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

(11) **EP 3 653 974 A1**

(12) **EUROPEAN PATENT APPLICATION**

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

(51) Int Cl.:
F25C 5/06 *(2006.01)* ***F25C 5/20*** *(2018.01)*

(21) Application number: **19209399.5**

(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

(30) Priority: **16.11.2018 KR 20180142118**
26.07.2019 KR 20190090912

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

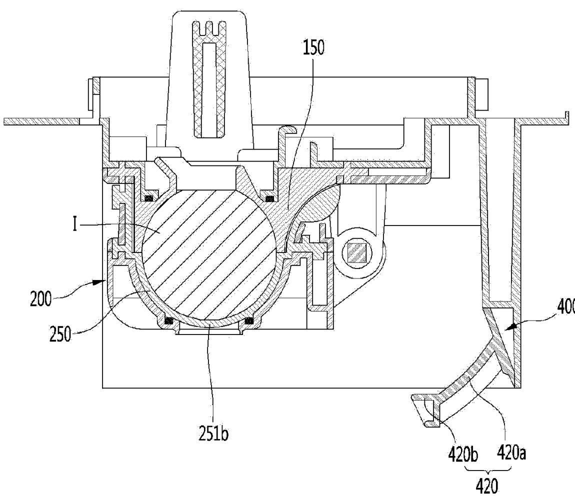
(72) Inventors:
- **KIM, Yonghyun**
  08592 Seoul (KR)
- **HONG, Jinil**
  08592 Seoul (KR)

(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 including an upper tray having at least one upper chamber part; a lower assembly (200) including a lower support and a flexible lower tray (250) separably supported thereon and having at least one lower chamber part, and a lower ejector (400) including at least one lower ejecting pin (420), wherein the lower assembly is movable with respect to the upper assembly between an open position and a closed position, wherein 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, wherein the lower support has at least one lower opening corresponding respectively to the at least one lower chamber part, and
wherein the lower ejector (400) is arranged such that in the open position, the lower ejecting pin (420) is configured to penetrate through the lower opening in the lower support and to partially separate the lower tray from the lower support for removing ice from the lower chamber part.

FIG. 41



EP 3 653 974 A1

Printed by Jouve, 75001 PARIS (FR)

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

[0007] 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.

[0008] Korean Patent No. 10-1850918 as Prior Art document 1 discloses an ice maker.

[0009] 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, 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, a rotary shaft connected to rear ends of the lower tray and the upper tray to allow the lower tray to rotate relative to the upper tray, a pair of links, one end of which is connected to the lower tray and the other end of which is connected to the link guide, and an upper ejecting pin assembly that is connected to the pair of links, with both ends thereof being fitted to the link guide, and ascending and descending with the link.

[0010] The lower tray includes a tray body in which the lower cell is 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.

[0011] In the ice maker of Prior Art document 1, the tray body is formed of a plastic material having a ductility, so that an outer face thereof may be changed.

[0012] Further, the ice maker in Prior Art document 1 includes a lower ejecting pin assembly to press the lower tray when the lower tray is rotated.

[0013] When the lower tray is pressed by the lower ejecting pin assembly, ice in the lower tray is separated from the lower tray.

[0014] However, in the case of Prior Art document 1, since a local portion of the lower tray is pressed by the lower ejecting pin, despite the pressurization of the lower ejecting pin, the ice does not separate from the lower tray.

[0015] In this connection, as a load applied to the lower ejecting pin assembly increases, there is a possibility that deformation of the lower ejecting pin assembly occurs.

[0016] Further, due to a tolerance of a motor gear, the lower tray may not reach a maximum ice-separating position and all ice may not be separated from the lower tray.

[0017] Further, as a plurality of ices are removed at the same time, a load applied on the motor rotating the lower tray may increase.

[0018] JP Patent No. 4657626 as Prior Art document 2 discloses an automatic ice-making apparatus.

[0019] The automatic ice-making apparatus includes an ice-making plate provided with a hole defined at a lower portion thereof, a rubber film disposed to close the hole in the ice-making plate, and ice pushing means for separating the ice from the ice-making plate by pushing the film through the hole.

[0020] However, since the ice pushing means of the Prior Art document is configured to press a local portion of the film, although the ice pushing means presses the film, ice does not separate from the film.

SUMMARY

[0021] An object of the present invention is to provide an ice maker in which a pressing force of a lower ejecting may be efficiently transmitted to a lower tray in an ice-separating process, thereby separating ice from the lower tray smoothly.

[0022] Another object of the present invention is to provide an ice maker in which a pressing force of a lower ejector pressing a lower tray may be applied on a central portion of the lower tray, thereby improving an ice-separation performance.

[0023] Another object of the present invention is to provide an ice maker that prevents ice from breaking or damaging in a process in which a lower ejector presses a lower tray.

[0024] Another object of the present invention is to provide an ice maker that prevents a lower ejector from interfering with a lower support supporting a lower tray in a process in which the lower ejector presses the lower tray.

[0025] Another object of the present invention is to provide an ice maker that may reduce a load applied on a motor instantaneously as the load applied on the motor included in a driving unit providing a rotational power to a lower assembly is distributed over time.

[0026] Another object of the present invention is to provide a refrigerator or a freezer including an ice maker according to any embodiment of the present invention.

[0027] One or more of these objects are solved by the features of the independent claim. Preferred embodiments are set out in the dependent claim.

[0028] An ice maker according to one aspect may include an upper tray and a lower tray forming an ice chamber, a lower support for supporting the lower tray, and a lower ejector for pressing the lower tray to separate ice from the lower tray.

[0029] The lower tray may be rotated relative to the upper tray. The lower ejector may further include a lower ejecting pin.

[0030] In a process in which the lower tray rotates, the lower ejecting pin may pass through the lower support to press the lower tray.

[0031] At least a portion of the lower ejecting pin may be formed in a curved shape in a longitudinal direction such that the ice may be separated from the lower tray smoothly.

[0032] A length of the lower ejecting pin may be larger than a radius of the ice chamber. The lower ejecting pin may include a pressing portion for pressing the lower tray.

[0033] In an ice-separating process, the pressing portion includes a pressing inclined portion such that a contact area of the pressing portion and the lower tray is increased. In the ice-separating process, an upper end of the pressing inclined portion comes into contact with the lower tray before a lower end thereof comes into contact with the lower tray.

[0034] When a rotation angle of the lower tray increases, the lower end of the pressing inclined portion also comes into contact with the lower tray. While the lower tray is rotated to an ice-separating position, the pressing inclined portion is in surface contact with a center of the lower tray.

[0035] At an ice-making position of the lower assembly, a first contact surface of the upper tray is in contact with a second contact surface of the lower tray. When a line passing through the first contact surface is referred to as a first virtual line and a line passing through the second contact surface is referred to as a second virtual line, while the lower assembly is rotated to the ice-separating position, an angle formed by the first virtual line and the second virtual line may be equal to or greater than 100 degrees.

[0036] The lower ejector may further include an ejector body having an inclined surface inclined with respect to a vertical line. The lower ejecting pin may protrude from the inclined surface.

[0037] While the lower assembly is rotated to the ice-separating position, a distance between an end of the lower ejecting pin and the ejector body may be equal to or greater than a distance between the second virtual line and the ejector body.

[0038] Further, while the lower assembly is rotated to the ice-separating position, a distance between a portion of the lower tray in contact with the end of the lower ejecting pin and the ejector body may be greater than the distance between the second virtual line and the ejector body.

[0039] A plurality of ice chambers distinguished by the upper tray and the lower tray may be defined.

[0040] A plurality of lower ejecting pins may protrude from the ejector body. A length of one of the plurality of lower ejecting pins may be larger than lengths of the others.

[0041] The ice maker may further include a driving unit for rotating the lower assembly.

[0042] A length of a lower ejecting pin positioned closest to the driving unit among the plurality of lower ejecting pins may be larger than that of at least one of the remaining lower ejecting pins.

[0043] A refrigerator according to another aspect may include an upper assembly including an upper tray for defining an upper chamber that is a portion of an ice chamber, a lower assembly including a lower tray for defining a lower chamber that is another portion of the ice chamber and a lower support for supporting the lower tray and having a lower opening defined therein, wherein the lower assembly is rotatable to the upper assembly, and a lower ejector having a lower ejecting pin for passing through the lower opening and pressing the lower tray when the lower assembly is rotated for an ice-separating process.

[0044] At least some of the lower ejecting pins are formed in a curved shape in a longitudinal direction and a length of the lower ejecting pin may be larger than a radius of the ice chamber.

[0045] A refrigerator according to another aspect may include a cabinet provided with a freezing compartment, and an ice maker for generating ice using cool air for cooling the freezing compartment.

[0046] The ice maker may include an upper tray for defining an upper chamber, a lower tray for defining a lower chamber forming an ice chamber with the upper chamber, a lower support for supporting the lower tray and having a lower opening defined therein, and a lower ejector for passing through the lower opening and pressing the lower tray when the lower tray rotates forward in an ice-separating process.

[0047] The lower tray may move from an ice-making position to an ice-separating position. While the lower tray is rotated to the ice-separating position, at least a portion of the lower tray in contact with the lower ejecting pin may be located opposite the lower opening around a virtual line passing through a surface of the lower tray in contact with the upper tray.

[0048] Alternatively, the lower tray includes a contact surface in contact with the upper tray at the ice-making position. While the lower tray is rotated to the ice-separating position, a portion of the lower ejecting pin may meet a virtual line passing through the contact surface of the lower tray.

[0049] An ice maker according to another aspect may include an upper assembly including an upper tray for defining an upper chamber that is a portion of an ice chamber, a lower assembly including a lower tray for defining a lower chamber that is another portion of the ice chamber and a lower support for supporting the lower tray and having a lower opening defined therein, wherein the lower assembly is rotatable to the upper assembly, and a lower ejector having a lower ejecting pin for passing through the lower opening and pressing the lower tray when the lower assembly is rotated forward for an ice-separating process.

[0050] At least some of the lower ejecting pins are formed in a curved shape in a longitudinal direction and a length of the lower ejecting pin may be larger than a radius of the ice chamber.

[0051] The lower ejecting pin may include a pressing portion for pressing the lower tray. The pressing portion includes a pressing inclined portion. The pressing inclined portion includes an upper end located close to the upper tray and a lower end located lower than the upper end.

[0052] In the ice-separating process, the upper end may come into contact with the lower tray before the lower end comes into contact with the lower tray.

[0053] When the lower tray is further rotated while the upper end is in contact with the lower tray, as the upper and the lower end comes into contact with the lower tray together, the pressing inclined portion may be in surface contact with the lower tray.

[0054] The lower ejecting pin may pass through the lower opening and be inserted into the lower support.

[0055] A length of a portion inserted into the lower support may be equal to or greater than a radius of the ice chamber.

[0056] The lower assembly may be rotated from an ice-making position to an ice-separating position. At the ice-making position of the lower assembly, a first contact surface of the upper tray is in contact with a second contact surface of the lower tray. A line passing through the first contact surface may be referred to as a first virtual line and a line passing through the second contact surface may be referred to as a second virtual line.

[0057] While the lower assembly is rotated to the ice-separating position, an angle formed by the first virtual line and the second virtual line may be equal to or greater than 100 degrees.

[0058] The lower ejector may further include an ejector body having an inclined surface that is inclined relative to a vertical line. The lower ejecting pin may extend from the inclined surface.

[0059] In a state in which the lower assembly is rotated to the ice-separating position, the second virtual line may be parallel to the inclined surface.

[0060] The second virtual line may be parallel with the inclined surface at a specific position before the lower assembly is rotated to the ice-separating position.

[0061] The lower ejector may further include an ejector body. Further, the lower ejecting pin may protrude from the ejector body.

[0062] While the lower assembly is rotated to the ice-separating position, a distance between an end of the lower ejecting pin and the ejector body may be equal to or greater than a distance between the second virtual line and the ejector body.

[0063] While the lower assembly is rotated to the ice-separating position, a distance between a portion of the lower tray in contact with the end of the lower ejecting pin and the ejector body may be greater than the distance between the second virtual line and the ejector body.

[0064] The supper assembly may further include an upper case for supporting the upper tray.

[0065] The ejector body may be fixed to the upper case.

[0066] A plurality of ice chambers distinguished by the upper tray and the lower tray may be defined. The lower ejector includes an ejector body. A plurality of lower ejecting pins may protrude from the ejector body.

[0067] A length of one of the plurality of lower ejecting pins may be larger than lengths of the others.

[0068] The ice maker may further include a driving unit for rotating the lower assembly.

[0069] A length of a lower ejecting pin positioned closest to the driving unit among the plurality of lower ejecting pins may be larger than that of at least one of the remaining lower ejecting pins.

[0070] Each of the lower ejecting pins may include a pin body extending from the ejector body, and a pressing portion for pressing the lower tray.

[0071] The pin body may be formed in a curved shape. The pressing portion may have a groove portion defined therein. The pin body may have a groove portion defined therein extending in a longitudinal direction.

[0072] An ice maker according to another aspect may include an upper assembly having an upper tray for defining a hemispherical upper chamber, and a lower assembly having a lower tray for defining a hemispherical lower chamber.

[0073] Ice in a sphere shape may be generated by the upper chamber and the lower chamber. The generated ice may be separated from the upper chamber and the lower chamber because of a rotation of the lower assembly.

[0074] Further, a lower ejector including a lower ejecting pin for pressing the lower tray to separate the ice from the lower tray when the lower assembly rotates to be away from the upper assembly after completing ice-making may be included.

[0075] Further, the lower ejector may include an ejector body coupled to the upper assembly and a plurality of lower ejecting pins protruding from the ejector body.

[0076] Further, a length of at least one of the plurality of lower ejecting pins may be smaller than a length of a lower ejecting pin disposed around. Further, the lower ejecting pin may be formed in a curved shape. Further, the lower ejecting pin may have a recessed groove portion defined at an end thereof in contact with the lower tray.

[0077] Further, the lower support may have a lower opening defined therein through which the lower ejecting pin passes.

[0078] Further, the lower ejector may be coupled to a vertical wall extending in a vertical direction in an upper case supporting an upper portion of the upper tray.

[0079] Further, the ejector body may form an inclined surface on one side thereof where the lower ejecting pin is formed. Further, the vertical wall may define a cavity recessed rearward.

[0080] Further, the cavity may define guide slots respectively on both sides thereof in a vertical direction. Guide protrusions respectively slided and inserted into the guide slots in the vertical direction may be formed on both sides of the lower ejector body, respectively.

[0081] Further, the ejector body may be provided with a fastening groove portion recessed rearward. Further, a top surface of the fastening groove portion and a top surface of the cavity may be in surface contact with each other and fastened with each other by fastening means.

[0082] Further, a coupling groove portion recessed upwardly may be defined in a lower end of the vertical wall. An extension protruding rearward may be formed on a lower end of the ejector body. A top surface of the coupling groove portion and an elevated portion formed on an upper end of the extension may be in surface contact with each other and fastened with each other by the fastening means.

[0083] A refrigerator according to another aspect may include a cabinet provided with a freezing compartment, a housing provided in the freezing compartment, and an ice maker installed in the housing. The ice maker may be an ice maker according to any one of the embodiments described herein.

[0084] The ice maker may include a lower ejector including a lower ejecting pin for pressing a lower tray to separate ice from the lower tray when a lower assembly rotates to be away from an upper assembly after completing ice-making.

[0085] According to one aspect, an ice maker for a home appliance, in particular for a refrigerator or freezer, for making 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.

[0086] 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.

[0087] 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.

[0088] 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.

[0089] 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.

[0090] 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.

[0091] 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.

[0092] 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.

[0093] 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.

[0094] 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.

[0095] 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 assembly, 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.

[0096] 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.

[0097] 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.

[0098] 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.

[0099] 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 corresponding 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.

[0100] 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.

[0101] 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.

[0102] According to the proposed invention, as the lower ejecting pin is curved in a longitudinal direction, a length thereof is larger than a radius of the ice chamber. Therefore, in the ice-separating process, a pressing force of the lower ejector pin is sufficiently applied to the lower tray, thereby separating ice from the lower tray smoothly.

[0103] Further, the pressing portion of the lower ejecting pin includes the pressing inclined portion. Further, in the ice-separating process of the lower tray, an upper end of the pressing inclined portion comes into contact with the lower tray first and then a lower end thereof comes into contact with the lower tray later. Therefore, when the lower tray is moved to the ice-separating position, the pressing inclined portion presses a center of the lower tray, thereby separating ice from the lower tray smoothly.

[0104] Further, when the lower tray is moved to the ice-separating position, the pressing inclined portion is in surface contact with the center of the lower tray. Thus, a local force may be applied to ice to prevent the ice from breaking.

[0105] Further, since the lower ejecting pin is formed curved in a longitudinal direction, interference with the lower support for supporting the lower tray may be prevented in the lower tray rotation process.

[0106] Further, while the lower tray is moved to the ice-separating position, at least a portion of the lower tray in contact with the lower ejecting pin is located opposite the lower opening around a virtual line passing through a surface of the lower tray in contact with the upper tray. Thus, ice may be completely separated from the lower tray.

[0107] Further, as some of the plurality of lower ejecting pins are formed longer than the others, the load applied on the motor included in the driving unit providing the rotational power to the lower assembly is distributed over time. Thus, the load applied on the motor instantaneously may be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0108]

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 connected 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 sectional view showing 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 line A-A of FIG. 3.

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

FIG. 31 is a bottom perspective view illustrating a state in which an ice maker and a lower ejector according to an embodiment of the present disclosure are separated from each other.

FIG. 32 is a bottom perspective view illustrating a state in which an ice maker and a lower ejector according to an embodiment of the present disclosure are separated from each other.

FIGS. 33 and 34 are perspective views of the lower ejector shown in FIG. 32 viewed from various directions.

FIG. 35 is a bottom perspective view illustrating a state in which an ice maker and a lower ejector according to another embodiment of the present disclosure are separated from each other.

FIGS. 36 and 37 are perspective views of the lower ejector shown in FIG. 35 viewed from various directions.

FIG. 38 is a bottom view of the lower ejector according to an embodiment of the present disclosure.

FIG. 39 is a cross-sectional view taken along line B-B of FIG. 3 in a water supplied state.

FIG. 40 is a cross-sectional view taken along line B-B of FIG. 3 in the ice-making state.

FIG. 41 is a cross-sectional view taken along line B-B of FIG. 3 in the ice-making completed state.

FIG. 42 is a cross-sectional view taken along line B-B of FIG. 3 in an initial state of ice-separation.

FIG. 43 is a cross-sectional view taken along line B-B of FIG. 3 in a state in which the lower ejecting pin is in contact with the lower tray.

FIG. 44 is a cross-sectional view taken along line B-B of FIG. 3 in an ice-separation completed state.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0109] 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.

[0110] 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.

[0111] 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.

[0112] 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.

[0113] 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.

[0114] 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.

[0115] 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.

[0116] 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.

[0117] 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.

[0118] 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.

[0119] A user may open the refrigerating compartment door 6 to approach the ice bin 102, thereby obtaining the ice.

[0120] 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.

[0121] 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.

[0122] Hereinafter, the ice maker will be described in detail with reference to the accompanying drawings.

[0123] 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.

[0124] 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).

[0125] 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.

[0126] 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.

[0127] 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.

[0128] 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.

[0129] The upper assembly 110 and the lower assembly 200 may define a plurality of ice chambers 111.

[0130] 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.

[0131] 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.

[0132] The water supply part 190 is coupled to the upper assembly 110 to guide water supplied from the outside to the ice chamber 111.

[0133] 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.

[0134] 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. 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. The driving motor may be a bi-directional rotatable motor. Thus, the lower assembly 200 may rotate in both directions.

[0135] 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. 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. 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.

[0136] The upper ejecting pins 320 may be provided in the same number of ice chambers 111.

[0137] 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.

[0138] For example, the pair of separation prevention protrusions 312 may protrude in opposite directions from the ejector body 310.

[0139] 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.

[0140] The ice pressed by the upper ejecting pin 320 may be separated from the upper assembly 110.

[0141] 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. 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. 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.

[0142] 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.

[0143] 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.

[0144] 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.

[0145] 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.

[0146] Hereinafter, the upper assembly 110 and the lower assembly 200 will be described in more detail.

[0147] 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.

[0148] The upper assembly 110 may further include an upper support 170 fixing a position of the upper tray 150.

[0149] The upper support 170 may restrict downward movement of the upper tray 150.

[0150] The upper assembly 110 may further include an upper case 120 fixing a position of the upper tray 150.

[0151] 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.

[0152] 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.

[0153] That is, the upper tray 150 may be fixed to the upper case 120 through coupling of the coupling member. For example, the water supply part 190 may be fixed to the upper case 120.

[0154] The ice maker 100 may further include a temperature sensor 500 detecting a temperature of the upper tray 150. 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.

[0155] 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. The lower tray 250 may be called as a second tray. Alternatively, the lower tray 250 may be called as a lower mold part.

[0156] The lower assembly 200 may further include a lower support 270 supporting a lower portion of the lower tray 250.

[0157] 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. The lower case 210, the lower tray 250, and the lower support 270 may be coupled to each other through a coupling member.

[0158] 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. 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. 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>

[0159] 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.

[0160] 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.

[0161] The upper case 120 may include an upper plate for fixing the upper tray 150.

[0162] 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.

[0163] An opening 123 through which a portion of the upper tray 150 passes may be defined in the upper plate 121.

[0164] 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.

[0165] 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.

[0166] 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. Thus, the upper tray 150 passing through the opening 123 may be disposed in a space defined by the recess 122.

[0167] 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. 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.

[0168] The upper case 120 may further include a plurality of installation ribs 128 and 129 for installing the temperature sensor 500. 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. The pair of installation ribs 128 and 129 may be provided on the upper plate 121.

[0169] A plurality of slots 131 and 132 coupled to the upper tray 150 may be provided in the upper plate 121. A portion of the upper tray 150 may be inserted into the plurality of slots 131 and 132.

[0170] 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. The opening 123 may be defined between the first upper slot 131 and the second upper slot 132.

[0171] 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.

[0172] 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).

[0173] 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.

[0174] 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. For example, the first upper slot 131 may be defined in a curved shape. Thus, the first upper slot 131 may increase in length. For example, the second upper slot 132 may be defined in a curved shape. Thus, the second upper slot 133 may increase in length.

[0175] 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.

[0176] 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.

[0177] 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.

[0178] 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.

[0179] The sleeve 133 may have a cylindrical shape and extend upward from the upper plate 121.

[0180] 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.

[0181] A portion of the plurality of sleeves may be disposed between the two first upper slots 131 adjacent to each other.

[0182] 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.

[0183] The upper case 120 may further include a plurality of hinge supports 135 and 136 allowing the lower assembly 200 to rotate. 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. For example, the plurality of hinge supports 135 and 136 may extend downward from the upper plate 121.

[0184] 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.

[0185] 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. The water supply part 190 may be coupled to the vertical extension part 140.

[0186] The upper case 120 may further include a horizontal extension part 142 horizontally extending to the outside of the vertical extension part 140. 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.

[0187] 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.

[0188] 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.

[0189] 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>

[0190] 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.

[0191] 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.

[0192] 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.

[0193] 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.

[0194] 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.

[0195] 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.

[0196] 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.

[0197] 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.

[0198] The upper tray body 151 may be define a plurality of upper chambers 152. 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.

[0199] 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.

[0200] 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.

[0201] 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.

[0202] 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. Thus, the upper opening 154 may also be denoted as inlet opening.

[0203] In the ice transfer process, the upper ejector 300 may be inserted into the upper chamber 152 through the upper opening 154. 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.

[0204] The inlet wall 155 may be disposed along a circumference of the upper opening 154 and extend upward from the upper tray body 151.

[0205] 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.

[0206] 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.

[0207] 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.

[0208] Although not limited, the plurality of connection ribs 155a may be disposed along the circumference of the inlet wall 155.

[0209] 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.

[0210] 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. Although not limited, the water supply guide 156 may be provided in the inlet wall corresponding to the second upper chamber 152b. 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.

[0211] 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.

[0212] 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.

[0213] 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.

[0214] 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.

[0215] 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.

[0216] 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.

[0217] 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.

[0218] 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.

[0219] 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.

[0220] The chamber wall 153 of the upper tray body 151 may include a vertical wall 153a and a curved wall 153b. The curved wall 153b may be rounded upward in a direction that is away from the upper chamber 152.

[0221] 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. The horizontal extension part 164 may contact the upper case 120 and the upper support 170.

[0222] 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. At least a portion of the horizontal extension part 164 may be disposed between the upper case 120 and the upper support 170.

[0223] 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.

[0224] 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.

[0225] 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. 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. 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. 9 may be the same direction as the direction of the arrow B of Fig. 7.

[0226] 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. The plurality of second upper protrusions 166 may be arranged to be spaced apart from each other in the direction of the arrow A. 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.

[0227] 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.

[0228] 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.

[0229] 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.

[0230] 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.

[0231] 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. 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. The first lower protrusion 167 may be disposed at an opposite 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.

[0232] 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.

[0233] 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.

[0234] 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.

[0235] For example, a plurality of through-holes 169 may be provided in the horizontal extension part 164.

[0236] 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.

[0237] 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>

[0238] 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.

[0239] Referring to Figs. 11 and 12, the upper support 170 may include a support plate 171 contacting the upper tray 150.

[0240] 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.

[0241] A plate opening 172 through which the upper tray body 151 passes may be defined in the support plate 171.

[0242] 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.

[0243] Also, a top surface of the circumferential wall 174 may contact a bottom surface of the upper plate 121.

[0244] The support plate 171 may include a plurality of lower slots 176 and 177. 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. 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.

[0245] 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.

[0246] 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.

[0247] 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.

[0248] 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.

[0249] 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.

[0250] 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. 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. 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.

[0251] Each of the unit guides 181 and 182 may include a guide slot 183 vertically extends. 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. 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 >

[0252] 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.

[0253] Referring to Figs. 13 to 15, the heater coupling part 124 may include a heater accommodation groove 124a accommodating the upper heater 148. 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.

[0254] The heater accommodation groove 124a may extend along a circumference of the opening 123 of the upper case 120.

[0255] 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.

[0256] The upper heater 148 may be a DC heater receiving DC power. The upper heater 148 may be turned on to transfer ice. The upper heater 148 may be called as an ice separating heater. When heat from the upper heater 148 is transferred to the upper tray 150, the ice may separate from a surface (inner face) of the upper tray 150. In this connection, the stronger the heat of the upper heater 148, the more opaque the portion of the spherical ice facing the upper heater 148 than other portions thereof. In other words, an opaque band of a shape corresponding to the upper heater is formed around the ice.

[0257] However, in the present embodiment, an amount of the heat transferred to the upper tray 150 may be reduced using the DC heater with a low output itself, thereby preventing the formation of the opaque band around the ice.

[0258] 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.

[0259] 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.

[0260] 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.

[0261] 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.

[0262] 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.

[0263] 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.

[0264] In Fig. 13, for example, a plurality of separation prevention protrusions 124d are provided on the inner wall 124c. The separation prevention protrusion 124d may protrude from an end of the inner wall 124c toward the outer wall 124b.

[0265] 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.

[0266] 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.

[0267] 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.

[0268] 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. The linear portion 148d may be a portion connecting the upper rounded portions 148c corresponding to the upper chambers 152 to each other.

[0269] 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.

[0270] 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.

[0271] 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.

[0272] 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.

[0273] 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.

[0274] 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.

[0275] 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.

[0276] 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.

[0277] 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.

[0278] 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.

[0279] In Fig. 15, for example, a structure in which the first guide part 126 guides the first connector 129a is illustrated. 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. Thus, the upper bent portion of the first guide part 126 may limit upward movement of the first connector 126.

[0280] 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.

[0281] 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.

[0282] 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. That is, each of the first guide 127 and the second guide 128 may include a curved portion.

[0283] 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.

[0284] Fig. 16 is a cross-sectional view illustrating a state in which an upper assembly is assembled.

[0285] 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.

[0286] 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.

[0287] 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.

[0288] 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.

[0289] 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.

[0290] 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.

[0291] 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.

[0292] 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. 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.

[0293] 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.

[0294] 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.

[0295] 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.

[0296] 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.

[0297] In this embodiment, the upper rounded portion 148c of the upper heater 148 may vertically overlap the upper chamber 152. 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>

[0298] 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.

[0299] Referring to Figs. 17 to 19, the lower assembly 200 may include a lower tray 250. The lower assembly 200 may further includes a lower support 270, and a lower case 210.

[0300] The lower case 210 may surround the circumference of the lower tray 250, and the lower support 270 may support the lower tray 250.

[0301] The connection unit 350 may be coupled to the lower support 270. 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.

[0302] 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.

[0303] The elastic member 360 may have one end connected to the first link 362 and the other end connected to the lower support 270. 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.

[0304] In this embodiment, the first link 352 and the second link 356 may be disposed on both sides of the lower support 270, respectively. One of the two first links may be connected to the driving unit 180 to receive the rotation force from the driving unit 180. The two first links 352 may be connected to each other by a connection shaft (see reference numeral 370 of Fig. 5).

[0305] 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.

[0306] The lower case 210 may include a lower plate 211 for fixing the lower tray 250. A portion of the lower tray 250 may be fixed to contact a bottom surface of the lower plate 211. An opening 212 through which a portion of the lower tray 250 passes may be defined in the lower plate 211. 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.

[0307] 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. The circumferential wall 214 may include a vertical wall 214a and a curved wall 215. 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. 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.

[0308] The curved wall 215 may include a second coupling slit 215a to the lower tray 250. The second coupling slit 215a may be defined by recessing an upper end of the curved wall 215 downward.

[0309] The lower case 210 may further include a first coupling boss 216 and a second coupling boss 217. 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. 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. 18.

[0310] 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.

[0311] 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. 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.

[0312] 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.

[0313] 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.

[0314] The lower case 210 may further include a slot 218 coupled to the lower tray 250. 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. 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.

[0315] 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.

[0316] 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>

[0317] 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.

[0318] Referring to Figs. 20 to 23, the lower tray 250 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.

[0319] 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.

[0320] 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.

[0321] 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.

[0322] 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.

[0323] 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.

[0324] 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.

[0325] The lower tray body 251 may be define a plurality of lower chambers 252. 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. 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.

[0326] 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.

[0327] 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.

[0328] 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.

[0329] The lower tray 250 may further include a circumferential wall 260 extended upward from an upper surface of the first extension part 253.

[0330] A bottom surface of the upper tray body 151 may be in contact with a top surface or end surface 251 e of the lower tray body 251. The top surface 251 e of the lower tray body 251 may be called as an end surface.

[0331] The circumferential wall 260 may surround the upper tray body 251 seated on the top surface 251e of the lower tray body 251. 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.

[0332] 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.

[0333] The lower tray 250 may further include a second extension part 254 horizontally extending from the circumferential wall 250. 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.

[0334] 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. 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.

[0335] 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.

[0336] 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. 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.

[0337] 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. A plurality of through-holes may be defined in the second extension part 254.

[0338] 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.

[0339] 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. 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.

[0340] 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.

[0341] 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.

[0342] 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.

[0343] 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.

[0344] 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.

[0345] 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.

[0346] The circumferential wall 260 of the lower tray 250 may include a first coupling protrusion 262 coupled to the lower case 210. 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.

[0347] 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.

[0348] The circumferential wall 260 of the lower tray 250 may further include a second coupling protrusion 262c coupled to the lower case 210. The second coupling protrusion 262c may horizontally 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.

[0349] 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. 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.

[0350] A portion of the plurality of first through-holes 256a may be defined between the second lower protrusion 266 and the lower chamber 252.

[0351] The second lower protrusion 266 may be accommodated in a guide groove defined in the lower support 270, which will be described later. 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.

[0352] 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.

[0353] 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.

<Lower support>

[0354] 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 sectional view showing a state in which the lower assembly has been assembled.

[0355] Referring to Figs. 24 to 26, the lower support 270 may include a support body 271 supporting the lower tray 250.

[0356] 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.

[0357] 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.

[0358] A reinforcement rib 275 reinforcing strength may be disposed along a circumference of the lower opening 274. Further, the two adjacent chamber accommodation parts 272 of the three chamber accommodation parts 272 may be connected with each other by a connection rib 273. Such connection rib 273 may enhance a strength of the chamber accommodation parts 272.

[0359] The lower support 270 may further include a first extension wall 285 horizontally extending from an upper end of the support body 271.

[0360] 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.

[0361] A top surface of the second extension wall 286 may be disposed higher than the first extension wall 285. 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.

[0362] The lower support 270 may further include a protrusion groove 287 accommodating the first lower protrusion 257 of the lower tray 250. 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.

[0363] 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. The first coupling groove 286a may be provided, for example, in the second extension wall 286. 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.

[0364] 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.

[0365] 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.

[0366] 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. The second coupling member B3 may be coupled to the second coupling boss 217 from a lower side of the lower support 270.

[0367] 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. 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.

[0368] 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.

[0369] The outer wall 280 may, for example, extend downward along an edge of the second extension wall 286.

[0370] 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.

[0371] 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.

[0372] 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.

[0373] 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.

[0374] 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.

[0375] 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.

[0376] 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 >

[0377] 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.

[0378] 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.

[0379] 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.

[0380] 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.

[0381] For example, the lower heater 296 may be a wire-type heater.

[0382] 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.

[0383] 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.

[0384] The lower support 270 may further include a heater coupling part 290 to which the lower heater 296 is coupled.

[0385] 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.

[0386] Since the heater accommodation groove 291 is recessed, the heater coupling part 290 may include an inner wall 291a and an outer wall 291b.

[0387] 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.

[0388] 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.

[0389] 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.

[0390] 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.

[0391] 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.

[0392] In Fig. 27, the separation prevention protrusions 291c is provided on the inner wall 291a.

[0393] 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.

[0394] 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.

[0395] The separation prevention protrusion 291c may protrude from an upper end of the inner wall 291a toward the outer wall 291b.

[0396] 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.

[0397] 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 divided into a lower rounded portion 296a and a linear portion 296b.

[0398] The 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.

[0399] The liner portion 296b may be a portion connecting the lower rounded portions 296a corresponding to the lower chambers 252 to each other.

[0400] 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.

[0401] 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.

[0402] 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.

[0403] 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.

[0404] 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.

[0405] For example, the first guide groove 293 may extend in a direction of an arrow B in the heater accommodation part 291.

[0406] 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.

[0407] 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.

[0408] 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.

[0409] 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.

[0410] The power input terminal 296c and the power output terminal 296d of the lower heater 296 may be connected to one first connector 297a.

[0411] 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.

[0412] 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.

[0413] 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.

[0414] 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.

[0415] 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.

[0416] 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.

[0417] 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.

[0418] 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.

[0419] 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.

[0420] 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.

[0421] 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.

[0422] 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.

[0423] 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.

[0424] 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.

[0425] 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.

[0426] 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.

[0427] 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.

[0428] 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.

[0429] 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.

[0430] A restriction guide 139 for restricting the movement of the wire 298 passing through the wire through-slot 138 may be provided in th 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.

[0431] 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.

[0432] In Fig. 30, a state in which the upper tray and the lower tray contact each other is illustrated.

[0433] Referring to Fig. 30, the upper tray 150 and the lower tray 250 vertically contact each other to complete the ice chamber 111.

[0434] The bottom surface 151a of the upper tray body 151 contacts the top surface 251e of the lower tray body 251. In the present embodiment, a bottom surface 151a of the upper tray body 151 is referred to as a first contact surface, and a top surface 251e of the lower tray body 251 is referred to as a second contact surface.

[0435] Here, 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, elastic force of the elastic member 360 is applied to the lower support 270.

[0436] 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.

[0437] 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.

[0438] 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.

[0439] 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.

[0440] The second extension part 254 of the lower tray 250 may be seated on the second extension wall 286 of the lower support 270.

[0441] 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.

[0442] 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.

[0443] 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 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.

[0444] 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 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.

[0445] 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.

[0446] 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.

[0447] 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 be formed in a ring shape on the bottom surface of the lower tray body 251. Further, a bottom surface of the heater contact portion 251a may be planar.

[0448] 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. That is, the convex portion 251b may be constructed to be convex toward an inner portion of the ice chamber 111.

[0449] 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.

[0450] 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.

[0451] The convex portion 251b may be disposed to vertically face the lower opening 274 of the lower support 270.

[0452] 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.

[0453] The convex portion 251b may have a diameter D1 less than that D2 of the lower opening 274.

[0454] 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.

[0455] 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.

[0456] 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.

[0457] 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.

[0458] 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.

[0459] 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.

[0460] In the present embodiment, the diameter D1 of the convex portion 251b is smaller than the diameter D2 of the lower opening 274. Thus, the convex portion 251b is deformed such that the convex portion may be located inside the lower opening 274.

[0461] Fig. 32 is a bottom perspective view illustrating a state in which an ice maker and a lower ejector according to an embodiment of the present disclosure are separated from each other. Figs. 33 and 34 are perspective views of the lower ejector shown in Fig. 32 viewed from various directions.

[0462] Fig. 35 is a bottom perspective view illustrating a state in which an ice maker and a lower ejector according to another embodiment of the present disclosure are separated from each other. Further, Figs. 36 and 37 are perspective views of the lower ejector shown in Fig. 35 viewed from various directions. Further, Fig. 38 is a bottom view of the lower ejector according to an embodiment of the present disclosure.

<Lower ejector>

[0463] As described above, 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.

[0464] In detail, when the lower assembly 200 rotates away from the upper assembly 110 after completing the ice-making, the lower ejector 400 may press the lower assembly 200, so that the ice attached to the lower assembly 200 may be separated from the lower assembly 200. In this connection, the lower ejector 400 may press the lower tray 250.

[0465] In one example, the lower ejector 400 may be fixed to the upper assembly 110.

[0466] The lower ejector 400 may include an ejector body 410 and a plurality of lower ejecting pins 420 protruding from the ejector body 410. The lower ejecting pins 420 may be provided in the same number of ice chambers 111.

[0467] In one example, the lower ejector 400 may be coupled to the upper case 120.

[0468] The lower ejector body 410 may be coupled to a support wall 120a extending in a vertical direction from the upper case 120. The lower ejector body 410 may be detachably assembled to the support wall 120a.

[0469] Further, the lower ejector body 410 may include a face parallel to the support wall 120a.

[0470] Further, the lower ejector body 410 may include an inclined surface 410a that is inclined with respect to the support wall 120a on one side facing the lower tray 250. The lower ejecting pin 420 may extend from the inclined surface 410a.

[0471] In one example, the inclined surface 410a may be inclined with respect to a vertical line.

[0472] In one example, in a state in which the lower assembly 200 is rotated to the lower ejector 400 side for ice-separation, the inclined surface 410a may be inclined by an angle corresponding to an inclined angle of the lower assembly 200.

[0473] In one example, in a state in which the lower assembly 200 is moved to an ice-separating position for the ice-separation, a second virtual line (L2 in Fig. 44) across the inclined surface 410a and the top surface 252e (or second contact surface) of the lower tray 250 may be substantially parallel.

[0474] In the state in which the lower assembly 200 is moved to the ice-separating position for the ice-separation, the lower ejecting pin 420 may meet the second virtual line.

[0475] Alternatively, the second virtual line (L2 in Fig. 44) across the inclined surface 410a and the top surface 252e (or second contact surface) of the lower tray 250 may be parallel at an angle before the lower assembly 200 is moved to the ice-separating position for the ice-separation.

[0476] In one example, the support wall 120a may be formed integrally with the upper case 120 or may be provided separately from the upper case 120.

[0477] Further, the support body 271 may have a lower opening 274 through which the lower ejector 400 passes during the ice-separating process. The lower opening 274 may be defined in each chamber accommodation part 272.

[0478] Further, the lower ejecting pins 420 may be provided in the same number of lower chambers 252 formed on the lower tray 250, chamber accommodation parts 272 in which the lower chambers 252 are accommodated, respectively, and lower openings 274 respectively defined in the chamber accommodation part 272.

[0479] In one example, three lower chambers 252 may be formed on the lower tray 250. Three chamber accommodation parts 272 are defined in the support body 271 to accommodate the three lower chambers 252 therein, respectively. Further, each of the chamber accommodation parts 272 may be provided with the lower opening 274. Three lower ejecting pins 420 may also be provided to pass through the lower openings 264 and press the three lower chambers 252, respectively.

[0480] Therefore, when the lower assembly 200 is rotated to the lower ejector 400 side while the lower ejector 400 is fixed, the lower ejecting pin 420 may pass through the lower opening 274 and press the lower tray 250. The lower tray 250 may be deformed by a pressing force of the lower ejecting pin 420 and the ice in the lower chamber 252 may be separated from the lower tray 250.

[0481] The plurality of lower ejecting pins 420 may include a first ejecting pin 421, a second ejecting pin 422, and a third ejecting pin 243.

[0482] A length of one of the first to third ejecting pins 421, 422, and 423 may be larger than lengths of the others.

[0483] In one example, a length of the third ejecting pin 423 positioned closer to the driving unit 180 among the first to third ejecting pins 421, 422, and 423 may be longer than a length of each of the first and second ejecting pins 421 and 422.

[0484] As such, when the length of one of the plurality of ejecting pins 421, 422, and 423 is short, the load applied on the motor may be reduced during the ice-separation.

[0485] In detail, when the length of the third ejecting pin is longer than lengths of the others, in a process in which the lower assembly 200 is rotated, the lower tray 250 contacts the third ejecting pin 423 first, and the other two ejecting pins 421 and 422 contact the lower tray 250 later.

[0486] When the lower assembly 200 is continuously rotated, the third ejecting pin 423 presses the lower tray 250, and the remaining two ejecting pins 421 and 422 press the lower tray 250 later.

[0487] After the ice of the lower tray 250 firstly pressed by the third ejecting pin 423 is separated from the surface of the lower tray 250, the ice in the lower tray 250, which is later pressed by the two ejecting pins 421 and 422, may be separated from the surface of the lower tray 250.

[0488] That is, the ice of the lower tray 250 may be sequentially separated from the surface of the lower tray 250.

[0489] Therefore, while the load applied to the motor included in the driving unit 180 that provides the rotational power to the lower assembly 200 is distributed over time, the load applied on the motor may be reduced instantaneously.

[0490] In particular, as the third ejecting pin 423 located close to the driving unit 180 among the first to third ejecting pins 421, 422, and 423 presses the ice first, the load applied on the motor may be prevented from increasing.

[0491] On the other hand, if the three ejecting pins 421, 422, and 423 have the same length, in the process in which the lower assembly 200 is rotating, the lower tray 250 comes into contact with the three lower ejecting pins 421, 422, and 423 simultaneously.

[0492] When the lower assembly 200 is rotated continuously, the three ejecting pins 421, 422, and 423 press the lower tray 250 simultaneously to deform the lower tray 250, and the pressing forces of the three ejecting pins 421, 422, and 423 are transferred to the ice, so that three ice may be separated from the surface of the lower tray 250 at about the same time.

[0493] In this connection, the load applied to the motor included in the driving unit 180 is inevitably increased.

[0494] The lower ejecting pin 420 may include a pin body 420a protruding from the lower ejector body 410, and a pressing portion 420b extending from the pin body 420a.

[0495] In one example the pin body 420a and the pressing portion 420b may be bent to form a constant angle. Further, the pressing portion 420b may extend from the pin body 420a to press a center portion of the lower tray 250.

[0496] In one example, the pin body 420a may be formed in a curved shape and may be formed to be inclined downward from one side connected to the lower ejector body 410 to the other side.

[0497] As another example, the pin body 420a may be inclined downward from one side connected to the lower ejector body 410 to the other side, and at least a portion thereof may be curved to be rounded.

[0498] As another example, the pin body 420a may be inclined downward from one side connected to the lower ejector body 410 to the other side, and may be formed in a round shape such that at least a portion thereof is positioned on an extension line of a rotational trajectory of the lower assembly 200.

[0499] A center of curvature of at least a portion thereof in a longitudinal direction of the lower ejecting pin 420 may coincide with a center of rotation C2 of the lower assembly 200.

[0500] The pressing portion 420b may be formed to extend from the pin body 420a to be in contact with the center portion of the lower tray 250 and to press the lower tray 250 when the lower assembly 200 is rotated for the ice-separation.

[0501] In detail, the pressing portion 420b may be connected at an angle with the pin body 420a so as to widen an area in contact with the center portion of the lower tray 250.

[0502] Further, the pressing portion 420b may include a pressing inclined portion 420c in contact with the lower tray 250.

[0503] For example, the pressing inclined portion 420c may be formed as a length of an upper end 420d of the pressing portion 420b is larger than a length of a lower end 420e of the pressing portion 420b.

[0504] The upper end 420d is located closer to the upper tray 150 than the lower end 420e.

[0505] The pressing inclined portion 420c may be formed such that an upper end of the pressing inclined portion 420c is in contact with the lower tray 250 first in the ice-separating process.

[0506] When the lower tray 250 rotates in a state in which the pressing inclined portion 420c is not formed on the pressing portion 420b, a lower end of the pressing portion 420b comes into contact with the lower tray 250 first.

[0507] In this case, only a portion of the pressing portion 420b presses the lower tray 250 or the lower tray

250 is deformed at a position spaced apart from the center of the lower tray 250 while the lower tray 250 is rotated to the ice-separating position, thereby degrading the ice-separation performance of the ice.

[0508] However, as in the present embodiment, when the pressing inclined portion 420c is formed on the pressing portion 420b, the upper end 420d of the pressing inclined portion 420c comes in contact with the lower tray 250 first in rotation process of the lower tray 250.

[0509] The upper end 420d is in contact with a position away from the center of the upper tray 150. However, when a rotation angle of the lower tray 250 is increased, the upper end 420d and the lower end 420e are in contact with the lower tray 250 together. When the upper end 420d and the lower end 420e come into contact with the lower tray 250 together, the pressing inclined portion 420c comes into surface contact with the center portion of the lower tray 250.

[0510] As such, the pressing inclined portion 420c is in surface contact with the center portion of the lower tray 250, the ice-separation performance may be improved.

[0511] Further, as such, when the lower assembly 200 is rotated further while the pressing portion 420b is in contact with the center portion of the lower tray 250, a pressing force is applied to the center of the lower tray 250 continuously, which is advantageous for the ice-separation.

[0512] Further, the pressing portion 420b may define a recessed groove portion or recess portion 424 at an end to be in contact with the lower tray 250. That is, on the contact surface or end surface of the lower ejecting pin 420, a recess portion may be formed.

[0513] Therefore, a strength of the lower ejecting pin 420 may be improved. Further, for the ice-separation, when the pressing portion 420b presses the sphere-shaped lower tray 250, that is, a convex lower portion of the lower chamber 252, stable contact may be achieved by the groove portion 424 and breaking of the ice due to concentration of a force at one portion may be prevented.

[0514] When an end of the pressing portion 420b is flat, the lower ejecting pin 420 comes in point contact with the lower chamber 252 of the sphere shape. Therefore, a contact area is reduced, so that a pressing force may not be properly transmitted. Alternatively, the ice may break since the force is concentrated at one portion.

[0515] On the other hand, in the present disclosure, as the recessed groove portion 242 is defined in the pressing portion 420b, the lower ejecting pin 420 may be in surface contact with the semispherically shaped lower chamber 252. Therefore, the contact area is increased, so that the pressing force may be properly transmitted. Further, as the force dissipates, the breaking of the ice may be prevented.

[0516] Further, the lower ejecting pin 420 may be provided with a reinforcing groove portion 425 on a bottom surface of the pin body 420a. The groove portion 425 may extend in the longitudinal direction of the pin body 420a.

[0517] Further, in the rotation of the lower assembly 200 for the ice-separation, sufficient pressing force may be transmitted to the lower chamber 252 even when the lower assembly 200 does not reach the ice-separating position because of the tolerance of the motor gear included in the driving unit 180 by extending the length of the lower ejecting pin 420.

[0518] In one example, the lower ejector 400 may be coupled with the support wall 120a in various manners.

[0519] Referring to Figs.32 and 35, the support wall 120a may form a protrusion 121a protruding forward toward the lower tray 250 on one face facing the lower tray 250 when the lower assembly 200 is rotated for the ice-separation.

[0520] A cavity 122a that is recessed rearward may be defined in a lower end of the protrusion 121a. The lower ejector body 410 of the lower ejector 400 may be accommodated in the cavity 122a. Therefore, the lower ejector body 410 may be located below the protrusion 121a.

[0521] Further, the protrusion 121a may include guide slots 123a which are arranged on both sides of the cavity 122a, respectively.

[0522] Guide protrusions 415 respectively slided and inserted into the guide slots 123a may be formed on both sides of the lower ejector body 410.

[0523] Therefore, the lower ejector body 410 may be coupled while sliding upward from the lower portion of the support wall 120a. In this connection, the guide protrusions 415 on the both sides of the lower ejector body 410 are inserted into the guide slots 123a defined on the both sides of the cavity 122a, respectively.

[0524] Referring to Figs. 32 and 33, the lower ejector body 410 may be coupled to the top surface 122b of the cavity 122a using fastening means 430 such as a bolt, a screw, or the like while being slide-coupled to the support wall 120a as described above.

[0525] To this end, the lower ejector body 410 may be provided with a fastening groove portion 416 recessed rearward. A fastening hole 416a through which the fastening means 430 passes may be defined in the top surface of the fastening groove portion 416.

[0526] Further, the fastening groove portion 416 may be defined in the inclined surface 410a. The fastening groove portion 410a may have a shape in which a width thereof in a front and rear direction gradually decreases downwardly.

[0527] Further, the fastening groove portion 416 may be defined between the lower ejecting pins 420.

[0528] When the fastening groove portion 416 is defined as described above, while the top surface of the fastening groove portion 416 and a top surface 122b of the cavity 122a are in surface contact with each other, the top surface of the fastening groove portion 416 and the top surface 122b of the cavity 122a may be fastened with each other by the fastening means 430 at a bottom surface of the fastening groove portion 416. Therefore, the lower ejector body 410 may be more easily fixed to the support wall 120a. Further, the lower ejector 400 may be coupled to the support wall 120a without the fastening portion being exposed to the outside.

[0529] Referring to Fig. 35, a coupling groove portion 122c recessed upwardly may be further defined in the lower end of the support wall 120a.

[0530] The lower ejector body 410 may be coupled to a top surface 122d of the coupling groove portion 122c using the fastening means 430 such as the bolt, the screw, or the like, while being slide coupled to the support wall 120a.

[0531] To this end, an extension 417 protruding rearward may be formed on the lower end of the lower ejector body 410. Because of the extension 417, an elevated portion 418 facing the top surface of the coupling groove portion 122c may be formed on a lower end of a rear face of the lower ejector body 410. The extension 417 may have a fastening boss 417b having a fastening hole 417a defined therein.

[0532] When the coupling groove portion 122c and the extension 417 are formed as described above, while the top surface 122d of the coupling groove portion 122c and the elevated portion 418 are in surface contact with each other, the top surface 122d of the coupling groove portion 122c and the extension 417 may be fastened with each other by the fastening means 430 at a bottom surface of the extension 417. Therefore, the lower ejector body 410 may be more easily fixed to the support wall 120a. Further, the lower ejector 400 may be coupled to the support wall 120a without the fastening portion being exposed to the outside.

[0533] When the lower ejector 400 is provided as described above, in the rotation process of the lower assembly 200 for the ice-separation, the lower tray 250 is pressed by the lower ejector 400 even when the ice is not separated from the lower tray 250 by a self-weight, and eventually the ice in the lower chamber 252 may be separated from the lower tray 250.

[0534] Specifically, in the process in which the lower assembly 200 is rotated toward the lower ejector 400, the lower tray 250 comes into contact with the lower ejecting pin 420.

[0535] When the lower assembly 200 rotates continuously toward the lower ejector 400, 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 transferred to the ice to separate the ice from the surface of the lower tray 250. The ice separated from the surface of the lower tray 250 may be dropped downward and stored in the ice bin 102.

[0536] When the lower assembly 200 is rotated for the ice-separation as described above, the lower assembly 200 may not reach the ice-separating position due to the tolerance of the motor gear included in the drive unit 180. In this case, the ice-separation may not proceed completely. Thus, control for further rotating the motor included in the driving unit 180 may be performed such that the ice-separation may be surely achieved and the lower assembly 200 may reach the ice-separating position.

[0537] Hereinafter, a process of making ice by using the ice maker according to an embodiment will be described.

[0538] Fig. 39 is a cross-sectional view taken along a B-B of Fig. 3 in a water supplied state. Further, Fig. 40 is a cross-sectional view taken along a B-B of Fig. 3 in the ice-making state.

[0539] Fig. 41 is a cross-sectional view taken along line B-B of Fig. 3 in the ice-making completed state. Further, Fig. 42 is a cross-sectional view taken along line B-B of Fig. 3 in an initial state of ice-separation. Further, Fig. 43 is a cross-sectional view taken along B-B of Fig. 3 in a state in which the lower ejecting pin is in contact with the lower tray.

[0540] Fig. 44 is a cross-sectional view taken along line B-B of Fig. 3 in an ice-separation completed state.

[0541] Referring to Figs. 39 to 44, first, the lower assembly 200 rotates to a water supply position.

[0542] In a following description, a virtual line passing through the bottom surface 151a (or a first contact surface) of the upper tray body 151 is referred to as a first virtual line L1 and a virtual line passing through the top surface 251e (or the second contact surface) of the lower tray body 251 is referred to as the second virtual line L2.

[0543] In the present embodiment, it is assumed that the rotation angle of the lower assembly 200 (or the lower tray 250) is an angle between the first virtual line L1 and the second virtual line L2.

[0544] 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.

[0545] The first virtual line L1 and the second virtual line L2 may form a first angle $\theta 1$ at the water supply position. Although not limiting, the first angle may be approximately 8 degrees.

[0546] 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 of the lower assembly 200.

[0547] 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.

[0548] In this state, the water is guided by the water supply part 190 and supplied to the ice chamber 111.

[0549] 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.

[0550] 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.

[0551] Another portion of the water may be filled in the upper chamber 151. In one example, depending on the angle between the top surface 251e of the lower tray 250 and the bottom surface 151e of the upper tray 150 or the volumes of the lower chamber 252 and the upper chamber 152, the water may not be located in the upper chamber 152 after completion of the water supplying.

[0552] In case of this embodiment, a channel for communication between the three lower chambers 252 may not be provided in the lower tray 250.

[0553] 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.

[0554] Thus, the water may be fully filled in each of the plurality of lower chambers 252 of the lower tray 250.

[0555] 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.

[0556] In the state in which the supply of the water is completed, as illustrated in Fig. 40, 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.

[0557] 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.

[0558] 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.

[0559] 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.

[0560] At the ice-making position, the first virtual line L1 and the second virtual line L2 coincide with each other.

[0561] In the state in which the lower assembly 200 moves to the ice making position, ice making is started.

[0562] 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.

[0563] 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.

[0564] 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.

[0565] 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.

[0566] Since the ice chamber 111 is formed in the sphere shape, a horizontal cross-sectional area of the ice chamber 111 varies in the vertical direction.

[0567] Thus, the output of the lower heater 296 may vary depending on a mass per unit height of the water in the ice chamber 111.

[0568] A unit mass of the water in the ice chamber 111 increases upward, becomes maximum at a boundary of the upper tray 150 and the lower tray 250, and then decreases downward.

[0569] The output of the lower heater 296 may decrease from the initial output based on the mass per unit height of the water in the ice chamber 111 and then increase again from a specific output.

[0570] 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.

[0571] In this state, when the ice is continuously made, the block part 251b may be pressed and deformed as shown in Fig. 41, and the spherical ice may be made when the ice making is completed.

[0572] A control unit (not shown) may determine whether the ice making is completed based on the temperature sensed by the temperature sensor 500.

[0573] The lower heater 296 may be turned off at the ice-making completion or before the ice-making completion.

[0574] When the ice-making is completed, the upper heater 148 is first turned on for the ice-separation 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.

[0575] 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.

[0576] As illustrated in Fig. 44, when the lower assembly 200 rotates forward, the lower tray 250 may be spaced apart from the upper tray 150.

[0577] 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.

[0578] 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.

[0579] In this case, the ice may rotate together with the lower assembly 200 in the state of being supported by the lower tray 250.

[0580] 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.

[0581] 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.

[0582] 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.

[0583] In one example, the angle between the first virtual line and the second virtual line becomes a second angle θ2 greater than the first angle, the upper ejecting pin 320 presses the ice attached to the upper tray 15, so that the ice may be separated from the upper tray 150.

[0584] However, in Fig. 42, the second angle θ2 is merely an example. The ice may be separated from the upper tray 150 at an angle smaller or larger than the second angle.

[0585] The ice separated from the upper tray 150 may be supported again by the lower tray 250.

[0586] 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.

[0587] 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 as shown in Fig. 44, the ice may be separated from the lower tray 250.

[0588] Particularly, while the lower assembly 200 rotates, the lower tray 250 may contact the lower ejecting pin 420.

[0589] A third angle θ3 between the first virtual line L1 and the second virtual line L2 when the lower ejecting pin 420 is in contact with the lower tray 250 may be approximately 90 degrees.

[0590] When the lower tray 250 is rotated by the third angle θ3, among the plurality of lower ejecting pins 421, 422, and 423, the third ejecting pin 423 first may come into contact with the lower tray 250.

[0591] In this connection, the upper end 420d of the pressing portion 420b of the third ejecting pin 423 may come into contact with the lower tray 250 first.

[0592] When the rotation angle of the lower tray 250 is increased, the upper end 420d and the lower end 420e of the pressing portion 420b of the third ejecting pin 423 come into contact with the lower tray 250 together.

[0593] Further, when the rotation angle of the lower tray 250 increases while the third ejecting pin 423 is in contact with the lower tray 250, the first and second ejecting pins 421 and 422 are in contact with the lower tray 250.

[0594] When the lower tray 250 continuously rotates forward while the lower ejecting pin 420 is in contact with the lower tray 250, 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 transferred to the ice to separate the ice from the surface of the lower tray 250.

[0595] In one example, the ice may be separated from the lower tray 250 from a position adjacent to the second virtual line L2 in the lower tray 250.

[0596] When the lower tray 250 continuously rotates forward, the contact area between the ice and the lower tray 250 is reduced, so that the ice may be eventually separated from the lower tray 250.

[0597] The lower tray 250 may be rotated to the ice-separating position by the drive unit 180. The ice-separating position may be referred to as an opened position.

[0598] At the ice-separating position, a fourth angle θ4 between the first imaginary line L1 and the second imaginary line L2 is not limited but may be greater than 100 degrees. In the present embodiment, the fourth angle may be set to about 115 degrees in one example.

[0599] While the lower tray 250 is rotated to the ice-separating position, the second virtual line L2 of the lower tray 250 may be substantially parallel to the inclined surface 410a of the lower ejector body 410.

[0600] An amount of deformation of the lower tray 250 is the maximum while the lower tray 250 is rotated to the ice-separating position.

[0601] In one example, the pressing inclined portion 420c of the pressing portion 420a of the lower ejecting pin 420 may be maintained in a state of being in surface contact with the lower tray 250 while the lower tray 250 is rotated to the ice-separating position.

[0602] While the lower tray 250 is rotated to the ice-separating position, a distance between the pressing portion 420a of the lower ejecting pin 420 and the lower ejector body 410 (in one example, the inclined surface 410a) may be equal to or greater than a distance between the second virtual line L2 and the inclined surface 410a.

[0603] In another aspect, while the lower tray 250 is rotated to the ice-separating position, at least a portion of the lower tray 250 in contact with the lower ejecting pin 420 may be located opposite the lower opening 274 with respect to the second virtual line L2.

[0604] In this case, considering a thickness of the lower tray 250, while the lower tray 250 is rotated to the ice-separating position, a distance between a portion 252f of the lower tray 250 in contact with the lower ejecting pin 420 and the lower ejector body 410 (in one example, the inclined surface 410a) may be greater than the distance between the second virtual line L2 and the inclined surface 410a.

[0605] In one example, while the lower tray 250 is rotated to the ice-separating position, equal to or more than three quarters of the length of the lower ejecting pin 420 may be inserted into the lower support 270. The length of the lower ejecting pin 420 inserted into the lower support 270 may be equal to or greater than the radius of the ice chamber 111.

[0606] As such, the length of the lower ejecting pin 420 may be larger than the radius of the ice chamber 111 such that the amount of deformation of the lower tray 250 by the lower ejecting pin 420 is increased.

[0607] Based on such structure, the ice may be completely separated from the lower tray 250 in the ice-separating process, thereby improving the ice-separation performance.

[0608] The ice separated from the surface of the lower tray 250 may drop downward and be stored in the ice bin 102.

[0609] 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.

[0610] 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.

[0611] 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 removed from the upper chamber 152.

[0612] 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 flexible lower tray (250) separably supported thereon and having at least one lower chamber part (252), and
   a lower ejector (400) including at least one lower ejecting pin (420),
   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,
   wherein the lower support (270) has at least one lower opening (274) corresponding respectively to the at least one lower chamber part (252), and
   wherein the lower ejector (400) is arranged such that in the open position, the lower ejecting pin (420) is configured to penetrate through the lower opening (274) in the lower support (270) and to partially separate the lower tray (250) from the lower support (270) for removing ice from the lower chamber part (252).

2. The ice maker of claim 1, wherein in the closed position of the lower assembly (200), a center line (C3) of the ice chamber (111), passing through both the lower chamber part (252) and the upper chamber part (152), passes through the lower opening (174).

3. The ice maker of claim 1 or 2, wherein in the closed position of the lower assembly (200), a center line of the ice chamber (111), passing through both the lower chamber part (252) and the upper chamber part (152), passes through a point on the lower tray (250) that is adjacent to or equal to a point of contact with the lower ejector (400) when moving into the open position.

4. 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 rotation axis (C2).

5. The ice maker of claim 4, wherein the rotation axis (C2) is perpendicular to a center line (C3) of the ice chamber (111) passing through both the lower chamber part (252) and the upper chamber part (152) in the closed position of the lower assembly (200), and/or
   wherein the rotation axis (C2) is within the same plane as an open end 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.

6. The ice maker of claim 4 or 5, wherein the lower ejecting pin (420) has a circular arc shape with a center of the arc on the rotation axis (C2).

7. The ice maker according to any one of the preceding claims, wherein an end surface of the lower ejecting pin (400) for contacting the lower tray (250) is inclined to a vertical line and/or to a center line (C3) of the ice chamber (111) passing through both the lower chamber part (252) and the upper chamber part (152) in the closed position of the lower assembly (200).

8. The ice maker according to any one of the preceding claims, wherein an end surface of the lower ejecting pin (400) for contacting the lower tray (250) includes a recess portion (424).

9. The ice maker according to any one of the preceding claims, wherein the lower ejecting pin (420) includes a reinforcing groove portion (425) extending along the lower ejecting pin (420).

10. The ice maker according to any one of the preceding

claims, wherein one portion of the lower tray (250) is fixed to the lower support (270) and another portion of the lower tray (250) is separably supported on the lower support (270).

11. The ice maker according to any one of the preceding claims, wherein the lower tray (250) is made of a flexible material and/or of silicon.

12. 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 (274) to be in contact with the lower tray (250).

13. The ice maker according to any one of the preceding claims, wherein at least one upper opening (154) is formed in the upper tray (150) corresponding to the at least one upper chamber part (151), the ice maker further comprising an upper ejector (400) configured to penetrate through the upper opening (154) for removing ice from the upper tray (150).

14. The ice maker according to any one of the preceding claims, wherein the lower chamber part (252) and the upper chamber part (252) have a semispherical shape, respectively, for forming a spherical ice chamber (111).

15. A refrigerator, including:
an ice maker according to any one of the preceding claims.

FIG. 1

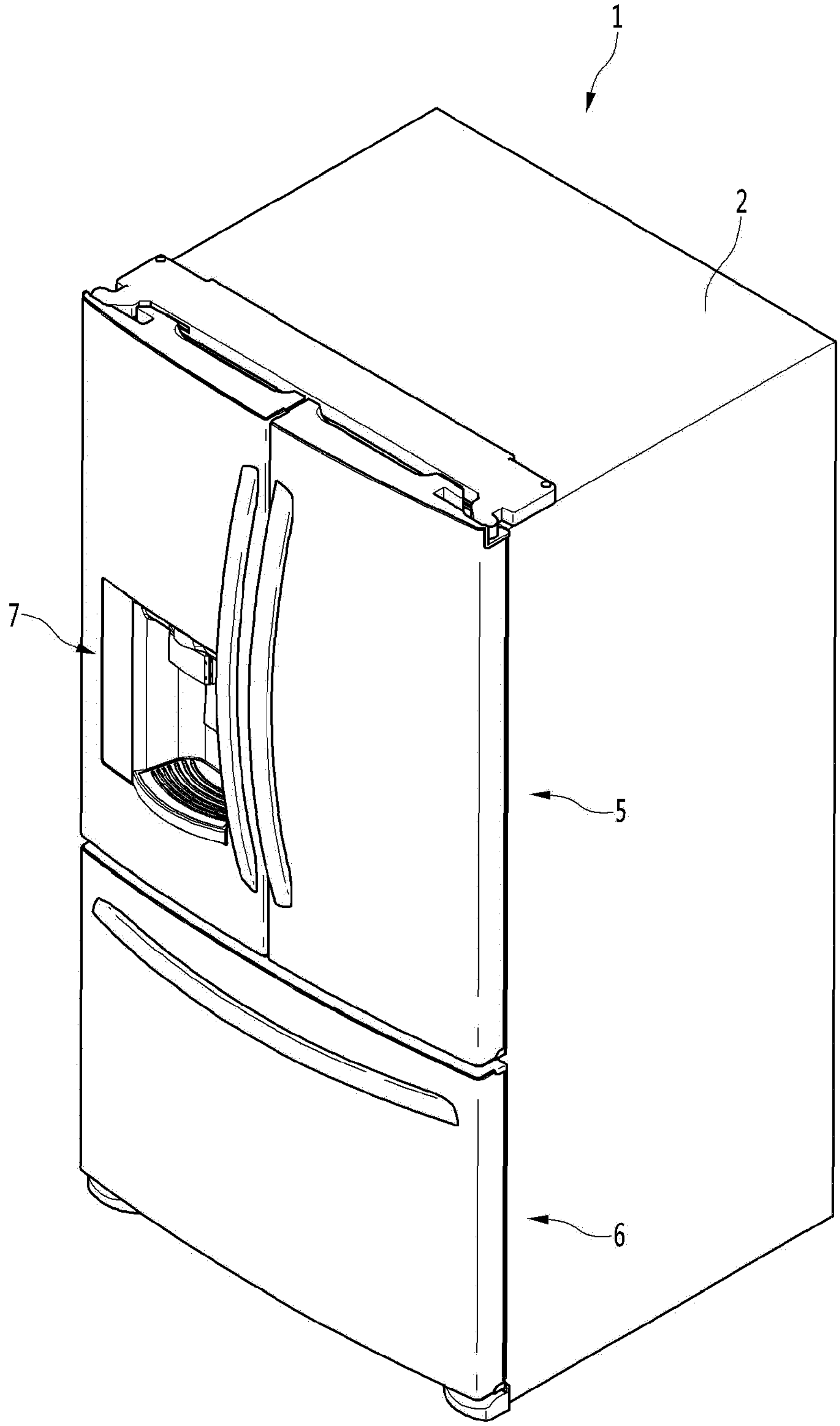


FIG. 2

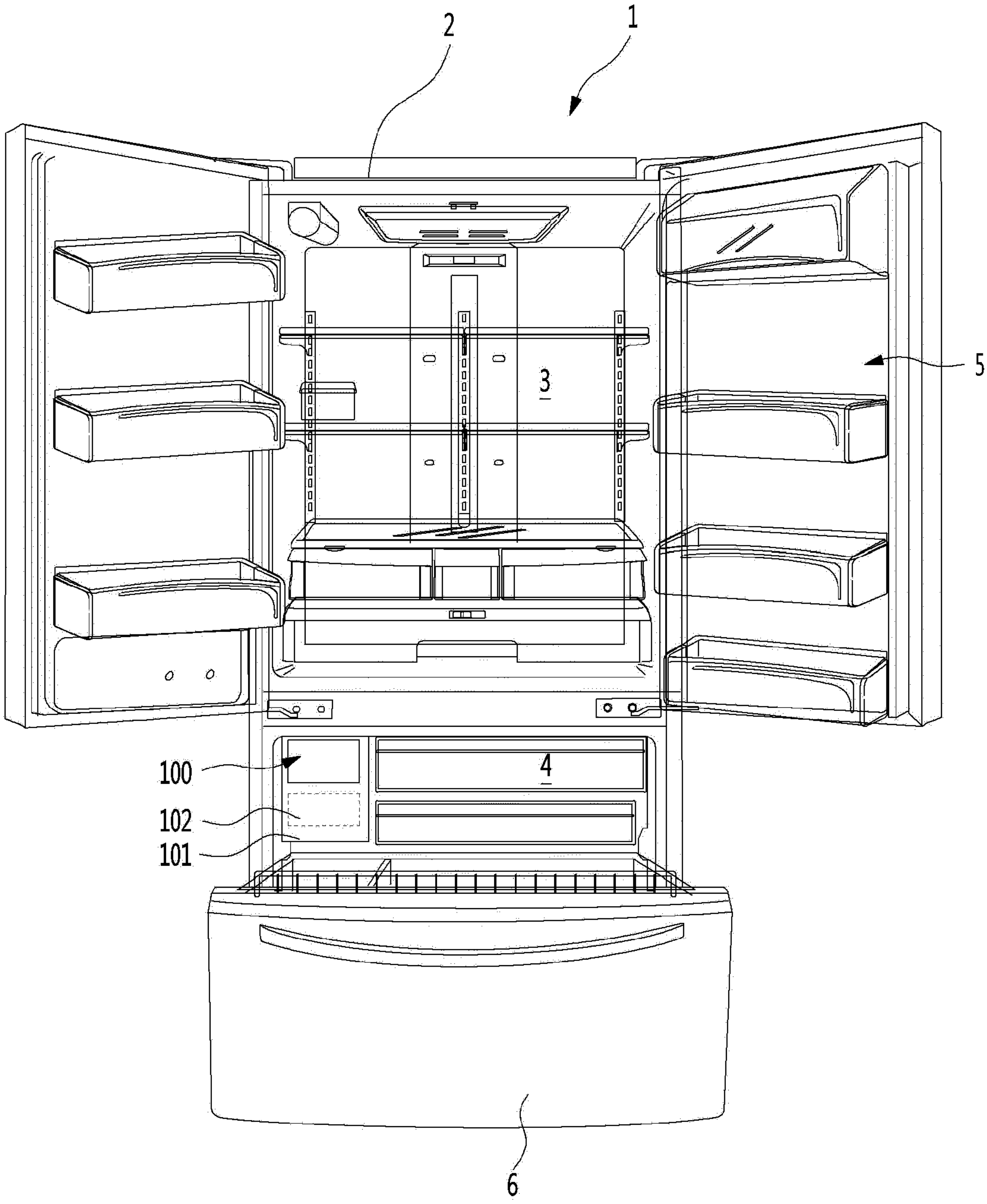


FIG. 3

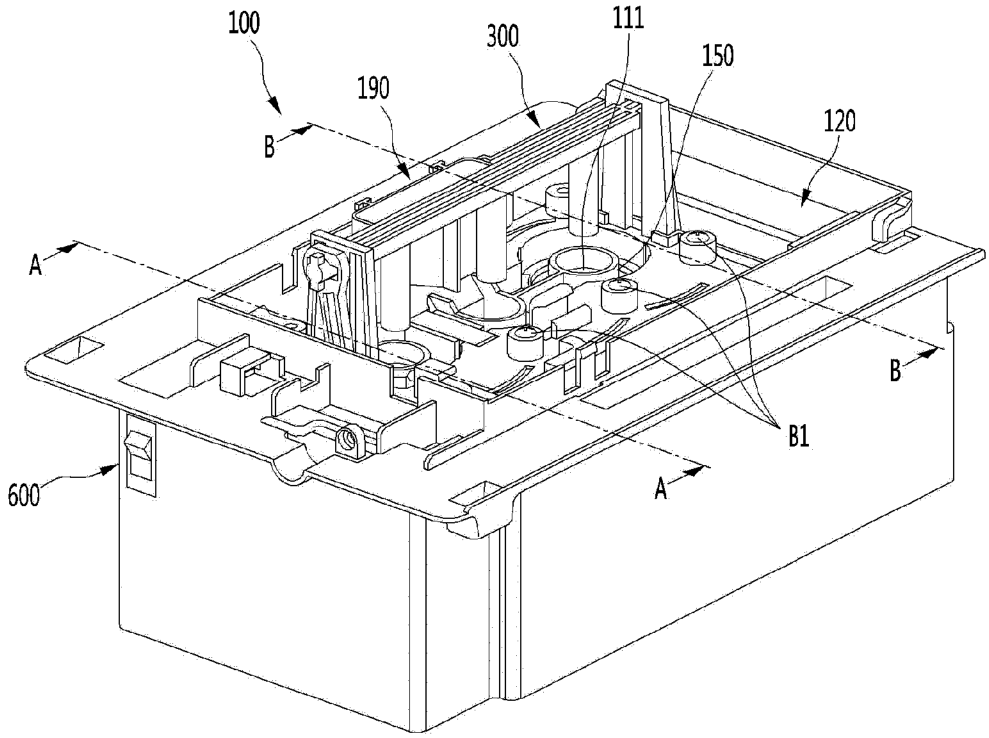


FIG. 4

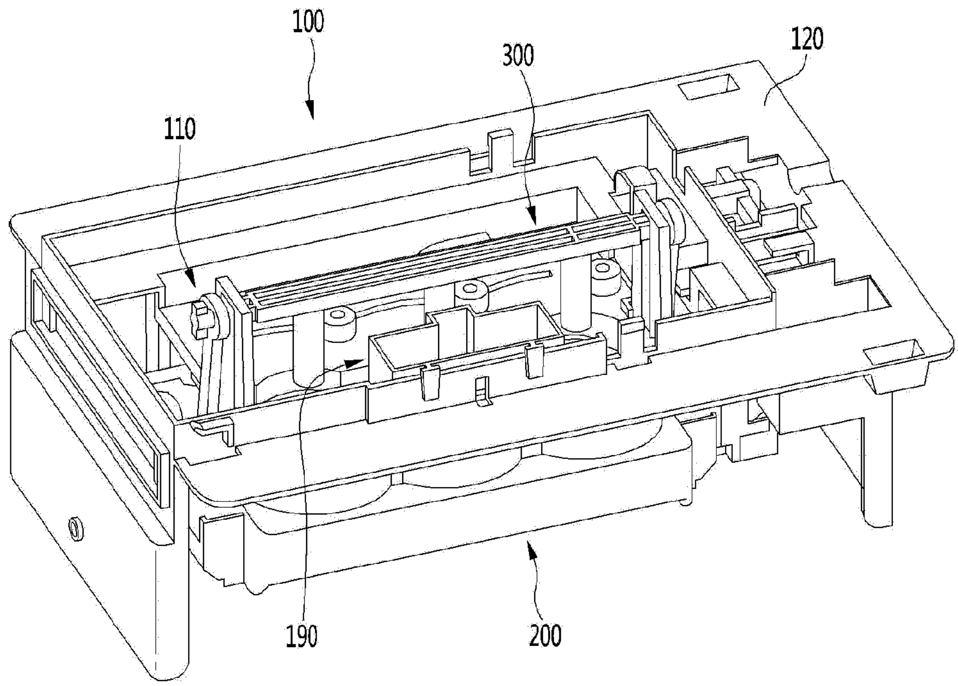


FIG. 5

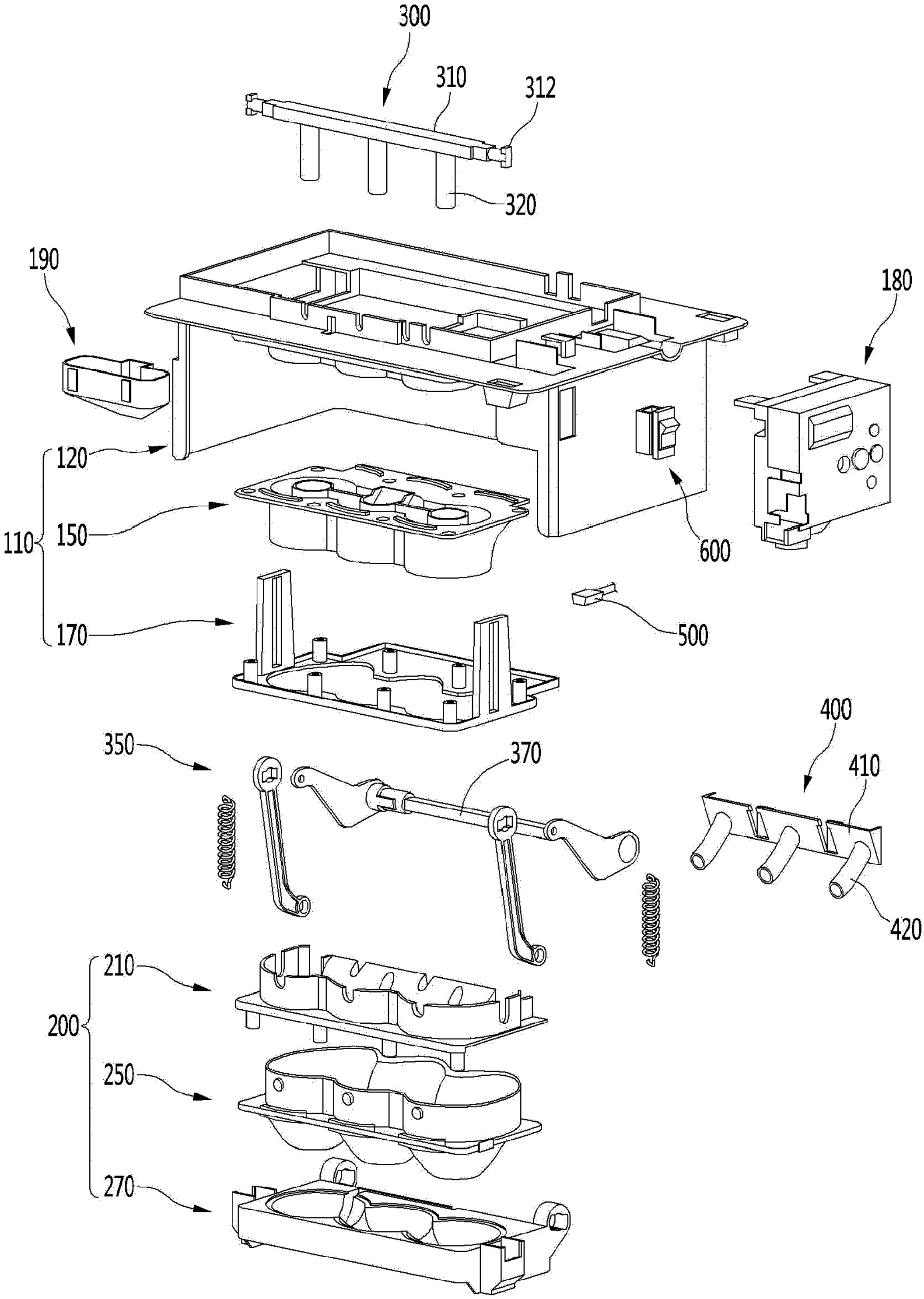

300
310
312
320
190
180
120
110
150
600
170
500
400
410
350
370
420
210
200
250
270

FIG. 6

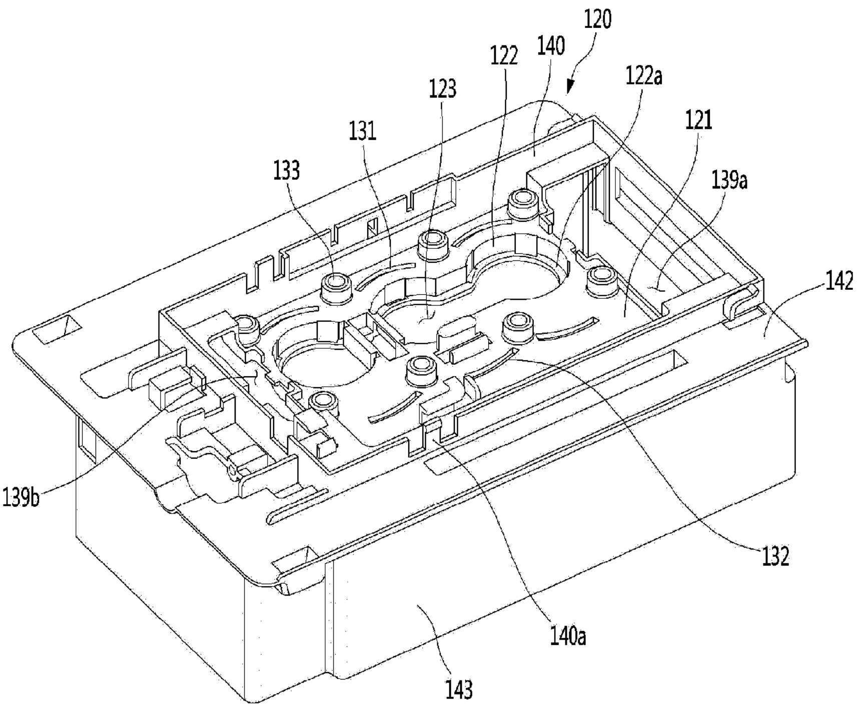

120
122
140
122a
123
131
121
133
139a
142
139b
132
140a
143

FIG. 7

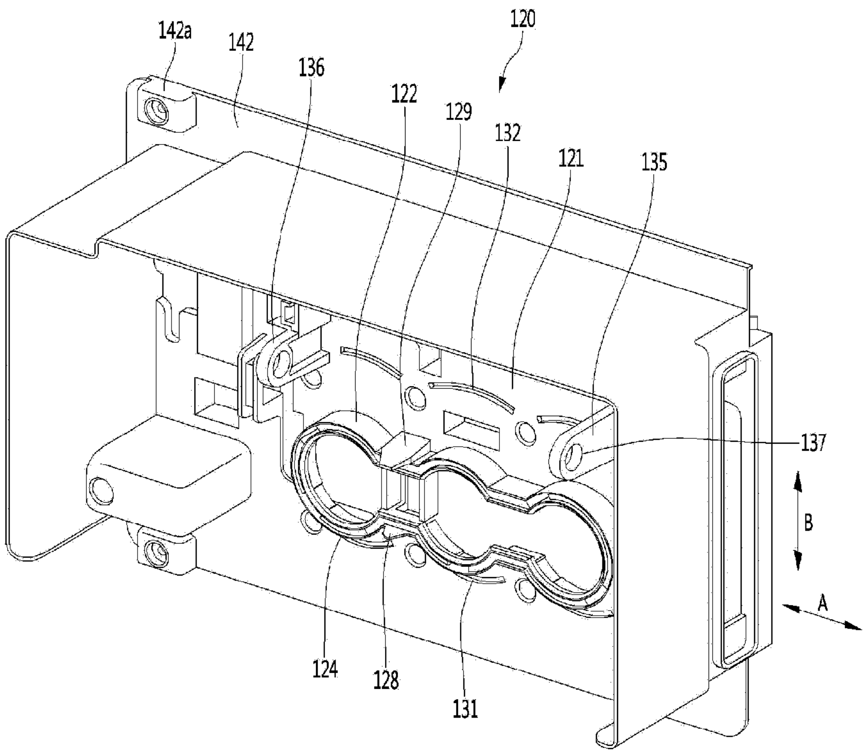

142a
142
120
136
122
129
132
121
135
137
B
A
124
128
131

FIG. 8

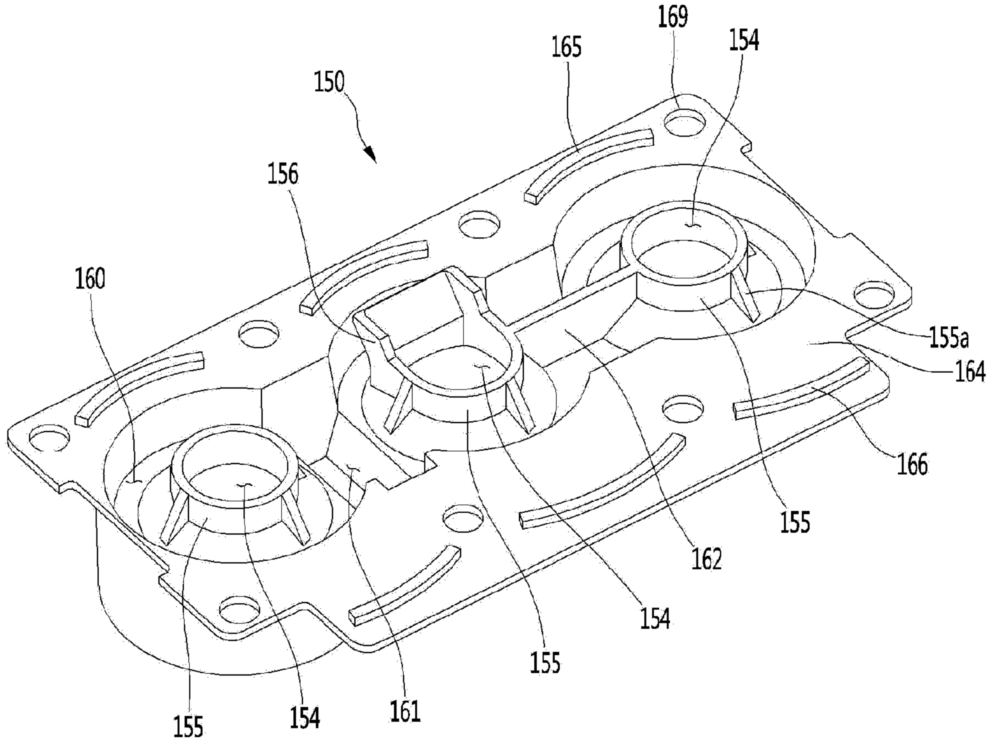

150
156
160
165
169
154
155a
164
166
155
162
154
155
161
154
155

FIG. 9

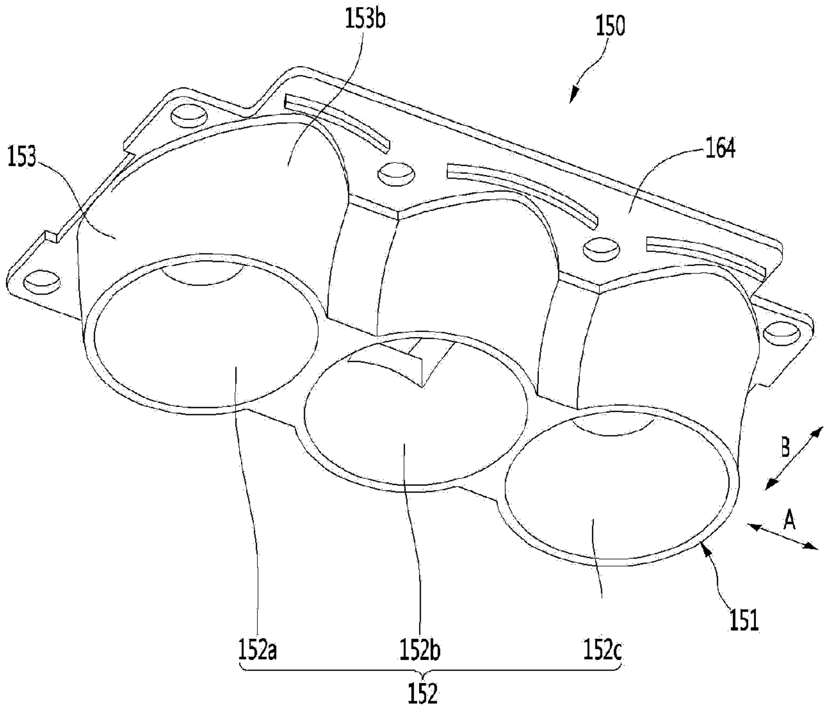

153b
150
153
164
B
A
151
152a
152b
152c
152

FIG. 10

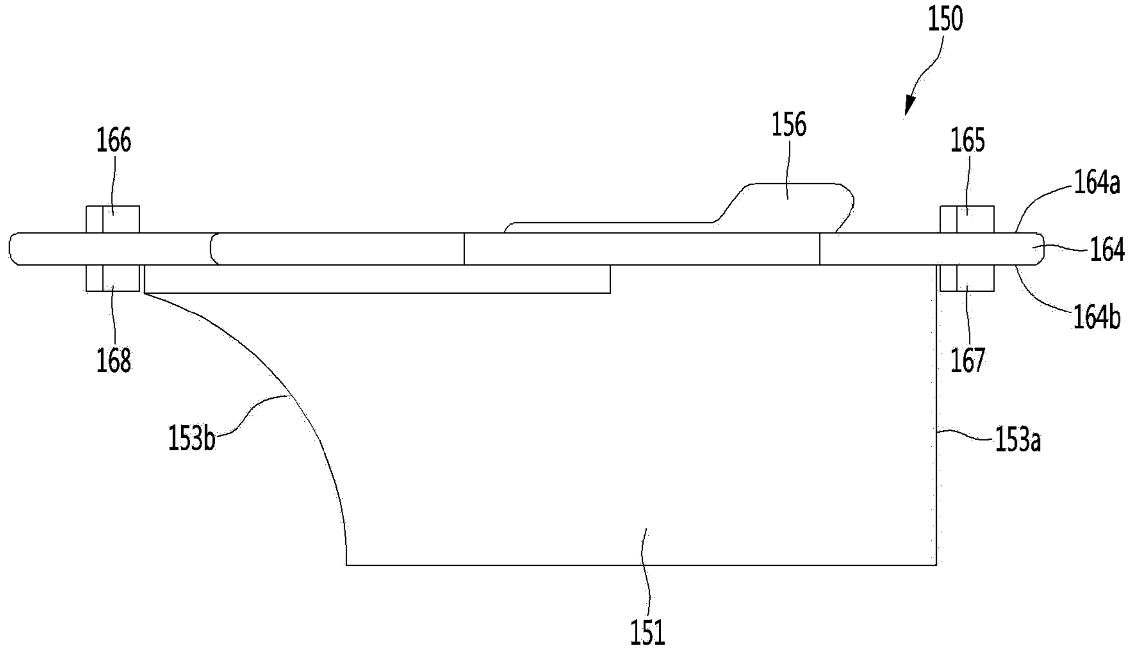

150
166
156
165
164a
164
164b
168
167
153b
153a
151

FIG. 11

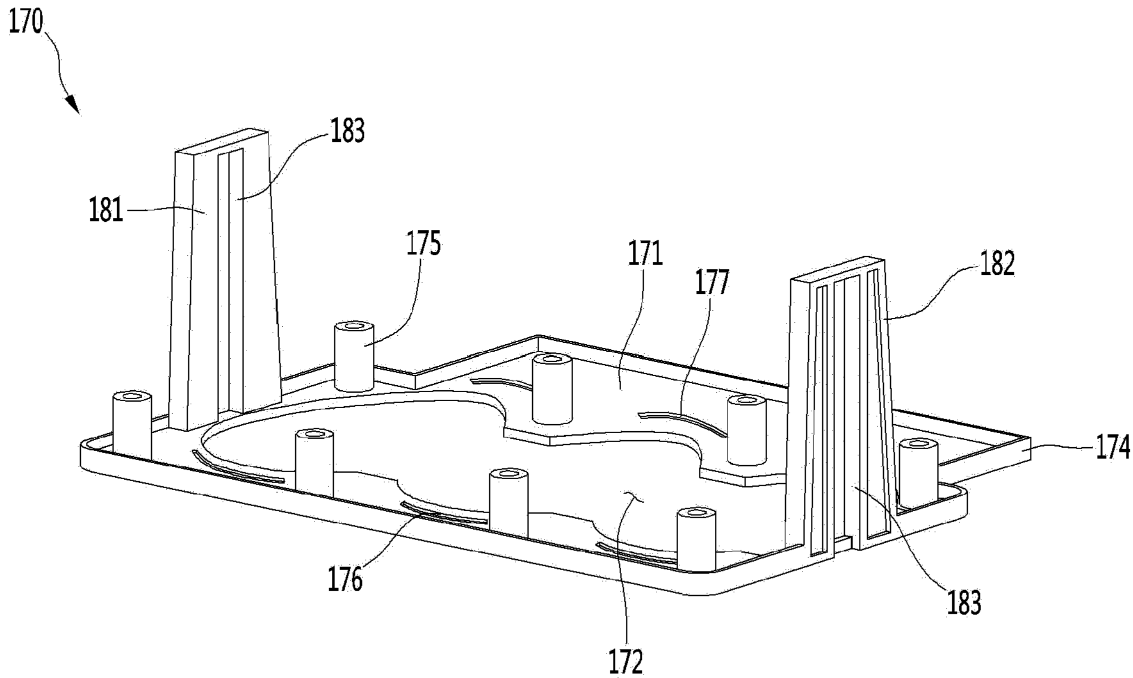

170
183
181
175
171
177
182
174
176
172
183

FIG. 12

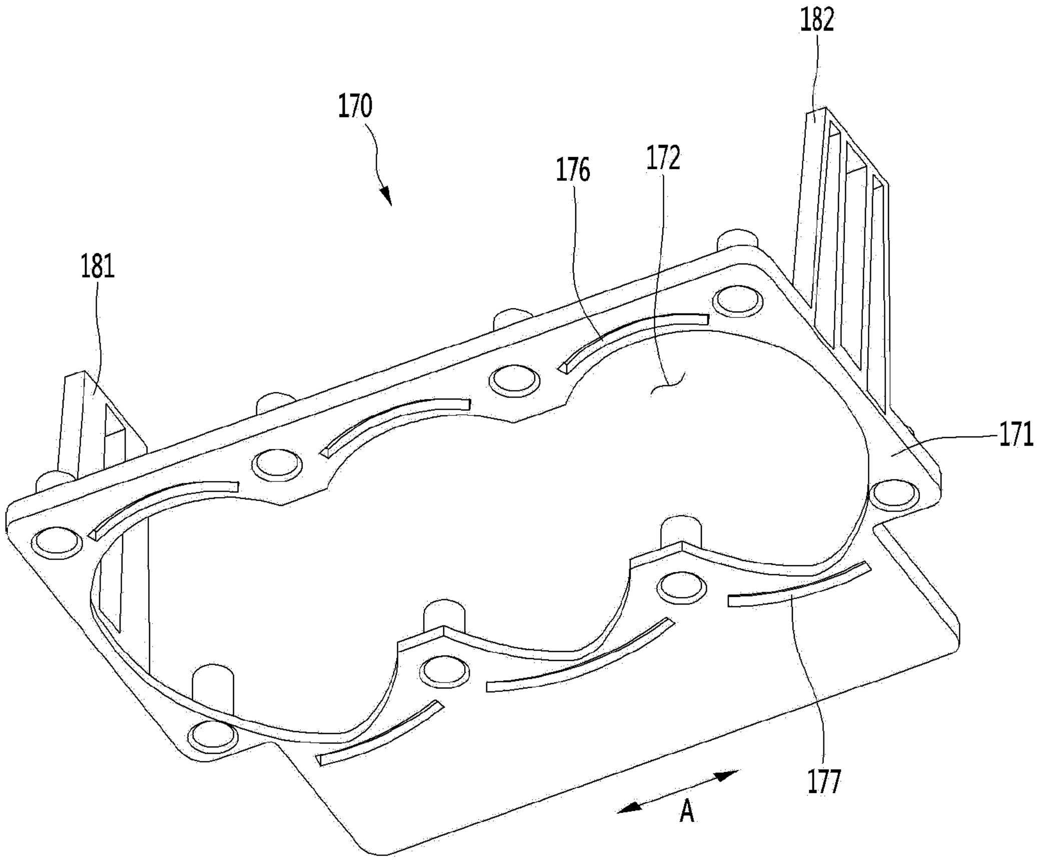

170
182
176
172
181
171
177
A

FIG. 13

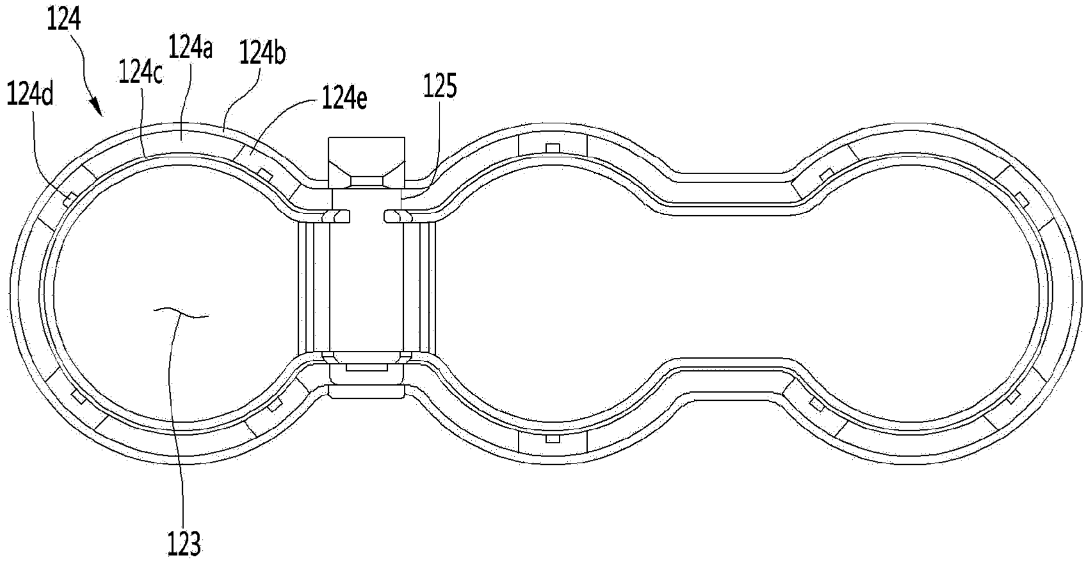

124
124a
124b
124c
124d
124e
125
123

FIG. 14

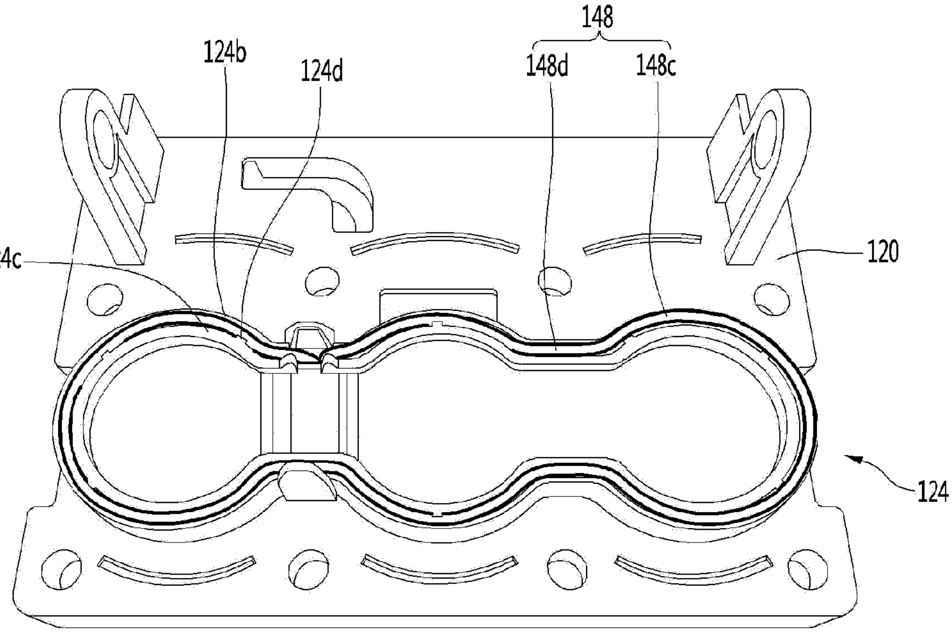

148
124b
124d
148d
148c
124c
120
124

FIG. 15

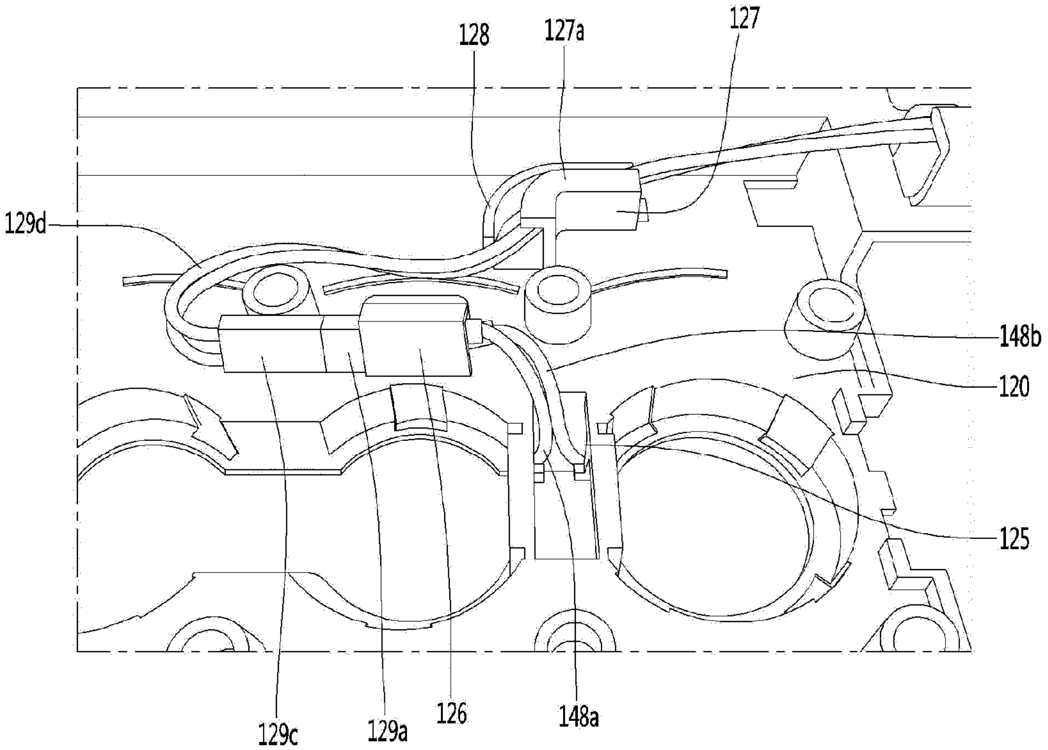

128
127a
127
129d
148b
120
125
129c
129a
126
148a

FIG. 16

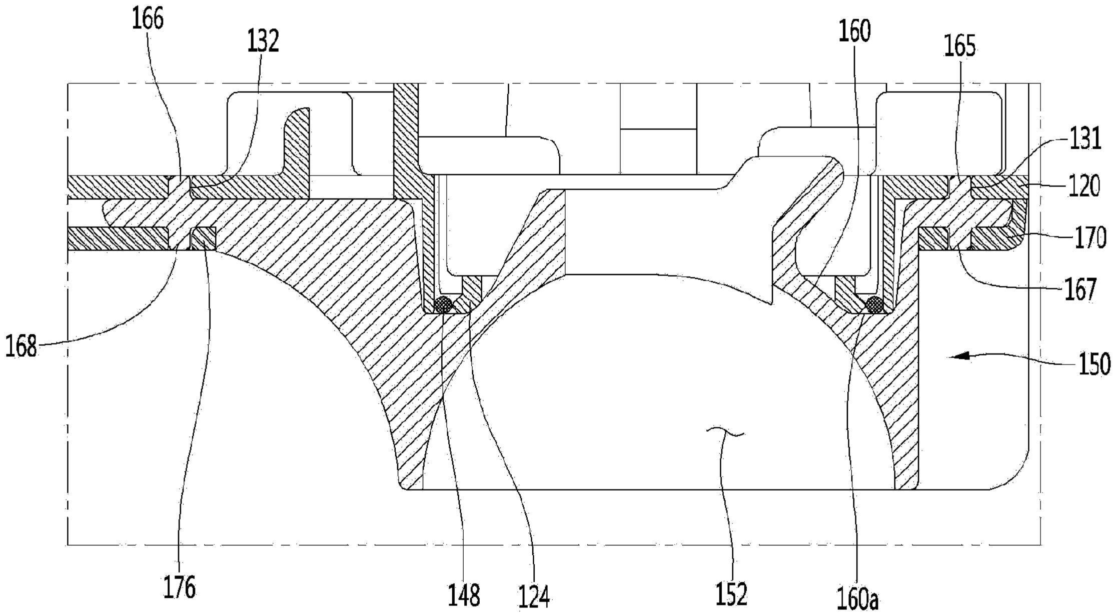

166
132
160
165
131
120
170
167
168
150
176
148
124
152
160a

FIG. 17

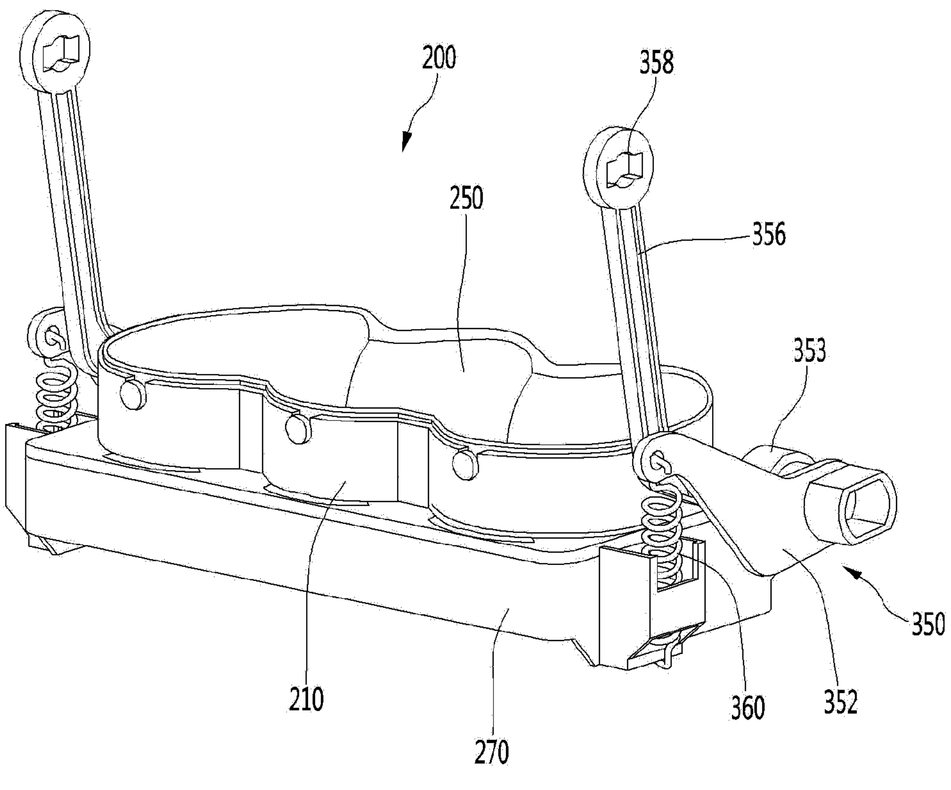

200
358
250
356
353
350
210
360
352
270

FIG. 18

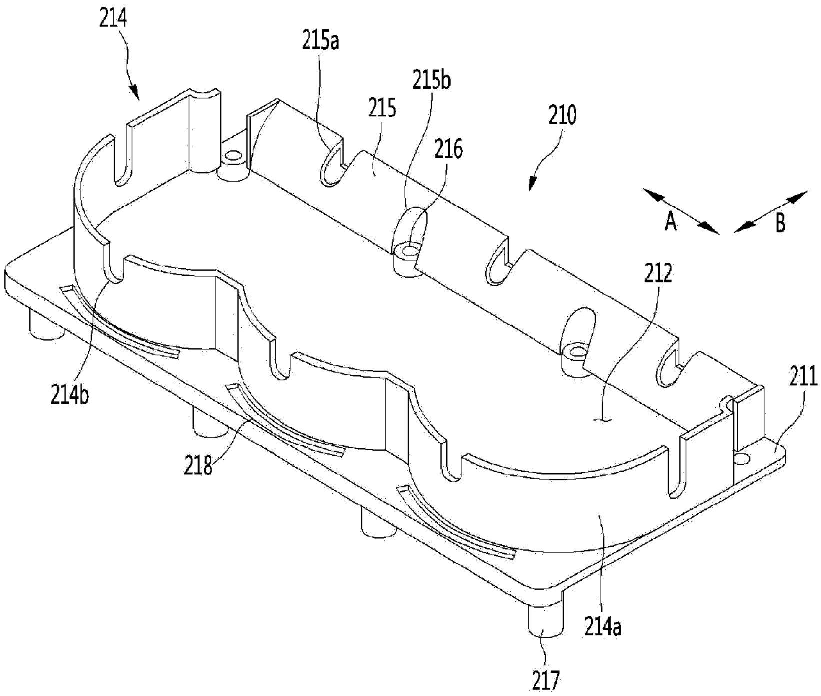

214
215a
215b
215
216
210
A
B
212
211
214b
218
214a
217

FIG. 19

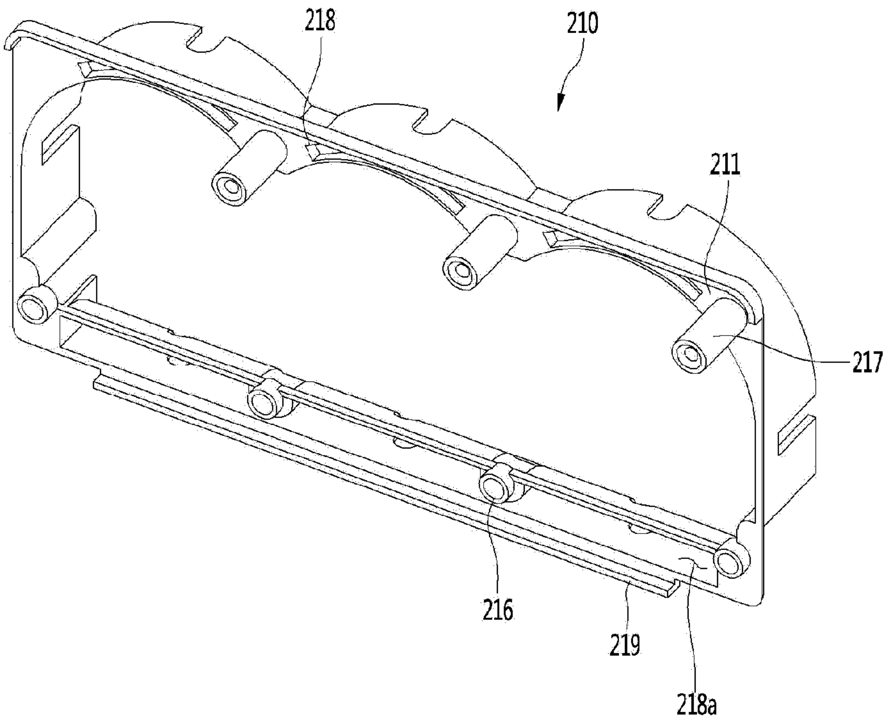

218
210
211
217
216
219
218a

FIG. 20

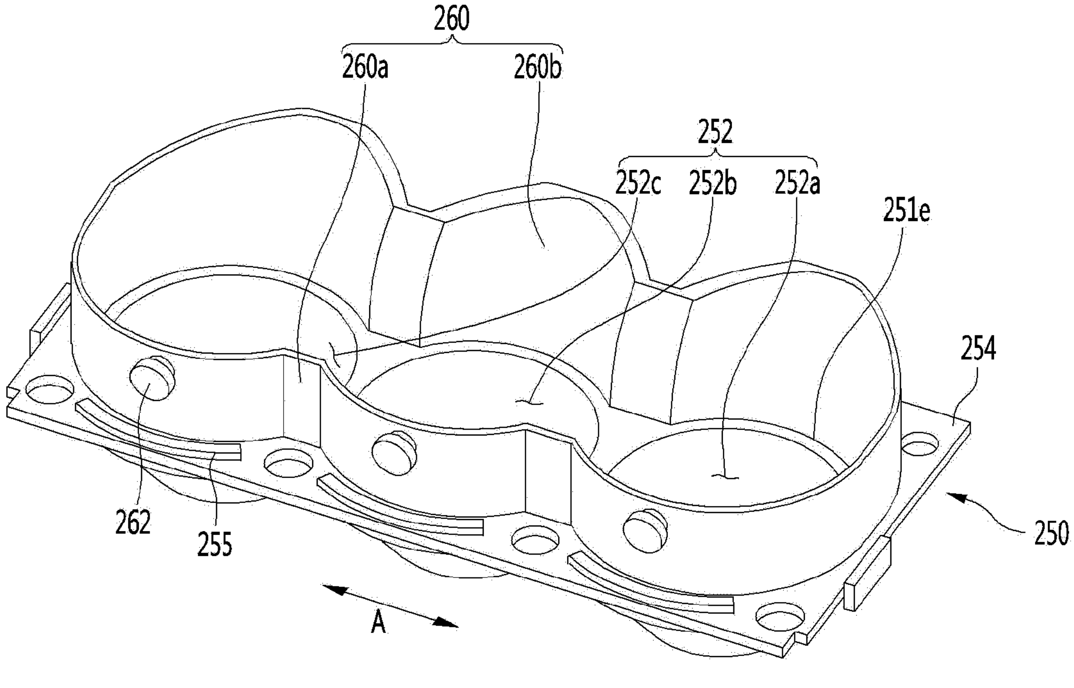

260
260a
260b
252
252c
252b
252a
251e
254
262
255
250
A

FIG. 21

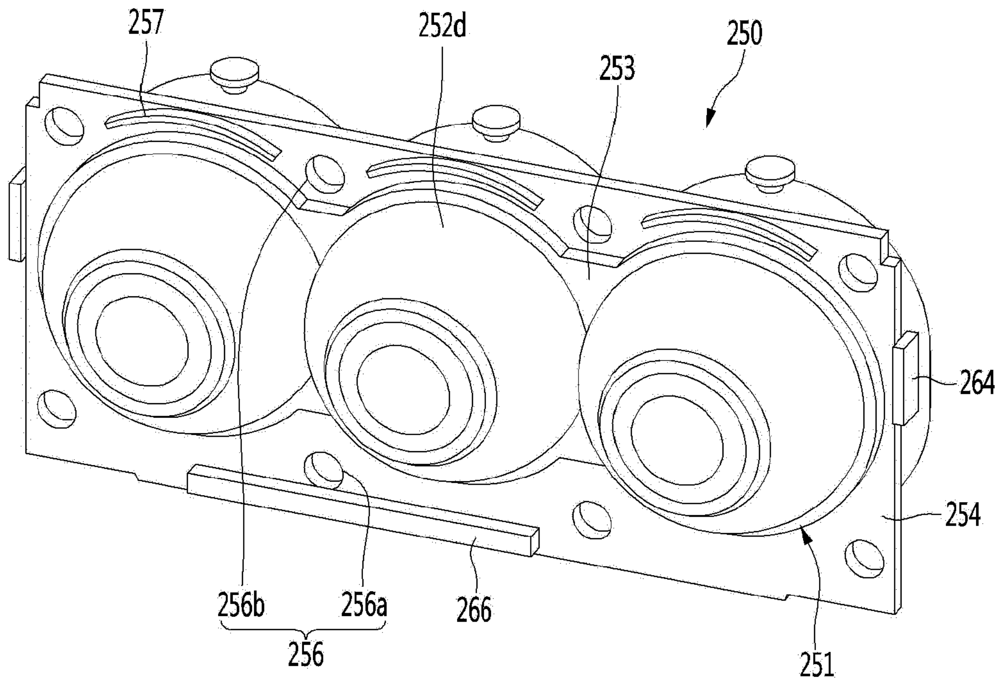

257
252d
250
253
264
254
256b
256a
266
256
251

FIG. 22

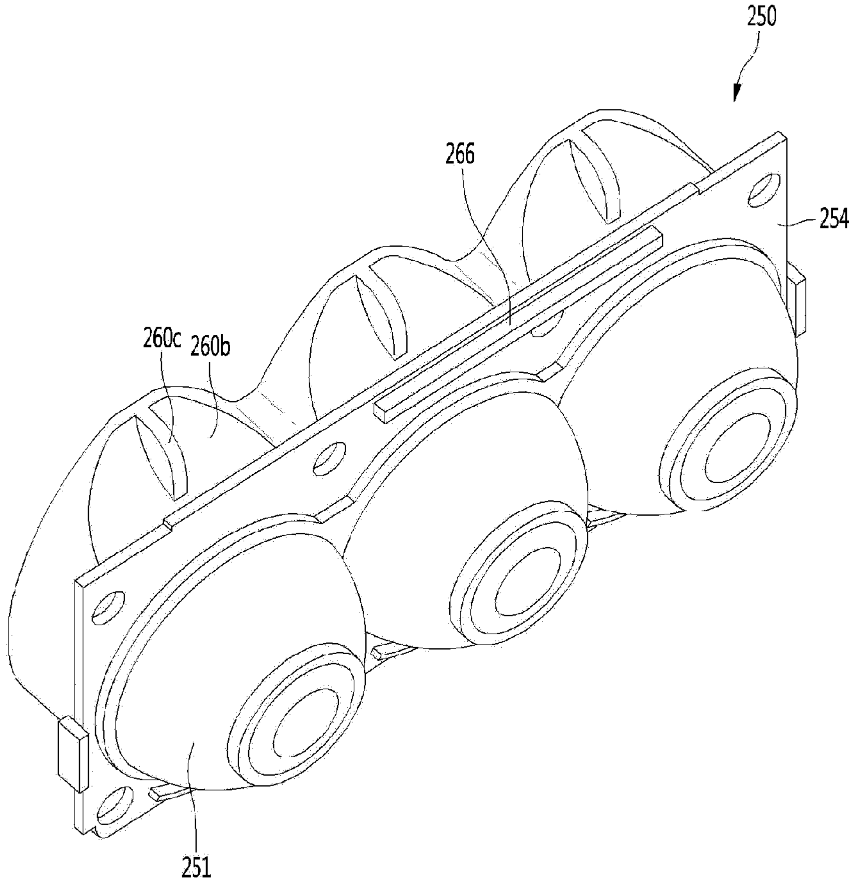

250
266
254
260c
260b
251

FIG. 23

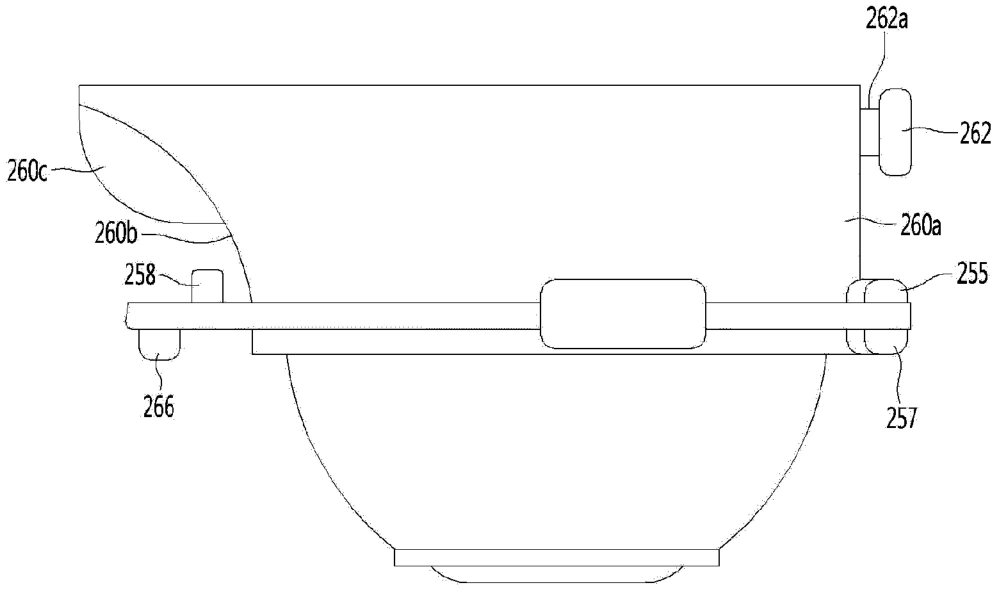

262a
262
260c
260a
260b
258
255
266
257

FIG. 24

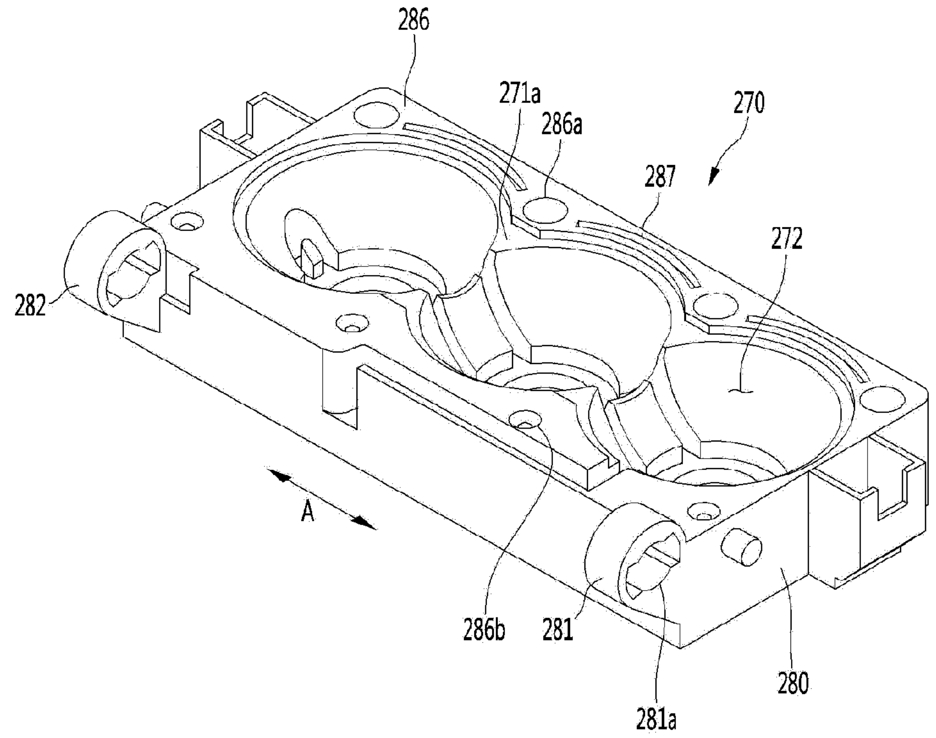

286
271a
286a
270
287
272
282
A
286b
281
281a
280

FIG. 25

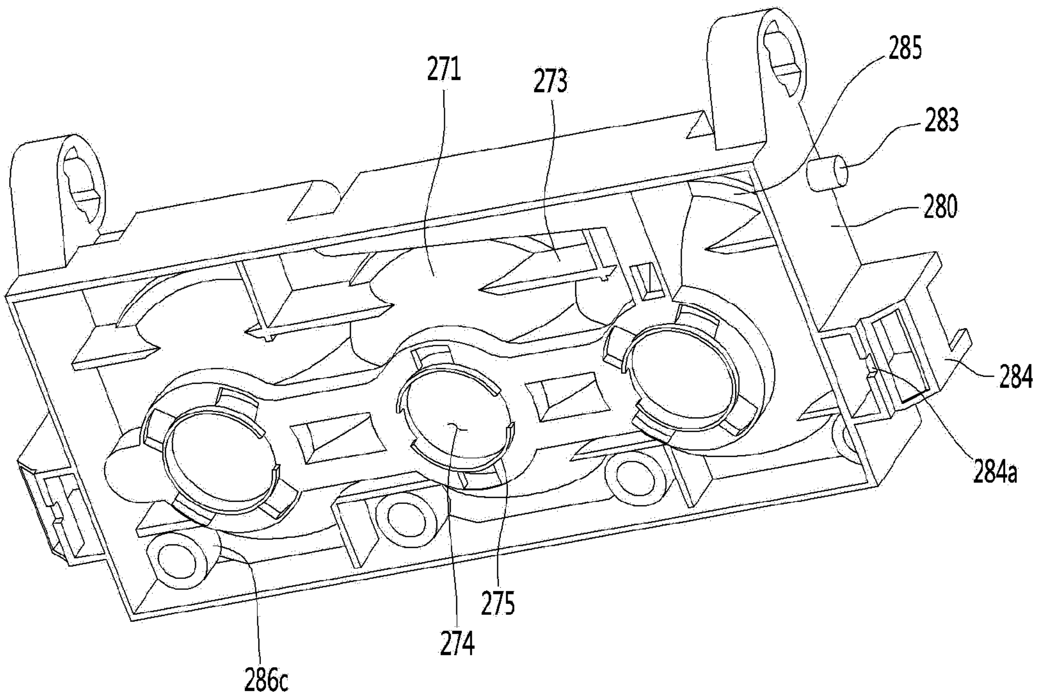

271
273
285
283
280
284
284a
275
274
286c

FIG. 26

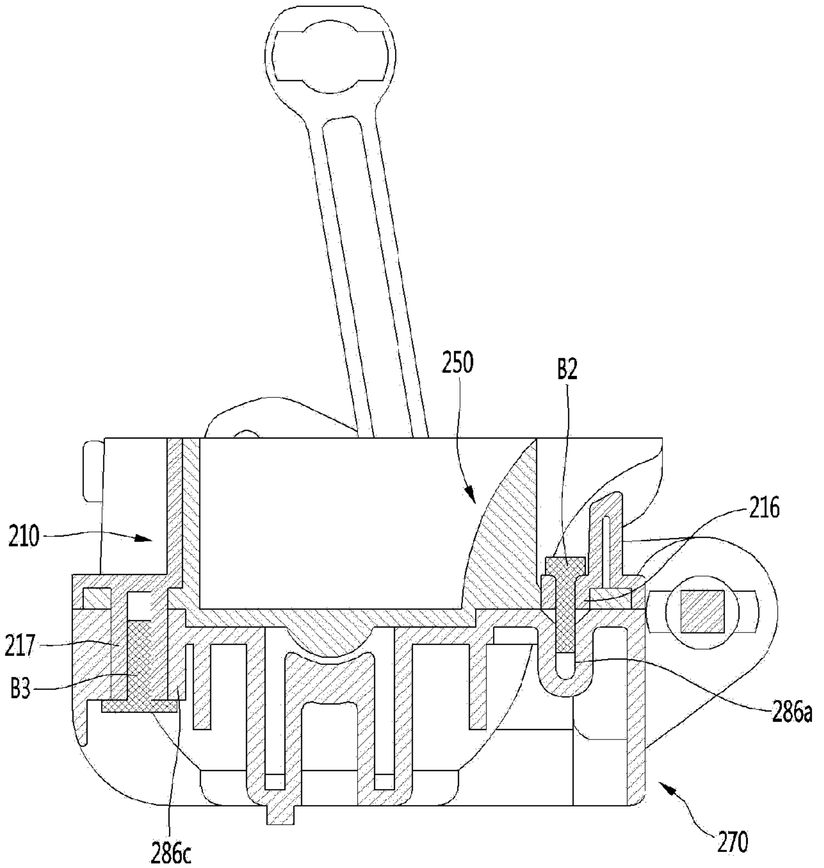

250
B2
210
216
217
B3
286a
286c
270

FIG. 27

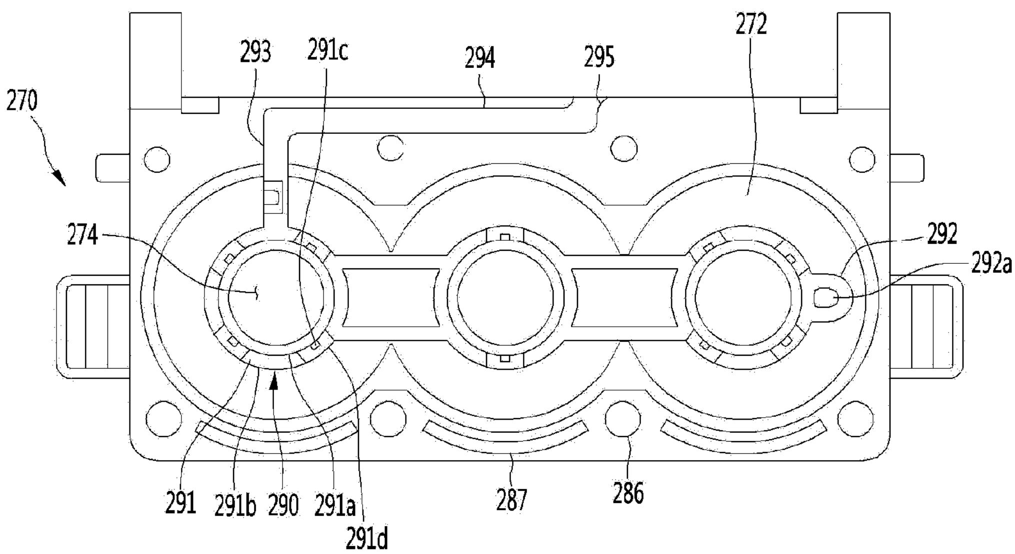

270
293
291c
294
295
272
274
292
292a
291
291b
290
291a
291d
287
286

FIG. 28

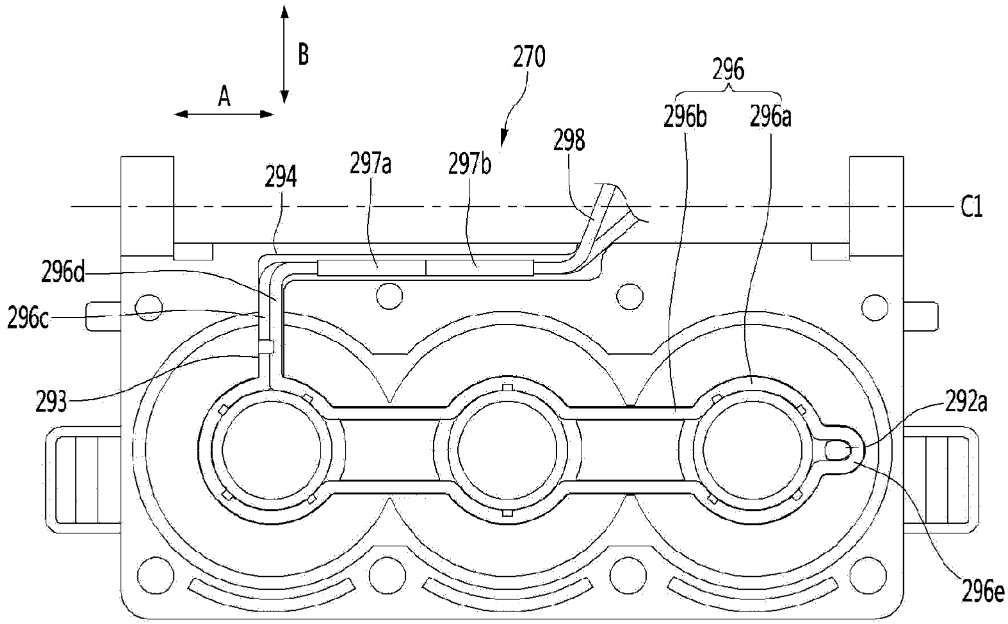

B
A
270
296
296b
296a
298
297a
297b
294
C1
296d
296c
293
292a
296e

FIG. 29

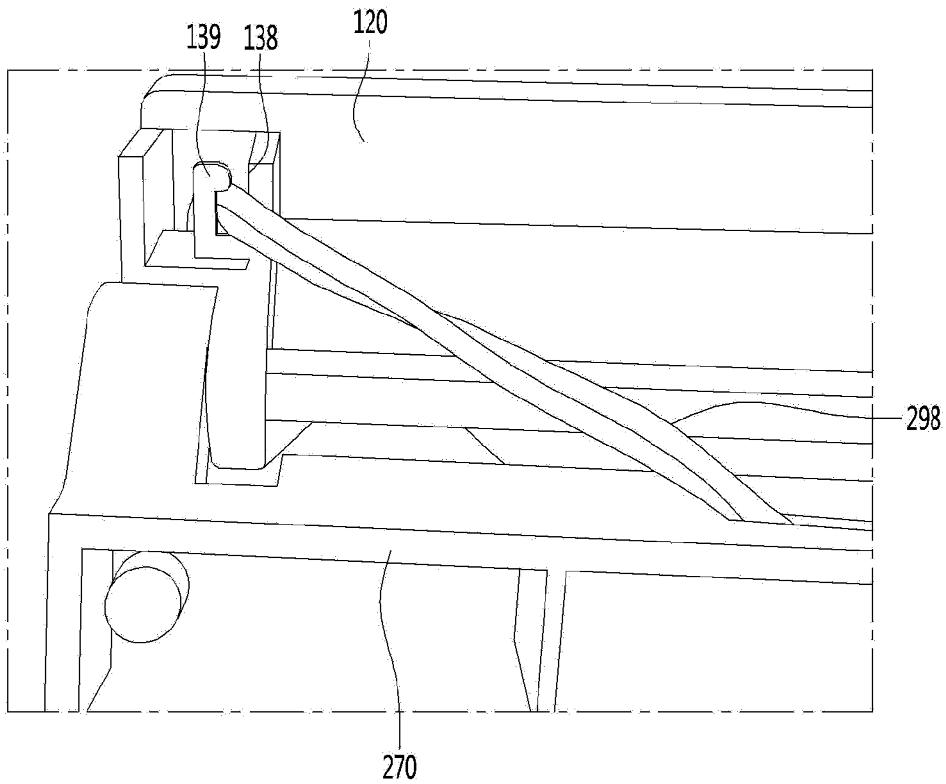

139
138
120
298
270

FIG. 30

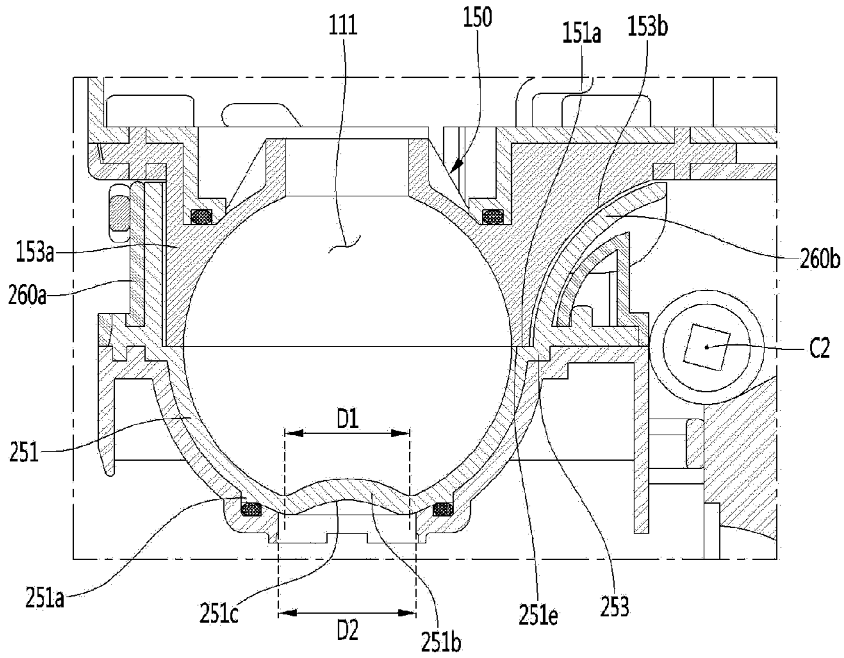

111
150
151a
153b
153a
260a
260b
C2
D1
251
251a
251c
D2
251b
251e
253

FIG. 31

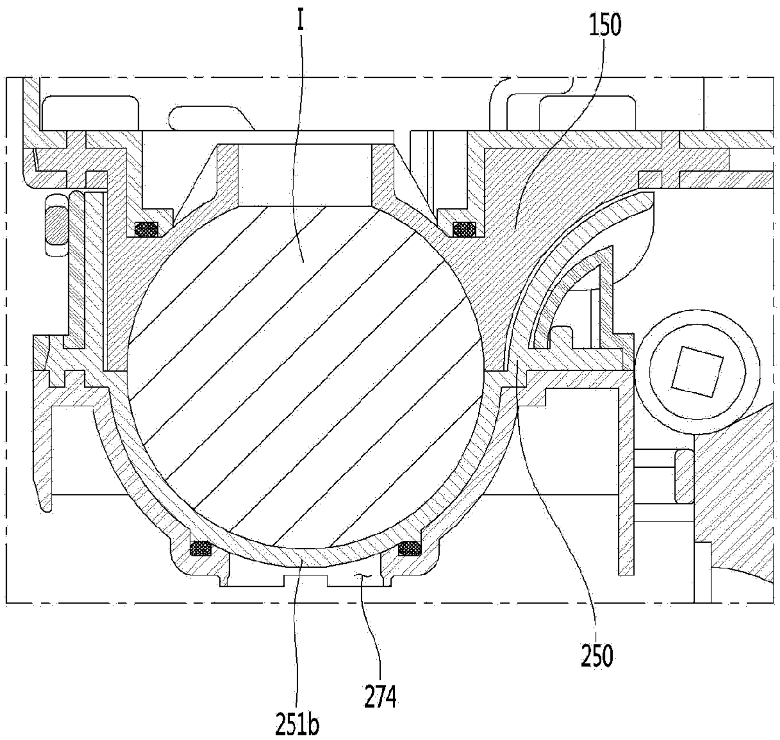

I
150
250
274
251b

FIG. 32

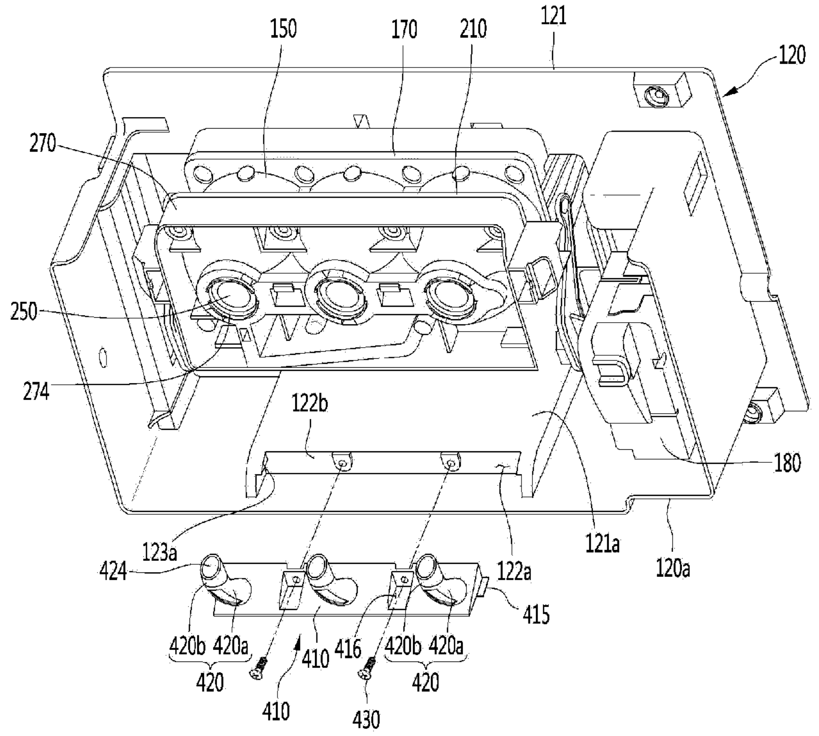

150
170
210
121
120
270
250
274
122b
180
123a
121a
120a
424
122a
415
420b 420a
420
410
416
420b 420a
420
410
430

FIG. 33

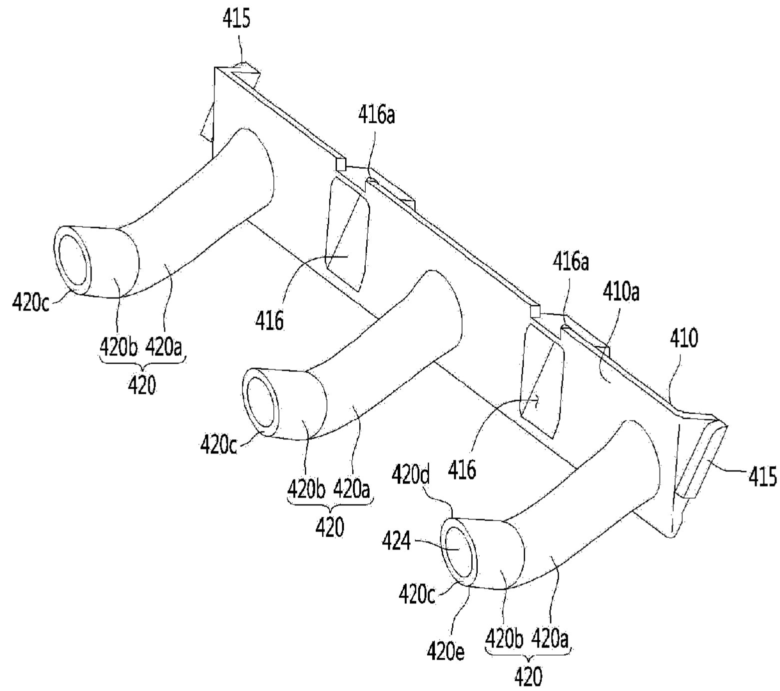

415
416a
420c
416
420b 420a
420
416a
410a
410
420c
420b 420a
420
420d
416
415
424
420c
420e
420b 420a
420

FIG. 34

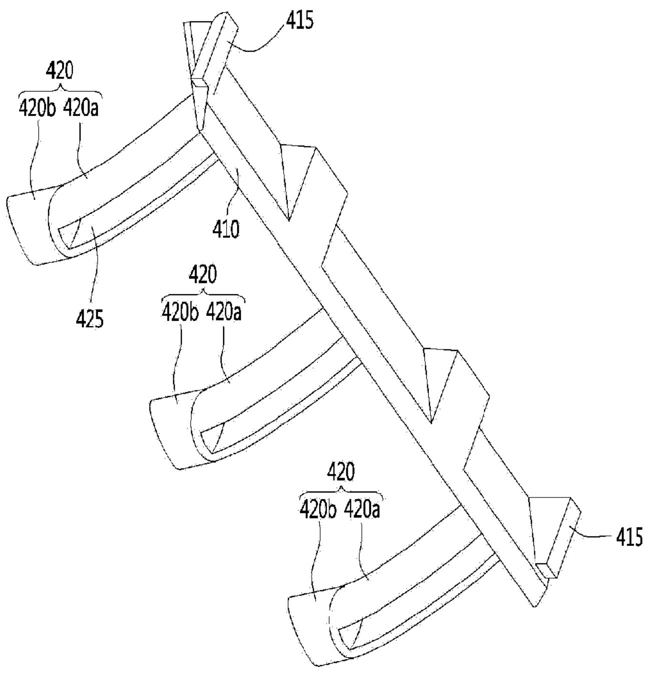

415
420
420b 420a
410
425
420
420b 420a
420
420b 420a
415

FIG. 35

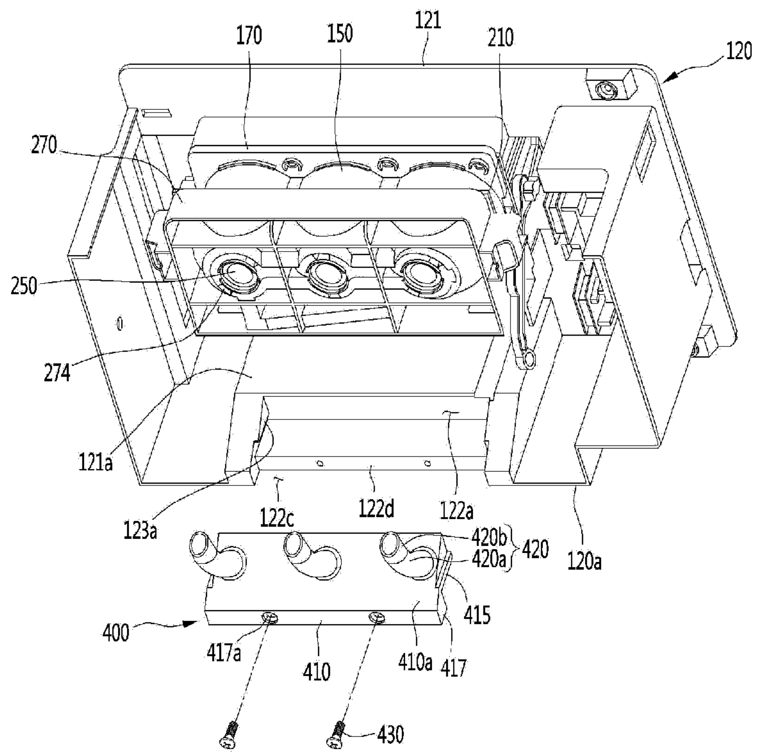

170
150
121
210
120
270
250
274
121a
123a
122c
122d
122a
420b
420a
420
120a
415
400
417a
410
410a
417
430

FIG. 36

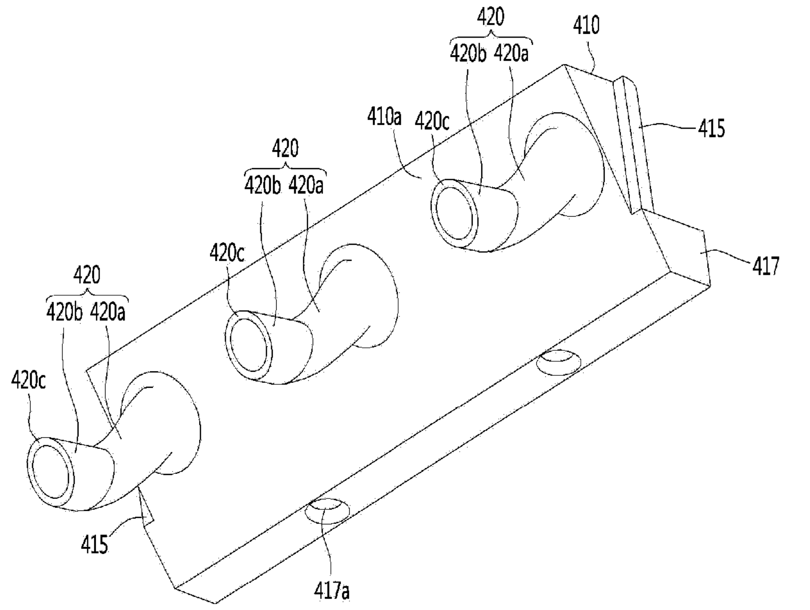

420
420b 420a
410
410a
420c
415
420
420b 420a
420c
417
420
420b 420a
420c
415
417a

FIG. 37

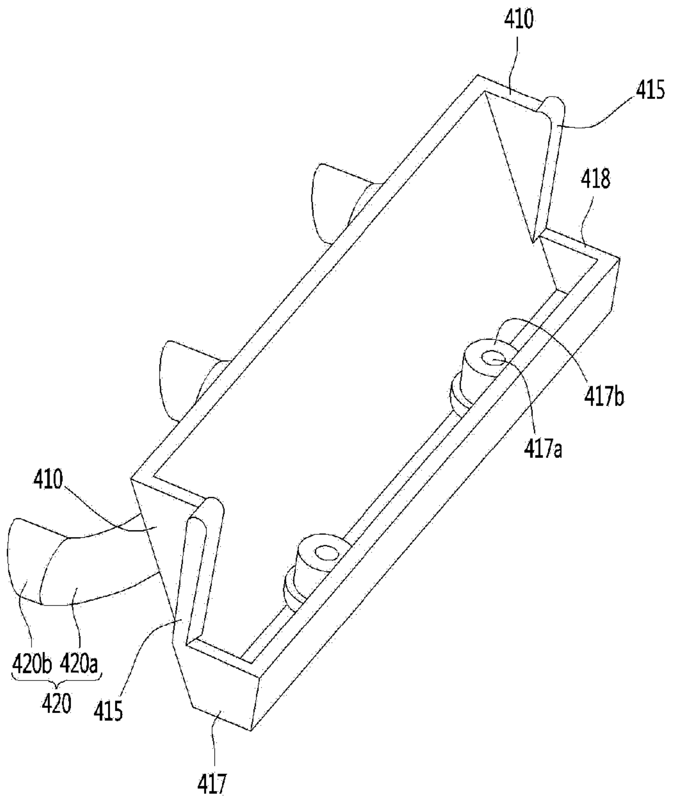

410
415
418
417b
417a
410
420b 420a
420
415
417

FIG. 38

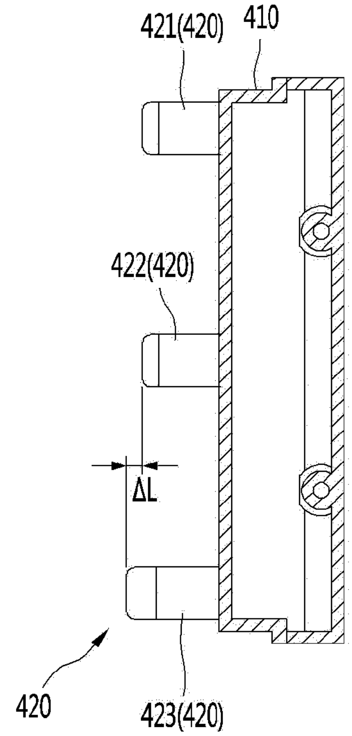

421(420)
410
422(420)
ΔL
420
423(420)

FIG. 39

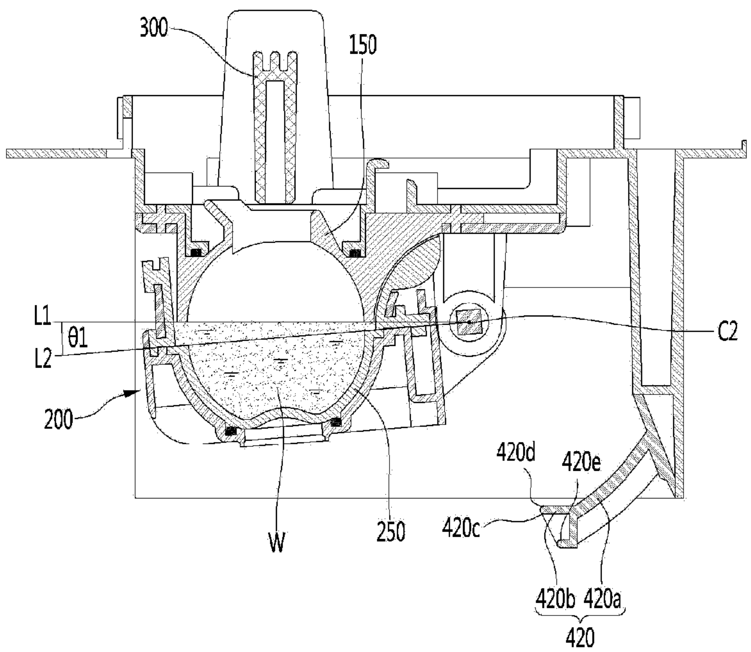

300
150
L1
θ1
L2
C2
200
420d
420e
W
250
420c
420b
420a
420

FIG. 40

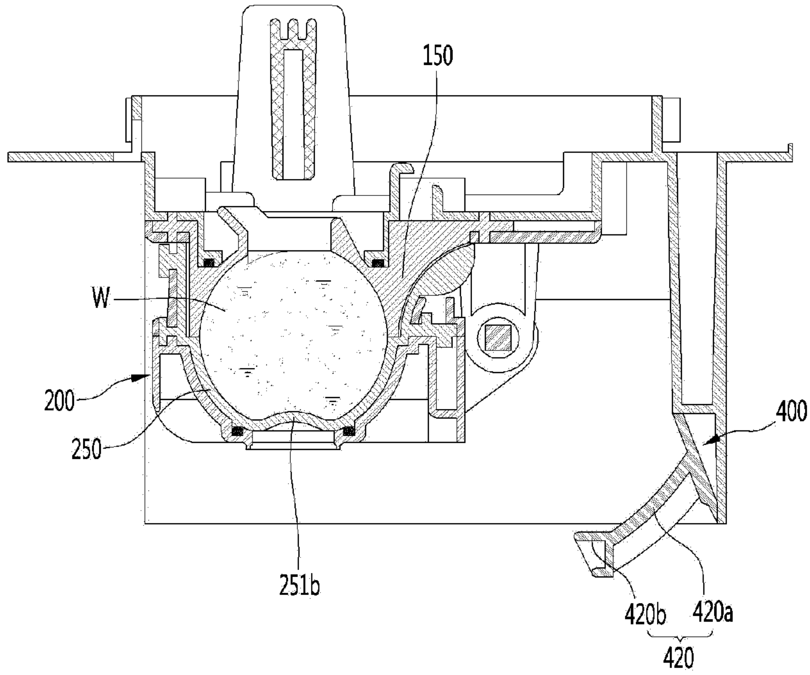

150
W
200
250
251b
400
420b
420a
420

FIG. 41

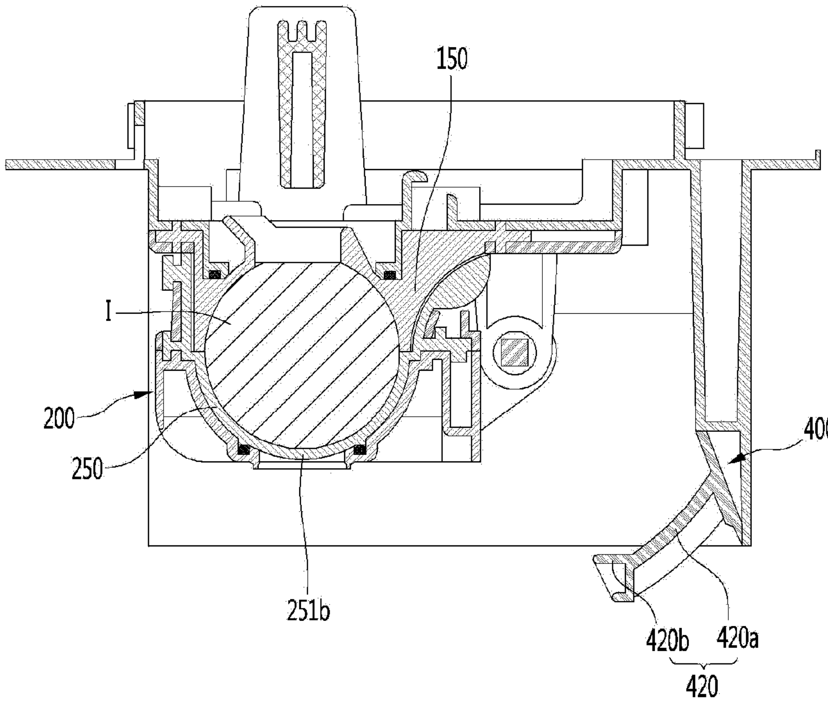

150
I
200
250
251b
400
420b
420a
420

FIG. 42

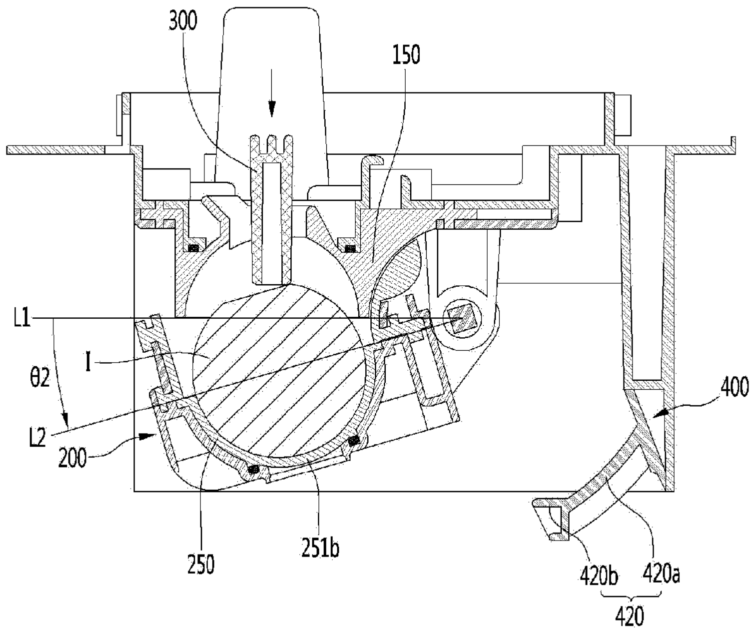

300
150
L1
I
θ2
L2
200
400
250
251b
420b
420a
420

FIG. 43

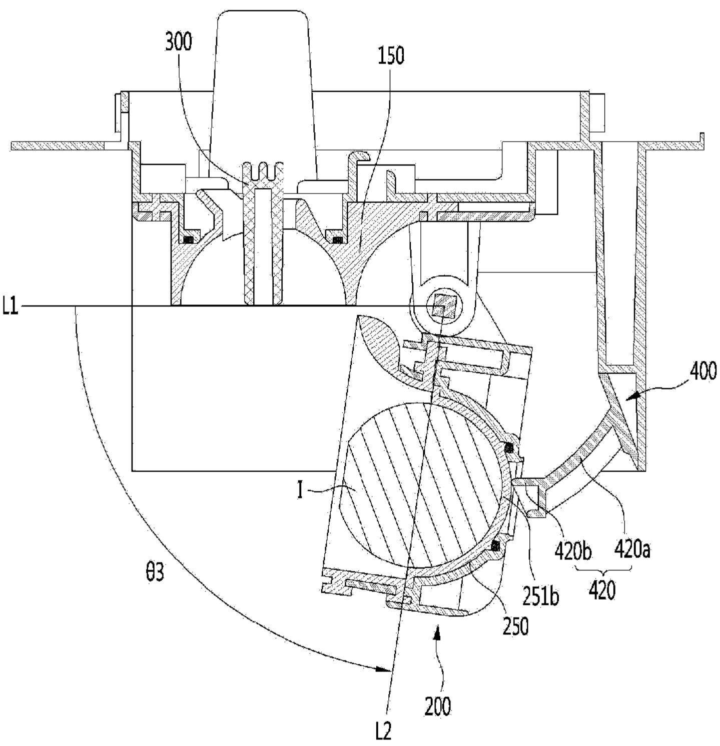
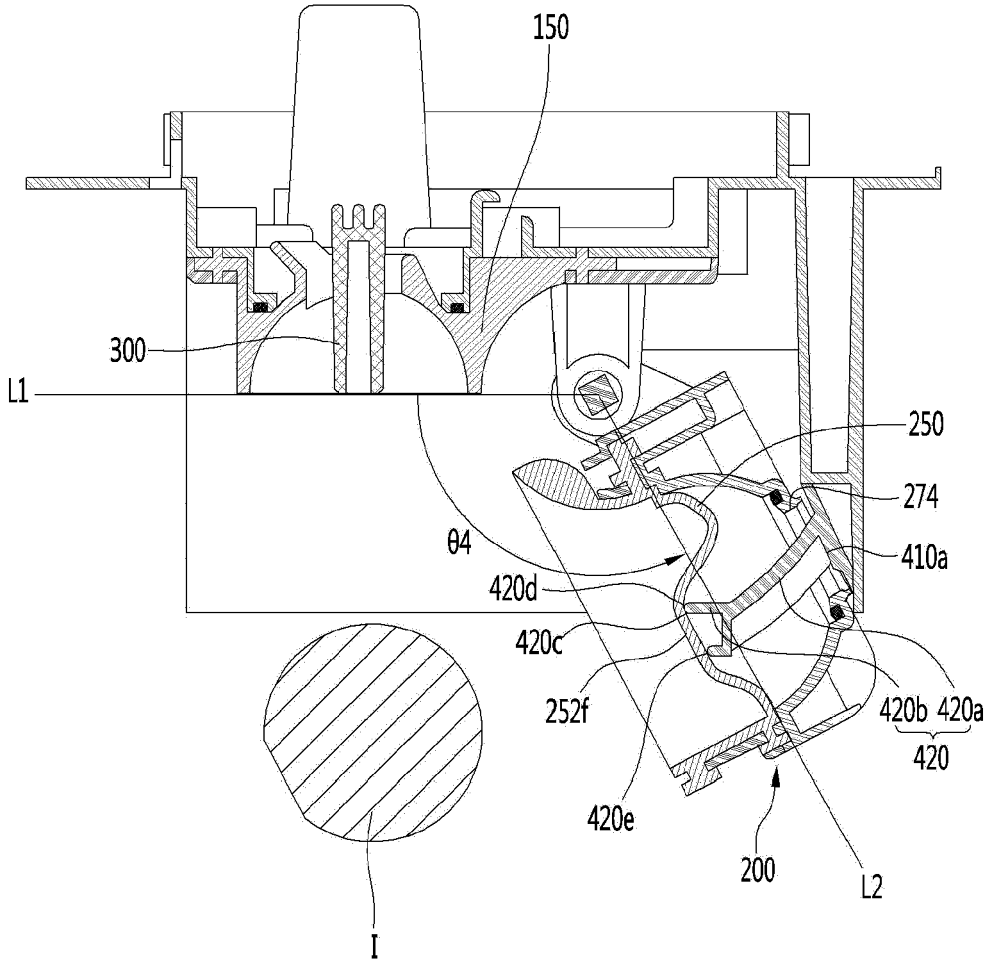

300
150
L1
400
I
420b
420a
θ3
251b
420
250
200
L2

FIG. 44


150
300
L1
250
274
θ4
410a
420d
420c
252f
420b
420a
420
420e
200
L2
I

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 19 20 9399

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 A	EP 2 549 207 A2 (LG ELECTRONICS INC [KR]) 23 January 2013 (2013-01-23) * figures 1-25 *	1-5,9-15 6-8	INV. F25C5/06 F25C5/20
A	JP S50 97042 U (UNKNOWN) 13 August 1975 (1975-08-13) * figures 2,3,4,6-11 *	6,7	
A	JP H02 176380 A (HOSHIZAKI ELECTRIC CO LTD) 9 July 1990 (1990-07-09) * figures 7-10 *	12	

TECHNICAL FIELDS SEARCHED (IPC)

F25C

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	30 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

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 19 20 9399

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.

30-03-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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
JP S5097042 U	13-08-1975	JP S5097042 U	13-08-1975
		JP S5151057 Y2	08-12-1976
JP H02176380 A	09-07-1990	JP H0544586 B2	06-07-1993
		JP H02176380 A	09-07-1990

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 **[0008]**
- JP 4657626 B **[0018]**