 50.

[0049] Under the control of the control part 90, the liquid supply part 72 supplies the liquid into the liquid storage region of the liquid container 50 at the ice making position. For example, the control part 90 controls a switching valve in the cooling system 80, such that the refrigerant changed to a low temperature in the cooling system 80 flows into the heat dissipation device 10. The rod-shaped component 24 of the metal piece 20 can reach an ice making temperature below the freezing point by a cooling operation by the heat dissipation device 10 in which the low-temperature refrigerant flows. Thus, the ice can be generated around the region of rod-shaped component 24 immersed in the liquid.

[0050] Further, in the case of including the semiconductor chilling plate 30, since the cooling operation can be performed by the semiconductor chilling plate 30 provided between the heat dissipation device 10 and the

metal piece 20 in addition to the heat dissipation device 10 in which the low-temperature refrigerant flows, the cooling operation can be performed at a lower temperature than a structure in which the rod-shaped component 24 is cooled only by the refrigerant, and the ice can be generated around the rod-shaped component 24 of the metal piece 20 in a short time.

[0051] The control part 90 controls the moving mechanism 60, such that the liquid container 50 is rotated from the ice making position to the escape position where the liquid container 50 is not located below the rod-shaped component 24 of the metal piece 20. Then, the rod-shaped component 24 is changed to the ice release temperature higher than the freezing point by the control part 90, and then, the generated ice falls from the rod-shaped component 24. The ice falls from the rod-shaped component 24 and is then stored in the ice storage container 56 provided below.

[0052] In the case where the semiconductor chilling plate 30 is not included, as a means for changing the rod-shaped component 24 to the ice release temperature, the following manner is considered: the switching valve in the cooling system 80 is switched by the control part 90, such that the high-temperature refrigerant just flowing out of the compressor 82 flows to the heat dissipation device 10 in place of the refrigerant which is changed to the low temperature through the condenser 84 and the capillary tube, thus raising the temperature of the heat dissipation device 10, and also increasing the temperature of the rod-shaped component 24 of the metal piece 20 by heat conduction to the ice release temperature higher than the freezing point.

[0053] In the case of including the semiconductor chilling plate 30, the semiconductor chilling plate 30 is powered on by the control part 90, such that the side in contact with the surface of the heat dissipation device 10 becomes the heat absorption side and the side in contact with the surface of the metal piece 20 becomes the heat release side, thus rapidly raising the temperature of the rod-shaped component 24 of the metal piece 20 to the ice release temperature. In this case, even in a state where the refrigerant changed to the low temperature in the cooling system 80 flows in the heat dissipation device 10, the temperature of the rod-shaped component 24 can be changed to the ice release temperature by the semiconductor chilling plate 30.

(Control processing operation)

[0054] Next, a control processing operation of the control part 90 will be described. FIGS. 7A to 7G are side sectional views of steps implemented by the ice maker according to the present invention, FIG. 7A shows a liquid supply step, FIG. 7B shows an ice making step, FIG. 7C shows a liquid removing step, FIG. 7D shows an escape step, FIG. 7E shows an ice release step, FIG. 7F shows a recovery step, and FIG. 7G shows a liquid supply step in the next cooling process.

(Ice making process)

[0055] For example, a description is given from an initial state in which the liquid container 50 is at the ice making position and no liquid is stored in the liquid container 50. Here, a detailed description will be given of the ice making process repeated a plurality of times, in which the following steps are performed: the liquid supply step of supplying liquid to the liquid container 50, the ice making step of generating ice around the rod-shaped component 24, the escape step of rotating the liquid container 50 from the ice making position to the escape position, the ice release step of dropping the generated ice from the rod-shaped component 24, and the recovery step of rotating the liquid container 50 from the escape position to the ice making position.

<Liquid supply step (refer to FIG. 7A)>

[0056] The liquid supply part 72 supplies liquid to the opening in the upper portion of the liquid container 50 located at the ice making position. Specifically, under the control of the control part 90, the driving motor of the liquid supply/removing pump of the liquid supply part 72 is driven in the liquid supply direction. Thus, the liquid supply/removing pump draws up the liquid in the storage container, and supplies the liquid to the liquid container 50 through the liquid supply/removing flow passage and the liquid supply/removing pipe 70. When the liquid level in the liquid container 50 is determined to reach a specified level based on a signal from a liquid level sensor or timing of a timer, the control part 90 stops the operation of the liquid supply/removing pump. In the liquid supply step, the following state is achieved: the predetermined range L from the tip portion 24B of the rod-shaped component 24 of the metal piece 20 is immersed in the liquid container 50.

<Ice making step (refer to FIG. 7B)>

[0057] When the ice making temperature is reached after a predetermined time elapses after the liquid supply step, the following ice making step is performed: the predetermined range L from the tip portion 24B of the rod-shaped component 24 of the metal piece 20 at the ice making temperature is immersed in the liquid contained in the liquid container 50.

[0058] Specifically, under the control of the control part 90, the refrigerant changed to the low temperature in the cooling system 80 flows to the heat dissipation device 10. The heat dissipation device 10 which is changed to a temperature below the freezing point by evaporation of the refrigerant flowing in the internal flow passage 12 cools down the rod-shaped component 24 of the metal piece 20 to the ice making temperature below the freezing point.

[0059] On the other hand, in the case where the semiconductor chilling plate 30 is included, the semiconduc-

tor chilling plate 30 is supplied with power under the control of the control part 90, such that the side of the semiconductor chilling plate 30 in contact with the heat dissipation device 10 becomes the heat release side, and the side in contact with the metal piece 20 becomes the heat absorption side, so as to further cool the rod-shaped component at the ice making temperature. That is, since heat is absorbed from the side of the metal piece 20 having the rod-shaped component 24 by the semiconductor chilling plate 30 and radiated to the heat dissipation device 10 side, the cooling operation is performed by the semiconductor chilling plate 30 in addition to the heat dissipation device having the flow passage for the low-temperature refrigerant to flow, and the temperature of the rod-shaped component 24 of the metal piece 20 can be lower than the temperature in the case of using only the refrigerant. Thus, the ice can be generated around the rod-shaped component 24 of the metal piece 20 in a short time.

[0060] Then, when the predetermined time T is determined to elapse based on the timing of the timer, the ice making step is ended. As shown in FIG. 7B, the ice G can be generated to cover the predetermined range L from the tip portion of the rod-shaped component 24 of the metal piece 20. The predetermined time T can be set to different values corresponding to the case where the semiconductor chilling plate 30 is included and the case where the semiconductor chilling plate 30 is not included. In the case where the semiconductor chilling plate 30 is included, the ice making step is ended, and the control part 90 stops the power supply to the semiconductor chilling plate 30.

<Liquid removing step (refer to FIG. 7C)>

[0061] After the ice making step, the liquid removing part 74 removes the liquid remaining in the liquid container 50 under the control of the control part 90. Specifically, the liquid supply/removing pump is driven in the liquid removing direction under the control of the control part 90. Thus, the liquid supply/removing pump draws out the liquid in the liquid container 50 through the liquid supply/removing pipe 70 and the liquid supply/removing flow passage, and returns the liquid to the storage container. At this point, the liquid returned to the storage container flows into the storage container after being filtered by the filter provided at an inlet of a return path of the storage container.

[0062] As described above, the tip opening 70A of the liquid supply/removing pipe 70 is provided at the height H from the bottom surface of the liquid container 50, and therefore, the liquid at least in the region with the height H on the bottom surface remains. In the escape step described later, the liquid container 50 is rotated to the escape position, and the liquid container 50 has a structure capable of containing a predetermined amount of liquid in the escape position. Thus, the amount of the liquid remaining in the region with the height H on the

bottom surface in the liquid container 50 is lower than a predetermined amount which can be stored in the liquid container 50 at the escape position even after the liquid removing step. When the predetermined amount of the liquid which can be stored in the liquid container 50 at the escape position is greater than the amount of the liquid in the region with the height H on the bottom surface of the liquid container 50, the operation of the liquid supply/removing pump can be stopped at a point in time when the remaining amount of the liquid in the liquid container 50 becomes less than the predetermined amount.

[0063] As described above, in the liquid removing step, after the ice making step, the liquid removing part 74 removes a part of the liquid remaining in the liquid container 50, such that the amount of the liquid remaining in the liquid container 50 is reduced to be less than the predetermined amount. In this way, since the amount of the liquid remaining in the liquid container 50 can be reduced to be less than the predetermined amount by the liquid removing part 74, the liquid container 50 can be reliably rotated while the remaining liquid is still stored in the liquid container 50 in the escape step and the recovery step described later. When the predetermined amount of the liquid which can be stored in the liquid container 50 at the escape position is greater than the total amount of the liquid remaining in the liquid container 50 at the end of the ice making step, the liquid removing step can not be performed.

<Escape step (refer to FIG. 7D)>

[0064] After the ice making step, under the control of the control part 90, when the remaining liquid is still stored in the liquid container 50, the moving mechanism 60 rotates the liquid container 50 from the ice making position to the escape position where the liquid container 50 is not located below the rod-shaped component 24 of the metal piece 20. The liquid container 50 is rotated by 70 to 120 degrees from the ice making position to the escape position by driving the driving motor of the moving mechanism 60. With such a rotation angle, even when the generated ice falls from the rod-shaped component 24 of the metal piece 20 in the ice release step described later, there is no risk of interference with the liquid container 50.

[0065] The liquid container 50 is provided with the rib 50C, and the rib 50C is connected with the side wall 50B forming the liquid container 50 and partially covers the opening in the upper portion, such that the predetermined amount of liquid is caught in the liquid container 50 by the rib 50C in the escape position. By providing such a structure in the liquid container 50, there is no risk that the liquid flows out of the liquid container 50 during the rotation of the liquid container 50 in the escape step, the state in the escape position in the ice removing step, and the rotation of the liquid container 50 in the recovery step, thus preventing the liquid from splashing around and preventing freeze and adherence of the flow-out liquid. As

such, by providing the rib 50C partially covering the opening in the upper portion of the liquid container 50, a simple structure can be realized and the predetermined amount of liquid can be reliably stored in the liquid container 50 in the escape position.

<Ice release step (refer to FIG. 7E)>

[0066] After the escape step, under the control of the control part 90, the rod-shaped component 24 of the metal piece 20 is changed to the ice release temperature, and the ice G generated around the rod-shaped component falls from the rod-shaped component 24. The falling ice G is stored in the ice storage container 56 provided below. The rod-shaped component 24 of the metal piece 20 is changed to the ice release temperature, and in the case where the semiconductor chilling plate 30 is not included, in place of the low-temperature refrigerant, the high-temperature refrigerant just flowing out of the compressor 82 can flow to the heat dissipation device 10, thus raising the temperature of the heat dissipation device 10, and also increasing the temperature of the rod-shaped component 24 of the metal piece 20 by heat conduction to the ice release temperature higher than the freezing point.

[0067] On the other hand, in the case of including the semiconductor chilling plate 30, the semiconductor chilling plate 30 is powered on, such that the side in contact with the surface of the heat dissipation device 10 becomes the heat absorption side and the side in contact with the surface of the metal piece 20 becomes the heat release side, thus rapidly raising the temperature of the rod-shaped component 24 of the metal piece 20 to the ice release temperature. Thus, a short ice making cycle can be realized reliably. In this case, even in a state where the refrigerant changed to the low temperature in the cooling system 80 still flows in the heat dissipation device 10, the temperature of the rod-shaped component 24 can be changed to the ice release temperature by the semiconductor chilling plate 30.

<Recovery step (refer to FIG. 7F)>

[0068] After the ice release step, under the control of the control part 90, when the remaining liquid is still stored in the liquid container 50, the moving mechanism 60 rotates the liquid container 50 from the escape position to the ice making position. The driving motor of the moving mechanism 60 is driven on an opposite side to the escape step, such that the liquid container 50 is rotated by 70 to 120 degrees in the opposite direction and returned to the original ice making position. Thus, the first ice making process is finished, and the liquid supply step of the second ice making process is performed.

<Ice making process after second ice making process (refer to FIG. 7G)>

[0069] In the liquid supply step of the second ice making process, as described above, under the control of the control part 90, the driving motor of the liquid supply/removing pump of the liquid supply part 72 is driven in the liquid supply direction, and the liquid is supplied to the liquid container 50 with the opening in the upper portion. FIG. 7G shows a time when the liquid supply to the liquid container 50 is completed in the liquid supply step of the next ice making process. In the liquid supply step of the ice making process after the second ice making process, the liquid is already stored in the region with a height greater than the height H on the bottom surface of the liquid container 50 before the liquid supply is started. Thus, the amount of the liquid supplied to the liquid container 50 in the liquid supply step of the second ice making process becomes less than the amount of the liquid just remaining in the first ice making process. The remaining liquid is cooled by the rod-shaped component 24 of the metal piece 20 in the previous ice making process, and changed to a lower temperature than a temperature of newly supplied liquid. Thus, in the ice making step of the ice making process after the second ice making process, since the temperature of the liquid to be frozen is low in advance, ice can be made efficiently in a short time.

[0070] As described above, the ice maker according to the present embodiment includes: the cooling part 40 having the heat dissipation device 10 and the metal piece 20, the heat dissipation device 10 having the flow passage 12 for the refrigerant to flow through, the metal piece 20 being mounted such that the rod-shaped component 24 extends downwards from the base end portion 24A to the tip portion 24B, and the rod-shaped component 24 is cooled by the heat dissipation device 10; the liquid container 50 capable of storing the liquid; the liquid supply part 72 which supplies the liquid to the liquid container 50; the moving mechanism 60 which rotates the liquid container 50; and the control part 90 which controls the temperature of the rod-shaped component 24, the operation of the liquid supply part 72, and the operation of the moving mechanism 60; under the control of the control part 90, the ice making process is repeated a plurality of times, in which the following steps are performed: the liquid supply step in which the liquid supply part 72 supplies the liquid to the liquid container 50 which is at the ice making position and has the opening in the upper portion; the ice making step which is after the liquid supply step and in which the ice making temperature is reached after the predetermined time: the predetermined range L from the tip portion 24B of the rod-shaped component 24 at the ice making temperature is immersed in the liquid contained in the liquid container 50; the escape step which is after the ice making step and in which while the remaining liquid is still stored in the liquid container 50, the moving mechanism 60 rotates the liquid container 50 from the ice making position to the escape position where

the liquid container 50 is not located below the rod-shaped component 24; the ice release step which is after the escape step and in which the rod-shaped component 24 is changed to the ice release temperature and the ice generated around the rod-shaped component 24 falls from the rod-shaped component 24; and the recovery step which is after the ice release step and in which the moving mechanism 60 rotates the liquid container 50 from the escape position to the ice making position when the remaining liquid is still stored in the liquid container 50. At this point, the liquid container 50 has the structure capable of containing the predetermined amount of liquid in the escape position.

[0071] Thus, since the liquid remaining in the liquid container 50 in the ice making step of the previous ice making process can be used in the ice making step of the next ice making process, the ice can be made using the low-temperature liquid cooled in the previous ice making process. Thus, the ice maker which has the high cooling efficiency and can make the ice in a short time can be provided. The plurality of ice making processes as described above are repeated, and a series of ice making processes is completed after a predetermined amount of ice G is stored in the ice storage container 56.

(Processing when plural ice making processes are completed)

[0072] FIGS. 8A to 8C are side sectional views of the ice maker 2 according to the present invention when the ice making process is completed, FIG. 8A shows a remaining liquid freezing step, FIG. 8B shows a view when the liquid container 50 is twisted in a remaining liquid ice release step, and FIG. 8C shows a view when the frozen remaining liquid falls from the liquid container 50 in the remaining liquid ice release step.

<Remaining liquid freezing step (refer to FIG. 8A)>

[0073] In the remaining liquid freezing step, after the series of ice making processes is completed, the remaining liquid remaining in the liquid container 50 is frozen. FIG. 8A shows a view obtained when the remaining liquid is frozen in a state where the liquid container 50 is at the ice making position.

[0074] The remaining liquid can be frozen by a means that a plurality of fins are provided on an outer surface of the heat dissipation device 10 of the cooling part 40, and cold gas passing between the fins of the cooling part 40 is blown to the remaining liquid by the fins. The remaining liquid can be frozen by blowing the cold gas cooled to a sub-zero temperature between the fins onto the remaining liquid. Furthermore, the cold gas cooled by a heat dissipation device or a semiconductor chilling plate, or the like, different from the cooling part 40 is blown to the remaining liquid.

[0075] Further, the bottom surface 50A of the liquid container 50 can be formed of metal having a good ther-

mal conductivity, and connected to the cooling part 40 using a member having a high thermal conductivity, or the liquid container 50 can be moved to be in contact with the cooling part 40. Furthermore, as described below, in a case where the ice maker 2 is provided in a refrigerator, the remaining liquid can be easily frozen by providing the liquid container 50 in a freezing chamber of the refrigerator.

<Remaining liquid ice release step (refer to FIGS. 8B and 8C)>

[0076] After the remaining liquid freezing step, the control part 90 drives the driving motor of the moving mechanism 60 in a direction the same as the direction in the escape step to rotate the liquid container 50. At this point, the liquid container is rotated beyond the escape position at 70 to 120 degrees to a position at about 180 degrees. At this point, the protrusion 54 provided at the end region of the liquid container 50 abuts against a frame of the ice maker 2. In a state where a part of the elastic liquid container 50 is restrained by this abutment, the driving motor is continuously driven to further rotate the liquid container 50, and thus, the liquid container 50 is twisted. The liquid container 50 is deformed by the twisting operation, as shown in FIG. 8C, and the frozen remaining liquid is released from the liquid container 50 and falls. The dropped frozen remaining liquid is stored in the ice storage container 56 provided below.

[0077] In the example shown in FIG. 8A, the remaining liquid present in the vicinity of the bottom wall 50A is frozen in the state where the liquid container 50 is at the ice making position. Thus, when the liquid container 50 is twisted, since the bottom wall 50A is deformed relatively largely, the frozen remaining liquid can be easily released from the liquid container 50. Further, since the frozen remaining liquid released from the liquid container 50 falls substantially directly downwards, there is substantially no risk of interference with other members. However, the present invention is not limited thereto; for example, the remaining liquid can be frozen in a state where the liquid container 50 is at the escape position. The means for releasing the frozen remaining liquid from the liquid container 50 is not limited to the above description, and any known ice-making-tray ice releasing means can be employed.

[0078] As described above, after the plurality of ice making processes are repeated, under the control of the control part 90, the following steps are performed: the remaining liquid freezing step in which the liquid remaining in the liquid container 50 at the ice making position or the escape position is placed in a freezing environment and frozen; and the remaining liquid ice release step in which the frozen remaining liquid falls from the liquid container 50. Thus, after the series of ice making processes is completed, the remaining liquid does not flow out of the liquid container, but can be frozen and released from the liquid container 50, thus realizing an efficient ice mak-

ing cycle.

(Refrigerator according to present invention)

[0079] FIG. 9 is a side sectional view of a refrigerator 100 according to the present invention. In FIG. 9, the flow of the refrigerant is shown by a dotted arrow. The refrigerator 100 according to the present invention having the above-mentioned ice maker 2 will be described with reference to FIG. 9.

[0080] The refrigerator 100 includes a freezing chamber 102A and a refrigerating chamber 102B. Inlet side flow passages 104A, 104B partitioned by a partition 106 are provided on back sides of the freezing chamber 102A and the refrigerating chamber 102B. An evaporator 140 is provided in the inlet side flow passage 104A on the freezing chamber 102A side, and a fan 170 is provided above the evaporator. A compressor 110 communicated with the evaporator 140 is provided in a machine chamber outside the back side of the freezing chamber 102A. A refrigerant (gas) compressed by the compressor 110 is liquefied in a condenser 120, is decompressed to lower a boiling point while passing through a capillary tube, and reaches a three-way valve 160 via a dryer 130. Although the dryer 130 is shown in FIG. 9 as being within the machine chamber, the dryer is actually provided near the three-way valve 160.

[0081] By the three-way valve 160, the refrigerant is switched between direct flow into a flow passage of the evaporator 140 of the refrigerator 100 and flow into the flow passage of the evaporator 140 after flow in the heat dissipation device 10 of the ice maker 2. When the ice maker 2 does not make ice, the refrigerant directly flows into the evaporator 140. Then, the refrigerant takes away heat of gas in the refrigerator and is vaporized in the evaporator 140, the vaporized refrigerant is compressed again in the compressor 110, and such a cycle is repeated. The compressor 110, the condenser 120, the dryer 130, the evaporator 140, or the like, are communicated to form a cooling system 150 of the refrigerator.

[0082] When ice is made by the ice maker 2, the refrigerant flows into the flow passage 12 of the heat dissipation device 10 through the connecting pipe 14A by switching the three-way valve 160. When passing through the flow passage 12, a part of the liquid or mist refrigerant absorbs heat from the surroundings and evaporates, and the vaporized refrigerant reaches the inlet side of the evaporator 140 through the connecting pipe 14B. Since the amount of the refrigerant vaporized in the heat dissipation device 10 is less than the capacity of the refrigerant circulating in the cooling system 150, the refrigerant overall maintains a liquid or mist state when entering the evaporator 140. Therefore, the refrigerant takes away the heat of the gas in the refrigerator and is vaporized in the evaporator 140, the vaporized refrigerant is compressed again in the compressor 110, and such a cycle is repeated.

[0083] The three-way valve 160 for the switching pur-

pose can be omitted, and the flow of refrigerant into the evaporator 140 and the flow of refrigerant into the evaporator 140 after passing through the heat dissipation device 10 are always generated.

[0084] A damper 180 is provided between the inlet side flow passage 104A on the freezing chamber 102A side and the inlet side flow passage 104B on the refrigerating chamber 102B side. FIG. 9 shows a state in which the damper 180 is closed. In the state where the damper 180 is closed, when the compressor 110 and the fan 170 are actuated, gas in the freezing chamber 102A flows, and the cold gas passing through the evaporator 140 flows into the freezing chamber 102A from a blow-out port 106A provided in the partition 106. As shown by the dot-and-dash arrow in FIG. 9, the inflow gas circulates in the freezing chamber 102A and returns to a lower side of the evaporator 140 in the inlet side flow passage 104A again. An interior of the freezing chamber 102A can be cooled by circulation of the gas cooled by the evaporator 140. In a state where the damper 180 is opened, the cold gas also circulates on the refrigerating chamber 102B side.

[0085] As described above, the refrigerator 100 according to the present embodiment includes the ice maker 2 according to the above embodiment, and a branch can be formed from the cooling system 150 for cooling an interior of the refrigerator, so as to supply the low temperature refrigerant in the liquid or mist state to the heat dissipation device 10 of the ice maker 2. Thus, the rod-shaped component 24 of the metal piece 20 of the cooling part 40 can be changed to the ice making temperature. Furthermore, in the case where the ice maker 2 includes the semiconductor chilling plate 30, since the cooling operation is performed by the semiconductor chilling plate 30 in addition to the heat dissipation device 10 of the cooling system 150 of the refrigerator 100, the ice making temperature of the rod-shaped component 24 can be further reduced as compared with a case where only the refrigerant is used.

[0086] In the ice release step, the high-temperature refrigerant from the compressor 110 can be supplied to the heat dissipation device 10 of the ice maker 2 by an unillustrated switching valve. Thus, the rod-shaped component 24 of the metal piece 20 of the cooling part 40 can be changed to the ice making temperature higher than the freezing point. Furthermore, in the case where the ice maker 2 includes the semiconductor chilling plate 30, in a state where the low-temperature refrigerant from the cooling system 150 is still supplied to the heat dissipation device 10, the temperature of the rod-shaped component 24 of the metal piece 20 can be raised by reversing the direction of the current applied to the semiconductor chilling plate 30 in the ice making process, thereby quickly releasing ice. Furthermore, in the ice release step, the three-way valve 160 can be switched, such that the refrigerant is not supplied to the heat dissipation device 10.

[0087] In the refrigerator 100 in which the above-mentioned ice maker 2 is included and the branch is formed

from the cooling system 150 for cooling the interior of the refrigerator, so as to supply the refrigerant to the heat dissipation device 10 of the ice maker 2 as described above, the cooling efficiency is high and ice can be made in a short time. In particular, since the liquid container 50 of the ice maker 2 is provided in the freezing chamber 102A, the remaining liquid of the liquid container 50 can be easily frozen in the remaining liquid freezing step described above.

[0088] So far, a person skilled in the art shall know that although a plurality of exemplary embodiments of the present invention have been described above in detail, various variations and improvements can be directly determined or deducted from the content disclosed by the present invention without departing from the spirit and scope of the present invention. Therefore, all those variations and improvements shall be deemed to be covered by the scope of the present invention.

Claims

1. An ice maker, comprising:

a cooling part having:

a heat dissipation device having a flow passage for a refrigerant to flow through; and
a metal piece mounted such that a rod-shaped component extends downwards from a base end portion to a tip portion, and the rod-shaped component is cooled by the heat dissipation device;
a liquid container capable of storing liquid;
a liquid supply part which supplies liquid to the liquid container;
a moving mechanism which rotates the liquid container; and
a control part which controls a temperature of the rod-shaped component, an operation of the liquid supply part, and an operation of the moving mechanism;

wherein an ice making process is repeated a plurality of times under control of the control part, in which the following steps are performed:

a liquid supply step in which the liquid supply part supplies liquid to the liquid container which has an opening in an upper portion when being at an ice making position;
an ice making step which is after the liquid supply step and in which an ice making temperature is reached after a predetermined time, and the following state is achieved: a predetermined range from the tip portion of the rod-shaped component at the ice making temperature is immersed in liquid con-

- tained in the liquid container;
 an escape step which is after the ice making step and in which while remaining liquid is still stored in the liquid container, the moving mechanism rotates the liquid container from the ice making position to an escape position where the liquid container is not located below the rod-shaped component;
 an ice release step which is after the escape step and in which the rod-shaped component is changed to an ice release temperature, such that ice generated around the rod-shaped component falls from the rod-shaped component; and
 a recovery step which is after the ice release step and in which the moving mechanism rotates the liquid container from the escape position to the ice making position when the remaining liquid is still stored in the liquid container;
 the liquid container has a structure capable of containing a predetermined amount of liquid in the escape position.
2. The ice maker according to claim 1, wherein the ice maker further comprises a liquid removing part for removing the liquid remaining in the liquid container; under the control of the control part, after the ice making step, the escape step is performed after the liquid removing step is performed; in the liquid removing step, the liquid removing part removes a part of the liquid remaining in the liquid container, such that an amount of the liquid remaining in the liquid container is reduced to be less than the predetermined amount.
3. The ice maker according to claim 1 or 2, wherein after the plurality of ice making processes are repeated, the following steps are performed under the control of the control part:
- a remaining liquid freezing step in which the remaining liquid remaining in the liquid container at the ice making position or the escape position is placed in a freezing environment and frozen;
 and
 a remaining liquid ice release step which is after the remaining liquid freezing step and in which the moving mechanism further rotates the liquid container in a state where a part of the liquid container having elasticity is restrained, so as to twist the liquid container to drop the frozen remaining liquid from the liquid container.
4. The ice maker according to claim 3, wherein the ice maker further comprises a semiconductor chilling plate provided between the heat dissipation device and the metal piece, one side surface of the semiconductor chilling plate is in contact with a surface of the heat dissipation device, and the other side surface thereof is in contact with a surface of the metal piece opposite to the surface on which the rod-shaped component is mounted;
- in the ice making step, the semiconductor chilling plate is supplied with power, such that the side of the semiconductor chilling plate in contact with the heat dissipation device becomes a heat release side, and the side in contact with the metal piece becomes a heat absorption side, so as to further cool the rod-shaped component at the ice making temperature; and
 in the ice release step, the semiconductor chilling plate is supplied with power, such that the side of the semiconductor chilling plate in contact with the heat dissipation device becomes the heat absorption side, and the side in contact with the metal piece becomes the heat release side, so as to change the rod-shaped component to the ice release temperature.
5. The ice maker according to claim 4, wherein in the ice release step, with an end region of the liquid container as a rotation center, the liquid container is rotated by 70 to 120 degrees from the ice making position to the escape position; the liquid container is provided with a rib, the rib is connected with a side wall forming the liquid container and partially covers the opening in the upper portion, and in the escape position, the predetermined amount of liquid is caught in the liquid container by the rib.
6. A refrigerator, comprising the ice maker according to any one of claims 1 to 5, a refrigerant branched from a cooling system for cooling an interior of the refrigerator being supplied to the heat dissipation device of the ice maker.

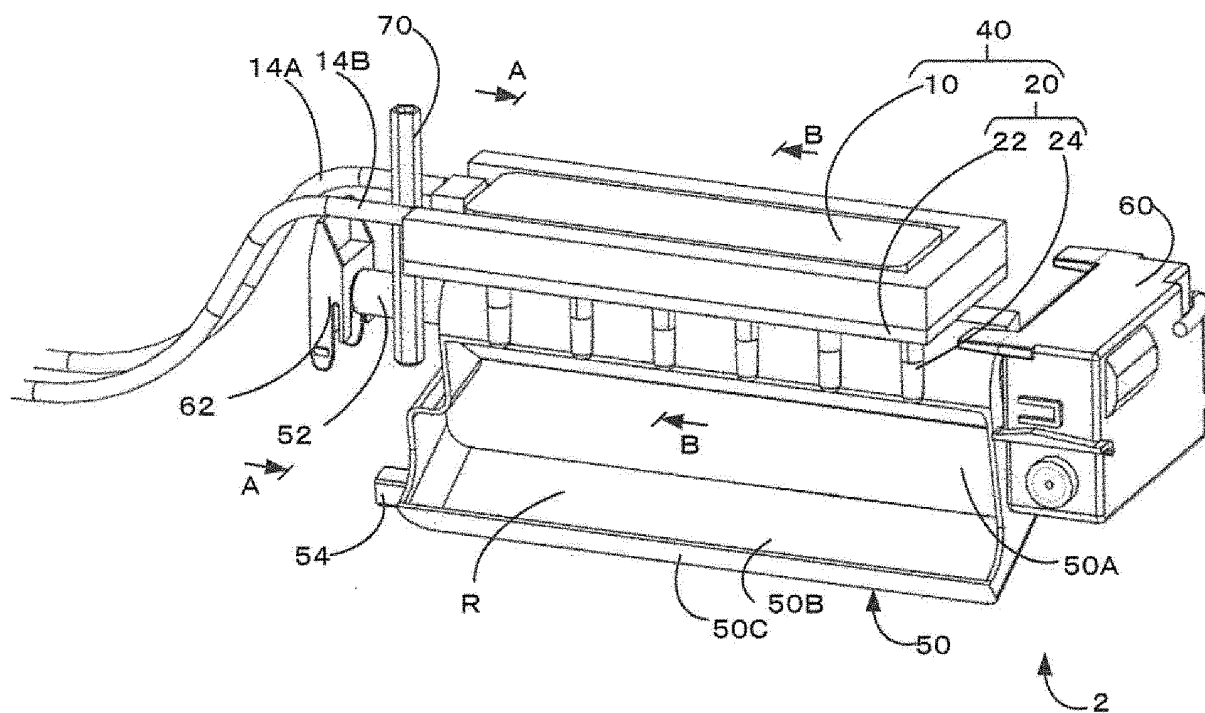


FIG. 1A

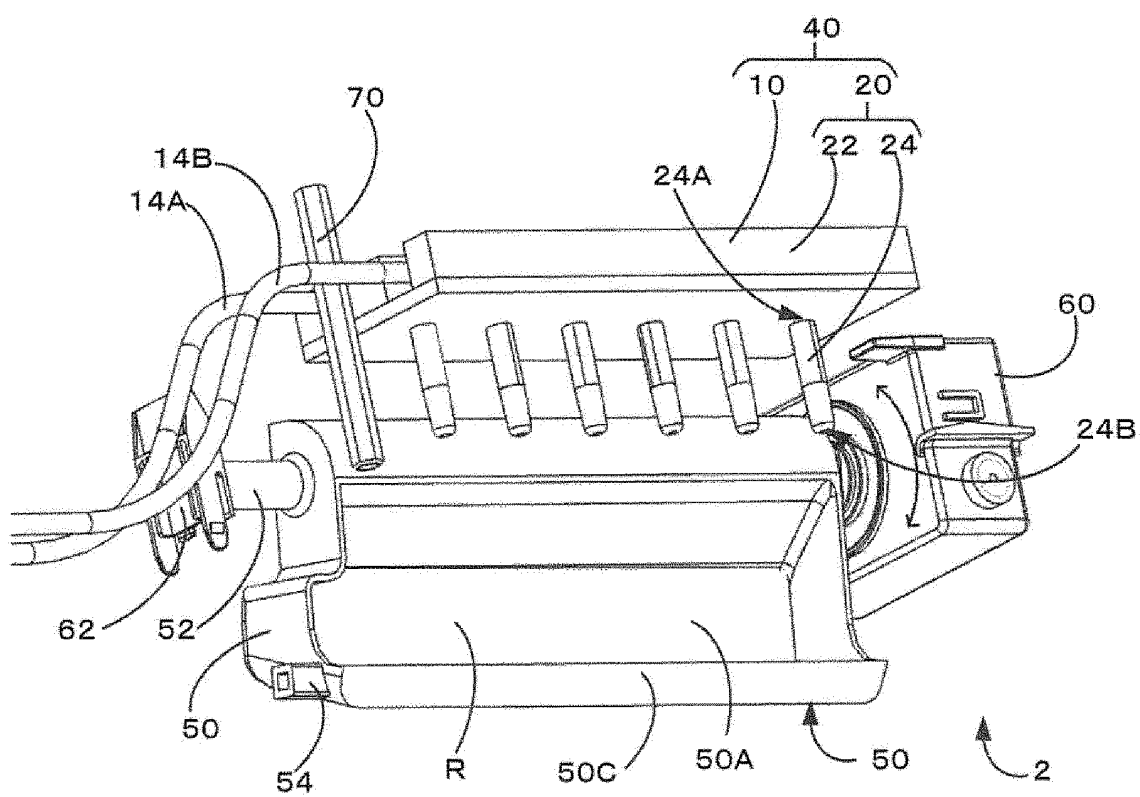


FIG. 1B

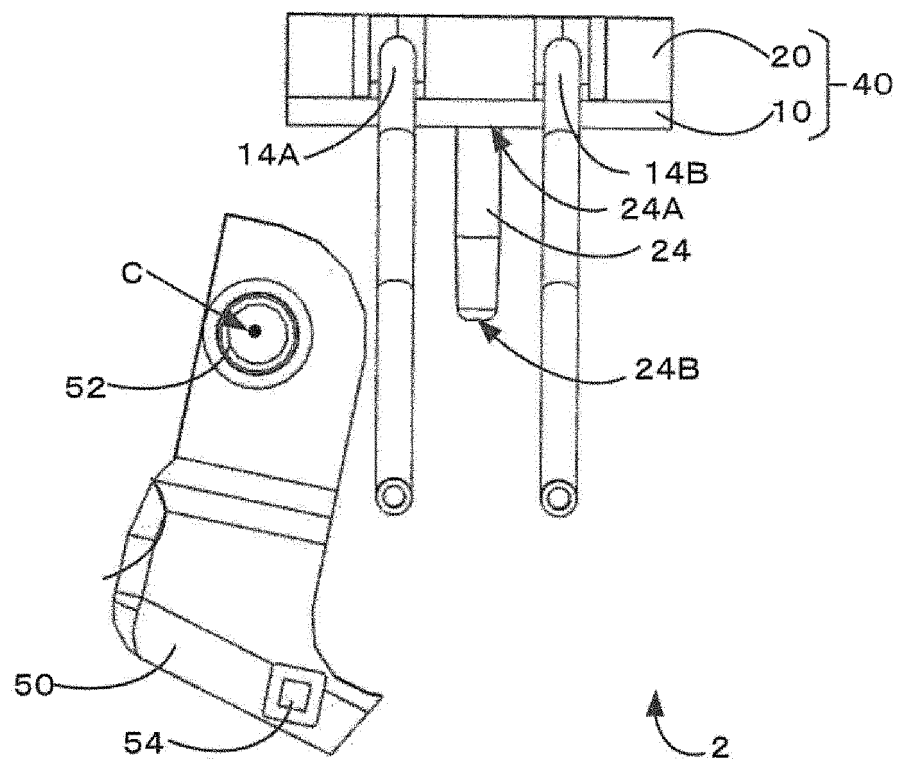


FIG. 2

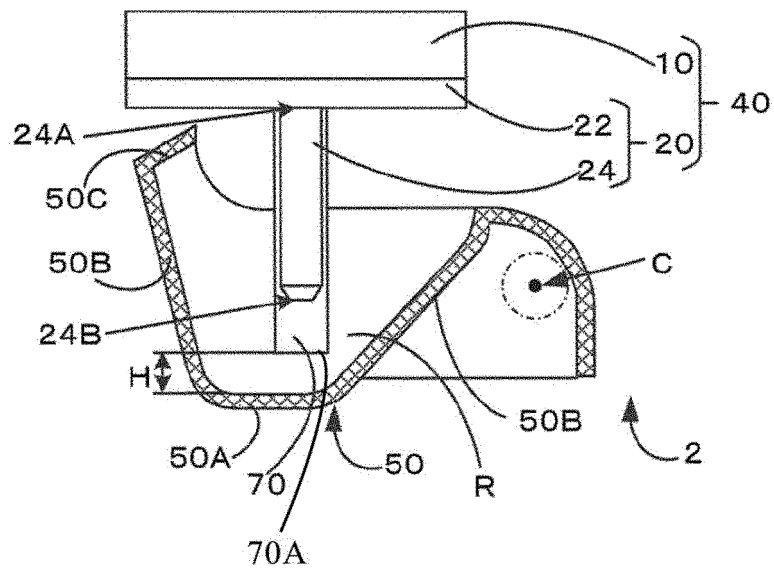


FIG. 3

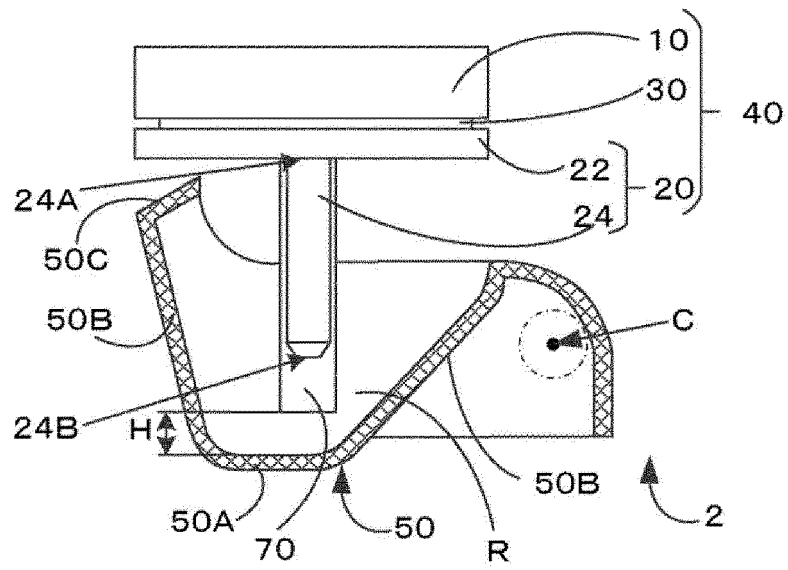


FIG. 4

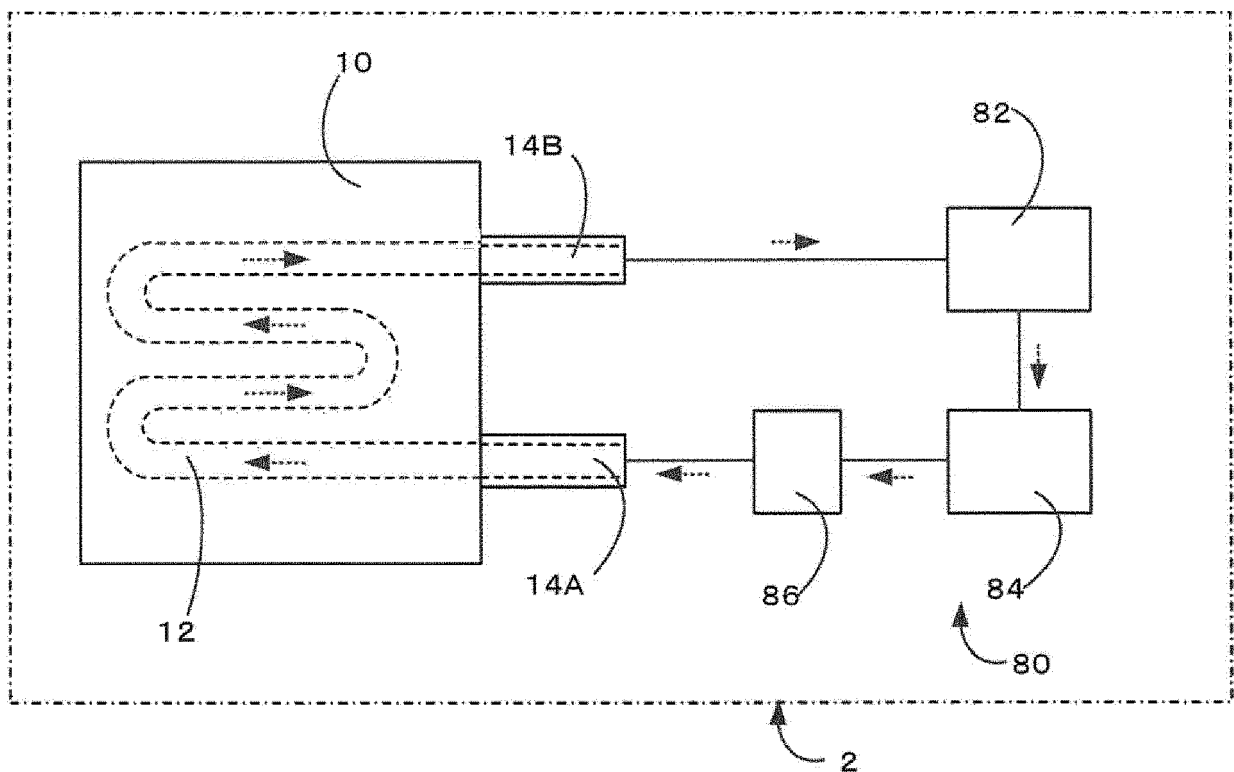


FIG. 5

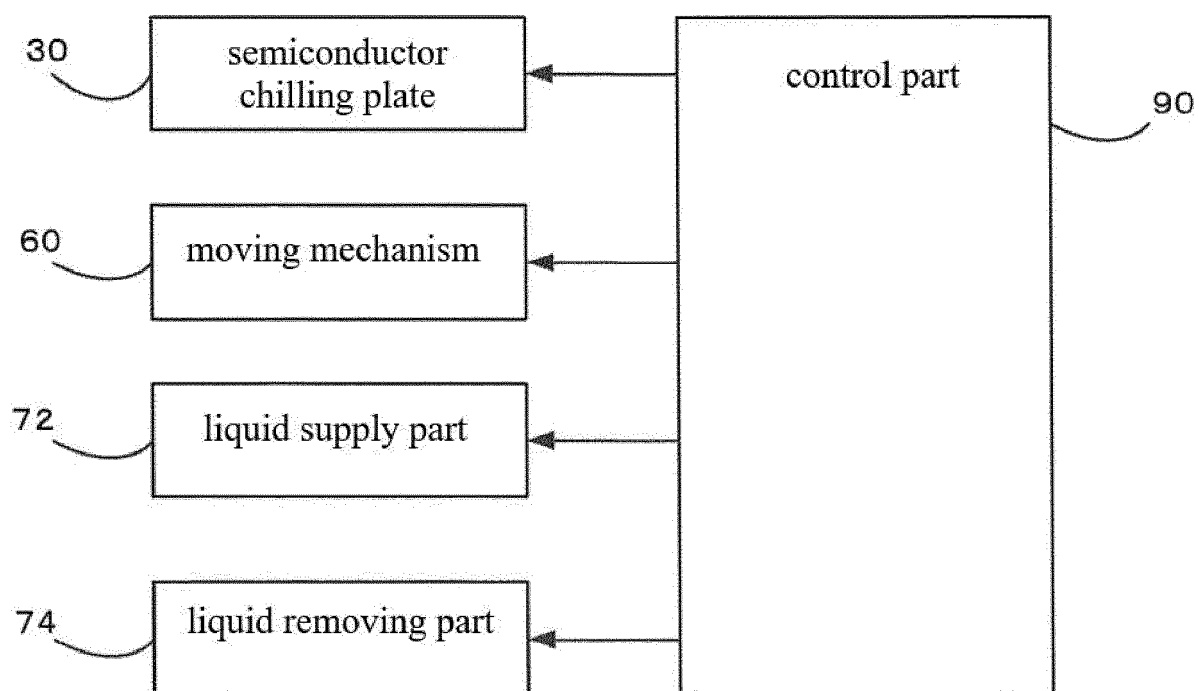


FIG.6

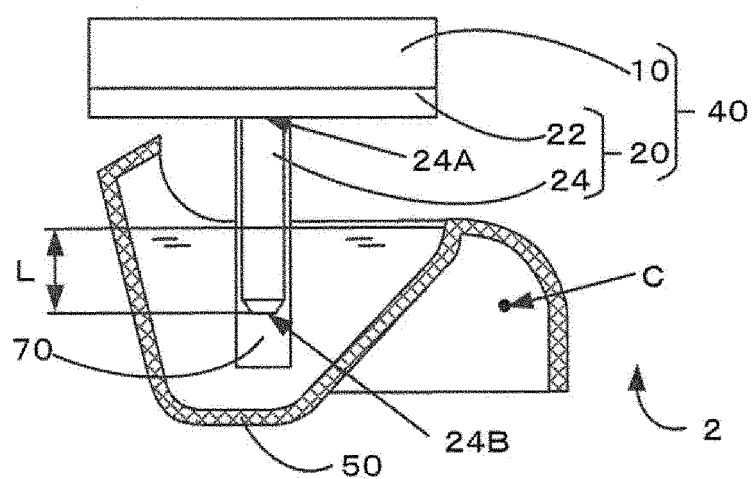


FIG.7A

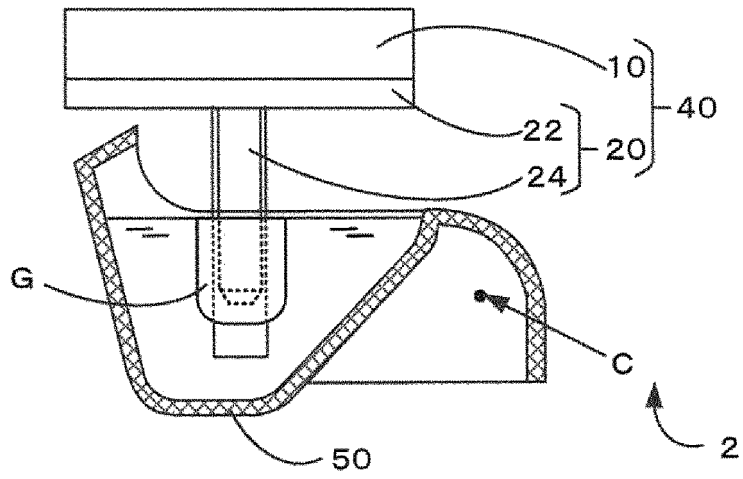


FIG. 7B

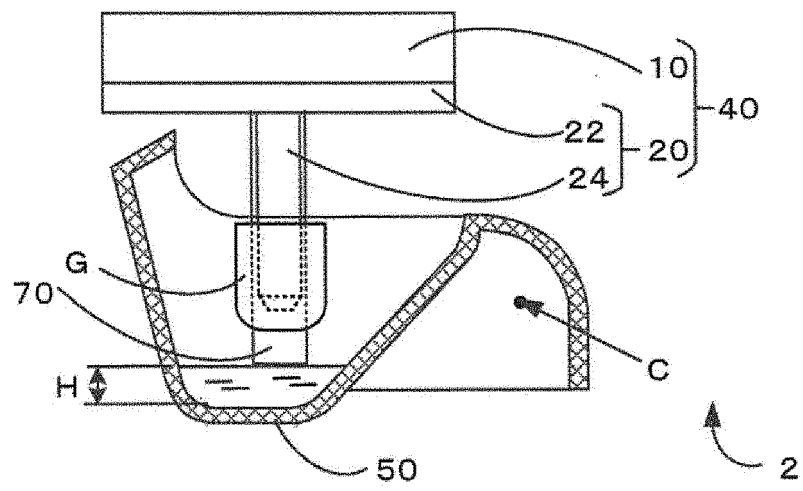


FIG. 7C

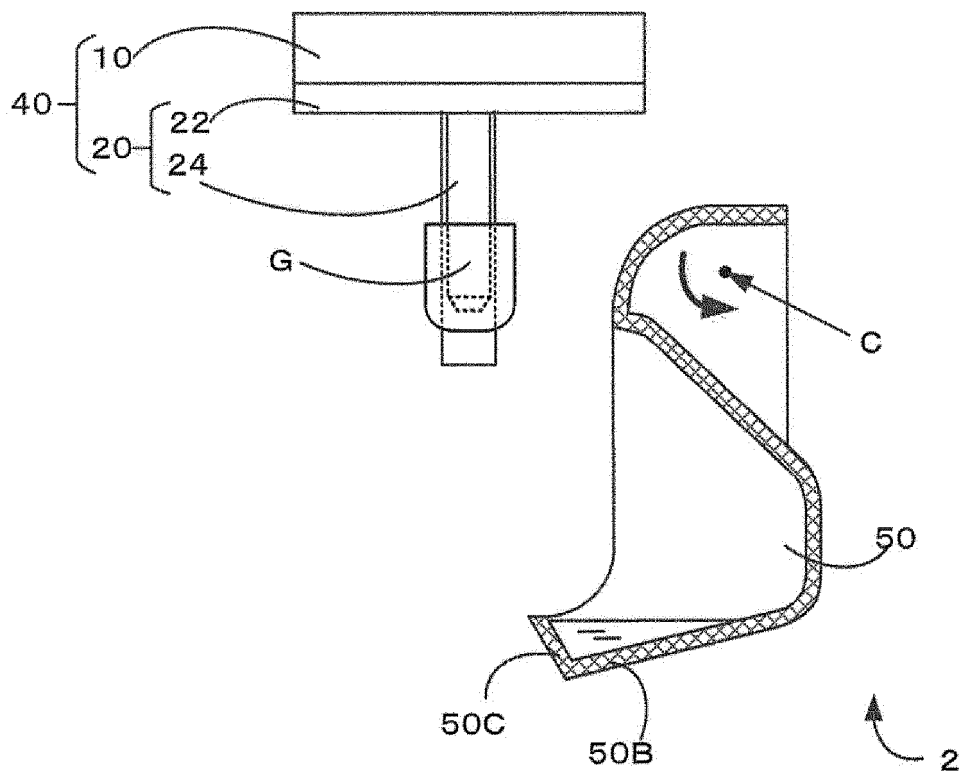


FIG. 7D

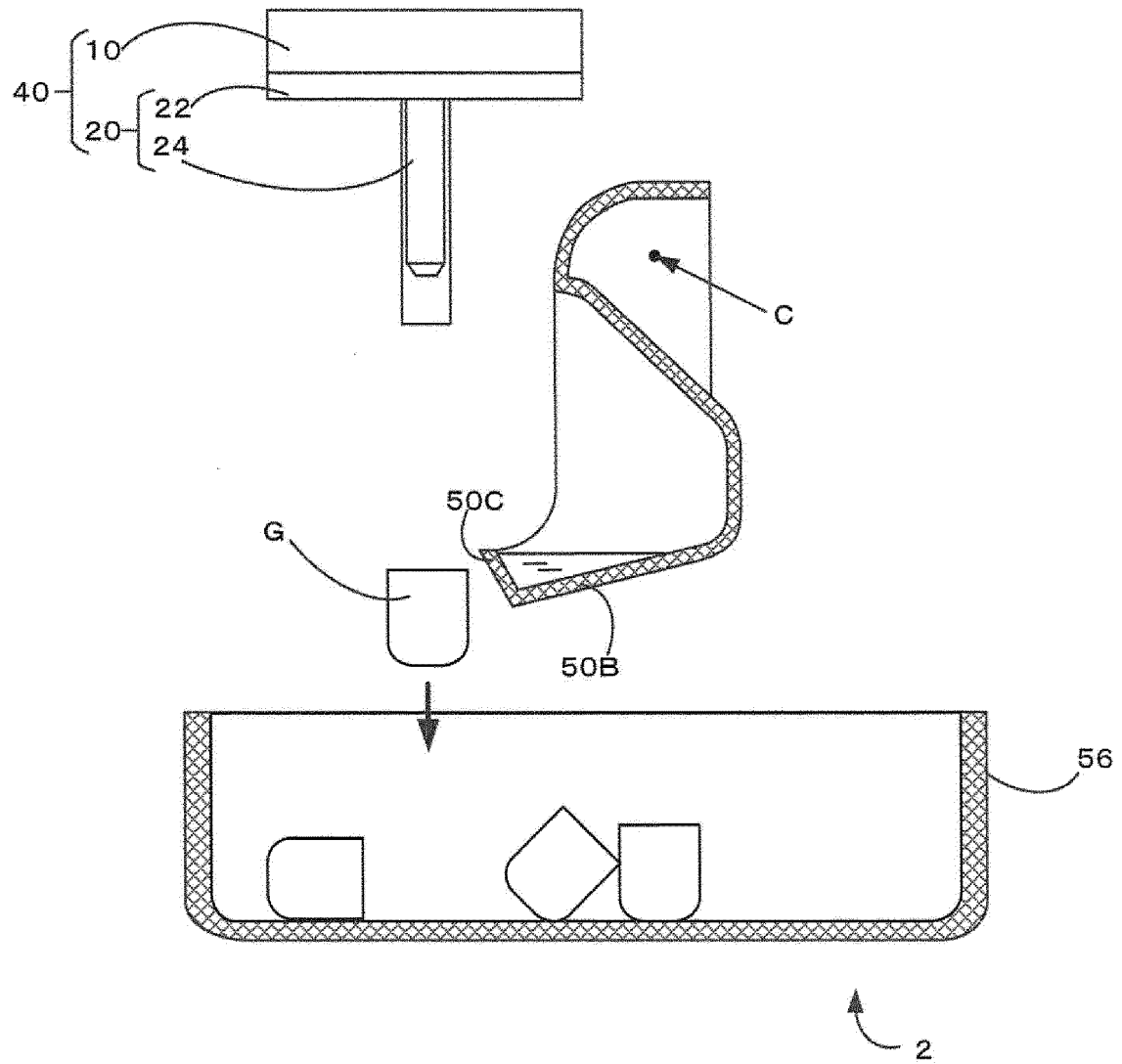


FIG. 7E

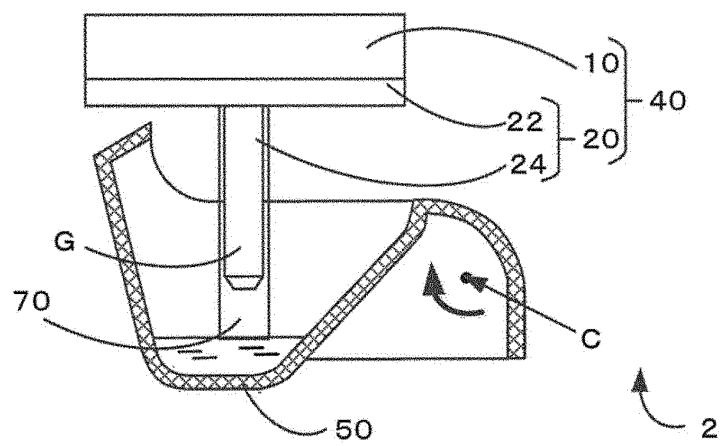


FIG. 7F

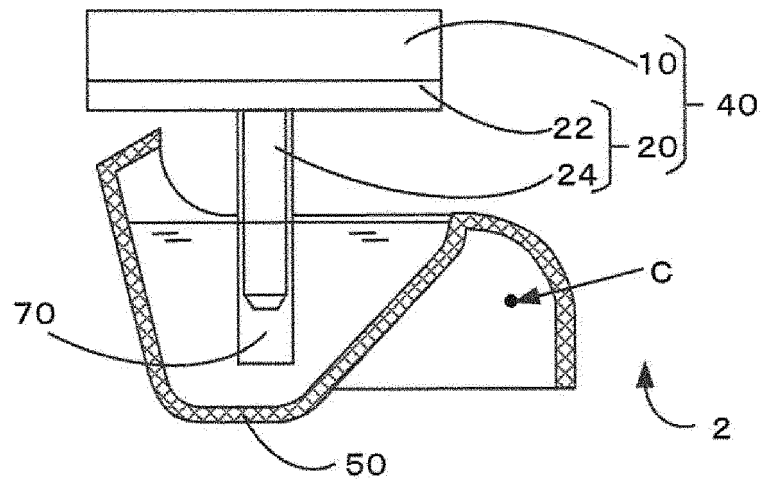


FIG. 7G

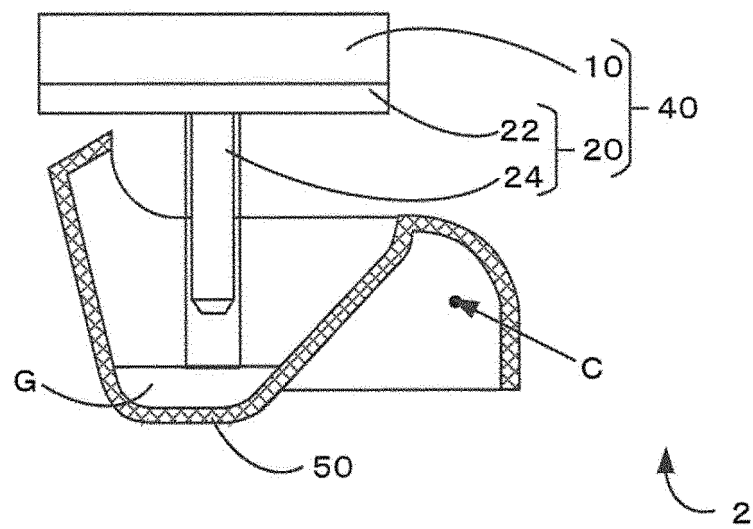


FIG. 8A

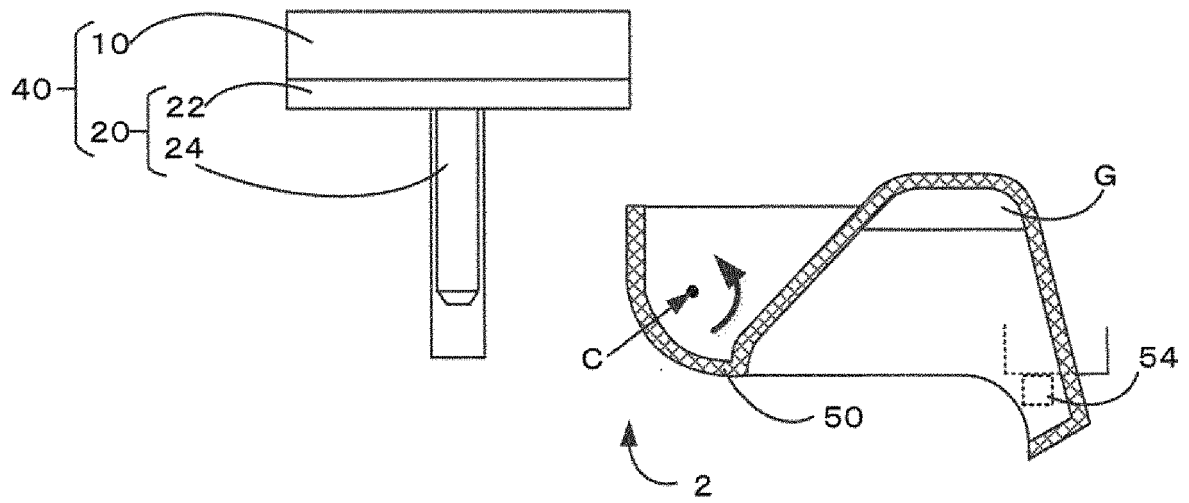


FIG. 8B

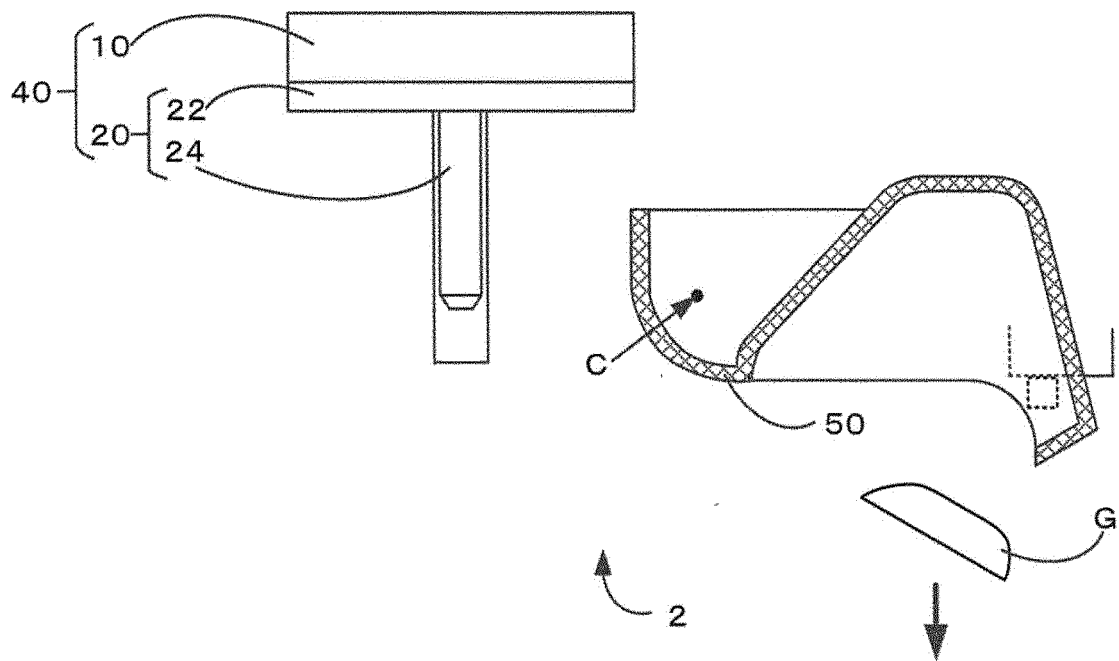


FIG. 8C

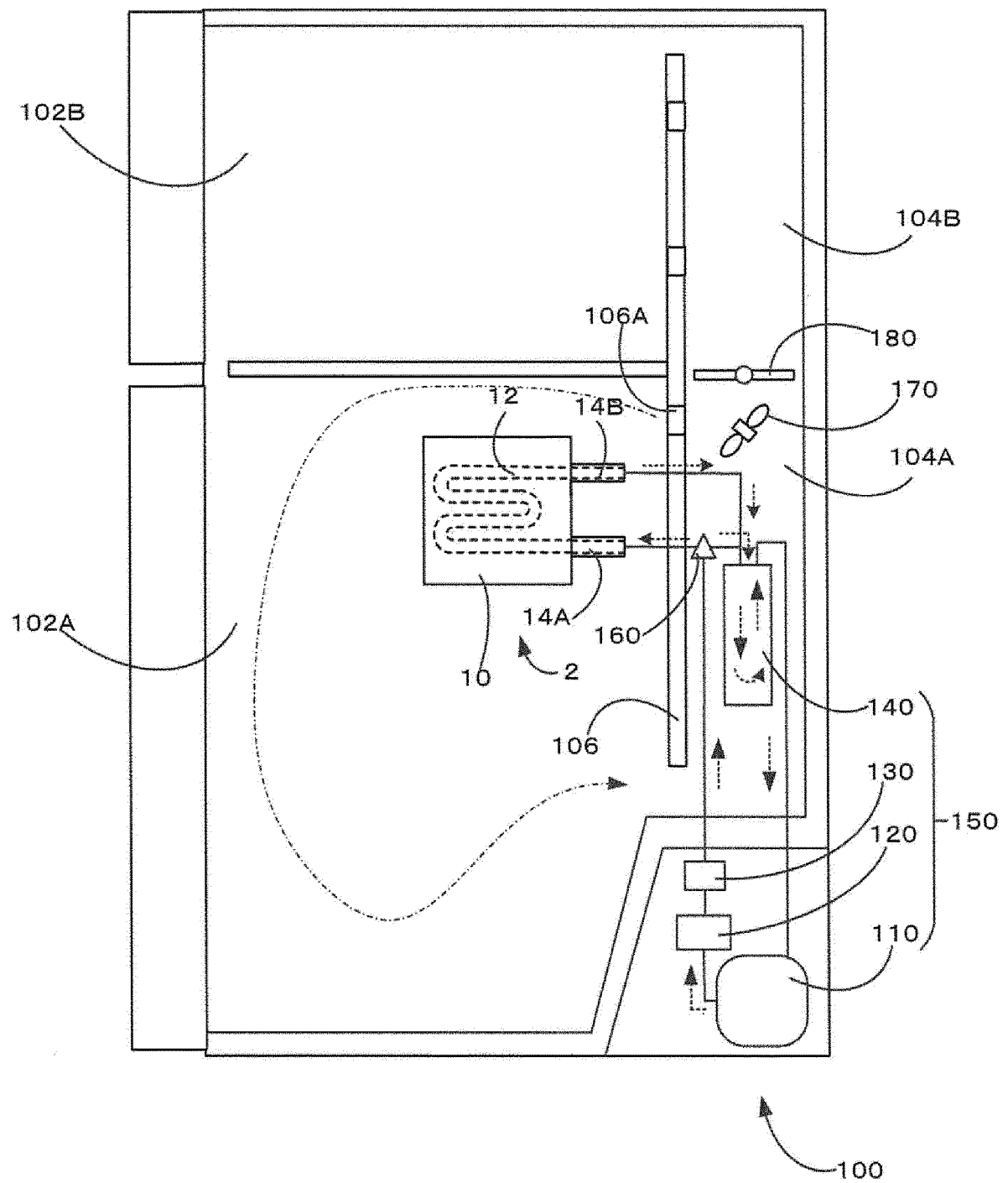


FIG.9

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2020/136817

A. CLASSIFICATION OF SUBJECT MATTER F25C 1/08(2006.01)i; F25C 5/08(2006.01)i; F25B 1/00(2006.01)i According to International Patent Classification (IPC) or to both national classification and IPC																					
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) F25C1/-, F25B1/- 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, SIPOABS, DWPI, CNTXT, JPTXT, USTXT, WOTXT, 中国期刊网全文数据库: 海尔, 制冰, 散热+蒸发, 棒+杆, 容器+腔+室+储, 移动+转, 控制, 供给, 避+躲, 脱冰, 复原, 残留+残余+剩余, 半导体, 冰箱; ice w mak+, vapor+ or vapour +, rod or bar or stick, room or contain+ or reservoir or vessel, rotat+, control+, feed+ or supply+, avoid+, remov+, remain+ or residu+, refrigerat+, semicon+																					
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>CN 102549360 A (WOONGJIN COWAY CO., LTD.) 04 July 2012 (2012-07-04) description, paragraphs [0056]-[0117], and figures 1-8</td> <td>1-6</td> </tr> <tr> <td>A</td> <td>CN 110274415 A (HEFEI HUALING CO., LTD. et al.) 24 September 2019 (2019-09-24) entire document</td> <td>1-6</td> </tr> <tr> <td>A</td> <td>CN 108895740 A (QINGDAO HAIER CO., LTD.) 27 November 2018 (2018-11-27) entire document</td> <td>1-6</td> </tr> <tr> <td>A</td> <td>CN 106123420 A (CHUZHOU FLURIDA MECHANICAL ELECTRONIC CO., LTD.) 16 November 2016 (2016-11-16) entire document</td> <td>1-6</td> </tr> <tr> <td>A</td> <td>CN 1936465 A (XU, Wenhuan) 28 March 2007 (2007-03-28) entire document</td> <td>1-6</td> </tr> <tr> <td>A</td> <td>CN 101903718 A (LG ELECTRONICS INC.) 01 December 2010 (2010-12-01) entire document</td> <td>1-6</td> </tr> </tbody> </table>	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	CN 102549360 A (WOONGJIN COWAY CO., LTD.) 04 July 2012 (2012-07-04) description, paragraphs [0056]-[0117], and figures 1-8	1-6	A	CN 110274415 A (HEFEI HUALING CO., LTD. et al.) 24 September 2019 (2019-09-24) entire document	1-6	A	CN 108895740 A (QINGDAO HAIER CO., LTD.) 27 November 2018 (2018-11-27) entire document	1-6	A	CN 106123420 A (CHUZHOU FLURIDA MECHANICAL ELECTRONIC CO., LTD.) 16 November 2016 (2016-11-16) entire document	1-6	A	CN 1936465 A (XU, Wenhuan) 28 March 2007 (2007-03-28) entire document	1-6	A	CN 101903718 A (LG ELECTRONICS INC.) 01 December 2010 (2010-12-01) entire document	1-6
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Date of the actual completion of the international search 22 February 2021	Date of mailing of the international search report 18 March 2021																				
Name and mailing address of the ISA/CN China National Intellectual Property Administration (ISA/ CN) No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088 China Facsimile No. (86-10)62019451	Authorized officer Telephone No.																				

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INTERNATIONAL SEARCH REPORT

International application No.

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Information on patent family members

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