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(54) **REFRIGERATOR**

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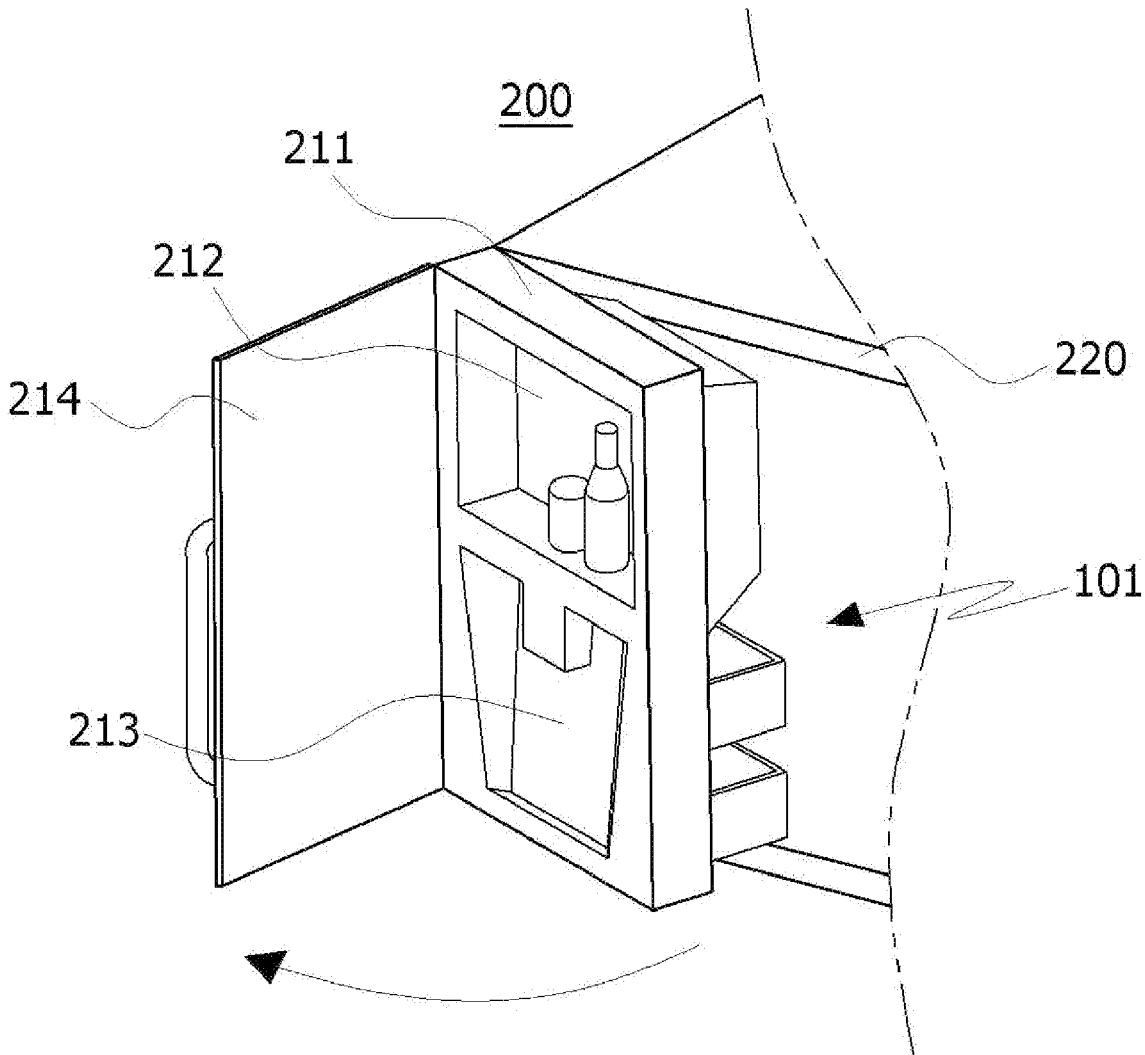
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(57) **ABSTRACT**

Proposed is a refrigerator. The refrigerator may include: main doors open and closed, while sealing a storage room of the refrigerator, and having accommodation spaces and a dispenser located therein; sub-doors open and closed, while sealing the accommodation spaces, and connected to the main doors; and an ice making room connected to one side main door to supply water or ice to the dispenser, while being connected to refrigerant pipe of the refrigerator.

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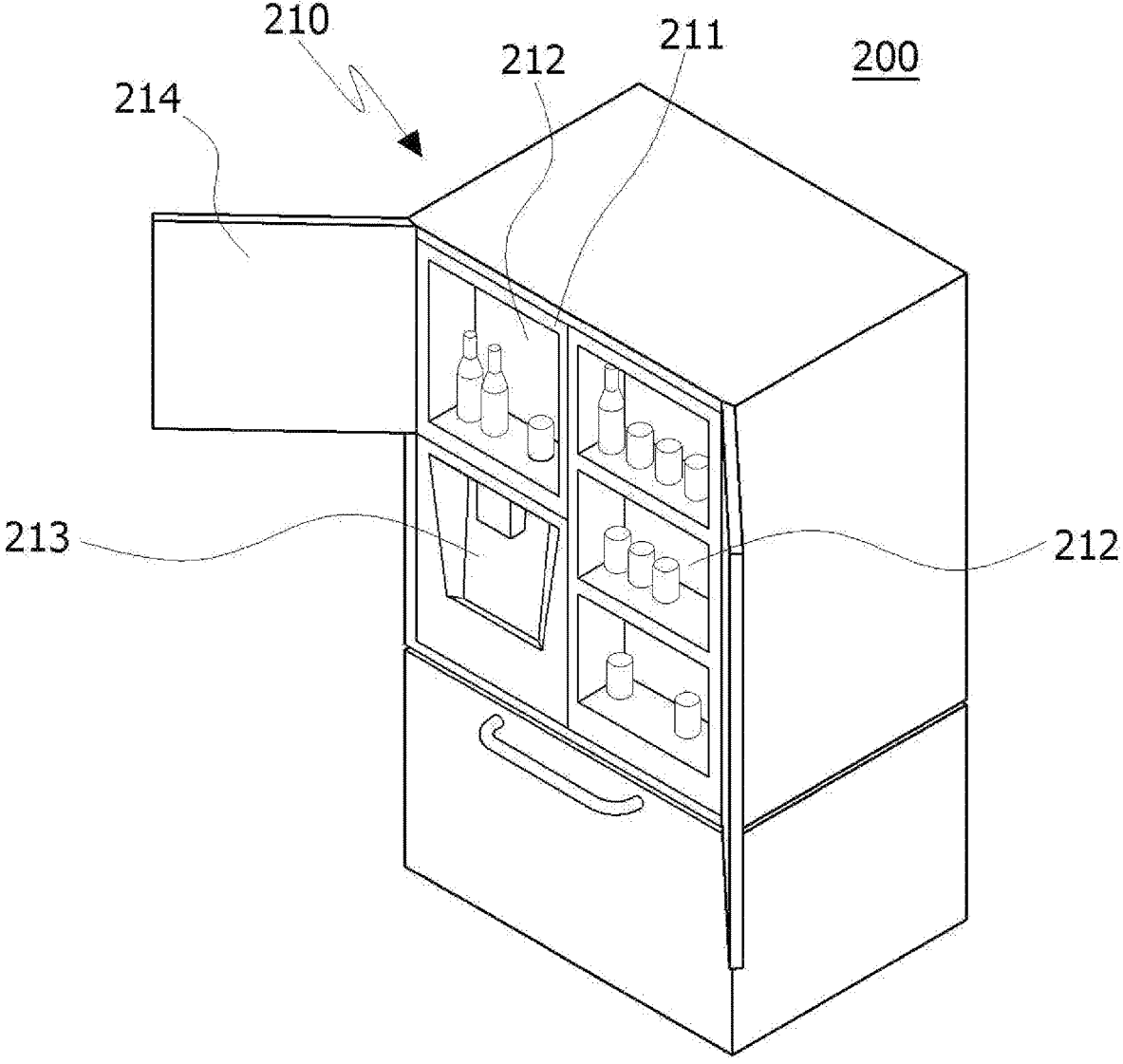


FIG. 1

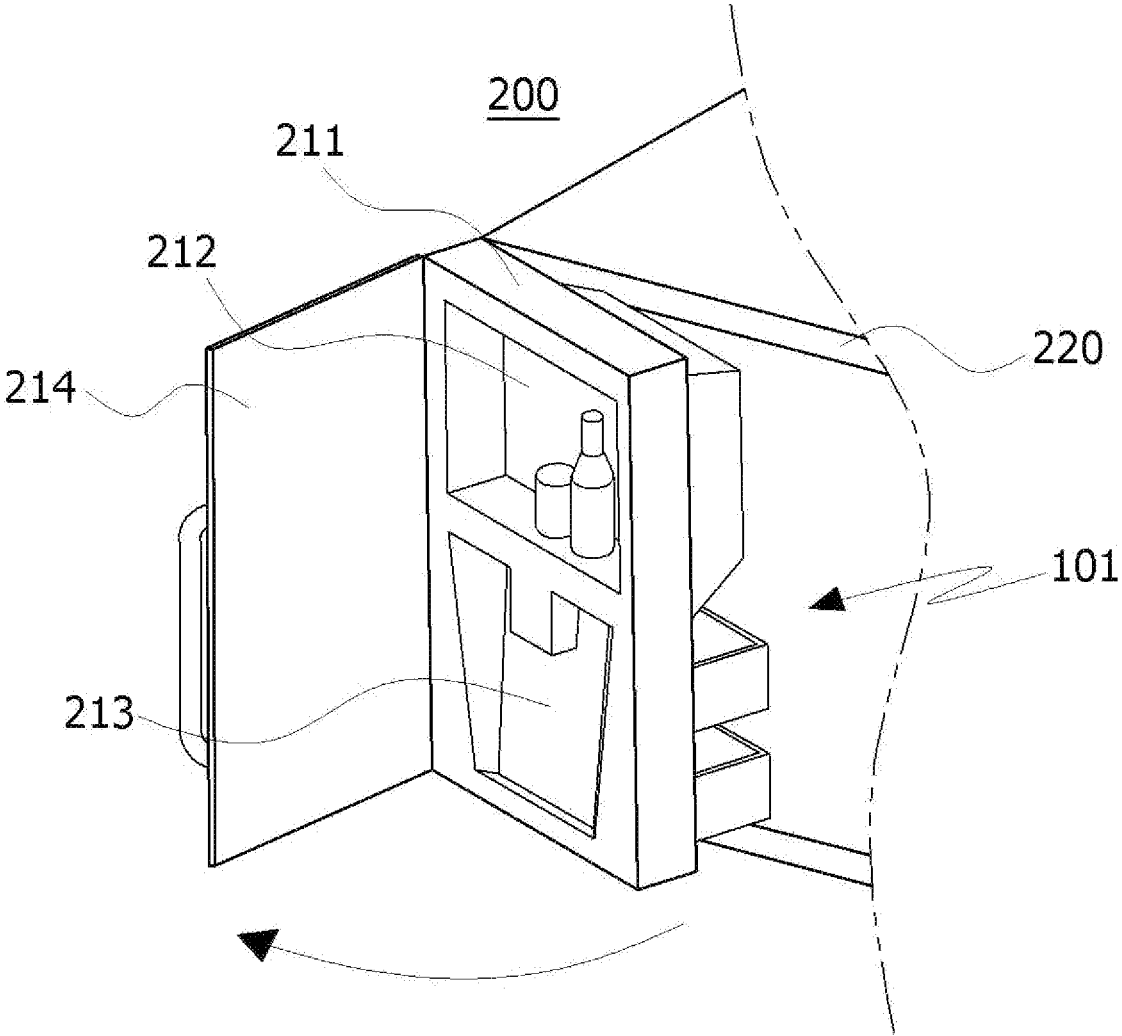


FIG. 2

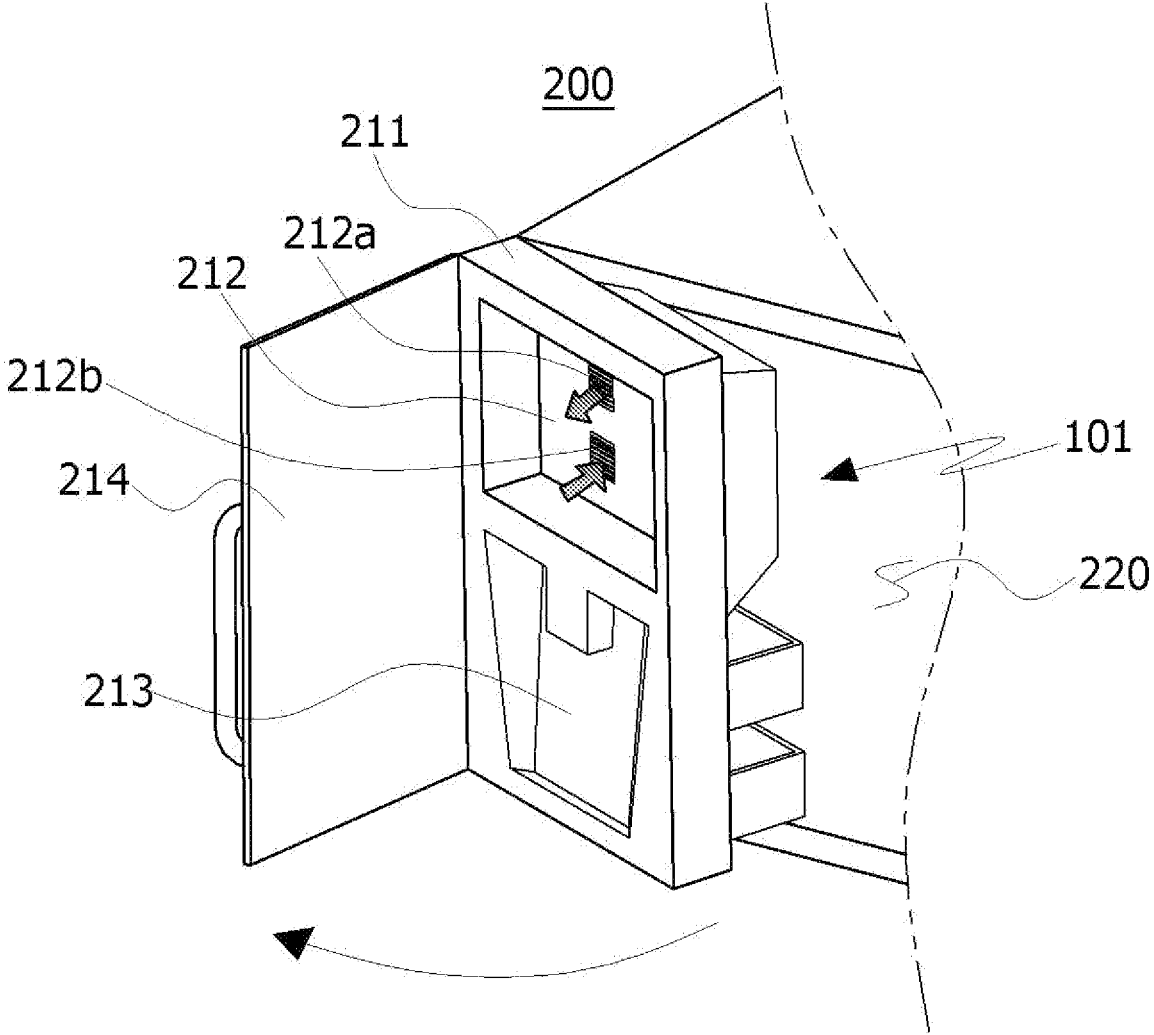


FIG. 3

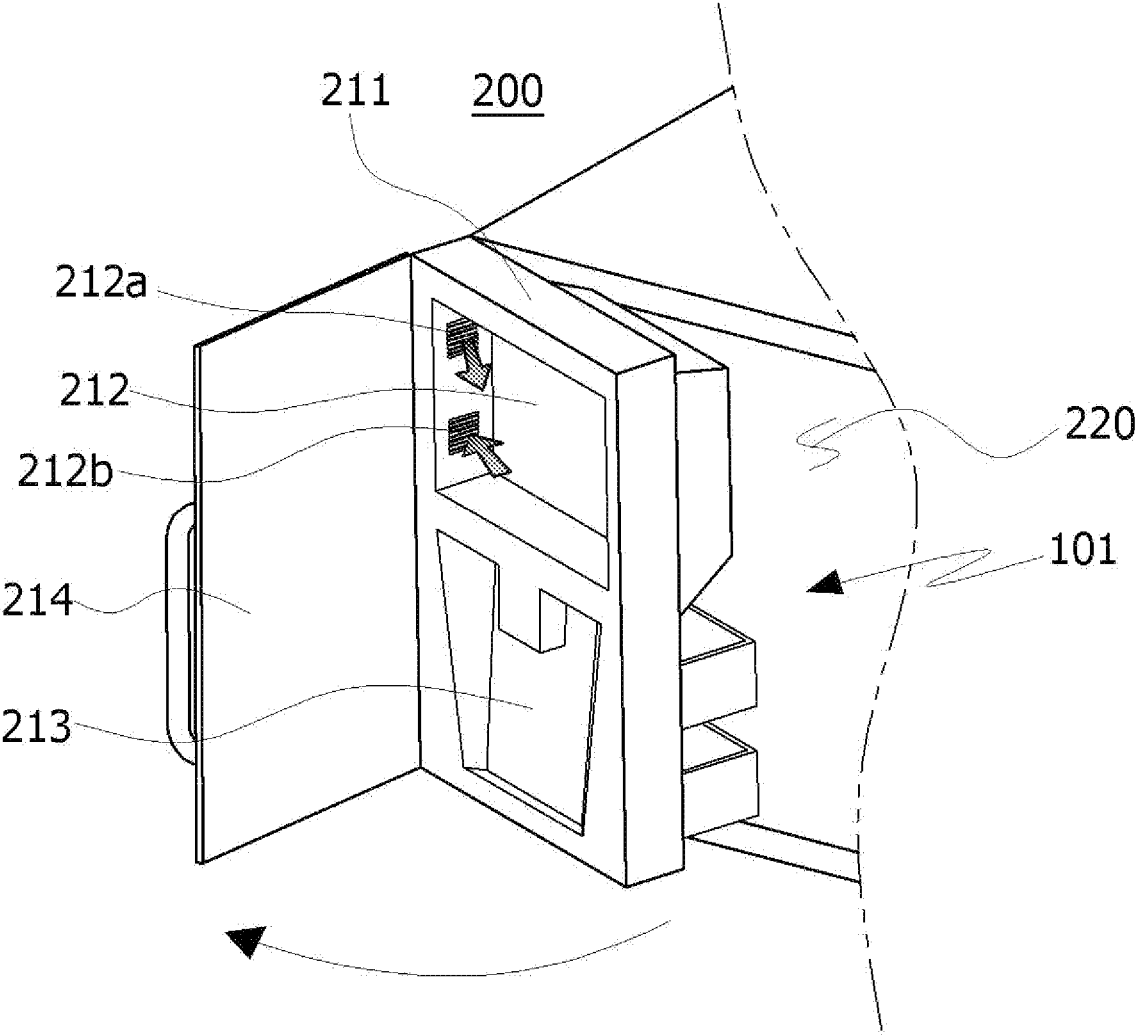


FIG. 4

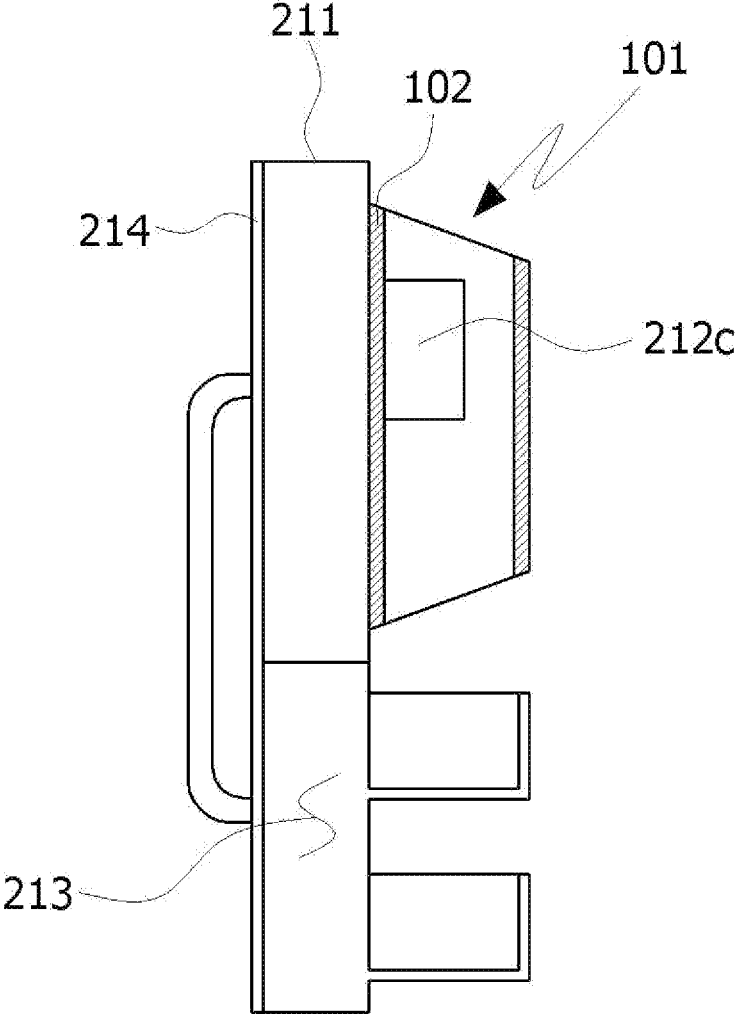


FIG. 5

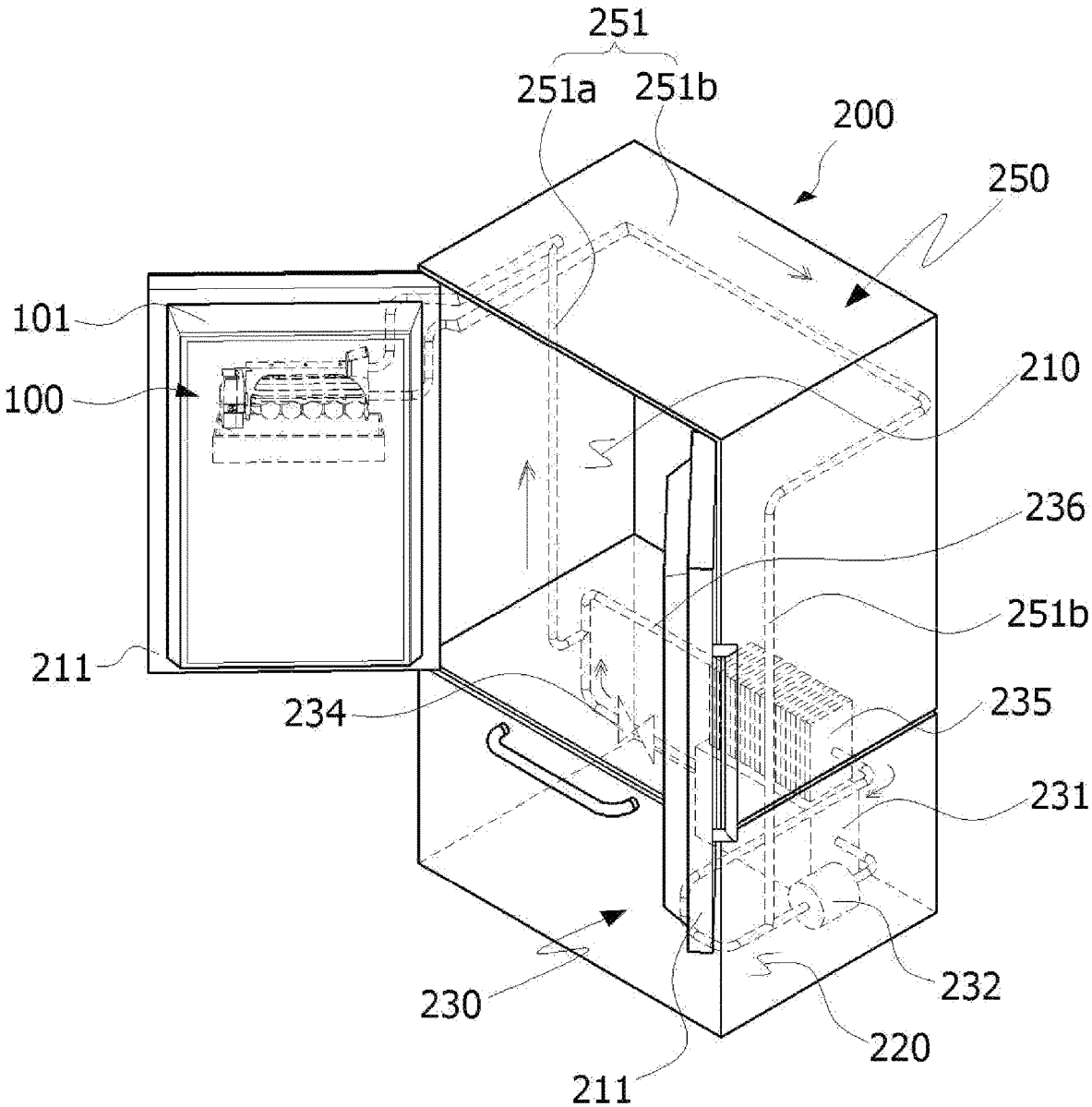


FIG. 6

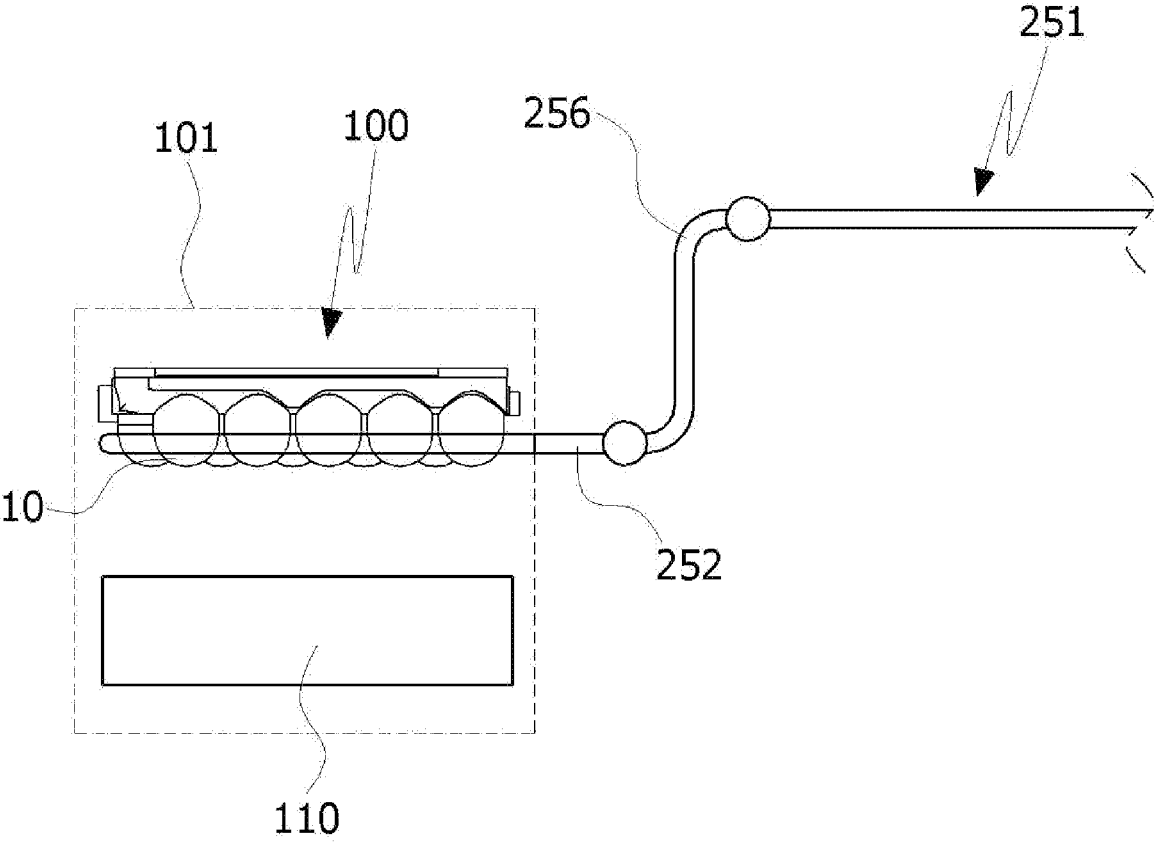


FIG. 7

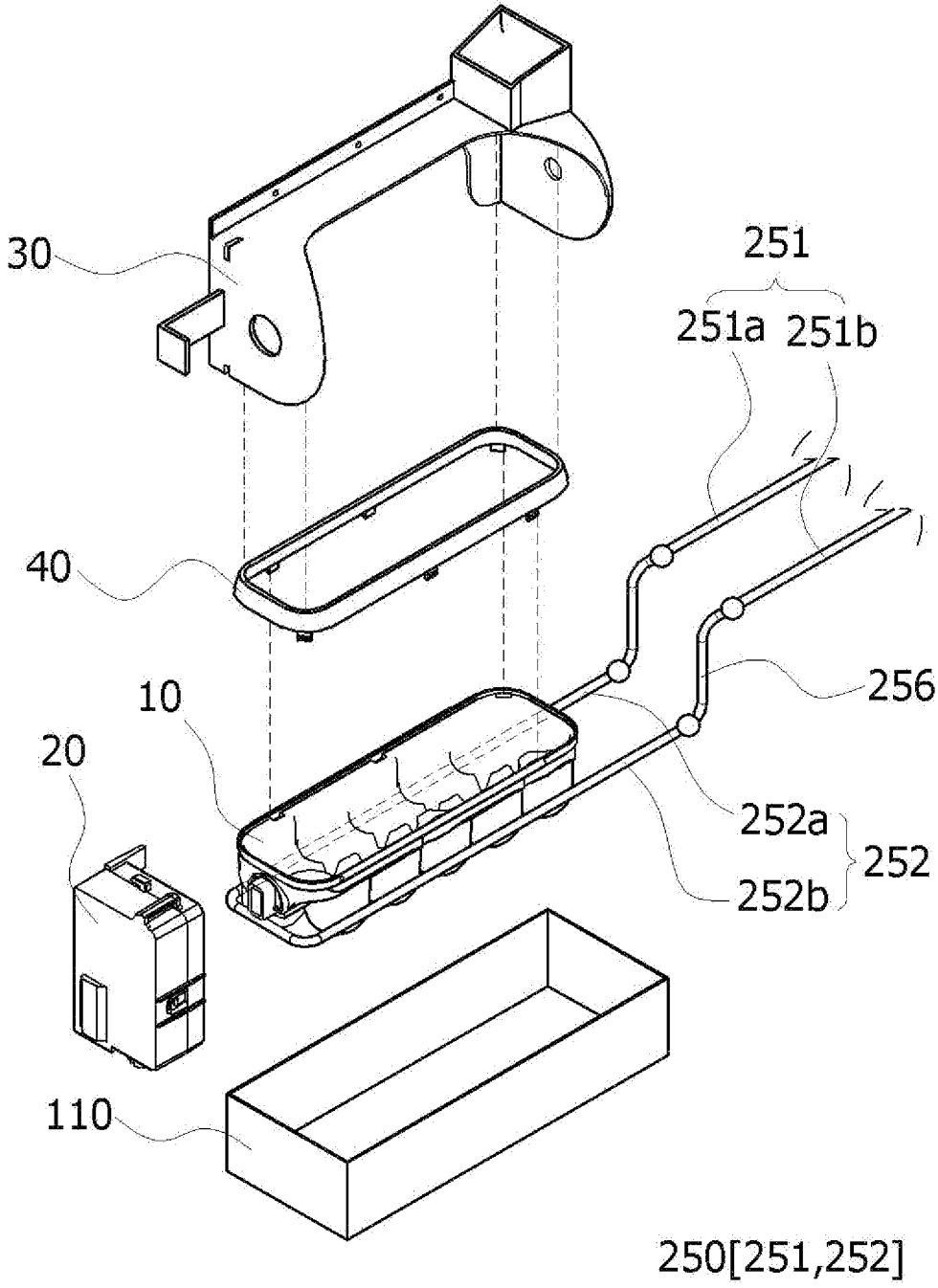


FIG. 8

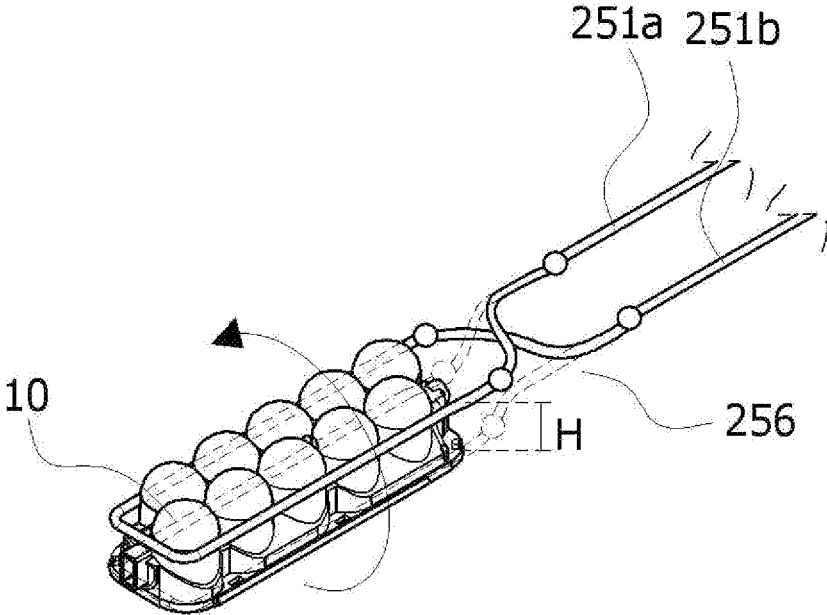


FIG. 9

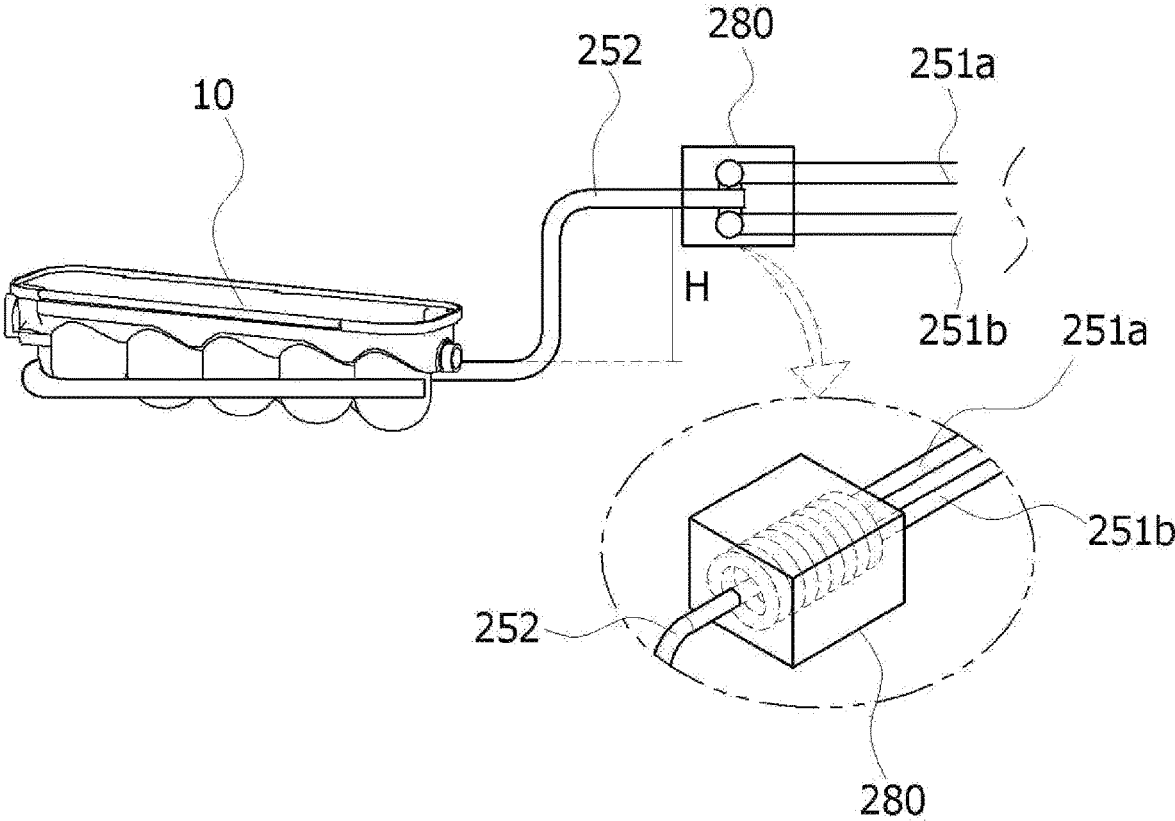


FIG. 10

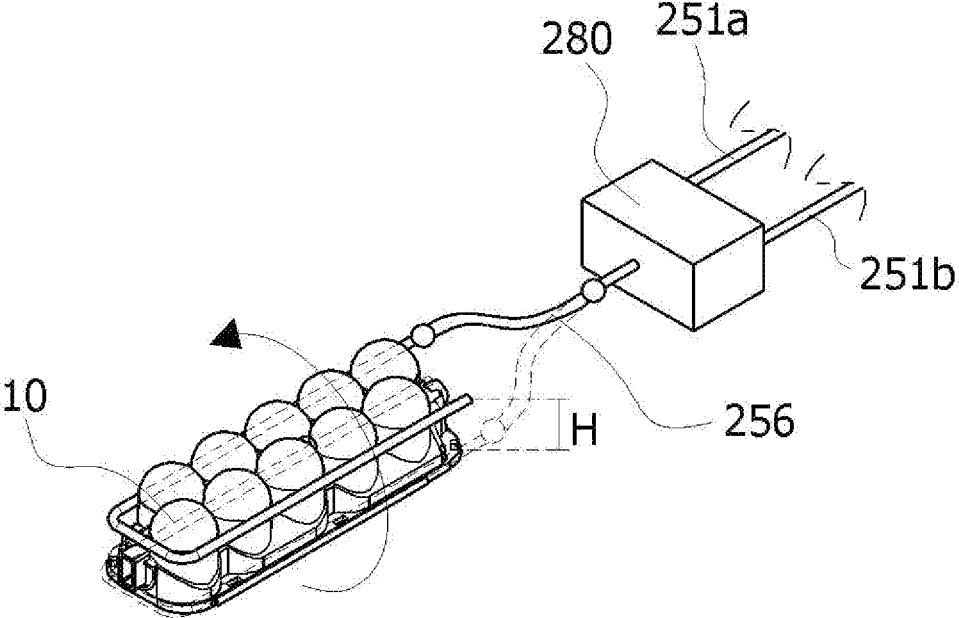


FIG. 11

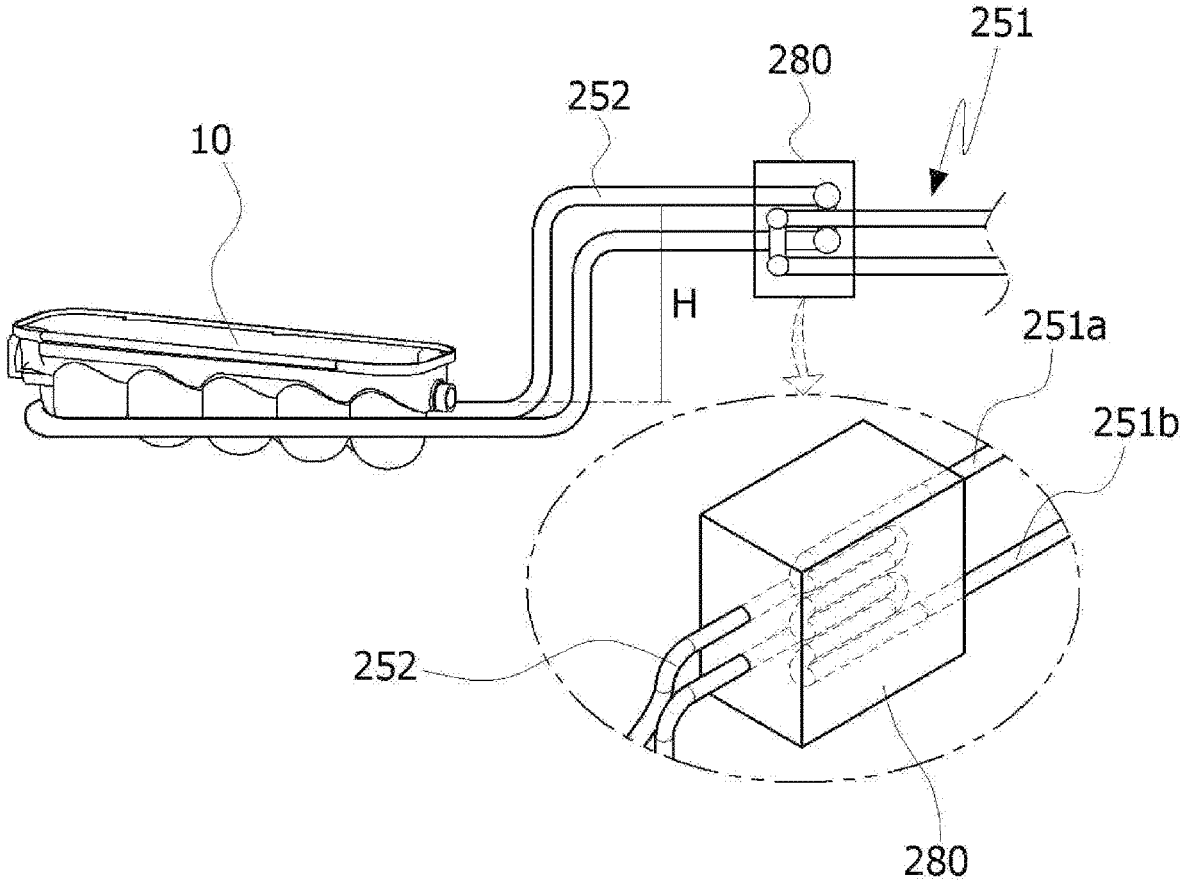


FIG. 12

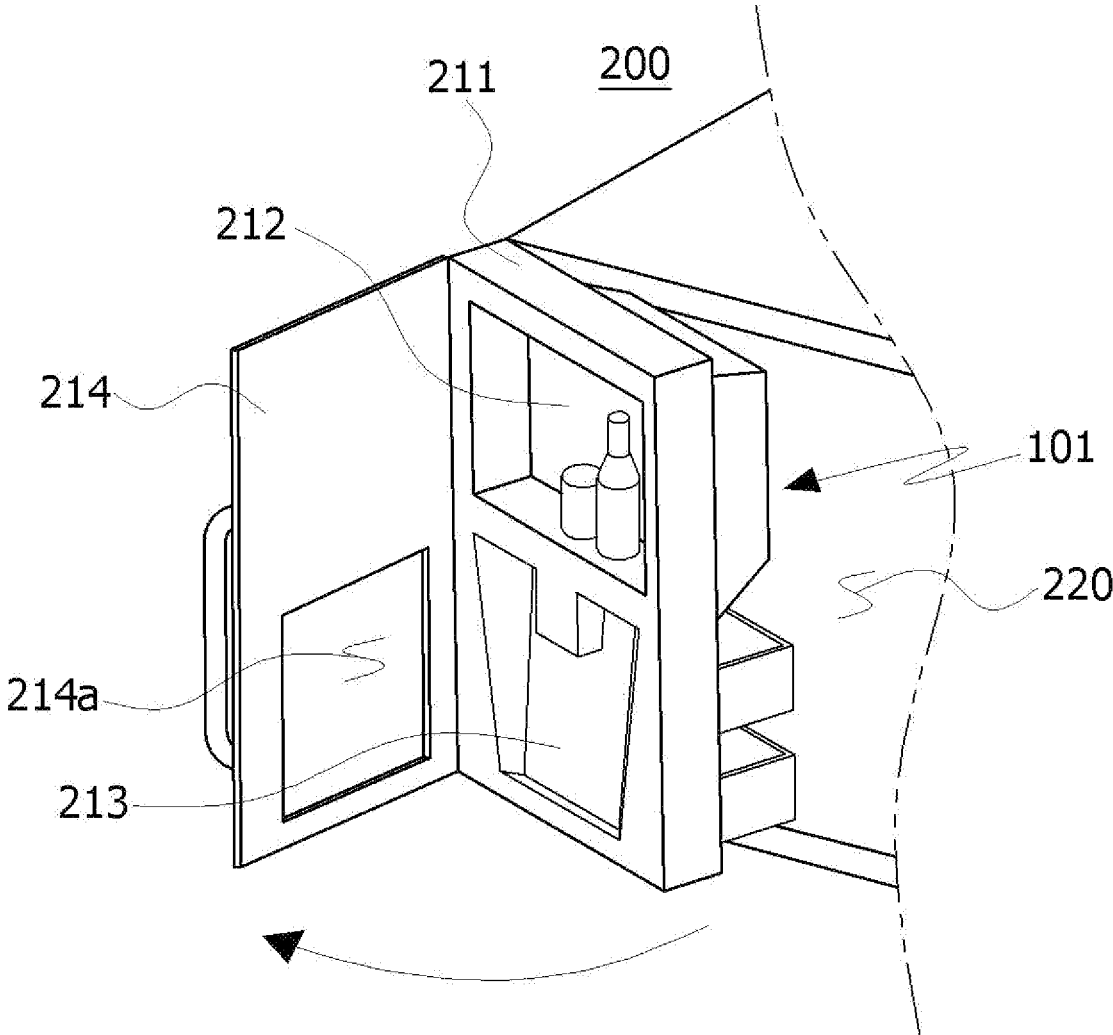


FIG. 13

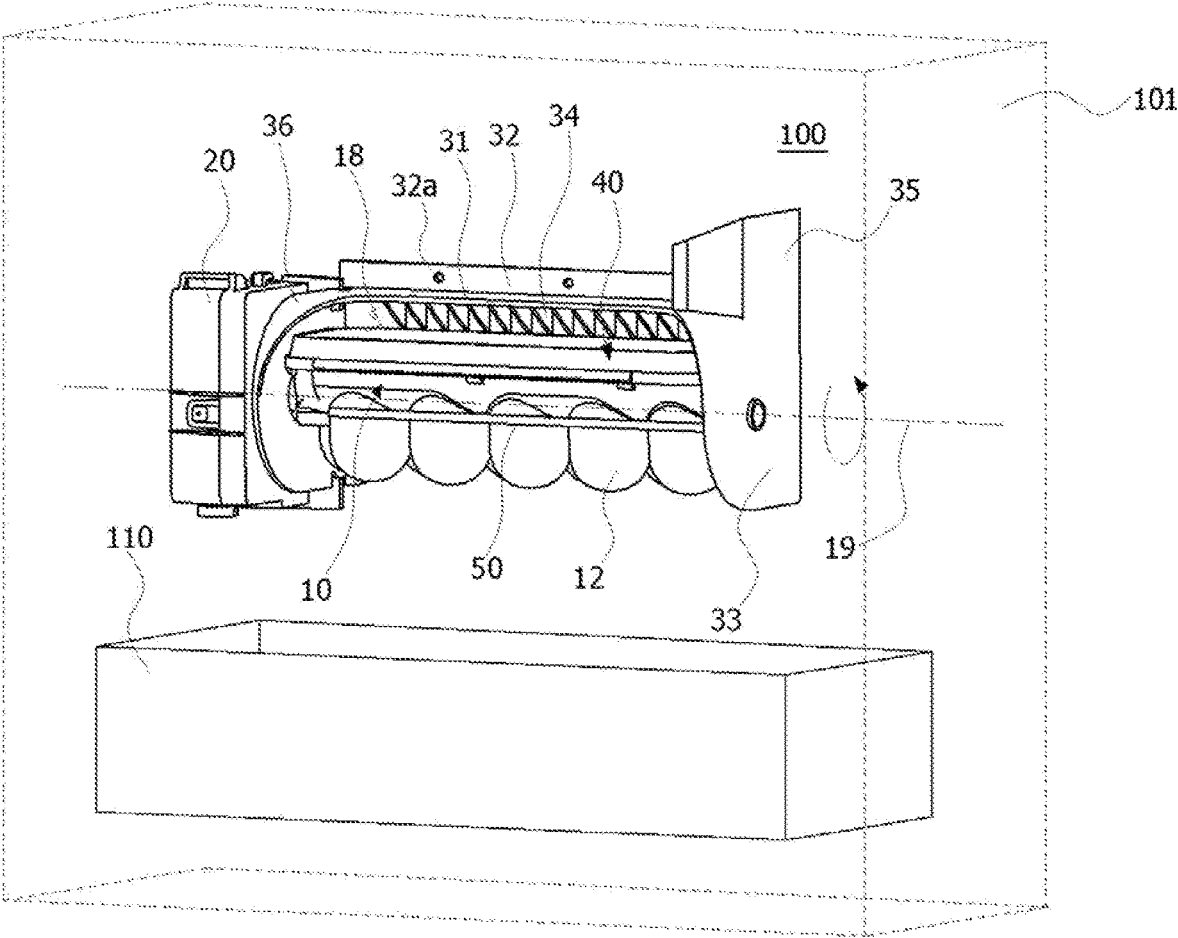


FIG. 14

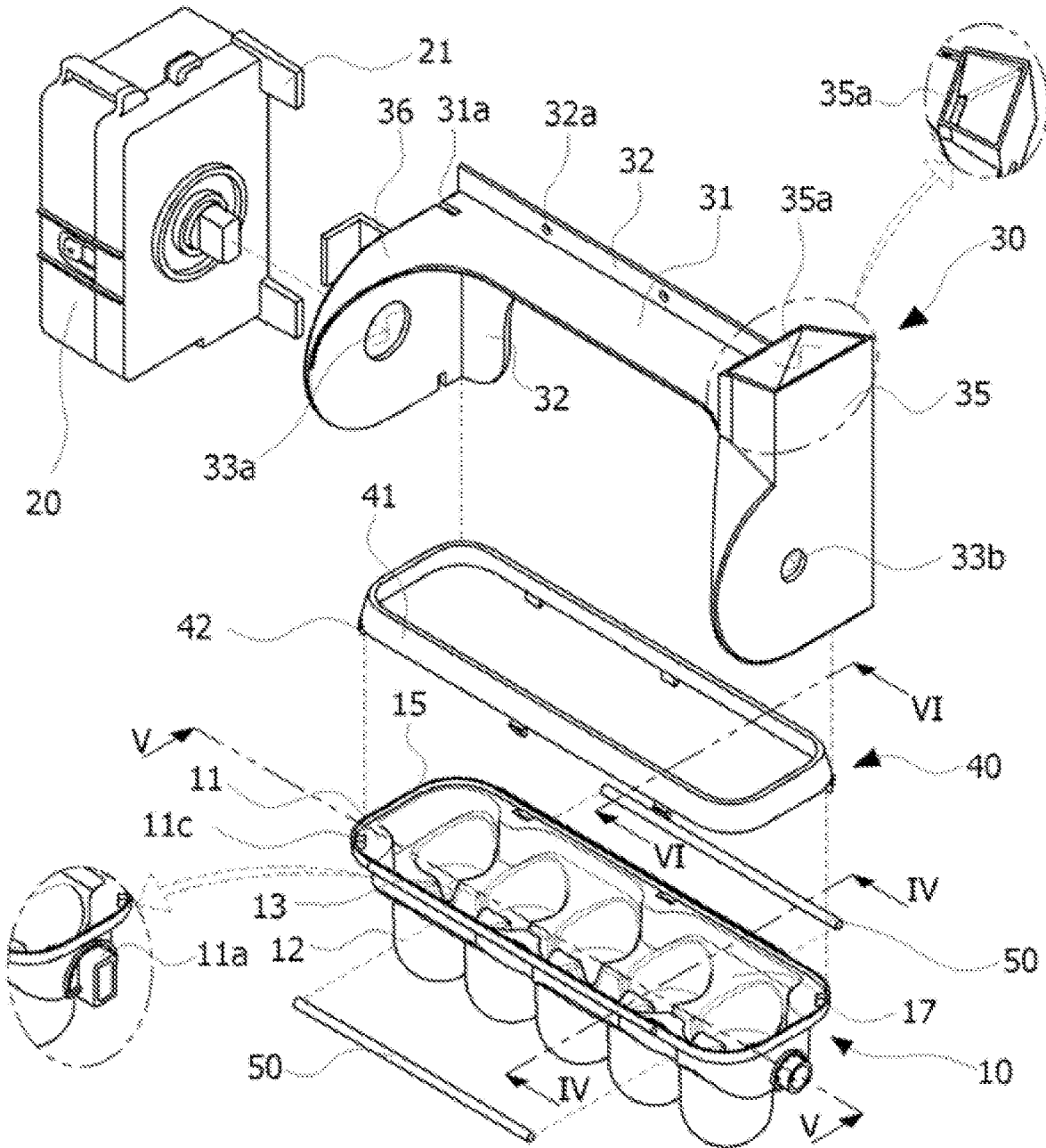


FIG. 15

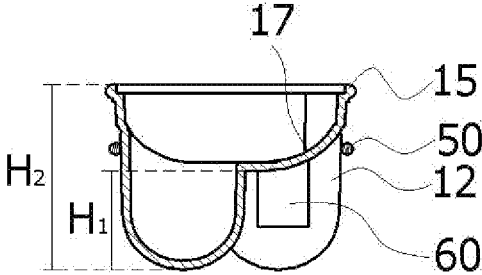


FIG. 16

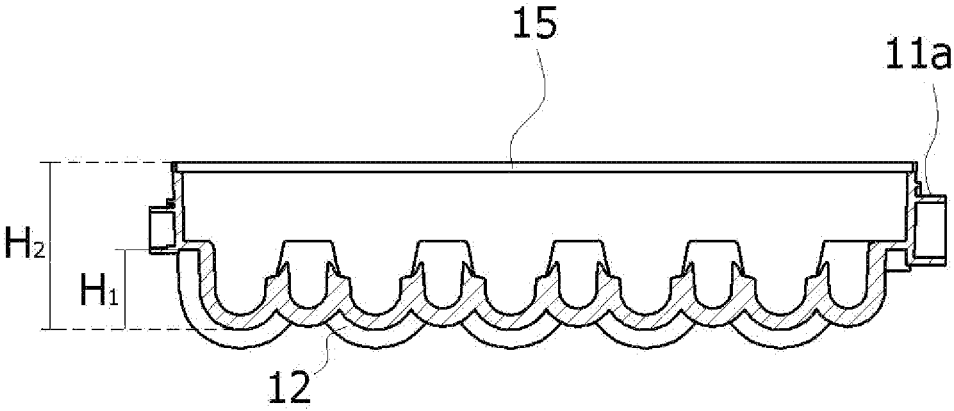


FIG. 17

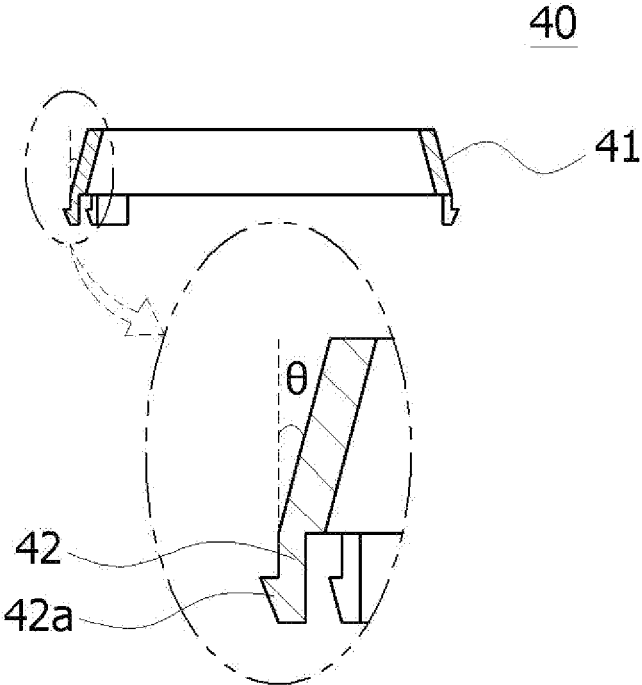


FIG. 18

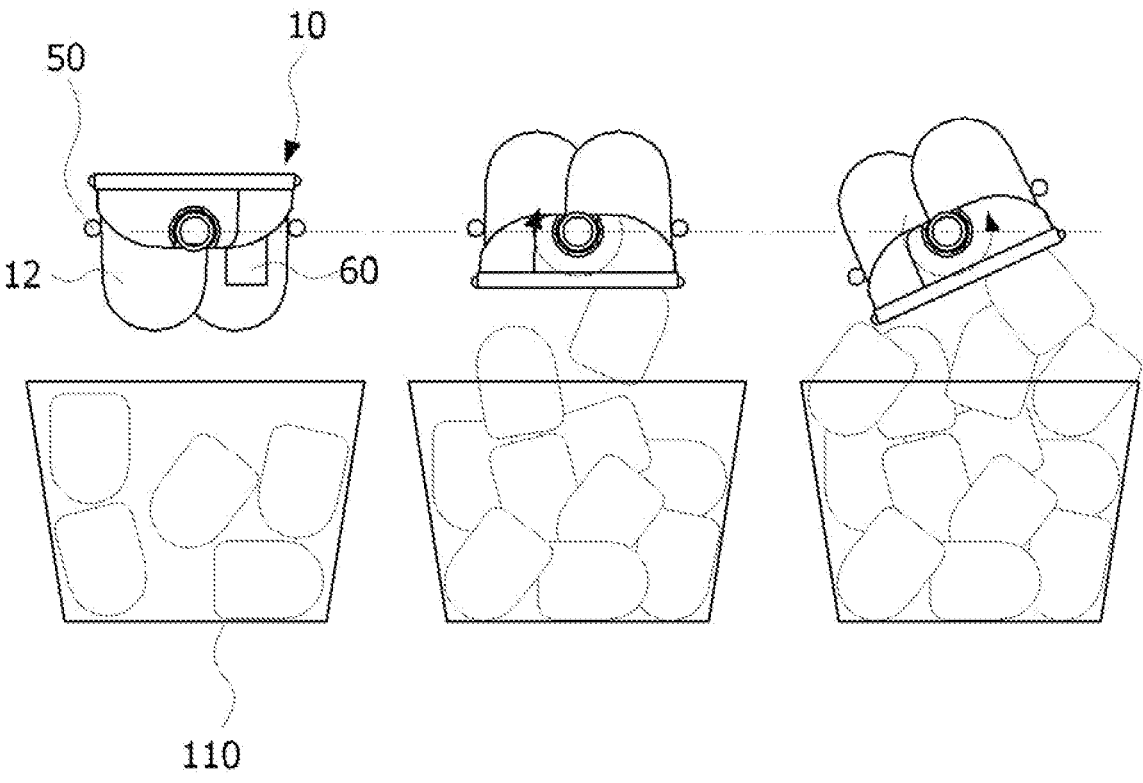


FIG. 19

REFRIGERATOR

CROSS REFERENCE TO RELATED APPLICATION

[0001] The present application claims the benefit of Korean Patent Application No. 10-2022-0112203 filed in the Korean Intellectual Property Office on Sep. 5, 2022 the entire contents of which are incorporated herein by reference.

FIELD OF THE INVENTION

[0002] The present invention relates to a refrigerator.

BACKGROUND

[0003] Generally, a refrigerator is a home appliance used for keeping things cold or frozen by using a refrigeration cycle. The refrigerator includes a body in which a storage room such as a freezing room and a refrigerating room is disposed and a door located on the body to open and close the storage room.

[0004] Refrigerators are largely classified into a top mount refrigerator in which a freezing room is located at the top of a refrigerating room, a bottom freezer refrigerator in which a freezing room is located at the underside of a refrigerating room, and a side by side refrigerator in which a freezing room and a refrigerating room are dividedly located on left and right sides.

[0005] Recently, the capacity of a refrigerator tends to greatly increase, door shelves and accommodation casings are provided even inside the doors to efficiently utilize accommodation spaces in which things are accommodatedly stored, and further, an ice maker is located in the door. The ice produced from the ice maker is supplied to a consumer through a dispenser which is installed on the door.

[0006] Especially, the recent refrigerator includes main doors for opening and closing the storage room and accommodation spaces formed as auxiliary storage rooms inside the main doors, in order to enhance energy efficiency and accessibility to refrigerated foods. Further, sub-doors are rotatably connected to the main doors to allow a user to easily access the accommodation spaces.

[0007] However, the restriction of the main doors in size may fail to allow the accommodation spaces, the dispenser, and the ice maker to be disposed in the main door, all together. If the ice maker and the dispenser are disposed in the main door, it is hard to supply a sufficiently large amount of ice, while the accommodation spaces utilizable on the main doors are being ensured.

SUMMARY OF THE INVENTION

[0008] Accordingly, one or more embodiments of the invention has been made in view of the above-mentioned problems occurring in the related art, and it is an object of the present invention to provide a refrigerator that is configured to have an ice maker capable of supplying a sufficiently large amount of ice, while locating accommodation spaces utilizable on main doors.

[0009] To accomplish the above-mentioned objects, according to an exemplary embodiment, there is provided a refrigerator including: main doors open and closed, while sealing a storage room of the refrigerator, and having accommodation spaces and a dispenser located therein; sub-doors open and closed, while sealing the accommoda-

tion spaces, and connected to the main doors; and an ice making room connected to one side main door to supply water or ice to the dispenser, while being connected to refrigerant pipe of the refrigerator.

[0010] According to an exemplary embodiment, the refrigerant pipe may include: first refrigerant pipe located on the ceiling of the refrigerator; and flexible tubes located between one side main door and the refrigerator and having one end connected to the first refrigerant pipe and the other end connected to the ice making room.

[0011] According to an exemplary embodiment, the ice making room may include: an ice maker connected to the flexible tubes to store water therein and turn the water into ice; a cooling fan disposed spaced apart from the ice maker therein; and an ice bucket located under the ice maker.

[0012] According to an exemplary embodiment, the ice maker may include a tray made of a thermal conductive composite material heated in response to an electric current supplied thereto, while the second refrigerant pipe connected to the flexible tube is located on a lower portion of the tray.

[0013] According to an exemplary embodiment, if the ice is produced in the tray, the tray may rotate toward the ice bucket to separate the produced ice therefrom.

[0014] According to an exemplary embodiment, the flexible tube may have connectors whose both ends are fitted to the first refrigerant pipe and the second refrigerant pipe so that as the tray rotates, the connectors rotate the flexible tubes.

[0015] According to an exemplary embodiment, the refrigerator may further include a draining plate located between the ice maker and the ice bucket to guide the defrosted water produced when the frost of the ice maker is melted to a water tray of the dispenser.

[0016] According to an exemplary embodiment, the refrigerant pipe may include: the first refrigerant pipe located on the ceiling of the refrigerator; the second refrigerant pipe connected to the ice maker located inside the ice making room and filled with a refrigerant; and a heat exchanger located between the first refrigerant pipe and the second refrigerant pipe to perform heat exchange between the first refrigerant pipe and the second refrigerant pipe to allow the refrigerant to be condensed to a fluid.

[0017] According to an exemplary embodiment, the ice maker may include the tray disposed at a lower position than the heat exchanger and coming into contact with the second refrigerant pipe connected to the heat exchanger to perform the heat exchange so that the ice is formed therein.

[0018] According to an exemplary embodiment, the second refrigerant pipe may include a circulation fan disposed between the tray and the heat exchanger to supply the refrigerant changed to a gas phase after the heat exchange with the tray to the heat exchanger.

[0019] According to an exemplary embodiment, one of the accommodation spaces may be located at the top of the dispenser so that when the corresponding sub-door is open, the accommodation space is located at the height of a user's eyes.

[0020] According to an exemplary embodiment, the storage room may include: a refrigerating room to which the main doors are connected; and a freezing room located at the underside of the refrigerating room to supply cold air to the main doors.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] The above and other objects, features and advantages of the present invention will be apparent from the following detailed description of the preferred embodiments of the invention in conjunction with the accompanying drawings, in which:

[0022] FIG. 1 is a front view showing a refrigerator according to an exemplary embodiment;

[0023] FIG. 2 is a perspective view showing one side main door of FIG. 1;

[0024] FIG. 3 is a perspective view showing an example of an accommodation space of FIG. 2;

[0025] FIG. 4 is a perspective view showing another example of the accommodation space of FIG. 2;

[0026] FIG. 5 is a perspective view showing the side surface of the main door of FIG. 2;

[0027] FIG. 6 is a perspective view showing a refrigeration system of the refrigerator of FIG. 1;

[0028] FIG. 7 is a schematic view showing an example of refrigerant pipe connected to an ice maker of FIG. 6;

[0029] FIG. 8 is a perspective view showing the refrigerant pipe connected to the ice maker of FIG. 7;

[0030] FIG. 9 is a perspective view showing a state where the ice maker of FIG. 7 rotates;

[0031] FIG. 10 is a schematic view showing another example of the refrigerant pipe connected to an ice maker of FIG. 6;

[0032] FIG. 11 is a perspective view showing a state where the ice maker of FIG. 10 rotates;

[0033] FIG. 12 is a schematic view showing yet another example of the refrigerant pipe connected to an ice maker of FIG. 6;

[0034] FIG. 13 is a perspective view showing the sub-door of FIG. 2;

[0035] FIG. 14 is a front view showing an ice making room of FIG. 2;

[0036] FIG. 15 is an exploded perspective view showing an ice maker of FIG. 14;

[0037] FIG. 16 is a sectional view showing a tray cut away along the line IV-IV of FIG. 15;

[0038] FIG. 17 is a sectional view showing the tray cut away along the line V-V of FIG. 15;

[0039] FIG. 18 is a sectional view showing a tray cap cut away along the line VI-VI of FIG. 15; and

[0040] FIG. 19 is a perspective view showing an ice separation operation of the ice maker of FIG. 15.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0041] Hereinafter, embodiments of the invention will be described in detail with reference to the attached drawings. It is to be understood that the disclosed embodiments are merely exemplary embodiments of the invention, which can be embodied in various forms. If it is determined that the detailed explanation on the well-known technology related to the present invention makes the scope of the present invention not clear, the explanation will be avoided for the brevity of the description. In the description and drawings, the corresponding parts in the embodiments of the present invention are indicated by corresponding reference numerals.

[0042] In the description, the term ‘coupled’ or ‘connected’, as used herein, is defined as connected, although not

necessarily directly, and not necessarily mechanically. To the contrary, the term ‘directly coupled’ or ‘directly connected’, as used herein, is defined as connected without having any component disposed therebetween. In the description, when it is said that one portion is described as “includes” any component, one element further may include other components unless no specific description is suggested.

[0043] Hereinafter, exemplary embodiments of the invention will be described in detail with reference to the attached drawings.

[0044] FIG. 1 is a front view showing a refrigerator according to an exemplary embodiment.

[0045] Referring to FIG. 1, a refrigerator 200 includes main doors 211 and sub-doors 214. The sub-doors 214 are connected to the main doors 211 to open and close the main doors 211. For example, the sub-doors 214 are made of glass to enable the insides of the main doors 211 to be seen by a user, while being not open by the user. For another example, the sub-doors 214 are made of LCD panels, LED panels, or other display panels, so that the user can obtain information even on the outside of the refrigerator using the sub-doors 214.

[0046] The main doors 211 include accommodation spaces 212 and a dispenser 213 located therein. For example, in the case of the main door 211 with no dispenser, the accommodation spaces 212 are formed on the entire main door 211. Even though the main doors 211 are not open, the user can access refrigerated foods such as beverages that are stored in the accommodation spaces 212, so that the advantages of easy accessibility and energy conservation are provided for the user. For another example, in the case of the main door 211 with the dispenser 213, the accommodation space 212 is located at the top of the dispenser 213. When the sub-door 214 is open, that is, the accommodation space 212 is located at the height of the user’s eyes. The refrigerated foods such as beverages are stored in the accommodation spaces 212, and as the sub-doors 214 are open and closed by the user, he or she can access the refrigerated foods stored in the accommodation spaces 212 more easily. As the main doors 211 closing a storage room 220 are not open, further, an amount of energy consumed can be greatly reduced.

[0047] The dispenser 213 is located at the underside of the accommodation space 212 to supply ice to the user. For example, the dispenser 213 is closed by the sub-door 214. As a result, external pollutants can be prevented from entering the dispenser 213 or the interior of the refrigerator 200 through the dispenser 213. As the dispenser 213 is closed by the sub-door 214, further, heat can be prevented from being transferred to an ice bucket 110 connected to the dispenser 213 or to an internal space of the storage room 220. Accordingly, energy conservation is more efficiently achieved.

[0048] FIG. 2 is a perspective view showing the main door of FIG. 1.

[0049] Referring to FIG. 2, the main door 211 opens and closes the storage room 220, while sealing the storage room 220. If the main door 211 is open, in specific, the storage room 220 is completely open so that the user can easily access the storage room 220, that is, a refrigerating room 221 or a freezing room 222.

[0050] An ice making room 101 is connected to the main door 211. More specifically, the ice making room 101 is

connected to the back of the accommodation space 212. An ice maker 100 and an ice bucket 110 as will be discussed later are located in the ice making room 101.

[0051] The underside of the ice making room 101 is connected to the dispenser 213 to supply the ice stored in the ice bucket 110 of the ice making room 101 to the outside through the dispenser 213.

[0052] FIG. 3 is a perspective view showing an example of the accommodation space of FIG. 2, and FIG. 4 is a perspective view showing another example of the accommodation space of FIG. 2.

[0053] Referring to FIGS. 3 and 4, a first cold air portion 212a and a second cold air portion 212b are formed in the accommodation space 212 of the main door 211. For example, the first cold air portion 212a and the second cold air portion 212b are formed on the surface where the accommodation space 212 comes into contact with the ice making room 101. Cold air is introduced from the first cold air portion 212a and is emitted from the second cold air portion 212b. The accommodation space 212 has a relatively higher temperature than the ice making room 101, and even if the cold air supplied and emitted to and from the ice making room 101 is induced to the accommodation space 212, accordingly, it is possible to refrigerate the accommodation space 212. That is, the temperature of the accommodation space 212 can be adjusted to a temperature above or below zero degree Celsius. Further, the air emitted from the second cold air portion 212b is induced to the refrigerating room 221 or the freezing room 222 to remove the moisture remaining in the accommodation spaces 212, so that the sub-doors 214 can be prevented from being dewy.

[0054] A blowing fan 212c is connected to the first cold air portion 212a. The blowing fan 212c supplies cold air to the accommodation space 212 gently and blows air to allow the internal air of the accommodation space 212 to be circulated well. The internal air of the accommodation space 212 is emitted from the second cold air portion 212b. Further, the moisture in the internal air is removed and then supplied to the accommodation space 212 through the ice making room 101 again. Through such processes, the cold air from which moisture is removed is supplied to the accommodation space 212 to thus prevent the interior of the accommodation space 212 or the sub-door 214 from being dewy owing to a temperature difference.

[0055] FIG. 5 is a perspective view showing the side surface of the main door of FIG. 2.

[0056] Referring to FIG. 5, the ice making room 101 has an insulation layer 102. The interior of the ice making room 101 is kept to a temperature below zero degree Celsius to make and store ice. The temperature of the ice making room 101 is relatively lower than the storage room 220 or the accommodation space 212, and if a lot of moisture exists in the cold air, dew condensation may occur around the ice making room 101 because of a temperature difference. Accordingly, heat transfer is prevented using the insulation layer 102 formed on the ice making room 101, thereby preventing the dew condensation from occurring. More specifically, the insulation layer 102 is a vacuum insulation panel. As a result, the insulation layer 102 is low in thickness to allow the ice making room 101 to be made to a relatively large size. Further, the insulation layer 102 prevents heat loss from occurring to allow the ice making room 101 to perform high-speed ice making.

[0057] The insulation layer 102 is formed between the accommodation space 212 and the ice making room 101. The dew condensation may occur in the accommodation space 212 by the heat received from the ice making room 101. More specifically, the sub-door 214 is open and closed more frequently than the main door 211, so that external air may be easily introduced through the sub-door 214. In this case, the external air has high humidity to cause the accommodation space 212 to be dewy. As mentioned above, the air in the accommodation space 212 is emitted to the freezing room 222 or an evaporator 235 from the second cold air portion 212b, and the cold air having relatively low humidity or the cold air from which moisture is removed is supplied through the second cold air portion 212b from the ice making room 101 to the accommodation space 212, thereby lowering the humidity of the accommodation space 212. Further, the insulation layer 102 blocks the cold heat received from the ice making room 100 to prevent the temperature at the back surface of the accommodation space 212 from being lowered. As a result, the accommodation space 212 can be prevented from being dewy.

[0058] The insulation layer 102 is formed in a direction where the ice making room 101 is oriented toward the storage room 220. For example, the storage room 220 is the refrigerating room 221. In this case, because the temperature of the ice making room 101 is lower than that of the storage room 220, the dew condensation may occur on the surface of the ice making room 101 owing to a temperature difference. Accordingly, the heat transfer to the surface of the ice making room 101 can be prevented using the insulation layer 102, thereby avoiding the occurrence of the dew condensation.

[0059] FIG. 6 is a perspective view showing a refrigeration system of the refrigerator of FIG. 1.

[0060] Referring to FIG. 6, the refrigerator 200 includes the refrigerating room 221 and the freezing room 222, and the refrigerating room 221 is located at the top of the freezing room 222. A refrigeration system 230 is located in the freezing room 222. The refrigeration system 230 circulates a refrigerant, generates cold air by the heat transfer to the surrounding air through the evaporator 235, and supplies the cold air to the freezing room 222 or the refrigerating room 221.

[0061] The refrigeration system 230 includes a condenser 231, a compressor 232, an expansion valve 234, the evaporator 235, a refrigerant pipe 236 connecting the components with one another.

[0062] The refrigeration system 230 serves to allow the compressor 232 to compress a refrigerant to a high temperature and a high pressure and allow the condenser 231 to perform heat emission so that the refrigerant is changed to a low-temperature and high-pressure state. After that, the refrigerant is changed to a low-temperature and low-pressure state using the expansion valve 234, and the refrigerant has heat exchange with the surrounding air using the evaporator 235, so that the refrigerant is changed to a gas phase from a two-phase. In this process, the cold air for cooling the surrounding air is generated from the evaporator 235 and thus supplied to the refrigerating room 221 and the freezing room 222.

[0063] The refrigerant pipe 236 connects the condenser 231, the compressor 232, the expansion valve 234, and the evaporator 235 in the refrigerator 200 with one another, thereby completing a refrigeration cycle.

[0064] Refrigerant pipe 250 is connected to the refrigerant pipe 236. For example, the refrigerant pipe 250 is connected to the refrigerant pipe 236 between the expansion valve 234 and the evaporator 235. The refrigerant pipe 250 is connected to the upper portion of the refrigerator 200 along the side and rear surfaces of the refrigerator 200 and thus extend up to the ice making room 101 connected to the main door 211. That is, the refrigerant at the low-temperature and low-pressure liquid phase is supplied directly to the ice making room 101 through the refrigerant pipe 250, thereby making it possible to produce a substantially large amount of ice because of high-speed ice making.

[0065] The refrigerant pipe 250 includes first refrigerant pipe 251 and flexible tubes 256. The first refrigerant pipe 251 is directly connected to the refrigerant pipe 236 and extended up to a portion where the main door 211 comes into contact with the refrigerator 200.

[0066] The first refrigerant pipe 251 is a first refrigerant supply pipe 251a and a first refrigerant emission pipe 251b. For example, the first refrigerant supply pipe 251a is connected to the refrigerant pipe 236 between the expansion valve 234 and the evaporator 235. The first refrigerant emission pipe 251b is connected to the refrigerant pipe 236 between the evaporator 235 and the compressor 232. As a result, the refrigerant generated from the refrigeration system 230 is directly supplied to the ice making room 101, thereby making it possible to produce a substantially large amount of ice because of high-speed ice making.

[0067] The flexible tubes 256 are located between the refrigerator 200 and the main door 211 to connect the first refrigerant pipe 251 to the ice making room 101. For example, the flexible tubes 256 may be made of nylon, polyamide, or the like. Even if the main door 211 is open and closed, the flexible tubes 256 stably supply the refrigerant supplied from the corresponding first refrigerant supply pipe 251a to the ice making room 101 and stably emit the refrigerant emitted from the ice making room 101 to the first refrigerant emission pipe 251b. Even if the flexible tubes 256 are twisted, further, they can stably connect the first refrigerant pipe 251 and the ice making room 101 to each other. As a result, the supply and emission of the refrigerant between the refrigerator 200 and the main door 211 can be stably performed.

[0068] FIG. 7 is a schematic view showing an example of the refrigerant pipe connected to the ice maker of FIG. 6. FIG. 8 is a perspective view showing the refrigerant pipe connected to the ice maker of FIG. 7, and FIG. 9 is a perspective view showing a state where the ice maker of FIG. 7 rotates.

[0069] Referring to FIGS. 7 to 9, the ice maker 100 is located inside the ice making room 101. Second refrigerant pipe 252 is connected to a lower portion of the ice maker 100. The second refrigerant pipe 252 is connected to the first refrigerant pipe 251 via the flexible tubes 256. For example, the second refrigerant pipe 252 is connected to the flexible tubes 256 and the first refrigerant pipe 251 is connected to the flexible tubes 256 with pipe connection portions. The flexible tubes 256 may be expanded in length or twisted by the opening and closing of the main door 211 and the rotation of the ice maker 100. In this case, the pipe connection portions serve to firmly connect the second refrigerant pipe 252 and the first refrigerant pipe 251 to the flexible tubes 256, thereby preventing the refrigerant from leaking to the outside.

[0070] The ice maker 100 is connected to a motor 20. For example, the ice maker 100 rotates by the motor 20 to separate ice therefrom. In this case, the second refrigerant pipe 252 is located reversely in position to cause the flexible tubes 256 to become twisted to each other.

[0071] More specifically, the second refrigerant pipe 252 is a second refrigerant supply pipe 252a and a second refrigerant emission pipe 252b connected to the first refrigerant supply pipe 251a and the first refrigerant emission pipe 251b via the flexible tubes 256. In a state where the ice maker 100 is located at a fixed position, that is, in a state where the ice maker 100 stores water supplied from the refrigerator 200 to turn the water into ice, the flexible tubes 256 between the first refrigerant pipe 251 and the second refrigerant pipe 252 may not be bent or twisted at all, thereby allowing the refrigerant to flow gently. If the ice maker 100 rotates to separate ice therefrom, the second refrigerant supply pipe 252a is changed in position to the second refrigerant emission pipe 252b, and the second refrigerant emission pipe 252b is changed in position to the second refrigerant supply pipe 252a. As the ice maker 100 rotates, further, the second refrigerant pipe 252 located at the lower portion of the ice maker 100 are changed in height. That is, the second refrigerant pipe 252 is changed in height and position. In this case, the first refrigerant supply pipe 251a and the first refrigerant emission pipe 251b are fixed in position, and accordingly, even if the flexible tubes 256 are twisted to change the second refrigerant pipe 252 in position, the first refrigerant pipe 251 and the second refrigerant pipe 252 are stably connected to each other. As the flexible tubes 256 are twisted to each other, their inner diameters may be reduced, but the refrigerant can still flow through the flexible tubes 256 stably.

[0072] FIG. 10 is a schematic view showing another example of the refrigerant pipe connected to the ice maker of FIG. 6, and FIG. 11 is a perspective view showing a state where the ice maker of FIG. 10 rotates.

[0073] Referring to FIGS. 10 and 11, a heat exchanger 280 is located between the first refrigerant pipe 251 and the second refrigerant pipe 252. For example, the first refrigerant pipe 251 and the second refrigerant pipe 252 are indirectly connected to each other via the heat exchanger 280. That is, the first refrigerant pipe 251 and the second refrigerant pipe 252 have heat exchange with each other using the heat exchanger 280. More specifically, the first refrigerant supply pipe 251a is connected to the heat exchanger 280 and connected to the first refrigerant emission pipe 251b at the inside of the heat exchanger 280. That is, the heat exchanger 280 has a first connector 251c adapted to connect the first refrigerant supply pipe 251a and the first refrigerant emission pipe 251b to each other. For example, the first connector 251c extends a flow path along which the refrigerant supplied from the first refrigerant supply pipe 251a remains long and thus has heat exchange in the heat exchanger 280. More specifically, the first connector 251c is located in a zigzag form inside the heat exchanger 280.

[0074] The second refrigerant pipe 252 is connected to the heat exchanger 280. The second refrigerant pipe 252 is located between the first refrigerant supply pipe 251a and the first refrigerant emission pipe 251b. For example, the second refrigerant pipe 252 is located close to the first connector 251c. As a result, a heat exchange efficiency can be greatly improved.

[0075] The second refrigerant pipe 252 is rotatably connected to the heat exchanger 280. For example, as the ice maker 100 rotates, ice is separated from the ice maker 100. When the ice maker 100 rotates, the second refrigerant pipe 252 rotates together. In this case, the second refrigerant pipe 252 connected to the heat exchanger 280 has heat exchange stably, while rotating in a state of being connected to the heat exchanger 280.

[0076] The second refrigerant pipe 252 is filled with the refrigerant. For example, if the refrigerant has heat exchange inside the heat exchanger 280, the refrigerant is changed to a fluid phase and naturally flows to a low position. That is, the first refrigerant pipe 251 and the heat exchanger 280 are located at a higher position than the second refrigerant pipe 252, and accordingly, the refrigerant, which is changed to the fluid phase inside the second refrigerant pipe 252, naturally flows to a low position because of gravity. The ice maker 100 connected to the second refrigerant pipe 252 is located at a relatively low position, and accordingly, the refrigerant, which is changed to the fluid phase inside the second refrigerant pipe 252, flows to the ice maker 100. In this case, the refrigerant has heat exchange with the water stored in the ice maker 100 so that it is changed to a gas phase. The refrigerant, which is changed to the gas phase, naturally moves to a higher position, that is, to the heat exchanger 280. The refrigerant changed to the gas phase is changed to a fluid phase again inside the heat exchanger 280 through heat exchange, so that the ice maker 100 and the heat exchanger 280 continuously and repeatedly have the heat exchange with each other. In this case, the second refrigerant pipe 252 has to have a height difference from the first refrigerant pipe 251 and the heat exchanger 280, and the refrigerant located inside the second refrigerant pipe 252 being located at the low position has a relatively high temperature, is changed to the gas phase by the absorption of heat, and moves to the high position. Next, the refrigerant located inside the heat exchanger 280 and the first refrigerant pipe 251 being located at the high position has a relatively low temperature, is changed to the fluid phase by the heat exchange with the refrigerant changed to the gas phase inside the second refrigerant pipe 252, and naturally flows.

[0077] The second refrigerant pipe 252 may be formed of the flexible tube 256. For example, if the ice maker 100 rotates, the second refrigerant pipe 252 is changed in height. That is, the second refrigerant pipe 252 is located relatively close to the heat exchanger 280. In this case, even if the second refrigerant pipe 252 formed of the flexible tube 256 is twisted, the refrigerant can be prevented from leaking to the outside from the second refrigerant pipe 252.

[0078] FIG. 12 is a schematic view showing yet another example of the refrigerant pipe connected to the ice maker of FIG. 6.

[0079] Referring to FIG. 12, the first refrigerant pipe 251 and the second refrigerant pipe 252 are connected to the heat exchanger 280. For example, the first refrigerant supply pipe 251a and the first refrigerant emission pipe 251b are connected to each other inside the heat exchanger 280 via the first connector 251c. The second refrigerant supply pipe 252a and the second refrigerant emission pipe 252b are connected to each other inside the heat exchanger 280 with a second connector 252c. The first connector 251c and the second connector 252c are located close to each other to allow the heat exchange between them to be more effectively

performed. The first connector 251c and the second connector 252c are located in a zigzag form to improve their heat exchange efficiency. The first connector 251c and the second connector 252c are located to cross each other. That is, the first refrigerant supply pipe 251a, the second refrigerant emission pipe 252b, the first refrigerant emission pipe 251b, and the second refrigerant supply pipe 252a, are located in order mentioned, and the first connector 251c connecting the first refrigerant supply pipe 251a and the first refrigerant emission pipe 251b to each other and the second connector 252c connecting the second refrigerant supply pipe 252a and the second refrigerant emission pipe 252b to each other are located to cross each other. As a result, the heat exchange inside the heat exchanger 280 can be more efficiently performed.

[0080] The second refrigerant pipe 252 may be formed of the flexible tubes 256. For example, if the ice in the ice maker 100 is separated by the rotation of the ice maker 100, the second refrigerant pipe 252 rotates in a fixed state to the first refrigerant pipe 251 according to the rotation of the ice maker 100, and in this case, the second refrigerant pipe 252 formed of the flexible tubes 256 are twisted.

[0081] FIG. 13 is a perspective view showing the sub-door of FIG. 2.

[0082] Referring to FIG. 13, the sub-door 214 has an opening 214a formed on the space corresponding to the dispenser 213. In this case, normally, the dispenser 213 is in an open state. When the ice or purified water is taken from the dispenser 213, accordingly, the number of unnecessary opening and closing times of the sub-door 214 can be reduced, thereby enhancing the energy efficiency. Further, the frequent opening and closing of the sub-door 214 causes the accommodation space 212 to be dewy, and accordingly, the closed time of the accommodation space 212 is ensured to the maximum, thereby reducing the possibility of dew condensation.

[0083] For another example, the sub-door 214 opens the portions corresponding to the accommodation space 212 and the dispenser 213, respectively. For example, the sub-door 214 is divided into upper and lower sub-doors. The upper sub-door 214 opens the accommodation space 212. The lower sub-door 214 opens the dispenser 213. In this case, the pollutants entering the dispenser 213 can be reduced, the heat transfer generated through the dispenser 213 can be blocked, and the accommodation space 212 is kept in a closed state, thereby enhancing the energy efficiency.

[0084] FIG. 14 is a front view showing the ice making room of FIG. 2, and FIG. 15 is an exploded perspective view showing the ice maker of FIG. 14.

[0085] Referring to FIGS. 14 and 15, the ice making room 101 has the ice maker 100 and the ice bucket 110 disposed therein.

[0086] The ice bucket 110 is disposed under the ice maker 100 to store the ice produced and separated from the ice maker 100. The stored ice is supplied to the dispenser 213.

[0087] The ice maker 100 includes a tray 10 and a frame part 30.

[0088] Water is supplied to tray 10 and the supplied water turns into ice. The tray 10 includes a tray body 11 and ice making parts 12. Ice making parts 12 may be referred to as ice making holders 12. Further, the tray 10 is located inside the frame assembly 30 and rotatably connected to the frame assembly 30. For example, the tray 10 has connectors 11a protruding outward from both side surfaces of the tray body

11. The connectors 11a are fittedly connected to the frame assembly 30 to allow the tray 10 to be rotatably supported against the frame assembly 30. For another example, the tray 10 has connection grooves formed on both side surfaces of the tray body 11, and connectors formed on both side surfaces of the frame assembly 30 are fitted to the connection grooves of the tray 10.

[0089] A rotation space 18 is formed between the frame assembly 30 and the tray 10. For example, a radius of rotation is formed around a rotating axis 19 formed by the connectors 11a of the tray 10, and the radius of rotation has a relation with depths of the ice making parts 12, that is, sizes of the ice making parts 12. The rotation space 18 enables the tray 10 to rotate gently through the rotation space 19. Further, this allows checking whether the insides of the frame assembly 30 and the tray 10 become dirty with the naked eye.

[0090] The ice making parts 12 protrude downward from the underside of the tray body 11. The number of ice making parts 12 is plural. Water is supplied to the ice making parts (ice making holders) 12 and the water turns into pieces of ice because of the cold air supplied to the ice making parts (ice making holders) 12. The shapes of the pieces of ice are determined on the inner shapes of the ice making parts (ice making holders) 12. The sectional shapes of the insides of the ice making parts (ice making holders) 12 are freely made to produce the pieces of ice having various shapes. For example, the ice making parts (ice making holders) 12 may have sectional shapes of star, square, circle, triangle, character, and the like. Further, different sectional shapes are combinedly provided to produce pieces of ice having various shapes from one tray.

[0091] The plurality of ice making parts (ice making holders) 12 are arranged inside the tray 10 in a zigzag manner. For example, if the ice making parts 12 are disposed in two rows, one row ice making parts 12 are arranged, and the other row ice making parts 12 are arranged in a misaligned manner with one row ice making parts 12, so that between the neighboring one row ice making parts 12, the other row ice making parts 12 are positioned. In this case, the tray 10 can be reduced in size, while the size of ice is being still maintained. Further, an area to which the cold air is supplied can be collectively formed to improve an ice making efficiency.

[0092] Moving parts 13 are formed between the neighboring ice making parts 12 to connect them to each other. Through the moving parts 13, that is, the water supplied to the tray 10 is stored in any one ice making part 12 and sequentially moved to other ice making parts 12. As a result, while the flow of water supplied to the tray 10 is being induced, the amount of water stored in the ice making parts 12 is adjusted, and further, the overflow of water, which may occur when the water is freely filled in the tray 10, is prevented. More specifically, the moving parts 13 are obliquely formed between the neighboring ice making parts 12. Through the moving parts 13, the supplied water is filled into the zigzag-arranged ice making parts 12 sequentially, and if a motion or impact occurs on an object connected to the frame assembly 30, for example, if the refrigerating room door 220 is open, further, the moving parts 13 prevent the water from overflowing to the outside of the tray 10.

[0093] The tray 10 is made of a high thermal conductive composite material. An electric current is supplied to the high thermal conductive composite material, and through

the heat generated from the high thermal conductive composite material, accordingly, the pieces of ice are separated from the inner surfaces of the ice making parts 12, respectively. More specifically, the bigger the ice making parts 12 become, the bigger the pieces of ice become. If the inner depths of the ice making parts 12 are increased, the pieces of ice become long. Accordingly, the ice making parts 12, which are made of the high thermal conductive composite material from which heat is emitted, apply the heat to the surfaces of the pieces of ice, so that the pieces of ice are separated from the ice making parts 12 more easily. The tray 10 rotates, and the pieces of ice separated from the ice making parts 12 fall down freely, thereby making it possible to more easily separate the pieces of ice from the ice making parts 12.

[0094] For example, the high thermal conductive composite material is made of any one polymer selected from carbon fiber, a carbon nanotube, a graphene, and a metal-containing polymer or a combination thereof. That is, the tray 10 improves thermal conductivity and emits heat therefrom through electrodes 50. The tray 10 is connected to the electrodes 50 for supplying the electric current to the high thermal conductive composite material. For example, the refrigerator power line (not shown) and the electrode 50 may be connected.

[0095] The tray 10 to which the electric current is supplied from the electrodes 50 emits heat. The electrodes 50 are disposed at the left and right sides with respect to the ice making parts 12, while being close to the portions where ice is made. Because the heating is generated between the two electrodes 50, that is, the two electrodes 50 are desirably located, while placing the ice making parts 12 therebetween.

[0096] Each electrode 50 includes a covered electrical wire formed of a bundle of wires. As the electrical wire is formed of the bundle of wires with relatively high flexibility, that is, the electrode 50 ensures good durability in spite of frequent rotations of the electrical wire. For example, the tray 10 is located fixedly, and if ice making on the ice maker 100 is finished, the tray 10 rotates. Next, the electric current is supplied to the electrodes 50 to allow heat to be emitted from the high thermal conductive composite material. That is, electric circuit connection is made according to the locations of the tray 10. For example, if the tray 10 rotates to its original position after the ice making of the ice maker 100 has been finished and the ice has been separated from the tray 10, the supply of the electric current stops. The supply of the electric current is controlled according to the changes in position of the tray 10, without having any additional control device, thereby making the ice maker 100 simplified in a configuration.

[0097] A tray cap 40 is connected to the tray 10. The tray cap 40 is located between the tray 10 and the frame assembly 30. The tray cap 40 includes a guard part 41 and tray connectors 42. The tray connectors 42 protrude downward from the guard part 41 in a direction toward the tray 10 and are thus fitted to fitting grooves 11c formed on the tray body 11 of the tray 10 to allow the tray 10 and the tray cap 40 to be connected to each other.

[0098] The guard part 41 is slantly formed toward the inside of the tray 10. The guard part 41 is adapted to induce water in the direction toward the inside of the tray 10 if a motion or impact occurs on an object connected to the frame assembly 30, for example, if the refrigerating room door 220 is open, to cause the water filled in the tray 10 to splash by

inertia, and accordingly, the guard part 41 prevents the water from overflowing to the outside of the tray 10.

[0099] A motor 20 is located at the outside of the frame assembly 30 and connected to the tray 10. Between the motor 20 and the tray 10 is located the frame assembly 30. That is, the motor 20 serves to transfer power to the tray 10 rotatably connected supportedly to the frame assembly 30 and thus allows the tray 10 to rotate. For example, the motor 20 rotates the tray 10 to an angle of 90° or more. For example, the motor 20 rotates the tray 10 to an angle in the range between 100 and 180°. Through the rotation, the ice made inside the tray 10 freely falls down by gravity, and through the smooth rotation of the tray 10 even in a narrow space, it is possible to separate the ice made in the tray 10 from the tray 10.

[0100] The motor 20 is connected to the connector 11a formed on one side of the tray 10. The connector 11a of the tray 10, which is connected to the motor 20, further includes a motor connector 11a with a given angle. That is, while the connectors 11a are being circular and connected to the frame assembly 30, the motor connector 11a is connected to the motor 20. Accordingly, the rotary force generated from the motor 20 is more stably transferred to the tray 10.

[0101] The frame assembly 30 determines the entire shape of the ice maker 100. That is, the tray 10 and the tray cap 40 excepting the motor 20 are located inside the frame assembly 30. Accordingly, only the frame assembly 30 is connected to the refrigerating room door 220 to stably fix the ice maker 100 to the refrigerating room door 220, and as the tray 10 rotates, in the state where the ice maker 100 is stably fixed to the refrigerating room door 220, the ice made in the tray 10 is separated from the tray 10 by free falling. That is, the ice maker 100 is simple in configuration and needs only the rotation of the tray 10, thereby ensuring high durability. Further, the frame assembly 30 whose front surface is open to allow the tray 10 located therein to be checked with the naked eye. As a result, the interior of the frame assembly 30 and the normal operation of the tray 10 or the tray cap 40 can be checked with the naked eye, thereby making it easy to perform the maintenance of the ice maker 100.

[0102] The frame assembly 30 includes a frame 31, supports 33, and a guide part 35. The frame 31 extends in a longitudinal direction of the frame assembly 30, and the supports 33 are disposed on both sides of the frame 31. The frame 31 includes an attachment plate 32. The attachment plate 32 comes into contact with the refrigerating room door 220 or a position at which the ice maker 100 is located. The attachment plate 32 has a plurality of attachment holes 32a formed thereon to connect the ice maker 100 to the refrigerating main door 211.

[0103] Further, a plurality of ribs 34 are located between the frame 31 and the attachment plate 32. For example, the frame 31 and the attachment plate 32 are connected vertically to each other, and the plurality of triangular ribs 34 are connected between the frame 31 and the attachment plate 32. The ribs 34 are located in a direction toward the tray 10. Through the ribs 34, accordingly, the frame 31 and the attachment plate 32 are more strongly coupled to each other, and further, the ice making parts 12 can be prevented from escaping from the refrigerating main door 211 or being damaged owing to external impacts.

[0104] The supports 33 are located on both sides of the tray 10 and fittedly coupled to the tray 10. The tray 10 has the connectors 11a protruding therefrom toward the supports

33. Through the coupling between the connectors 11a and the supports 33, accordingly, the rotating axis 19 of the tray 10 is formed, and the tray 10 rotates around the rotating axis 19.

[0105] The supports 33 are semi-circularly rounded toward the front side of the frame assembly 30, that is, toward the body 210 of the refrigerator 200. Further, each support 33 has an extension portion 36 extending from the center thereof and increasing in width as it becomes close to the frame 31 of the frame assembly 30. Accordingly, the structural stiffness of the frame assembly 30 can be more improved.

[0106] The guide part 35 is located on top of the frame 31. The guide part 35 includes an inclined injection portion 35a formed therein. The injection portion 35a becomes narrow in area as it goes toward the tray 10 and is open toward the tray 10. Through the injection portion 35a, accordingly, the water supplied through the water supply hose 250 is induced to the tray 10, and as the water is supplied to the tray 10 in a state of being stored in the guide part 35, the water can be supplied to the tray 10 to a constant speed.

[0107] FIG. 16 is a sectional view taken along the line IV-IV of FIG. 15, and FIG. 17 is a sectional view taken along the line V-V of FIG. 15.

[0108] Referring to FIGS. 16 and 17, the tray 10 includes the tray body 11, the ice making parts 12, and tray walls 15. The connectors 11a protrude outward from both sides of the tray body 11. The ice making parts 12 are arranged in the tray body 11 in the zigzag manner (zigzag formation).

[0109] Further, the tray walls 15 are formed on the outer surfaces of the tray body 11. The tray walls 15 are higher than the ice making parts 12 to prevent the water filled in the tray 10 from overflowing when the refrigerating room door 220 moves or external impacts are applied to cause the water filled in the tray 10 to splash. More specifically, heights H₂ of the tray walls 15 are higher by 1.5 to 3 times than heights H₁ of the ice making parts 12. For example, if the refrigerating main door 211 is closed at a very fast speed to apply inertia to the water filled in the tray 10, the water moves along the tray walls 15 and falls down inside the tray 10 again by gravity, thereby being prevented from overflowing to the outside of the tray 10.

[0110] Further, the tray 10 includes curved surfaces 17 concavely formed from the tray walls 15 to the ice making parts 12. The curved surfaces 17 are formed in the range from the tray walls 15 to the ice making parts 12 in the direction of the inside of the tray 10. For example, the curved surfaces 17 are concavely formed. As mentioned above, when the water moves by inertia, it moves along the curved surfaces 17. In this case, the concave curved surfaces 17 increase the moving path of the water to thus decrease the moving speed of the water. Further, the curved surfaces 17 form one side surface of each ice making part 12, and if the pieces of ice are made in the ice making parts 12, accordingly, the entire stiffness of the tray 10 may be increased. For another example, the curved surfaces 17 may be convexly formed. Otherwise, the curved surfaces 17 may be concavely and convexly formed alternately. Accordingly, the moving path of the water can be more increased.

[0111] Temperature detecting sensors 60 are connected to the underside of the tray 10 or the side surface of the lower portion of the tray 10. For example, the temperature detecting sensors 60 are fitted to tray holders located at the lower portions of the ice making parts 12 of the tray 10 and thus

connected to the tray 10. The temperature detecting sensors 60 serve to control the rotation of the tray 10 and the water supplied to the tray 10.

[0112] The temperature detecting sensors 60 generate signals for controlling the operation of the ice maker 100 and thus transmit the signal to a controller of the refrigerator 200. For example, the temperature detecting sensors 60 measure the temperatures at the insides of the ice making parts 12. If ice making is finished, the inner temperatures of the ice making parts 12 are below zero degree Celsius. Accordingly, it can be determined whether ice is made in the ice making parts 12. For another example, the temperature detecting sensors 60 measure temperature differences. That is, the temperature detecting sensors 60 measure a difference between a temperature when water is filled in the ice making parts 12 and a temperature when ice is made in the ice making parts 12. More specifically, as the mean temperature of the water supplied from the water supply hose 250 of the refrigerator is above zero degree Celsius, water is filled into the ice making parts 12 so that the inner temperatures of the ice making parts 12 become above zero degree Celsius. After that, if ice making is finished in the ice making parts 12, the inner temperatures of the ice making parts 12 become below zero degree Celsius. If the inner temperatures of the ice making parts 12 are 10 degrees below zero degree Celsius, a temperature difference in the ice making parts 12 is in the range between 10 and 30° C. Like this, the temperature detecting sensors 60 detect whether ice is made in the ice making parts 12 through the temperature difference.

[0113] If it is determined that the ice making is finished in the ice making parts 12, the temperature detecting sensors 60 transmit signals for separating the ice from the ice making parts 12. For example, if it is determined that the ice making is finished in the ice making parts 12, the temperature detecting sensors 60 transmit signals for transmitting electric current to the electrodes 50, so that heat is emitted from the tray 10. After that, if the ice is spaced apart from the inner surfaces of the ice making parts 12, the temperature detecting sensors 60 transmit signals for rotating the tray 10 to separate the ice from the tray 10. Further, if the insides of the ice making parts 12 are empty after the ice separation, the temperature detecting sensors 60 transmit signals for supplying water.

[0114] The temperature detecting sensors 60 are connected to the tray 10. For example, the temperature detecting sensors 60 are connected to the ice making parts 12 divided by section to detect the inside states of the ice making parts 12. More specifically, the ice making parts 12 have various shapes, and accordingly, the pieces of ice made in the ice making parts 12 are free in size. As a result, the ice making parts 12 are sorted by section, and the temperature detecting sensors 60 are disposed on the sections, respectively. Accordingly, the temperature detecting sensors 60 detect whether ice is made in the ice making parts 12 or not more accurately, thereby preventing water from pouring into the ice bucket 110 in a state where the water does not turn into ice.

[0115] The electrodes 50 are disposed on both sides of the tray body 11. For example, the electrodes 50 are located under the tray walls 15. Generally, the ice making parts 12 whose sectional areas become narrow as they are distant away from the tray 10, and accordingly, the electrodes 50 are disposed at starting positions where the ice making parts 12

whose sectional areas are biggest to melt the surfaces of the pieces of ice formed on tops of the ice making parts 12, so that the pieces of ice naturally escape from the ice making parts 12. For another example, the electrodes 50 may be located on the moving parts 13 between the neighboring ice making parts 12. In the case where the water filled in the tray 10 turns into ice, the ice is formed even on the moving parts 13 to connect the pieces of ice made in the ice making parts 12 to one another. In this case, a lump of ice may be made irrespective of the shapes of the ice making parts 12, so that the lump of ice may apply an impact to the ice bucket 110 because of its size when separated from the tray 10 and freely falls. To avoid such a problem, accordingly, the electrodes 50 are located on the moving parts 13, and the pieces of ice produced according to the shapes of the ice making parts 12 are supplied to the ice bucket 110, thereby transferring the pieces of ice to the ice bucket 110 more easily and reducing the weight and impact applied to the ice bucket 110. For yet another example, the electrodes 50 are located on the undersides of the ice making parts 12. The higher the heights H_1 of the ice making parts 12 are, that is, the longer the depths of the ice making parts 12 are, the longer the pieces of ice become. In this case, the longer the depths of the ice making parts 12 are, the stronger the contact forces between the ice making parts 12 and the pieces of ice become. Accordingly, while the electrodes 50 are being not seen from the outside, they are located close to the ice making parts 12. That is, the electrodes 50 are located on the undersides of the ice making parts 12 to allow heat to be generated from the portions where the contact forces between the inner surfaces of the ice making parts 12 and the pieces of ice are strong, thereby enabling the pieces of ice from escaping from the ice making parts 12 more easily.

[0116] FIG. 18 is a sectional view taken along the line VI-VI of FIG. 15.

[0117] Referring to FIG. 18, the guard part 41 of the tray cap 40 is inclinedly formed in the direction toward the inside of the tray 10. In this case, the guard part 41 has an inclination θ in the range between 5 and 90°. For example, the water moving along the curved surfaces 17 of the tray 10 moves to the tray walls 15 as the moving speed thereof is decreased. In this case, the water moves along the guard part 41 inclined in the direction toward the inside of the tray 10 and then moves between the tray 10 and the tray cap 40 as if it swirls. Through the formation of the guard part 41, accordingly, even water to which a substantially high inertial force is applied can be prevented from overflowing to the outside of the ice maker 100.

[0118] The guard part 41 may be changed in shape by the transfer of the ice. For example, the guard part 41 is made of silicone. In addition to prevent water from overflowing, accordingly, the guard part 41, which is made of a soft material, does not interfere with the hard ice transferred.

[0119] The tray connectors 42 are formed in a direction from the guard part 41 to the tray 10 and have protrusions 42a protruding from one side thereof to be lockedly fitted to the tray 10. Accordingly, the tray 10 and the tray cap 40 can be more tightly coupled to each other.

[0120] FIG. 19 is a perspective view showing an ice separation operation of the ice maker of FIG. 15.

[0121] Referring to FIG. 19, the tray 10 of the ice maker 100 rotates around the rotating axis 19 formed by the connectors 11a. In this case, the ice freely falls into the ice

bucket **110**. Through the free falling, accordingly, there is no need for providing an additional space for an ice moving pipe for moving the ice down. As a result, the ice making parts **12** of the tray **10** can be increased in size by the space made by separating the additional space, thereby allowing the tray **10** having a larger amount of ice than the trays in other ice makers that separate ice using an ejector, without any rotation.

[0122] For example, while the tray **10** rotates to move the ice to the ice bucket **110** by free falling, if the ice is full in the ice bucket **110**, the tray **10** does not rotate by the ice and detects a full ice state. According to a case wherein the tray **10**, to which a rotary force is transferred, does not rotate by a desired degree to apply a load to the motor **20** and a case wherein the tray **10** does not rotate to a desired degree or does not return to its original position after rotating to the desired degree, a degree of full ice is measured. More specifically, if the tray **10** does not twist by a desired angle upon ice separation, the tray **10** returns to its original position and stops ice making. Further, if the tray **10** is locked onto the ice and does not return to its original position after the ice separation through its rotation, the tray **10** recognizes the full ice state and stops ice making. After that, if the ice is used, the height of ice accumulated in the ice bucket **110** is reduced, and accordingly, the tray **10** tries to return to its original position by periodic operation of the motor **20**.

[0123] More specifically, if it is defined that the rotation of 180° of the tray **10** is a forward rotation with respect to the normal state (0°) of the tray **10**, a rotation in a direction from a position of 180° to a position of 0° is a reverse rotation. Further, the time required from the position of 0° to the position of 180° or from the position of 180° to the position of 0° is called set time.

[0124] For example, in the case where it is determined that the ice making in the ice making parts **12** is finished through the temperature detection sensors **60**, if electricity is applied to the motor **20**, the tray **10** performs the forward rotation of 180°, and if the tray **10** reaches the position of 180° within the set time, the electric current is increased. In this case, the tray **10** stops, and the electricity is applied to the ice maker **100** during given time to heat the tray **10**, so that the ice making parts **12** are heated to melt the pieces of ice made therein to allow the pieces of ice to freely fall down. If the temperature of the tray **10** is increased, the supply of electric current to the tray **10** is stopped to thus rotate the tray **10** reversely through the motor **20**. In this case, if a load is increased before the set time needed for the rotation, it is determined that the tray **10** is locked onto the ice because of full ice, and next, the supply of water to the ice maker **100** is stopped to allow the tray **10** to rotate forwardly again to the position of 180°. The reverse rotation is periodically tried, and if the tray **10** reaches the position of 0° within the set time to thus increase the load, the full ice state is released, so that water is supplied again to the ice maker **100** to perform ice making.

[0125] For another example, in the case where it is determined that the ice making in the ice making parts **12** is finished through the temperature detection sensors **60**, if electricity is applied to the motor **20**, the tray **10** rotates forwardly to increase a load current within the time shorter than the set time, full ice is determined.

[0126] In this case, the tray **10** rotates reversely and reaches the position of 0°. If the tray **10** periodically rotates

forwardly to increase the load within the set time, the tray **10** reaches the position of 180°, and in this case, electricity is applied to the tray **10** to heat the tray **10**, so that ice separation is performed. After the ice separation, if the tray **10** twists reversely to increase the load within the set time, water is continuously supplied to perform ice making. If the load is increased before the set time during the reverse rotation at the position of 180°, full ice is determined, and in this case, the tray **10** rotates forwardly again to reach the position of 180° and stops. The tray **10** periodically tries to rotate reversely, and if the tray **10** reaches the position of 0° within the set time to increase the load, the full ice state is released, so that water is supplied again to the ice maker **100** to perform ice making.

[0127] That is, the ice maker **100** detects ice separation and full ice through the principle of the rotation of the motor **20**, not through a mechanism or optical sensor for detecting full ice.

[0128] Further, the ice maker **100** detects the full ice more reliably through the entire tray **10** mechanically rotating, than that through a shut-off arm, ball wire, or an optical sensor that just detects the full ice on portions thereof. That is, if the full ice is detected through the rotation of the tray **10** itself, the entire three-dimensional space of the ice maker **100** is sensed, thereby removing detection errors, and without any additional sensor, further, a control logic can be made only with the load of the motor. In the existing full ice detection method wherein a gear structure is additionally provided to an ice separation motor to perform line detection for a portion to which ice falls in a longitudinal direction by a full ice detection sensor or optical sensor that moves or rotates vertically with respect to a direction along which ice moves down, however, the entire top of the ice bucket **110** cannot be sensed, so that the ice is accumulated on the space not sensed and thus overloaded on the ice bucket **110**.

[0129] As described above, the refrigerator according to an exemplary embodiment is configured to have the ice maker capable of supplying a sufficiently large amount of ice, while locating the accommodation spaces utilizable on the main doors.

What is claimed is:

1. A refrigerator comprising:
 - at least one main door for a storage room of the refrigerator, the at least one main door having at least one auxiliary storage room and a dispenser;
 - at least one sub-door for the at least one auxiliary storage room, the at least one sub-door connected to the at least one main door; and
 - an ice making room connected to the at least one main door to supply water or ice to the dispenser, and connected to a refrigerant pipe of the refrigerator.
2. The refrigerator according to claim 1, wherein the refrigerant pipe comprises:
 - a first refrigerant pipe positioned on a ceiling of the refrigerator; and
 - at least one flexible tube positioned between the at least one main door and the refrigerator and having one end connected to the first refrigerant pipe and the other end connected to the ice making room.
3. The refrigerator according to claim 2, wherein the ice making room comprises:
 - an ice maker configured to store water therein and turn the water into ice and connected to the at least one flexible tube;

a cooling fan disposed in the ice making room, being spaced apart from the ice maker; and
an ice bucket located under the ice maker.

4. The refrigerator according to claim 3, wherein the ice maker comprises a tray made of a thermal conductive composite material heated in response to an electric current supplied thereto, and wherein a second refrigerant pipe connected to the at least one flexible tube is located on a lower portion of the tray.

5. The refrigerator according to claim 3, wherein as the ice is produced in the tray, the tray rotates toward the ice bucket to separate the produced ice therefrom.

6. The refrigerator according to claim 5, wherein the at least one flexible tube has connectors whose both ends are fitted to the first refrigerant pipe and the second refrigerant pipe so that as the tray rotates, the connectors rotate the at least one flexible tube.

7. The refrigerator according to claim 5, further comprising a draining plate provided between the ice maker and the ice bucket to induce defrosted water of the ice maker to a water tray of the dispenser.

8. The refrigerator according to claim 1, wherein the refrigerant pipe comprises:

- a first refrigerant pipe located on a ceiling of the refrigerator;
- a second refrigerant pipe connected to an ice maker located inside the ice making room and filled with a refrigerant; and

a heat exchanger located between the first refrigerant pipe and the second refrigerant pipe to perform heat exchange between the first refrigerant pipe and the second refrigerant pipe so that the refrigerant is condensed to a fluid.

9. The refrigerator according to claim 8, wherein the ice maker comprises the tray disposed lower than the heat exchanger and being contact with the second refrigerant pipe connected to the heat exchanger so that the ice is formed therein by the heat exchange.

10. The refrigerator according to claim 9, wherein the second refrigerant pipe comprises a circulation fan disposed between the tray and the heat exchanger to supply the refrigerant to the heat exchanger, and the refrigerant is supplied to the heat exchanger after being changed to a gas phase by the heat exchange with the tray.

11. The refrigerator according to claim 1, wherein the at least one auxiliary storage room is located at a top of the dispenser.

12. The refrigerator according to claim 1, wherein the storage room comprises:

- a refrigerating room to which the at least one main door is connected; and
- a freezing room located at a underside of the refrigerating room to supply cold air to the at least one main door.

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