

DESCRIPTION

TITLE OF INVENTION

Ice-Making Device and Freezer Refrigerator Including the Same

5 TECHNICAL FIELD

The present invention relates to an ice-making device and a freezer refrigerator including the same.

BACKGROUND ART

10 An example of a freezer refrigerator including an ice-making device is disclosed, for example, in Japanese Patent Laying-Open No. 2006-78098 (Patent Document 1). An ice-making tray that is a part of the ice-making device is held horizontally inside of the freezer refrigerator. The ice-making tray includes a plurality of ice-making cells arranged in a matrix. A certain amount of water is supplied into the ice-making tray, and the water stored in the ice-making tray becomes ice. After the water in the ice-

15 making tray is frozen, the ice-making tray is turned and twisted. The twisting of the ice-making tray causes ice in each ice-making cell to come out of the ice-making cell and drop into an ice bank prepared below in advance.

When making ice in a freezer refrigerator, if the water temperature rapidly drops, the produced ice contains bubbles inside thereof. Therefore, the ice is cloudy

20 white. In order to produce ice with high transparency (hereinafter referred to as "transparent ice"), for example, water is slowly cooled while the temperature is monitored so that the water temperature does not drop too rapidly. This is done because slow cooling allows the air in water to easily escape from the water surface to the outside and reduces the possibility that bubbles are contained inside.

25 In order to produce transparent ice in such an ice-making tray, it is necessary to monitor the temperature. In order to grasp the actual temperature, a thermistor is generally used. In the freezer refrigerator shown in Fig. 18 of Patent Document 1, a thermistor is attached on the back surface of the ice-making tray. The thermistor is arranged in the deepest position of a gap between the ice-making cells, that is, to be

pushed into the uppermost position.

CITATION LIST

PATENT DOCUMENT

PTD 1: Japanese Patent Laying-Open No. 2006-78098

5 SUMMARY OF INVENTION

TECHNICAL PROBLEM

10 In the ice-making device or the freezer refrigerator based on the prior art, the amount of water that makes ice is fixed. Since it is necessary to cool slowly while monitoring the temperature in order to produce transparent ice, a mechanism for monitoring the temperature is installed in the vicinity of the ice-making tray, which makes it difficult to exchange ice-making trays. In particular when a structure for making ice come out of the ice-making tray after making ice is provided, the user cannot exchange ice-making trays in most cases. The mechanism for monitoring the temperature for slow cooling is configured based on the premise that the ice-making tray is filled with water to a certain level. Therefore, merely reducing the water volume in the same ice-making tray does not ensure normal operation.

In the ice-making device or the freezer refrigerator based on the prior art, it is impossible to produce transparent ice of different sizes by intentionally switching modes using the same ice-making tray.

20 Even when ice that is not transparent is produced in an automatic ice maker, it is desired to measure the temperature in order to determine whether water in the ice-making tray is frozen. The conventional structure, however, cannot measure the temperature properly in a state in which the water volume is merely reduced in the same ice-making tray.

25 The present invention aims to provide an ice-making device or a freezer refrigerator capable of automatically producing ice of difference sizes.

SOLUTION TO PROBLEM

In order to achieve the aforementioned object, an ice-making device according to the present invention includes an ice-making tray. The ice making tray includes a

first ice-making cell and a second ice-making cell arranged so as to be horizontally adjacent to each other. The first ice-making cell and the second ice-making cell each have a bottom portion, a cell upper end, and a plate-shaped sidewall extending so as to expand from the bottom portion toward the cell upper end in the form of a slope. A portion of the sidewall of the first ice-making cell that is close to the second ice-making cell and a portion of the sidewall of the second ice-making cell that is close to the first ice-making cell form a shape of an inverse letter V as viewed in cross section. The ice-making tray has a maximum water volume mode in which at least the first ice-making cell is filled to a maximum water volume and a minimum water volume mode in which at least the first ice-making cell is filled to a minimum water volume that is at most 1/2 of the maximum water volume. A temperature measuring tool is arranged below a position of a water level in the minimum water volume mode in a space inside of the shape of an inverse letter V, so as to be proximate to the sidewall of the first ice-making cell.

ADVANTAGEOUS EFFECTS OF INVENTION

According to the present invention, the temperature of water in the first ice-making cell can be measured properly even at the minimum water volume, and transparent ice of different sizes can be produced automatically.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 is a front view showing a freezer refrigerator of the present invention with doors open.

Fig. 2 is a cross-sectional view of an ice-making device in the freezer refrigerator according to the present invention, as viewed from a first direction.

Fig. 3 is a cross-sectional view of the ice-making device in the freezer refrigerator according to the present invention, as viewed from a second direction.

Fig. 4 is an exploded perspective view showing an ice-making tray, a thermistor, etc. for use in the ice-making device according to the present invention.

Fig. 5 is an exploded perspective view showing the ice-making tray, a heater, etc. for use in the ice-making device according to the present invention.

Fig. 6 is a perspective view showing a combination of the ice-making tray, a cover, etc. for use in the ice-making device according to the present invention.

Fig. 7 is a perspective view of the ice-making tray for use in the ice-making device according to the present invention.

5 Fig. 8 is a perspective view of the back surface of the ice-making tray for use in the ice-making device according to the present invention.

Fig. 9 is a control block diagram of the freezer refrigerator according to the present invention.

10 Fig. 10 is a bottom view of the ice-making tray for use in the ice-making device in a first embodiment according to the present invention.

Fig. 11 is a perspective view showing the thermistor arranged on the bottom surface of the ice-making tray for use in the ice-making device in the first embodiment according to the present invention.

15 Fig. 12 is a plan view showing the thermistor arranged on the bottom surface of the ice-making tray for use in the ice-making device in the first embodiment according to the present invention.

Fig. 13 is a cross-sectional view showing the ice-making tray, etc. for use in the ice-making device in the first embodiment according to the present invention.

20 Fig. 14 is a side view of the thermistor for use in the ice-making device in the first embodiment according to the present invention.

Fig. 15 is a partial cross-sectional view of the thermistor for use in the ice-making device in the first embodiment according to the present invention.

Fig. 16 is a cross-sectional view showing the ice-making tray, etc. for use in the ice-making device in a second embodiment according to the present invention.

25 DESCRIPTION OF EMBODIMENTS

An example of a freezer refrigerator according to the present invention will be described. A freezer refrigerator 1 shown in Fig. 1 is configured to include a refrigerator compartment 2 with a double door 3L, 3R at the top, an ice compartment 4 with a door 5 and a freezer compartment 6 with a door 7 on the next level, a drawer-

type freezer compartment 8 on the next level, and a drawer-type vegetable compartment 9 at the bottom. A not-shown refrigeration cycle including a compressor and a heat exchanger generates cool air, which is distributed to each compartment through a duct to attain a refrigerator temperature or a freezer temperature that is
5 required in each compartment. This mechanism is well known and therefore is not described in detail.

An ice-making device 10 is installed on the ceiling of ice-making compartment 4, as shown in Fig. 2 and Fig. 3. Ice-making device 10 is an automatic ice maker. In general, the automatic ice maker means a device that can automatically perform a series
10 of operations of storing liquid water in an ice-making tray, freezing the water, and removing ice from the ice-making tray to obtain ice blocks. Although the process of feeding water to the ice-making tray is preferably performed automatically, the process of feeding water to the ice-making tray may be performed manually. Although the process of removing ice from the ice-making tray is also preferably performed
15 automatically, this process may be performed manually.

The structure of ice-making device 10 will be described below with reference to Fig. 4 to Fig. 6 in addition to Fig. 2 and Fig. 3.

Fig. 2 is a cross-sectional view of ice-making device 10 as viewed from the left side of freezer refrigerator 1. A duct 11 for blowing cool air into ice-making
20 compartment 4 is formed in the rear wall of ice-making compartment 4. An ice-making tray casing 12 extends from the upper end of duct 11 toward the front side. The bottom surface of ice-making tray casing 12 is open in order to drop ice made in the ice-making tray. Duct 11 has a cool air discharge port 13 oriented toward the inside of ice-making tray casing 12.

25 In the inside of ice-making tray casing 12, ice-making tray 20 is arranged at a position that receives cool air discharged from cool air discharge port 13. Ice-making tray 20 is molded from a synthetic resin that does not lose its elasticity even at low temperatures. It is difficult to obtain transparent ice if bubbles in the fed water adhere to the inner surface of ice-making tray 20. It is therefore preferable that measures for

reducing adherence of bubbles should be taken, for example, by blending silicone in polypropylene as a molding material, or coating the molded ice-making tray 20 with fluorocarbon resin.

5 Fine particles adsorbed by static electricity generated on the surface of ice-making tray 20 also hinders successful production of transparent ice. In order to avoid such adsorption of fine particles, it is preferable to take measures, for example, such as molding ice-making tray 20 from a material that is unlikely cause static electricity, such as a silicone-blended resin or a resin containing an antistatic agent, or coating the molded ice-making tray 20 with an antistatic agent.

10 Fig. 7 and Fig. 8 show ice-making tray 20 alone taken out. Fig. 7 is a view from the obliquely upper side, and Fig. 8 is a view from the obliquely lower side. Ice-making tray 20 includes, in total, eight ice-making cells 21 for producing ice having a trapezoidal shape in cross section. Eight ice-making cells 21 are arranged in two columns and four rows. Ice-making tray 20 thus has an elongate planar shape. Such
15 elongate ice-making tray 20 is arranged such that its longitudinal direction is aligned with the depth direction of freezer refrigerator 1, as shown in Fig. 2.

As shown in Fig. 4, ice-making tray 20 has a support shaft 22 at one end in the longitudinal direction and a socket portion 23 at the other end. Support shaft 22 is pivotably supported on ice-making tray casing 12. Socket portion 23 is coupled to the
20 shaft of an ice-removing device 24 (see Fig. 3) in the inside of ice-making tray casing 12 and supported by ice-removing device 24. Support shaft 22 and socket portion 23 are arranged on a common horizontal axial line. Ice-removing device 24 includes a motor and a speed reducer to turn ice-making tray 20 around the horizontal axial line in a certain angular range.

25 A thermistor 25 is arranged in a space 219 between two rows of ice-making cells 21 on the bottom surface of ice-making tray 20. Thermistor 25 measures the temperature of the inside of ice-making cell 21 with the wall of ice-making cell 21 interposed.

Thermistor 25 is fixed by a thermistor cover 26. Pins 27 protrude from four

corners of thermistor cover 26 in a direction at the right angle with respect to the longitudinal direction of ice-making tray 20. In total, four leg portions 28 protrude from the bottom surface of ice-making tray 20 so as to surround thermistor 25. A horizontal through hole 29 for receiving pin 27 is formed at the tip of each leg portion 28. Thermistor 25 is fixed by putting a thermistor protection sealer 30 on thermistor 25, putting thermistor cover 26 on thermistor protection sealer 30, and engaging pins 27 in horizontal through holes 29 of leg portions 28.

A heater 31 is arranged on the bottom surface of ice-making tray 20 as shown in Fig. 5. Heater 31 is formed with a heating wire covered with silicone resin and is finished flexible as a whole to follow twisting of ice-making tray 20. A parallel rib 32 for receiving heater 31 is formed at the peak portion of each ice-making cell 21 turned upside down.

Parallel rib 32 is formed with two ribs arranged parallel to each other at a predetermined distance. The distance between the ribs is set so as to receive heater 31 in a free fit manner. The distance between the ribs is set in this manner so that heater 31 can move freely to some extent when ice-making tray 20 is twisted.

Heater 31 is routed so as to be shaped into a laterally symmetric form with respect to the longitudinal center line of ice-making tray 20. Here, heater 31 as a whole is approximately U-shaped. A pair of feed lines 33 is connected to open ends of the U shape.

Heater 31, which is designed to generate a small amount of heat, is structured such that an extremely thin heating wire is wound around a glass fiber core. If heater 31 is twisted in a direction in which the winding is tightened, the heating wire is likely to broken. For this reason, heater 31 is designed so as to be movable freely to some extent as described above, and, in addition, the routing of heater 31 as a whole is shaped such that force acting on the heating wire is minimized.

After heater 31 is put in parallel ribs 32 and brought into intimate contact with the bottom surface of ice-making tray 20, the bottom surface of ice-making tray 20 is covered with a cover 34. Cover 34 prevents intrusion of cool air on the bottom

surface portion of ice-making tray 20 to make the temperature distribution uniform among ice-making cells 21 and also serves to keep heater 31 pushed in parallel ribs 32.

Cover 34 is shaped like a rectangular tray and has a ring 35 at one end, through which support shaft 22 is passed. Cover 34 is attached to ice-making tray 20 with two screws 36 and one spring 37, with ring 35 fitted in support shaft 22. The attachment of cover 34 is not so strong as to restrain the motion of ice-making tray 20 but is flexible so as not hinder twisting of ice-making tray 20 when ice is removed. Preferably, cover 34 itself is also molded from a synthetic resin that does not lose its elasticity even at low temperatures in the same manner as ice-making tray 20.

Cover 34 has two through holes 38 formed closer to the opposite ends of the longitudinal center line. Two through holes 39 are formed symmetrically with respect to the longitudinal center line at places closer to the cover center from through holes 38. Through holes 38 are circular and receive bosses 40, which have a circular cross section and are formed on the bottom surface of ice-making tray 20. Through holes 39 are rectangular and receive spring-attached ribs 41 formed on the bottom surface of ice-making tray 20.

When screws 36 are screwed and fixed in bosses 40 exposed from through holes 38, cover 34 is held so as to be movable along the axial line of boss 40 with screw 36 serving as a stopper for retaining. That is, screws 36 prevent cover 34 from becoming separated from ice-making tray 20 without clamping cover 34.

When cover 34 is retained with screws 36, as shown in Fig. 6, spring-attached ribs 41 protrude from through holes 39 of cover 34. Attachment hooks 43 at opposite ends of spring 37 are engaged in horizontal through holes 42 formed at tip ends of spring-attached ribs 41. Spring 37 is formed by bending a spring steel wire material to have attachment hooks 43 at the center in the longitudinal direction and a hairpin portion 44 at opposite ends in the longitudinal direction.

Hairpin portion 44 extends obliquely downward in Fig. 6, in other words, toward ice-making tray 20. Therefore, when attachment hooks 43 are engaged in horizontal through holes 42 of spring-attached ribs 41, hairpin portion 44 pushes

against cover 34. Cover 34 is pressed against heater 31 as shown in Fig. 3 and holds heater 31 with a certain load so that heater 31 is not detached from parallel ribs 32. Accordingly, heater 31 comes into intimate contact with ice-making cells 21 so that heat is efficiently transferred to ice-making cells 21.

5 Windshield plates 45 extending downward are integrally molded at both edges in the longitudinal direction of ice-making tray 20. Windshield plates 45 block cool air blown toward ice-making tray 20 from above from coming downward. The provision of windshield plates 45 prevents cool air from intruding on the bottom surface of ice-making tray 20 and from impairing the heating effect by heater 31, so
10 that cool air is concentrated on the top surface of ice-making tray 20.

Windshield plate 45 has a notch 46 cut vertically from the edge at a place corresponding to the boundary between ice-making cells 21. In the embodiment, one shield plate 45 has two notches 46. If notch 46 is not provided, stress on windshield plate 45 is concentrated on one point when ice-making tray 20 is twisted. As a result,
15 the resin material at that point undergoes blushing at an earlier stage and then eventually becomes cracked. The formation of notch 46 can distribute stress and prevent blushing and cracking.

As shown in Fig. 3, a gap 47 is provided between windshield 45 and cover 34 to such an extent that they do not interfere with each other when ice-making tray 20 is
20 twisted for removing ice.

A protrusion 48 is formed on one side surface at that end of ice-making tray 20 on which support shaft 22 is provided. Protrusion 48 is provided to give a twist to ice-making tray 20 when removing ice.

A control unit 50 shown in Fig. 9 has control over freezer refrigerator 1 as a
25 whole, including operation control of the refrigeration cycle and power feed control to heater 31. Control unit 50 is connected with ice-removing device 24 and heater 31 as well as a compressor 51 as part of the refrigeration cycle, a blower 52 for sending cool air to each unit inside, a water feeder 53 for feeding water to ice-making device 10, a temperature sensor 54, and an ice volume sensor 55 arranged in ice-making

compartment 4. Temperature sensor 54 is a concept that encompasses a temperature measuring tool such as a thermistor arranged in each unit. Thermistor 25 is embraced in this concept.

Control unit 50 controls power feed to heater 31 in the following three stages:
5 "normal heating", "preheating" with the amount of heat generation smaller than "normal heating", and "rapid heating" with the amount of heat generation greater than "normal heating". The amount of heat generation can be varied, for example, by setting power consumption in "normal heating" to 5 to 6 W, power consumption in "preheating" to 2 W, and power consumption in "rapid heating" to 7 to 8 W.

10 (First Embodiment)

Referring to Fig. 2, Fig. 3, Fig. 10 to Fig. 15, the ice-making device in a first embodiment according to the present invention will be described.

As shown in Fig. 2 and Fig. 3, ice-making device 10 in the present embodiment includes ice-making tray 20. As shown in Fig. 10 to Fig. 13, ice-making tray 20
15 includes a first ice-making cell 21a and a second ice-making cell 21b arranged to be horizontally adjacent to each other. Fig. 11 is an enlarged perspective view showing the vicinity of thermistor 25 arranged at a position sandwiched between first ice-making cell 21a and second ice-making cell 21b. Fig. 12 is a planar view thereof.

As shown in Fig. 11 and Fig. 13, first ice-making cell 21a and second ice-making cell
20 21b each have a bottom portion 211, a cell upper end 212, and a plate-shaped sidewall 213 extending so as to expand from bottom portion 211 toward cell upper end 212 in the form of a slope. In first ice-making cell 21a shown in Fig. 13, the slopes

extending from the left and right ends of bottom portion 211 in the obliquely upward direction, either leftward or rightward, correspond to side wall 213. That is, sidewall

25 213 of first ice-making cell 21a includes a portion 214. In second ice-making cell 21b, sidewall 213 includes a slope extending either leftward or rightward, similarly.

Therefore, sidewall 213 of second ice-making cell 21b includes a portion 215. Portion 214 of sidewall 213 of first ice-making cell 21a that is close to second ice-making cell 21b and portion 215 of sidewall 213 of second ice-making cell 21b that is close to first

ice-making cell 21a form the shape of an inverse letter V as viewed in cross section. Ice-making tray 20 has a maximum water volume mode in which at least first ice-making cell 21a is filled to a maximum water volume, and a minimum water volume mode in which at least first ice-making cell 21a is filled to a minimum water volume that is at most 1/2 of the maximum water volume. In the maximum water volume mode, the water level reaches a position 218, whereas in the minimum water volume mode, the water level reaches a position 217. Thermistor 25 as a temperature measuring tool is arranged below position 217 of the water level in the minimum water volume mode in a space 219 inside of the shape of an inverse letter V, so as to be proximate to at least portion 214 of sidewall 213 of first ice-making cell 21a that is close to second ice-making cell 21b.

As shown in Fig. 13, heater 31 may be arranged under bottom portion 211. Heater 31 alleviates a drop of water temperature. When transparent ice is desired, heater 31 can be brought into operation. When transparent ice is not required, heater 31 may not be necessary.

Here, thermistor 25 is used as an example of the temperature measuring tool. However, the temperature measuring tool may be any sensor other than a thermistor that can detect the temperature in a thin gap in the same manner as in a thermistor.

In the ice-making device in the present embodiment, the temperature measuring tool is preferably a thermistor. One reason is that a thermistor generally has a thin shape and therefore can be arranged in a narrow gap. Another reason is that a thermistor is readily available. It is applicable in other embodiments that the thermistor is preferred as a temperature measuring tool.

Fig. 14 shows thermistor 25 alone taken out. Thermistor 25 includes a head 251, a lead 252, and a protective tube portion 253. Head 251 is shown in cross section in Fig. 15. A thermistor element 254 is arranged inside of head 251. Thermistor element 254 is electrically connected to lead 252. Head 251 includes a resin head cover 255. The gap in the inside of head cover 255 with thermistor element 254 inserted in head cover 255 is filled with sealing resin 256.

Sidewall 213 of each ice-making cell is not formed as a vertical wall but as a slope in order to allow ice to drop smoothly when ice-making tray 20 is tilted by ice-removing device 24.

5 In the ice-making device in the present embodiment, since the water volume in the minimum water volume mode is at most 1/2 of the water volume in the maximum water volume mode, the height of the water level greatly varies. Therefore, if the temperature measuring tool is arranged in the deepest portion of the gap between ice-making cells as in the conventional example, the water level is located below the temperature measuring tool in the minimum water volume mode, so that the water
10 temperature cannot be measured properly. In the present embodiment, however, the temperature measuring tool is positioned below position 217 of the water level in the minimum water volume mode in space 219 in the inside of the shape of an inverse letter V, and the temperature measuring tool is arranged so as to be proximate to at least
15 sidewall 213 of first ice-making cell 21a, so that the temperature of water in first ice-making cell 21a can be measured properly even at the minimum water volume.

Accordingly, the present embodiment can provide an ice-making device capable of automatically producing transparent ice of different sizes.

In particular when transparent ice is to be produced, in the present embodiment, feeding cool air to ice-making compartment 4 can be controlled using temperature
20 information obtained by measuring the temperature with the temperature measuring tool, thereby carrying out the operation of slowly cooling accurately.

In the present embodiment, the number of ice-making cells included in ice-making tray 20 is eight. However, the number is not limited thereto. In the present embodiment, as shown in Fig. 10, particular two ice-making cells included in ice-
25 making tray 20 are assumed as first ice-making cell 21a and second ice-making cell 21b. These two ice-making cells may be at any other positions in ice-making tray 20. Two ice-making cells that sandwich the position at which thermistor 25 is arranged in ice-making cell 20 can be considered as first ice-making cell 21a and second ice-making cell 21b, as necessary. In particular, the ice-making cell closest to the

temperature measuring tool can be considered as first ice-making cell 21a.

In the present embodiment, the temperature measuring tool is arranged so as to be sandwiched between two ice-making cells. However, the temperature measuring tool may be arranged so as to be surrounded with three or more, for example, four ice-making cells.

As illustrated in the present embodiment, in ice-making device 10, a member that defines the position of the temperature measuring tool preferably extends from ice-making tray 20. As shown in Fig. 11 to Fig. 13, a positioning rib 261 serving as a member that defines the position of the temperature measuring tool is provided so as to extend from the back side of ice-making tray 20. A specific structure of positioning rib 261 is not limited to the one shown in the figure. It is preferable that the temperature measuring tool should be positioned with such a member, because the temperature measuring tool can stably measure the temperature. In particular when ice-making device 10 includes ice-removing device 24, ice-making tray 20 is repeatedly twisted and deformed. Therefore, it is preferable that the temperature measuring tool should be positioned with such a member, because the temperature measuring tool is unlikely to be displaced during twisting and deforming.

(Second Embodiment)

Referring to Fig. 16, the ice-making device in a second embodiment according to the present invention will be described. The ice-making device in the present embodiment is partially shown in Fig. 16. The basic configuration of this ice-making device is the same as the one described in the first embodiment. Therefore, the ice-making device in the present embodiment includes ice-making tray 20. This ice-making device can produce transparent ice. In this ice-making device, heater 31 is arranged under bottom portion 211 of the ice-making cell. When the height from bottom portion 211 to the position of the water level in the minimum water volume mode is H , thermistor 25 as a temperature measuring tool is arranged above the height that is $1/4$ of H relative to bottom portion 211. That is, the height T of thermistor 25 shown in Fig. 16 is greater than $H/4$.

In the ice-making device in the present embodiment, a heater is provided under the bottom portion so that water can be cooled slowly. This causes a concern that heat from the heater is transferred to the temperature measuring tool to prevent accurate measurement of water temperature in the ice-making cell. In particular when the height T of the temperature measuring tool is H/4 or less, the thermistor as the temperature measuring tool is influenced by heat from the heater and may be unable to accurately sense the water temperature in the ice-making cell.

In the present embodiment, however, the temperature measuring tool is arranged at a distance of the height greater than H/4, upward from the bottom portion, thereby avoiding the influence of heat from the heater. The temperature thus can be measured accurately.

(Third Embodiment)

Referring to Fig. 1, the freezer refrigerator in a third embodiment according to the present invention will be described. The freezer refrigerator in the present embodiment includes the ice-making device in each embodiment above. Therefore, the overall structure is shown in Fig. 1. It should be noted that the structure shown in Fig. 1 is illustrated only by way of example. The arrangement of doors, the arrangement of compartments, and the like are not necessarily as shown in Fig. 1. Although the freezer refrigerator shown in Fig. 1. is intended for home use, the freezer refrigerator in the present embodiment may be intended for commercial use.

Since the present embodiment includes the ice-making device as explained in each embodiment above, ice of differences sizes can be automatically produced by switching the modes.

The embodiment disclosed here should be understood as being illustrative rather than being limitative in all respects. The scope of the present invention is shown not in the foregoing description but in the claims, and it is intended that all modifications that come within the meaning and range of equivalence to the claims are embraced here.

INDUSTRIAL APPLICABILITY

The present invention can be used in an ice-making device and a freezer refrigerator including the same.

REFERENCE SIGNS LIST

1 freezer refrigerator, 2 refrigerator compartment, 3L, 3R door, 4 ice-making
5 compartment, 5, 7 door, 6, 8 freezer compartment, 9 vegetable compartment, 10 ice-
making device, 11 duct, 12 ice-making tray casing, 13 cool air discharge port, 20 ice-
making tray, 21 ice-making cell, 21a first ice-making cell, 21b second ice-making cell,
22 support shaft, 23 socket, 24 ice-removing device, 25 thermistor, 26 thermistor cover,
27 pin, 28 leg portion, 29 horizontal through hole, 30 thermistor protection sealer, 31
10 heater, 32 parallel rib, 33 feed line, 34 cover, 35 ring, 36 screw, 37 spring, 38, 39
through hole, 40 boss, 41 spring-attached rib, 42 horizontal through hole, 43 attachment
hook, 44 hairpin portion, 45 windshield plate, 46 notch, 47 gap, 48 protrusion, 50
control unit, 51 compressor, 52 blower, 53 water feeder, 54 temperature sensor, 55 ice
volume sensor, 211 bottom portion, 212 cell upper end, 213 sidewall, 214 portion (of
15 the sidewall of the first ice-making cell that is close to the second ice-making cell), 215
portion (of the sidewall of the second ice-making cell that is close to the first ice-
making cell), 217 position (of water level in the minimum water volume mode), 218
position (of water level in the maximum water volume mode), 219 space (inside of the
shape of an inverse letter V), 251 head, 252 lead, 253 protective tube portion, 254
20 thermistor element, 255 head cover, 256 sealing resin, 261 positioning rib.

CLAIMS

1. An ice-making device comprising an ice-making tray (20),
said ice-making tray including a first ice-making cell (21a) and a second ice-
5 making cell (21b) arranged so as to be horizontally adjacent to each other,
said first ice-making cell and said second ice-making cell each having a bottom
portion (211), a cell upper end (212), and a plate-shaped sidewall (213) extending so as
to expand from said bottom portion toward said cell upper end in the form of a slope,
wherein
10 a portion (214) of said sidewall of said first ice-making cell that is close to said
second ice-making cell and a portion (215) of said sidewall of said second ice-making
cell that is close to said first ice-making cell form a shape of an inverse letter V as
viewed in cross section,
said ice-making tray has a maximum water volume mode in which at least said
15 first ice-making cell is filled to a maximum water volume and a minimum water
volume mode in which at least said first ice-making cell is filled to a minimum water
volume that is at most $1/2$ of the maximum water volume, and
a temperature measuring tool is arranged below a position (217) of a water level
in said minimum water volume mode in a space (219) inside of said shape of an inverse
20 letter V, so as to be proximate to at least said portion (214) of said sidewall of said first
ice-making cell that is close to said second ice-making cell.

2. The ice-making device according to claim 1, wherein a member that defines
a position of said temperature measuring tool extends from said ice-making tray.

25 3. The ice-making device according to claim 1, wherein a heater (31) is
arranged under said bottom portion, and when a height from said bottom portion to a
position of a water level in said minimum water volume mode is H, said temperature
measuring tool is arranged above a height that is $1/4$ of said H relative to said bottom

portion.

4. The ice-making device according to claim 1, wherein said temperature measuring tool is a thermistor (25).

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5. A freezer refrigerator comprising the ice-making device (10) of claim 1.