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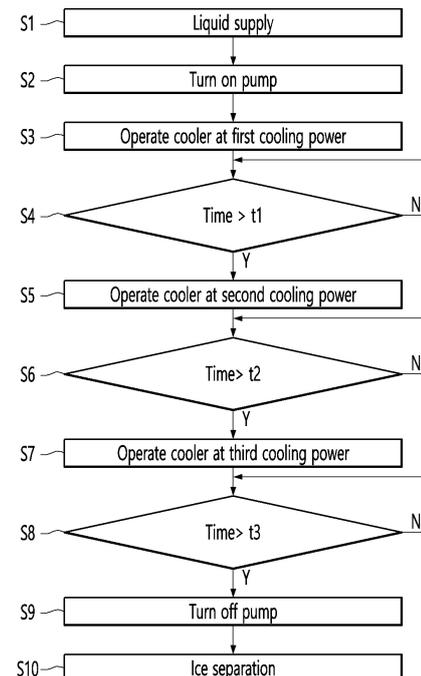
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(54) **ICEMAKING APPARATUS AND REFRIGERATOR**

(57) An icemaking apparatus according to an embodiment of the present invention may comprise a tray which is provided in an icemaking compartment and has an icemaking cell for making ice. The icemaking apparatus may comprise a cooling unit which provides cold for making ice by the icemaking cell during an icemaking process. The icemaking apparatus may comprise a controller for controlling the cooling unit.

[Figure 14]



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**Description**

[Disclosure]

[Technical Field]

[Technical Problem]

**[0001]** The present disclosure relates to an ice making device and a refrigerator.

5 **[0012]** The present embodiment provides an ice making device and a refrigerator capable of variably controlling an output of a cooler in an ice making process.

[Background Art]

**[0013]** Alternatively or additionally, one embodiment provides an ice making device and a refrigerator to prevent crack from being formed in ice during an ice making process.

**[0002]** In general, a refrigerator is a home appliance for storing food at a low temperature in a storage space that is covered by a refrigerator door. The refrigerator is configured to keep stored food in an optimal state by cooling the inside of the storage space using cold air generated through heat exchange with a refrigerant circulating in a refrigeration cycle.

10 **[0014]** Alternatively or additionally, one embodiment provides an ice making device and a refrigerator that increase an ice making speed.

**[0003]** The refrigerator may be placed independently in a kitchen or a living room or may be accommodated in a kitchen cabinet.

15 **[0015]** Alternatively or additionally, one embodiment provides an ice making device and a refrigerator that increase a transparency of generated ice.

**[0004]** The refrigerator is gradually becoming larger and more multi-functional in accordance with the change in dietary life and the trend of higher quality products. Refrigerators including various structures and convenience devices that take user convenience into consideration are being released.

[Technical Solution]

**[0005]** An automatic ice maker is disclosed in Japanese Registration Patent No. 5687018 that is a prior art document.

20 **[0016]** The present invention relates to a cooling device. The cooling device may include a refrigerator including at least one refrigerating chamber. The cooling device may include a freezer including at least one freezing chamber. The freezer may include an ice making device. A component or a control method of the ice making device may be applied to the cooling device.

**[0006]** The automatic ice maker includes an ice making chamber for forming ice, an evaporator disposed at an upper side of the ice making chamber, a water tray disposed at a lower side of the ice making chamber and rotatably supported on a support shaft, an ice making water tank assembled at a lower side of the water tray, a supply pump connected to one side of the ice making water tank, a guide member disposed at one side of the ice making water tank and being rotatable, and an ice storage compartment for storing ice.

25 The cooling device may include a storage chamber (e.g., main body) in which an item is stored. The cooling device may include a door that opens and close the storage chamber. The cooling device may include an ice making device. The cooling device may include an ice making chamber. The ice making chamber may be defined as a space in which at least a portion of an ice maker. The ice making chamber may be disposed in the storage chamber and/or the door. The cooling device may include an ice maker. In one embodiment, an ice making device may include a tray having an ice making cell for generating ice and provided in an ice making chamber. The ice making device may include a cooler configured to provide cold for ice generation in the ice making cell in an ice making process.

**[0007]** In an ice making process, water is supplied from a supply pump while the water tray closes a space of the ice making chamber, and the water supplied to the ice making cell may be cooled by an evaporator.

30 The ice making chamber may be disposed in the storage chamber and/or the door. The cooling device may include an ice maker. In one embodiment, an ice making device may include a tray having an ice making cell for generating ice and provided in an ice making chamber. The ice making device may include a cooler configured to provide cold for ice generation in the ice making cell in an ice making process.

**[0008]** In an ice separation process, high-temperature gas is supplied to the evaporator to heat the ice making cell, and at the same time, the water tray is tilted downward, and in a process of tilting the water tray downward, the guide member is rotated to cover an upper side of the water tray.

35 The ice making chamber may be disposed in the storage chamber and/or the door. The cooling device may include an ice maker. In one embodiment, an ice making device may include a tray having an ice making cell for generating ice and provided in an ice making chamber. The ice making device may include a cooler configured to provide cold for ice generation in the ice making cell in an ice making process.

**[0009]** As the ice making cell is heated, ice is separated from the ice making cell, falls to an upper side of the guide member, and finally moves to the ice storage compartment.

40 **[0017]** The ice making device may further include a controller configured to control the cooler.

**[0010]** However, the prior art does not disclose a technology for preventing crack from being formed in generated ice during an ice making process.

45 **[0018]** The controller may increase a cooling power of the cooler so that an ice making speed increases after supplying cold to the tray.

**[0011]** Additionally, the prior art does not disclose a technology for improving ice making speed while preventing crack from being formed.

50 **[0019]** The controller may gradually increase a cooling power of the cooler.

**[0020]** The controller may gradually increase a cooling power of the cooler based on an elapse of time.

**[0021]** The ice making device may further include a temperature sensor for detecting a temperature of the tray.

55 **[0022]** The controller may increase a cooling power of the cooler according to a change in temperature detected by the temperature sensor.

**[0023]** The ice making device may further include a

60 **[0023]** The ice making device may further include a

65 **[0023]** The ice making device may further include a

temperature sensor for detecting a temperature of a space where an ice making device is disposed.

**[0024]** A cooling power of the cooler may be determined based on a temperature detected by the temperature sensor.

**[0025]** Alternatively, the controller may decrease a cooling power of the cooler to prevent crack from being formed after supplying cold to the tray.

**[0026]** In another embodiment, an ice making device may include a tray having an ice making cell for generating ice and provided in an ice making chamber. The ice making device may further include a cooler. The cooler may include a compressor that operates to generate ice in the ice making cell in an ice making process. The cooler may further include a heat exchanger including an evaporator for providing cold to the tray.

**[0027]** The ice making device may further include a temperature sensor for detecting a temperature of the evaporator. The ice making device may further include a controller configured to control the compressor.

**[0028]** The controller may adjust a cooling power of the compressor based on a difference value between a temperature of liquid (e.g., water) supplied to the ice making cell and a temperature of an evaporator detected by the temperature sensor.

**[0029]** The controller may operate the compressor at a predetermined first cooling power to provide cold to the tray.

**[0030]** When a difference value between a temperature of the liquid and a temperature of the evaporator is greater than a first reference value, the controller may operate the compressor at a second cooling power greater than the first cooling power.

**[0031]** When a difference value between a temperature of the liquid and a temperature of the evaporator is less than a second reference value, which is less than the first reference value, the controller may operate the compressor at a third cooling power less than the first cooling power.

**[0032]** When a difference between a temperature of the liquid and a temperature of the evaporator is equal to or less than the first reference value and equal to or greater than the second reference value, the controller may maintain the first cooling power of the compressor.

**[0033]** Alternatively, the controller may operate the compressor at a predetermined first cooling power to provide cold to the tray. When a difference value between a temperature of the liquid and a temperature of the evaporator is less than a second reference value, the controller may operate the compressor at a third cooling power greater than the first cooling power.

**[0034]** Alternatively, the controller may operate the compressor at a predetermined first cooling power to provide cold to the tray. The controller may maintain the first cooling power of the compressor when a difference value between a temperature of the liquid and a temperature of the evaporator is equal to or less than the first reference value and equal to or greater than the

second reference value.

**[0035]** The predetermined first cooling power may be determined based on a temperature of a space where an ice making device is disposed, or may be determined based on a type of ice generated in the ice making cell.

**[0036]** The ice making device may further include a temperature sensor for detecting a temperature of the tray. A timing for determining whether to adjust a cooling power of the cooler may be determined based on a change in temperature of a tray detected by a temperature sensor, or may be determined based on an elapse of time.

**[0037]** In further another embodiment, an ice making device may include a tray having an ice making cell for generating ice and provided in an ice making chamber. The ice making device may further include a cooler configured to provide cold to the tray for generating ice in the ice making cell in an ice making process. The ice making device may further include a temperature sensor for detecting a temperature of the tray. The ice making device may further include a controller configured to control the cooler.

**[0038]** The controller may adjust a cooling power of the cooler based on a difference value between a temperature of liquid supplied to the ice making cell and a temperature of a tray detected by the temperature sensor.

**[0039]** The controller may operate the cooler at a predetermined first cooling power to provide cold to the tray. When a difference value between a temperature of the liquid and a temperature of the tray is greater than a first reference value, the controller may operate the cooler at a second cooling power greater than the first cooling power.

**[0040]** When a difference value between a temperature of the liquid and a temperature of the tray is less than the second reference value, which is less than the first reference value, the controller may operate the cooler at a third cooling power less than the first cooling power.

**[0041]** When a difference value between a temperature of the liquid and a temperature of the tray is equal to or less than the first reference value and equal to or greater than the second reference value, the controller may maintain the first cooling power of the cooler.

**[0042]** Alternatively, the controller may operate the cooler at a predetermined first cooling power to provide cold to the tray. When a difference value between a temperature of the liquid and a temperature of the tray is less than the second reference value, the controller may operate the cooler at a third cooling power greater than the first cooling power.

**[0043]** Alternatively, the controller may operate the cooler at a predetermined first cooling power to provide cold to the tray. When a difference value between a temperature of the liquid and a temperature of the tray is equal to or less than the first reference value and equal to or greater than the second reference value, the controller may maintain the first cooling power of the cooler.

**[0044]** The predetermined first cooling power may be

determined based on a temperature of a space where an ice making device is disposed, or may be determined based on a type of ice generated in the ice making cell.

**[0045]** A timing of determining whether to adjust a cooling power of the cooler may be determined based on a change in temperature of a tray detected by the temperature sensor, or may be determined based on an elapse of time.

**[0046]** In further another embodiment, an ice making device may include a tray having an ice making cell for generating ice and provided in an ice making chamber. The ice making device may further include a cooler configured to provide cold for generating ice in the ice making cell in an ice making process. The ice making device may further include a controller configured to control the cooler.

**[0047]** When the ice making cell includes a portion where a volume or mass per unit height increases, a cooling power of the cooler may be increased during an ice making process. When the ice making cell includes a portion where a volume or mass per unit height decreases, a cooling power of the cooler may be decreased during an ice making process.

**[0048]** In further another embodiment, a refrigerator may include a cabinet having a storage chamber. The refrigerator may further include a door that opens and closes the storage chamber. The refrigerator may further include an ice making chamber provided in the door or the cabinet. The refrigerator may include a tray having an ice making cell for generating ice and provided in the ice making chamber. The refrigerator may further include a cooler configured to supply cold to the tray in an ice making process. The refrigerator may further include a controller configured to control the cooler. The controller may vary a cooling power of the cooler so that an ice making speed increases after supplying cold to the tray.

**[0049]** Alternatively, the controller may reduce a cooling power of the cooler so as to prevent crack from being formed after supplying cold to the tray.

#### [Advantageous Effects]

**[0050]** According to this embodiment, by variably controlling a cooler in an ice making process, crack can be prevented from being formed in ice.

**[0051]** In addition, by variably controlling a cooler in an ice making process, a transparency of ice can be increased.

**[0052]** In addition, by variably controlling a cooler in an ice making process, an ice making speed can be increased.

#### [Description of Drawings]

##### [0053]

FIG. 1 is a perspective view of an ice making device according to the present embodiment.

FIG. 2 is a front view showing a door of an ice making device in an opened state according to the present embodiment.

FIG. 3 is a cross-sectional view showing an inside of an ice making device according to the present embodiment.

FIG. 4 is a diagram showing an inside of an ice making device according to the present embodiment.

FIG. 5 is a refrigerant cycle diagram configuring a cooler.

FIG. 6 is a diagram showing a liquid supply passage in an ice making device according to the present embodiment.

FIGS. 7 and 8 are perspective views showing liquid being supplied to an ice maker.

FIG. 9 is a perspective view showing an arrangement of a first tray assembly and a second tray assembly according to the present embodiment.

FIGS. 10 and 11 are perspective views showing an ice maker and a heat exchanger according to the present embodiment.

FIG. 12 is a control block diagram of an ice making device of the present invention.

FIG. 13 is a cross-sectional view showing a process of supplying liquid from a liquid supplier to an ice maker during an ice making process.

FIG. 14 is a flowchart for explaining a control method of an ice making device according to a first embodiment of the present invention.

FIG. 15 is a table showing a change in cooling power of a cooler according to a first embodiment of the present invention.

FIG. 16 is a flowchart for explaining a control method of an ice making device according to a second embodiment of the present invention.

FIG. 17 is a table showing a change in cooling power of a cooler according to a second embodiment of the present invention.

FIG. 18 is a flowchart for explaining a control method of an ice making device according to a third embodiment of the present invention.

#### [Mode for Invention]

**[0054]** Hereinafter, some embodiments of the present disclosure will be described in detail with reference to the accompanying drawings. It should be noted that when components in the drawings are designated by reference numerals, the same components have the same reference numerals as far as possible even though the components are illustrated in different drawings. Further, in description of embodiments of the present disclosure, when it is determined that detailed descriptions of well-known configurations or functions disturb understanding of the embodiments of the present disclosure, the detailed descriptions will be omitted.

**[0055]** Also, in the description of the embodiments of

the present disclosure, the terms such as first, second, A, B, (a) and (b) may be used. Each of the terms is merely used to distinguish the corresponding component from other components, and does not delimit an essence, an order or a sequence of the corresponding component. It should be understood that when one component is "connected", "coupled", "joined" or "supported" to another component, the former may be directly connected, coupled, jointed or supported to the latter or may be "connected", "coupled", "joined" or "supported" to the latter with a third component interposed therebetween.

**[0056]** In this specification, the present invention relates to a cooling device. The cooling device may include a refrigerator including at least one refrigerating chamber. The cooling device may include a freezer including at least one freezing chamber. The freezer may include an ice making device. An ice making device may include some or all of a tray defining an ice making cell that is a space in which liquid is phase-changed into ice, a cooler for supplying cold to the ice making cell, a liquid supplier for supplying liquid to the ice making cell, and a controller.

**[0057]** The cooling device may include a cooler. The cooler is a source that supplies cold and/or heat, and may be referred to as a cold source and/or a heat source.

**[0058]** The ice making device may further include an ice separation assembly.

**[0059]** The tray may include a first tray. The tray may further include a second tray.

**[0060]** The first tray and the second tray may generate different types of ice.

**[0061]** The liquid supplier may independently supply liquid to each of the first tray and the second tray.

**[0062]** The liquid supplier may be configured to simultaneously supply liquid to the first tray and the second tray.

**[0063]** The liquid supplier may include a pump for pumping liquid.

**[0064]** The cooler may include a heat exchanger. The cooler may cool the ice making chamber. Alternatively, the cooler may cool and heat the ice making chamber. The heat exchanger may include at least one of a pipe to supply the cold and/or heat, a refrigerant pipe through which refrigerant flows, an evaporator refrigerant pipe through which refrigerant flows, or a thermoelectric element to supply the cold and/or heat. The evaporator may be located adjacent to or in contact with the tray. Alternatively, cold air cooled by the cooler may be supplied to the tray and liquid is phase-changed into ice in the ice making cell. The heat exchanger may include an evaporator.

**[0065]** The cooler may cool the first tray. The cooler may cool the second tray. The cooler may cool the first tray and the second tray independently or simultaneously.

**[0066]** The cooler may optionally include a valve for controlling a flow of refrigerant, a fan for flowing cold air, or a damper for controlling a flow of cold air within the two spaces.

**[0067]** The controller may adjust a cooling power (or output) of the cooler. The cooling power of the cooler may be an output of a thermoelectric element, an amount of cold supplied to the tray, or a cooling power of the compressor (or output or frequency) or an amount of refrigerant flowing into an evaporator. The cold may include at least cold air.

**[0068]** The ice separation assembly includes at least one of a heater for heating the tray, a pusher for pressing at least a portion of the tray, a refrigerant pipe through which refrigerant flows to heat the tray, a liquid supply assembly for supplying liquid to an outside of the tray, or a driver for moving at least a portion of the tray.

**[0069]** The ice separation assembly may separate ice from the first tray. The ice separation assembly may separate ice from the second tray.

**[0070]** The ice separation assembly may separate ice from each of the first tray and the second tray independently or simultaneously separate ice from the first tray and the second tray.

**[0071]** For example, a power of a driver is transmitted simultaneously to the first tray and the second tray, heat from a heater or a refrigerant pipe is transmitted simultaneously to the first tray and the second tray, or liquid is transmitted simultaneously to the first tray and the second tray.

**[0072]** FIG. 1 is a perspective view of an ice making device according to the present embodiment. FIG. 2 is a front view showing a door of an ice making device in an opened state according to the present embodiment. FIG. 3 is a cross-sectional view showing an inside of an ice making device according to the present embodiment. FIG. 4 is a diagram showing an inside of an ice making device according to the present embodiment. FIG. 5 is a refrigerant cycle diagram configuring a cooler.

**[0073]** Referring to FIGS. 1 to 5, an ice making device 1 of this embodiment may be installed independently to generate ice.

**[0074]** The ice making device 1 may include a cabinet 10 that forms an external shape. The ice making device 1 may further include a door 20 connected to the cabinet 10.

**[0075]** The cabinet 10 may include an ice making chamber 12 that generates ice. The cabinet 10 may include a storage chamber 13 where ice is stored.

**[0076]** The ice making chamber 12 and the storage chamber 13 may be partitioned by a partition member. The ice making chamber 12 and the storage chamber 13 may be communicated through a communication hole in the partition member. Alternatively, the ice making chamber 12 and the storage chamber 13 may be communicated without a partition member.

**[0077]** Alternatively, the ice making chamber 12 may include the storage chamber 13, or the storage chamber 13 may include the ice making chamber 12.

**[0078]** The cabinet 10 may include a front opening 102. The door 20 may open and close the front opening 102. For example, the door 20 may open and close the front

opening 102 by rotating.

**[0079]** When the door 20 opens the front opening 102, a user can access the storage chamber 13 through the front opening 102. The user can take out ice stored in the storage chamber 13 to an outside through the front opening 102.

**[0080]** The ice making device 1 may further include an ice maker 40 located in the ice making chamber 12.

**[0081]** Ice generated in the ice maker 40 may fall from the ice maker 40 and be stored in the storage chamber 13.

**[0082]** The cabinet 10 may further include an inner case 101 defining the ice making chamber 12. The cabinet 10 may further include an outer case 110 disposed outside the inner case 101.

**[0083]** Although not shown, an insulating material may be provided between the inner case 101 and the outer case 100.

**[0084]** The inner case 101 may additionally define the storage chamber 13.

**[0085]** The ice making chamber 12 may be formed at one side of the inner case 101.

**[0086]** The ice maker 40 may be located close to a rear wall 101a of the inner case 101. When the ice maker 40 is located close to a rear wall 101a of the inner case 101, usability of the storage chamber 13 can be increased.

**[0087]** To facilitate a user's access to the storage chamber 13, ice generated by the ice maker 40 may fall in a direction closer to the door 20.

**[0088]** The cabinet 10 may further include a machine room 18 divided from the storage chamber 13. For example, the machine room 18 may be located at one side of the storage chamber 13. For example, the one side may be a lower side.

**[0089]** Although not limited, a portion of the storage chamber 13 may be located between the ice making chamber 12 and the machine room 18. A volume of the storage chamber 13 may be greater than a volume of the ice making chamber 12 and a volume of the machine room 18.

**[0090]** The machine room 18 may be placed outside the inner case 101.

**[0091]** The inner case 101 may include a bottom wall 104 that forms a bottom of the storage chamber 13. The machine room 18 may be located at one side of the bottom wall 104.

**[0092]** For example, the machine room 18 may be located at a lower side of the bottom wall 104.

**[0093]** The bottom wall 104 may be provided with a drain hole 105 for discharging liquid.

**[0094]** A portion of a cooler may be located in the machine room 18. For example, the cooler may be a refrigerant cycle for circulating refrigerant.

**[0095]** The cooler may include at least one of a compressor 183, a condenser 184, an expander 186, or a heat exchanger 50. The heat exchanger 50 may be an evaporator through which refrigerant flows.

**[0096]** In this embodiment, a flow of refrigerant in the

refrigerant cycle may be controlled by a valve 188. The refrigerant cycle may include a bypass pipe 187 for bypassing refrigerant discharged from the compressor 183 to an inlet of the heat exchanger 50. The valve 188 may be provided in the bypass pipe 187.

**[0097]** When the valve 188 is turned off, refrigerant compressed in the compressor 183 may flow directly to the condenser 184. When the valve 188 is turned on, some or all of refrigerant compressed in the compressor 183 may be bypassed through the bypass pipe 187 and flow directly into the heat exchanger 50. Although not limited, refrigerant from the compressor 183 may flow to the evaporator during an ice separation process.

**[0098]** Refrigerant flowing through the heat exchanger 50 may flow through an accumulator 189 and then into the compressor 183.

**[0099]** The compressor 183 and the condenser 184 may be located in the machine room 18. The machine room 18 may be provided with a condenser fan 185 to allow air to pass through the condenser 184. For example, the condenser fan 185 may be disposed between the condenser 184 and the compressor 183.

**[0100]** A front grille 180 in which an air hole 182 is formed may be provided at a front of the cabinet 10. A plurality of air holes 182 may be formed in the front grille 180. The front grille 180 may be located at one side of the front opening 102. When the door 20 closes the front opening 102, the door 20 may cover a portion of the front grille 180.

**[0101]** The heat exchanger 50 may include refrigerant pipes 510 and 520 through which refrigerant flows. At least a portion of the heat exchanger 50 may be located in the ice making chamber 12.

**[0102]** At least a portion of the heat exchanger 50 may be in contact with the ice maker 40. That is, liquid supplied to the ice maker 40 may be phase-changed into ice by low-temperature refrigerant flowing through the heat exchanger 50. Alternatively, the heat exchanger 50 may be located adjacent to the ice maker 40.

**[0103]** A cooling type in which the heat exchanger 50 directly contacts the ice maker 40 to generate ice can be referred to as a direct cooling type.

**[0104]** As another example, air that has heat-exchanged with the heat exchanger 50 is supplied to the ice maker 40, and liquid in the ice maker 40 can be phase-changed into ice by the cooling air. A cooling type of generating ice by supplying cooling air can be called an indirect cooling type or an air cooling type. In a case of the indirect cooling type, it is possible that the heat exchanger 50 is not located in the ice making chamber 12. However, a guide duct that guides cooling air heat-exchanged with the heat exchanger 50 to the ice making chamber 12 may be additionally provided.

**[0105]** In this embodiment, the ice maker 40 may generate a single type of ice or at least two different types of ice.

**[0106]** Hereinafter, it will be described as an example that the ice maker 40 generates at least two different

types of ice.

**[0107]** The ice maker may include a tray assembly. The tray assembly may include a tray that defines a space in which an ice making cell is formed. The tray assembly may include a tray case to which the tray is connected and/or coupled and/or joined and/or supported. In this specification, the present invention describes using a tray. However, the present invention may also include embodiments understood by replacing a tray assembly instead of the tray. The tray case may include a first tray case (e.g., tray cover) connected and/or coupled and/or supported and/or jointed to a first portion of the tray. The tray case may include a second tray case (e.g., tray supporter) connected and/or coupled and/or supported and/or jointed to a second portion of the tray. The ice maker 40 may include a first tray assembly 410 for generating a first type of first ice I1. The ice maker 40 may further include a second tray assembly 450 for generating a second type of second ice I2 different from the first type.

**[0108]** The first ice I1 and the second ice I2 may differ in one or more of shape, size, transparency, etc.

**[0109]** Hereinafter, it will be described as an example that the first ice I1 is polygonal ice, and the second ice I2 is spherical ice.

**[0110]** The storage chamber may include a first storage space 132. The storage chamber may further include a second storage space 134.

**[0111]** Ice generated in the first tray assembly 410 may be stored in the first storage space 132. Ice generated in the second tray assembly 450 may be stored in the second storage space 134.

**[0112]** Although not limited, the second storage space 134 may be defined by the ice bin 14. That is, an internal space of the ice bin 14 may serve as the second storage space 134. The ice bin 14 may be fixed or detachably coupled to the inner case 101.

**[0113]** The ice bin 14 may also be referred to as a partition member that divides the storage chamber 13 into the first storage space 132 and the second storage space 134.

**[0114]** A volume of the first storage space 132 may be greater than a volume of the second storage space 134. Although not limited, a size of the first ice I1 stored in the first storage space 132 may be smaller than a size of the second ice I2 stored in the second storage space 134.

**[0115]** A front surface of the ice bin 14 may be arranged to be spaced apart from a rear side of the front opening 102. A bottom surface of the ice bin 14 may be spaced apart from a bottom wall 104 of the storage chamber 13.

**[0116]** Accordingly, the first ice I1 may be located at one side of the ice bin 14. The first ice I1 may also be located at another side of the ice bin 14. The first ice I1 stored in the first storage space 132 may surround the ice bin 14.

**[0117]** A bottom wall 104 of the storage chamber 13 may form a floor of the second storage space 134.

**[0118]** A bottom wall 104 of the storage chamber 13

may be positioned lower than one end 102a of the front opening 102. A bottom surface of the ice bin 14 may be positioned higher than one end 102a of the front opening 102.

**[0119]** The ice bin 14 may be located adjacent to one surface (left surface in the drawing) of left and right surfaces of the inner case 101. The second tray assembly 450 may be located adjacent to the one surface. Accordingly, ice separated from the second tray assembly 450 may be stored in the second storage space 134 of the ice bin 14. Ice separated from the first tray assembly 410 may be stored in the first storage space 132 outside the second storage space 134.

**[0120]** When an amount of first ice stored in the first storage space 132 increases, to prevent the first ice from being unintentionally discharged through the front opening 102 when the door 20 is opened, the cabinet 10 may further include an opening cover 16. The opening cover 16 may be rotatably provided to the inner case 101. The opening cover 16 may cover one side of the front opening 102.

**[0121]** The opening cover 16 can be received in the storage chamber 13 when the door 20 is closed. When the door 20 is opened, other end of the opening cover 16 may be rotated with respect to one end so that the other end protrudes to an outside of the storage chamber 13.

**[0122]** The opening cover 16 may be elastically supported by, for example, an elastic member (not shown). When the door 20 is opened, the opening cover 16 can be rotated by the elastic member.

**[0123]** The opening cover 16 may be formed in a convex shape toward the door 20. Accordingly, although not limited, the first ice may be filled in the first storage space 132 up to one end 16a of the opening cover 16.

**[0124]** When the opening cover 16 is rotated, a portion of the first ice is drawn out of the storage chamber 13 while being located within the convex portion of the opening cover 16, so that a user can easily obtain the first ice.

**[0125]** Of course, it is also possible to omit the opening cover 16 by varying a height of one end 102a of the front opening 102.

**[0126]** The cabinet 10 may further include a guide 70 that guides ice separated from the ice maker 40 to the storage chamber 13.

**[0127]** The guide 70 may be arranged to be spaced apart from one side of the ice maker 40. The guide 70 may guide a first ice I1 separated from the first tray assembly 410. The guide 70 may guide a second ice I2 separated from the second tray assembly 450.

**[0128]** For example, the guide 70 may include a first guide 710. The guide 70 may further include a second guide 730.

**[0129]** The first ice I1 separated from the first tray assembly 410 may fall onto the first guide 710. First ice I1 may be moved to the first storage space 132 by the first guide 710.

**[0130]** The second ice I2 separated from the second

tray assembly 450 may fall onto the second guide 730. Second ice I2 may be moved to the second storage space 134 by the second guide 730.

**[0131]** One end of the ice bin 14 may be positioned adjacent to one end of the second guide 730 so that the second ice I2 is moved to the second storage space 134.

**[0132]** The ice making device 1 may further include a partition plate 80 to prevent the first ice and the second ice that fall onto the guide 70 from being mixed. The partition plate 80 extends in a vertical direction and may be coupled to the guide 70 or the ice maker 40.

**[0133]** FIG. 6 is a diagram showing a liquid supply passage in an ice making device according to the present invention. FIGS. 7 and 8 are perspective views showing liquid being supplied to an ice maker.

**[0134]** Referring to FIGS. 6 to 8, the ice making device 1 may include a liquid supply passage for guiding liquid supplied from a liquid source 302 to the ice maker 40. The liquid source (e.g., water source) may include a faucet or a liquid tank provided at an inside and/or outside of the ice making device.

**[0135]** The liquid supply passage may include a first passage 303 connected to the liquid source 302. A liquid supply valve 304 may be provided in the first passage 303. By operating the liquid supply valve 304, a supply of liquid from the liquid source 302 to the ice making device 1 can be controlled. A supply flow rate when liquid is supplied to the ice making device 1 can be controlled by operating the liquid supply valve 304.

**[0136]** The liquid supply passage may further include a second passage 305 connected to the liquid supply valve 304. The second passage 305 may be connected to a filter 306. For example, the filter 306 may be located in the machine room 18.

**[0137]** The liquid supply passage may further include a third passage 308 that guides liquid that has passed through the filter 306.

**[0138]** The cooling device may include a supply component to supply liquid to the ice making device. Alternatively, the supply component may include a liquid supply assembly. The supply component may supply liquid to an ice maker (e.g., tray) from a liquid source (e.g., a faucet or a liquid tank provided at an inside and/or outside of an ice making device). The liquid supply assembly may include a pipe through which the liquid flows. For example, liquid supplied from the liquid supply assembly may be supplied to a liquid supplier, which will be described later. The ice making device 1 may further include a liquid supply assembly 320. The liquid supply assembly 320 may be connected to the third passage 308.

**[0139]** The liquid supply assembly 320 can supply liquid to the ice maker 40 during a liquid supply process.

**[0140]** Alternatively, the supply component may include a liquid supplier. The supplier may supply liquid supplied from the liquid supply assembly to an ice maker (e.g., tray). The liquid supplier may include a sub liquid supplier. The sub liquid supplier may include a pipe

through which the liquid flows. The sub liquid supplier may include a nozzle. The sub liquid supplier may further include a pump. The sub liquid supplier may include a sub\_first liquid supplier. The sub liquid supplier may include a sub\_second liquid supplier. The ice making device 1 may further include a liquid supplier 330. The liquid supplier may supply liquid to an ice maker (e.g., tray) from a liquid source (e.g., a faucet or a liquid tank provided at an inside and/or outside of an ice making device). The liquid supplier may include a sub liquid supplier. The sub liquid supplier may include a pipe through which the liquid flows. For example, liquid supplied from the liquid supply assembly may be supplied to the ice maker. The liquid supplier 330 may supply liquid to the ice maker 40 during an ice making process. The liquid supplier 330 can store liquid supplied from the liquid supply assembly 320 and supply liquid to the ice maker 40.

**[0141]** In this embodiment, the liquid supply assembly 320 may be referred to as a first liquid supply assembly. The liquid supplier 330 may be referred to as a second liquid supply assembly.

**[0142]** The liquid supply assembly 320 may be located at one side of the ice maker 40. Liquid supplied from the liquid supply assembly 320 may fall onto the ice maker 40.

**[0143]** The liquid supplier 330 may be located at another side of the ice maker 40.

**[0144]** The liquid supplier 330 may be spaced apart from the liquid supply assembly 320. The liquid supplier 330 can store liquid supplied from the liquid supply assembly 320 and supply liquid to the ice maker 40.

**[0145]** In FIGS. 6 to 8, a dotted line shows a flow of liquid supplied from the liquid supply assembly 320, and a solid line shows a flow of liquid supplied from the liquid supplier 330.

**[0146]** The liquid supplier 330 may include a liquid storage 350 in which liquid is stored. The liquid storage may include a wall to form a space to store the liquid. The ice maker 40 may include one or more through holes 426 through which liquid passes. Liquid supplied from the liquid supply assembly 320 and dropped toward the ice maker 40 may be stored in the liquid storage 350 after passing through the through hole 426. The guide 70 may be provided with a plurality of through holes through which liquid passing through the ice maker 40 passes.

**[0147]** In a state in which the liquid supply valve 304 is turned on, liquid supplied from the liquid supply assembly 320 falls to one side of the ice maker 40, passes through the ice maker 40, and then may be stored in the liquid storage 350.

**[0148]** The liquid storage 350 may be provided with a liquid level detector 356 that detects a liquid level. When a liquid level of the liquid storage 350 detected by the liquid level detector 356 reaches a reference liquid level, the liquid supply valve 304 may be turned off.

**[0149]** In this specification, a process from when the liquid supply valve 304 is turned on to when the liquid

supply valve 304 is turned off may be referred to as a liquid supply process. For example, the liquid supply valve 304 may be turned off when a liquid level of the liquid storage 350 detected by the liquid level detector 356 reaches a reference liquid level.

**[0150]** The liquid supplier 330 may further include liquid pumps 360 and 362 for pumping liquid stored in the liquid storage 350.

**[0151]** In this embodiment, in an ice making process, liquid stored in the liquid storage 350 may be pumped by the liquid pumps 360 and 362 and supplied to the ice maker 40.

**[0152]** The liquid pumps 360 and 362 may include a first pump 360. The liquid pumps may further include a second pump 362. When the first pump 360 operates, liquid may be supplied to the first tray assembly 410. When the second pump 362 operates, liquid may be supplied to the second tray assembly 450.

**[0153]** The first pump 360 and the second pump 362 may operate independently. Pumping capacities of the first pump 360 and the second pump 362 may be the same or different.

**[0154]** The liquid supplier 330 may further include first connection pipes 352 and 354 connecting each of the pumps 360 and 362 and the liquid storage 350.

**[0155]** The first connection pipes 352 and 354 may be connected to the liquid storage 350 at the same or similar height to a bottom of the liquid storage 350.

**[0156]** The sub liquid supplier may include a sub\_first liquid supplier. The sub liquid supplier may include a sub\_second liquid supplier. The liquid supplier 330 may further include a sub\_first liquid supplier 380 for supplying liquid pumped by the first pump 360 to the first tray assembly 410.

**[0157]** The liquid supplier 330 may further include a sub\_second liquid supplier 382 for supplying liquid pumped by the second pump 362 to the second tray assembly 450.

**[0158]** The sub\_first liquid supplier 380 may supply liquid to the first tray assembly 410 from one side of the first tray assembly 410.

**[0159]** The sub\_second liquid supplier 382 may supply liquid to the second tray assembly 450 from one side of the second tray assembly 450.

**[0160]** The sub\_first liquid supplier 380 and the sub\_second liquid supplier 382 may be located at one side of the guide 70.

**[0161]** The liquid supplier 330 may further include second connection pipes 370 and 372 connecting each of the pumps 360 and 362 and each of the sub liquid suppliers 380 and 382.

**[0162]** Liquid supplied from the sub\_first liquid supplier 380 to the first tray assembly 410 may be used to generate ice. Liquid that falls again from the first tray assembly 410 may be stored in the liquid storage 350 after passing through the guide 70.

**[0163]** Liquid supplied from the sub\_second liquid supplier 382 to the second tray assembly 450 may be used to

generate ice. Liquid that falls again from the second tray assembly 450 may be stored in the liquid storage 350 after passing through the guide 70.

**[0164]** A drain pipe 360 may be connected to the liquid storage 350. The drain pipe 360 may extend through the drain hole 105 into the machine room 18. The machine room 18 may be provided with a drain tube 362 connected to the drain pipe 360. The drain tube 362 can finally discharge liquid to an outside of the ice making device 1.

**[0165]** Hereinafter, the ice maker 40 will be described in detail.

**[0166]** FIG. 9 is a perspective view showing an arrangement of a first tray assembly and a second tray assembly according to the present embodiment. FIGS. 10 and 11 are perspective views showing an ice maker and a heat exchanger according to the present embodiment.

**[0167]** FIG. 12 is a control block diagram of an ice making device of the present invention. FIG. 13 is a cross-sectional view showing a process of supplying liquid from a liquid supplier to an ice maker during an ice making process.

**[0168]** Referring to FIGS. 9 to 13, the heat exchanger 50 may contact the ice maker 40. For example, the heat exchanger 50 may be located at one side of the ice maker 40. The one side may be, but is not limited to, an upper side.

**[0169]** The ice maker 40 may include a first tray assembly 410 and a second tray assembly 450 as described above.

**[0170]** The first tray assembly 410 and the second tray assembly 450 may be arranged in a horizontal direction. It is also possible for the first tray assembly 410 and the second tray assembly 450 to be arranged in a vertical direction. The first tray assembly 410 and the second tray assembly 450 may be installed in the cabinet 10 while being connected to each other. That is, the first tray assembly 410 and the second tray assembly 450 can be modularized.

**[0171]** As another example, the first tray assembly 410 and the second tray assembly 450 may be installed in the cabinet 10 in a separated state. The first tray assembly 410 and the second tray assembly 450 may be positioned close to each other in a horizontal direction.

**[0172]** The first tray assembly 410 may include a first ice making cell 440.

**[0173]** In this embodiment, an ice making cell refers to a space where ice is generated. One ice may be generated in one ice making cell.

**[0174]** The first tray assembly 410 may include a first tray. The first tray may include a first one tray 420 and a first another tray 430 coupled to the first one tray 420.

**[0175]** For example, the first tray may form a plurality of first ice making cells 440. A plurality of first another trays 430 may be coupled to the first one tray 420. The first ice making cell 440 may be defined by one cell or by a plurality of cells. For example, the first ice making cell

440 may include a first one cell 441 and a first another cell 442. Although not limited, the first one cell may be one of a first lower cell and a first upper cell. The first another cell may be another one of the first lower cell and the first upper cell. The first one cell may be one of a first left cell or a first right cell. The first another cell may be another one of the first left cell and the first right cell. Although not limited, it is possible that terms of first one cell and first another cell are opposite to each other.

**[0176]** The first another cell 442 may be formed by the first another tray 430. The first one cell 441 may be formed by the first one tray 420.

**[0177]** For example, the first one tray 420 may form a plurality of first one cells 441. Each of the plurality of first another trays 430 may form a first another cell 442.

**[0178]** Accordingly, when the plurality of first another trays 430 are coupled to a single first one tray 420, a plurality of first ice making cells 440 may be formed.

**[0179]** The first one tray 420 may include a first opening 423. The first opening 423 communicates with the first one cell 441.

**[0180]** A number of first openings 423 may be equal to a number of first ice making cells 440.

**[0181]** The first one cell 441 may form another portion of an appearance of the first ice and the first another cell 442 may form a portion of an appearance of the first ice.

**[0182]** After the first another tray 430 is coupled to the first one tray 420, separation of the first another tray 430 from the first one tray 420 may be restricted.

**[0183]** Liquid supplied from the sub\_first liquid supplier 380 may pass through the first opening 423 and be supplied to the first ice making cell 440. Accordingly, the first opening 423 may serve as a liquid supply opening during an ice making process.

**[0184]** A portion of liquid supplied to the first ice making cell 440 may fall to a lower part of the first tray assembly 410 through the first opening 423. Accordingly, the first opening 423 may serve as a liquid outlet opening during an ice making process.

**[0185]** Ice generated in the first ice making cell 440 may be separated from the first tray assembly 410 through the first opening 423 in an ice separation process. Accordingly, the first opening 423 may serve as an ice outlet opening during an ice separation process.

**[0186]** Each of the first one cell 441 and the first another cell 442 may be formed, for example, in a hexahedral shape. A volume of the first another cell 442 and a volume of the first one cell 441 may be the same or different.

**[0187]** A horizontal perimeter (or horizontal cross-sectional area) of the first one cell 441 may be greater than a horizontal perimeter (or horizontal cross-sectional area) of the first another cell 442 so that first ice can be discharged through the first opening 423 after the first ice is generated in the first ice making cell 440.

**[0188]** That is, during a liquid supply process, an ice making process, or an ice separation process, the first another tray 430 and the first one tray 420 are maintained in a coupled state, so that a shape of the first ice making

cell 440 can be maintained.

**[0189]** The heat exchanger 50 may be in contact with the first another tray 430 so that ice is firstly generated in the first another cell 442.

5 **[0190]** The first one tray 420 may include through holes 421 and 425 through which liquid passes.

**[0191]** The second tray assembly 450 may further include a second tray forming a second ice making cell 451.

10 **[0192]** The second tray may be defined by one tray or by a plurality of trays. For example, the second tray may include a second one tray 460 and a second another tray 470. Although not limited, the second one tray may be an upper tray, or a left tray. The second another tray 470 may be a lower tray, or a right tray. It is also possible that terms of the second one tray 460 and the second another tray 470 are opposite to each other.

15 **[0193]** The second ice making cell 451 may be defined by one cell or by a plurality of cells. For example, the second ice making cell 451 may include a second one cell 462 and a second another cell 472.

20 **[0194]** The second one tray 460 can form the second one cell 462. The second another tray 470 may form the second another cell 472. For example, each of the second one cell 462 and the second another cell 472 may be formed in a hemispherical shape.

25 **[0195]** For example, the second tray may form a plurality of second ice making cells 451. Accordingly, the second one tray 460 can form a plurality of second one cells 462. The second another tray 470 can form a plurality of second another cells 472.

30 **[0196]** A portion of the first ice making cell 440 may be located at the same height as the second ice making cell 451. For example, at least a portion of the first ice making cell 440 may be arranged to overlap the second ice making cell 451 in a horizontal direction.

35 **[0197]** The second ice making cell 451 may be disposed between a rotation center C1 of the second another tray 470 and the first ice making cell 440.

40 **[0198]** A height of one end of the first ice making cell 440 and one end of the second ice making cell 451 may be different. For example, one end of the first ice making cell 440 may be positioned lower than one end of the second ice making cell 451.

45 **[0199]** A height of the other end of the first ice making cell 440 and the other end of the second ice making cell 451 may be different. For example, the other end of the first ice making cell 440 may be positioned higher than the other end of the second ice making cell 451.

50 **[0200]** A contact surface of the second one tray 460 and the second another tray 470 may have a different height from a coupling portion of the first one tray 420 and the first another tray 430. For example, a contact surface of the second one tray 460 and the second another tray 470 may be positioned higher than a coupling portion of the first one tray 420 and the first another tray 430.

55 **[0201]** A height of the first ice making cell 440 and a height of the second ice making cell 451 may be different.

For example, a height of the first ice making cell 440 may be less than a height of the second ice making cell 451.

**[0202]** A maximum horizontal perimeter of the first ice making cell 440 may be different from a maximum horizontal perimeter of the second ice making cell 451. For example, a maximum horizontal perimeter of the first ice making cell 440 may be less than a maximum horizontal perimeter of the second ice making cell 451.

**[0203]** A number of first ice making cells 440 may be different from a number of second ice making cells 451. For example, a number of first ice making cells 440 may be greater than a number of second ice making cells 451.

**[0204]** A volume of the first ice making cell 440 may be different from a volume of the second ice making cell 451. A volume of the first ice making cell 440 may be less than a volume of the second ice making cell 451.

**[0205]** A sum of volumes of the plurality of first ice making cells 440 may be different from a sum of volumes of the plurality of second ice making cells 451. For example, a sum of volumes of the plurality of first ice making cells 440 may be greater than a sum of volumes of the plurality of second ice making cells 451.

**[0206]** The second another tray 470 may include a second opening 473.

**[0207]** A liquid supply process and an ice making process may be performed in a state in which the second one tray 460 and the second another tray 470 are in contact to form the second ice making cell 451.

**[0208]** Liquid supplied from the sub-second liquid supplier 382 may pass through the second opening 473 and be supplied to the second ice making cell 451. Accordingly, the second opening 473 may serve as a liquid supply opening during an ice making process.

**[0209]** A portion of liquid supplied to the second ice making cell 451 may fall to a lower part of the second tray assembly 450 through the second opening 473. Accordingly, the second opening 473 may serve as a liquid outlet opening during an ice making process.

**[0210]** In an ice separation process, the second another tray 470 may be moved relative to the second one tray 460.

**[0211]** The first opening 423 and the second opening 473 may be located at different heights. For example, the first opening 423 may be located higher than the second opening 473.

**[0212]** The second tray assembly 450 may further include a case 452 supporting the second one tray 460.

**[0213]** A portion of the second one tray 460 may pass through the case 452 from one side. Another portion of the second one tray 460 may be seated on the case 452.

**[0214]** A driver 690 for moving the second another tray 470 may be installed on the case 452.

**[0215]** The case 452 may include a circumferential portion 453. The circumferential portion 453 may be provided with a seating end 454. The seating end 454 may be seated on the first tray assembly 410. For example, the seating end 454 may be seated on the first one tray 420.

**[0216]** A through hole 456 through which liquid passes may be formed in the case 452

**[0217]** The second tray assembly 450 may further include a supporter 480 supporting the second another tray 470.

**[0218]** In a state in which the second another tray 470 is seated on the supporter 480, the supporter 480 and the second another tray 470 may be moved together. For example, the supporter 480 may be movably connected to the second one tray 460.

**[0219]** The supporter 480 may include a supporter opening 482a through which liquid passes. The supporter opening 482a may be aligned with the second opening 473.

**[0220]** A diameter of the supporter opening 482a may be greater than a diameter of the second opening 473.

**[0221]** The second tray assembly 450 may further include a pusher 490 for separating ice from the second another tray 470 in an ice separation process. For example, the pusher 490 may be installed on the case 452.

**[0222]** The pusher 490 may include a pushing column 492. When the second another tray 470 and the supporter 480 are moved in an ice separation process, the pushing column 492 passes through the supporter opening 482a of the supporter 480 to press the second another tray 470. When the second another tray 470 is pressed by the pushing column 492, a shape of the second another tray 470 is deformed and the second ice may be separated from the second another tray 470. To enable deformation of the second another tray 470, the second another tray 470 may be formed of a non-metallic material. In terms of ease of deformation, the second another tray 470 may be formed of a flexible material.

**[0223]** Meanwhile, the heat exchanger 50 may include a first refrigerant pipe 510 that is in contact with or adjacent to the first tray assembly 410.

**[0224]** The heat exchanger 50 may further include a second refrigerant pipe 520 located adjacent to or in contact with the second tray assembly 450.

**[0225]** The first refrigerant pipe 510 and the second refrigerant pipe 520 may be connected in series or in parallel. Hereinafter, it will be described as an example that the first refrigerant pipe 510 and the second refrigerant pipe 520 are connected in series.

**[0226]** The first refrigerant pipe 510 may include a first inlet pipe 511. The first inlet pipe 511 may be located at one side of the first one tray 420. The first inlet pipe 511 may extend at a position adjacent to the driver 690. The first inlet pipe 511 may extend from one side of the driver 690. That is, the first inlet pipe 511 may extend in a space between the driver 690 and a rear wall 101a of the inner case 101.

**[0227]** The first refrigerant pipe 510 may further include a first bent pipe 512 extending from the first inlet pipe 511 toward one side.

**[0228]** The first refrigerant pipe 510 may further include a first cooling pipe 513 extending from the first bent pipe 512.

**[0229]** The first cooling pipe 513 may be in contact with the first another tray 430. Accordingly, the first another tray 430 may be cooled by refrigerant flowing through the first cooling pipe 513.

**[0230]** The first cooling pipe 513 may include a plurality of straight parts 513a. The first cooling pipe 513 may include a curved shaped connection part 513b connecting ends of two adjacent straight parts 513a.

**[0231]** The first inlet pipe 511 may be located adjacent to a boundary portion between the first tray assembly 410 and the second tray assembly 450. The first cooling pipe 513 may extend from the boundary portion in a direction away from the second tray assembly 450.

**[0232]** One straight part may contact an upper surface of a plurality of first another trays 430.

**[0233]** A plurality of straight parts 513a may be arranged at substantially the same height.

**[0234]** The first refrigerant pipe 510 may further include a first connection pipe 514 extending from an end of the first cooling pipe 513. The first connection pipe 514 may extend to be lower in height than the first cooling pipe 513.

**[0235]** The first refrigerant pipe 510 may further include a second cooling pipe 515 connected to the first connection pipe 514. The second cooling pipe 515 may be located lower than the first cooling pipe 513.

**[0236]** The second cooling pipe 515 may contact a side surface of the first another tray 430.

**[0237]** The second cooling pipe 515 may include a plurality of straight parts 515a and 515b. The second cooling pipe 515 may include a curved shaped connection portion 515c connecting two adjacent straight parts 515a and 515b.

**[0238]** A plurality of second first another trays 430 may be arranged in a plurality of columns and rows.

**[0239]** Among a plurality of straight parts 515a and 515b, a portion of straight parts 515a may contact one side of the first another tray 430 in one row. Among the plurality of straight parts 515a and 515b, another straight part 515b may contact the first another trays 430 of two adjacent rows, respectively.

**[0240]** For example, the portion of the straight part 515a may contact a first surface of first another tray in a first row. For example, another straight part 515b may contact a second surface of a first another tray in a first row and a first surface of a first another tray in a second row.

**[0241]** The first refrigerant pipe 510 may further include a first discharge pipe 516. The first discharge pipe 516 may extend from an end of the second cooling pipe 515. The first discharge pipe 516 may extend toward the second tray assembly 450. A height of the first discharge pipe 516 may be variable in an extension direction.

**[0242]** The second refrigerant pipe 520 may receive refrigerant from the first discharge pipe 516. A height of the first discharge pipe 516 may be variable in an extension direction. The second refrigerant pipe 520 may be a pipe formed integrally with the first discharge pipe 516 or may be a pipe coupled to the second discharge pipe 516.

**[0243]** The second refrigerant pipe 520 may include a second inlet pipe 522 connected to the first discharge pipe 516. The second inlet pipe 522 may be located at an opposite side of the driver 690 in the second tray assembly 450.

**[0244]** The second refrigerant pipe 520 may further include a third cooling pipe 523. The third cooling pipe 523 may extend from the second inlet pipe 522.

**[0245]** A portion of the second refrigerant pipe 520 (for example, the third cooling pipe 523) may be positioned higher than the second ice making cell 451.

**[0246]** The third cooling pipe 523 may contact the second one tray 460. Therefore, the second one tray 460 may be cooled by refrigerant flowing through the third cooling pipe 523. For example, the third cooling pipe 523 may contact an upper surface of the second one tray 460.

**[0247]** The liquid supply assembly 320 may be positioned higher than the third cooling pipe 523.

**[0248]** The third cooling pipe 523 may include a plurality of straight parts 523a. The third cooling pipe 523 may further include a curved shaped connection part 523b connecting two adjacent straight parts 523a.

**[0249]** One or more of a plurality of straight parts 523a may extend in a direction parallel to an arrangement direction of a plurality of second ice making cells 451. A plurality of straight parts 523a may overlap the second ice making cell 451 in a first direction. Some of the plurality of straight parts 523a may overlap the second opening 473 in the first direction. The first direction may be an arrangement direction of one cell and the other cell forming an second ice making cell 451.

**[0250]** The third cooling pipe 523 may be located higher than the first cooling pipe 513. The third cooling pipe 523 may be located higher than the second cooling pipe 515.

**[0251]** The second refrigerant pipe 520 may further include a second bent pipe 524 extending from an end of the third cooling pipe 523. A portion of the second bent pipe 524 may extend from an end of the third cooling pipe 523 along one side of the driver 690.

**[0252]** Another portion of the second bent pipe 524 may extend in another direction.

**[0253]** The second refrigerant pipe 520 may further include a second discharge pipe 525 connected to the second bent pipe 524. At least a portion of the second discharge pipe 525 may extend parallel to the first inlet pipe 511. The second discharge pipe 525 may be located at a rear side of the driver 690. That is, the second discharge pipe 525 may extend in a space between the driver 690 and a rear wall 101a of the inner case 101.

**[0254]** At least a portion of the second discharge pipe 525 and the first inlet pipe 511 may be arranged in an arrangement direction between a second one cell and a second another cell (first direction).

**[0255]** At least a portion of the second discharge pipe 525 may overlap the first inlet pipe 511 in the first direction. At least a portion of the second discharge pipe 525 may be located at one side of the first inlet pipe 511.

**[0256]** In this embodiment, the liquid supply assembly 320 may supply liquid to the ice maker 40 during a liquid supply process. The liquid supply assembly 320 may supply liquid to the ice maker 40 during an ice separation process.

**[0257]** When ice making is completed in the ice maker 40, the ice maker 40 may be maintained at a sub-zero temperature. The liquid supply assembly 320 can supply liquid supplied from an external liquid source 302 to the ice maker 40. Since liquid supplied from the external liquid source 302 may be liquid having normal temperature or liquid having a temperature similar to a normal temperature, liquid may be supplied from the liquid supply assembly 320 to the ice maker 40 in an ice separation process to increase a temperature of the ice maker 40.

**[0258]** The ice making device 1 may further include a controller 190. The controller 190 may control the liquid supply valve 304 during a liquid supply process.

**[0259]** The controller 190 may control the cooler in an ice making process. For example, the controller 190 may vary a cooling power of the cooler.

**[0260]** Although not limited, the controller 190 may variably control an output of one or more of the compressor 183 and the condenser fan 185 (or fan driver).

**[0261]** For example, the compressor 183 may be an inverter compressor capable of variable frequency.

**[0262]** The controller 190 may control the first pump 360 and/or the second pump 362 in the ice making process. The controller 190 may independently control the first pump 360 and the second pump 362.

**[0263]** The controller 190 may control an ice separation assembly in an ice separation process. For example, the ice separation assembly may include one or more of the liquid supply assembly 320 and the refrigerant pipes 510 and 520. The controller 190 may control liquid discharge from the liquid supply assembly 320 by controlling the liquid supply valve 304 in an ice separation process. The controller 190 may control the valve 188 to allow high-temperature refrigerant to flow to the refrigerant pipes 510 and 520 in the ice separation process.

**[0264]** The ice making device 1 may further include a first temperature sensor 191 for detecting a temperature of the first ice making cell 440 or a temperature around the first ice making cell 440.

**[0265]** The ice making device 1 may further include a second temperature sensor 192 for detecting a temperature of the second ice making cell 451 or a temperature around the second ice making cell 451.

**[0266]** The controller 190 may determine whether ice making in the first tray assembly 410 is completed based on a temperature detected by the first temperature sensor 191.

**[0267]** The controller 190 may determine whether ice making in the second tray assembly 450 is completed based on a temperature detected by the second temperature sensor 192.

**[0268]** Hereinafter, a series of processes by which ice is generated in an ice maker will be described.

**[0269]** FIG. 14 is a flowchart for explaining a control method of an ice making device according to a first embodiment of the present invention. FIG. 15 is a table showing a change in cooling power of a cooler according to a first embodiment of the present invention.

**[0270]** With reference to FIGS. 1 to 15, a process of generating ice in the ice making device 1 will be described.

**[0271]** A process for generating ice may include a liquid supply process (S1). A process for generating ice may further include an ice making process (S2 to S9). A process for generating ice may further include an ice separation process (S10).

**[0272]** When the liquid supply process starts (S1), the liquid supply valve 304 is turned on and liquid supplied from an external liquid source 302 flows along the liquid supply passage. The liquid flowing along the liquid supply passage is supplied to the ice maker 40 through the liquid supply assembly 320.

**[0273]** The liquid supplied to the ice maker 40 falls downward from the ice maker 40 and is stored in the liquid storage 350. When a liquid level of liquid stored in the liquid storage 350 reaches a reference liquid level, the liquid supply valve 304 is turned off and the liquid supply process is completed.

**[0274]** After the liquid supply process is completed, an ice making process begins.

**[0275]** In the ice making process, a cooler operates and low-temperature refrigerant may flow into the heat exchanger 50. For example, the compressor 183 may be turned on (S2). Of course, the condenser fan 185 may also be turned on. Alternatively, the compressor 183 and the condenser fan 185 may be turned on before the ice making process and remain turned on during the ice making process. The valve 188 can be turned off.

**[0276]** In the ice making process, liquid may be supplied to the ice maker 40 by the liquid supplier 330.

**[0277]** The controller 390 may turn on the pumps 360 and 362 simultaneously or sequentially.

**[0278]** The cooler may be operated with a first cooling power at a beginning of operation (S3). For example, the compressor 183 may be operated at a first frequency (A1, B1, C1).

**[0279]** For example, when the first pump 360 operates, liquid may be supplied to the first tray assembly 410 through the sub\_first liquid supplier 380.

**[0280]** The sub\_first liquid supplier 380 may include a first liquid supply nozzle 381. The sub\_second liquid supplier 382 may include a second liquid supply nozzle 383.

**[0281]** The first liquid supply nozzle 381 may be positioned at one side of the first tray assembly 410. Liquid sprayed from the first liquid supply nozzle 381 may be supplied to the first ice making cell 440 of the first tray assembly 410.

**[0282]** Liquid sprayed from the first liquid supply nozzle 381 is supplied to the first ice making cell 440 410 through a first opening of the first one tray 420.

**[0283]** Liquid supplied to the first ice making cell 440 flows toward one surface of the first another tray 430. A portion of liquid within the first ice making cell 440 is frozen by the first refrigerant pipe 510. Unfrozen liquid falls downward again through the first opening 423. Liquid that falls downward through the first opening 423 is stored in the liquid storage 350 again.

**[0284]** During the ice making process, ice is generated at one side of the first ice making cell 440 and grows toward another side. As liquid is sprayed into the first ice making cell 440, a portion of the liquid is frozen. In a process of spraying the liquid into the first one tray 420 or the first another tray 430, air bubbles in the liquid may be discharged from the liquid.

**[0285]** When the second pump 362 operates, liquid may be supplied to the second tray assembly 450 through the sub\_second liquid supplier 382.

**[0286]** The second liquid supply nozzle 383 may be positioned at one side of the second tray assembly 450. Liquid sprayed from the second liquid supply nozzle 383 may be supplied to the second ice making cell 451 of the second tray assembly 450.

**[0287]** Liquid sprayed from the second liquid supply nozzle 383 is supplied into the second ice making cell 451 through a supporter opening 482a of the supporter 480 and a second opening 473 of the second another tray 470.

**[0288]** Liquid supplied to the second ice making cell 451 flows toward an inner upper surface of the second one tray 460. Some of the liquid within the second ice making cell 451 may be frozen by the second refrigerant pipe 520. Unfrozen liquid falls downward again through the second opening 473. Liquid that falls downward through the second opening 473 is stored again in the liquid storage 350.

**[0289]** The controller 190 may determine whether an elapsed time after the pumps 360 and 362 are turned on or the cooler operates at a first cooling power is greater than a first reference time t1 (S4).

**[0290]** As a result of the determination in step S4, if it is determined that the elapsed time is greater than the first reference time t1, the controller 190 may control the cooler to operate at a second cooling power (S5). The second cooling power is greater than the first cooling power. For example, the compressor 183 may operate at a second frequency A2, B2, and C2 that is greater than the first frequency.

**[0291]** The controller 190 may determine whether an elapsed time after a cooling power of the cooler is changed to a second cooling power is greater than a second reference time t2 (S6).

**[0292]** As a result of the determination in step S6, if it is determined that the elapsed time is greater than the second reference time t2, the controller 190 may control the cooler to operate at a third cooling power (S7). The third cooling power is greater than the second cooling power. For example, the compressor 183 may operate at a third frequency A3, B3 and C3 that is greater than the

second frequency.

**[0293]** At this time, a difference between the first cooling power and the second cooling power may be equal to or different from a difference between the second cooling power and the third cooling power.

**[0294]** While performing the ice making process, the controller 190 may determine whether ice making is completed in the tray assembly.

**[0295]** For example, if the controller 190 determines that an elapsed time after a cooling power of the cooler is changed to a third cooling power is greater than the third reference time t3 (S8), it may determine that an ice making is completed.

**[0296]** As a result of the determination in step S8, if it is determined that the elapsed time is greater than the third reference time t3 (S8), the controller 190 may turn off the pumps 360 and 362 (S9).

**[0297]** As another example, to determine a completion of an ice making, the controller 190 may determine whether a temperature detected by temperature sensors 191 and 192 is lower than an end reference temperature. If it is determined that a temperature detected by the temperature sensors 191 and 192 is lower than an end reference temperature, the controller 190 may turn off the pumps 360 and 362.

**[0298]** When the ice making process is completed, the controller 190 can perform an ice separation process (S10).

**[0299]** When the ice separation process starts, the valve 188 may be turned on. When the valve 188 is turned on, high-temperature refrigerant compressed in the compressor 183 may flow into the heat exchanger 50. High-temperature refrigerant flowing into the heat exchanger 50 may be heat exchanged with the ice maker 40. When high-temperature refrigerant flows into the heat exchanger 50, heat may be transferred to the ice maker 40.

**[0300]** The first ice I1 may be separated from the first tray assembly 410 by the heat transferred to the ice maker 40. When the first ice I1 is separated from the first tray assembly 410, the first ice I1 may fall onto the guide 70. The first ice I1 that fell onto the guide 70 may be stored in the first storage space 132.

**[0301]** The second ice I2 may be separated from at least a surface of the second one tray 460 by heat transferred to the ice maker 40.

**[0302]** As time passes, or when a temperature of each tray assembly reaches a set temperature, a flow of high-temperature refrigerant to the heat exchanger 50 may be blocked.

**[0303]** Next, the driver 690 may operate to separate the second ice I2 from the second tray assembly 450. By operating the driver 690, the second another tray 470 may be moved in a forward direction (clockwise direction with respect to FIG. 13).

**[0304]** When the second ice I2 is separated from the second one tray 460 and second another tray 470 by high-temperature refrigerant flowing into the heat ex-

changer 50, the second another tray 470 may be moved while second ice I2 is supported on the second another tray 470. In this case, when the second another tray 470 moves at an angle of approximately 90 degrees, the second ice I2 may fall from the second another tray 470.

**[0305]** On the other hand, when the second ice I2 has been separated from the second one tray 460 by the high-temperature refrigerant flowing into the heat exchanger 50 but has not yet been separated from the second another tray 470, the pusher 490 presses the second another tray 470 and the second ice I2 may be separated from the second another tray 470 and falls downward while the second another tray 470 moves to an ice separation angle.

**[0306]** When the second ice I2 is separated from the second tray assembly 450, the second ice I2 may fall onto the guide 70. The second ice I2 that fell onto the guide 70 may be stored in the second storage space 134.

**[0307]** After the second another tray 470 is moved in the forward direction, the second another tray 470 is moved in a reverse direction (counterclockwise direction in the drawing) by the driver 690 and in contact with the second one tray 460.

**[0308]** Hereinafter, a technical significance of varying a cooling power of the cooler in the ice making process will be described in detail.

**[0309]** In the present invention, the ice can be generated at one end of the ice making cell and grow to the other side. For example, the one end may be an uppermost side, and the other side may be a lower side.

**[0310]** When ice grows, if a difference between a temperature of liquid supplied to the ice making cell and a temperature of cold supplied to the ice making cell is large, there is a disadvantage in that crack is formed in ice during an ice making process. Crack increases an opacity of ice.

**[0311]** In this embodiment, an initial cooling power of the cooler is relatively low at a beginning of an ice making to reduce an occurrence of crack during an ice making process.

**[0312]** As the ice making process progresses, ice grows. As a thickness of ice increases, the ice itself acts as thermal resistance and heat conduction efficiency decreases.

**[0313]** If a cooling power of the cooler is maintained at an initial cooling power, an occurrence of crack can be reduced, but an ice making speed may be reduced. In addition, the heat exchanger is located at one side of the ice maker, and the ice grows on the other side, so when a cooling power of the cooler is maintained at an initial cooling power, as the ice grows, a distance between the heat exchanger and a portion of the ice that contacts liquid increases, an ice making speed may be decreased.

**[0314]** Therefore, in this embodiment, a cooling power of the cooler may be increased in the ice making process so that an ice making speed can be increased while preventing the occurrence of crack.

**[0315]** That is, in this present invention, a cooling

power of the cooler may be gradually increased in an ice making process.

**[0316]** In the above embodiment, it is explained that a cooling power of the cooler is varied twice, but it should be noted that this is an example and there is no limitation on a number of times of varying a cooling power of the cooler.

**[0317]** According to this embodiment, by increasing a cooling power of the cooler in an ice making process, an occurrence of crack can be reduced, and thus a transparency of ice can be increased, and an ice making speed can also be increased.

**[0318]** Meanwhile, a cooling power of the cooler may vary depending on an indoor temperature. In this specification, the indoor temperature may be a temperature of a space where the ice making device 1 is disposed.

**[0319]** The higher the indoor temperature, the greater a cooling power of the cooler. That is, a first cooling power of the cooler when the indoor temperature is greater than a first indoor temperature T1 may be greater than a first cooling power of the cooler when the indoor temperature is equal to or less than the first indoor temperature T1.

**[0320]** A first cooling power of the cooler when the indoor temperature is greater than the second indoor temperature T2 may be greater than the first cooling power of the cooler when the indoor temperature is equal to or less than the second indoor temperature T2.

**[0321]** Referring to FIG. 15, when the indoor temperature is equal to or less than the first indoor temperature T1, a frequency of the compressor may be varied in an order of A1, A2, and A3. When the indoor temperature is greater than a first indoor temperature T1 and less than a second indoor temperature T2, a frequency of the compressor may be changed in an order of B1, B2, and B3. When the indoor temperature is greater than a second indoor temperature T2, a frequency of the compressor may be varied in an order of C1, C2, and C3.

**[0322]** A2 may be equal to or different from B1. B2 may be equal to or different from C1. A3 may be equal to or different from B2. B3 may be equal to or different from C2.

**[0323]** FIG. 16 is a flowchart for explaining a control method of an ice making device according to a second embodiment of the present invention. FIG. 17 is a table showing a change in cooling power of a cooler according to a second embodiment of the present invention.

**[0324]** The present embodiment is the same as a first embodiment in other portions, but is different in determining a timing of varying a cooling power of the cooler. Accordingly, only characteristic portions of this embodiment will be described.

**[0325]** Referring to FIGS. 16 and 17, when the liquid supply process starts (S1), the liquid supply valve 304 is turned on and liquid supplied from an external liquid supply source 302 flows along the liquid supply passage.

**[0326]** Liquid flowing along the liquid supply passage is supplied to the ice maker 40 through the liquid supply assembly 320. Liquid supplied to the ice maker 40 falls to a lower side of the ice maker 40 and is stored in the liquid storage 350. When a level of liquid stored in the liquid

storage 350 reaches a reference level, the liquid supply valve 304 is turned off and the liquid supply process is completed.

**[0327]** After the liquid supply process is completed, an ice making process starts.

**[0328]** In the ice making process, the cooler operates to allow low-temperature refrigerant to flow into the heat exchanger 50. For example, the compressor 183 may be turned on (S2). Of course, the condenser fan 185 may also be turned on. Alternatively, the compressor 183 and the condenser fan 185 may be turned on before the ice making process and remained in a turned-on state during the ice making process. The valve 188 can be turned off.

**[0329]** In the ice making process, liquid may be supplied to the ice maker 40 by the liquid supplier 330.

**[0330]** The controller 190 may turn on the pumps 360 and 362 simultaneously or sequentially.

**[0331]** The cooler may be operated at a first cooling power at a beginning of operation (S3). For example, the compressor 183 may be operated at a first frequency (A1, B1, C1).

**[0332]** For example, when the first pump 360 operates, liquid may be supplied to the first tray assembly 410 through the sub\_first liquid supplier 380.

**[0333]** The first liquid supply nozzle 381 may be disposed at one side of the first tray assembly 410. Liquid sprayed from the first liquid supply nozzle 381 is supplied to a first ice making cell 440 of the first tray assembly 410.

**[0334]** When the second pump 362 is operated at a first output, liquid may be supplied to the second tray assembly 450 through the sub\_second liquid supplier 382.

**[0335]** The controller 190 may determine whether a temperature detected by the temperature sensors 191 and 192 is lower than a first set temperature a while the cooler is operating at a first cooling power (S11).

**[0336]** As a result of the determination in step S11, while the cooler is operated at a first cooling power, if it is determined that a temperature detected by the temperature sensors 191 and 192 is lower than a first set temperature, the controller 190 may control the cooler such that the assembly operates at a second cooling power (S5). The second cooling power is greater than the first cooling power.

**[0337]** As the ice making process is performed, a temperature detected by the temperature sensors 191 and 192 may be decreases. In this embodiment, a timing of varying a cooling power of the cooler may be determined based on a change in temperature detected by the temperature sensors 191 and 192.

**[0338]** When the cooler operates at a second cooling power, an ice making speed may be increased compared to when the cooler operates at a first cooling power.

**[0339]** The controller 190 may determine whether a temperature detected by the temperature sensors 191 and 192 is lower than a second set temperature b while the cooler is operating at a second cooling power (S12).

**[0340]** The second set temperature b is lower than the first set temperature a.

**[0341]** As a result of the determination in step S12, if it is determined that a temperature detected by the temperature sensors 191 and 192 is lower than a second set temperature b, the controller 190 may control cooler such that the cooler operates at the third cooling power. The third cooling power is greater than the second cooling power.

**[0342]** While performing the ice making process, the controller 190 may determine whether an ice making is completed in the tray assembly.

**[0343]** For example, the controller 190 may determine whether a temperature detected by the temperature sensors 191 and 192 is lower than a third set temperature c (S13). The third set temperature c is lower than the second set temperature b.

**[0344]** As a result of the determination in step S13, if it is determined that a temperature detected by the temperature sensors 191 and 192 is lower than a third set temperature c, the controller 190 may turn off the pumps 360 and 362 (S9). That is, if it is determined that a temperature detected by the temperature sensors 191 and 192 is lower than a third set temperature c, the controller 190 may determine that an ice making is completed.

**[0345]** When an ice making process is completed, the controller 190 may perform an ice separation process (S10).

**[0346]** In this embodiment, a cooling power of the cooler may vary depending on an indoor temperature.

**[0347]** The higher the indoor temperature, the greater a cooling power of the cooler. That is, a first cooling power of the cooler when the indoor temperature is greater than a first indoor temperature T1 may be greater than a first cooling power of the cooler when the indoor temperature is equal to or less than a first indoor temperature T1.

**[0348]** A first cooling power of the cooler when the indoor temperature is greater than a second indoor temperature T2 may be greater than a first cooling power of the cooler when the indoor temperature is equal to or less than a second indoor temperature T2.

**[0349]** Referring to FIG. 17, when the indoor temperature is equal to or less than a first indoor temperature T1, a frequency of the compressor may be changed in an order of A1, A2, and A3. When the indoor temperature is greater than a first indoor temperature T1 and less than a second indoor temperature T2, a frequency of the compressor may be changed in an order of B1, B2, and B3. When the indoor temperature is greater than a second indoor temperature T2, a frequency of the compressor may be changed in an order of C1, C2, and C3.

**[0350]** A2 may be equal to or different from B1. B2 may be equal to or different from C1. A3 may be equal to or different from B2. B3 may be equal to or different from C2.

**[0351]** FIG. 18 is a flowchart for explaining a control method of an ice making device according to a third embodiment of the present invention.

**[0352]** The present embodiment is the same as a first embodiment or a second embodiment in other portions,

but is different in determining a timing of varying a cooling power of the cooler. Accordingly, only characteristic portions of this embodiment will be described.

**[0353]** Referring to FIG. 18, when the liquid supply process starts (S1), the liquid supply valve 304 is turned on and liquid supplied from an external liquid supply source 302 flows along the liquid supply passage.

**[0354]** Liquid flowing along the liquid supply passage is supplied to the ice maker 40 through the liquid supply assembly 320. Liquid supplied to the ice maker 40 falls to a lower side of the ice maker 40 and is stored in the liquid storage 350. When a level of liquid stored in the liquid storage 350 reaches a reference level, the liquid supply valve 304 is turned off and the liquid supply process is completed.

**[0355]** After the liquid supply process is completed, the ice making process starts.

**[0356]** In the ice making process, the cooler operates to allow low-temperature refrigerant to flow into the heat exchanger 50. For example, the compressor 183 may be turned on (S2). Of course, the condenser fan 185 may also be turned on. Alternatively, the compressor 183 and the condenser fan 185 may be turned on before the ice making process and remained in a turned-on state during the ice making process. The valve 188 may be turned off.

**[0357]** In the ice making process, liquid may be supplied to the ice maker 40 by the liquid supplier 330.

**[0358]** The controller 190 may turn on the pumps 360 and 362 simultaneously or sequentially.

**[0359]** The cooler may be operated at a first cooling power at a beginning of operation (S3). For example, the compressor 183 may be operated at a first frequency.

**[0360]** For example, when the first pump 360 operates, liquid may be supplied to the first tray assembly 410 through the sub\_first liquid supplier 380.

**[0361]** The first liquid supply nozzle 381 may be disposed at one side of the first tray assembly 410. Liquid sprayed from the first liquid supply nozzle 381 is supplied to a first ice making cell 440 of the first tray assembly 410.

**[0362]** When the second pump 362 is operated at a first output, liquid may be supplied to the second tray assembly 450 through the sub\_second liquid supplier 382.

**[0363]** The controller 190 may determine whether a difference value between a temperature of a tray and liquid detected by the temperature sensors 191 and 192 is greater than a first reference value D1 while the cooler is operating at a first cooling power (S21).

**[0364]** In this embodiment, a temperature of liquid may be set to a room temperature and stored in a memory in advance, or may be stored in a memory in advance as a temperature set differently based on an indoor temperature. Alternatively, it is also possible to detect a temperature of liquid using a separate temperature sensor.

**[0365]** As a result of the determination in step S21, when the cooler is operated at the first cooling power, if it is determined that a difference value between a temperature of a tray and a temperature of liquid detected by the temperature sensors 191 and 192 is greater than a first

reference value, the controller 190 may control the cooler so that the cooler operates at a second cooling power (S5). The second cooling power is greater than the first cooling power.

5 **[0366]** As the ice making process is performed, a temperature of a tray detected by the temperature sensors 191 and 192 may be decreased. On the other hand, a temperature of the liquid may be constant at a room temperature or may be similar to a room temperature.

10 **[0367]** In this embodiment, a timing of varying a cooling power of the cooler may be determined based on a change in a difference value (absolute value) between a temperature of a tray and the temperature of liquid detected by the temperature sensors 191 and 192.

15 **[0368]** When the cooler operates at a second cooling power, an ice making speed may be increased compared to when the cooler operates at a first cooling power.

**[0369]** The controller 190 may determine whether a difference value between a temperature of a tray and a temperature of liquid detected by the temperature sensors 191 and 192 is greater than a second reference value D2 while the cooler is operating at a second cooling power (S22).

20 **[0370]** The second reference value D2 is greater than the first reference value D1.

25 **[0371]** As a result of the determination in step S22, if it is determined that a difference value between a temperature of a tray and a temperature of liquid detected by the temperature sensors 191 and 192 is lower than a second reference value D2, the controller 190 may control the cooler such that the cooler operates at a third cooling power (S7). The third cooling power is greater than the second cooling power.

30 **[0372]** While performing the ice making process, the controller 190 may determine whether an ice making is completed in the tray assembly.

35 **[0373]** For example, the controller 190 may determine whether a difference value between a temperature of a tray and a temperature of liquid detected by the temperature sensors 191 and 192 is greater than a third reference value D3 (S23). The third reference value (D3) is greater than the second reference value (D2).

40 **[0374]** As a result of the determination in step S23, if it is determined that a difference value between a temperature of a tray and a temperature of liquid detected by the temperature sensors 191 and 192 is greater than a third reference value D3, the controller 190 may turn off the pumps 360 and 362. That is, if it is determined that a difference value between a temperature of a tray and a temperature of liquid detected by the temperature sensors 191 and 192 is greater than a third reference value D3, the controller 190 may determine that an ice making is completed.

45 **[0375]** When an ice making process is completed, the controller 190 may perform an ice separation process (S10).

50 **[0376]** In this embodiment, a cooling power of the cooler may vary depending on an indoor temperature.

**[0377]** In the third embodiment above, step S21 may be replaced with a step of determining whether a difference between a temperature of liquid and a temperature of an evaporator is greater than a first reference value. A temperature of an evaporator may be sensed by a separate temperature sensor, not shown.

**[0378]** Step S22 may be replaced with a step of determining whether a difference between a temperature of liquid and a temperature of an evaporator is greater than a second reference value. Step S23 may be replaced with a step of determining whether a difference between a temperature of liquid and a temperature of an evaporator is greater than a third reference value.

**[0379]** In an ice making process, a temperature of the evaporator may be lowered similar to a reduction pattern of a temperature of a tray.

**[0380]** Meanwhile, unlike a third embodiment, a cooling power of a cooler may be increased, decreased, or maintained during an ice making process, depending on a capacity of a first cooling power, which is an initial cooling power of the cooler.

**[0381]** For example, a cooling power of the cooler can be adjusted based on a difference between a temperature of supplied liquid and a temperature of an evaporator.

**[0382]** The cooler may operate with a predetermined first cooling power. While the cooler is operating at the first cooling power, if it is determined that a difference between a temperature of supplied liquid and a temperature of an evaporator is greater than a first reference value, the cooler may be operated at a second cooling power less than a first cooling power. Crack may be formed if a difference value between a temperature of liquid supplied at a beginning of an ice making process and a temperature of an evaporator is greater than a first reference value. Therefore, in order to reduce generating of crack, a cooling power of the cooler may be reduced.

**[0383]** Alternatively, while the cooler is operating at the first cooling power, if a difference value between a temperature of supplied liquid and a temperature of an evaporator is less than a second reference value, the cooler may be operated at a third cooling power greater than the first cooling power. At this time, the second reference value is less than the first reference value.

**[0384]** When a difference value between a temperature of the supplied liquid and a temperature of an evaporator is less than a second reference value, an ice making speed may be reduced, and thus a cooling power of the cooler may be increased to increase an ice making speed.

**[0385]** Alternatively, while the cooler is operating at the first cooling power, if a difference between a temperature of supplied liquid and a temperature of an evaporator is less than the first reference value and equal to or greater than the second reference value, a cooling power of the cooler may be maintained at the first cooling part.

**[0386]** The predetermined first cooling power may vary depending on an indoor temperature described above.

The predetermined first cooling power may be determined based on a type of ice. That is, a first cooling power may be determined depending on a shape of an ice making cell, a transparency or size of ice.

**[0387]** based on an elapse of time or a change in temperature of a tray, a difference between a temperature of the supplied liquid and a temperature of an evaporator may be compared to a first reference value or a second reference value. That is, a determination of a timing of varying a cooling power of the cooler may be performed based on a change in temperature of a tray or an elapse of time.

**[0388]** As another example, unlike a third embodiment, a cooling power of a cooler may be increased, decreased, or maintained during an ice making process, depending on a capacity of the first cooling power, which is an initial cooling power of the cooler.

**[0389]** For example, a cooling power of the cooler may be adjusted based on a difference between a temperature of supplied liquid and a temperature of a tray.

**[0390]** The cooler may be operated at a predetermined first cooling power. While the cooler is operating with the first cooling power, if a difference between a temperature of supplied liquid and a temperature of a tray is greater than a first reference value, the cooler may be operated at a second cooling power less than the first cooling power. If a difference between a temperature of liquid supplied at a beginning of an ice making process and a temperature of a tray is greater than a first reference value, crack may be formed. Therefore, to reduce generating of crack, a cooling power of the cooler may be reduced.

**[0391]** Alternatively, while the cooler is operating at the first cooling power, if a difference between a temperature of supplied liquid and a temperature of a tray is less than a second reference value, the cooler may be operated at a third cooling power greater than the first cooling power. At this time, the second reference value is less than the first reference value.

**[0392]** When a difference between a temperature of the supplied liquid and a temperature of a tray is less than a second reference value, an ice making speed may be reduced, and thus a cooling power of the cooler may be increased to increase an ice making speed.

**[0393]** Alternatively, while the cooler is operating at the first cooling power, if a difference between a temperature of supplied liquid and a temperature of a tray is less than the first reference value and equal to or greater than the second reference value, a cooling power of the cooler may be maintained at the first cooling power.

**[0394]** The predetermined first cooling power may vary depending on an indoor temperature described above. The predetermined first cooling power may be determined based on a type of ice. That is, the first cooling power may be determined depending on a shape of an ice making cell, a transparency or size of ice.

**[0395]** A difference between a temperature of the supplied liquid and a temperature of a tray may be compared to a first reference value or a second reference value

based on a change in temperature of a tray or an elapse of time. That is, a determination of a timing of varying a cooling power of the cooler may be performed based on a change in temperature of a tray or an elapse of time.

**[0396]** As another example, depending on a shape of an ice making cell, a variable pattern of a cooling power of a cooler may be determined.

**[0397]** For example, if an ice making cell (or generated ice) includes a portion where a volume or mass per unit height increases, a cooling power of the cooler may be increased in an ice making process. For example, if an ice making cell is formed in a triangular shape, a cooling power of the cooler may be increased in an ice making process.

**[0398]** Alternatively, if an ice making cell (or generated ice) includes a portion where a volume or mass per unit height is reduced, a cooling power of the cooler may be reduced in an ice making process. For example, if an ice making cell is formed in a shape of an inverted triangle, a cooling power of a cooler may be reduced in an ice making process.

**[0399]** Meanwhile, the above-mentioned control method of an ice making device may be equally applied even when an ice maker includes one tray assembly.

**[0400]** It is also possible to apply technology applied to the ice making device to a refrigerator. That is, the refrigerator may include some or all of the components of the ice making device 1.

**[0401]** First, the ice maker 40 in the ice making device 1 can be applied to the refrigerator. The refrigerator may include a cabinet having a storage chamber, and a door that opens and closes the storage chamber.

**[0402]** An ice making chamber may be provided in the cabinet or the door. An ice maker 40 may be provided in the ice making chamber with the same structure or a similar form as the ice maker 40 of this embodiment.

**[0403]** In this embodiment, the cooler in the ice making device 1 may be replaced with a cooler or a refrigerant cycle that cools the storage chamber of the refrigerator.

**[0404]** A guide 70, a liquid supply assembly 320, and a liquid supplier 330 provided in the ice making device 1 may also be applied to the refrigerator or may be modified in shape, size, or location to suit characteristics of the refrigerator.

## Claims

1. An ice making device comprising:

a tray provided in an ice making chamber and having an ice making cell for generating ice;  
a cooler configured to provide cold for ice generation in the ice making cell in an ice making process; and  
a controller configured to control the cooler.

2. The ice making device of claim 1,

wherein the controller is configured to increase a cooling power of the cooler so that an ice making speed increases after supplying cold to the tray.

3. The ice making device of claim 2, wherein the controller is configured to gradually increase a cooling power of the cooler.

4. The ice making device of claim 2, wherein the controller is configured to gradually increase a cooling power of the cooler based on an elapse of time.

5. The ice making device of claim 2, further comprising a temperature sensor for detecting a temperature of the tray, wherein the controller is configured to increase a cooling power of the cooler according to a change in temperature detected by the temperature sensor.

6. The ice making device of claim 2, further comprising a temperature sensor for detecting a temperature of a space where an ice making device is disposed, wherein a cooling power of the cooler is determined based on a temperature detected by the temperature sensor.

7. An ice making device comprising:

a tray provided in an ice making chamber and having an ice making cell for generating ice;  
a cooler including a compressor that operates to generate ice in the ice making cell in an ice making process and an evaporator for providing cold to the tray;  
a temperature sensor for detecting a temperature of the evaporator; and  
a controller configured to control the compressor.

8. The ice making device of claim 7, wherein the controller is configured to adjust a cooling power of the compressor based on a difference value between a temperature of liquid supplied to the ice making cell and a temperature of the evaporator detected by the temperature sensor.

9. The ice making device of claim 8,

wherein the controller is configured to operate the compressor at a predetermined first cooling power provide cold to the tray, wherein when a difference value between a temperature of the liquid and a temperature of the evaporator is greater than a first reference value, the controller is configured to operate the compressor at a second cooling power greater

than the first cooling power.

10. The ice making device of claim 9,  
wherein when a difference value between a tem-  
perature of the liquid and a temperature of the eva-  
porator is less than a second reference value, which  
is less than the first reference value, the controller is  
configured to operate the compressor at a third cool-  
ing power less than the first cooling power.

11. The ice making device of claim 10,  
wherein when a difference value between a tem-  
perature of the liquid and a temperature of the eva-  
porator is equal to or less than the first reference  
value and equal to or greater than the second re-  
ference value, the controller is configured to maintain  
the first cooling power of the compressor.

12. The ice making device of claim 8,  
  
wherein the controller is configured to operate  
the compressor at a predetermined first cooling  
power to provide cold to the tray,  
wherein when a difference value between a  
temperature of the liquid and a temperature of  
the evaporator is less than a second reference  
value, the controller is configured to operate the  
compressor at a third cooling power greater than  
the first cooling power.

13. The ice making device of claim 8,  
  
wherein the controller is configured to operate  
the compressor at a predetermined first cooling  
power to provide cold to the tray,  
wherein when a difference value between a  
temperature of the liquid and a temperature of  
the evaporator is equal to or less than the first  
reference value and equal to or greater than the  
second reference value, the controller is config-  
ured to maintain the first cooling power of the  
compressor.

14. The ice making device of claim 9,  
wherein the predetermined first cooling power is  
determined based on a temperature of a space  
where an ice making device is disposed, or is de-  
termined based on a type of ice generated in the ice  
making cell.

15. The ice making device of claim 8,  
wherein a timing for determining whether to adjust a  
cooling power of the cooler is determined based on a  
change in temperature of the tray detected by a  
temperature sensor, or is determined based on an  
elapse of time.

16. An ice making device comprising:

a tray having an ice making cell for generating  
ice and provided in an ice making chamber;  
a cooler configured to provide cold to the tray for  
generating ice in the ice making cell in an ice  
making process;  
a temperature sensor for detecting a tempera-  
ture of the tray; and  
a controller configured to control the cooler.

17. The ice making device of claim 16,  
wherein the controller is configured to adjust a cool-  
ing power of the cooler based on a difference value  
between a temperature of liquid supplied to the ice  
making cell and a temperature of the tray detected by  
the temperature sensor.

18. The ice making device of claim 17,  
  
wherein the controller is configured to operate  
the cooler at a predetermined first cooling power  
to provide cold to the tray,  
wherein when a difference value between a  
temperature of the liquid and a temperature of  
the tray is greater than a first reference value, the  
controller is configured to operate the cooler at a  
second cooling power greater than the first cool-  
ing power.

19. The ice making device of claim 18,  
wherein when a difference value between a tem-  
perature of the liquid and a temperature of the tray  
is less than the second reference value, which is less  
than the first reference value, the controller is con-  
figured to operate the cooler at a third cooling power  
less than the first cooling power.

20. The ice making device of claim 19,  
wherein when a difference value between a tem-  
perature of the liquid and a temperature of the tray  
is equal to or less than the first reference value and  
equal to or greater than the second reference value,  
the controller is configured to maintain the first cool-  
ing power of the cooler.

21. The ice making device of claim 19,  
  
wherein the controller is configured to operate  
the cooler at a predetermined first cooling power  
to provide cold to the tray,  
wherein when a difference value between a  
temperature of the liquid and a temperature of  
the tray is less than the second reference value,  
the controller is configured to operate the cooler  
at a third cooling power greater than the first  
cooling power.

22. The ice making device of claim 17,

wherein the controller is configured to operate the cooler at a predetermined first cooling power to provide cold to the tray,  
 wherein when a difference value between a temperature of the liquid and a temperature of the tray is equal to or less than the first reference value and equal to or greater than the second reference value, the controller is configured to maintain the first cooling power of the cooler.

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- 23.** The ice making device of claim 18,  
 wherein the predetermined first cooling power is determined based on a temperature of a space where an ice making device is disposed, or is determined based on a type of ice generated in the ice making cell.

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- 24.** The ice making device of claim 17,  
 wherein a timing of determining whether to adjust a cooling power of the cooler is determined based on a change in temperature of a tray detected by the temperature sensor, or is determined based on an elapsed time.

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- 25.** An ice making device comprising:

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a tray provided in an ice making chamber and having an ice making cell for generating ice;  
 a cooler configured to provide cold for generating ice in the ice making cell in an ice making process; and  
 a controller configured to control the cooler, wherein when the ice making cell includes a portion where a volume or mass per unit height increases, a cooling power of the cooler is increased during an ice making process, and wherein when the ice making cell includes a portion where a volume or mass per unit height decreases, a cooling power of the cooler is decreased during an ice making process.

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- 26.** A refrigerator comprising:

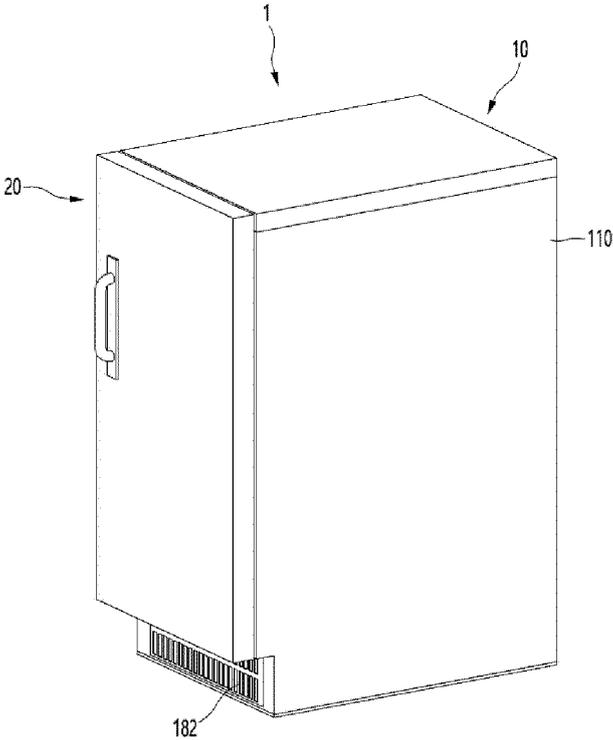
a cabinet having a storage chamber;  
 a door that opens and closes the storage chamber;  
 an ice making chamber provided in the door or the cabinet;  
 a tray provided in an ice making chamber and having an ice making cell for generating ice;  
 a cooler configured to provide cold to the tray in an ice making process; and  
 a controller configured to control the cooler, wherein the controller is configured to vary a cooling power of the cooler so that an ice making speed increases after supplying cold to the tray.

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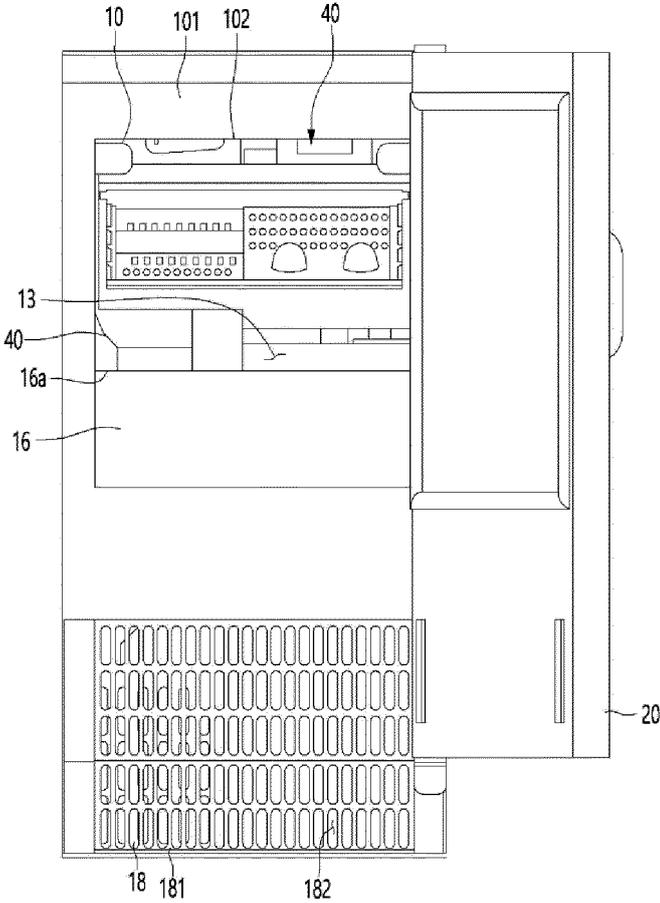
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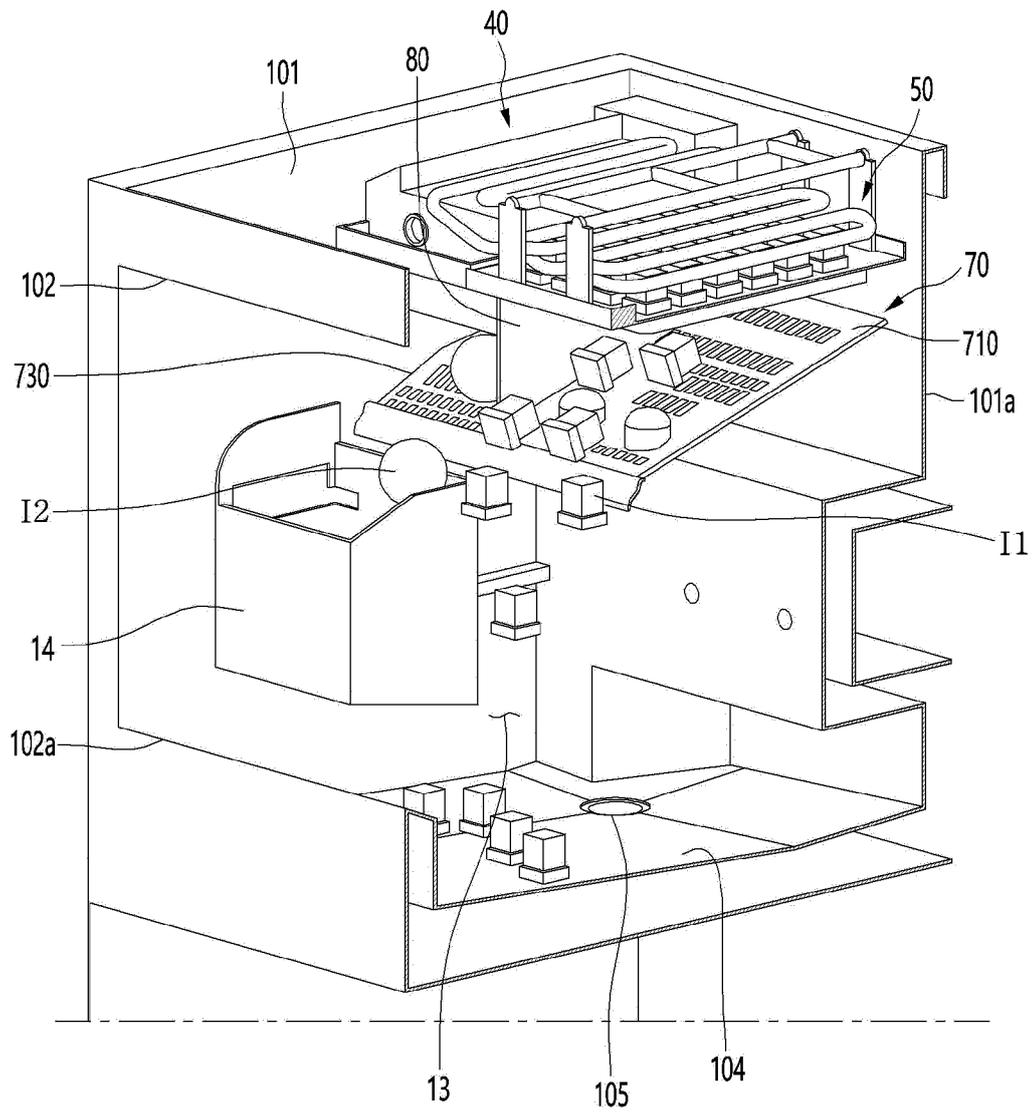
【Figure 1】



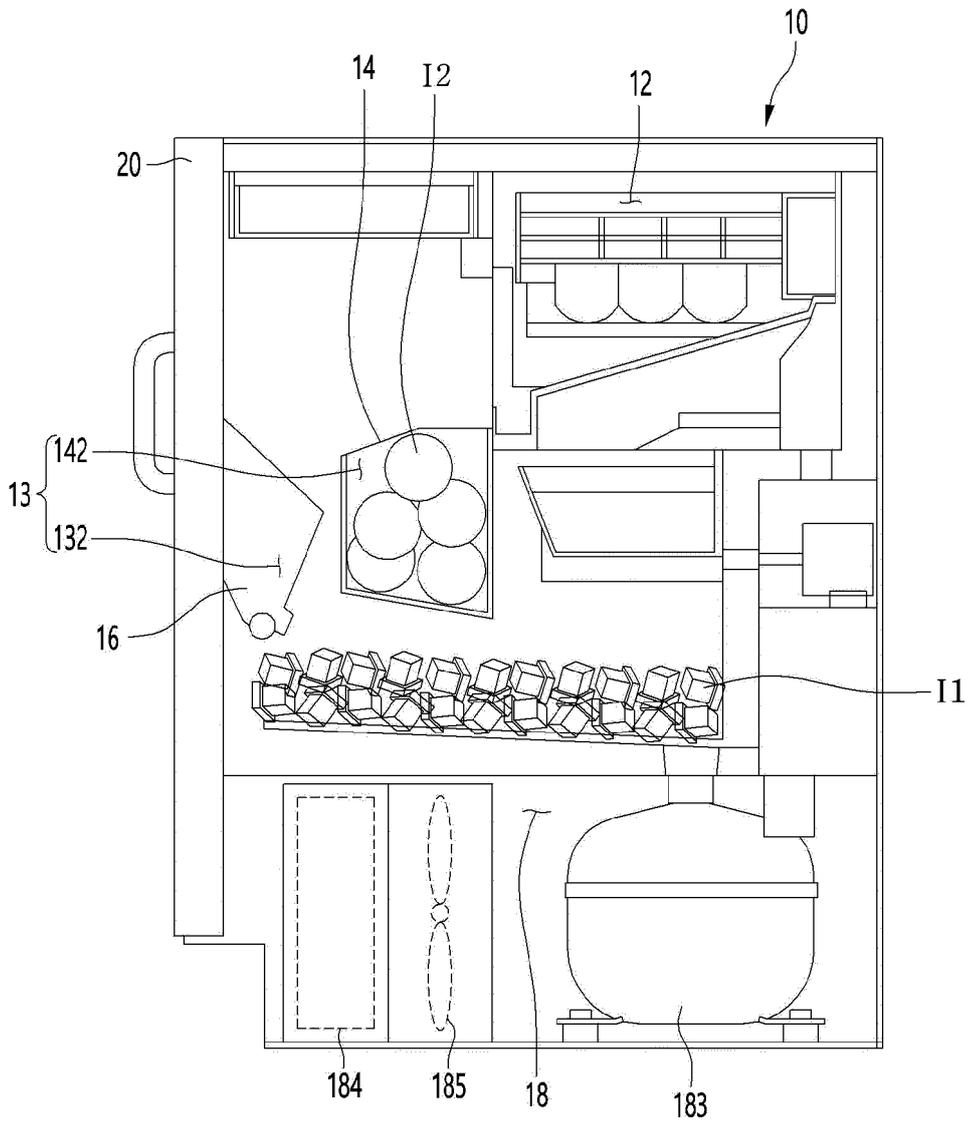
【Figure 2】



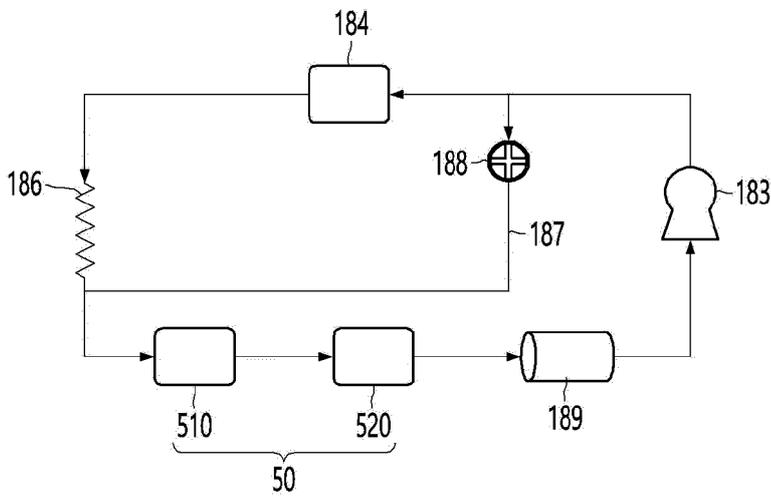
【Figure 3】



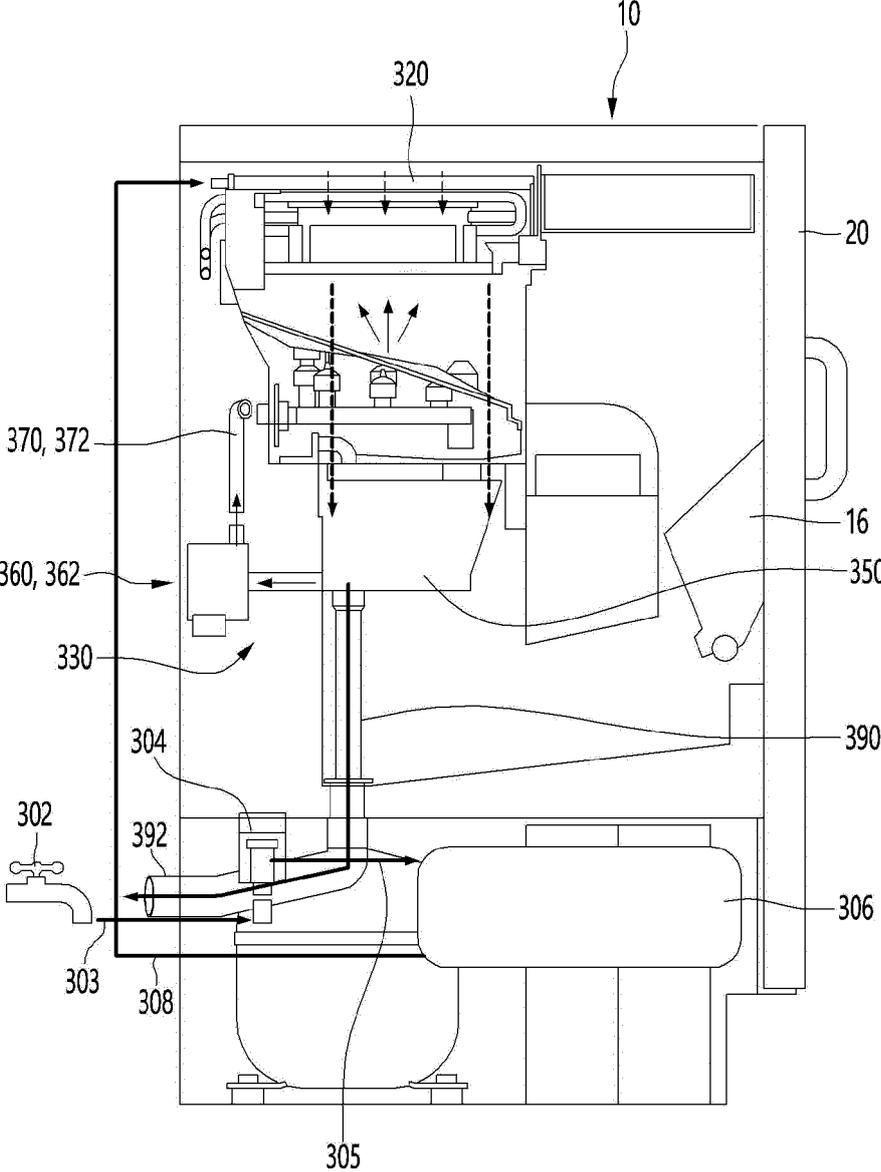
【Figure 4】



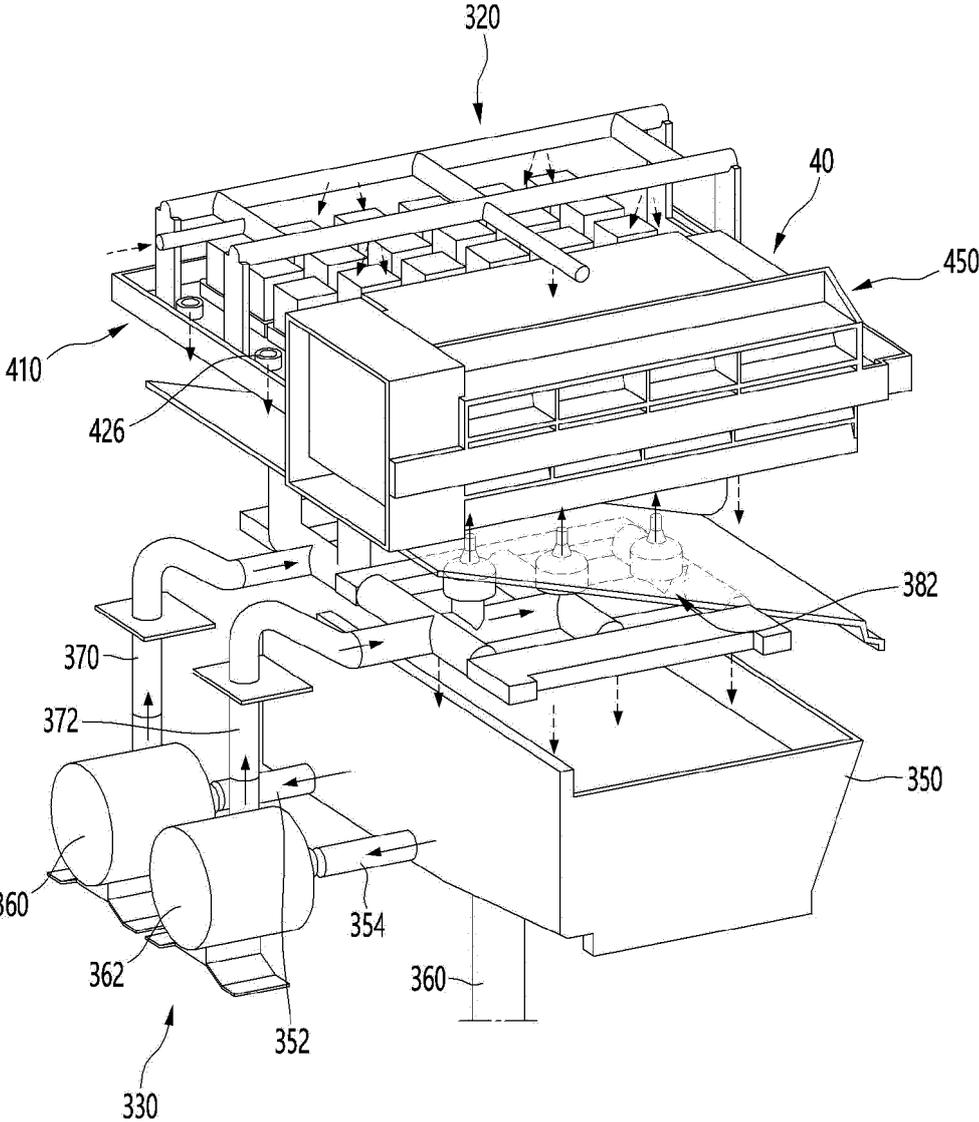
【Figure 5】



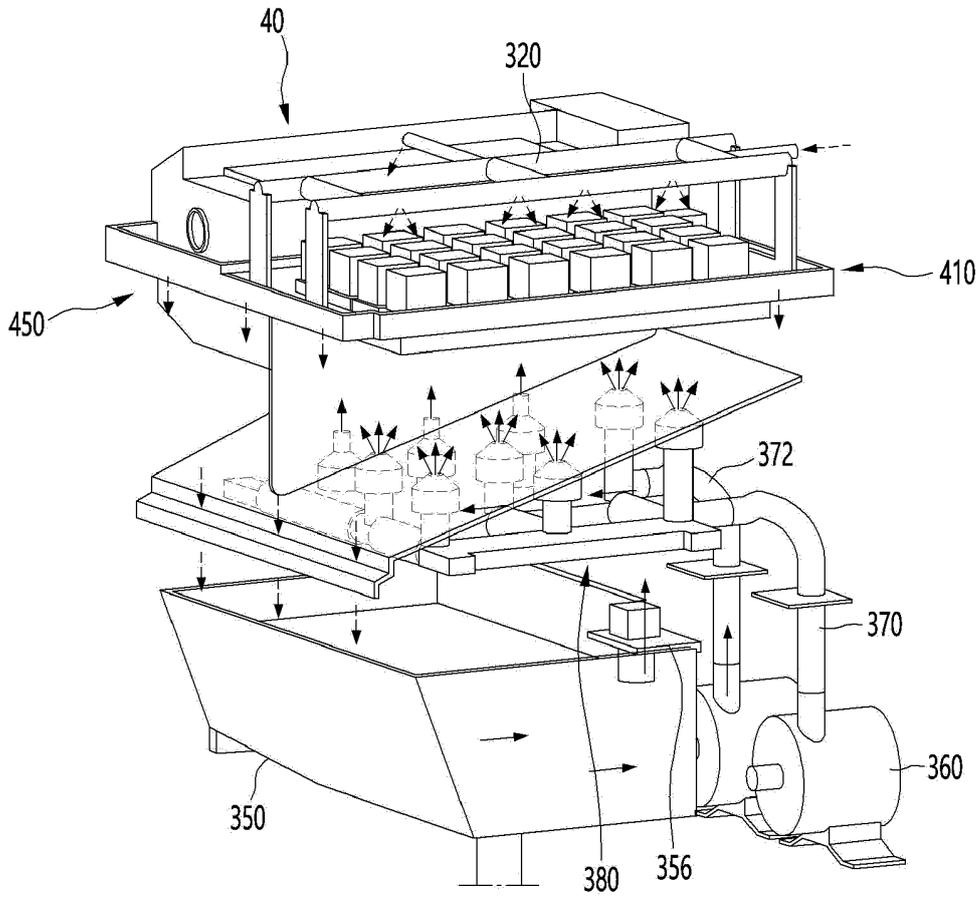
【Figure 6】



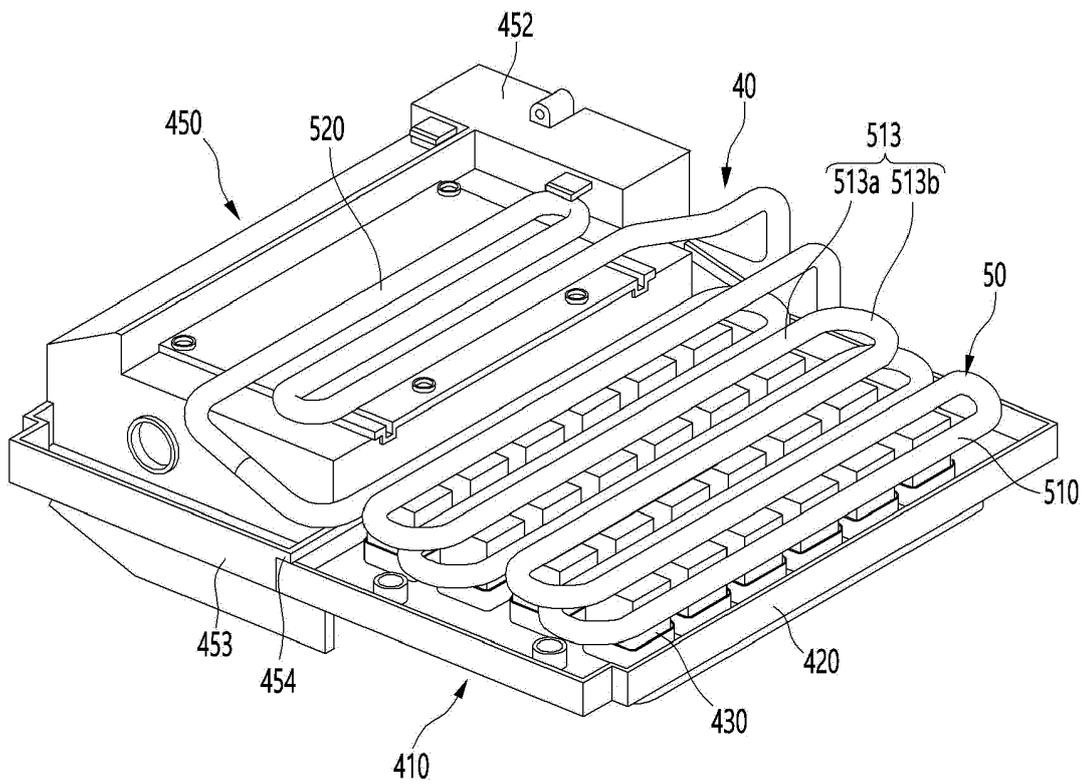
【Figure 7】



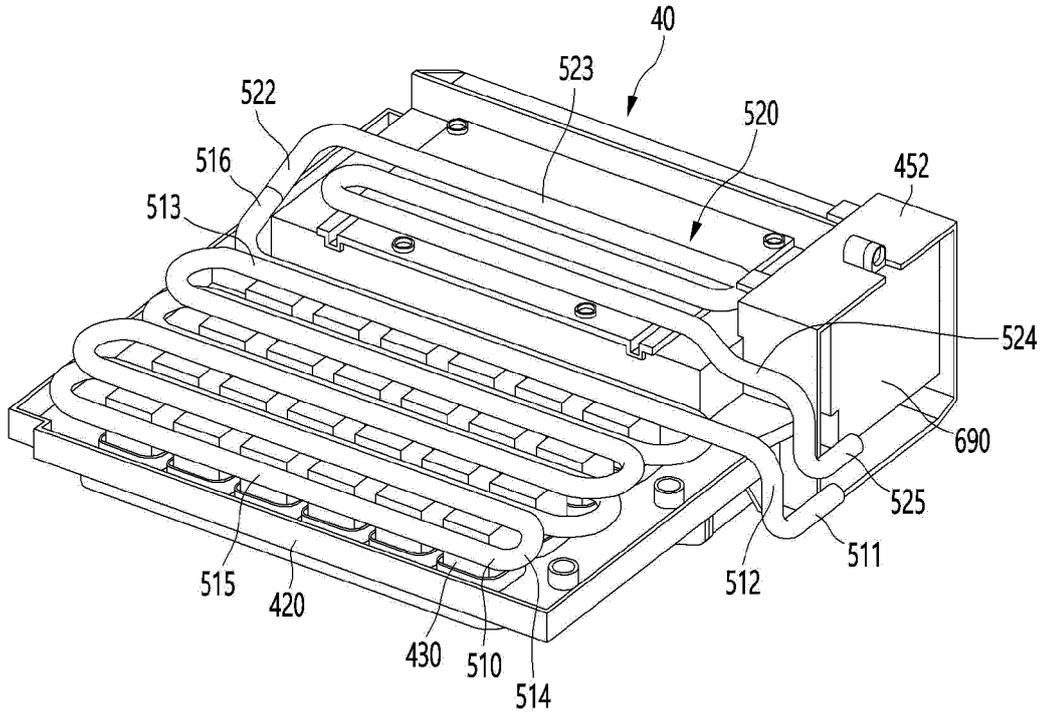
【Figure 8】



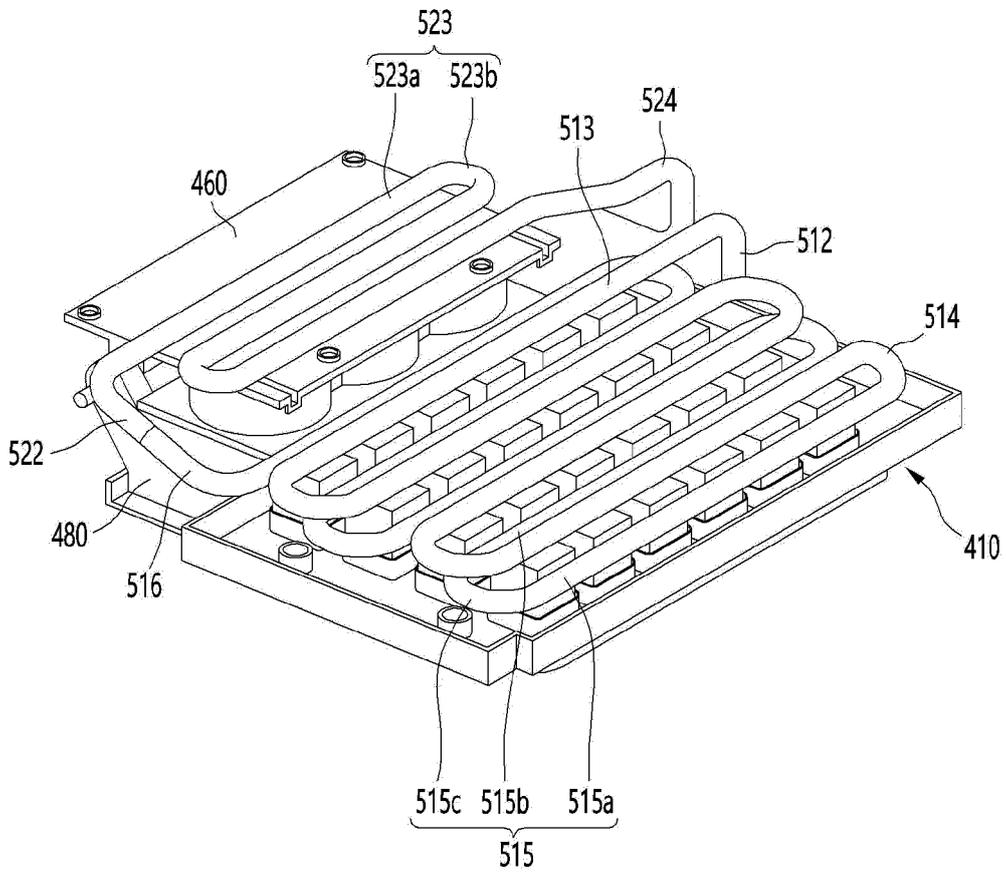
【Figure 9】



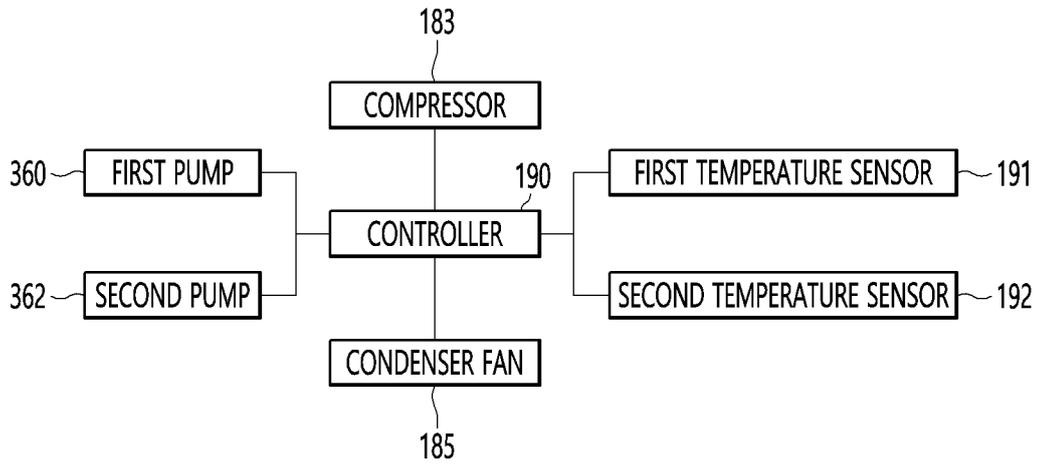
【Figure 10】



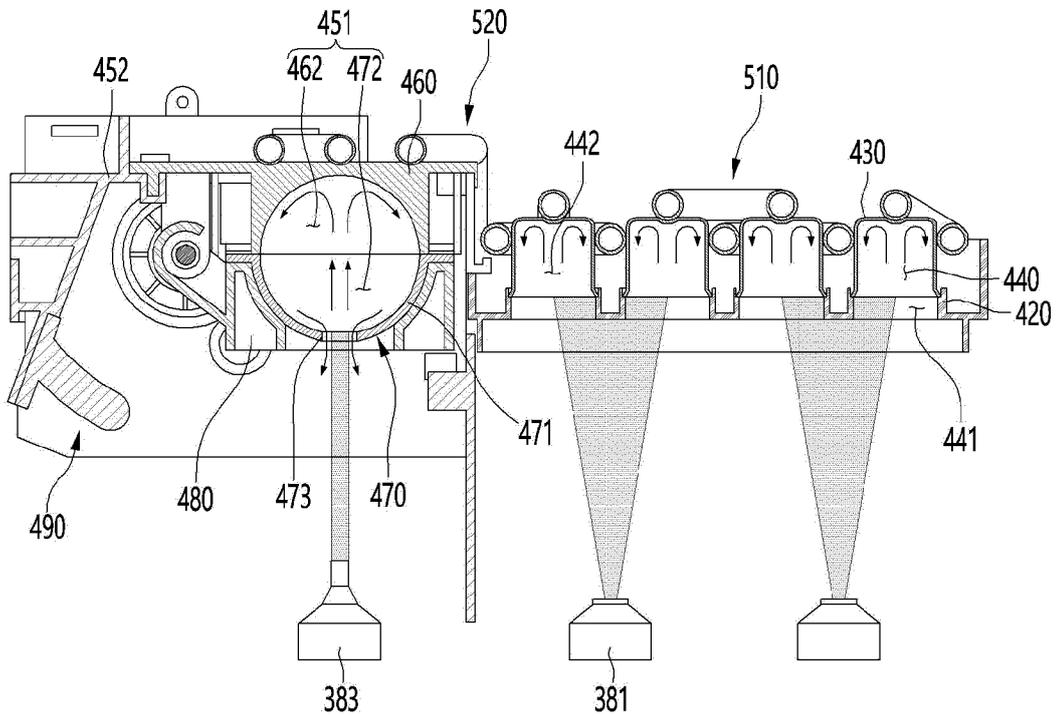
【Figure 11】



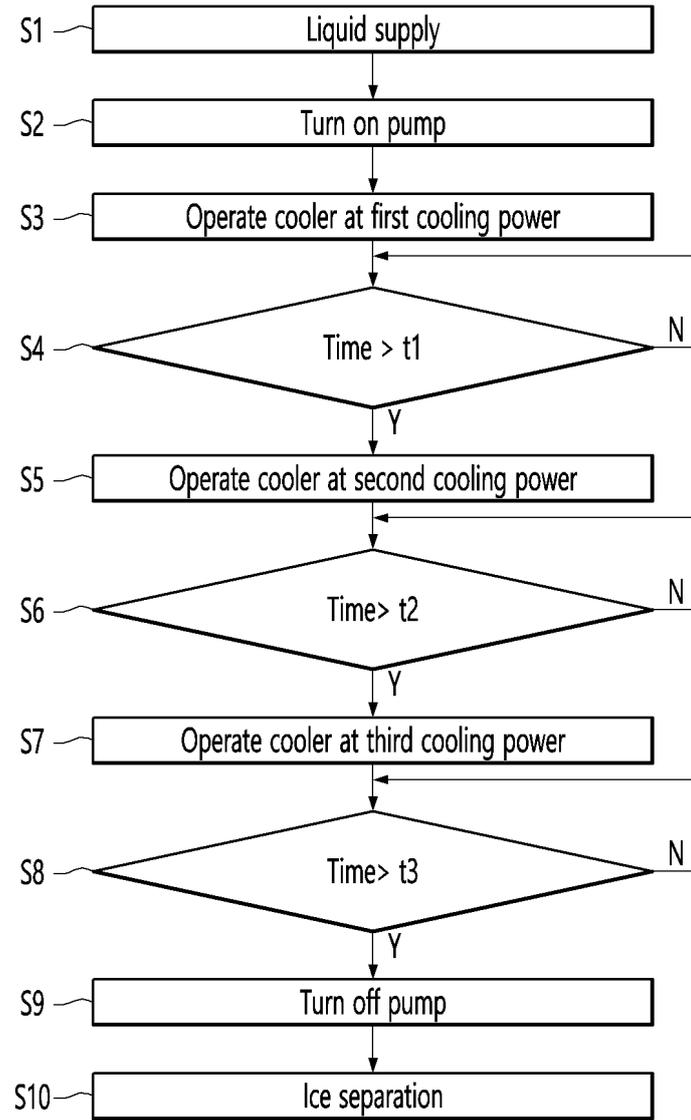
【Figure 12】



【Figure 13】



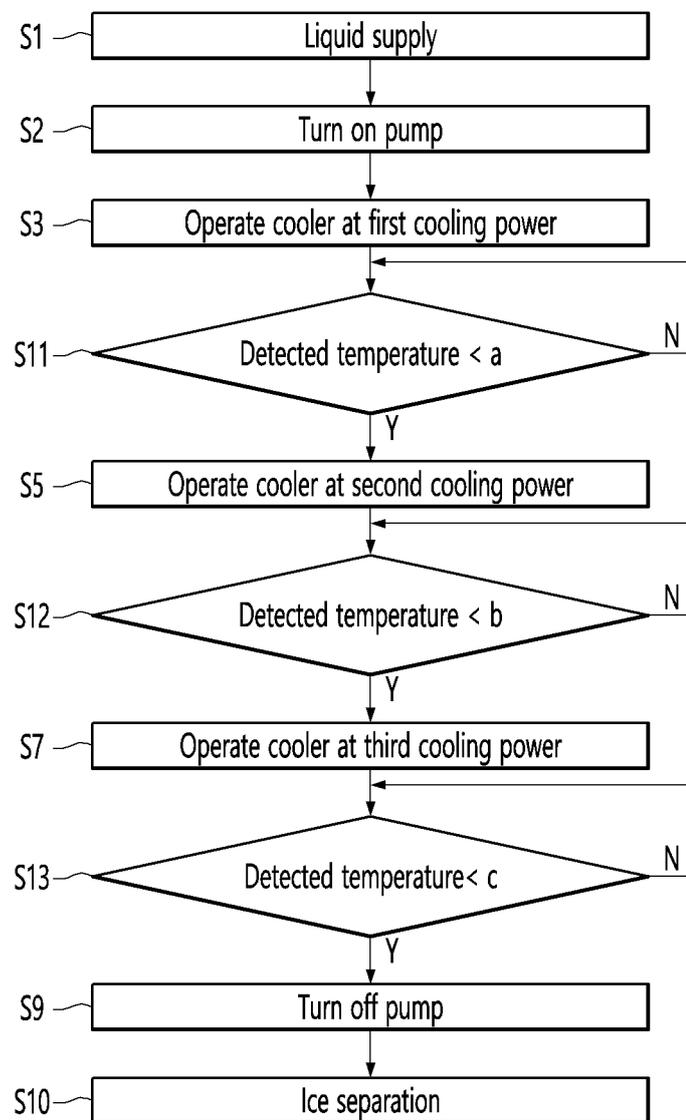
【Figure 14】



【Figure 15】

	$(RT \leq T1(^{\circ}C))$	$(T1 < RT \leq T2(^{\circ}C))$	$(RT > T2)$
$0 < t \leq t1$	A1 Hz	B1 Hz	C1 Hz
$t1 < t \leq t2$	A2 Hz	B2 Hz	C2 Hz
$t2 < t \leq t3$	A3 Hz	B3 Hz	C3 Hz

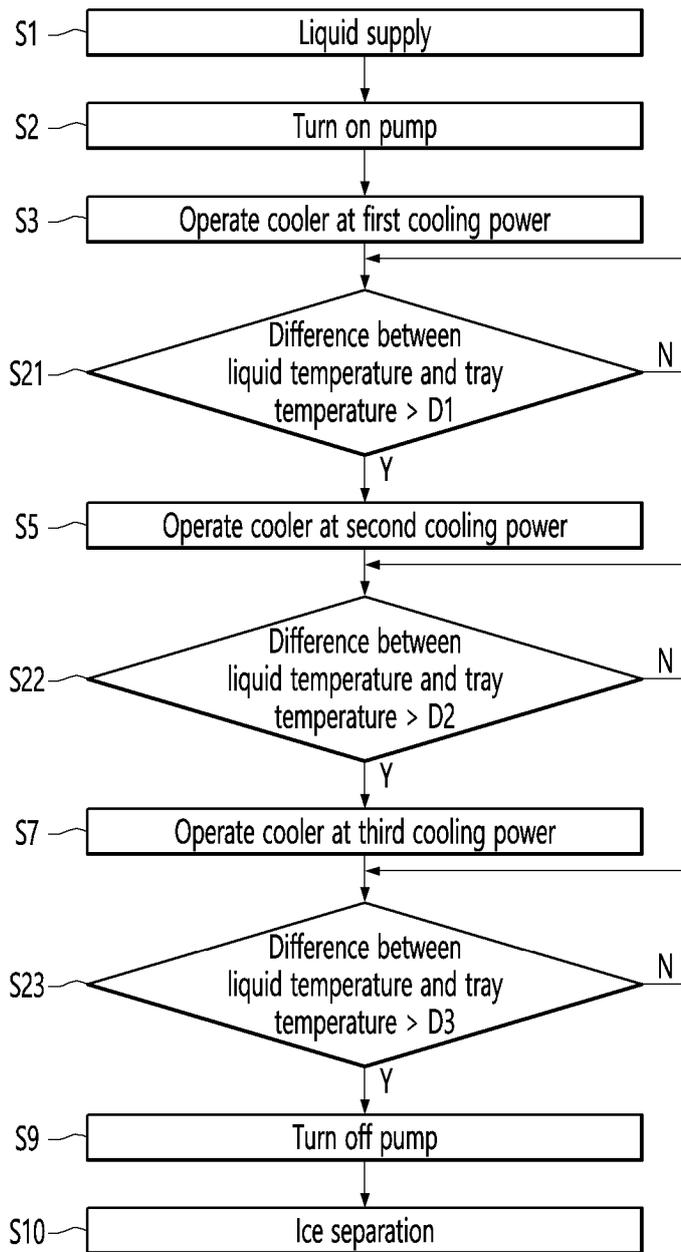
【Figure 16】



【Figure 17】

	$(RT \leq T1(^{\circ}C))$	$(T1 < RT \leq T2(^{\circ}C))$	$(RT > T2)$
$a \leq T_{tray}$	A1 Hz	B1 Hz	C1 Hz
$b \leq T_{tray} < a$	A2 Hz	B2 Hz	C2 Hz
$c \leq t < b$	A3 Hz	B3 Hz	C3 Hz

【Figure 18】



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**A. CLASSIFICATION OF SUBJECT MATTER**  
**F25C 1/24(2006.01)i; F25B 49/02(2006.01)i; F25D 23/04(2006.01)i; F25D 23/12(2006.01)i**  
 According to International Patent Classification (IPC) or to both national classification and IPC

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**B. FIELDS SEARCHED**  
 Minimum documentation searched (classification system followed by classification symbols)  
 F25C 1/24(2006.01); F25B 39/04(2006.01); F25B 41/00(2006.01); F25C 1/08(2006.01); F25C 1/10(2006.01);  
 F25C 1/22(2006.01); F25C 5/02(2006.01); F25D 29/00(2006.01)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
 Korean utility models and applications for utility models: IPC as above  
 Japanese utility models and applications for utility models: IPC as above

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Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
 eKOMPASS (KIPO internal) & keywords: 제빙(ice making), 트레이(tray), 냉각 유닛(cooling unit), 냉력(cold power), 압축기  
 (compressor), 온도(temperature), 물(water), 센서(sensor)

20

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 10-2014-0089210 A (LG ELECTRONICS INC.) 14 July 2014 (2014-07-14) See paragraphs [0009], [0019]-[0020], [0043]-[0047] and [0055], claim 1 and figures 1-2 and 5-6.	1-4,6,26
Y		5,7-25
Y	KR 10-0807280 B1 (SAMSUNG ELECTRONICS CO., LTD.) 28 February 2008 (2008-02-28) See paragraphs [0013] and [0031] and figure 3.	5,16-24
Y	KR 10-1573383 B1 (LG ELECTRONICS INC.) 01 December 2015 (2015-12-01) See paragraph [0024] and figure 2.	7-15,22
Y	KR 10-2021-0005799 A (LG ELECTRONICS INC.) 15 January 2021 (2021-01-15) See paragraph [0058].	25
A	JP 08-261613 A (MITSUBISHI ELECTRIC CORP.) 11 October 1996 (1996-10-11) See paragraphs [0019]-[0020] and figures 1-2.	1-26

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

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Date of the actual completion of the international search **24 May 2023**  
 Date of mailing of the international search report **24 May 2023**

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International application No.

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5

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2017-0350630 A1 (SAMSUNG ELECTRONICS CO., LTD.) 07 December 2017 (2017-12-07) See claim 1.	1-26

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**INTERNATIONAL SEARCH REPORT**  
**Information on patent family members**

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20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
KR 10-2014-0089210 A	14 July 2014	KR 10-1487527 B1	28 January 2015
KR 10-0807280 B1	28 February 2008	None	
KR 10-1573383 B1	01 December 2015	KR 10-2015-0115320 A	14 October 2015
KR 10-2021-0005799 A	15 January 2021	AU 2019-352419 A1	09 April 2020
		AU 2019-353490 A1	27 May 2021
		AU 2019-353516 A1	27 May 2021
		AU 2019-354473 A1	27 May 2021
		AU 2019-354475 A1	27 May 2021
		AU 2019-354477 A1	27 May 2021
		AU 2019-354482 A1	27 May 2021
		AU 2019-354500 A1	27 May 2021
		AU 2019-355673 A1	27 May 2021
		AU 2019-355675 A1	27 May 2021
		AU 2019-355677 A1	27 May 2021
		AU 2019-355691 A1	03 June 2021
		AU 2019-355698 A1	27 May 2021
		CN 112752940 A	04 May 2021
		CN 112771326 A	07 May 2021
		CN 112771327 A	07 May 2021
		CN 112789463 B	17 February 2023
		CN 112789464 A	11 May 2021
		CN 112789464 B	24 January 2023
		CN 112789465 A	11 May 2021
		CN 112789466 A	11 May 2021
		CN 112789467 A	11 May 2021
		CN 112823264 A	18 May 2021
		CN 112867899 A	28 May 2021
		CN 112912675 A	04 June 2021
		CN 112912675 B	26 August 2022
		CN 115289761 A	04 November 2022
		CN 115289762 A	04 November 2022
		CN 115289763 A	04 November 2022
		CN 115289764 A	04 November 2022
		EP 3861261 A1	11 August 2021
		EP 3861262 A1	11 August 2021
		EP 3861263 A1	11 August 2021
		EP 3862662 A1	11 August 2021
		EP 3862676 A1	11 August 2021
		EP 3862677 A1	11 August 2021
		EP 3862678 A1	11 August 2021
		EP 3862679 A1	11 August 2021
		EP 3862680 A1	11 August 2021
		EP 3862681 A1	11 August 2021
		EP 3862682 A1	11 August 2021
		EP 3862683 A1	11 August 2021
		EP 3862684 A1	11 August 2021
		EP 3862699 A1	11 August 2021
		EP 3862700 A1	11 August 2021
		EP 3862701 A1	11 August 2021
		EP 3862702 A1	11 August 2021

Form PCT/ISA/210 (patent family annex) (July 2022)

**INTERNATIONAL SEARCH REPORT**  
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**PCT/KR2023/002691**

5

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
		EP 3862707 A1	11 August 2021
		EP 3862708 A1	11 August 2021
		EP 3862709 A1	11 August 2021
		KR 10-2020-0038092 A	10 April 2020
		KR 10-2020-0038093 A	10 April 2020
		KR 10-2020-0038094 A	10 April 2020
		KR 10-2020-0038095 A	10 April 2020
		KR 10-2020-0038096 A	10 April 2020
		KR 10-2020-0038106 A	10 April 2020
		KR 10-2020-0038107 A	10 April 2020
		KR 10-2020-0038108 A	10 April 2020
		KR 10-2020-0038109 A	10 April 2020
		KR 10-2020-0038110 A	10 April 2020
		KR 10-2020-0038116 A	10 April 2020
		KR 10-2020-0038117 A	10 April 2020
		KR 10-2020-0038118 A	10 April 2020
		KR 10-2020-0038119 A	10 April 2020
		KR 10-2020-0057557 A	26 May 2020
		KR 10-2021-0005471 A	14 January 2021
		KR 10-2021-0005472 A	14 January 2021
		KR 10-2021-0005497 A	14 January 2021
		KR 10-2021-0005498 A	14 January 2021
		KR 10-2021-0005769 A	15 January 2021
		KR 10-2021-0005770 A	15 January 2021
		KR 10-2021-0005771 A	15 January 2021
		KR 10-2021-0005772 A	15 January 2021
		KR 10-2021-0005773 A	15 January 2021
		KR 10-2021-0005774 A	15 January 2021
		KR 10-2021-0005775 A	15 January 2021
		KR 10-2021-0005776 A	15 January 2021
		KR 10-2021-0005777 A	15 January 2021
		KR 10-2021-0005778 A	15 January 2021
		KR 10-2021-0005779 A	15 January 2021
		KR 10-2021-0005780 A	15 January 2021
		KR 10-2021-0005781 A	15 January 2021
		KR 10-2021-0005782 A	15 January 2021
		KR 10-2021-0005783 A	15 January 2021
		KR 10-2021-0005785 A	15 January 2021
		KR 10-2021-0005786 A	15 January 2021
		KR 10-2021-0005787 A	15 January 2021
		KR 10-2021-0005788 A	15 January 2021
		KR 10-2021-0005789 A	15 January 2021
		KR 10-2021-0005790 A	15 January 2021
		KR 10-2021-0005791 A	15 January 2021
		KR 10-2021-0005792 A	15 January 2021
		KR 10-2021-0005793 A	15 January 2021
		KR 10-2021-0005796 A	15 January 2021
		KR 10-2021-0005797 A	15 January 2021
		KR 10-2021-0005798 A	15 January 2021
		KR 10-2021-0005800 A	15 January 2021

**INTERNATIONAL SEARCH REPORT**  
**Information on patent family members**

International application No.  
**PCT/KR2023/002691**

5

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
		KR 10-2021-0005801 A	15 January 2021
		KR 10-2021-0005802 A	15 January 2021
		KR 10-2021-0005803 A	15 January 2021
		KR 10-2021-0026849 A	10 March 2021
		KR 10-2021-0027871 A	11 March 2021
		KR 10-2021-0027872 A	11 March 2021
		KR 10-2021-0030014 A	17 March 2021
		KR 10-2021-0030018 A	17 March 2021
		KR 10-2021-0031251 A	19 March 2021
		KR 10-2021-0031255 A	19 March 2021
		KR 10-2021-0032775 A	25 March 2021
		KR 10-2021-0032829 A	25 March 2021
		RU 2022101436 A	10 February 2022
		RU 2022101439 A	08 February 2022
		RU 2765255 C1	27 January 2022
		RU 2765876 C1	04 February 2022
		US 2021-0356189 A1	18 November 2021
		US 2021-0356190 A1	18 November 2021
		US 2021-0356191 A1	18 November 2021
		US 2021-0381741 A1	09 December 2021
		US 2021-0381742 A1	09 December 2021
		US 2021-0381743 A1	09 December 2021
		US 2021-0381744 A1	09 December 2021
		US 2021-0381745 A1	09 December 2021
		US 2021-0389034 A1	16 December 2021
		US 2021-0389035 A1	16 December 2021
		US 2021-0389036 A1	16 December 2021
		US 2021-0389037 A1	16 December 2021
		US 2021-0389038 A1	16 December 2021
		US 2021-0396439 A1	23 December 2021
		US 2021-0396441 A1	23 December 2021
		US 2021-0396442 A1	23 December 2021
		US 2021-0396443 A1	23 December 2021
		US 2021-0396444 A1	23 December 2021
		US 2021-0396445 A1	23 December 2021
		US 2021-0404722 A1	30 December 2021
		US 2021-0404724 A1	30 December 2021
		US 2022-0003477 A1	06 January 2022
		US 2022-0003479 A1	06 January 2022
JP	08-261613 A	11 October 1996	None
US	2017-0350630 A1	07 December 2017	CN 107257905 A 17 October 2017
			EP 3244145 A1 15 November 2017
			EP 3244145 B1 02 June 2021
			JP 2016-136082 A 28 July 2016
			KR 10-2016-0084321 A 13 July 2016
			KR 10-2472504 B1 01 December 2022
			US 11029072 B2 08 June 2021
			WO 2016-111531 A1 14 July 2016

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- JP 5687018 B [0005]