



(11)

EP 3 653 957 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
20.05.2020 Bulletin 2020/21

(51) Int Cl.:
F25C 1/04 ^(2018.01) **F25C 5/06** ^(2006.01)
F25C 1/243 ^(2018.01) **F25C 5/20** ^(2018.01)

(21) Application number: **19209331.8**

(22) Date of filing: **15.11.2019**

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

(71) Applicant: **LG Electronics Inc.**
SEOUL, 07336 (KR)

(72) Inventors:
• **Hong, Jinil**
08592 Seoul (KR)
• **Kim, Yonghyun**
08592 Seoul (KR)

(30) Priority: **16.11.2018 KR 20180142067**
19.07.2019 KR 20190087468
19.07.2019 KR 20190087489

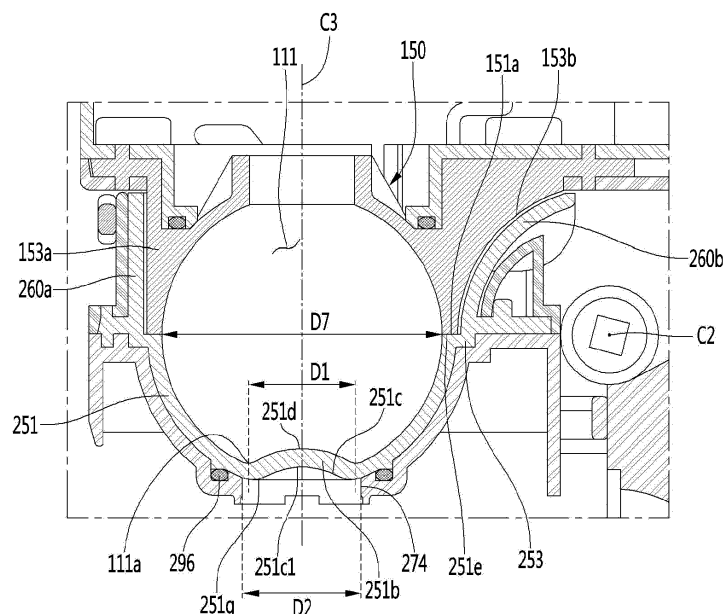
(74) Representative: **Ter Meer Steinmeister & Partner**
Patentanwälte mbB
Nymphenburger Straße 4
80335 München (DE)

(54) **ICE MAKER AND REFRIGERATOR**

(57) Provided is an ice maker for a home appliance, in particular for a refrigerator or freezer, including: an upper assembly (110) including an upper tray (150) having at least one upper chamber part (152); a lower assembly (200) including a lower support (270) and a lower tray (250) having at least one lower chamber part (252), wherein the lower assembly (200) is movable with respect to the upper assembly (110) between an open po-

sition and a closed position, wherein in the closed position, the lower chamber part (252) and the upper chamber part (152) form at least one ice chamber (111) in which ice is to be formed, and wherein the lower tray (250) has a convex portion (251b) protruding into the lower chamber part (252) and configured to be deformed towards an outside of the lower chamber part (252) for compensating a volume increase during ice formation

FIG.30



Description

BACKGROUND

[0001] The present disclosure relates to an ice maker and a refrigerator.

[0002] In general, refrigerators are home appliances for storing foods at a low temperature in a storage space that is covered by a door.

[0003] The refrigerator may cool the inside of the storage space by using cold air to store the stored food in a refrigerated or frozen state.

[0004] Generally, an ice maker for making ice is provided in the refrigerator.

[0005] The ice maker is constructed so that water supplied from a water supply source or a water tank is accommodated in a tray to make ice.

[0006] Also, the ice maker is constructed to transfer the made ice from the ice tray in a heating manner or twisting manner.

[0007] As described above, the ice maker through which water is automatically supplied, and the ice automatically transferred may be opened upward so that the made ice is pumped up.

[0008] As described above, the ice made in the ice maker may have at least one flat surface such as crescent or cubic shape.

[0009] When the ice has a spherical shape, it is more convenient to ice the ice, and also, it is possible to provide different feeling of use to a user. Also, even when the made ice is stored, a contact area between the ice cubes may be minimized to minimize a mat of the ice cubes.

[0010] Korean Patent No. 10-1850918 as Prior Art document 1 discloses an ice maker.

[0011] The ice maker of Prior Art document 1 includes an upper tray in which a plurality of upper cells of a hemispherical shape are arranged and a pair of link guides extending upwardly from both sides are disposed, and a lower tray in which a plurality of lower cells of a hemispherical shape are arranged and which is pivotally connected to the upper tray, and an ice separating heater to heat the upper tray.

[0012] Further, the ice maker includes a lower ejecting pin for separating the ice attached to the lower tray in the ice separating process.

[0013] The lower tray includes a tray body in which a plurality of lower cells are formed, a lower frame having a tray body seat on which the tray body is seated, and an upper frame having a bottom surface to which the tray body and the lower frame are fixed.

[0014] The tray body has an extension extending radially from a top surface edge of the lower cell. The tray body seat supports the extension.

[0015] In the ice maker of Prior Art document 1, the tray body seat supports only the extension of the tray body. Therefore, the lower cell is not covered by the lower frame. Thus, the lower cell is deformable by external force in the ice generation process.

[0016] In the ice-making process, water is expanded, such that an expansion force of the water acts on the lower tray.

[0017] However, in the case of Prior Art document 1, since the lower cell is not covered by the lower frame, there is a risk that the lower cell is deformed by the expansion force of the water acting on the lower cell. When the lower cell is deformed, the ice is formed in a shape corresponding to a shape of the deformed lower cell, such that the ice does not have a perfect sphere shape.

[0018] Further, in Prior Art document 1, it is possible to produce ice in a form similar to a sphere. However, since ice is frozen in each of the upper and lower cells, bubbles are present in the completed ice, so that the ice becomes opaque.

[0019] US Patent No. 2182454 as Prior Art document 2 discloses an ice cube tray.

[0020] The ice cube tray of Prior Art document 2 may include a frame and a soft rubber tray supported by the frame. The tray may include multiple pockets.

[0021] Each of the plurality of pockets has a recess in a downward recessed form defined in a lower portion thereof.

[0022] In the ice-making process, water is placed in the plurality of pockets and recesses, in which the water phase-changes into ice. Therefore, according to the Prior Art document 2, after the ice-making is completed, the ice includes a protrusion having a convex shape downwards. After the ice-making is completed, the user presses the recess to separate the ice from the tray, and, thus, the recess is deformed upwards and thus the ice is separated from the tray.

[0023] Therefore, in the Prior Art document 2, the convex portion protruding downwards from the overall shape of ice may be formed. Combining the Prior Art document 1 and Prior Art document 2 may not form the completely sphere-shaped ice.

SUMMARY

[0024] An object of the present invention is to provide an ice maker in which ice-making completed ice may maintain a sphere shape.

[0025] According to the present invention an ice maker may be provided in which a convex portion of a lower tray for producing ice in a sphere form may be easily deformed in the ice-making process.

[0026] According to the present invention an ice maker may be provided in which a convex portion deformed in an ice-making process may be further deformed in an ice separating process.

[0027] Another object of the present invention is to provide an ice maker in which ice in a form of a transparent sphere may be produced.

[0028] According to the present invention an ice maker may be provided in which heat from a lower heater may be smoothly transferred to the lower tray.

[0029] According to the present invention an ice maker

may be provided in which heat from a lower heater may be smoothly transferred to the lower tray while the lower heater for producing transparent ice does not interfere with a lower ejector for ice separation.

[0030] Another object of the present invention is to provide a refrigerator or a freezer having an ice maker according to any embodiment of the present invention.

[0031] One or more of these objects are solved by the features of the independent claim. Preferred embodiments are set out in the dependent claim.

[0032] An ice maker according to one aspect may include an upper tray to form an upper chamber as a portion of an ice chamber, a lower tray including a chamber wall to define a lower chamber as a remaining portion of the ice chamber, and a lower support for supporting the chamber wall of the lower tray, and having a lower opening defined therein.

[0033] Each of the upper chamber and the lower chamber may be formed in a hemispherical shape. Ice produced in the ice chamber composed of the upper chamber and the lower chamber may have a sphere shape.

[0034] In consideration of deformation of a portion of the chamber wall of the lower tray toward the lower opening, the chamber wall may include a convex portion. The convex portion may be convex in a direction away from the lower opening

[0035] The chamber wall may include a contact region in contact with the lower support, a non-contact region in non-contact therewith, and at least portion of the convex portion is provided on the non-contact region.

[0036] A center of the convex portion may coincide with a center of the lower opening.

[0037] The upper tray may include an upper opening, and a vertical center line passing through a center of the ice chamber may pass through the upper opening, the convex portion and the lower opening.

[0038] Before the ice-making is completed, a portion of the convex portion may be located outside of the lower opening. After completion of the ice-making, the portion of the convex portion that was located outside of the lower opening may be deformed toward the lower opening and thus is located within the lower opening, such that ice may be in a form of a sphere as a whole.

[0039] In the present embodiment, since a recess convex toward the upper tray is formed below the convex portion, the convex portion may be easily deformed by an expansion force of water, and may be easily deformed again by a pressing force in the ice separating process.

[0040] In the present embodiment, the ice maker may further include a lower ejector that passes through the lower opening and then presses the convex portion for the ice separation, and a lower heater for transferring heat to the lower tray in the ice-making process.

[0041] The lower heater may be located radially outward of the lower opening such that interference between the lower heater and the lower ejector may be prevented.

[0042] In one example, a portion of the lower heater may be constructed to surround the convex portion in the

horizontal direction.

[0043] The lower heater may be supported by the lower support.

[0044] An outer face of the chamber wall may include a round surface, and a heater contact portion for contacting the lower heater may protrude from the round surface.

[0045] A bottom surface of the heater contact portion may be planar so that the contact area thereof with the lower heater increases. The heater contact portion may be constructed to surround the convex portion.

[0046] A refrigerator according to another aspect may include a cabinet having a freezing compartment defined therein; and an ice maker that generates ice using cold air for cooling the freezing compartment. The ice maker may be an ice maker according to any one of the herein described embodiments.

[0047] The ice maker may include an upper tray defining an upper chamber; a lower tray defining a lower chamber forming an ice chamber together with the upper chamber; and a lower support supporting the lower tray and having a lower opening defined therein. The lower tray may include a convex portion that is convex toward the upper tray and disposed at a position corresponding to the lower opening.

[0048] An ice maker according to another aspect may include an upper tray to form an upper chamber as a portion of an ice chamber; a lower tray including a chamber wall forming a lower chamber as a remaining portion of the ice chamber; and a lower support for supporting the chamber wall of the lower tray, and having a lower opening defined therein, wherein the lower tray is made of a non-metallic and ductile material, wherein the chamber wall may include a convex portion that is convex in a direction away from the lower opening.

[0049] A recess convex toward the upper tray may be formed below the convex portion. Before the ice-making is completed, a portion of the convex portion is located outside of the lower opening. After completion of ice-making, the portion of the convex portion located outside of the lower opening may be deformed toward the lower opening and positioned within the lower opening.

[0050] Before the completion of ice-making, a linear dimension of the convex portion may be smaller than a linear dimension of the lower opening.

[0051] Before the ice-making, the highest level of the convex portion may be located higher than the lowest level of the ice chamber, the highest level of the recess may be located lower than the lowest level of the ice chamber.

[0052] Before the ice-making is completed, the highest level of the recess may be located higher than the lowest level of the lower tray.

[0053] The ice maker may further include a lower heater to provide heat to the lower tray in the ice-making process. The highest level of the recess may be higher than the lower heater before ice-making is completed.

[0054] A vertical centerline passing through the center of the ice chamber may pass through the lower opening.

Before the ice-making is completed, the lowest level of the lower tray may be spaced horizontally from the vertical centerline.

[0055] A distance between the lowest level of the lower tray and the vertical centerline after the completion of ice-making may be smaller than a distance between the lowest level of the lower tray and the vertical centerline before completion of ice-making.

[0056] The ice maker may include a lower ejector that passes through the lower opening and then presses the convex portion for ice separation. The lower heater may provide heat to the lower tray in the ice-making process.

[0057] The lower heater may be located radially outward of the lower opening.

[0058] At least portion of the lower heater may be constructed to surround the convex portion in a horizontal direction.

[0059] Before the ice-making is completed, the lowest level of the ice chamber may be positioned higher than the highest level of the lower heater. After completion of ice-making, the lowest level of the ice chamber may be positioned lower than the highest level of the lower heater.

[0060] Before the ice-making completion, at least a portion of the lower heater may be located higher than the lowest level of the lower tray. After the ice-making completion, the lowest level of the lower tray may be located lower than the lower heater.

[0061] The lower heater may be supported by the lower support.

[0062] An outer face of the chamber wall may include a round surface. A heater contact portion for contacting the lower heater may protrude from the round surface. A bottom surface of the heater contact portion may be planar.

[0063] The heater contact portion may be constructed to surround the convex portion.

[0064] The lower support may include a heater accommodating groove for receiving the lower heater. The heater accommodating groove may be formed by an inner wall and an outer wall.

[0065] At least a portion of the heater contact portion may be located between a top surface of the inner wall and a top surface of the outer wall while the heater contact portion is in contact with the lower heater.

[0066] Each of the top surface of the inner wall and the top surface of the outer wall may be rounded and may be in contact with the chamber wall.

[0067] An ice maker according to another aspect may include an upper tray having an upper tray body to form a plurality of upper chambers, each chamber having a hemispherical shape; a lower tray having a lower tray body to form a plurality of lower chambers, each chamber having a hemispherical shape, wherein the lower tray has a lower tray body having a top surface contacting a bottom surface of the upper tray body.

[0068] In the present embodiment, each of the upper tray and the lower tray may be formed of a silicon material.

[0069] In the present embodiment, the lower tray body may include a convex portion that is rounded and convex toward the upper chamber. In the ice generation process, the convex portion is deformed so that a protrusion of ice protruding out of the spherical ice are not formed, thereby making a sphere-shaped ice.

[0070] In order to facilitate deformation of the convex portion, the recess convex upwardly may be formed below the convex portion.

[0071] The lower tray may include a first extension extending in a horizontal direction from the lower tray body, and a circumferential wall extending from the first extension upwardly, and surrounding the upper tray body.

[0072] An inner face of the chamber wall and an outer face of the lower tray body may be spaced apart from each other.

[0073] The upper tray body may include a chamber wall forming the plurality of upper chambers. The chamber wall may include a vertical wall and a curved wall. The circumferential wall may include a first wall surrounding the vertical wall and a second wall surrounding the curved wall.

[0074] The upper tray body has an upper opening for cold air inflow, and an inlet wall extending along a circumference of the upper opening, and a first connection rib connecting the inlet wall and the upper tray body to each other.

[0075] The upper tray body may include a number of upper openings and a number of inlet walls corresponding to a number of upper chambers. Two adjacent inlet walls among a plurality of inlet walls may be connected to each other via a second connection rib.

[0076] An ice maker according to another aspect may include an upper tray to form an upper chamber as a portion of an ice chamber and a lower tray to form a lower chamber as a remaining portion of the ice chamber.

[0077] At least a portion of the lower tray may be spaced apart from the upper tray at a water supply position, and at least a portion of the lower tray may be in contact with the upper tray at an ice making position.

[0078] A hardness of the upper tray may be greater than a hardness of the lower tray such that water is prevented from leaking at a portion where the lower tray and the upper tray are in contact with each other in an ice-making process.

[0079] The upper tray and the lower tray may be made of a flexible material, which is a non-metal material. In one example, the upper tray and the lower tray may be made of a silicon material.

[0080] The ice maker may further include a lower ejector for pressing the lower tray in an ice separating process.

[0081] When the upper tray and the lower tray are made of the flexible material, and the hardness of the upper tray is greater than the hardness of the lower tray, in the ice separating process, deformation of the upper tray may be limited, and the lower tray may be deformed in a process of being pressed by the lower ejector. Ice

attached to the lower tray may be separated from the lower tray by the deformation of the lower tray.

[0082] The upper tray may include an upper tray body defining the upper chamber, and the lower tray may include a lower tray body defining the lower chamber and a circumferential wall extending from the lower tray body and surrounding the upper tray body at the ice making position.

[0083] At the ice making position, a gap may be defined between an outer face of the upper tray body and an inner face of the circumferential wall to prevent water from overflowing from the ice chamber in a process in which the lower tray moves to the ice making position after water supplying.

[0084] A thickness of the gap may be smaller than a thickness of the circumferential wall.

[0085] The upper tray body may include an upper opening. At the ice making position, an upper end of the circumferential wall may be positioned higher than the upper opening.

[0086] The ice maker may further include an upper ejector that passes through the upper opening to press the ice in the ice separating process.

[0087] The ice maker may further include a lower support for supporting the lower tray and a lower case having a circumferential wall surrounding the circumferential wall of the lower tray, thereby limiting deformation of the circumferential wall of the lower tray in an outward direction.

[0088] The circumferential wall of the lower tray may include a coupling protrusion formed thereon, and the circumferential wall of the lower case may include a coupling slit defined therein to which the coupling protrusion is coupled, thereby limiting deformation of the circumferential wall of the lower tray in an inward direction.

[0089] The ice maker may further include a lower support for supporting a portion of the lower tray and a lower case for supporting the remaining portion of the lower tray.

[0090] The lower tray may further include a horizontal extension part extending from the circumferential wall.

[0091] The lower support may be in contact with a bottom surface of the horizontal extension part. The lower case may be in contact with an upper surface of the horizontal extension part.

[0092] A protrusion may be disposed on at least one of the top surface or the bottom surface of the horizontal extension part. A slot for receiving the protrusion therein may be defined in at least one of the lower support or the lower case.

[0093] The ice maker may further include an upper support for supporting the upper tray, and an upper case for pressing a portion of the upper tray toward the upper support.

[0094] The upper tray may include an upper tray body defining the upper chamber, and a horizontal extension part extending in a horizontal direction from the upper tray body and supported by the upper support.

[0095] The upper support may include a support plate having an opening through which a portion of the upper tray passes and in contact with the bottom surface of the horizontal extension part.

[0096] The upper case may include an upper plate having an opening defined therein through which a portion of the upper tray passes, and in contact with the top surface of the horizontal extension part.

[0097] A protrusion may be disposed on at least one of the top surface or the bottom surface of the horizontal extension part. A slot for receiving the protrusion therein may be defined in at least one of the lower support or the lower case, thereby preventing deformation of the horizontal extension part.

[0098] A refrigerator according to another aspect may include a cabinet having a freezing compartment defined therein; and an ice maker using cold air for cooling the freezing compartment to make ice. The ice maker may be an ice maker according to any one of the herein described embodiments.

[0099] The ice maker may include an upper tray defining an upper chamber; and a lower tray defining a lower chamber defining an ice chamber together with the upper chamber, wherein the lower tray is rotatable with respect to the upper tray.

[0100] The upper tray and the lower tray are made of a flexible material, which is a non-metal material. A hardness of the upper tray is greater than a hardness of the lower tray.

[0101] An ice maker according to another aspect may include an upper tray defining an upper chamber, which is a portion of an ice chamber, and made of a flexible material, which is a non-metal material; and a lower tray defining a lower chamber, which is the remaining portion of the ice chamber, and made of a flexible material, which is a non-metal material.

[0102] At least a portion of the lower tray is spaced apart from the upper tray at a water supply position. Further, at least a portion of the lower tray is in contact with the upper tray at an ice making position. The hardness of the upper tray is greater than the hardness of the lower tray.

[0103] The upper tray and the lower tray may be made of the same material.

[0104] For example, the upper tray and the lower tray may be made of a silicon material.

[0105] The upper tray may include an upper tray body defining the upper chamber. Further, the lower tray may include a lower tray body defining the lower chamber, and a circumferential wall extending from the lower tray body and surrounding the upper tray body at an ice making position.

[0106] At the ice making position, a gap may be defined between an outer face of the upper tray body and an inner face of the circumferential wall. A thickness of the gap may be smaller than a thickness of the circumferential wall.

[0107] The upper tray body may include an upper

opening defined therein. At the ice making position, an upper end of the circumferential wall may be positioned higher than the upper opening.

[0108] The lower tray may further include a first extension part horizontally extending from the lower tray body. circumferential wall may extend upward from the first extension part, and a bottom surface of the upper tray body may be in contact with a bottom surface of the lower tray body.

[0109] The ice maker may further include a lower support for supporting a portion of the lower tray and a lower case for supporting the remaining portion of the lower tray. The lower tray may further include a second extension part extending from the circumferential wall.

[0110] A protrusion may be disposed on at least one of a top surface or a bottom surface of the second extension part, and a slot for receiving the protrusion therein may be defined in at least one of the lower support or the lower case.

[0111] The upper tray body may include a vertical wall and a curved wall that is rounded in a direction away from the upper chamber. The circumferential wall may include a first wall surrounding the vertical wall and a second wall surrounding the curved wall.

[0112] The first wall is a vertical wall, and the second wall is a curved wall.

[0113] The lower tray may be rotated with respect to the upper tray relative to a rotational center. Further, the second wall may be located closer to a rotational center than the first wall.

[0114] A center of curvature of the second wall may coincide with the rotational center.

[0115] The ice maker may further include a lower support for supporting the lower tray and a lower case having the circumferential wall surrounding the circumferential wall of the lower tray.

[0116] The circumferential wall of the lower tray may include a coupling protrusion formed thereon, and the circumferential wall of the lower case may include a coupling slit defined therein to which the coupling protrusion is coupled.

[0117] The ice maker may further include an upper support for supporting the upper tray, and an upper case for pressing a portion of the upper tray toward the upper support.

[0118] The upper tray may include an upper tray body defining the upper chamber, and a horizontal extension part extending in a horizontal direction from the upper tray body and supported by the upper support.

[0119] The upper support may include a support plate having an opening through which a portion of the upper tray passes and in contact with the bottom surface of the horizontal extension part.

[0120] The upper case may include an upper plate having an opening defined therein through which a portion of the upper tray passes, and in contact with the top surface of the horizontal extension part.

[0121] A protrusion may be disposed on at least one

of the top surface or the bottom surface of the horizontal extension part, and a slot for receiving the protrusion therein may be defined in at least one of the lower support or the lower case.

[0122] According to the proposed disclosure, the lower tray includes a convex portion convex toward the upper chamber. The convex portion is formed in consideration of the expansion force of water in the ice formation process. Thus, when the convex portion is deformed in the ice generation process, the convex portion forms a portion of the hemispherical lower chamber. Therefore, there is no ice portion protruding outward from the produced ice, such that the produced ice may have a sphere shape.

[0123] Further, when the heat of the lower heater is provided to the lower tray in the ice-making process, the water in an upper portion of the ice chamber may be frozen first such that the finally produced sphere-shaped ice is transparent.

[0124] Further, the convex portion of the lower tray may be pressed by the lower ejector for the ice separation. As a recess convex toward the upper tray is defined below the convex portion, the convex portion may be easily deformed during the ice-making process.

[0125] Further, in the ice separating process, the deformed block portion may be pressurized by the lower ejector and may be further deformed, thereby improving the separation performance between the ice and the lower tray.

[0126] Further, since the lower heater may be located radially outwardly of the block portion, the lower ejector and the lower heater do not interfere with each other. Further, the lower heater is positioned around the convex portion, heat from the lower heater may be transferred to the lower tray.

[0127] In addition, the upper tray and the lower tray, which may be made of the flexible material, may be in contact with each other at the ice making position. Since the hardness of the upper tray may be greater than the hardness of the lower tray, an adhesion of the portion at which the upper tray and the lower tray are in contact with each other may be improved.

[0128] When the adhesion of the portion at which the upper tray and the lower tray are in contact with each other is improved, water may be prevented from flowing between the upper tray and the lower tray and leaking in the ice-making process.

[0129] Further, according to the present embodiment, deformation and movement of the upper tray in the ice separating process may be limited, and the lower tray may be easily deformed in the process of being pressed by the lower ejector, thereby separating the ice attached to the lower tray from the lower tray.

[0130] Further, the lower tray may include the circumferential wall surrounding the upper tray at the ice making position, and there may be the gap between the circumferential wall and the outer face of the upper tray. Therefore, even when the water is oversupplied in the water supplying process, the water may be located in the gap,

thereby preventing the water in the ice chamber from overflowing to the outside of the ice maker.

[0131] In addition, since the lower support for supporting the lower tray may include the circumferential wall surrounding the circumferential wall of the lower tray, the circumferential wall of the lower tray may be prevented from being deformed outward.

[0132] In addition, the coupling protrusion is formed on the circumferential wall of the lower tray, and the coupling slit for receiving the coupling protrusion therein may be defined in the circumferential wall of the lower support. Thus, the circumferential wall may be prevented from being deformed inward.

[0133] In addition, the upper tray may include the horizontal extension part. Further, the upper case may be in contact with the top surface of the horizontal extension part, and the upper support may be in contact with the bottom surface of the horizontal extension part. Therefore, movement of the upper tray may be prevented.

[0134] In addition, the protrusion may be formed on the horizontal extension part, and the protrusion may be coupled to at least one of the upper support or the upper case. Therefore, the horizontal extension part may be prevented from being stretched and plastically deformed.

[0135] In addition, the lower tray may include the extension part extending in the horizontal direction, the lower support may be in contact with the bottom surface of the extension part, and the lower case is in contact with the bottom surface of the extension. Therefore, the extension part may be prevented from being moved while the lower tray body is deformed in the ice separating process.

[0136] In addition, the protrusion may be formed on the extension part, and the protrusion may be coupled to at least one of the lower support or the lower case. Therefore, the extension part may be prevented from being stretched and plastically deformed.

[0137] According to one aspect, an ice maker for a home appliance, in particular for a refrigerator or freezer, for making clear ice includes an upper assembly including an upper tray having at least one upper chamber part, and a lower assembly including a lower support part and a lower tray having at least one lower chamber part. The lower assembly is movable with respect to the upper assembly between an open position and a closed position, e.g. the lower assembly may be rotatable around a rotation axis. In the closed position, the lower chamber part and the upper chamber part form at least one ice chamber in which ice is to be formed.

[0138] Preferably, the ice chamber has a spherical shape in order to form spherical ice balls. In this instance, the upper chamber part may have a semispherical shape and the lower chamber part may have a semispherical shape (except for an optional convex part if present) for forming spherical ice in the ice chamber. However, the ice chamber may have any shape that is formable by an upper chamber part and a lower chamber part, e.g. a spherical shape, a pyramid shape, a star shape, and a

cylinder shape.

[0139] The lower tray and/or the lower tray body and/or the upper tray and/or the upper tray body may be made of a flexible or deformable material, such as silicon. The lower tray and the upper tray may be made of the same material. The upper tray has a lower flexibility and/or a higher hardness or stiffness than the lower tray. The lower tray may be detachably fixed to the lower assembly so that the lower tray is removable from the lower assembly for cleaning. Similarly, the upper tray may be detachably fixed to an upper assembly so that the upper tray is removable from the upper assembly for cleaning.

[0140] Preferably, the lower support part covers a portion of, e.g. more than half of, an outer surface of the lower chamber part for stabilizing a shape of the lower chamber part. That is, the lower support part may be in contact with a major part of an outside of the lower chamber part. A lower opening may be formed in the lower support part corresponding to the lower chamber part, e.g. the lower opening may be formed in the lower support part to allow an ejector to push through the lower opening against the lower tray. The lower opening may be formed in the lower support part at an intersection with a center line of the lower chamber part. That is, the lower opening may correspond to a center point of an outer surface of the lower chamber part.

[0141] The lower tray may have a convex portion protruding into the lower chamber part and configured to be deformed towards an outside of the lower chamber part for compensating a volume increase during ice formation. The convex portion may be formed corresponding to the lower opening in the lower support part.

[0142] The lower assembly may include a lower heater for heating the lower chamber part. The lower heater may be a DC heater. By means of the lower heater, it is possible to make clear ice and/or ice having a shape better corresponding to the shape of the ice chamber. The lower heater may be provided between the lower support part and the lower tray. The lower heater may be accommodated within a heater accommodation groove formed in the lower support part. The heater accommodation groove may be preferably formed adjacent to a lower opening of the lower support part. The heater accommodation groove may have a depth less than a diameter of the lower heater. Thus, the lower heater may protrude from the heater accommodation groove for improved contact with the lower tray.

[0143] The lower heater may be in contact with the lower tray. The lower tray may include a heater contact part protruding towards the lower support part. That is, the heater contact part may protrude towards the lower heater for being in contact with the lower heater, e.g. at least in the closed position of the lower assembly. The heater contact part may be formed at a position corresponding to the heater accommodation groove.

[0144] The lower heater may be positioned closer to an axis of symmetry of the lower chamber part than to a peripheral edge of the lower chamber part and/or than

to an open end surface of the lower chamber part. The lower heater may be positioned closer to a vertical center line of the lower chamber part than to a peripheral edge of the lower chamber part and/or than to an open end surface of the lower chamber part. The lower heater may be positioned such that in the closed position of the lower assembly, a connecting line between the lower heater and a center of the ice chamber forms an angle less than 45° or less than 30° with an axis of symmetry of the lower chamber part. The upper assembly may further comprise an upper heater for heating the upper chamber part. In the closed position of the lower assembly, the lower heater may be positioned closer to a vertical centerline through the ice chamber than the upper heater.

[0145] The lower tray may comprise at least three lower chamber parts, preferably positioned along a straight line. A lower chamber part that is positioned between at least two other lower chamber parts may have a smaller contact area with the lower heater than the lower chamber parts that have only one adjacent lower chamber part, i.e. that are located at outer positions. This is because the central lower chamber parts will be shielded from cold temperature more than lower chamber parts at the outer positions.

[0146] The lower tray may include a lower mold body defining the lower chamber part. The lower mold body may have a top surface or end surface for contacting the upper tray in the closed position of the lower assembly. The end surface of the lower mold body may be plane or may have a shape corresponding to the end surface of the upper tray. A circumferential wall may be formed along a peripheral edge of the lower tray. The circumferential wall may surround an open surface of the lower chamber parts and/or the end surface of the lower mold body. The circumferential wall may extend from the lower chamber part, e.g. in a vertical direction when the lower assembly is in the closed position. That is in the closed position of the lower assembly, the circumferential wall may extend towards the upper assembly. The circumferential wall of the lower tray may include a first wall portion, e.g. extending linearly or straight in the vertical direction when the lower assembly is in the closed position. The circumferential wall of the lower tray may include a curved second wall portion being bent away from the lower chamber part, e.g. with a center of the curvature being on the rotation axis. The second wall portion may be closer to the rotation axis than the first wall portion. Preferably, the lower mold body is made of flexible, i.e. deformable, material. The lower support part may cover a portion of, e.g. more than half of, an outer surface of the lower mold body for stabilizing the shape of the lower chamber part. At least a portion of the lower mold body may be separably supported by the lower support part.

[0147] The upper tray may include an upper mold body defining the upper chamber part. The upper chamber part may have a top surface or end surface for contacting an end surface of the lower tray in the closed position of the lower assembly. In the closed position of the lower as-

sembly, the upper tray may be inserted within the lower tray to form a predefined gap therebetween. In particular, the upper mold body may be inserted within the circumferential wall of the lower mold body with the end surfaces being in close contact with one another in order to form the ice chamber. The upper mold body may be inserted within the circumferential wall while being spaced apart therefrom by a predefined gap for preventing overflow of water.

[0148] The lower assembly may be rotatable with respect to the upper assembly around a horizontal rotation axis. The rotation axis may be within the same plane as an open surface of the upper chamber part and/or as an interface between the lower chamber part and the upper chamber part in the closed position.

[0149] The ice maker may further comprise a lower ejector for removing ice from the lower chamber part. The lower ejector may be arranged such that in the open position of the lower assembly, the lower ejector may be configured to penetrate through a lower opening in the lower support part and to partially separate the lower tray from the lower support part. The separation is possible since the lower tray may be deformable. The lower opening may be formed at a position corresponding to a center point of an outer surface of the lower chamber part. A contact point of the lower ejector on the lower tray may correspond to a projection of a center point of ice onto the lower tray. That is, a contact point of the lower ejector on the lower tray may correspond to a point of intersection of an axis of symmetry of the lower chamber part with the lower tray. By these means, a pushing force for pushing the ice formed in the ice chamber out of the lower tray can be applied centrally to the ice. When the lower assembly is rotatable with respect to the upper assembly around a rotation axis, the lower ejector may have a circular arc shape with a center being on the rotation axis. Preferably, the lower ejector has a flat end in order not to penetrate the lower tray. That is, an end surface of the lower ejector may be formed to be parallel to a vertical line. In other words, the end surface of the lower ejector may be formed parallel to a tangent line of an outer surface of the lower tray at a point of first contact of the lower tray with the lower ejector.

[0150] The lower tray may comprise a plurality of lower chamber parts and the upper tray may correspondingly comprise a plurality of upper chamber parts, the lower and upper chamber parts forming a plurality of ice chambers in the closed position of the lower assembly. A plurality of lower openings may be formed in the lower support part, each corresponding to one of the lower chamber parts, respectively. The lower ejector may comprise a plurality of ejecting pins, each corresponding to one of the lower chamber parts, respectively.

[0151] The ice maker may further comprise an upper ejector configured to penetrate through an upper opening for removing ice from the upper tray. In case that a plurality of ice chambers is provided, a plurality of upper openings may be formed in the upper tray, each corre-

sponding to one of the upper chamber parts, respectively. In case that a plurality of ice chambers is provided, the upper ejector may comprise a plurality of ejecting pins, each corresponding to one of the upper chamber parts, respectively. The upper ejecting pins may be arranged such as to penetrate the upper openings.

[0152] The upper tray may include at least one upper opening corresponding to the at least one upper chamber part. A water supply part may be connected to at least one upper opening for filling water into the lower assembly.

[0153] According to another aspect, a refrigerator or a freezer may include an ice maker according to any one of the herein described embodiments. The ice maker may be provided in one of a freezing compartment, a refrigerating compartment and a door for closing a freezing compartment or a refrigerating compartment.

BRIEF DESCRIPTION OF THE DRAWINGS

[0154]

FIG. 1 is a perspective view of a refrigerator according to one embodiment of the present disclosure.

FIG. 2 is a view showing a state in which a door of the refrigerator of FIG. 1 is opened.

FIG. 3 and FIG. 4 is a perspective view of an ice maker according to one embodiment of the present disclosure.

FIG. 5 is an exploded perspective view of an ice maker according to one embodiment of the present disclosure.

FIG. 6 is a top perspective view of an upper case according to one embodiment of the present disclosure.

FIG. 7 is a bottom perspective view of an upper case according to one embodiment of the present disclosure.

FIG. 8 is a top perspective view of an upper tray according to one embodiment of the present disclosure.

FIG. 9 is a bottom perspective view of an upper tray according to one embodiment of the present disclosure.

FIG. 10 is a side elevation view of an upper tray according to one embodiment of the present disclosure.

FIG. 11 is a top perspective view of an upper support according to one embodiment of the present disclosure.

FIG. 12 is a bottom perspective view of an upper support according to one embodiment of the present disclosure.

FIG. 13 is an enlarged view showing a heater coupling portion in the upper case of FIG. 6.

FIG. 14 is a view showing a state in which a heater is coupled to the upper case of FIG. 6.

FIG. 15 is a view showing a layout of a wire connect-

ed to the heater in the upper case.

FIG. 16 is a sectional view showing a state in which the upper assembly has been assembled.

FIG. 17 is a perspective view of a lower assembly according to one embodiment of the present disclosure.

FIG. 18 is a top perspective view of a lower case according to one embodiment of the present disclosure.

FIG. 19 is a bottom perspective view of a lower case according to one embodiment of the present disclosure.

FIG. 20 is a top perspective view of a lower tray according to one embodiment of the present disclosure.

FIG. 21 and FIG. 22 are bottom perspective views of a lower tray according to one embodiment of the present disclosure.

FIG. 23 is a side elevation view of a lower tray according to one embodiment of the present disclosure.

FIG. 24 is a top perspective view of a lower support according to one embodiment of the present disclosure.

FIG. 25 is a bottom perspective view of a lower support according to one embodiment of the present disclosure.

FIG. 26 is a cross-sectional view taken along a line D-D of FIG. 17 to show a state in which the lower assembly has been assembled.

FIG. 27 is a plan view of a lower support according to one embodiment of the present disclosure.

FIG. 28 is a perspective view showing a state in which a lower heater is coupled to a lower support of FIG. 27.

FIG. 29 is a view showing a state in which a lower assembly is coupled to an upper assembly and, at the same time, a wire connected to a lower heater penetrates an upper case.

FIG. 30 is a cross-sectional view taken along a A-A of FIG. 3.

FIG. 31 is a view showing a state in which ice generation is completed in FIG. 30.

FIG. 32 is a cross-sectional view taken along a B-B of FIG. 3 in a water supplied state.

FIG. 33 is a cross-sectional view taken along a B-B of FIG. 3 in the ice-making state.

FIG. 34 is a cross-sectional view taken along a B-B of FIG. 3 in the ice-making completed state.

FIG. 35 is a cross-sectional view taken along a B-B of FIG. 3 in an initial state of ice separation.

FIG. 36 is a cross-sectional view taken along a B-B of FIG. 3 in an ice separation completed state.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0155] Fig. 1 is a perspective view of a refrigerator according to an embodiment, and Fig. 2 is a view illustrating

a state in which a door of the refrigerator of Fig. 1 is opened.

[0156] Referring to Figs. 1 and 2, a refrigerator 1 according to an embodiment may include a cabinet 2 defining a storage space and a door that opens and closes the storage space.

[0157] In detail, the cabinet 2 may define the storage space that is vertically divided by a barrier. Here, a refrigerating compartment 3 may be defined at an upper side, and a freezing compartment 4 may be defined at a lower side.

[0158] Accommodation members such as a drawer, a shelf, a basket, and the like may be provided in the refrigerating compartment 3 and the freezing compartment 4.

[0159] The door may include a refrigerating compartment door 5 opening/closing the refrigerating compartment 3 and a freezing compartment door 6 opening/closing the freezing compartment 4.

[0160] The refrigerating compartment door 5 may be constituted by a pair of left and right doors and be opened and closed through rotation thereof. Also, the freezing compartment door 6 may be inserted and withdrawn in a drawer manner.

[0161] Alternatively, the arrangement of the refrigerating compartment 3 and the freezing compartment 4 and the shape of the door may be changed according to kinds of refrigerators, but are not limited thereto. For example, the embodiments may be applied to various kinds of refrigerators. For example, the freezing compartment 4 and the refrigerating compartment 3 may be disposed at left and right sides, or the freezing compartment 4 may be disposed above the refrigerating compartment 3.

[0162] An ice maker 100 may be provided in the freezing compartment 4. The ice maker 100 is constructed to make ice by using supplied water. Here, the ice may have a spherical shape. Alternatively, the ice maker 100 may be provided in the freezing compartment door 6, the refrigerating compartment 3, or the freezing compartment door 5.

[0163] Also, an ice bin 102 in which the made ice is stored after being transferred from the ice maker 100 may be further provided below the ice maker 100.

[0164] The ice maker 100 and the ice bin 102 may be mounted in the freezing compartment 4 in a state of being respectively mounted in separate housings 101.

[0165] A user may open the refrigerating compartment door 6 to approach the ice bin 102, thereby obtaining the ice.

[0166] For another example, a dispenser 7 for dispensing purified water or the made ice to the outside may be provided in the refrigerating compartment door 5.

[0167] Also, the ice made in the ice maker 100 or the ice stored in the ice bin 102 after being made in the ice maker 100 may be transferred to the dispenser 7 by a transfer unit. Thus, the user may obtain the ice from the dispenser 7.

[0168] Hereinafter, the ice maker will be described in

detail with reference to the accompanying drawings.

[0169] Figs. 3 and 4 are perspective views of the ice maker according to an embodiment, and Fig. 5 is an exploded perspective view of the ice maker according to an embodiment.

[0170] Referring to Figs. 3 to 5, the ice maker 100 may include an upper assembly 110 (or upper tray assembly) and a lower assembly 200 (or lower tray assembly).

[0171] The lower assembly 200 may rotate with respect to the upper assembly 110. For example, the lower assembly 200 may be connected to be rotatable with respect to the upper assembly 110.

[0172] In a state in which the lower assembly 200 contacts the upper assembly 110, the lower assembly 200 together with the upper assembly 110 may make spherical ice.

[0173] That is, the upper assembly 110 and the lower assembly 200 may define an ice chamber 111 for making the spherical ice. The ice chamber 111 may have a chamber having a substantially spherical shape.

[0174] As used herein, a term "spherical or hemisphere form" not only includes a geometrically complete sphere or hemisphere form but also a geometrically complete sphere-like or geometrically complete hemisphere-like form.

[0175] The upper assembly 110 and the lower assembly 200 may define a plurality of ice chambers 111.

[0176] Hereinafter, a structure in which three ice chambers are defined by the upper assembly 110 and the lower assembly 200 will be described as an example, and also, the embodiments are not limited to the number of ice chambers 111.

[0177] In the state in which the ice chamber 111 is defined by the upper assembly 110 and the lower assembly 200, water is supplied to the ice chamber 111 through a water supply part 190.

[0178] The water supply part 190 is coupled to the upper assembly 110 to guide water supplied from the outside to the ice chamber 111.

[0179] After the ice is made, the lower assembly 200 may rotate in a forward direction. Thus, the spherical ice made between the upper assembly 110 and the lower assembly 200 may be separated from the upper assembly 110 and the lower assembly 200.

[0180] The ice maker 100 may further include a driving unit 180 so that the lower assembly 200 is rotatable with respect to the upper assembly 110.

[0181] The driving unit 180 may include a driving motor and a power transmission part for transmitting power of the driving motor to the lower assembly 200. The power transmission part may include one or more gears.

[0182] The driving motor may be a bi-directional rotatable motor. Thus, the lower assembly 200 may rotate in both directions.

[0183] The ice maker 100 may further include an upper ejector 300 so that the ice is capable of being separated from the upper assembly 110.

[0184] The upper ejector 300 may be constructed so

that the ice closely attached to the upper assembly 110 is separated from the upper assembly 110.

[0185] The upper ejector 300 may include an upper ejector body 310 and a plurality of upper ejecting pins 320 extending in a direction crossing the upper ejector body 310.

[0186] The upper ejecting pins 320 may be provided in the same number of ice chambers 111.

[0187] A separation prevention protrusion 312 for preventing a connection unit 350 from being separated in the state of being coupled to the connection unit 350 that will be described later may be provided on each of both ends of the ejector body 310.

[0188] For example, the pair of separation prevention protrusions 312 may protrude in opposite directions from the ejector body 310.

[0189] While the upper ejecting pin 320 passing through the upper assembly 110 and inserted into the ice chamber 111, the ice within the ice chamber 111 may be pressed.

[0190] The ice pressed by the upper ejecting pin 320 may be separated from the upper assembly 110.

[0191] Also, the ice maker 100 may further include a lower ejector 400 so that the ice closely attached to the lower assembly 200 is capable of being separated.

[0192] The lower ejector 400 may press the lower assembly 200 to separate the ice closely attached to the lower assembly 200 from the lower assembly 200. For example, the lower ejector 400 may be fixed to the upper assembly 110.

[0193] The lower ejector 400 may include a lower ejector body 410 and a plurality of lower ejecting pins 420 protruding from the lower ejector body 410. The lower ejecting pins 420 may be provided in the same number of ice chambers 111.

[0194] While the lower assembly 200 rotates to transfer the ice, rotation force of the lower assembly 200 may be transmitted to the upper ejector 300.

[0195] For this, the ice maker 100 may further include the connection unit 350 connecting the lower assembly 200 to the upper ejector 300. The connection unit 350 may include one or more links.

[0196] For example, when the lower assembly 200 rotates in one direction, the upper ejector 300 may descend by the connection unit 350 to allow the upper ejector pin 320 to press the ice.

[0197] On the other hand, when the lower assembly 200 rotates in the other direction, the upper ejector 300 may ascend by the connection unit 350 to return to its original position.

[0198] Hereinafter, the upper assembly 110 and the lower assembly 200 will be described in more detail.

[0199] The upper assembly 110 may include an upper tray 150 defining a portion of the ice chamber 111 making the ice. For example, the upper tray 150 may define an upper portion of the ice chamber 111. The upper tray 150 may be called as a first tray. Alternatively, the upper tray 150 may be called as an upper mold part.

[0200] The upper assembly 110 may further include an upper support 170 fixing a position of the upper tray 150. The upper support 170 may restrict downward movement of the upper tray 150. The upper assembly 110 may further include an upper case 120 fixing a position of the upper tray 150. The upper case 120 may press a portion of the upper tray 150 toward the upper support 170.

[0201] The upper tray 150 may be disposed below the upper case 120. A portion of the upper support 170 may be disposed below the upper tray 150.

[0202] As described above, the upper case 120, the upper tray 150, and the upper support 170, which are vertically aligned, may be coupled to each other through a coupling member.

[0203] That is, the upper tray 150 may be fixed to the upper case 120 through coupling of the coupling member.

[0204] For example, the water supply part 190 may be fixed to the upper case 120.

[0205] The ice maker 100 may further include a temperature sensor 500 detecting a temperature of the upper tray 150.

[0206] For example, the temperature sensor 500 may be mounted on the upper case 120. Also, when the upper tray 150 is fixed to the upper case 120, the temperature sensor 500 may contact the upper tray 150.

[0207] The lower assembly 200 may include a lower tray 250 defining the other portion of the ice chamber 111 making the ice. For example, the lower tray 250 may define a lower portion of the ice chamber 111.

[0208] The lower tray 250 may be called as a second tray. Alternatively, the lower tray 250 may be called as a lower mold part.

[0209] The lower assembly 200 may further include a lower support 270 supporting a lower portion of the lower tray 250. The lower assembly 200 may further include a lower case 210 of which at least a portion covers an upper side of the lower tray 250.

[0210] The lower case 210, the lower tray 250, and the lower support 270 may be coupled to each other through a coupling member.

[0211] The ice maker 100 may further include a switch for turning on/off the ice maker 100. When the user turns on the switch 600, the ice maker 100 may make ice.

[0212] That is, when the switch 600 is turned on, water may be supplied to the ice maker 100. Then, an ice making process of making ice by using cold air and an ice transfer process of transferring the ice through the rotation of the lower assembly 200.

[0213] On the other hand, when the switch 600 is manipulated to be turned off, the making of the ice through the ice maker 100 may be impossible. For example, the switch 600 may be provided in the upper case 120.

<Upper case>

[0214] Fig. 6 is a top perspective view of the upper

case according to an embodiment, and Fig. 7 is a bottom perspective view of the upper case according to an embodiment.

[0215] Referring to Figs. 6 and 7, the upper case 120 may be fixed to a housing 101 within the freezing compartment 4 in a state in which the upper tray 150 is fixed.

[0216] The upper case 120 may include an upper plate for fixing the upper tray 150.

[0217] The upper tray 150 may be fixed to the upper plate 121 in a state in which a portion of the upper tray 150 contacts a bottom surface of the upper plate 121.

[0218] An opening 123 through which a portion of the upper tray 150 passes may be defined in the upper plate 121.

[0219] For example, when the upper tray 150 is fixed to the upper plate 121 in a state in which the upper tray 150 is disposed below the upper plate 121, a portion of the upper tray 150 may protrude upward from the upper plate 121 through the opening 123.

[0220] Alternatively, the upper tray 150 may not protrude upward from the upper plate 121 through opening 123 but protrude downward from the upper plate 121 through the opening 123.

[0221] The upper plate 121 may include a recess 122 that is recessed downward. The opening 123 may be defined in a bottom surface 122a of the recess 122.

[0222] Thus, the upper tray 150 passing through the opening 123 may be disposed in a space defined by the recess 122.

[0223] A heater coupling part 124 for coupling an upper heater (see reference numeral 148 of Fig. 14) that heats the upper tray 150 so as to transfer the ice may be provided in the upper case 120.

[0224] For example, the heater coupling part 124 may be provided on the upper plate 121. The heater coupling part 124 may be disposed below the recess 122.

[0225] The upper case 120 may further include a plurality of installation ribs 128 and 129 for installing the temperature sensor 500.

[0226] The pair of installation ribs 128 and 129 may be disposed to be spaced apart from each other in a direction of an arrow B of FIG. 7. The pair of installation ribs 128 and 129 may be disposed to face each other, and the temperature sensor 500 may be disposed between the pair of installation ribs 128 and 129.

[0227] The pair of installation ribs 128 and 129 may be provided on the upper plate 121.

[0228] A plurality of slots 131 and 132 coupled to the upper tray 150 may be provided in the upper plate 121.

[0229] A portion of the upper tray 150 may be inserted into the plurality of slots 131 and 132.

[0230] The plurality of slots 131 and 132 may include a first upper slot 131 and a second upper slot 132 disposed at an opposite side of the first upper slot 131 with respect to the opening 123.

[0231] The opening 123 may be defined between the first upper slot 131 and the second upper slot 132.

[0232] The first upper slot 131 and the second upper

slot 132 may be spaced apart from each other in a direction of an arrow B of Fig. 7.

[0233] Although not limited, the plurality of first upper slots 131 may be arranged to be spaced apart from each other in a direction of an arrow A (hereinafter, referred to as a first direction) that a direction crossing a direction of an arrow B (hereinafter, referred to as a second direction).

[0234] Also, the plurality of second upper slots 132 may be arranged to be spaced apart from each other in the direction of the arrow A.

[0235] In this specification, the direction of the arrow A may be the same direction as the arranged direction of the plurality of ice chambers 111.

[0236] For example, the first upper slot 131 may be defined in a curved shape. Thus, the first upper slot 131 may increase in length.

[0237] For example, the second upper slot 132 may be defined in a curved shape. Thus, the second upper slot 133 may increase in length.

[0238] When each of the upper slots 131 and 132 increases in length, a protrusion (that is disposed on the upper tray) inserted into each of the upper slots 131 and 132 may increase in length to improve coupling force between the upper tray 150 and the upper case 120.

[0239] A distance between the first upper slot 131 and the opening 123 may be different from that between the second upper slot 132 and the opening 123. For example, the distance between the first upper slot 131 and the opening 123 may be greater than that between the second upper slot 132 and the opening 123.

[0240] Also, when viewed from the opening 123 toward each of the upper slots 131, a shape that is convexly rounded from each of the slots 131 toward the outside of the opening 123 may be provided.

[0241] The upper plate 121 may further include a sleeve 133 into which a coupling boss of the upper support, which will be described later, is inserted.

[0242] The sleeve 133 may have a cylindrical shape and extend upward from the upper plate 121.

[0243] For example, a plurality of sleeves 133 may be provided on the upper plate 121. The plurality of sleeves 133 may be arranged to be spaced apart from each other in the direction of the arrow A. Also, the plurality of sleeves 133 may be arranged in a plurality of rows in the direction of the arrow B.

[0244] A portion of the plurality of sleeves may be disposed between the two first upper slots 131 adjacent to each other.

[0245] The other portion of the plurality of sleeves may be disposed between the two second upper slots 132 adjacent to each other or be disposed to face a region between the two second upper slots 132.

[0246] The upper case 120 may further include a plurality of hinge supports 135 and 136 allowing the lower assembly 200 to rotate.

[0247] The plurality of hinge supports 135 and 136 may be disposed to be spaced apart from each other in the

direction of the arrow A with respect to Fig. 7. Also, a first hinge hole 137 may be defined in each of the hinge supports 135 and 136.

[0248] For example, the plurality of hinge supports 135 and 136 may extend downward from the upper plate 121.

[0249] The upper case 120 may further include a vertical extension part 140 vertically extending along a circumference of the upper plate 121. The vertical extension part 140 may extend upward from the upper plate 121.

[0250] The vertical extension part 140 may include one or more coupling hooks 140a. The upper case 120 may be hook-coupled to the housing 101 by the coupling hooks 140a.

[0251] The water supply part 190 may be coupled to the vertical extension part 140.

[0252] The upper case 120 may further include a horizontal extension part 142 horizontally extending to the outside of the vertical extension part 140.

[0253] A screw coupling part 142a protruding outward to screw-couple the upper case 120 to the housing 101 may be provided on the horizontal extension part 142.

[0254] The upper case 120 may further include a side circumferential part 143. The side circumferential part 143 may extend downward from the horizontal extension part 142.

[0255] The side circumferential part 143 may be disposed to surround a circumference of the lower assembly 200. That is, the side circumferential part 143 may prevent the lower assembly 200 from being exposed to the outside.

[0256] Although the upper case is coupled to the separate housing 101 within the freezing compartment 4 as described above, the embodiment is not limited thereto. For example, the upper case 120 may be directly coupled to a wall defining the freezing compartment 4.

<Upper tray>

[0257] Fig. 8 is a top perspective view of the upper tray according to an embodiment, Fig. 9 is a bottom perspective view of the upper tray according to an embodiment, and Fig. 10 is a side view of the upper tray according to an embodiment.

[0258] Referring to Figs. 8 to 10, the upper tray 150 may be made of a non-metal material and a flexible material that is capable of being restored to its original shape after being deformed by an external force.

[0259] For example, the upper tray 150 may be made of a silicon material. Like this embodiment, when the upper tray 150 is made of the silicon material, even though external force is applied to deform the upper tray 150 during the ice transfer process, the upper tray 150 may be restored to its original shape. Thus, in spite of repetitive ice making, spherical ice may be made.

[0260] If the upper tray 150 is made of a metal material, when the external force is applied to the upper tray 150 to deform the upper tray 150 itself, the upper tray 150 may not be restored to its original shape any more.

[0261] In this case, after the upper tray 150 is deformed in shape, the spherical ice may not be made. That is, it is impossible to repeatedly make the spherical ice.

[0262] On the other hand, like this embodiment, when the upper tray 150 is made of the flexible material that is capable of being restored to its original shape, this limitation may be solved.

[0263] Also, when the upper tray 150 is made of the silicon material, the upper tray 150 may be prevented from being melted or thermally deformed by heat provided from an upper heater that will be described later.

[0264] In addition, when the upper tray 150 is made of the flexible material, cohesion or adhesion between the ice and the upper tray 150 may be reduced, so that the ice may be easily separated from the upper tray 150.

[0265] The upper tray 150 may include an upper tray body 151 defining an upper chamber or upper chamber part 152 that is a portion of the ice chamber 111. The upper tray body 151 may be called as an upper mold body.

[0266] The upper tray body 151 may be define a plurality of upper chambers 152.

[0267] For example, the plurality of upper chambers 152 may define a first upper chamber 152a, a second upper chamber 152b, and a third upper chamber 152c.

[0268] The upper tray body 151 may include three chamber walls 153 defining three independent upper chambers 152a, 152b, and 152c. The three chamber walls 153 may be connected to each other to form one body.

[0269] The first upper chamber 152a, the second upper chamber 152b, and the third upper chamber 152c may be arranged in a line. For example, the first upper chamber 152a, the second upper chamber 152b, and the third upper chamber 152c may be arranged in a direction of an arrow A with respect to Fig. 9. The direction of the arrow A of Fig. 9 may be the same direction as the direction of the arrow A of Fig. 7.

[0270] At least an inner circumferential surface of the chamber wall 153 may have a hemispherical shape. Accordingly, the upper chamber 152 may have a hemispherical shape. That is, an upper portion of the spherical ice may be made by the upper chamber 152.

[0271] An upper opening 154 through which water is introduced into the upper chamber may be defined in an upper side of the upper tray body 151. For example, three upper openings 154 may be defined in the upper tray body 151. Cold air may be guided into the ice chamber 111 through the upper opening 154.

[0272] In the ice transfer process, the upper ejector 300 may be inserted into the upper chamber 152 through the upper opening 154.

[0273] While the upper ejector 300 is inserted through the upper opening 154, an inlet wall 155 may be provided on the upper tray 150 to minimize deformation of the upper opening 154 in the upper tray 150.

[0274] The inlet wall 155 may be disposed along a circumference of the upper opening 154 and extend upward from the upper tray body 151.

[0275] The inlet wall 155 may have a cylindrical shape. Thus, the upper ejector 30 may pass through the upper opening 154 via an inner space of the inlet wall 155.

[0276] One or more first connection ribs 155a may be provided along a circumference of the inlet wall 155 to prevent the inlet wall 155 from being deformed while the upper ejector 300 is inserted into the upper opening 154.

[0277] The first connection rib 155a may connect the inlet wall 155 to the upper tray body 151. For example, the first connection rib 155a may be integrated with the circumference of the inlet wall 155 and an outer face of the upper tray body 151.

[0278] Although not limited, the plurality of connection ribs 155a may be disposed along the circumference of the inlet wall 155.

[0279] The two inlet walls 155 corresponding to the second upper chamber 152b and the third upper chamber 152c may be connected to each other through the second connection rib 162. The second connection rib 162 may also prevent the inlet wall 155 from being deformed.

[0280] A water supply guide 156 may be provided in the inlet wall 155 corresponding to one of the three upper chambers 152a, 152b, and 152c.

[0281] Although not limited, the water supply guide 156 may be provided in the inlet wall corresponding to the second upper chamber 152b.

[0282] The water supply guide 156 may be inclined upward from the inlet wall 155 in a direction which is away from the second upper chamber 152b.

[0283] The upper tray 150 may further include a first accommodation part 160. The recess 122 of the upper case 120 may be accommodated in the first accommodation part 160.

[0284] A heater coupling part 124 may be provided in the recess 122, and an upper heater (see reference numeral 148 of Fig. 14) may be provided in the heater coupling part 124. Thus, it may be understood that the upper heater (see reference numeral 148 of Fig. 14) is accommodated in the first accommodation part 160.

[0285] The first accommodation part 160 may be disposed in a shape that surrounds the upper chambers 152a, 152b, and 152c. The first accommodation part 160 may be provided by recessing a top surface of the upper tray body 151 downward.

[0286] The heater coupling part 124 to which the upper heater (see reference numeral 148 of Fig. 14) is coupled may be accommodated in the first accommodation part 160.

[0287] The upper tray 150 may further include a second accommodation part 161 (or referred to as a sensor accommodation part) in which the temperature sensor 500 is accommodated.

[0288] For example, the second accommodation part 161 may be provided in the upper tray body 151. Although not limited, the second accommodation part 161 may be provided by recessing a bottom surface of the first accommodation part 160 downward.

[0289] Also, the second accommodation part 161 may be disposed between the two upper chambers adjacent to each other. For example, the second accommodation part 161 may be disposed between the first upper chamber 152a and the second upper chamber 152b.

[0290] Thus, an interference between the upper heater (see reference numeral 148 of Fig. 14) accommodated in the first accommodation part 160 and the temperature sensor 500 may be prevented.

[0291] In the state in which the temperature sensor 500 is accommodated in the second accommodation part 161, the temperature sensor 500 may contact an outer face of the upper tray body 151.

[0292] The chamber wall 153 of the upper tray body 151 may include a vertical wall 153a and a curved wall 153b.

[0293] The curved wall 153b may be rounded upward in a direction that is away from the upper chamber 152.

[0294] The upper tray 150 may further include a horizontal extension part 164 horizontally extending from the circumference of the upper tray body 151. For example, the horizontal extension part 164 may extend along a circumference of an upper edge of the upper tray body 151.

[0295] The horizontal extension part 164 may contact the upper case 120 and the upper support 170.

[0296] For example, a bottom surface 164b (or referred to as a "first surface") of the horizontal extension part 164 may contact the upper support 170, and a top surface 164a (or referred to as a "second surface") of the horizontal extension part 164 may contact the upper case 120.

[0297] At least a portion of the horizontal extension part 164 may be disposed between the upper case 120 and the upper support 170.

[0298] The horizontal extension part 164 may include a plurality of upper protrusions 165 and 166 respectively inserted into the plurality of upper slots 131 and 132.

[0299] The plurality of upper protrusions 165 and 166 may include a first upper protrusion 165 and a second upper protrusion 166 disposed at an opposite side of the first upper protrusion 165 with respect to the upper opening 154.

[0300] The first upper protrusion 165 may be inserted into the first upper slot 131, and the second upper protrusion 166 may be inserted into the second upper slot 132.

[0301] The first upper protrusion 165 and the second upper protrusion 166 may protrude upward from the top surface 164a of the horizontal extension part 164.

[0302] The first upper protrusion 165 and the second upper protrusion 166 may be spaced apart from each other in the direction of the arrow B of Fig. 9. The direction of the arrow B of Fig. 8 may be the same direction as the direction of the arrow B of Fig. 7.

[0303] Although not limited, the plurality of first upper protrusions 165 may be arranged to be spaced apart from each other in the direction of the arrow A.

[0304] The plurality of second upper protrusions 166 may be arranged to be spaced apart from each other in the direction of the arrow A.

[0305] For example, the first upper protrusion 165 may be provided in a curved shape. Also, for example, the second upper protrusion 166 may be provided in a curved shape.

[0306] In this embodiment, each of the upper protrusions 165 and 166 may be constructed so that the upper tray 150 and the upper case 120 are coupled to each other, and also, the horizontal extension part is prevented from being deformed during the ice making process or the ice transfer process.

[0307] Here, when each of the upper protrusions 165 and 166 is provided in the curved shape, distances between the upper protrusions 165 and 166 and the upper chamber 152 in a longitudinal direction of the upper protrusions 165 and 166 may be equal or similar to each other to effectively prevent the horizontal extension parts 264 from being deformed.

[0308] For example, the deformation in the horizontal direction of the horizontal extension part 264 may be minimized to prevent the horizontal extension part 264 from being plastic-deformed. If when the horizontal extension part 264 is plastic-deformed, since the upper tray body is not positioned at the correct position during the ice making, the shape of the ice may not close to the spherical shape.

[0309] The horizontal extension part 164 may further include a plurality of lower protrusions 167 and 168. The plurality of lower protrusions 167 and 168 may be inserted into a lower slot of the upper support 170, which will be described below.

[0310] The plurality of lower protrusions 167 and 168 may include a first lower protrusion 167 and a second lower protrusion 168 disposed at an opposite side of the first lower protrusion 167 with respect to the upper chamber 152.

[0311] The first lower protrusion 167 and the second lower protrusion 168 may protrude upward from the bottom surface 164b of the horizontal extension part 164.

[0312] The first lower protrusion 167 may be disposed at an opposite to the first upper protrusion 165 with respect to the horizontal extension part 164. The second lower protrusion 168 may be disposed at an opposite side of the second upper protrusion 166 with respect to the horizontal extension part 164.

[0313] The first lower protrusion 167 may be spaced apart from the vertical wall 153a of the upper tray body 151. The second lower protrusion 168 may be spaced apart from the curved wall 153b of the upper tray body 151.

[0314] Each of the plurality of lower protrusions 167 and 168 may also be provided in a curved shape. Since the protrusions 165, 166, 167, and 168 are disposed on each of the top and bottom surfaces 164a and 164b of the horizontal extension part 164, the deformation in the horizontal direction of the horizontal extension part 164

may be effectively prevented.

[0315] A through-hole 169 through which the coupling boss of the upper support 170, which will be described later, may be provided in the horizontal extension part 164.

[0316] For example, a plurality of through-holes 169 may be provided in the horizontal extension part 164.

[0317] A portion of the plurality of through-holes 169 may be disposed between the two first upper protrusions 165 adjacent to each other or the two first lower protrusions 167 adjacent to each other.

[0318] The other portion of the plurality of through-holes 169 may be disposed between the two second lower protrusions 168 adjacent to each other or be disposed to face a region between the two second lower protrusions 168.

<Upper support>

[0319] Fig. 11 is a top perspective view of the upper support according to an embodiment, and Fig. 12 is a bottom perspective view of the upper support according to an embodiment.

[0320] Referring to Figs. 11 and 12, the upper support 170 may include a support plate 171 contacting the upper tray 150.

[0321] For example, a top surface of the support plate 171 may contact the bottom surface 164b of the horizontal extension part 164 of the upper tray 150.

[0322] A plate opening 172 through which the upper tray body 151 passes may be defined in the support plate 171.

[0323] A circumferential wall 174 that is bent upward may be provided on an edge of the support plate 171.

For example, the circumferential wall 174 may contact at least a portion of a circumference of a side surface of the horizontal extension part 164.

[0324] Also, a top surface of the circumferential wall 174 may contact a bottom surface of the upper plate 121.

[0325] The support plate 171 may include a plurality of lower slots 176 and 177.

[0326] The plurality of lower slots 176 and 177 may include a first lower slot 176 into which the first lower protrusion 167 is inserted and a second lower slot 177 into which the second lower protrusion 168 is inserted.

[0327] The plurality of first lower slots 176 may be disposed to be spaced apart from each other in the direction of the arrow A on the support plate 171. Also, the plurality of second lower slots 177 may be disposed to be spaced apart from each other in the direction of the arrow A on the support plate 171.

[0328] The support plate 171 may further include a plurality of coupling bosses 175. The plurality of coupling bosses 175 may protrude upward from the top surface of the support plate 171.

[0329] Each of the coupling bosses 175 may pass through the through-hole 169 of the horizontal extension part 164 and be inserted into the sleeve 133 of the upper

case 120.

[0330] In the state in which the coupling boss 175 is inserted into the sleeve 133, a top surface of the coupling boss 175 may be disposed at the same height as a top surface of the sleeve 133 or disposed at a height lower than that of the top surface of the sleeve 133.

[0331] A coupling member coupled to the coupling boss 175 may be, for example, a bolt (see reference symbol B1 of Fig. 3). The bolt B1 may include a body part and a head part having a diameter greater than that of the body part. The bolt B1 may be coupled to the coupling boss 175 from an upper side of the coupling boss 175.

[0332] While the body part of the bolt B1 is coupled to the coupling boss 175, when the head part contacts the top surface of the sleeve 133, and the head part contacts the top surface of the sleeve 133 and the top surface of the coupling boss 175, assembling of the upper assembly 110 may be completed.

[0333] The upper support 170 may further include a plurality of unit guides 181 and 182 for guiding the connection unit 350 connected to the upper ejector 300.

[0334] The plurality of unit guides 181 and 182 may be, for example, disposed to be spaced apart from each other in the direction of the arrow A with respect to Fig. 12.

[0335] The unit guides 181 and 182 may extend upward from the top surface of the support plate 171. Each of the unit guides 181 and 182 may be connected to the circumferential wall 174.

[0336] Each of the unit guides 181 and 182 may include a guide slot 183 vertically extends.

[0337] In a state in which both ends of the ejector body 310 of the upper ejector 300 pass through the guide slot 183, the connection unit 350 is connected to the ejector body 310.

[0338] Thus, when the rotation force is transmitted to the ejector body 310 by the connection unit 350 while the lower assembly 200 rotates, the ejector body 310 may vertically move along the guide slot 183.

< Upper heater Coupling Structure >

[0339] Fig. 13 is an enlarged view of the heater coupling part in the upper case of Fig. 6, Fig. 14 is a view illustrating a state in which a heater is coupled to the upper case of Fig. 6, and Fig. 15 is a view illustrating an arrangement of a wire connected to the heater in the upper case.

[0340] Referring to Figs. 13 to 15, the heater coupling part 124 may include a heater accommodation groove 124a accommodating the upper heater 148.

[0341] For example, the heater accommodation groove 124a may be defined by recessing a portion of a bottom surface of the recess 122 of the upper case 120 upward.

[0342] The heater accommodation groove 124a may extend along a circumference of the opening 123 of the upper case 120.

[0343] For example, the upper heater 148 may be a

wire-type heater. Thus, the upper heater 148 may be bendable. The upper heater 148 may be bent to correspond to a shape of the heater accommodation groove 124a so as to accommodate the upper heater 148 in the heater accommodation groove 124a. The upper heater 148 may be called as an ice separating heater.

[0344] The upper heater 148 may be a DC heater receiving DC power. The upper heater 148 may be turned on to transfer ice.

[0345] When heat of the upper heater 148 is transferred to the upper tray 150, ice may be separated from a surface (inner face) of the upper tray 150.

[0346] If the upper tray 150 is made of a metal material, and the heat of the upper heater 148 has a high temperature, a portion of the ice, which is heated by the upper heater 148, may be adhered again to the surface of the upper tray after the upper heater 148 is turned off. As a result, the ice may be opaque.

[0347] That is, an opaque band having a shape corresponding to the upper heater may be formed around the ice.

[0348] However, in this embodiment, since the DC heater having low output is used, and the upper tray 150 is made of the silicon material, an amount of heat transferred to the upper tray 150 may be reduced, and thus, the upper tray itself may have low thermal conductivity.

[0349] Thus, the heat may not be concentrated into the local portion of the ice, and a small amount of heat may be slowly applied to prevent the opaque band from being formed around the ice because the ice is effectively separated from the upper tray.

[0350] The upper heater 148 may be disposed to surround the circumference of each of the plurality of upper chambers 152 so that the heat of the upper heater 148 is uniformly transferred to the plurality of upper chambers 152 of the upper tray 150.

[0351] Also, the upper heater 148 may contact the circumference of each of the chamber walls 153 respectively defining the plurality of upper chambers 152. Here, the upper heater 148 may be disposed at a position that is lower than that of the upper opening 154.

[0352] Since the heater accommodation groove 124a is recessed from the recess 122, the heater accommodation groove 124a may be defined by an outer wall 124b and an inner wall 124c.

[0353] The upper heater 148 may have a diameter greater than that of the heater accommodation groove 124a so that the upper heater 148 protrudes to the outside of the heater coupling part 124 in the state in which the upper heater 148 is accommodated in the heater accommodation groove 124a.

[0354] Since a portion of the upper heater 148 protrudes to the outside of the heater accommodation groove 124a in the state in which the upper heater 148 is accommodated in the heater accommodation groove 124a, the upper heater 148 may contact the upper tray 150.

[0355] A separation prevention protrusion 124d may

be provided on one of the outer wall 124b and the inner wall 124c to prevent the upper heater 148 accommodated in the heater accommodation groove 124a from being separated from the heater accommodation groove 124a.

[0356] In Fig. 13, for example, a plurality of separation prevention protrusions 124d are provided on the inner wall 124c.

[0357] The separation prevention protrusion 124d may protrude from an end of the inner wall 124c toward the outer wall 124b.

[0358] Here, a protruding length of the separation prevention protrusion 124d may be less than about 1/2 of a distance between the outer wall 124b and the inner wall 124c to prevent the upper heater 148 from being easily separated from the heater accommodation groove 124a without interfering with the insertion of the upper heater 148 by the separation prevention protrusion 124d.

[0359] As illustrated in Fig. 14, in the state in which the upper heater 148 is accommodated in the heater accommodation groove 124a, the upper heater 148 may be divided into an upper rounded portion 148c and a linear portion 148d.

[0360] That is, the heater accommodation groove 124a may include an upper rounded portion and a linear portion. Thus, the upper heater 148 may be divided into the upper rounded portion 148c and the linear portion 148d to correspond to the upper rounded portion and the linear portion of the heater accommodation groove 124a.

[0361] The upper rounded portion 148c may be a portion disposed along the circumference of the upper chamber 152 and also a portion that is bent to be rounded in a horizontal direction.

[0362] The liner portion 148d may be a portion connecting the upper rounded portions 148c corresponding to the upper chambers 152 to each other.

[0363] Since the upper heater 148 is disposed at a position lower than that of the upper opening 154, a line connecting two points of the upper rounded portions, which are spaced apart from each other, to each other may pass through upper chamber 152.

[0364] Since the upper rounded portion 148c of the upper heater 148 may be separated from the heater accommodation groove 124a, the separation prevention protrusion 124d may be disposed to contact the upper rounded portion 148c.

[0365] A through-opening 124e may be defined in a bottom surface of the heater accommodation groove 124a. When the upper heater 148 is accommodated in the heater accommodation groove 124a, a portion of the upper heater 148 may be disposed in the through-opening 124e. For example, the through-opening 124e may be defined in a portion of the upper heater 148 facing the separation prevention protrusion 124d.

[0366] When the upper heater 148 is bent to be horizontally rounded, tension of the upper heater 148 may increase to cause disconnection, and also, the upper heater 148 may be separated from the heater accommodation groove 124a.

[0367] However, when the through-opening 124e is defined in the heater accommodation groove 124a like this embodiment, a portion of the upper heater 148 may be disposed in the through-opening 124e to reduce the tension of the upper heater 148, thereby preventing the heater accommodation groove 124a from being separated from the upper heater 148.

[0368] As illustrated in Fig. 15, in a state in which a power input terminal 148a and a power output terminal 148b of the upper heater 148 are disposed in parallel to each other, the upper heater 148 may pass through a heater through-hole 125 defined in the upper case 120.

[0369] Since the upper heater 148 is accommodated from a lower side of the upper case 120, the power input terminal 148a and the power output terminal 148b of the upper heater 148 may extend upward to pass through the heater through-hole 125.

[0370] The power input terminal 148a and the power output terminal 148b passing through the heater through-hole 125 may be connected to one first connector 129a.

[0371] Also, a second connector 129c to which two wires 129d connected to correspond to the power input terminal 148a and the power output terminal 148b are connected may be connected to the first connector 129a.

[0372] A first guide part 126 guiding the upper heater 148, the first connector 129a, the second connector 129c, and the wire 129d may be provided on the upper plate 121 of the upper case 120.

[0373] In Fig. 15, for example, a structure in which the first guide part 126 guides the first connector 129a is illustrated.

[0374] The first guide part 126 may extend upward from the top surface of the upper plate 121 and have an upper end that is bent in the horizontal direction.

[0375] Thus, the upper bent portion of the first guide part 126 may limit upward movement of the first connector 126.

[0376] The wire 129d may be led out to the outside of the upper case 120 after being bent in an approximately "U" shape to prevent interference with the surrounding structure.

[0377] Since the wire 129d is bent at least once, the upper case 120 may further include wire guides 127 and 128 for fixing a position of the wire 129d.

[0378] The wire guides 127 and 128 may include a first guide 127 and a second guide 128, which are disposed to be spaced apart from each other in the horizontal direction. The first guide 127 and the second guide 128 may be bent in a direction corresponding to the bending direction of the wire 129d to minimize damage of the wire 129d to be bent.

[0379] That is, each of the first guide 127 and the second guide 128 may include a curved portion.

[0380] To limit upward movement of the wire 129d disposed between the first guide 127 and the second guide 128, at least one of the first guide 127 and the second guide 128 may include an upper guide 127a extending toward the other guide.

[0381] Fig. 16 is a cross-sectional view illustrating a state in which an upper assembly is assembled.

[0382] Referring to Fig. 16, in the state in which the upper heater 148 is coupled to the heater coupling part 124 of the upper case 120, the upper case 120, the upper tray 150, and the upper support 170 may be coupled to each other.

[0383] The first upper protrusion 165 of the upper tray 150 may be inserted into the first upper slot 131 of the upper case 120. Also, the second upper protrusion 166 of the upper tray 150 may be inserted into the second upper slot 132 of the upper case 120.

[0384] Then, the first lower protrusion 167 of the upper tray 150 may be inserted into the first lower slot 176 of the upper support 170, and the second lower protrusion 168 of the upper tray 150 may be inserted into the second lower slot 177 of the upper support 170.

[0385] Thus, the coupling boss 175 of the upper support 170 may pass through the through-hole of the upper tray 150 and then be accommodated in the sleeve 133 of the upper case 120. In this state, the bolt B1 may be coupled to the coupling boss 175 from an upper side of the coupling boss 175.

[0386] In the state in which the bolt B1 is coupled to the coupling boss 175, the head part of the bolt B1 may be disposed at a position higher than that of the upper plate 121.

[0387] On the other hand, since the hinge supports 135 and 136 are disposed lower than the upper plate 121, while the lower assembly 200 rotates, the upper assembly 110 or the connection unit 350 may be prevented from interfering with the head part of the bolt B1.

[0388] While the upper assembly 110 is assembled, a plurality of unit guides 181 and 182 of the upper support 170 may protrude upward from the upper plate 121 through the through-opening (see reference numerals 139a and 139b of Fig. 6) defined in both sides of the upper plate 121.

[0389] As described above, the upper ejector 300 passes through the guide slots 183 of the unit guides 181 and 182 protruding upward from the upper plate 121.

[0390] Thus, the upper ejector 300 may descend in the state of being disposed above the upper plate 121 and be inserted into the upper chamber 152 to separate ice of the upper chamber 152 from the upper tray 150.

[0391] When the upper assembly 110 is assembled, the heater coupling part 124 to which the upper heater 148 is coupled may be accommodated in the first accommodation part 160 of the upper tray 150.

[0392] In the state in which the heater coupling part 124 is accommodated in the first accommodation part 160, the upper heater 148 may contact the bottom surface 160a of the first accommodation part 160.

[0393] Like this embodiment, when the upper heater 148 is accommodated in the heater coupling part 124 having the recessed shape to contact the upper tray body 151, heat of the upper heater 148 may be minimally transferred to other portion except for the upper tray body 151.

[0394] At least a portion of the upper heater 148 may be disposed to vertically overlap the upper chamber 152 so that the heat of the upper heater 148 is smoothly transferred to the upper chamber 152.

[0395] In this embodiment, the upper rounded portion 148c of the upper heater 148 may vertically overlap the upper chamber 152.

[0396] That is, a maximum distance between two points of the upper rounded portion 148c, which are disposed at opposite sides with respect to the upper chamber 152 may be less than a diameter of the upper chamber 152.

<Lower case>

[0397] Fig. 17 is a perspective view of a lower assembly according to an embodiment, Fig. 18 is a top perspective view of a lower case according to an embodiment, and Fig. 19 is a bottom perspective view of the lower case according to an embodiment.

[0398] Referring to Figs. 17 to 19, the lower assembly 200 may include a lower tray 250. The lower tray 250 defines the ice chamber 121 together with the upper tray 150.

[0399] The lower assembly 200 may further include a lower support 270 that supports the lower tray 250. The lower support 270 and the lower tray 250 may rotate together while the lower tray 250 is seated on the lower support 270.

[0400] The lower assembly 200 may further include a lower case 210 for fixing a position of the lower tray 250.

[0401] The lower case 210 may surround the circumference of the lower tray 250, and the lower support 270 may support the lower tray 250.

[0402] The connection unit 350 may be coupled to the lower support 270.

[0403] The connection unit 350 may include a first link 352 that receives power of the driving unit 180 to allow the lower support 270 to rotate and a second link 356 connected to the lower support 270 to transmit rotation force of the lower support 270 to the upper ejector 300 when the lower support 270 rotates.

[0404] The first link 352 and the lower support 270 may be connected to each other by an elastic member 360. For example, the elastic member 360 may be a coil spring.

[0405] The elastic member 360 may have one end connected to the first link 362 and the other end connected to the lower support 270.

[0406] The elastic member 360 provide elastic force to the lower support 270 so that contact between the upper tray 150 and the lower tray 250 is maintained.

[0407] In this embodiment, the first link 352 and the second link 356 may be disposed on both sides of the lower support 270, respectively.

[0408] One of the two first links may be connected to the driving unit 180 to receive the rotation force from the driving unit 180.

[0409] The two first links 352 may be connected to each other by a connection shaft (see reference numeral 370 of Fig. 5).

[0410] A hole 358 through which the ejector body 310 of the upper ejector 300 passes may be defined in an upper end of the second link 356.

[0411] The lower case 210 may include a lower plate 211 for fixing the lower tray 250.

[0412] A portion of the lower tray 250 may be fixed to contact a bottom surface of the lower plate 211.

[0413] An opening 212 through which a portion of the lower tray 250 passes may be defined in the lower plate 211.

[0414] For example, when the lower tray 250 is fixed to the lower plate 211 in a state in which the lower tray 250 is disposed below the lower plate 211, a portion of the lower tray 250 may protrude upward from the lower plate 211 through the opening 212.

[0415] The lower case 210 may further include a circumferential wall 214 (or a cover wall) surrounding the lower tray 250 passing through the lower plate 211.

[0416] The circumferential wall 214 may include a vertical wall 214a and a curved wall 215.

[0417] The vertical wall 214a is a wall vertically extending upward from the lower plate 211. The curved wall 215 is a wall that is rounded in a direction that is away from the opening 212 upward from the lower plate 211.

[0418] The vertical wall 214a may include a first coupling slit 214b coupled to the lower tray 250. The first coupling slit 214b may be defined by recessing an upper end of the vertical wall downward.

[0419] The curved wall 215 may include a second coupling slit 215a to the lower tray 250.

[0420] The second coupling slit 215a may be defined by recessing an upper end of the curved wall 215 downward.

[0421] The lower case 210 may further include a first coupling boss 216 and a second coupling boss 217.

[0422] The first coupling boss 216 may protrude downward from the bottom surface of the lower plate 211. For example, the plurality of first coupling bosses 216 may protrude downward from the lower plate 211.

[0423] The plurality of first coupling bosses 216 may be arranged to be spaced apart from each other in the direction of the arrow A with respect to Fig. 17.

[0424] The second coupling boss 217 may protrude downward from the bottom surface of the lower plate 211. For example, the plurality of second coupling bosses 217 may protrude from the lower plate 211. The plurality of first coupling bosses 217 may be arranged to be spaced apart from each other in the direction of the arrow A with respect to Fig. 18.

[0425] The first coupling boss 216 and the second coupling boss 217 may be disposed to be spaced apart from each other in the direction of the arrow B.

[0426] In this embodiment, a length of the first coupling boss 216 and a length of the second coupling boss 217 may be different from each other. For example, the first

coupling boss 216 may have a length less than that of the second coupling boss 217.

[0427] The first coupling member may be coupled to the first coupling boss 216 at an upper portion of the first coupling boss 216. On the other hand, the second coupling member may be coupled to the second coupling boss 217 at a lower portion of the second coupling boss 217.

[0428] A groove 215b for movement of the coupling member may be defined in the curved wall 215 to prevent the first coupling member from interfering with the curved wall 215 while the first coupling member is coupled to the first coupling boss 216.

[0429] The lower case 210 may further include a slot 218 coupled to the lower tray 250.

[0430] A portion of the lower tray 250 may be inserted into the slot 218. The slot 218 may be disposed adjacent to the vertical wall 214a.

[0431] For example, a plurality of slots 218 may be defined to be spaced apart from each other in the direction of the arrow A of Fig. 18. Each of the slots 218 may have a curved shape.

[0432] The lower case 210 may further include an accommodation groove 218a into which a portion of the lower tray 250 is inserted. The accommodation groove 218a may be defined by recessing a portion of the lower tray 211 toward the curved wall 215.

[0433] The lower case 210 may further include an extension wall 219 contacting a portion of the circumference of the side surface of the lower plate 212 in the state of being coupled to the lower tray 250. The extension wall 219 may linearly extend in the direction of the arrow A.

<Lower tray>

[0434] Fig. 20 is a top perspective view of the lower tray according to an embodiment, Figs. 21 and 22 are bottom perspective views of the lower tray according to an embodiment, and Fig. 23 is a side view of the lower tray according to an embodiment.

[0435] Referring to Figs. 20 to 23, the lower tray 250 may be made of a flexible material that is capable of being restored to its original shape after being deformed by an external force.

[0436] For example, the lower tray 250 may be made of a silicon material. Like this embodiment, when the lower tray 250 is made of a silicon material, the lower tray 250 may be restored to its original shape even through external force is applied to deform the lower tray 250 during the ice transfer process. Thus, in spite of repetitive ice making, spherical ice may be made.

[0437] If the lower tray 250 is made of a metal material, when the external force is applied to the lower tray 250 to deform the lower tray 250 itself, the lower tray 250 may not be restored to its original shape any more.

[0438] In this case, after the lower tray 250 is deformed in shape, the spherical ice may not be made. That is, it is impossible to repeatedly make the spherical ice.

[0439] On the other hand, like this embodiment, when the lower tray 250 is made of the flexible material that is capable of being restored to its original shape, this limitation may be solved.

[0440] Also, when the lower tray 250 is made of the silicon material, the lower tray 250 may be prevented from being melted or thermally deformed by heat provided from an upper heater that will be described later.

[0441] In addition, when the lower tray 250 is made of the flexible material, cohesion or adhesion between the ice and the lower tray 250 may be reduced, so that the ice may be easily separated from the lower tray 250.

[0442] The lower tray 250 may include a lower tray body 251 defining a lower chamber 252 that is a portion of the ice chamber 111. The lower tray body 251 may be called as a lower mold body.

[0443] The lower tray body 251 may be define a plurality of lower chambers 252.

[0444] For example, the plurality of lower chambers 252 may include a first lower chamber 252a, a second lower chamber 252b, and a third lower chamber 252c.

[0445] The lower tray body 251 may include three chamber walls 252d defining three independent lower chambers 252a, 252b, and 252c. The three chamber walls 252d may be integrated in one body to form the lower tray body 251.

[0446] The first lower chamber 252a, the second lower chamber 252b, and the third lower chamber 252c may be arranged in a line. For example, the first lower chamber 252a, the second lower chamber 252b, and the third lower chamber 252c may be arranged in a direction of an arrow A with respect to Fig. 20.

[0447] A inner circumferential surface of the chamber wall 252d may have a hemispherical shape or a shape similar to the hemispherical shape

[0448] Accordingly, the lower chamber 252 may have a hemispherical shape or a shape similar to the hemispherical shape.. That is, a lower portion of the spherical ice may be made by the lower chamber 252.

[0449] In this specification, the shape similar to the hemispherical shape is not a completely hemispherical shape, but a shape that is close to the hemispherical shape.

[0450] The lower tray 250 may further include a first extension part 253 horizontally extending from an edge of an upper end of the lower tray body 251. The first extension part 253 may be continuously formed along the circumference of the lower tray body 251.

[0451] The lower tray 250 may further include a circumferential wall 260 extended upward from an upper surface of the first extension part 253.

[0452] A bottom surface of the upper tray body 151 may be contact with the top surface or end surface 251e of the lower tray body 251. A top surface 251e of the lower tray body 251 may be called as an end surface.

[0453] The circumferential wall 260 may surround the upper tray body 251 seated on the top surface 251 e of the lower tray body 251.

[0454] In the present embodiment, the circumferential wall 214 of the lower case 210 may surround the circumferential wall 260 of the lower tray 250. When the circumferential wall 214 of the lower case 210 surrounds the circumferential wall 260 of the lower tray 250, deformation in the outward direction of the circumferential wall 260 of the lower tray 250 during the rotation of the lower tray 250 may be limited.

[0455] The circumferential wall 260 may include a first wall 260a surrounding the vertical wall 153a of the upper tray body 151 and a second wall 260b surrounding the curved wall 153b of the upper tray body 151.

[0456] The first wall 260a is a vertical wall vertically extending from the top surface of the first extension part 253. The first wall 260a may be called a first vertical wall portion. The second wall 260b is a curved wall having a shape corresponding to that of the upper tray body 151. That is, the second wall 260b may be rounded upward from the first extension part 253 in a direction that is away from the lower chamber 252. The second wall 260b may be called a second curved wall portion.

[0457] A center of curvature of the second wall 260b may be a rotation center C2 of the lower assembly 200.

[0458] The lower tray 250 may further include a second extension part 254 horizontally extending from the circumferential wall 260.

[0459] The second extension part 254 may be disposed higher than the first extension part 253. Thus, the first extension part 253 and the second extension part 254 may be stepped with respect to each other.

[0460] The second extension part 254 may include a first upper protrusion 255 inserted into the slot 218 of the lower case 210. The first upper protrusion 255 may be disposed to be horizontally spaced apart from the circumferential wall 260.

[0461] For example, the first upper protrusion 255 may protrude upward from a top surface of the second extension part 254 at a position adjacent to the first wall 260a.

[0462] Although not limited, a plurality of first upper protrusions 255 may be arranged to be spaced apart from each other in the direction of the arrow A with respect to Fig. 20. The first upper protrusion 255 may extend, for example, in a curved shape.

[0463] The second extension part 254 may include a first lower protrusion 257 inserted into a protrusion groove of the lower case 270, which will be described later. The first lower protrusion 257 may protrude downward from a bottom surface of the second extension part 254.

[0464] Although not limited, the plurality of first lower protrusions 257 may be arranged to be spaced apart from each other in the direction of arrow A.

[0465] The first upper protrusion 255 and the first lower protrusion 257 may be disposed at opposite sides with respect to a vertical direction of the second extension part 254. At least a portion of the first upper protrusion 255 may vertically overlap the second lower protrusion 257.

[0466] A plurality of through-holes may be defined in the second extension part 254.

[0467] The plurality of through-holes 256 may include a first through-hole 256a through which the first coupling boss 216 of the lower case 210 passes and a second through-hole 256b through which the second coupling boss 217 of the lower case 210 passes.

[0468] For example, the plurality of through-holes 256a may be defined to be spaced apart from each other in the direction of the arrow A of Fig. 20.

[0469] Also, the plurality of second through-holes 256b may be disposed to be spaced apart from each other in the direction of the arrow A of Fig. 20.

[0470] The plurality of first through-holes 256a and the plurality of second through-holes 256b may be disposed at opposite sides with respect to the lower chamber 252.

[0471] A portion of the plurality of second through-holes 256b may be defined between the two first upper protrusions 255. Also, a portion of the plurality of second through-holes 256b may be defined between the two first lower protrusions 257.

[0472] The second extension part 254 may further a second upper protrusion 258. The second upper protrusion 258 may be disposed at an opposite side of the first upper protrusion 255 with respect to the lower chamber 252.

[0473] The second upper protrusion 258 may be disposed to be horizontally spaced apart from the circumferential wall 260. For example, the second upper protrusion 258 may protrude upward from a top surface of the second extension part 254 at a position adjacent to the second wall 260b.

[0474] Although not limited, the plurality of second upper protrusions 258 may be arranged to be spaced apart from each other in the direction of the arrow A of Fig. 20.

[0475] The second upper protrusion 258 may be accommodated in the accommodation groove 218a of the lower case 210. In the state in which the second upper protrusion 258 is accommodated in the accommodation groove 218a, the second upper protrusion 258 may contact the curved wall 215 of the lower case 210.

[0476] The circumferential wall 260 of the lower tray 250 may include a first coupling protrusion 262 coupled to the lower case 210.

[0477] The first coupling protrusion 262 may horizontally protrude from the first wall 260a of the circumferential wall 260. The first coupling protrusion 262 may be disposed on an upper portion of a side surface of the first wall 260a.

[0478] The first coupling protrusion 262 may include a neck part 262a having a relatively less diameter when compared to those of other portions. The neck part 262a may be inserted into a first coupling slit 214b defined in the circumferential wall 214 of the lower case 210.

[0479] The circumferential wall 260 of the lower tray 250 may further include a second coupling protrusion 262c coupled to the lower case 210.

[0480] The second coupling protrusion 262c may hor-

izontally protrude from the second wall 260a of the circumferential wall 260. The second coupling protrusion 260c may be inserted into a second coupling slit 215a defined in the circumferential wall 214 of the lower case 210.

[0481] As in the present embodiment, the coupling protrusions 262 and 260c disposed on the circumferential wall 260 of the lower tray 250 are respectively inserted into the coupling slits 214b and 215a defined in the circumferential wall of the lower case 210. Therefore, the circumferential wall 260 of the lower tray 250 may be prevented from being deformed in the inward direction during the rotation of the lower tray 250.

[0482] For example, a portion of the circumferential wall 260 of the lower tray 250 may be prevented from being deformed inward and inserted into the upper chamber 152 in a process in which the lower assembly 200 moves from an ice separating position to the ice making position.

[0483] The second extension part 254 may include a second lower protrusion 266. The second lower protrusion 266 may be disposed at an opposite side of the second lower protrusion 257 with respect to the lower chamber 252.

[0484] The second lower protrusion 266 may protrude downward from a bottom surface of the second extension part 254. For example, the second lower protrusion 266 may linearly extend.

[0485] A portion of the plurality of first through-holes 256a may be defined between the second lower protrusion 266 and the lower chamber 252.

[0486] The second lower protrusion 266 may be accommodated in a guide groove defined in the lower support 270, which will be described later.

[0487] The second extension part 254 may further a side restriction part 264. The side restriction part 264 restricts horizontal movement of the lower tray 250 in the state in which the lower tray 250 is coupled to the lower case 210 and the lower support 270.

[0488] The side restriction part 264 laterally protrudes from the second extension part 254 and has a vertical length greater than a thickness of the second extension part 254. For example, one portion of the side restriction part 264 may be disposed higher than the top surface of the second extension part 254, and the other portion of the side restriction part 264 may be disposed lower than the bottom surface of the second extension part 254.

[0489] Thus, the one portion of the side restriction part 264 may contact a side surface of the lower case 210, and the other portion may contact a side surface of the lower support 270.

[0490] In one example, the lower tray body 251 may have a heater contact portion 251a which the lower heater 296 contacts.

[0491] In one example, the heater contact portion 251a may be formed on each of the chamber walls 252d. The heater contact portion 251a may protrude from the respective chamber wall 252d. In one example, the heater

contact portion 251a may be formed in a circular ring shape.

<Lower support>

[0492] Fig. 24 is a top perspective view of the lower support according to an embodiment, Fig. 25 is a bottom perspective view of the lower support according to an embodiment, and Fig. 26 is a cross-sectional view taken along line D-D of Fig. 17, for illustrating a state in which the lower assembly is assembled.

[0493] Referring to Figs. 24 to 26, the lower support 270 may cover more than half of the lower chamber 272 so that the shape of the lower chamber 272 may be maintained in the ice-making process.

[0494] The lower support 270 may include a support body 271 supporting the lower tray 250.

[0495] The support body 271 may include three chamber accommodation parts 272 accommodating the three chamber walls 252d of the lower tray 250. The chamber accommodation part 272 may have a hemispherical shape.

[0496] The support body 271 may have a lower opening 274 through which the lower ejector 400 passes during the ice transfer process. For example, three lower openings 274 may be defined to correspond to the three chamber accommodation parts 272 in the support body 271.

[0497] A reinforcement rib 275 reinforcing strength may be disposed along a circumference of the lower opening 274.

[0498] Also, the adjacent two accommodation part 272 of the three accommodation part 272 may be connected to each other by a connection rib 273. The connection rib 273 may reinforce strength of the chamber wells 252d.

[0499] The lower support 270 may further include a first extension wall 285 horizontally extending from an upper end of the support body 271.

[0500] The lower support 270 may further include a second extension wall 286 that is formed to be stepped with respect to the first extension wall 285 on an edge of the first extension wall 285.

[0501] A top surface of the second extension wall 286 may be disposed higher than the first extension wall 285.

[0502] The first extension part 253 of the lower tray 250 may be seated on a top surface 271a of the support body 271, and the second extension part 285 may surround side surface of the first extension part 253 of the lower tray 250. Here, the second extension wall 286 may contact the side surface of the first extension part 253 of the lower tray 250.

[0503] The lower support 270 may further include a protrusion groove 287 accommodating the first lower protrusion 257 of the lower tray 250.

[0504] The protrusion groove 287 may extend in a curved shape. The protrusion groove 287 may be defined, for example, in a second extension wall 286.

[0505] The lower support 270 may further include a

first coupling groove 286a to which a first coupling member B2 passing through the first coupling boss 216 of the upper case 210 is coupled.

[0506] The first coupling groove 286a may be provided, for example, in the second extension wall 286.

[0507] The plurality of first coupling grooves 286a may be disposed to be spaced apart from each other in the direction of the arrow A in the second extension wall 286. A portion of the plurality of first coupling grooves 286a may be defined between the adjacent two protrusion grooves 287.

[0508] The lower support 270 may further include a boss through-hole 286b through which the second coupling boss 217 of the upper case 210 passes.

[0509] The boss through-hole 286b may be provided, for example, in the second extension wall 286. A sleeve 286c surrounding the second coupling boss 217 passing through the boss through-hole 286b may be disposed on the second extension wall 286. The sleeve 286c may have a cylindrical shape with an opened lower portion.

[0510] The first coupling member B2 may be coupled to the first coupling groove 286a after passing through the first coupling boss 216 from an upper side of the lower case 210.

[0511] The second coupling member B3 may be coupled to the second coupling boss 217 from a lower side of the lower support 270.

[0512] The sleeve 286c may have a lower end that is disposed at the same height as a lower end of the second coupling boss 217 or disposed at a height lower than that of the lower end of the second coupling boss 217.

[0513] Thus, while the second coupling member B3 is coupled, the head part of the second coupling member B3 may contact bottom surfaces of the second coupling boss 217 and the sleeve 286c or may contact a bottom surface of the sleeve 286c.

[0514] The lower support 270 may further include an outer wall 280 disposed to surround the lower tray body 251 in a state of being spaced outward from the outside of the lower tray body 251.

[0515] The outer wall 280 may, for example, extend downward along an edge of the second extension wall 286.

[0516] The lower support 270 may further include a plurality of hinge bodies 281 and 282 respectively connected to hinge supports 135 and 136 of the upper case 210.

[0517] The plurality of hinge bodies 281 and 282 may be disposed to be spaced apart from each other in a direction of an arrow A of Fig. 24. Each of the hinge bodies 281 and 282 may further include a second hinge hole 281a.

[0518] The shaft connection part 353 of the first link 352 may pass through the second hinge hole 281. The connection shaft 370 may be connected to the shaft connection part 353.

[0519] A distance between the plurality of hinge bodies 281 and 282 may be less than that between the plurality

of hinge supports 135 and 136. Thus, the plurality of hinge bodies 281 and 282 may be disposed between the plurality of hinge supports 135 and 136.

[0520] The lower support 270 may further include a coupling shaft 283 to which the second link 356 is rotatably coupled. The coupling shaft 383 may be disposed on each of both surfaces of the outer wall 280.

[0521] Also, the lower support 270 may further include an elastic member coupling part 284 to which the elastic member 360 is coupled. The elastic member coupling part 284 may define a space in which a portion of the elastic member 360 is accommodated. Since the elastic member 360 is accommodated in the elastic member coupling part 284 to prevent the elastic member 360 from interfering with the surrounding structure.

[0522] Also, the elastic member coupling part 284 may include a hook part 284a on which a lower end of the elastic member 370 is hooked.

<Coupling Structure of Lower heater >

[0523] Fig. 27 is a plan view of the lower support according to an embodiment, Fig. 28 is a perspective view illustrating a state in which a lower heater is coupled to the lower support of Fig. 27, and Fig. 29 is a view illustrating a state in which the wire connected to the lower heater passes through the upper case in a state in which the lower assembly is coupled to the upper assembly.

[0524] Referring to Figs. 27 to 29, the ice maker 100 according to this embodiment may further include a lower heater 296 for applying heat to the lower tray 250 during the ice making process.

[0525] The lower heater 297 may provide the heat to the lower chamber 252 during the ice making process so that ice within the ice chamber 111 is frozen from an upper side.

[0526] Also, since lower heater 296 generates heat in the ice making process, bubbles within the ice chamber 111 may move downward during the ice making process. When the ice is completely made, a remaining portion of the spherical ice except for the lowermost portion of the ice may be transparent. According to this embodiment, the spherical ice that is substantially transparent may be made.

[0527] For example, the lower heater 296 may be a wire-type heater.

[0528] The lower heater 296 may be installed on the lower support 270. Also, the lower heater 296 may contact the lower tray 250 to provide heat to the lower chamber 252.

[0529] For example, the lower heater 296 may contact the lower tray body 251. Also, the lower heater 296 may be disposed to surround the three chamber walls 252d of the lower tray body 251.

[0530] The lower support 270 may further include a heater coupling part 290 to which the lower heater 296 is coupled.

[0531] The heater coupling part 290 may include a

heater accommodation groove 291 that is recessed downward from the chamber accommodation part 272 of the lower tray body 251.

[0532] Since the heater accommodation groove 291 is recessed, the heater coupling part 290 may include an inner wall 291a and an outer wall 291b.

[0533] The inner wall 291a may have, for example, a ring shape, and the outer wall 291b may be disposed to surround the inner wall 291a.

[0534] When the lower heater 296 is accommodated in the heater accommodation groove 291, the lower heater 296 may surround at least a portion of the inner wall 291a.

[0535] The lower opening 274 may be defined in a region defined by the inner wall 291a. Thus, when the chamber wall 252d of the lower tray 250 is accommodated in the chamber accommodation part 272, the chamber wall 252d may contact a top surface of the inner wall 291a. The top surface of the inner wall 291a may be a rounded surface corresponding to the chamber wall 252d having the hemispherical shape.

[0536] The lower heater may have a diameter greater than a recessed depth of the heater accommodation groove 291 so that a portion of the lower heater 296 protrudes to the outside of the heater accommodation groove 291 in the state in which the lower heater 296 is accommodated in the heater accommodation groove 291.

[0537] A separation prevention protrusion 291c may be provided on one of the outer wall 291b and the inner wall 291a to prevent the lower heater 296 accommodated in the heater accommodation groove 291 from being separated from the heater accommodation groove 291.

[0538] In Fig. 26, the separation prevention protrusions 291c is provided on the inner wall 291a.

[0539] Since the inner wall 291a has a diameter less than that of the chamber accommodation part 272, the lower heater 296 may move along a surface of the chamber accommodation part 272 and then be accommodated in the heater accommodation groove 291 in a process of assembling the lower heater 296.

[0540] That is, the lower heater 296 is accommodated in the heater accommodation groove 291 from an upper side of the outer wall 291a toward the inner wall 291a. Thus, the separation prevention protrusion 291c may be disposed on the inner wall 291a to prevent the lower heater 296 from interfering with the separation prevention protrusion 291c while the lower heater 296 is accommodated in the heater accommodation groove 291.

[0541] The separation prevention protrusion 291c may protrude from an upper end of the inner wall 291a toward the outer wall 291b.

[0542] A protruding length of the separation prevention protrusion 291c may be about 1/2 of a distance between the outer wall 291b and the inner wall 291a.

[0543] As illustrated in Fig. 28, in the state in which the lower heater 296 is accommodated in the heater accommodation groove 291, the lower heater 296 may be di-

vided into a lower rounded portion 296a and a linear portion 296b.

[0544] That is, the heater accommodation groove 291 may include a lower rounded portion and a linear portion. Thus, the lower heater 296 may be divided into the lower rounded portion 296a and the linear portion 296b to correspond to the lower rounded portion and the linear portion of the heater accommodation groove 296.

[0545] The lower rounded portion 296a may be a portion disposed along the circumference of the lower chamber 252 and also a portion that is bent to be rounded in a horizontal direction.

[0546] The liner portion 296b may be a portion connecting the lower rounded portions 296a corresponding to the lower chambers 252 to each other.

[0547] Since the lower rounded portion 296a of the lower heater 296 may be separated from the heater accommodation groove 291, the separation prevention protrusion 291c may be disposed to contact the lower rounded portion 296a.

[0548] A through-opening 291d may be defined in a bottom surface of the heater accommodation groove 291. When the lower heater 296 is accommodated in the heater accommodation groove 291, a portion of the lower heater 296 may be disposed in the through-opening 291d. For example, the through-opening 291d may be defined in a portion of the lower heater 296 facing the separation prevention protrusion 291c.

[0549] When the lower heater 296 is bent to be horizontally rounded, tension of the lower heater 296 may increase to cause disconnection, and also, the lower heater 296 may be separated from the heater accommodation groove 291.

[0550] However, when the through-opening 291d is defined in the heater accommodation groove 291 like this embodiment, a portion of the lower heater 296 may be disposed in the through-opening 291d to reduce the tension of the lower heater 296, thereby preventing the heater accommodation groove 291 from being separated from the lower heater 296.

[0551] The lower support 270 may include a first guide groove 293 guiding a power input terminal 296c and a power output terminal of the lower heater 296 accommodated in the heater accommodation groove 291 and a second guide groove 294 extending in a direction crossing the first guide groove 293.

[0552] For example, the first guide groove 293 may extend in a direction of an arrow B in the heater accommodation part 291.

[0553] The second guide groove 294 may extend from an end of the first guide groove 293 in a direction of an arrow A. In this embodiment, the direction of the arrow A may be a direction that is parallel to the extension direction of a rotational central axis C1 of the lower assembly.

[0554] Referring to Fig. 28, the first guide groove 293 may extend from one of the left and right chamber accommodation parts except for the intermediate chamber

accommodation part of the three chamber accommodation parts.

[0555] For example, in Fig. 28, the first guide groove 293 extends from the chamber accommodation part, which is disposed at the left side, of the three chamber accommodation parts.

[0556] As illustrated in Fig. 28, in a state in which the power input terminal 296c and the power output terminal 296d of the lower heater 296 are disposed in parallel to each other, the lower heater 296 may be accommodated in the first guide groove 293.

[0557] The power input terminal 296c and the power output terminal 296d of the lower heater 296 may be connected to one first connector 297a.

[0558] A second connector 297b to which two wires 298 connected to correspond to the power input terminal 296c and the power output terminal 296d are connected may be connected to the first connector 297a.

[0559] In this embodiment, in the state in which the first connector 297a and the second connector 297b are connected to each other, the first connector 297a and the second connector 297b are accommodated in the second guide groove 294.

[0560] The wire 298 connected to the second connector 297b is led out from the end of the second guide groove 294 to the outside of the lower support 270 through an lead-out slot 295 defined in the lower support 270.

[0561] According to this embodiment, since the first connector 297a and the second connector 297b are accommodated in the second guide groove 294, the first connector 297a and the second connector 297b are not exposed to the outside when the lower assembly 200 is completely assembled.

[0562] As described above, the first connector 297a and the second connector 297b may not be exposed to the outside to prevent the first connector 297a and the second connector 297b from interfering with the surrounding structure while the lower assembly 200 rotates and prevent the first connector 297a and the second connector 297b from being separated.

[0563] Since the first connector 297a and the second connector 297b are accommodated in the second guide groove 294, one portion of the wire 298 may be disposed in the second guide groove 294, and the other portion may be disposed outside the lower support 270 by the lead-out slot 295.

[0564] Here, since the second guide groove 294 extends in a direction parallel to the rotational central axis C1 of the lower assembly 200, one portion of the wire 298 may extend in the direction parallel to the rotational central axis C1.

[0565] The other part of the wire 298 may extend from the outside of the lower support 270 in a direction crossing the rotational central axis C1.

[0566] According to the arrangement of the wires 298, tensile force may not merely act on the wires 298, but torsion force may act on the wires 298 during the rotation

of the lower assembly 200.

[0567] When compared that the tensile force acts on the wire 298, if the torsion acts on the wire 298, possibility of disconnection of the wire 298 may be very little.

[0568] According to this embodiment, while the lower assembly 200 rotates, the lower heater 296 may be maintained at a fixed position, and twisting force may act on the wire 298 to prevent the lower heater 296 from being damaged and disconnected.

[0569] A separation prevention protrusion 293a for preventing the accommodated lower heater 296 or wire 298 from being separated may be provided on at least one of the first guide groove 293 and the second guide groove 294.

[0570] The power input terminal 296c and the power output terminal 296d of the lower heater 296 are disposed in the first guide groove 293. Here, since heat is also generated in the power input terminal 296c and the power output terminal 296d, heat provided to the left chamber accommodation part to which the first guide groove 293 extends may be greater than that provided to other chamber accommodation parts.

[0571] In this case, if intensities of the heat provided to each chamber accommodating part are different, transparency of the made spherical ice after the ice making process and the ice transfer process may be changed for each ice.

[0572] Thus, a detour accommodation groove 292 may be further provided in the chamber accommodation part (for example, the right chamber accommodation part), which is disposed farthest from the first guide groove 292, of the three chamber accommodation parts to minimize a difference in transparency for each ice.

[0573] For example, the detour accommodation groove 292 may extend outward from the heater accommodation groove 291 and then be bent so as to be disposed in a shape that is connected to the heater accommodation groove 291.

[0574] When a portion 296e of the lower heater 296 is additionally accommodated in the detour accommodation groove 292, a contact area between the chamber wall accommodated in the right chamber accommodation part 272 and the lower heater 296 may increase.

[0575] Thus, a protrusion 292a for fixing a position of the lower heater accommodated in the detour accommodation groove 292 may be additionally provided in the right chamber accommodation part 272.

[0576] Referring to Fig. 29, in the state in which the lower assembly 200 is coupled to the upper case 120 of the upper assembly 110, the wire 298 led out to the outside of the lower support 270 may pass through a wire through-slot 138 defined in the upper case 120 to extend upward from the upper case 120.

[0577] A restriction guide 139 for restricting the movement of the wire 298 passing through the wire through-slot 138 may be provided in the wire through-slot 138. The restriction guide 139 may have a shape that is bent several times, and the wire 298 may be disposed in a region

defined by the restriction guide 139.

[0578] Fig. 30 is a cross-sectional view taken along line A-A of Fig. 3, and Fig. 31 is a view illustrating a state in which ice is completely made in Fig. 30.

[0579] In Fig. 30, a state in which the upper tray and the lower tray contact each other is illustrated.

[0580] Referring to Fig. 30, the upper tray 150 and the lower tray 250 vertically contact each other to complete the ice chamber 111.

[0581] In this connection, the upper tray 150 and the lower tray 250 may be made of the same material.

[0582] When the upper tray 150 and the lower tray 250 are made of the same material, and the hardness of the upper tray 150 and the hardness of the lower tray 250 are the same, while the bottom surface 151a of the upper tray 150 and the top surface 251e of the lower tray 250 are in contact with each other, adhesion therebetween is reduced.

[0583] On the other hand, when the hardness of the upper tray 150 and the hardness of the lower tray 250 are different from each other, while the bottom surface 151a of the upper tray 150 and the top surface 251e of the lower tray 250 are in contact with each other, a degree of deformation of a tray having a relatively low hardness is greater than that of the other tray. Therefore, the adhesion between the bottom surface 151a of the upper tray 150 and the top surface 251e of the lower tray 250 is improved.

[0584] In the ice separating process, the upper ejector 300 passes through the upper opening 154 and presses the ice in the ice chamber 111.

[0585] In this connection, the upper ejector 300 needs to be prevented from being deformed along with the ice in the process of pressing the ice. On the other hand, when the lower ejector 400 presses the ice, the lower tray 250 should be smoothly deformed to improve the separation performance of the ice.

[0586] Therefore, the hardness of the upper tray 150 may be greater than the hardness of the lower tray 250.

[0587] In addition, when the hardness of the upper tray 150 is the same as the hardness of the lower tray 250, after the ice making is completed, the upper tray 150 and the lower tray 250 serve as one tray at a portion at which the upper tray 150 and the lower tray 250 are in contact with each other. Therefore, there is a possibility that the upper tray 150 and the lower tray 250 are not easily separated from each other.

[0588] However, when the hardness of the upper tray 150 is greater than the hardness of the lower tray 250, in the ice-making process, the adhesion between the upper tray 150 and the lower tray 250 may be improved, and in the ice separating process, the lower tray 250 and the upper tray 150 may be easily separated from each other in the rotation of the lower tray 250.

[0589] The bottom surface 151a of the upper tray body 151 contacts the top surface 251e of the lower tray body 251.

[0590] Here, in the state in which the top surface 251

e of the lower tray body 251 contacts the bottom surface 151a of the upper tray body 151, elastic force of the elastic member 360 is applied to the lower support 270.

[0591] The elastic force of the elastic member 360 may be applied to the lower tray 250 by the lower support 270, and thus, the top surface 251e of the lower tray body 251 may press the bottom surface 151a of the upper tray body 151.

[0592] Thus, in the state in which the top surface 251e of the lower tray body 251 contacts the bottom surface 151a of the upper tray body 151, the surfaces may be pressed with respect to each other to improve the adhesion.

[0593] As described above, when the adhesion between the top surface 251e of the lower tray body 251 and the bottom surface 151a of the upper tray increases, a gap between the two surface may not occur to prevent ice having a thin band shape along a circumference of the spherical ice from being made after the ice making is completed.

[0594] The first extension part 253 of the lower tray 250 is seated on the top surface 271a of the support body 271 of the lower support 270. Also, the second extension wall 286 of the lower support 270 contacts a side surface of the first extension part 253 of the lower tray 250.

[0595] The second extension part 254 of the lower tray 250 may be seated on the second extension wall 286 of the lower support 270.

[0596] In the state in which the bottom surface 151a of the upper tray body 151 is seated on the top surface 251e of the lower tray body 251, the upper tray body 151 may be accommodated in an inner space of the circumferential wall 260 of the lower tray 250.

[0597] Here, the vertical wall 153a of the upper tray body 151 may be disposed to face the vertical wall 260a of the lower tray 250, and the curved wall 153b of the upper tray body 151 may be disposed to face the second wall 260b of the lower tray 250.

[0598] An outer face of the chamber wall 153 of the upper tray body 151 is spaced apart from an inner face of the circumferential wall 260 of the lower tray 250. That is, a space (or a gap) may be defined between the outer face of the chamber wall 153 of the upper tray body 151 and the inner face of the circumferential wall 260 of the lower tray 250.

[0599] Water supplied through the water supply part 180 is accommodated in the ice chamber 111. When a relatively large amount of water than a volume of the ice chamber 111 is supplied, water that is not accommodated in the ice chamber 111 may flow into the space (or the gap) between the outer face of the chamber wall 153 of the upper tray body 151 and the inner face of the circumferential wall 260 of the lower tray 250.

[0600] Thus, according to this embodiment, even though a relatively large amount of water than the volume of the ice chamber 111 is supplied, the water may be prevented from overflowing from the ice maker 100.

[0601] The larger the space (or the gap), the larger the

volume of the lower assembly 200. Therefore, the space (or the gap) is defined smaller than the circumferential wall 260 in thickness such that the volume increase of the lower assembly 200.

[0602] A diameter of the space (or the gap) may be greater than 1/100 and smaller than 1/50 of a diameter of the ice chamber 100.

[0603] In the state in which the top surface 251e of the lower tray body 251 contacts the bottom surface 151a of the upper tray body 151, the top surface of the circumferential wall 260 may be disposed higher than the upper opening 14 of the upper tray 150 or the upper chamber 152.

[0604] A heater contact part 251a for allowing the contact area with the lower heater 296 to increase may be further provided on the lower tray body 251.

[0605] The heater contact portion 251a may protrude from the bottom surface of the lower tray body 251. In one example, the heater contact portion 251a may protrude from a chamber wall 252d having a rounded outer surface.

[0606] The heater contact portion 251a may be formed in the form of a ring. The bottom surface of the heater contact portion 251a may be planar. Thus, the heater contact portion 251a may be in face-contact with the lower heater 296.

[0607] Although not limited, in the state in which the lower heater 296 contacts the heater contact part 251a, the lower heater 296 may be disposed lower than an intermediate point of a height of the lower chamber 252.

[0608] A portion of the heater contact portion 251a may be located between the top surface of the inner wall 291a and the top surface of the outer wall 291b while the heater contact portion 251a is in contact with the lower heater 296.

[0609] The lower tray body 251 may further include a convex portion 251b in which a portion of the lower portion of the lower tray body 251 is convex upward. In one example, the chamber wall 252d may include the convex portion 251b.

[0610] Referring to FIG. 30, a portion of the chamber wall 252d is supported by the lower support 270, and the other portion thereof is not supported by the chamber wall 252d. Thus, the chamber wall 252d may include a contact region in contact with the lower support 270 and a non-contact region in non-contact with the lower support 270. At least a portion of the convex portion 251b may be provided in the non-contact region.

[0611] The convex portion 251b may be constructed to be convex toward the center of the ice chamber 111. The lower chamber 252 may be formed in a hemispherical shape except for the convex portion 251b.

[0612] In another aspect, the convex portion 251b may be convex in a direction away from the lower opening 274 of the lower support 270.

[0613] A recess 251c may be defined below the convex portion 251b so that the convex portion 251b has substantially the same thickness as the other portion of the

lower tray body 251.

[0614] In this specification, the "substantially the same" is a concept that includes completely the same shape and a shape that is not similar but there is little difference.

[0615] The convex portion 251b may be disposed to vertically face the lower opening 274 of the lower support 270. The center of the convex portion 251b may coincide with the center of the lower opening 274.

[0616] A vertical centerline C3 passing through the center of the ice chamber 111 may pass through the upper opening 153 and the convex portion 251d and the lower opening 274.

[0617] The heater contact portion 251a may be constructed to surround the convex portion 251b.

[0618] The lower opening 274 may be defined just below the lower chamber 252. That is, the lower opening 274 may be defined just below the convex portion 251b.

[0619] The diameter D2 of the lower opening 274 may be smaller than the radius ($1/2 * D7$) of the ice chamber 111 so that the contact area between the lower support 270 and the lower tray 250 is increased.

[0620] The convex portion 251b may have a diameter D less than that D2 of the lower opening 274.

[0621] When cold air is supplied to the ice chamber 111 in the state in which the water is supplied to the ice chamber 111, the liquid water is phase-changed into solid ice. Here, the water may be expanded while the water is changed in phase. The expansive force of the water may be transmitted to each of the upper tray body 151 and the lower tray body 251.

[0622] In case of this embodiment, although other portions of the lower tray body 251 are surrounded by the support body 271, a portion (hereinafter, referred to as a "corresponding portion") corresponding to the lower opening 274 of the support body 271 is not surrounded.

[0623] If the lower tray body 251 has a complete hemispherical shape, when the expansive force of the water is applied to the corresponding portion of the lower tray body 251 corresponding to the lower opening 274, the corresponding portion of the lower tray body 251 is deformed toward the lower opening 274.

[0624] In this case, although the water supplied to the ice chamber 111 exists in the spherical shape before the ice is made, the corresponding portion of the lower tray body 251 is deformed after the ice is made. Thus, additional ice having a projection shape may be made from the spherical ice by a space occurring by the deformation of the corresponding portion.

[0625] Thus, in this embodiment, the convex portion 251b may be disposed on the lower tray body 251 in consideration of the deformation of the lower tray body 251 so that the ice has the completely spherical shape. The convex portion 251b may compensate for the volume increase of ice in the ice-making process.

[0626] In FIG. 30, the line passing vertically through the center of the ice chamber 111 may be referred to as the vertical center line C3. In one example, the vertical center line C3 may pass through the upper opening 154

and lower opening 274.

[0627] In the present embodiment, the convex portion 251b is pressed by the lower ejector 400 in an ice separating process.

[0628] The lower heater 296 may be located radially outside of the lower opening 274 such that the lower ejector 400 and the lower heater 296 do not interfere with each other while the lower ejector 400 presses the convex portion 251b. Further, the lower heater 296 may be located radially outward of the convex portion 251b.

[0629] In one example, a lower round portion of the lower heater 296 may be constructed to surround the convex portion 251b in the horizontal direction while being located radially outwardly of the convex portion 251b.

[0630] As shown in FIG. 30, before the ice-making is completed, the lowest level 251g of the lower tray 250 is positioned apart from the vertical centerline C3.

[0631] Prior to the ice-making completion, the lowest level 111a of the ice chamber 111 may be positioned higher than the lower heater 296.

[0632] Further, before completion of ice-making, at least a portion of the lower heater 296 may be positioned higher than the lowest level 251g of the lower tray 250.

[0633] Prior to ice-making completion, the highest level 251d of the convex portion 251a may be located higher than the lowest level 111a of the ice chamber 111. Further, the highest level 251c1 of the recess 251c may be located lower than the lowest level 111a of the ice chamber 111.

[0634] Prior to ice-making completion, the highest level 251c1 of the recess 251c may be positioned higher than the lower heater 296 or the heater contact portion 251a.

[0635] Before the ice-making is completed, the highest level 251c1 of the recess 251c may be located higher than the lowest level 251g of the lower tray 250.

[0636] In one example, the diameter D1 of the convex portion 251b is smaller than the diameter D2 of the lower opening 274. Thus, when ice-making is completed as shown in FIG. 31, the convex portion 251b is deformed such that the convex portion may be located inside the lower opening 274.

[0637] Further, once the ice-making is completed, the lowest level 251f of the lower tray 250 may be located on the vertical centerline C3. Further, once the ice-making is completed, the lowest level 251f of the lower tray 250 is close to the vertical centerline C3.

[0638] Therefore, the distance between the lowest level 251f of the lower tray 250 and the vertical center line C3 after the ice-making completion is smaller than the distance between the lowest level 251g of the lower tray 250 and the vertical centerline C3 after ice-making is completed..

[0639] When ice-making is completed, the lowest level 251f of the lower tray 250 may be located lower than the lower heater 296.

[0640] When ice-making is completed, the lowest level 111b of the ice chamber 111 may be located lower than the highest level of the lower heater 296.

[0641] In this embodiment, the water supplied to the ice chamber 111 may not have a spherical shape before the ice is made. However, after the ice is completely made, the convex portion 251b of the lower tray body 251 may move toward the lower opening 274, and thus, the spherical ice may be made.

[0642] In the present embodiment, the convex portion 251b is formed. As the recess 251c is formed below the convex portion 251b, deformation of the convex portion 251b may be facilitated. Further, after the convex portion 251b is deformed into the recess 251c, the convex portion 251b may be easily restored to its original shape when the external force is removed.

[0643] Hereinafter, a process of making ice by using the ice maker according to an embodiment will be described.

[0644] Fig. 32 is a cross-sectional view taken along line B-B of Fig. 3 in a water supply state, and Fig. 33 is a cross-sectional view taken along line B-B of Fig. 3 in an ice making state.

[0645] Fig. 34 is a cross-sectional view taken along line B-B of Fig. 3 in a state in which ice is completely made, Fig. 35 is a cross-sectional view taken along line B-B of Fig. 3 in an initial state of ice separation, and Fig. 36 is a cross-sectional view taken along line B-B of Fig. 3 in an ice separation completed state.

[0646] Referring to Figs. 32 to 36, first, the lower assembly 200 rotates to a water supply position.

[0647] The top surface 251e of the lower tray 250 is spaced apart from the bottom surface or end surface 151e of the upper tray 150 at the water supply position of the lower assembly 200. The bottom surface 151e of the upper tray 150 may be called as an end surface.

[0648] Although not limited, the bottom surface 151e of the upper tray 150 may be disposed at a height that is equal or similar to a rotational center C2 (called as a horizontal rotation axis) of the lower assembly 200.

[0649] The center of rotation C2 of the lower assembly 200 may be located on a face extending from the top surface 251e of the lower tray 250. Alternatively, the rotation center C2 of the lower assembly 200 may be located on a face extending from the contact face of the lower tray 250 and the upper tray 150.

[0650] In this embodiment, the direction in which the lower assembly 200 rotates (in a counterclockwise direction in the drawing) is referred to as a forward direction, and the opposite direction (in a clockwise direction) is referred to as a reverse direction.

[0651] Although not limited, an angle between the top surface 251e of the lower tray 250 and the bottom surface 151e of the upper tray 150 at the water supply position of the lower assembly 200 may be about 8 degrees.

[0652] In this state, the water is guided by the water supply part 190 and supplied to the ice chamber 111.

[0653] Here, the water is supplied to the ice chamber 111 through one upper opening of the plurality of upper openings 154 of the upper tray 150.

[0654] In the state in which the supply of the water is

completed, a portion of the supplied water may be fully filled into the lower chamber 252, and the other portion of the supplied water may be fully filled into the space between the upper tray 150 and the lower tray 250.

[0655] For example, the upper chamber 151 may have the same volume as that of the space between the upper tray 150 and the lower tray 250. Thus, the water between the upper tray 150 and the lower tray 250 may be fully filled in the upper tray 150. In another example, the volume of the upper chamber 152 may be larger than the volume of the space between the upper tray 150 and the lower tray 250.

[0656] In case of this embodiment, a channel for communication between the three lower chambers 252 may be provided in the lower tray 250.

[0657] As described above, although the channel for the flow of the water is not provided in the lower tray 250, since the top surface 251e of the lower tray 250 and the bottom surface 151e of the upper tray 150 are spaced apart from each other, the water may flow to the other lower chamber along the top surface 251e of the lower tray 250 when the water is fully filled in a specific lower chamber in the water supply process.

[0658] Thus, the water may be fully filled in each of the plurality of lower chambers 252 of the lower tray 250.

[0659] In the case of this embodiment, since the channel for the communication between the lower chambers 252 is not provided in the lower tray 250, additional ice having a projection shape around the ice after the ice making process may be prevented being made.

[0660] In the state in which the supply of the water is completed, as illustrated in Fig. 33, the lower assembly 200 rotates reversely. When the lower assembly 200 rotates reversely, the top surface 251e of the lower tray 250 is close to the bottom surface 151e of the upper tray 150.

[0661] Thus, the water between the top surface 251e of the lower tray 250 and the bottom surface 151e of the upper tray 150 may be divided and distributed into the plurality of upper chambers 152.

[0662] Also, when the top surface 251e of the lower tray 250 and the bottom surface 151e of the upper tray 150 are closely attached to each other, the water may be fully filled in the upper chamber 152.

[0663] In the state in which the top surface 251e of the lower tray 250 and the bottom surface 151e of the upper tray 150 are closely attached to each other, a position of the lower assembly 200 may be called an ice making position. The ice making position may be called as a closed position.

[0664] Upper ends 260d and 260e of the circumferential wall 260a of the lower tray 250 may be positioned higher than the upper opening 154 such that, in the water supplying process, water oversupplied and moved to the space (or the gap) in the process in which the lower assembly 200 moves from the water supply position to the ice making position is prevented from overflowing outward.

[0665] In addition, the upper ends 260d and 260e of the circumferential wall 260 of the lower tray 250 may be located higher than a highest water level in the ice chamber 111.

[0666] In the ice making position, the second wall 260b of the circumferential wall 260 is located closer to a rotational center C2 of the lower assembly 200 (or lower tray 250) than the first wall 260a.

[0667] A center of curvature of the second wall 260b may coincide with the rotational center C2 as an example.

[0668] In the state in which the lower assembly 200 moves to the ice making position, ice making is started.

[0669] Since pressing force of water during ice making is less than the force for deforming the convex portion 251b of the lower tray 250, the convex portion 251b may not be deformed to maintain its original shape.

[0670] When the ice making is started, the lower heater 296 is turned on. When the lower heater 296 is turned on, heat of the lower heater 296 is transferred to the lower tray 250.

[0671] Thus, when the ice making is performed in the state where the lower heater 296 is turned on, ice may be made from the upper side in the ice chamber 111.

[0672] That is, water in a portion adjacent to the upper opening 154 in the ice chamber 111 is first frozen. Since ice is made from the upper side in the ice chamber 111, the bubbles in the ice chamber 111 may move downward.

[0673] In the present embodiment, the output of the lower heater 296 may vary depending on the mass per unit height of water in the ice chamber 111.

[0674] If the heating amount of the lower heater 296 is constant, a rate at which ice is generated per unit height may vary since the mass per unit height of water may vary in the ice chamber 111.

[0675] For example, when the mass per unit height of water is small, the rate of ice formation is fast, whereas when the mass per unit height of water is large, the rate of ice generation is slow.

[0676] If the rate of ice generation per unit height of the water is not constant, the transparency of the ice may vary as a height varies. In particular, when ice is generated at a high rate, bubbles may not move from the ice to the water, and the thus formed ice may include bubbles therein, thereby lowering transparency.

[0677] Thus, in the present embodiment, the output of the lower heater 296 may be controlled based on the mass per unit height of water in the ice chamber 111.

[0678] When the ice chamber 111 is formed in a sphere shape, the mass per unit height of water increases from the upper side to the lower side, and then the maximum at the boundary of the upper tray 150 and the lower tray 250 decreases to the lower side again.

[0679] Thus, in the case of the present embodiment, the output of the lower heater 296 may decrease initially and then increase.

[0680] While ice is continuously made from the upper side to the lower side in the ice chamber 111, the ice may contact a top surface of a block part 251b of the lower

tray 250.

[0681] In this state, when the ice is continuously made, the block part 251b may be pressed and deformed as shown in Fig. 34, and the spherical ice may be made when the ice making is completed.

[0682] A control unit (not shown) may determine whether the ice making is completed based on the temperature sensed by the temperature sensor 500.

[0683] The lower heater 296 may be turned off at the ice-making completion or before the ice-making completion.

[0684] When the ice-making is completed, the upper heater 148 is first turned on for the ice separating of the ice. When the upper heater 148 is turned on, the heat of the upper heater 148 is transferred to the upper tray 150, and thus, the ice may be separated from the surface (the inner face) of the upper tray 150.

[0685] After the upper heater 148 has been activated for a set time duration, the upper heater 148 may be turned off and then the drive unit 180 may be operated to rotate the lower assembly 200 in a forward direction.

[0686] As illustrated in Fig. 35, when the lower assembly 200 rotates forward, the lower tray 250 may be spaced apart from the upper tray 150.

[0687] Also, the rotation force of the lower assembly 200 may be transmitted to the upper ejector 300 by the connection unit 350. Thus, the upper ejector 300 descends by the unit guides 181 and 182, and the upper ejecting pin 320 may be inserted into the upper chamber 152 through the upper opening 154.

[0688] In the ice transfer process, the ice may be separated from the upper tray 250 before the upper ejecting pin 320 presses the ice. That is, the ice may be separated from the surface of the upper tray 150 by the heat of the upper heater 148.

[0689] In this case, the ice may rotate together with the lower assembly 200 in the state of being supported by the lower tray 250.

[0690] Alternatively, even though the heat of the upper heater 148 is applied to the upper tray 150, the ice may not be separated from the surface of the upper tray 150.

[0691] Thus, when the lower assembly 200 rotates forward, the ice may be separated from the lower tray 250 in the state in which the ice is closely attached to the upper tray 150.

[0692] In this state, while the lower assembly 200 rotates, the upper ejecting pin 320 passing through the upper opening 154 may press the ice closely attached to the upper tray 150 to separate the ice from the upper tray 150. The ice separated from the upper tray 150 may be supported again by the lower tray 250.

[0693] When the ice rotates together with the lower assembly 200 in the state in which the ice is supported by the lower tray 250, even though external force is not applied to the lower tray 250, the ice may be separated from the lower tray 250 by the self-weight thereof.

[0694] While the lower assembly 200 rotates, even though the ice is not separated from the lower tray 250

by the self-weight thereof, when the lower tray 250 is pressed by the lower ejector 400, the ice may be separated from the lower tray 250.

[0695] Particularly, while the lower assembly 200 rotates, the lower tray 250 may contact the lower ejecting pin 420.

[0696] When the lower assembly 200 continuously rotates forward, the lower ejecting pin 420 may press the lower tray 250 to deform the lower tray 250, and the pressing force of the lower ejecting pin 420 may be transmitted to the ice to separate the ice from the lower tray 250. The ice separated from the surface of the lower tray 250 may drop downward and be stored in the ice bin 102. The ice separation position may be called as an open position.

[0697] After the ice is separated from the lower tray 250, the lower assembly 200 may be rotated in the reverse direction by the drive unit 180.

[0698] When the lower ejecting pin 420 is spaced apart from the lower tray 250 in a process in which the lower assembly 200 is rotated in the reverse direction, the deformed lower tray 250 may be restored to its original form. That is, the deformed convex portion 251b may be restored to its original form.

[0699] In the reverse rotation process of the lower assembly 200, the rotational force is transmitted to the upper ejector 300 by the connecting unit 350, such that the upper ejector 300 is raised, and thus, the upper ejecting pin 320 is withdrawn from the upper chamber 152.

[0700] When the lower assembly 200 reaches the water supply position, the drive unit 180 is stopped, and then water supply starts again.

Claims

1. An ice maker for a home appliance, in particular for a refrigerator or freezer, including:

an upper assembly (110) including an upper tray (150) having at least one upper chamber part (152);

a lower assembly (200) including a lower support (270) and a lower tray (250) having at least one lower chamber part (252),

wherein the lower assembly (200) is movable with respect to the upper assembly (110) between an open position and a closed position, wherein in the closed position, the lower chamber part (252) and the upper chamber part (152) form at least one ice chamber (111) in which ice is to be formed, and

wherein the lower tray (250) has a convex portion (251b) protruding into the lower chamber part (252) and configured to be deformed towards an outside of the lower chamber part (252) for compensating a volume increase during ice formation.

2. The ice maker according to claim 1, wherein the lower tray (150) is made of a flexible or deformable material and/or of silicon.

3. The ice maker according to any one of the preceding claims, wherein the lower support (270) covers more than half of an outer surface of the lower chamber part (252) for stabilizing a shape of the lower chamber part (252).

4. The ice maker according to any one of the preceding claims, wherein a lower opening (274) is formed in the lower support (270) corresponding to the lower chamber part (252) and the convex portion (251b) is formed corresponding to the lower opening (274).

5. The ice maker according to any one of the preceding claims, wherein a lower heater (296) is accommodated within a heater accommodation groove (291) adjacent to the lower opening (174) to be in contact with the lower tray (250).

6. The ice maker of claim 4 or 5, wherein the lower opening (274) corresponds to a center point of an outer surface of the lower chamber part (252).

7. The ice maker according to any one of the preceding claims, wherein the lower tray (250) includes:

a lower tray body (251) forming a wall of the lower chamber part (252) and having an end surface (251e) for contacting the upper tray (150) in the closed position of the lower assembly (200), and

a circumferential wall (260) along a peripheral edge of the lower tray (250) and extending from the lower chamber part (252).

8. The ice maker according to claim 7, wherein the upper tray (150) includes an upper tray body (151) forming a wall of the upper chamber part (152) and having an end surface (151e) for contacting the end surface (251e) of the lower tray (250) in the closed position of the lower assembly (200),

wherein in the closed position of the lower assembly (200), the upper tray body (151) is inserted within the circumferential wall (260) with the end surfaces (151e, 251e) being in contact with one another.

9. The ice maker according to claim 8, wherein in the closed position of the lower assembly (200), the upper tray body (151) is inserted within the circumferential wall (260) while being spaced apart therefrom by a predefined gap for preventing overflow of water.

10. The ice maker of claim 7, 8 or 9, wherein in the closed position of the lower assembly (200), the circumferential wall (260) extends towards the upper assembly

bly (110).

11. The ice maker according to any one of the preceding claims, wherein the lower assembly (200) is rotatable with respect to the upper assembly 110 around a horizontal rotation axis (C2). 5
12. The ice maker of claim 11, wherein the rotation axis (C2) is within the same plane as an open surface of the upper chamber part (152) and/or as an interface between the lower chamber part (252) and the upper chamber part (152) in the closed position. 10
13. The ice maker of claim 11 or 12, wherein the circumferential wall (260) of the lower tray (250) includes a first vertical wall portion (260a) and a second curved wall portion (260b) being bent away from the lower chamber part with a center of the curvature being on the rotation axis (C2)), the first vertical wall portion (260a) and the second curved wall portion (260b) being opposite to each other. 15 20
14. The ice maker according to any one of the preceding claims, wherein the upper chamber part (252) has a semispherical shape and the lower chamber part (252) has a semispherical shape except for the convex portion (251b), for forming spherical ice in the ice chamber (111). 25
15. A refrigerator, including: 30
an ice maker according to any one of the preceding claims.

35

40

45

50

55

FIG.1

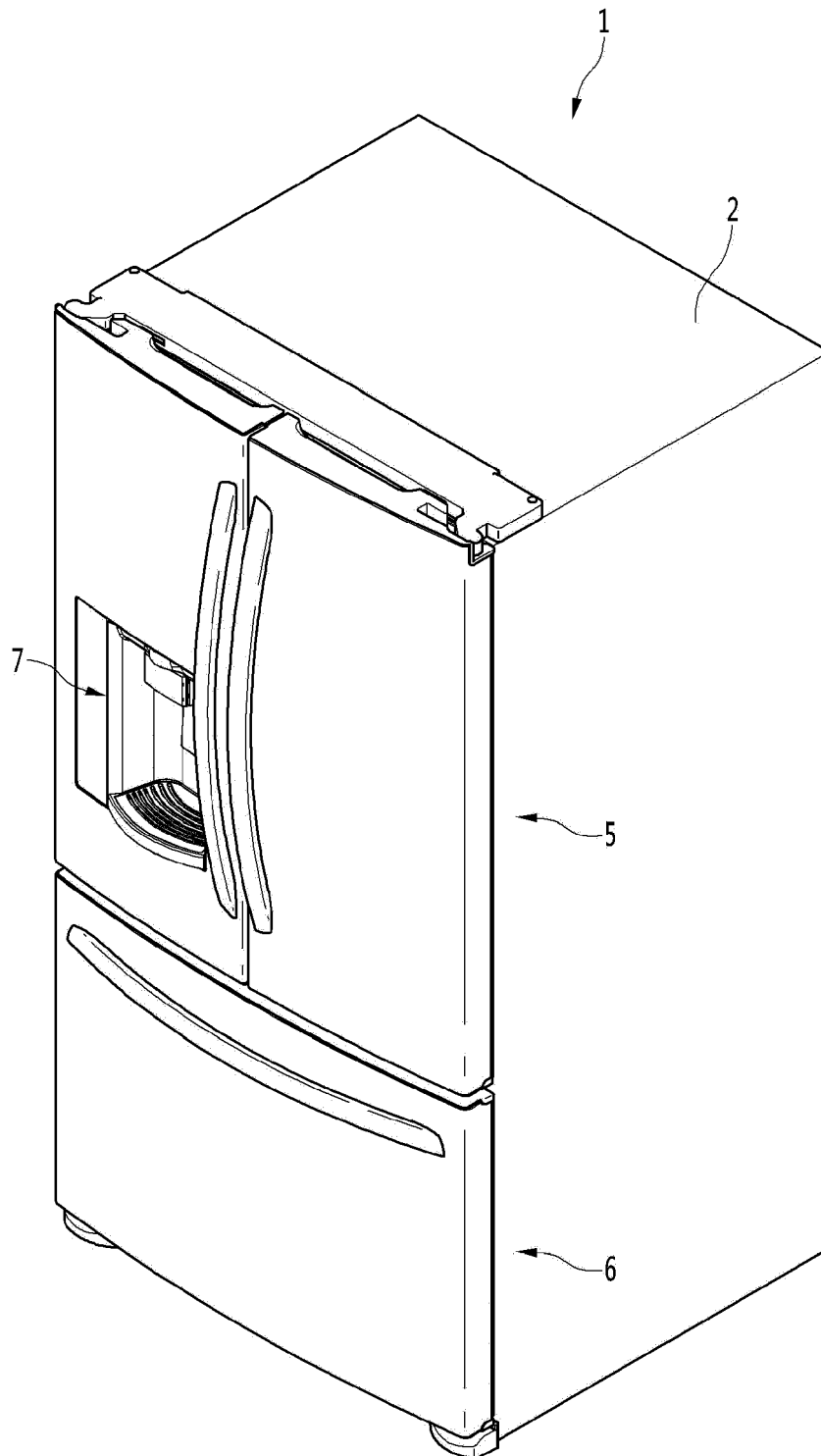


FIG.2

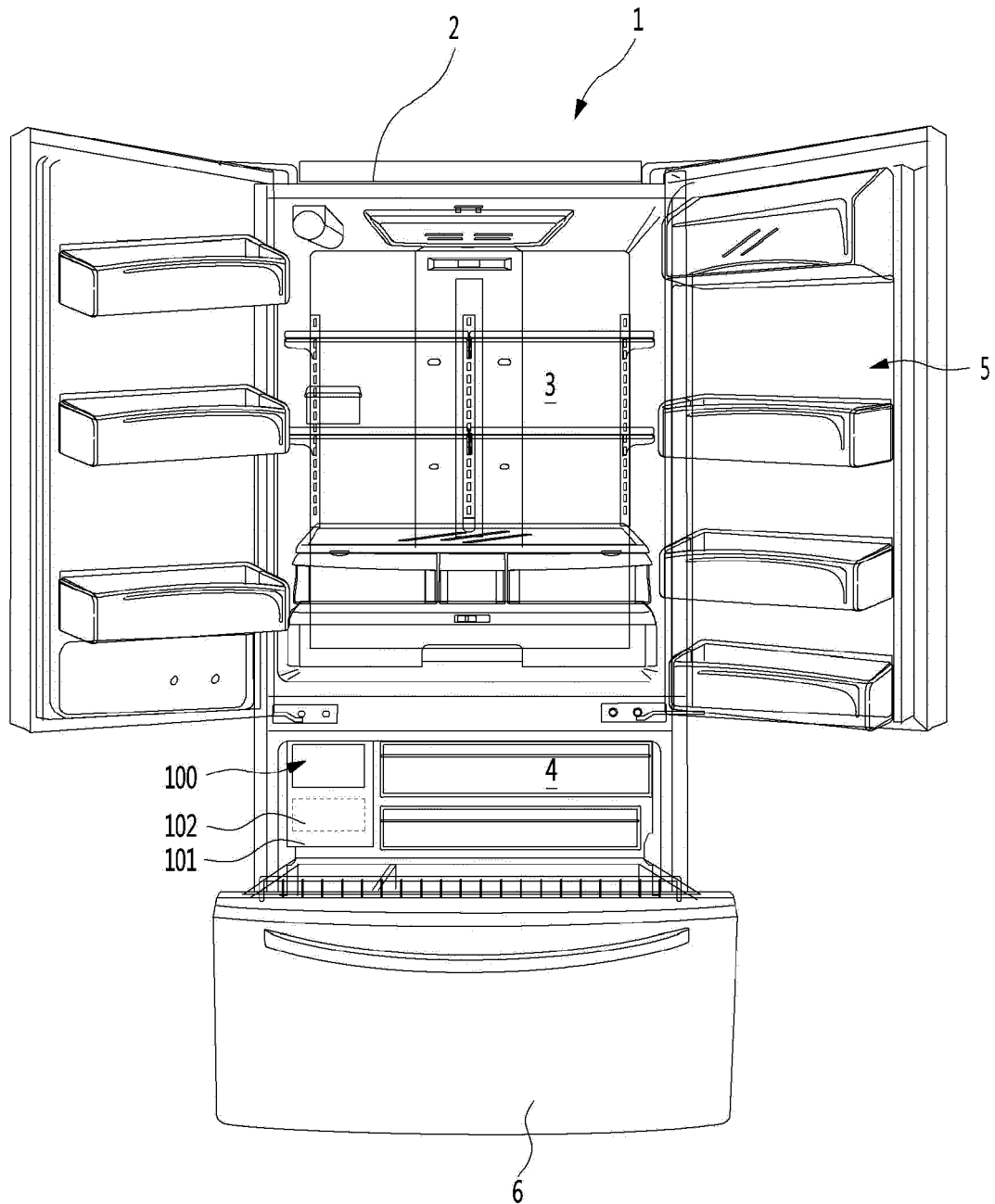


FIG.3

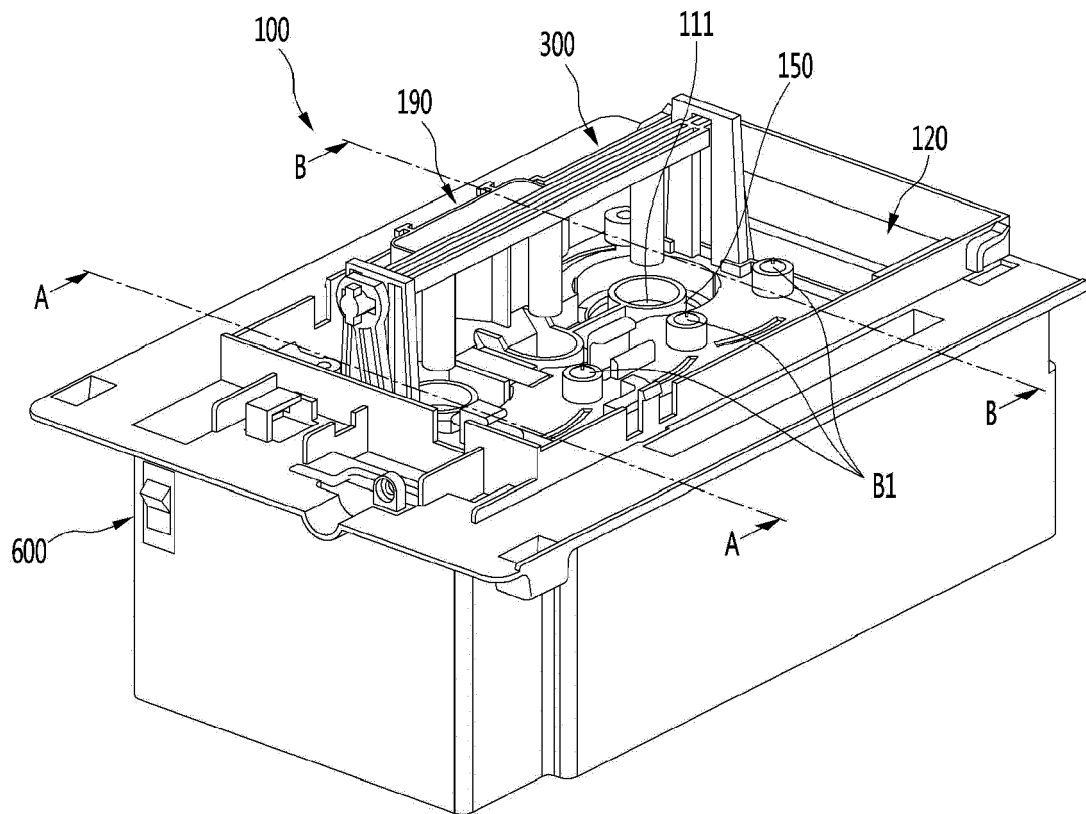


FIG.4

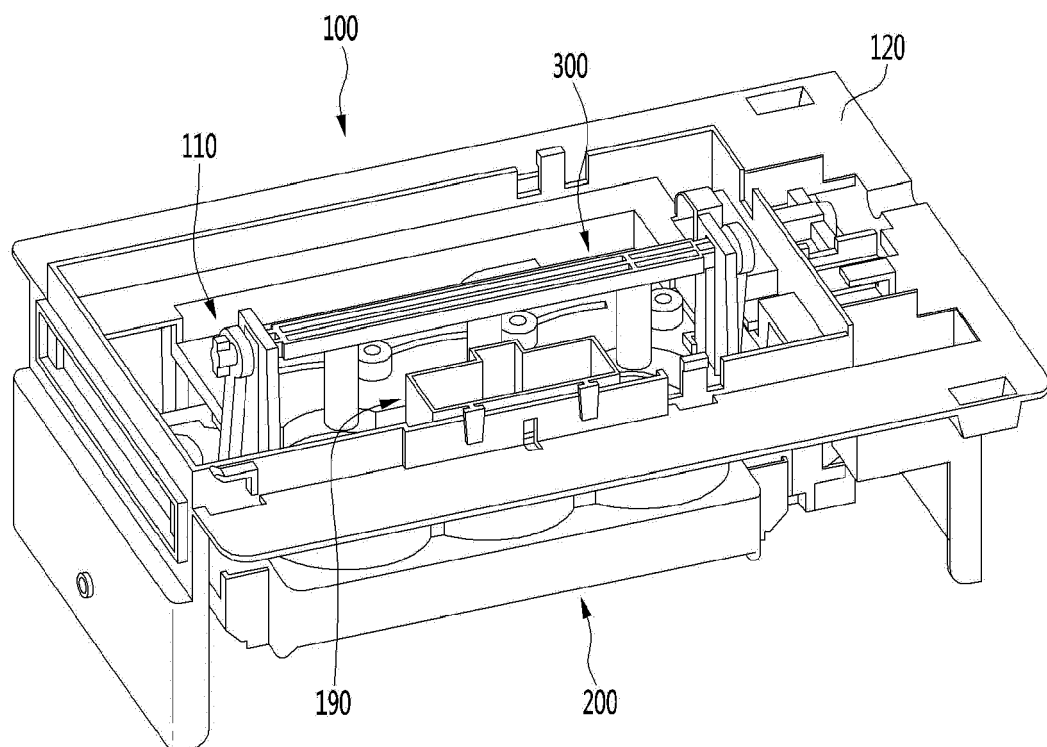


FIG.5

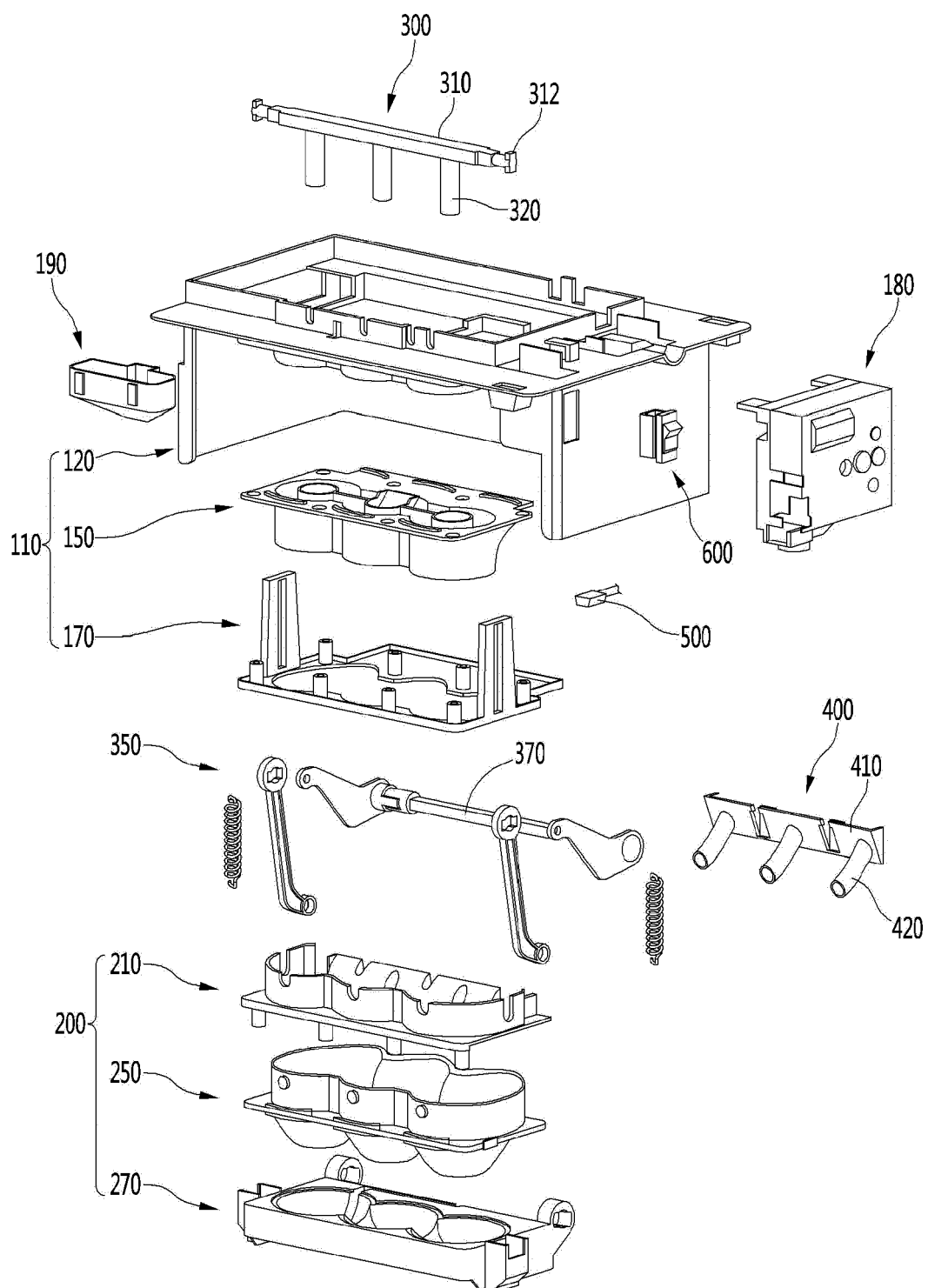


FIG.6

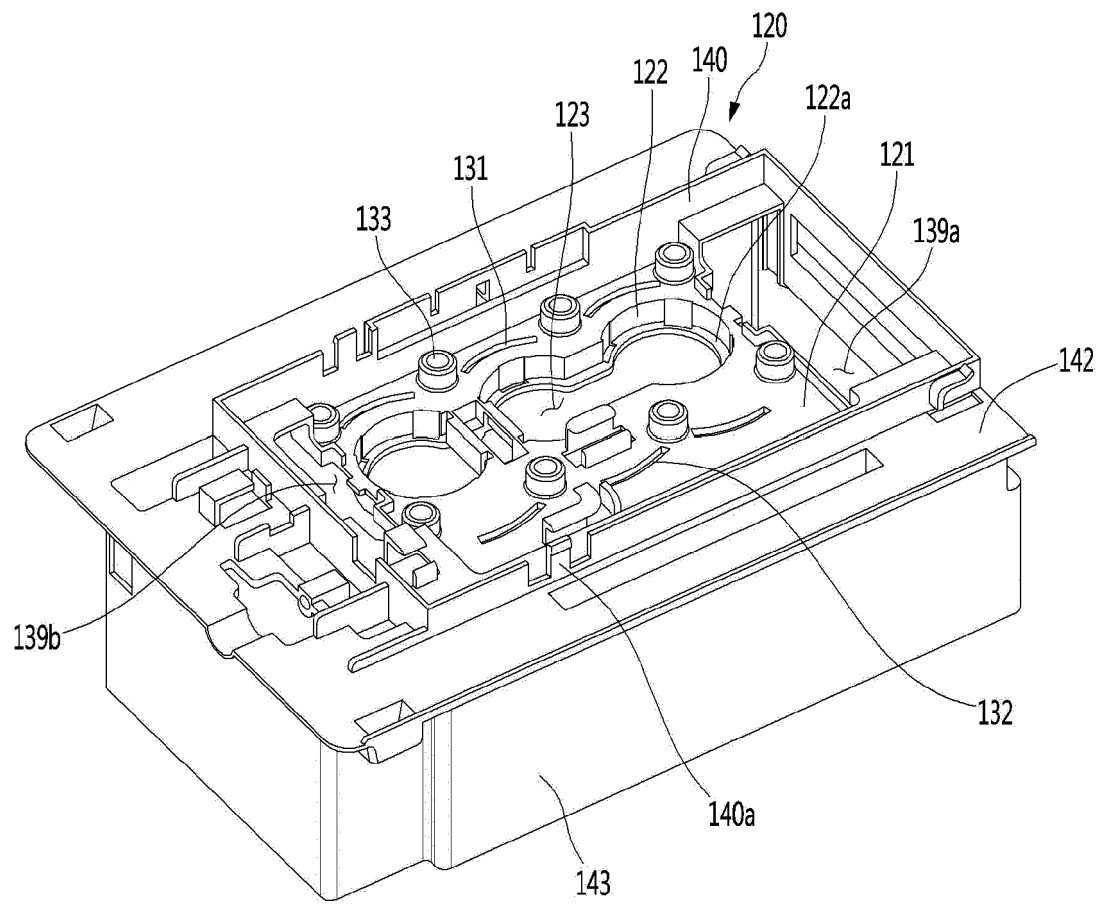


FIG.7

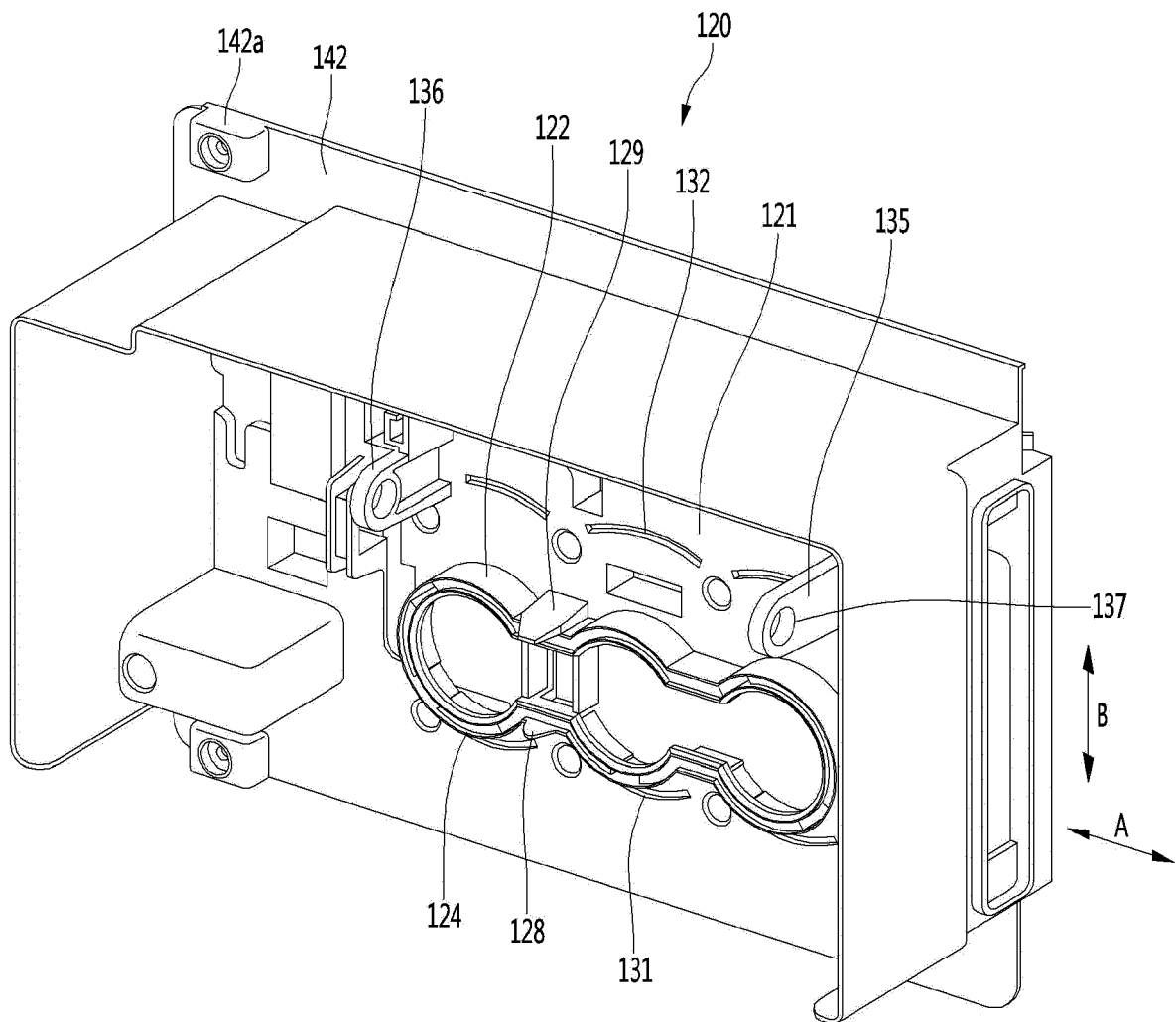


FIG.8

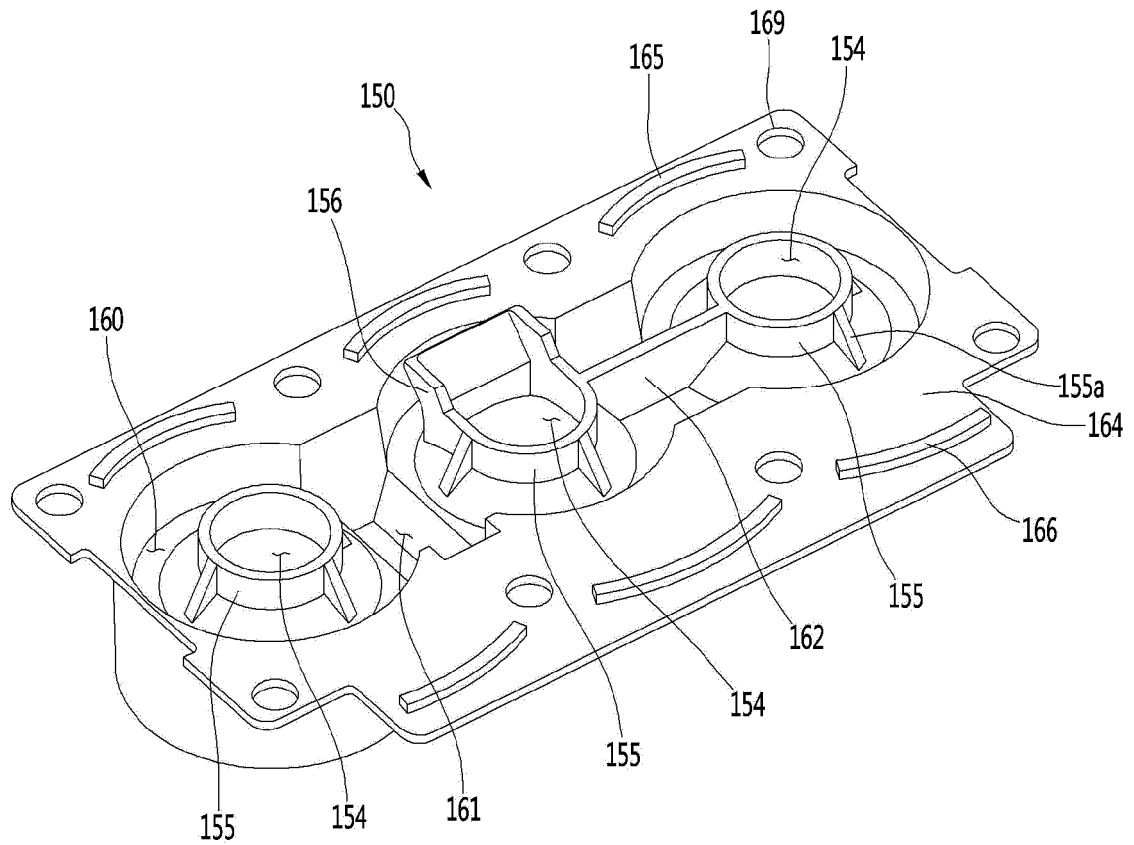


FIG.9

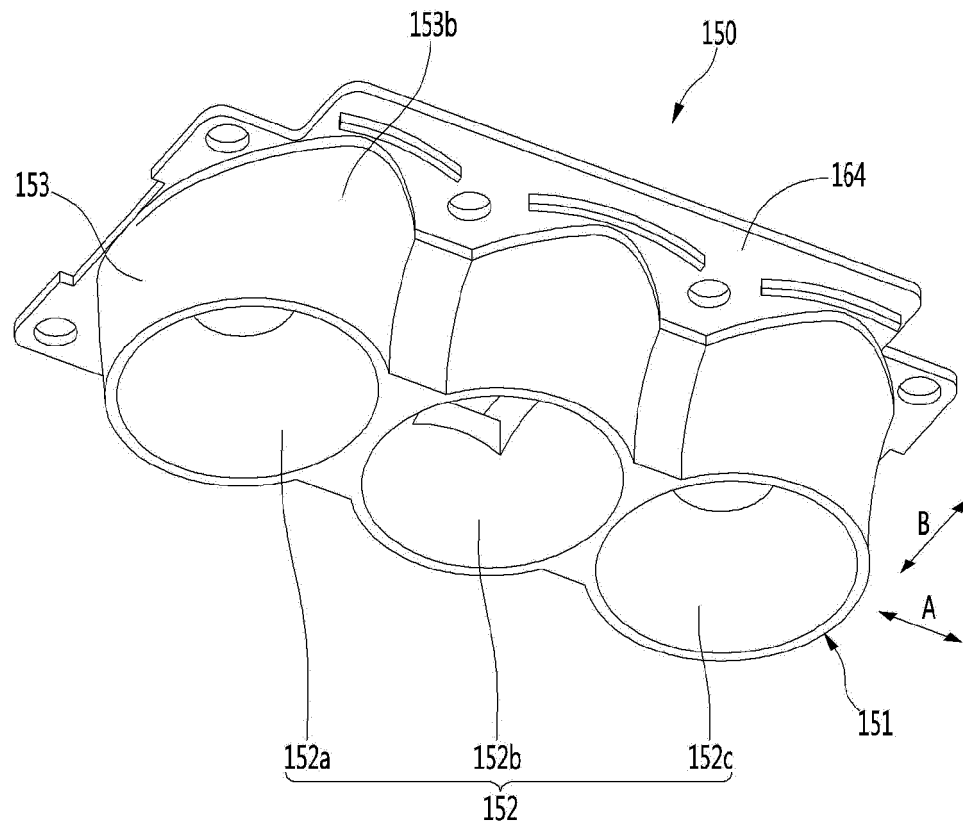


FIG.10

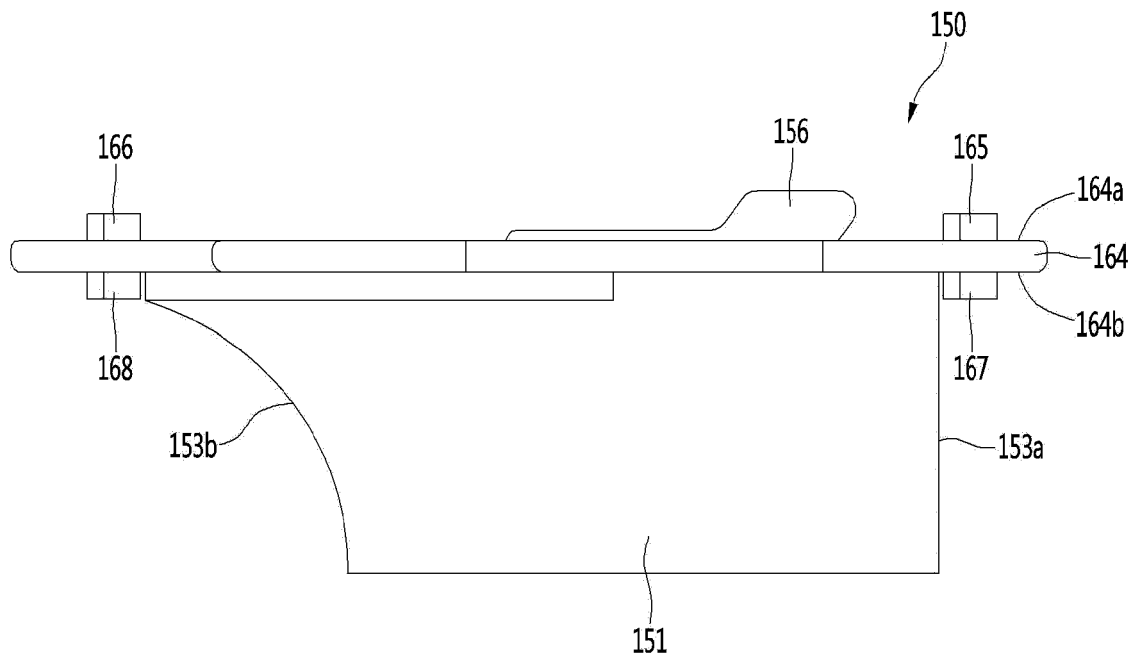


FIG.11

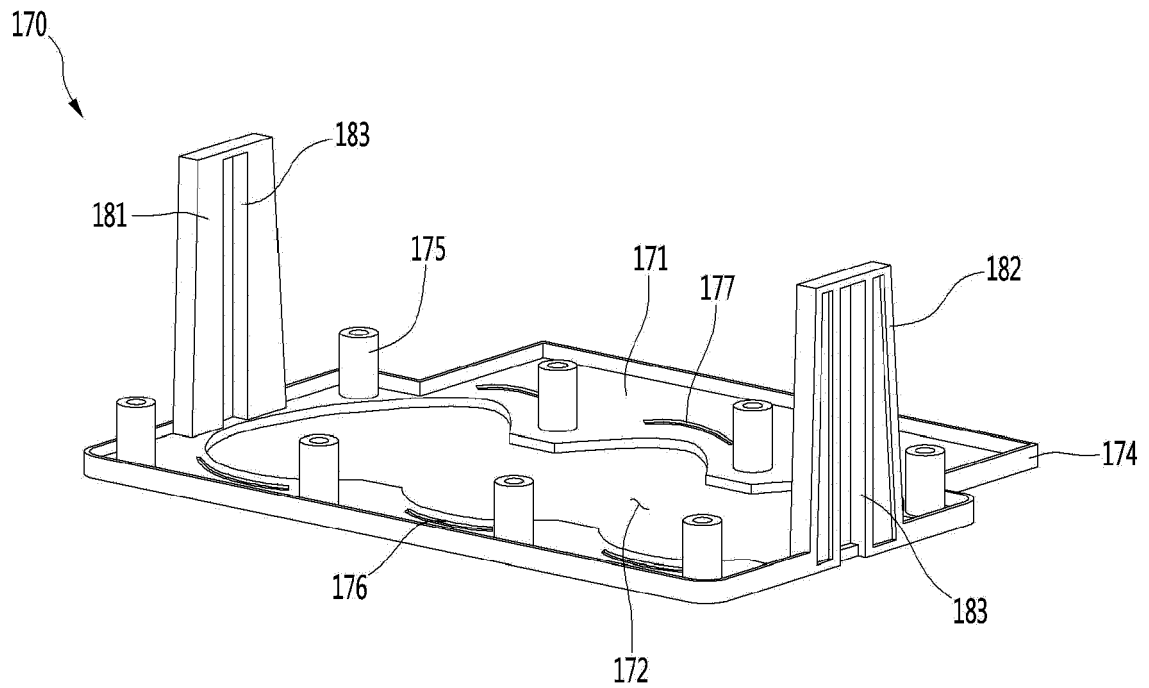


FIG.12

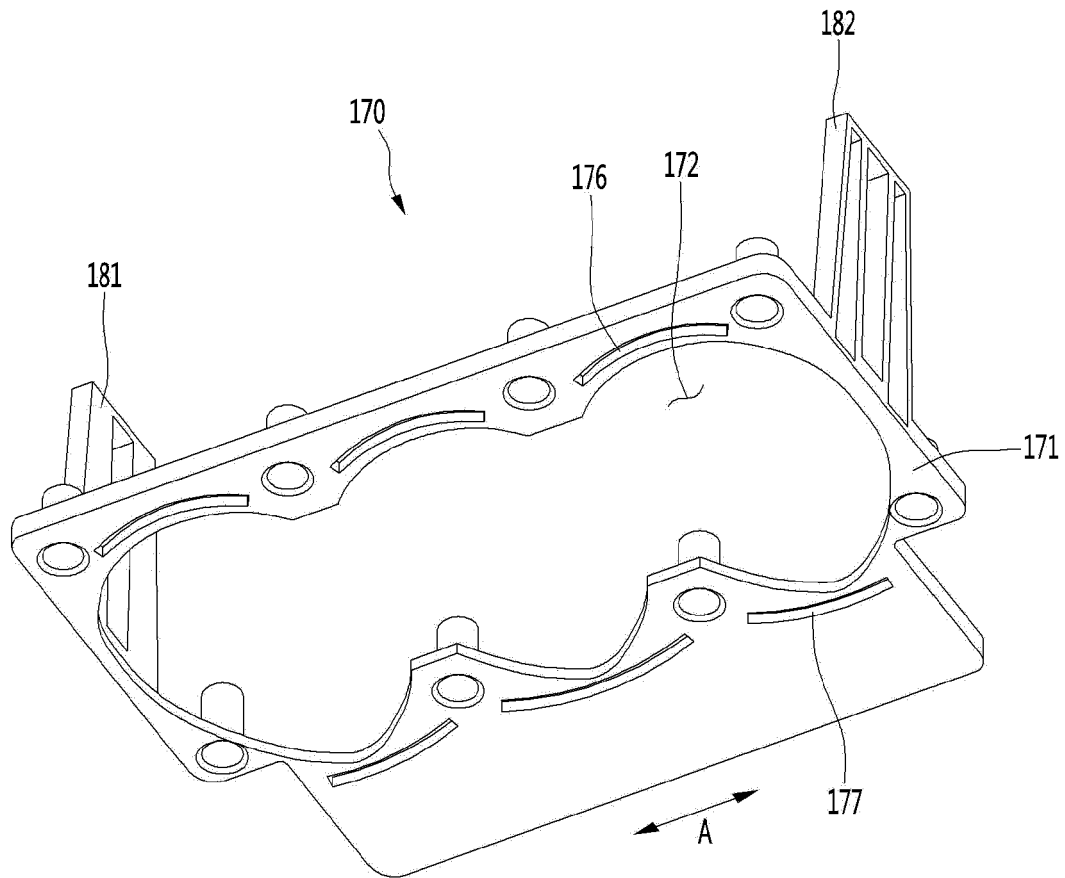


FIG.13

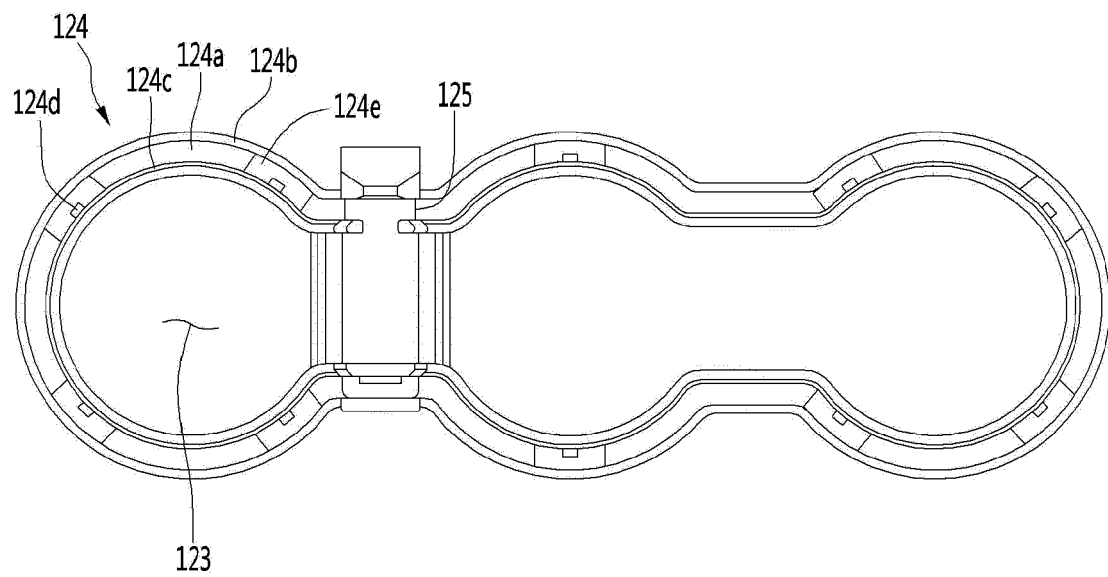


FIG.14

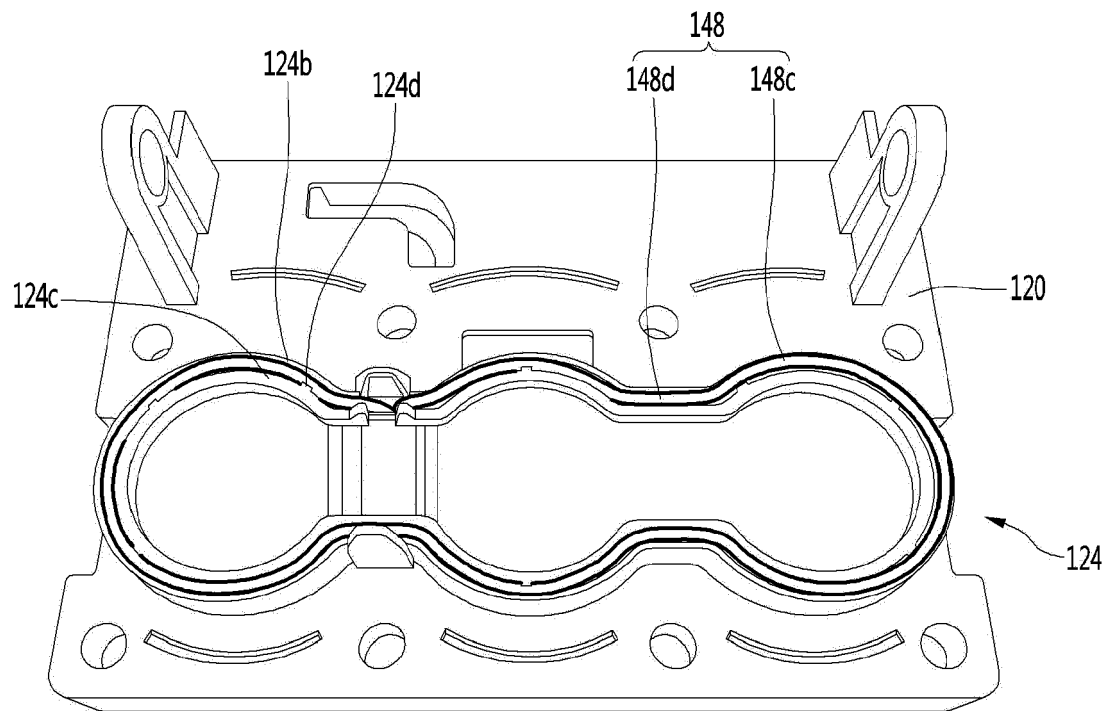


FIG.15

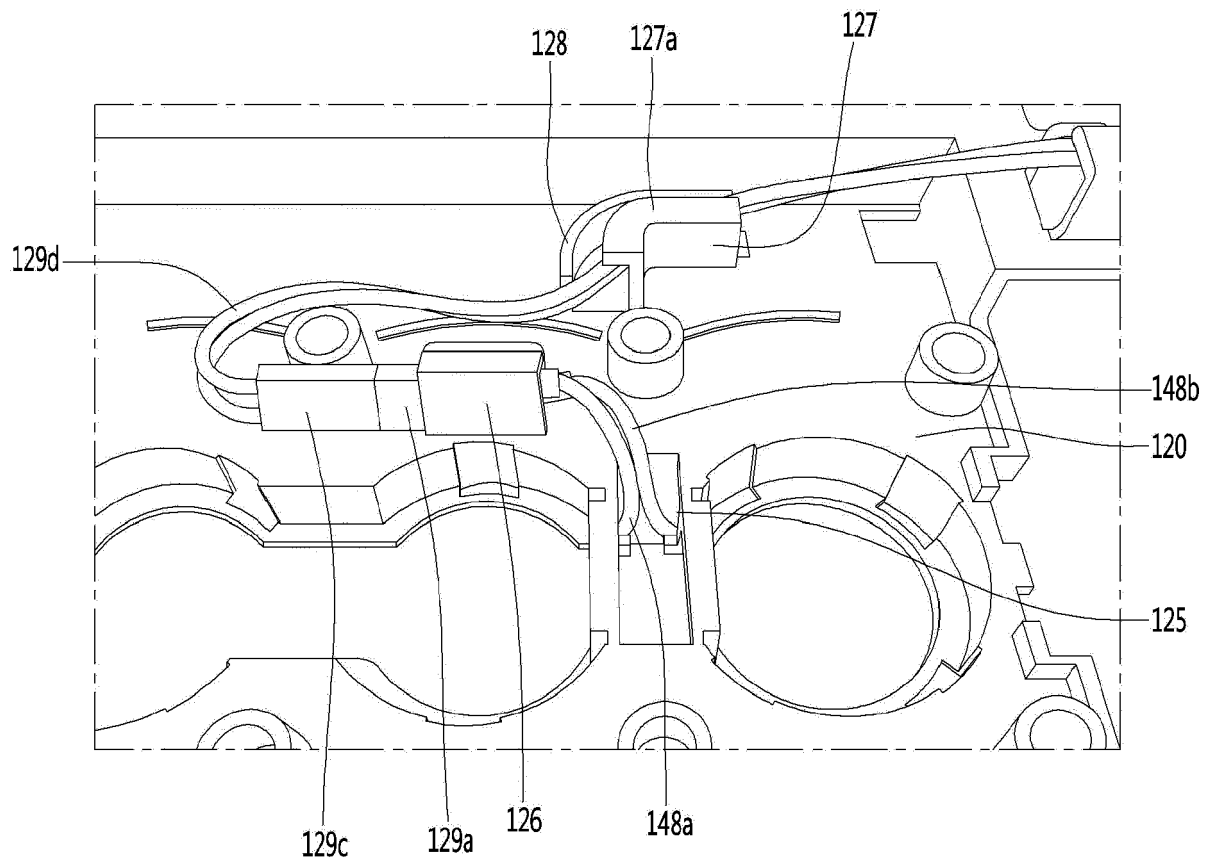


FIG.16

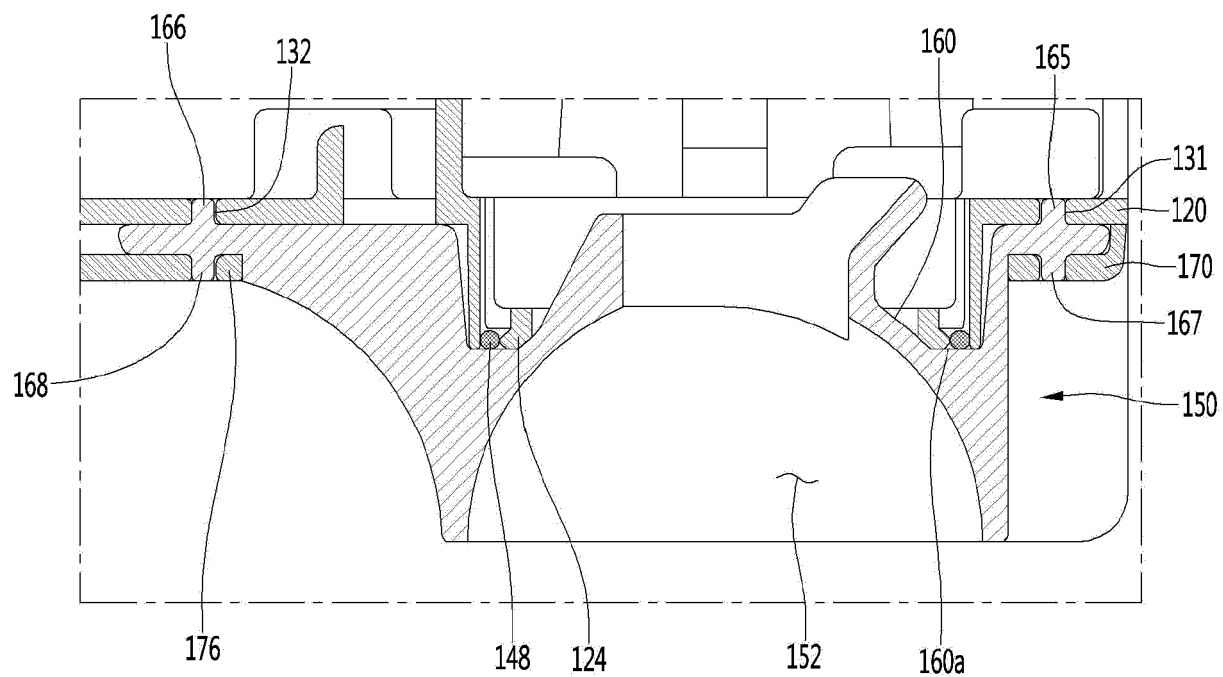


FIG.17

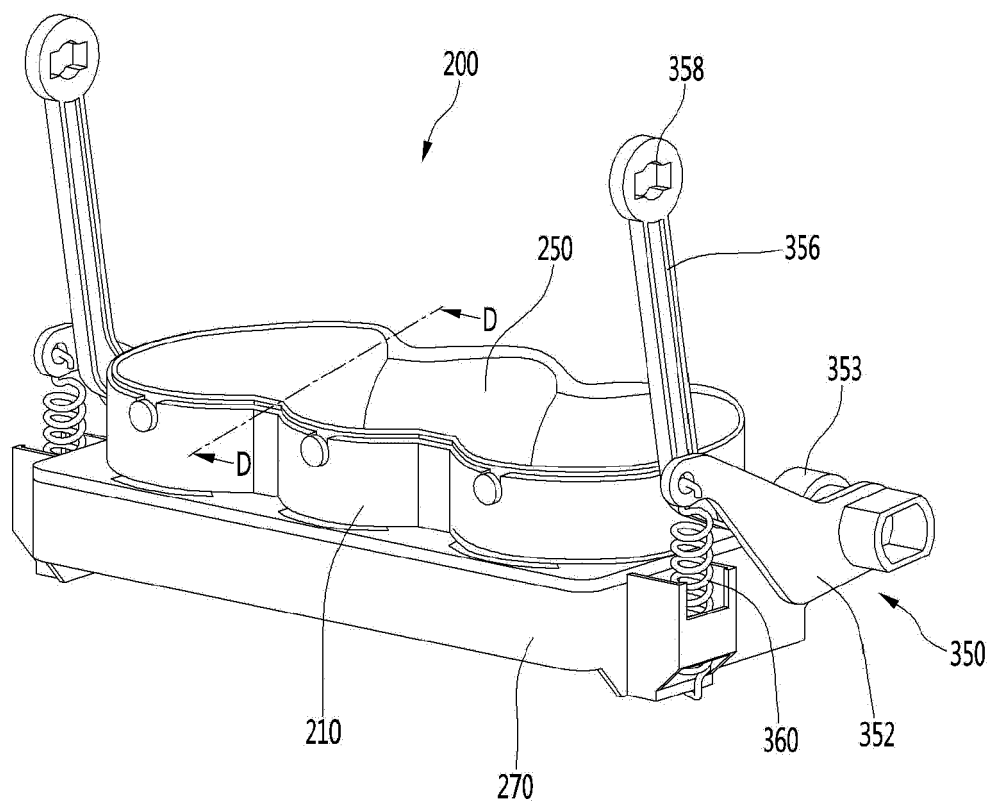


FIG.18

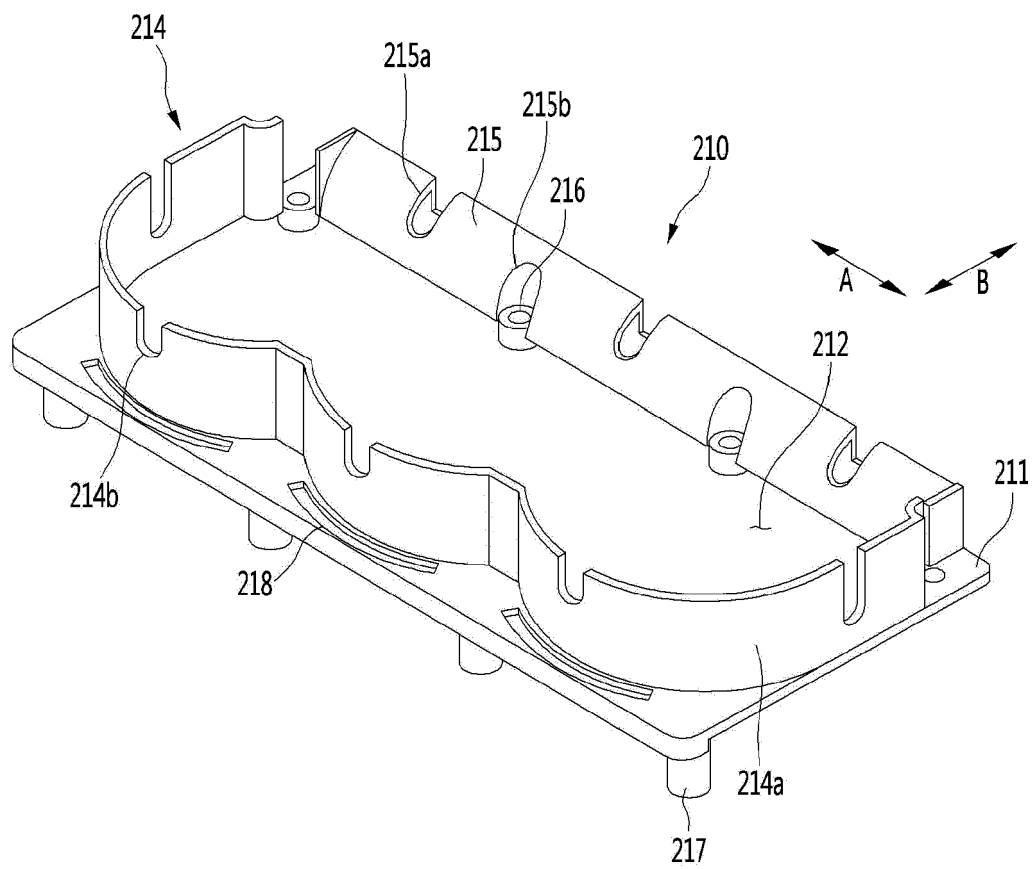


FIG.19

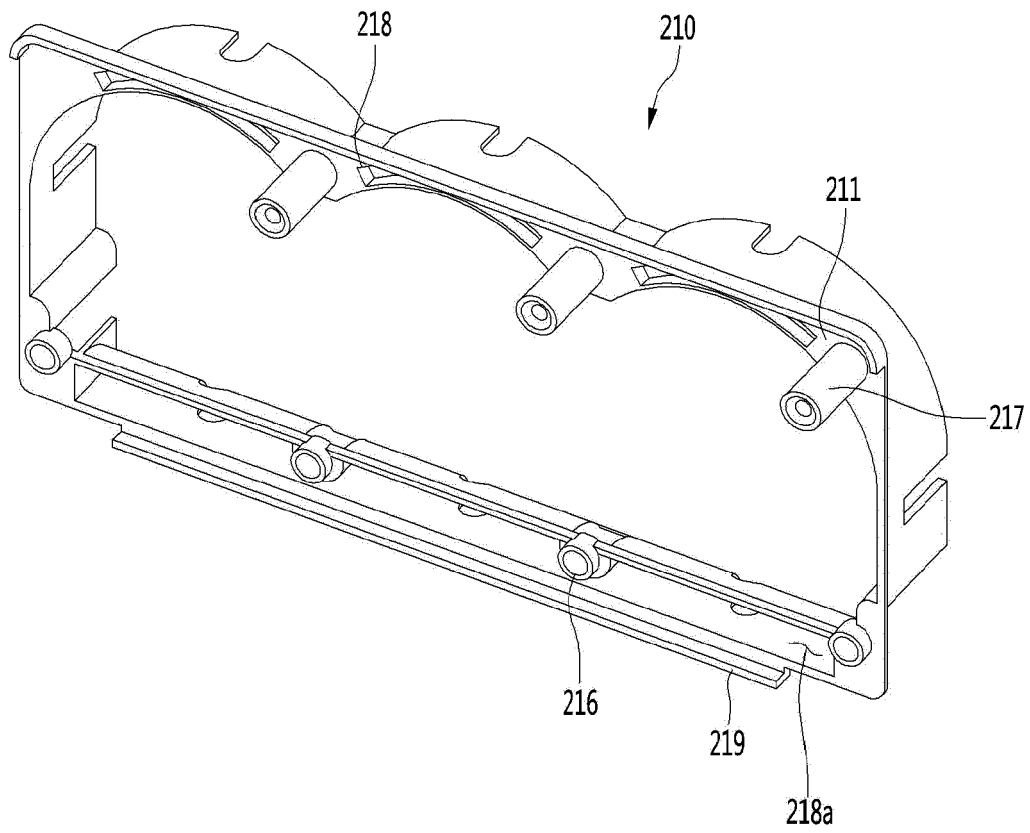


FIG.20

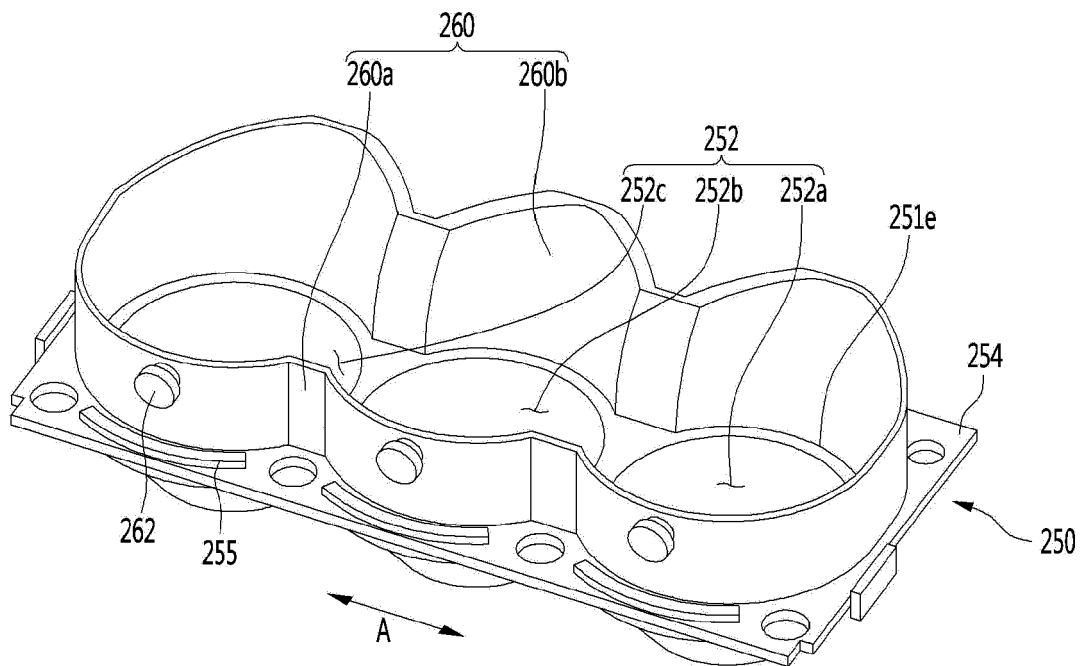


FIG.21

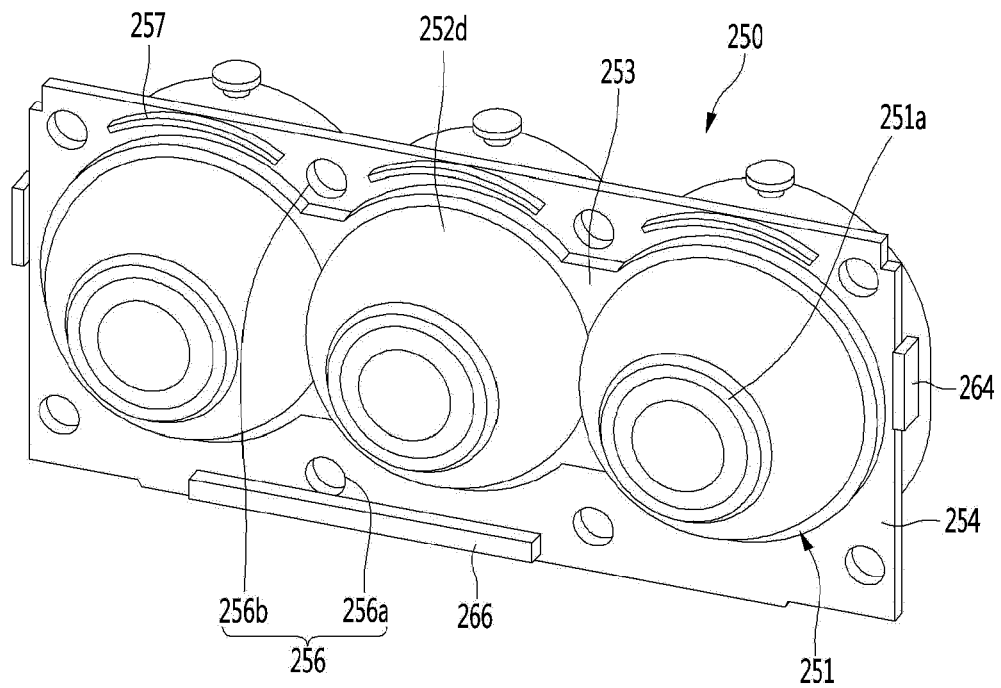


FIG.22

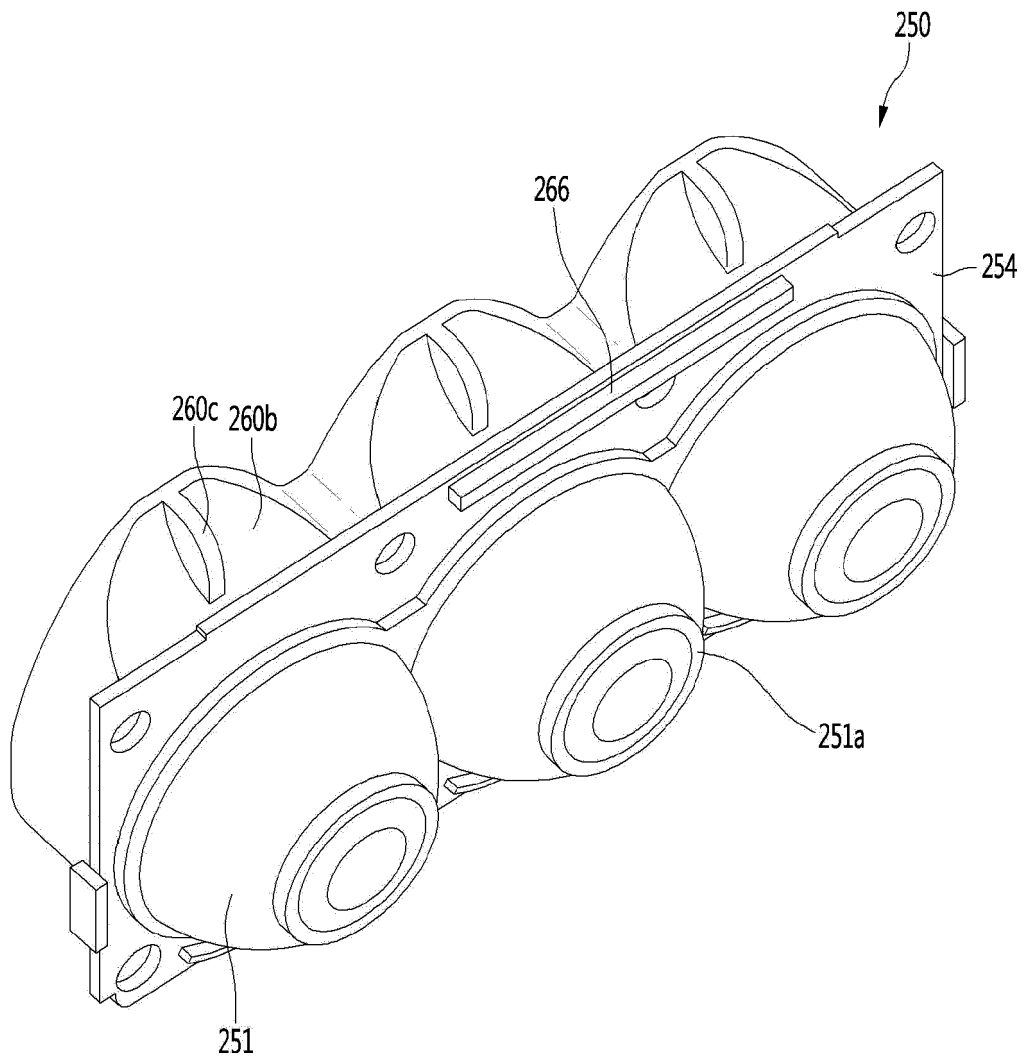


FIG.23

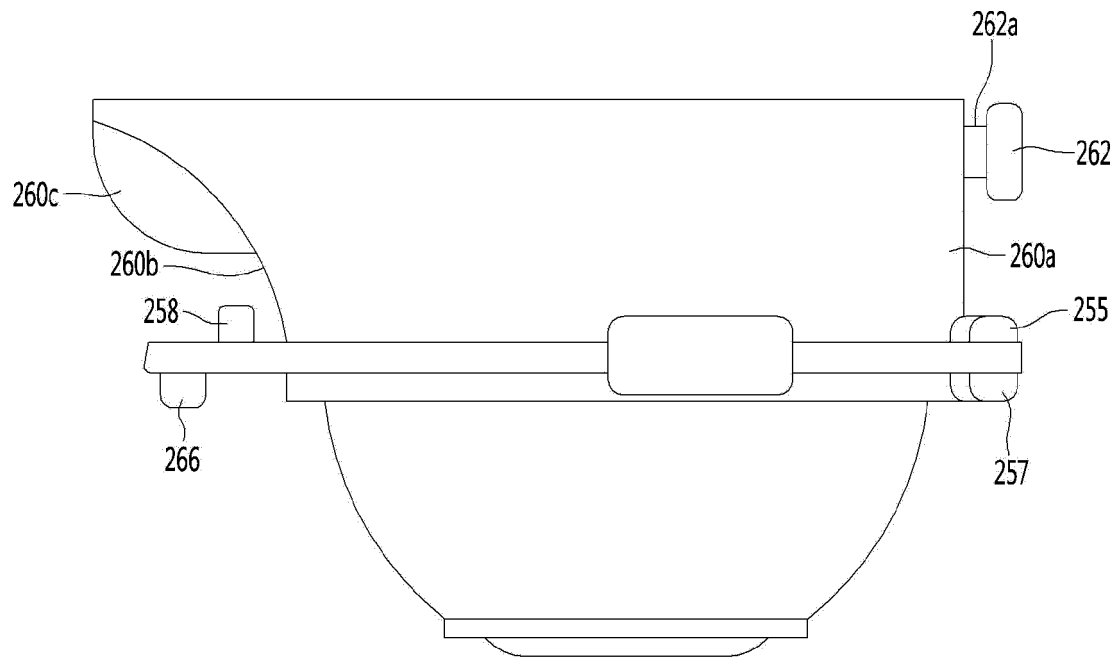


FIG.24

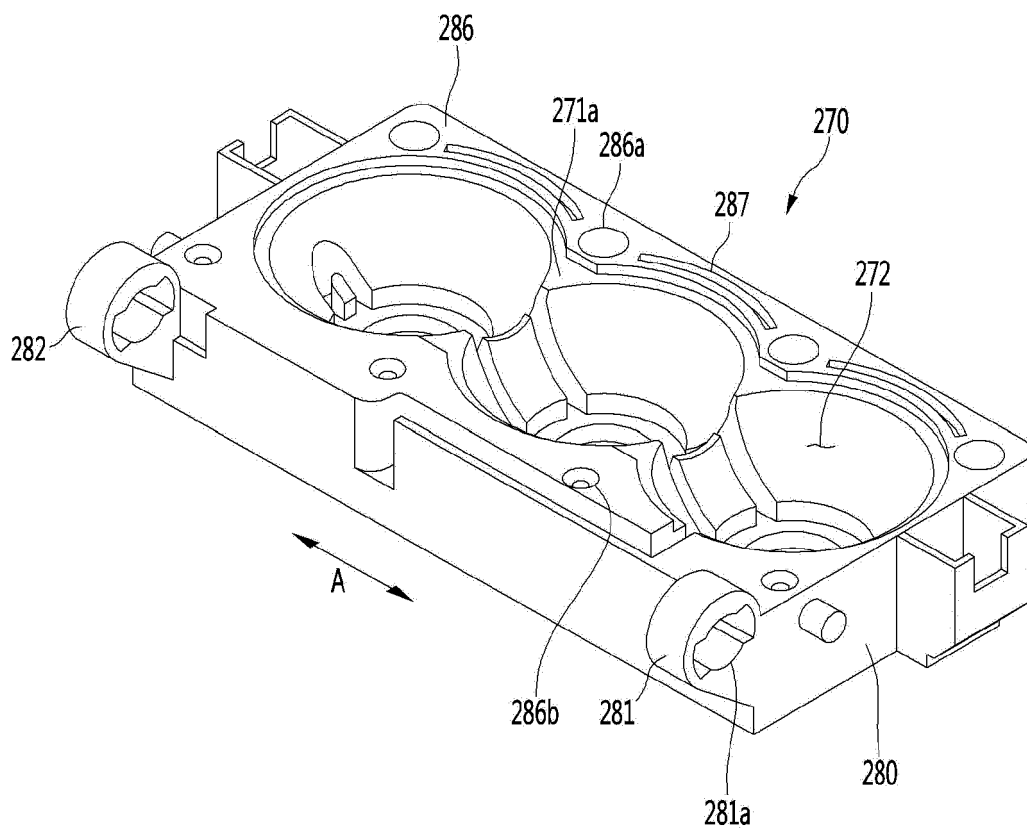


FIG.25

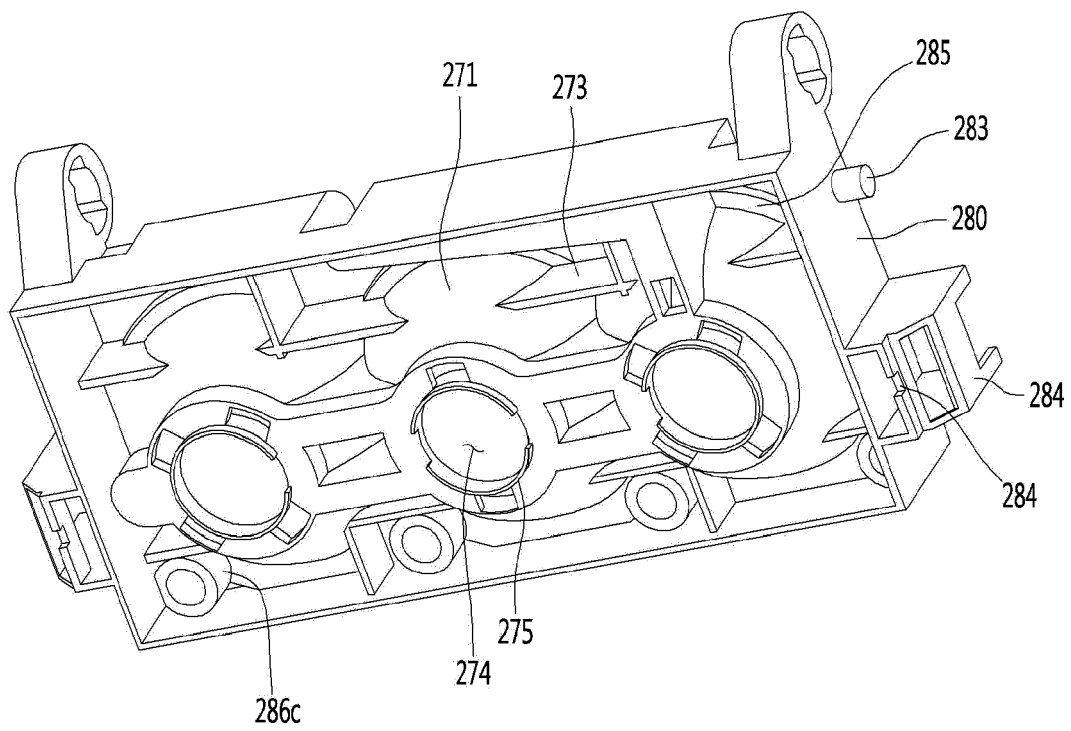


FIG.26

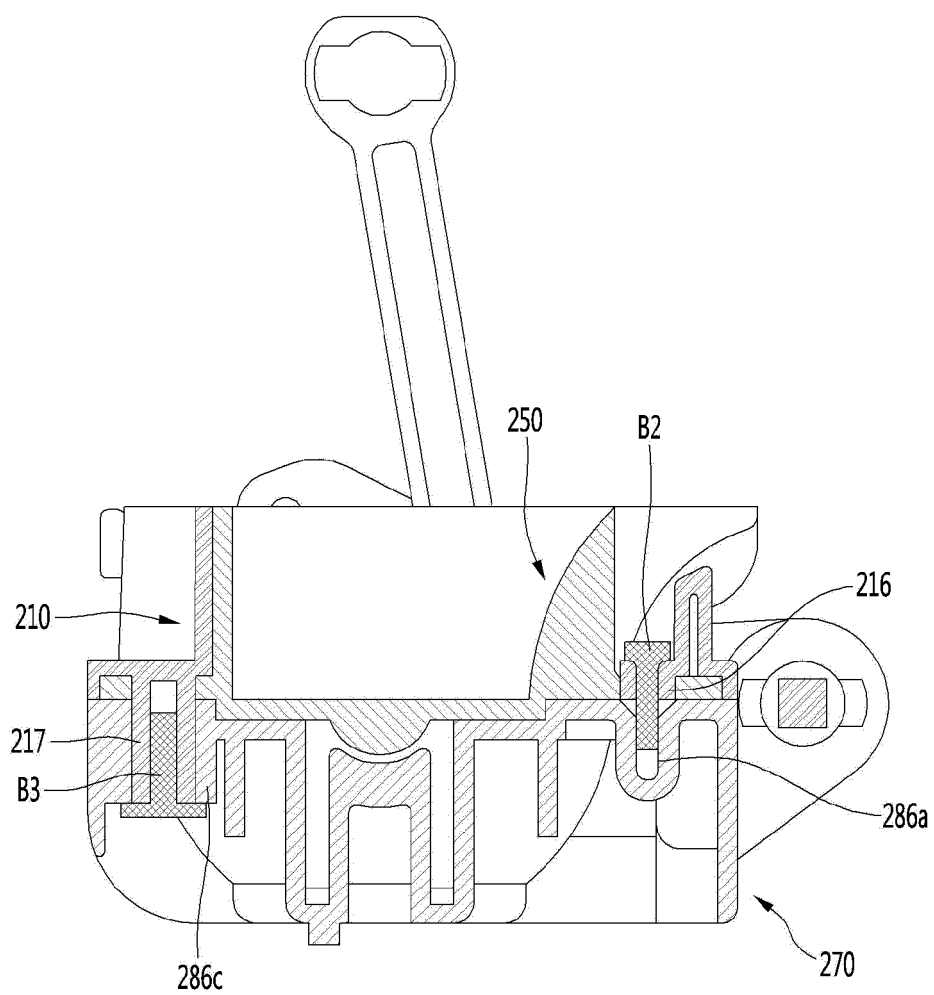


FIG.27

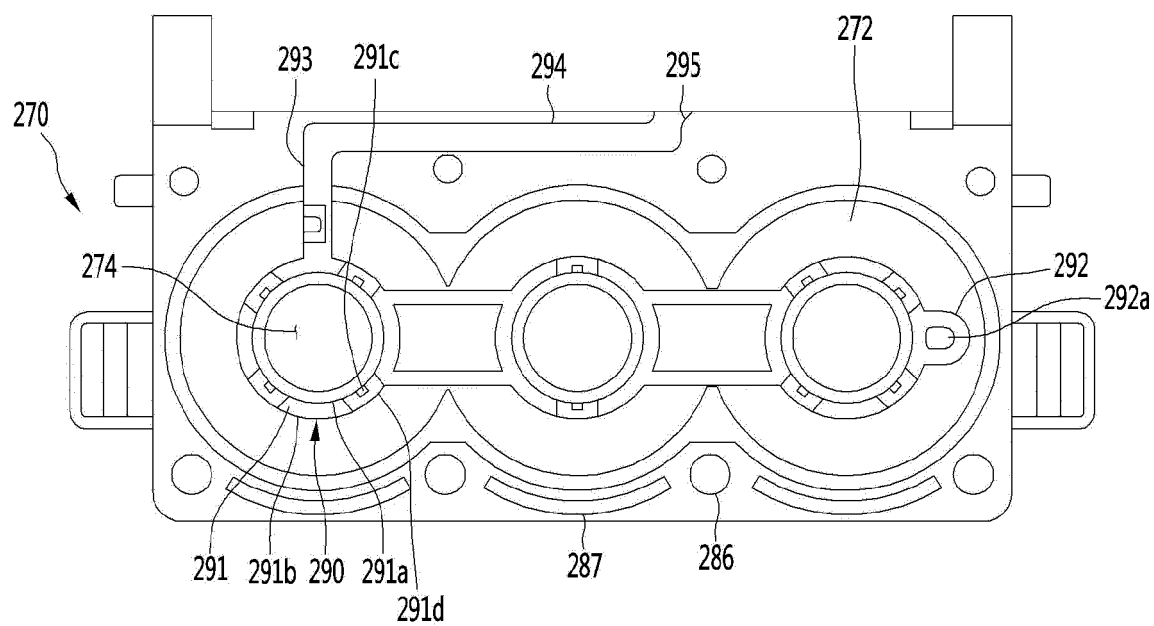


FIG.28

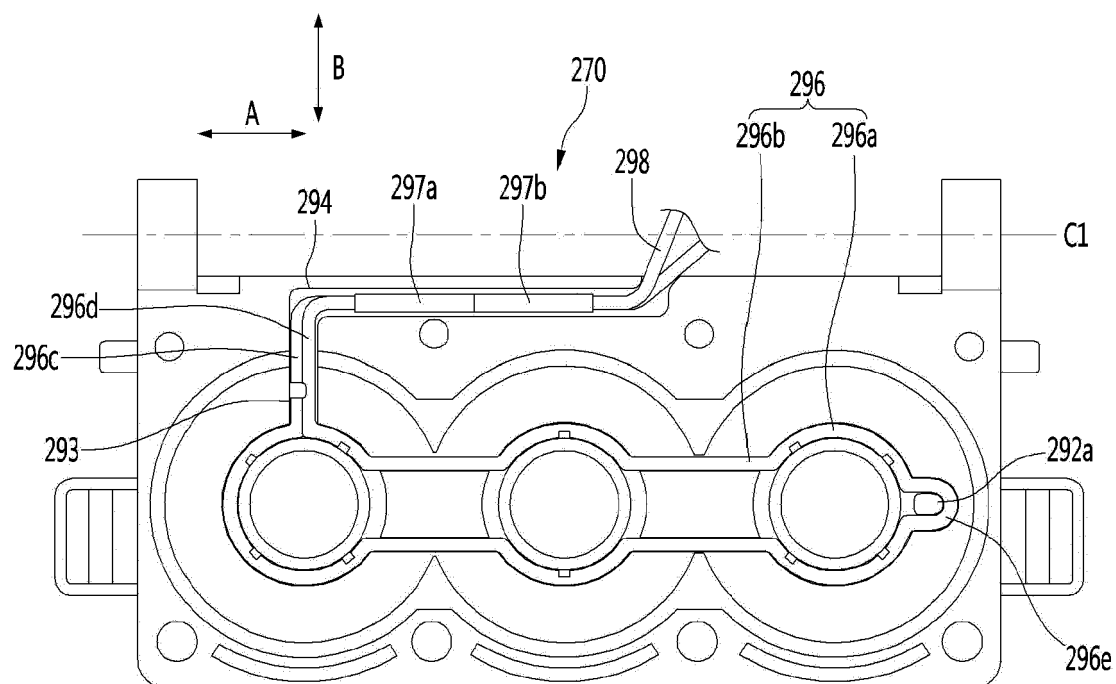


FIG.29

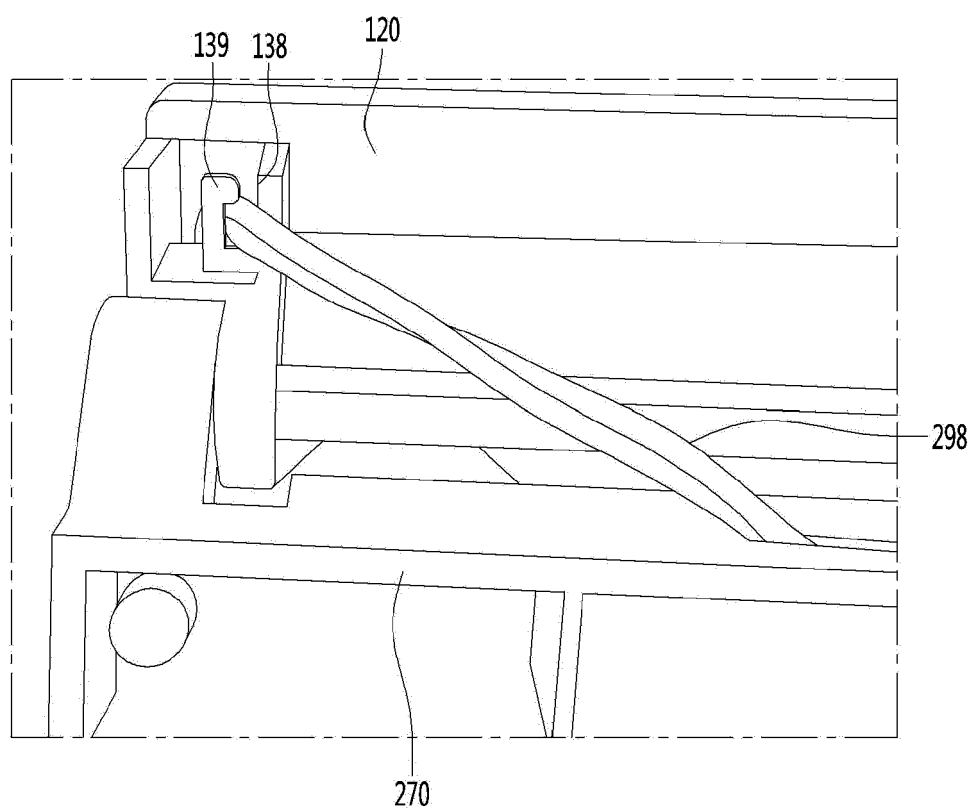


FIG.30

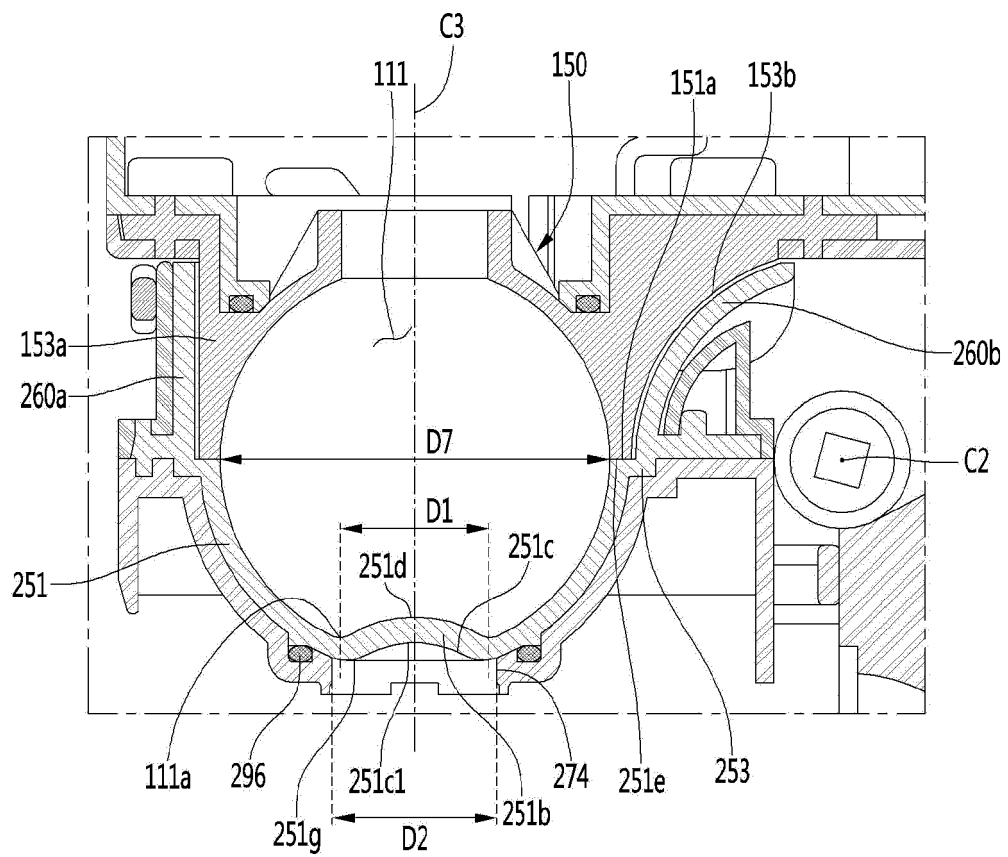


FIG.31

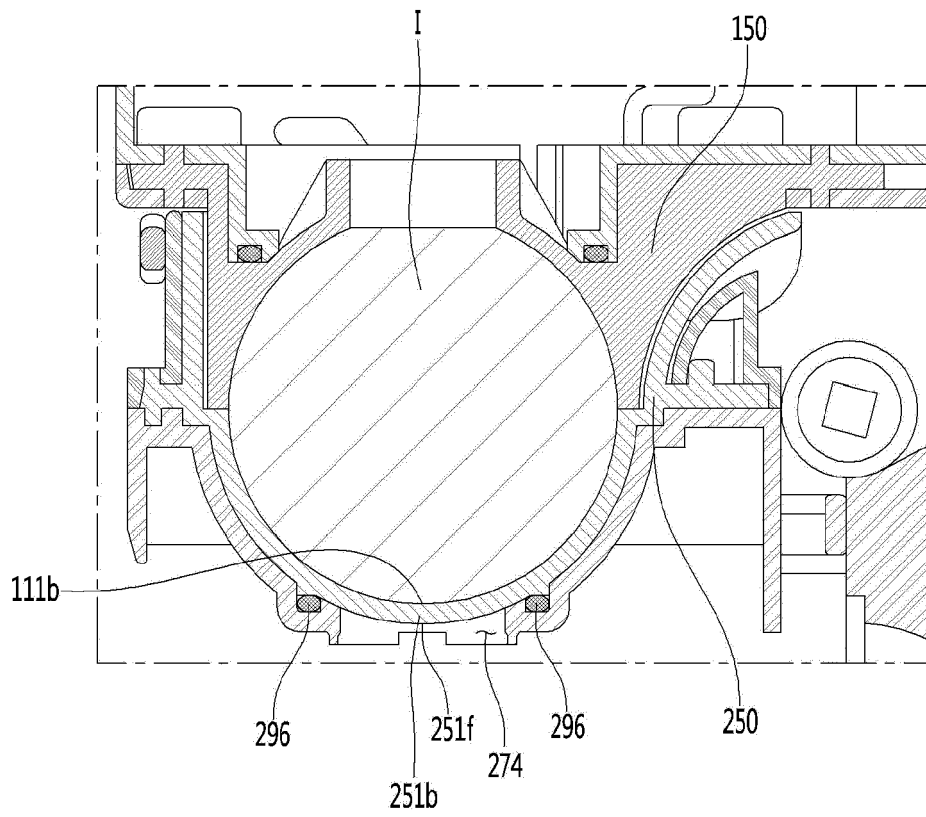


FIG.32

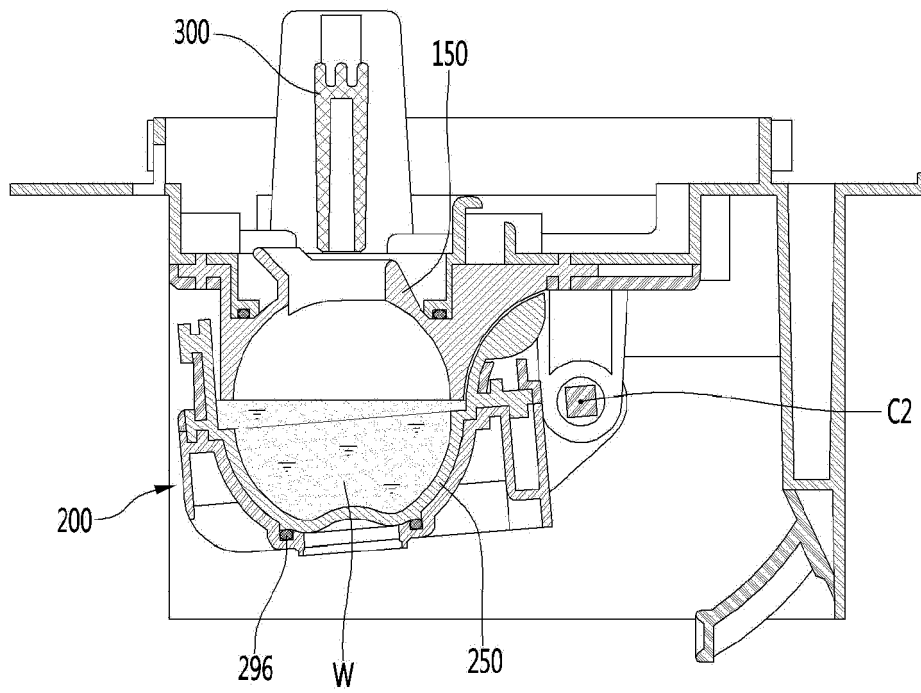


FIG.33

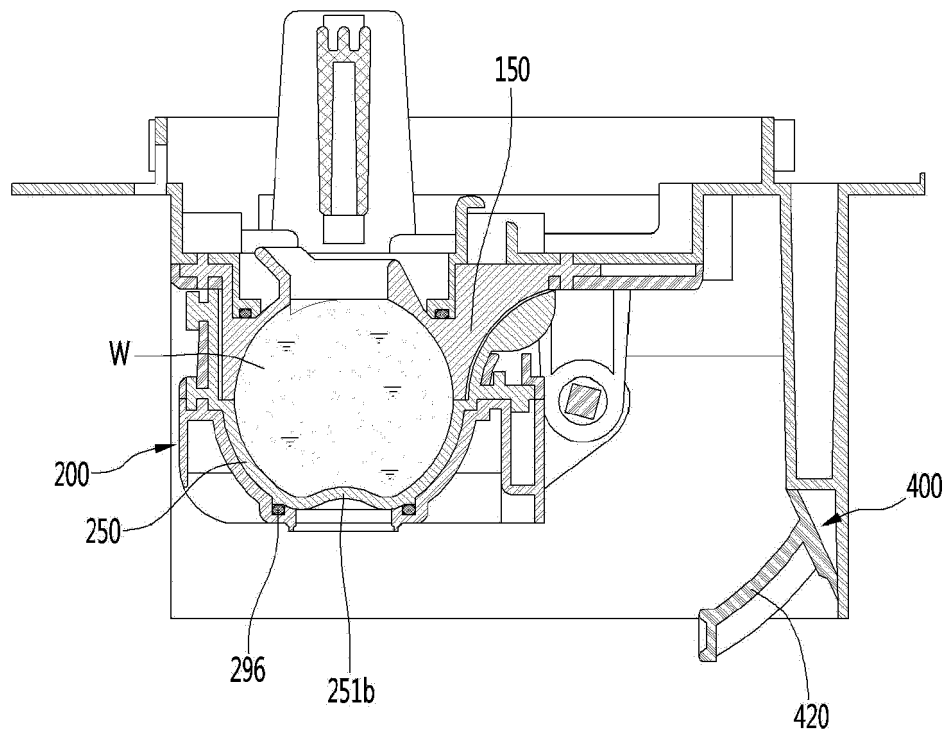


FIG.34

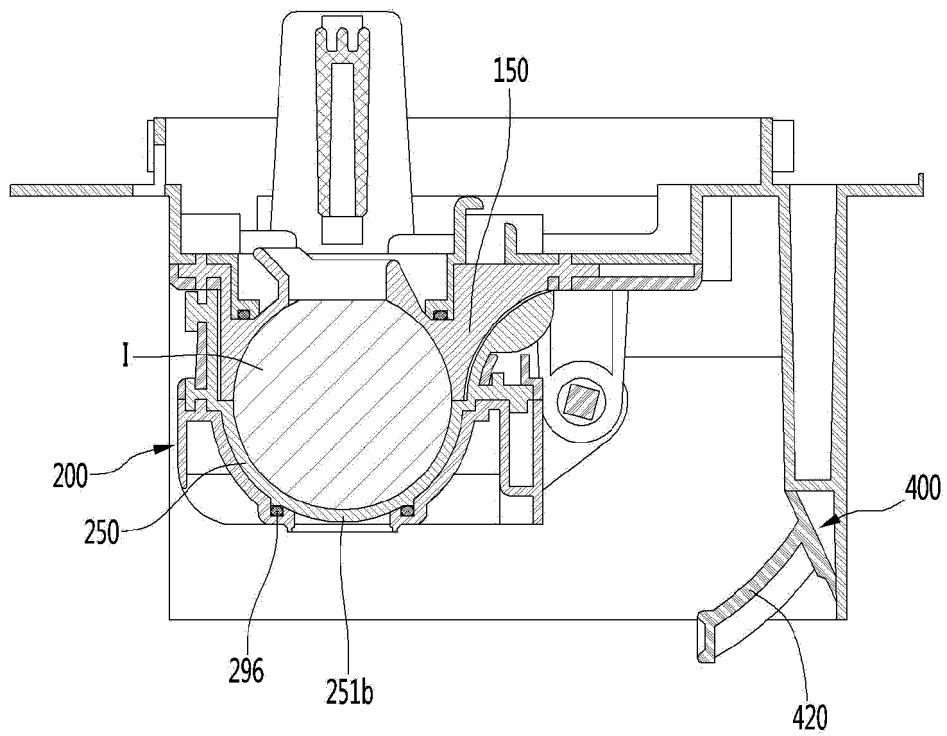


FIG.35

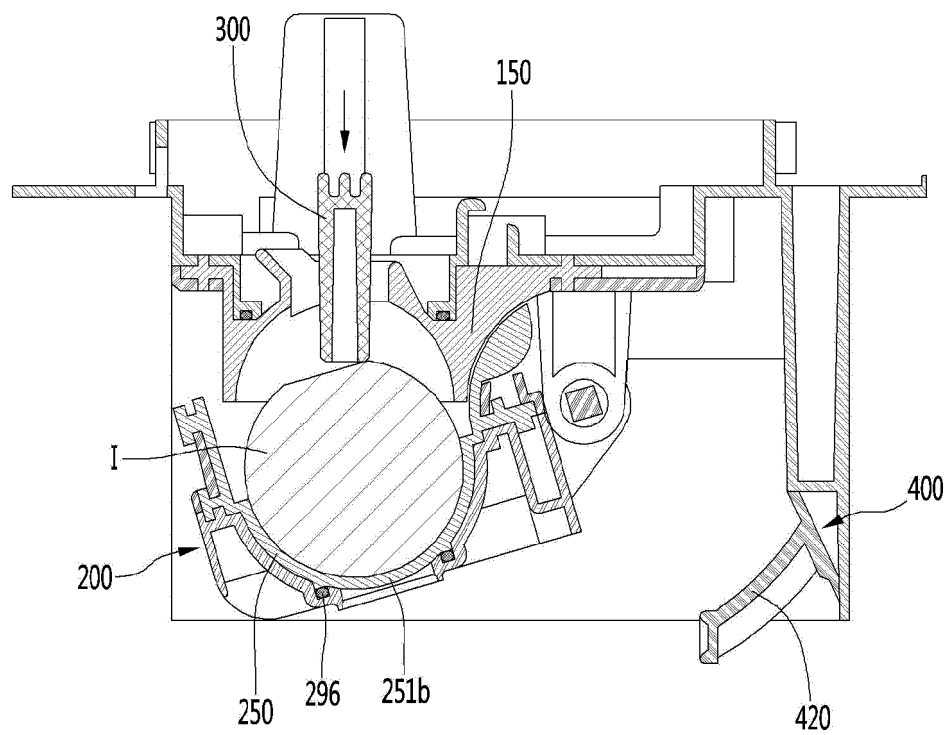
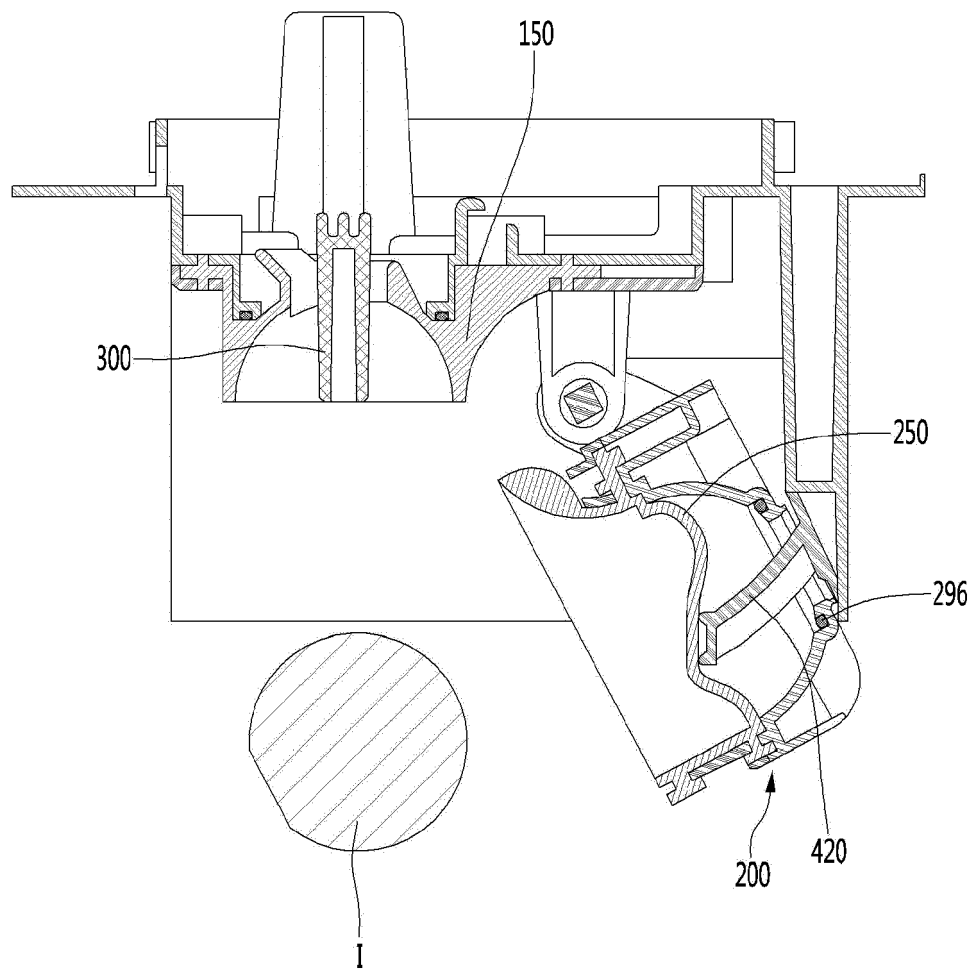


FIG.36





EUROPEAN SEARCH REPORT

 Application Number
 EP 19 20 9331

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 298 20 139 U1 (STADTELMAYER ULRICH [DE]) 23 March 2000 (2000-03-23)	1-3,7,15	INV.
Y	* page 5, paragraph 3; figures 1-7 *	4-6,8-14	F25C1/04
	-----		F25C5/06
Y	EP 2 549 207 A2 (LG ELECTRONICS INC [KR]) 23 January 2013 (2013-01-23)	4-6,8-14	F25C1/243
	* paragraphs [0048] - [0058], [0119] - [0138]; figures 3-8,22-25 *		F25C5/20

A	US 2014/182325 A1 (LEE DONGHOON [KR] ET AL) 3 July 2014 (2014-07-03)	1-15	
	* the whole document *		

			TECHNICAL FIELDS SEARCHED (IPC)
			F25C
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		26 March 2020	Léandre, Arnaud
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

 1
 EPO FORM 1503 03/02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 19 20 9331

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

26-03-2020

10

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 29820139	U1	23-03-2000	NONE
EP 2549207	A2	23-01-2013	CN 102878743 A 16-01-2013
			EP 2549207 A2 23-01-2013
			KR 20130009332 A 23-01-2013
			US 2013014536 A1 17-01-2013
US 2014182325	A1	03-07-2014	KR 20140088321 A 10-07-2014
			US 2014182325 A1 03-07-2014

15

20

25

30

35

40

45

50

55

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- KR 101850918 [0010]
- US 2182454 A [0019]