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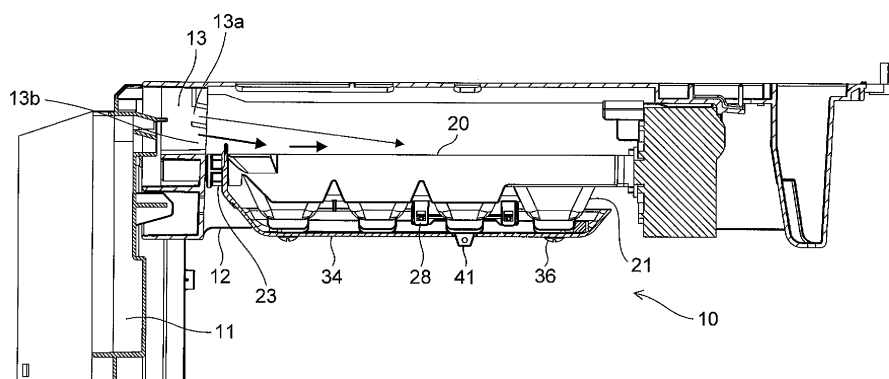
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(54) **ICE-MAKING DEVICE FOR REFRIGERATOR/FREEZER**

(57) An ice-making device (10) installed in an ice-making chamber (4) of a refrigerator/freezer (1) comprises: an ice-making tray (20) for making ice using cold air blown into the ice-making chamber (4); a thermistor (25) for measuring the temperature inside the ice-making tray (20); a heater (31) for heating the ice-making tray (20) from below; and a control unit (50) for controlling the flow of electricity in the heater (31) and controlling the operation of the refrigeration cycle by using the temperature measured by the thermistor (25) as a determination criterion. A cold air discharge port (13) of the ice-making chamber (4) comprises a distal discharge port (13a) directed toward a distal portion of the ice-making tray (20) when viewed from the cold air discharge port (13), and a proximal discharge port (13b) directed toward a proximal portion of the ice-making tray (20) when viewed from the cold air discharge port (13).

ation of the refrigeration cycle by using the temperature measured by the thermistor (25) as a determination criterion. A cold air discharge port (13) of the ice-making chamber (4) comprises a distal discharge port (13a) directed toward a distal portion of the ice-making tray (20) when viewed from the cold air discharge port (13), and a proximal discharge port (13b) directed toward a proximal portion of the ice-making tray (20) when viewed from the cold air discharge port (13).

FIG.2



Description

TECHNICAL FIELD

[0001] The present invention relates to an ice-making device for refrigerator/freezer.

BACKGROUND ART

[0002] A refrigerator/freezer is usually equipped with an ice-making device for making ice cubes utilizing cold air for freezing. Examples of the ice-making device disposed in the refrigerator/freezer are shown in Patent Documents 1 to 6.

[0003] Ice cubes produced by the ice-making device for refrigerator/freezer usually have low transparency. Therefore, inventions have been made for improving transparency of ice cubes. The ice-making devices described in Patent Documents 1 to 6 also include such inventions.

[0004] The ice-making devices described in Patent Documents 1 and 2 have structures in which a heater is disposed above an ice-making tray so that temperature is higher above the ice-making tray than below the same. Thus, ice cubes are produced in order from a lower part to an upper part in the ice-making tray. Thus, in the ice-making process, air in water is easily discharged from an upper part of the water so that transparent ice cubes without air can be produced. The ice-making device described in Patent Document 3 has also a structure in which a heater is disposed above an ice-making tray.

[0005] The ice-making devices described in Patent Documents 4 to 6 have structures in which transparent ice cubes and cloudy ice cubes are produced in a combined state, and the transparent ice cubes and the cloudy ice cubes are severed from each other when the ice cubes are released from the ice-making tray, and the cloudy ice cubes are left in the ice-making tray while only the transparent ice cubes are released.

PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0006]

Patent Document 1: JP-A-4-260768
 Patent Document 2: JP-A-5-196331
 Patent Document 3: JP-A-1-203869
 Patent Document 4: JP-A-2007-232336
 Patent Document 5: JP-A-2008-151504
 Patent Document 6: JP-A-2008-157619

DISCLOSURE OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0007] It is an object of the present invention to provide

a novel mechanism for producing transparent ice cubes in an ice-making device for refrigerator/freezer.

MEANS FOR SOLVING THE PROBLEM

[0008] In order to achieve the above-mentioned object, the present invention is characterized as follows: an ice-making device for refrigerator/freezer comprises an ice-making chamber, an ice-making tray disposed in the ice-making chamber for making an ice cube by cold air blown into the ice-making chamber, a thermistor for measuring temperature in the ice-making tray, a heater for heating the ice-making tray from below, and a control unit for exercising operation control of refrigeration cycle and control of power supply to the heater on the basis of the temperature measured by the thermistor as determination criterion. The control unit controls progress of freezing by supplying power to the heater after supplying water to the ice-making tray, and a cold air discharge port of the ice-making chamber includes a distal discharge port directed toward a distal portion of the ice-making tray in a view from the cold air discharge port, and a proximal discharge port directed toward a proximal portion of the ice-making tray in a view from the cold air discharge port.

[0009] According to a preferred embodiment of the present invention, in the ice-making device for refrigerator/freezer having the above-mentioned structure, an amount of discharge flow from the distal discharge port is set to be smaller than an amount of discharge flow from the proximal discharge port.

[0010] According to a preferred embodiment of the present invention, in the ice-making device for refrigerator/freezer having the above-mentioned structure, the heater is attached to and intimately contacts with an underside of the ice-making tray, and the underside of the ice-making tray is sheltered with a cover.

[0011] According to a preferred embodiment of the present invention, in the ice-making device for refrigerator/freezer having the above-mentioned structure, a spring attachment rib is formed on the underside of the ice-making tray, the cover is provided with a through hole through which the spring attachment rib passes, and the cover is pressed to the heater by a pressure of a spring attached to the spring attachment rib passing through the through hole.

[0012] According to a preferred embodiment of the present invention, in the ice-making device for refrigerator/freezer having the above-mentioned structure, the ice-making tray includes a support stud on a longitudinal-direction end thereof, and the cover shelters the underside of the ice-making tray in a state where a ring formed at an end of the cover engages with the support stud.

[0013] According to a preferred embodiment of the present invention, in the ice-making device for refrigerator/freezer having the above-mentioned structure, the cover is provided with a through hole through which a boss formed on the underside of the ice-making tray is exposed, and a screw is screwed into the boss exposed

from the through hole so that the cover is held in a movable manner along an axis of the boss.

[0014] According to a preferred embodiment of the present invention, in the ice-making device for refrigerator/freezer having the above-mentioned structure, a top surface of the cover is provided with a rib for pressing the heater to the ice-making tray.

[0015] According to a preferred embodiment of the present invention, in the ice-making device for refrigerator/freezer having the above-mentioned structure, each of longitudinal rims of the ice-making tray is provided with an wind shield plate for preventing cold air blown from above from proceeding to an underside of the ice-making tray.

[0016] According to a preferred embodiment of the present invention, in the ice-making device for refrigerator/freezer having the above-mentioned structure, the wind shield plate has a notch formed from an edge thereof.

[0017] According to a preferred embodiment of the present invention, in the ice-making device for refrigerator/freezer having the above-mentioned structure, a cover attached to the underside of the ice-making tray shelters the heater, and a gap is formed between a rim of the cover and the opposing wind shield plate so as not to cause a contact therebetween when the ice-making tray is twisted for releasing of ice cubes.

EFFECTS OF THE INVENTION

[0018] According to the present invention, because the water in the ice-making tray is frozen while being heated by the heater from below, a major core part of the produced ice cube becomes transparent though the surface thereof becomes uneven as a trace of bubbles discharged from the periphery. In addition, because freezing proceeds uniformly in every part of the ice-making tray, it is easy to control the freezing speed by controlling the heater so that transparency of the ice cube can be improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019]

Fig. 1 is a front view of a refrigerator/freezer equipped with an ice-making device.

Fig. 2 is a partial vertical cross-sectional view of the refrigerator/freezer illustrating the ice-making device.

Fig. 3 is a vertical cross-sectional view of the ice-making device taken along the direction perpendicular to Fig. 2.

Fig. 4 is a perspective view of the ice-making tray in an upside down state and a thermistor to be combined thereto.

Fig. 5 is a perspective view of the ice-making tray in an upside down state, and a heater and a cover to

be combined thereto.

Fig. 6 is a perspective view of the ice-making tray in an upside down state to which the cover for the heater is attached.

Fig. 7 is a side view of a spring.

Fig. 8 is a plan view of the cover.

Fig. 9 is a partial plan view of the heater.

Fig. 10 is a cross-sectional view of the heater.

Fig. 11 is a control block diagram of the refrigerator/freezer.

Fig. 12 is a flowchart illustrating an operation of the ice-making device.

Fig. 13 is a flowchart illustrating another operation of the ice-making device.

BEST MODE FOR CARRYING OUT THE INVENTION

[0020] A refrigerator/freezer 1 illustrated in Fig. 1 has a structure in which a cold chamber 2 with double doors 3L and 3R is disposed in the uppermost part, an ice-making chamber 4 with a door 5 and a freezing chamber 6 with a door 7 are disposed thereunder, a drawer type freezing chamber 8 is disposed thereunder, and a drawer type vegetable chamber 9 is disposed in the lowermost part. A refrigeration cycle (not shown) including a compressor and a heat exchanger generates cold air, which is distributed to each chamber through ducts, and hence cold storage temperature or freezing temperature necessary in each chamber is obtained. This mechanism is well known and is not described here in detail.

[0021] As illustrated in Fig. 2 and Fig. 3, an ice-making device 10 is disposed in a ceiling part of the ice-making chamber 4. A structure thereof is described below with reference to the drawings of Fig. 4 to Fig. 10.

[0022] Fig. 2 is a cross-sectional view of the ice-making device 10 viewed from the left side of the refrigerator/freezer 1. On a wall behind the ice-making chamber 4, there is formed a duct 11 blowing cold air into the ice-making chamber 4. An ice-making tray casing 12 extends to the front from an upper end of the duct 11. An opening is formed in the underside of the ice-making tray casing 12 so that ice cubes produced in an ice-making tray can be dropped therethrough. The duct 11 is provided with a cold air discharge port 13 facing toward the inside of the ice-making tray casing 12.

[0023] An ice-making tray 20 is disposed inside the ice-making tray casing 12 at a position for receiving the cold air blown from the cold air discharge port 13. The ice-making tray 20 is molded with synthetic resin that does not lose elasticity at low temperature. If bubbles in supplied water adhere to the inner surface of the ice-making tray 20, it is difficult to produce transparent ice cubes. Therefore, as means for preventing bubbles from adhering to the ice-making tray 20, it is preferable to use polypropylene mixed with silicone as molding material for the ice-making tray 20 or to coat the ice-making tray 20 with fluorocarbon resin after molding.

[0024] Fine particles attracted by static electricity gen-

erated on the surface of the ice-making tray 20 also become obstacles to production of transparent ice cubes. Therefore, it is preferable to mold the ice-making tray 20 with a material that hardly generate static electricity, such as resin mixed with silicone or resin in which an antistatic agent is kneaded and mixed, or to apply an antistatic agent onto the ice-making tray 20 after molding.

[0025] The ice-making tray 20 includes a total of eight ice-making cells 21 for producing ice cubes having a trap-ezoidal cross section. The eight ice-making cells 21 are arranged in two columns and four rows, and therefore the ice-making tray 20 has an elongated shape in a plan view. This elongated ice-making tray 20 is placed so that the longitudinal direction thereof coincides with the front-rear direction of the refrigerator/freezer 1.

[0026] A support stud 22 is formed on a longitudinal-direction end of the ice-making tray 20, and a socket 23 is formed on an opposing end of the ice-making tray. The support stud 22 is supported in a rotatable manner by the ice-making tray casing 12. The socket 23 is connected to a shaft of an ice-releasing device 24 (see Fig. 3) disposed inside the ice-making tray casing 12 and is supported by the ice-releasing device 24. The support stud 22 and the socket 23 are disposed on the same horizontal axis. The ice-releasing device 24 includes a motor and a reduction gear which give the ice-making tray 20 rotation of a certain angle about the horizontal axis.

[0027] On an underside of the ice-making tray 20, there is disposed a thermistor 25 at a position between two rows of the ice-making cells 21. The thermistor 25 measures temperature inside the ice-making cell 21 through a wall of the ice-making cell 21.

[0028] The thermistor 25 is fixed by a thermistor cover 26. Pins 27 protrude from four corners of the thermistor cover 26 in the direction perpendicular to the longitudinal direction of the ice-making tray 20. A total of four legs 28 protrude from the underside of the ice-making tray 20 so as to surround the thermistor 25. A horizontal through hole 29 for the pin 27 to pass through the leg 28 is formed on the tip of the leg 28. A thermistor protection sealer 30 is placed on the thermistor 25, the thermistor cover 26 is placed thereon, and the pin 27 is engaged in the horizontal through hole 29 of the leg 28, so that the thermistor 25 is fixed.

[0029] On the underside of the ice-making tray 20, a heater 31 illustrated in Fig. 5 is disposed in addition to the thermistor 25. The heater 31 is formed by coating a heater wire with silicone resin, and an entirety thereof is flexible so as to conform to a twist of the ice-making tray 20. Parallel ribs 32 for receiving the heater 31 are formed on a top of each ice-making cell 21 in an upside down state.

[0030] The parallel ribs 32 include two ribs disposed in parallel at a predetermined interval, and the interval between the ribs is determined so that the heater 31 is received between the ribs in a loose fit manner. The interval between the ribs is determined in this way for a purpose that the heater 31 can move freely to a certain

extent when the ice-making tray 20 is twisted.

[0031] The heater 31 is laid so as to form a symmetric shape in the left and right with respect to the longitudinal center line of the ice-making tray 20. In the embodiment, an outline of the heater 31 is substantially a U-shape. A pair of power supply lines 33 is connected to open ends of the U-shape.

[0032] Being designed to generate a small amount of heat, the heater 31 has a structure in which very thin heater wire is wound around a glass fiber core. Therefore, if the heater 31 is twisted in a direction in which the winding is tightened, the heater wire may easily be severed. Therefore, as described above, the heater 31 can move freely to a certain extent, and the layout of the heater 31 is shaped such that an excessive force is not applied to the heater wire as much as possible.

[0033] After the heater 31 is housed between the parallel ribs 32 so as to contact intimately with the underside of the ice-making tray 20, the underside of the ice-making tray 20 is sheltered with a cover 34. The cover 34 prevents the cold air from entering into an underside space of the ice-making tray 20 and makes temperature distribution among the ice-making cells 21 become uniform. In addition, the cover 34 plays a role of keeping the heater 31 between the parallel ribs 32.

[0034] The cover 34 has a rectangular tray shape, and a ring 35 for the support stud 22 to pass through is formed at one end thereof. After the ring 35 is engaged with the support stud 22, the cover 34 is attached to the ice-making tray 20 with two screws 36 and one spring 37. The attachment of the cover 34 is not a firm one restricting movement of the ice-making tray 20 but a flexible one not hampering twist of the ice-making tray 20 when ice cubes are released. It is preferable to mold the cover 34 with synthetic resin that does not lose elasticity at low temperature, similarly to the ice-making tray 20.

[0035] Two through holes 38 are formed near both ends in the longitudinal direction of the cover 34. In addition, two through holes 39 are formed symmetrically with respect to the longitudinal center line at a position closer to the center of the cover 34 than the through holes 38. The through hole 38 has a circular shape and a boss 40 having a circular cross-section shape formed on the underside of the ice-making tray 20 passes through the through hole 38. The through hole 39 has a rectangular shape and a spring attachment rib 41 formed on the underside of the ice-making tray 20 passes through the through hole 39.

[0036] After the screws 36 are screwed and fixed to the bosses 40 exposed from the through holes 38, the cover 34 is held in a movable manner along the axes of the bosses 40 with the screws 36 as drop-off stoppers. In other words, the screws 36 do not fasten the cover 34 but prevent the cover 34 from disengaging from the ice-making tray 20.

[0037] When the cover 34 is prevented from disengaging by the screws 36, the spring attachment ribs 41 protrude from the through holes 39 of the cover 34 as illus-

trated in Fig. 6. Attachment hooks 43 on both ends of the spring 37 are engaged with horizontal through holes 42 formed on the tips of the spring attachment ribs 41. The spring 37 is made by bending and forming a spring steel wire in a shape having the attachment hooks 43 in the middle in the longitudinal direction and hairpin portions 44 at both ends in the longitudinal direction.

[0038] The hairpin portion 44 extends at a downward slant in Fig. 6, namely in the direction of the ice-making tray 20. As illustrated in Fig. 7, the hairpin portions 44 are lower than the attachment hooks 43 in the spring 37, and a linear portion connecting the hairpin portions 44 is horizontal. Therefore, if the attachment hooks 43 are engaged with the horizontal through holes 42 of the spring attachment rib 41, the hairpin portions 44 and the linear portion connecting the hairpin portions 44 exert pressure on the cover 34. The cover 34 is pressed to the heater 31 as illustrated in Fig. 3, and hence the heater 31 is held by a constant load so as not to disengage from the parallel ribs 32. In this way, the heater 31 intimately contacts with the ice-making cell 21 so that heat of the heater 31 can be efficiently conducted to the ice-making cell 21.

[0039] As illustrated in Fig. 8, ribs 34a for pressing the heater 31 to the ice-making tray 20 are formed along the shape of the heater 31 and on the top surface of the cover 34. Thanks to the ribs 34a, contact area between the heater 31 and the cover 34 can be reduced so that sliding between the heater 31 and the cover 34, which is inevitably generated when the ice-making tray 20 is twisted, becomes smooth. In addition, strength of the cover 34 is enhanced by the ribs 34a.

[0040] On the top surface of the cover 34, there is also formed a lateral rib 34b connecting the ribs 34a. A position of the rib 34b corresponds to a position at which the spring 37 presses the cover 34. Therefore, pressure from the spring 37 can be transmitted uniformly to the heater 31. The rib 34b is also useful for reinforcement of the cover 34.

[0041] On a side of the heater 31 facing the cover 34, there is formed a low-lying rib 31a illustrated in Fig. 9 and Fig. 10. The rib 31a is useful for distinguishing whether the heater 31 is disposed in a twisted state or not.

[0042] On each of longitudinal rims of the ice-making tray 20, there is integrally formed a wind shield plate 45 extending downward. The wind shield plate 45 prevents the cold air blown from above to the ice-making tray 20 from proceeding to a lower portion of the ice-making tray 20. Therefore, it is possible to reduce loss of heating effect of the heater 31 caused by the cold air having entered into the underside space of the ice-making tray 20, and let the cold air concentrate on the top of the ice-making tray 20.

[0043] In the wind shield plate 45, there are formed notches 46 vertically from the edge at positions corresponding to boundaries between the ice-making cells 21. In the embodiment, there are two notches 46 in a wind shield plate 45. If the notches 46 are not formed, when the ice-making tray 20 is twisted, a stress inside the wind

shield plate 45 is concentrated at one part, and hence resin material at the part is whitened at an early stage and a crack may open there. By the existence of the notches 46, the stress inside the wind shield plate 45 is dispersed and occurrence of whitening or a crack can be prevented.

[0044] As illustrated in Fig. 3, between the wind shield plate 45 and the cover 34, there is formed gaps 47 for preventing contact between them when the ice-making tray 20 is twisted for releasing of ice cubes.

[0045] In the end of the ice-making tray 20 on the support stud 22 side, there is formed a protrusion 48 on a side thereof. The protrusion 48 is used for twisting the ice-making tray 20 when the ice cubes are released.

[0046] A control unit 50 illustrated in Fig. 11 exercises control over the entire refrigerator/freezer 1: the control includes operation control of the refrigeration cycle and power supply control to the heater 31. The control unit 50 is connected to the ice-releasing device 24, the heater 31, a compressor 51 constituting the refrigeration cycle, a blower 52 for sending cold air to each portion inside the refrigerator/freezer, a water supply device 53 for supplying water to the ice-making device 10, a temperature sensor 54, an ice amount sensor 55 disposed in the ice-making chamber 4. The temperature sensor 54 is a generic term including temperature measuring elements such as a thermistor disposed at where it is necessitated, including the thermistor 25.

[0047] The control unit 50 controls power supply to the heater 31 by the following three steps. The three steps include "normal heating", "preheating" having a smaller heat value than the "normal heating", and "rapid heating" having a larger heat value than the "normal heating". For instance, power consumption of the "normal heating" is set to 5 to 6 W, power consumption of the "preheating" is set to 2 W, and power consumption of the "rapid heating" is set to 7 to 8 W, so that there is a difference between the heat values.

[0048] Next, with reference to the flowchart of Fig. 12, an operation of the ice-making device 10 is described. The flow of Fig. 12 starts when the ice-making tray 20 restores its right-side-up posture after the ice-releasing operation.

[0049] In Step #101, the control unit 50 operates the water supply device 53 to supply water to the ice-making tray 20.

[0050] Because the temperature of the ice-making chamber 4 is near freezing temperature (being set to minus 18 degrees Celsius), temperature of the ice-making tray 20 rises when the water is supplied. The thermistor 25 detects the temperature rise in Step #102.

[0051] Because the water is cooled as soon as it is supplied, the temperature measured by the thermistor 25 temporarily rises and then starts to drop. Then, the process proceeds to Step #103.

[0052] Step #103 is a freezing preparation step. The control unit 50 supplies the heater 31 with power for "preheating", and makes water temperature drop at a prede-

terminated rate.

[0053] Also in the following steps heating by the heater 31 is performed. By freezing the ice-making tray 20 while heating from below by the heater 31, transparent ice cubes can be grown not from a part contacting with the inner surface of the ice-making tray 20 but from a part away from the inner surface of the ice-making tray 20. Therefore, ice cubes having high transparency can be easily grown.

[0054] If the compressor 51 enters a stop period during Step #103, the temperature drop is naturally decelerated. The control unit 50 stops power supply to the heater 31 so as to avoid wasteful power consumption.

[0055] The control unit 50 also stops power supply to the heater 31 if the temperature measured by the thermistor 25 is a predetermined value or higher, namely, 1 degrees Celsius or higher, for example. In this way, it is avoided to waste power supplied to the heater 31 when there is no possibility that water is frozen from a part contacting with the ice-making tray 20.

[0056] In Step #104, the control unit 50 checks whether the temperature measured by the thermistor 25 has dropped down below freezing point or not. If the temperature has dropped down below freezing point, the process proceeds to Step #105.

[0057] Step #105 is an ice melting step. The control unit 50 supplies power for the "rapid heating" to the heater 31 for a predetermined period to heat the ice-making tray 20. Even if there is a delay in proceeding from Step #104 to Step #105 because of a measurement error of the thermistor 25 so that an ice cube is adhered to the inner surface of the ice-making cell 21, the ice cube is melted in this stage. Therefore, it is possible to proceed to Step #106 without generating residual ice fraction that hampers making of uniformly transparent ice cubes.

[0058] The control unit 50 supplies power for the "rapid heating" to the heater 31 in Step #105 regardless of the compressor 51 is operating or stopped. In this way, melting of ice can be proceeded rapidly.

[0059] Step #106 is a freezing proceeding step. The control unit 50 supplies power for the "normal heating" to the heater 31 until the temperature measured by the thermistor 25 has dropped to a predetermined temperature.

[0060] The control unit 50 stops power supply to the heater 31 if the compressor 51 enters the stop period during Step #106, so as to avoid wasteful power consumption. However, because of the stop of power supply to the heater 31, the inner surface of the ice-making tray 20 may be already frozen when operation of the compressor 51 is resumed. Therefore, after resuming the operation of the compressor 51, the heater 31 is supplied with power for "rapid heating" for a predetermined period so as to melt ice possibly existing on the inner surface of the ice-making tray 20. In this way, transparent ice cubes can be produced continuously despite of intermittent power supply to the heater 31.

[0061] In Step #107, the control unit 50 checks whether

the temperature measured by the thermistor 25 has dropped to a predetermined temperature or not. If the temperature measured by the thermistor 25 has dropped to a predetermined temperature, namely minus 9 degrees Celsius for example, it is determined that making of ice cubes is completed, and the process proceeds to Step #108.

[0062] The control unit 50 stops power supply to the heater 31 in Step #108. When a predetermined period has elapsed, it is determined that transparent ice cubes have securely produced, and the process proceeds to Step #109.

[0063] In Step #109, the control unit 50 controls the ice-releasing device 24 to turn over the ice-making tray 20. As the ice-releasing device 24 is turning the ice-making tray 20 about the support stud 22, a little before the upside-down turn is completed, the protrusion 48 abuts a stopper (not shown) formed on the ice-making tray casing 12. Because the ice-releasing device 24 continues to turn the ice-making tray 20 by a predetermined angle after that, the ice-making tray 20 is twisted and deformed. As described above, between the wind shield plate 45 and the cover 34, there is disposed the gap 47 such that they do not contact with each other when the ice-making tray 20 is twisted. Therefore, the rim of the cover 34 and the wind shield plate 45 do not rub each other and no creak or abrasion is caused between them.

[0064] When the ice-making tray 20 is twisted, ice cubes in the ice-making cells 21 are extruded and drop into an ice container (not shown) placed in the ice-making chamber 4. After releasing of ice cubes, the ice-releasing device 24 turns the ice-making tray 20 in the opposite direction so as to restore the original posture of the ice-making tray 20. In this way, one cycle of the ice making operation is finished. If the ice amount sensor 55 indicates that the amount of ice cube in the ice container is not sufficient, the ice-making operation of the next cycle is started in succession. If the ice amount sensor 55 indicates that there is sufficient amount of ice cube in the ice container, the ice-making device 10 enter an idle period.

[0065] It is possible to operate the ice-making device 10 in accordance with the flowchart of Fig. 13. In the flowchart of Fig. 13, steps other than Step #108' are the same as those in the flowchart of Fig. 12. In Step #108', the control unit 50 gradually decreases current supplied to the heater 31 until stopping the power supply, instead of stopping the power supply to the heater 31 promptly after the temperature measured by the thermistor 25 has dropped to a predetermined temperature.

[0066] Temperatures of all the ice-making cells 21 are not necessarily identical to the temperature measured by the thermistor 25. Even when the temperature measured by the thermistor 25 has dropped to the predetermined temperature, temperatures of some ice-making cells 21 have not dropped that low yet, and unfrozen water may still remain. It is possible to prevent the water from remaining unfrozen by the process of gradually de-

creasing the supplied current until stopping the power supply instead of stopping the power supply to the heater 31 promptly after the temperature measured by the thermistor 25 has dropped to a predetermined temperature.

[0067] The control unit 50 also operates as follows.

[0068] If the temperature in the ice-making chamber 4 or the temperature of the cold air blown into the ice-making chamber 4 is a predetermined value or higher, the control unit 50 sets the current supplied to the heater 31 to a low level. As an example, default set temperature is set to minus 18 degrees Celsius. If the temperature is higher than minus 18 degrees Celsius, the current supplied to the heater 31 is set to a low level. If the temperature is minus 18 degrees Celsius or lower, the current supplied to the heater 31 is set to a normal level.

[0069] In this way, the heater 31 is supplied with power of a calorific value necessary for controlling the progress of freezing so that the ice making process can be optimized.

[0070] If the cold chamber temperature is set to a relatively high temperature when the outdoor temperature is low, the control unit 50 reduces rotational frequency of the compressor 51 and rotational frequency of the blower 52.

[0071] If the cold chamber temperature is set to a relatively high temperature when the outdoor temperature is low, operation time of the compressor 51 is usually shortened, and a period of time while the ice-making tray 20 is exposed to the cold air is decreased so that the ice-making time is prolonged. By reducing both the rotational frequency of the compressor 51 and the rotational frequency of the blower 52, the operation time of the compressor 51 is prolonged so that the ice making time can be shortened.

[0072] A feature of the present invention is in a structure of the cold air discharge port 13. As illustrated in Fig. 2, the cold air discharge port 13 is divided into two parts, namely an upper part and a lower part. The upper part is a distal discharge port 13a directed toward a distal portion of the ice-making tray 20 in a view from the cold air discharge port 13. The lower part is a proximal discharge port 13b directed toward a proximal portion of the ice-making tray 20 in a view from the cold air discharge port 13.

[0073] An amount of discharge flow from the distal discharge port 13a is set to be smaller than an amount of discharge flow from the proximal discharge port 13b. This can be realized by setting the proximal discharge port 13b larger than the distal discharge port 13a, for example.

[0074] Since the distal discharge port 13a and the proximal discharge port 13b are disposed in this way, the cold air is not concentrated on a particular ice-making cell 21 of the ice-making tray 20, and hence the freezing can be proceeded uniformly in every ice-making cell 21.

[0075] In addition, if only the proximal discharge port 13b exists, only the portion of the ice-making tray 20 close to the cold air discharge port is heavily cooled to cause a large temperature difference with the portion of the ice-

making tray 20 distant from the cold air discharge port. However, because the distal discharge port 13a exists, the cold air having small airflow amount from the distal discharge port 13a helps to cool the distant part as an auxiliary cold air. As a result, temperature variation among the ice-making cells 21 can be suppressed, and the freezing proceeds uniformly in every ice-making cell 21. Thus, freezing speed can be easily controlled by the heater 31 so that transparency of the ice cubes can be improved.

[0076] In this embodiment, the cold air discharge port 13 is divided into two parts of upper and lower, but the number of division is not limited to this. It is possible to adopt a larger number of division. In addition, it is possible to adopt another structure in which the cold air discharge port 13 is divided not into upper and lower but into left and right, and the left part is used as the distal discharge port while the right part is used as the proximal discharge port, for example.

[0077] Although the embodiment of the present invention is described above, the scope of the present invention is not limited to this. The present invention can be embodied with various modifications within the scope thereof without deviating from the spirit of the present invention.

INDUSTRIAL APPLICABILITY

[0078] The present invention can be widely applied to an ice-making device for refrigerator/freezer.

EXPLANATION OF NUMERALS

[0079]

- 1 refrigerator/freezer
- 4 ice-making chamber
- 10 ice-making device
- 11 duct
- 13 cold air discharge port
- 13a distal discharge port
- 13b proximal discharge port
- 20 ice-making tray
- 21 ice-making cell
- 24 ice-releasing device
- 25 thermistor
- 31 heater
- 34 cover
- 36 screw
- 37 spring
- 38, 39 through hole
- 40 boss
- 41 spring attachment rib
- 45 wind shield plate
- 46 notch
- 50 control unit
- 51 compressor
- 52 blower

53 water supply device

Claims

1. An ice-making device for refrigerator/freezer comprising:

an ice-making chamber;
 an ice-making tray disposed in the ice-making chamber for making an ice cube by cold air blown into the ice-making chamber;
 a thermistor for measuring temperature in the ice-making tray;
 a heater for heating the ice-making tray from below; and
 a control unit for exercising operation control of refrigeration cycle and control of power supply to the heater on the basis of the temperature measured by the thermistor as determination criterion, wherein
 the control unit controls progress of freezing by supplying power to the heater after supplying water to the ice-making tray, and
 a cold air discharge port of the ice-making chamber includes a distal discharge port directed toward a distal portion of the ice-making tray in a view from the cold air discharge port, and a proximal discharge port directed toward a proximal portion of the ice-making tray in a view from the cold air discharge port.

2. The ice-making device for refrigerator/freezer according to claim 1, wherein an amount of discharge flow from the distal discharge port is set to be smaller than an amount of discharge flow from the proximal discharge port.

3. The ice-making device for refrigerator/freezer according to claim 1, wherein the heater is attached to and intimately contacts with an underside of the ice-making tray, and the underside of the ice-making tray is sheltered with a cover.

4. The ice-making device for refrigerator/freezer according to claim 3, wherein a spring attachment rib is formed on the underside of the ice-making tray, the cover is provided with a through hole through which the spring attachment rib passes, and the cover is pressed to the heater by a pressure of a spring attached to the spring attachment rib passing through the through hole.

5. The ice-making device for refrigerator/freezer according to claim 3, wherein the ice-making tray includes a support stud on a longitudinal-direction end thereof, and the cover shelters the underside of the ice-making tray in a state where a ring formed at an

end of the cover engages with the support stud.

6. The ice-making device for refrigerator/freezer according to claim 3, wherein the cover is provided with a through hole through which a boss formed on the underside of the ice-making tray is exposed, and a screw is screwed into the boss exposed from the through hole so that the cover is held in a movable manner along an axis of the boss.

7. The ice-making device for refrigerator/freezer according to claim 3, wherein a top surface of the cover is provided with a rib for pressing the heater to the ice-making tray.

8. The ice-making device for refrigerator/freezer according to claim 1, wherein each of longitudinal rims of the ice-making tray is provided with a wind shield plate for preventing cold air blown from above from proceeding to an underside of the ice-making tray.

9. The ice-making device for refrigerator/freezer according to claim 8, wherein the wind shield plate has a notch formed from an edge thereof.

10. The ice-making device for refrigerator/freezer according to claim 8, wherein a cover attached to the underside of the ice-making tray shelters the heater, and a gap is formed between a rim of the cover and the opposing wind shield plate so as not to cause a contact therebetween when the ice-making tray is twisted for releasing of ice cubes.

FIG.1

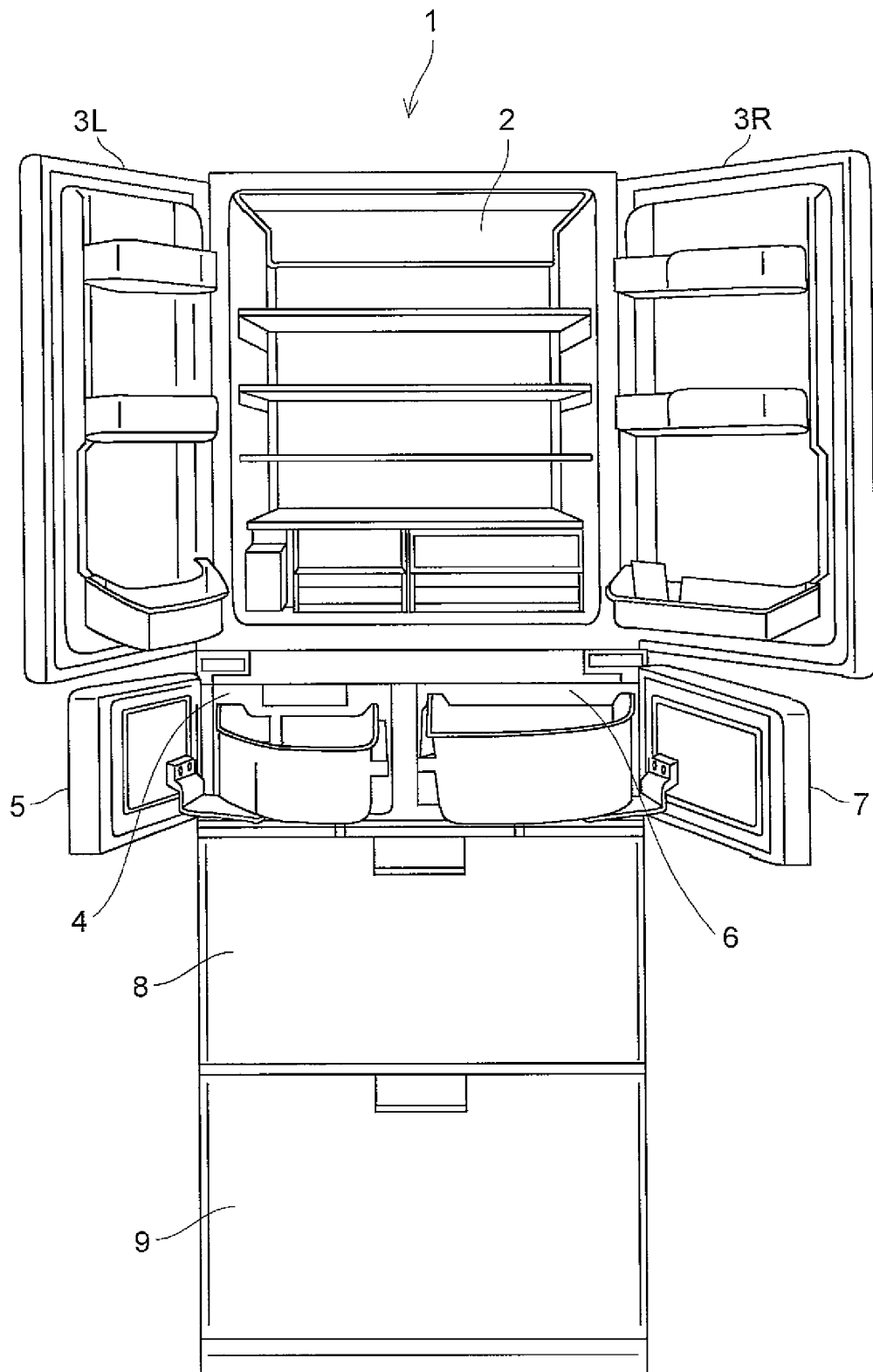


FIG.2

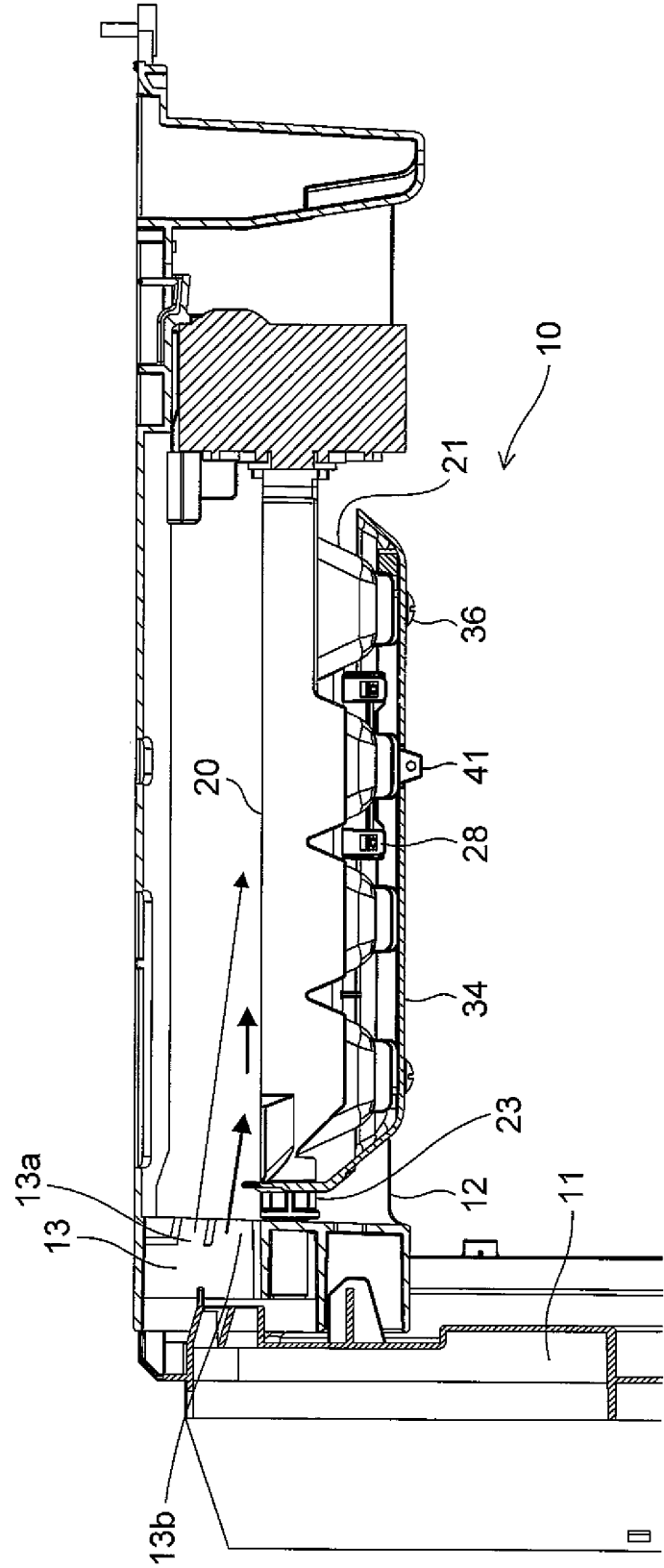


FIG.3

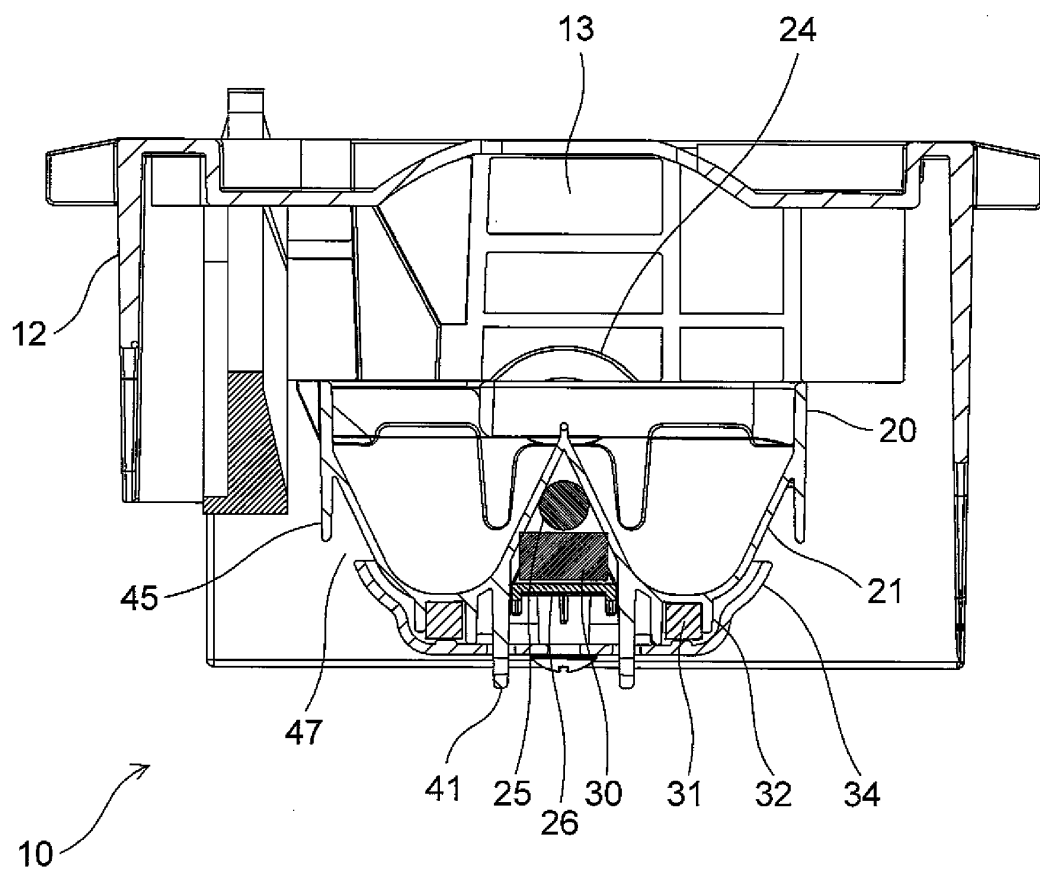


FIG.4

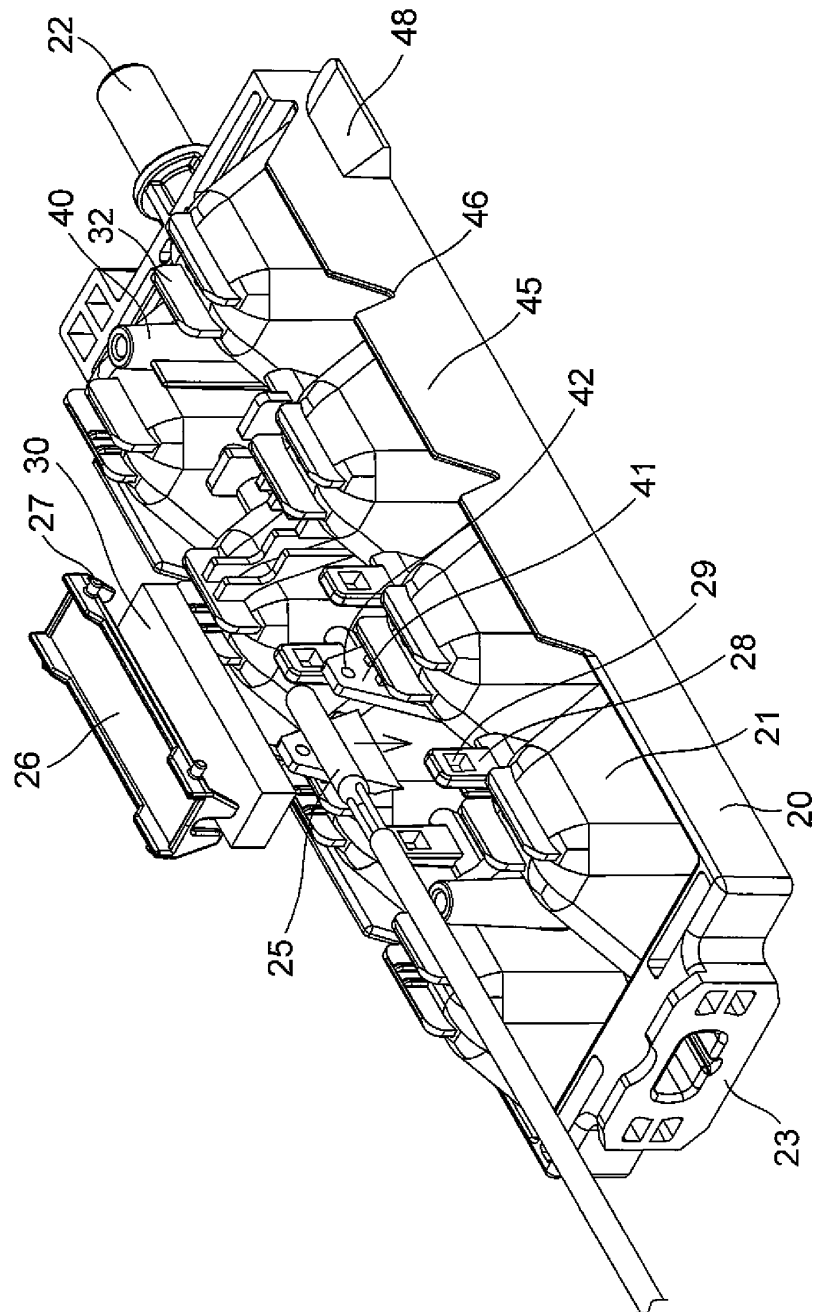


FIG.5

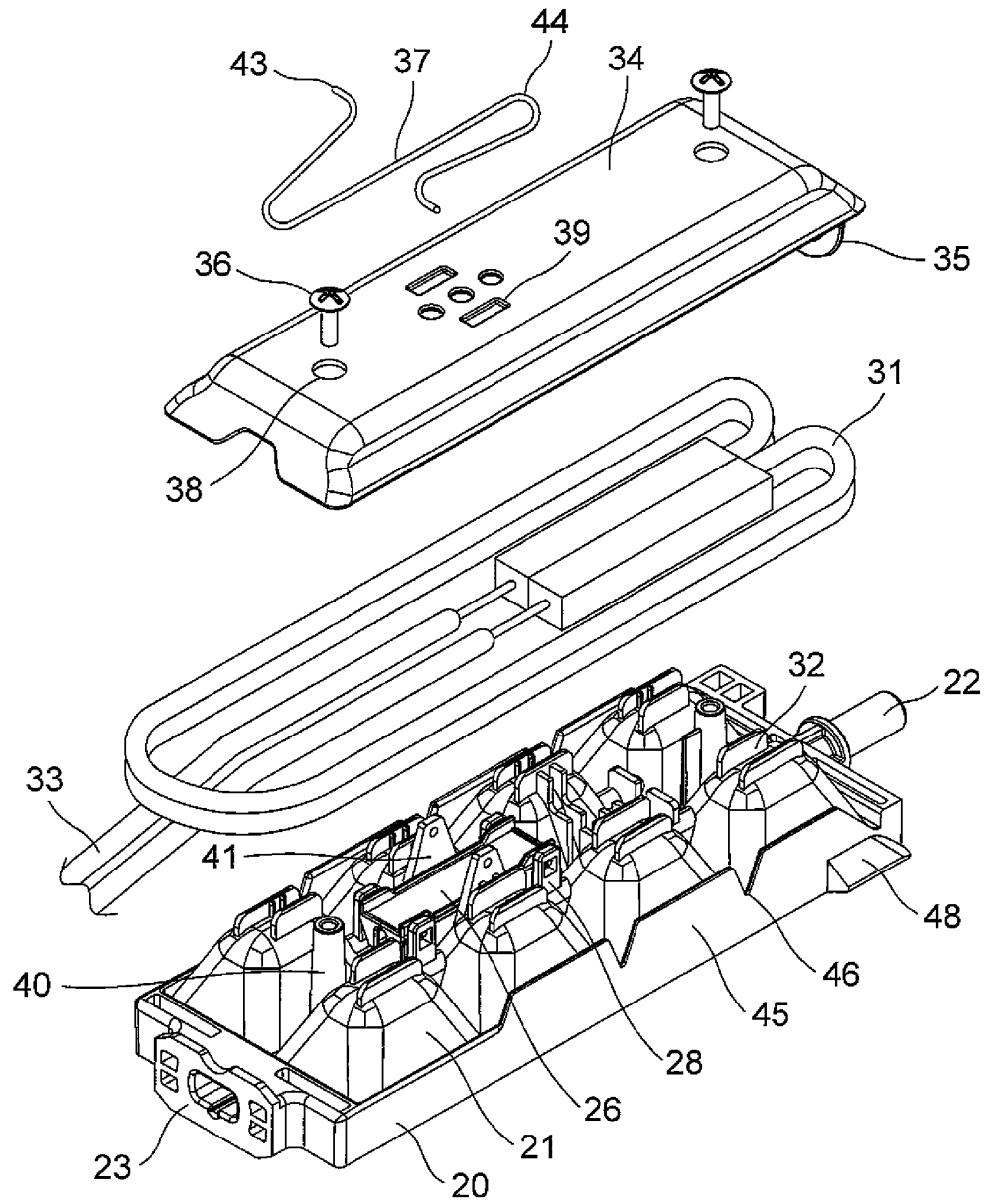


FIG.6

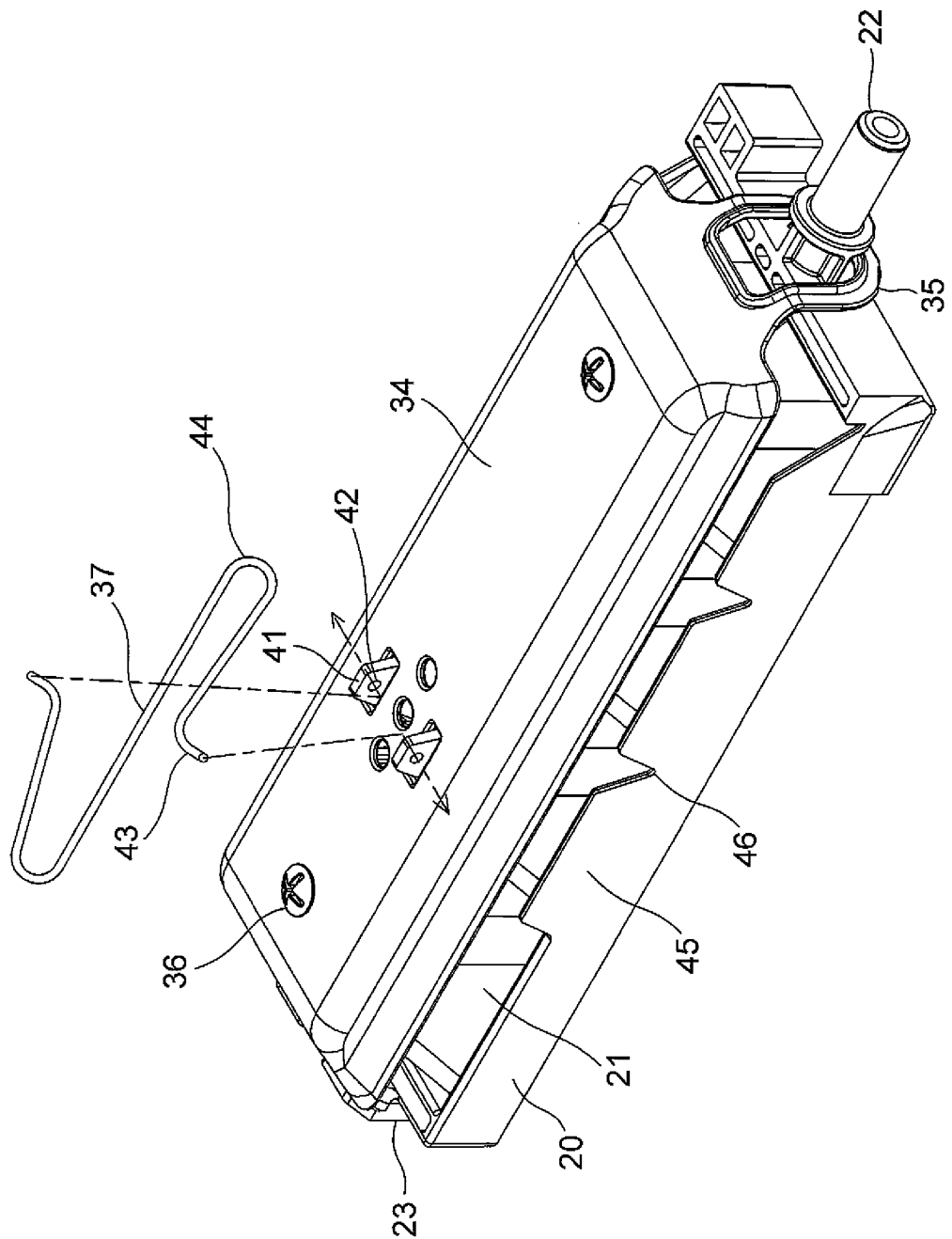


FIG.7

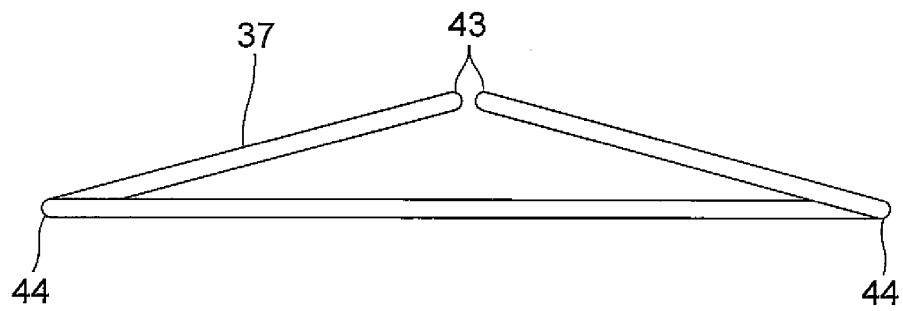


FIG.8

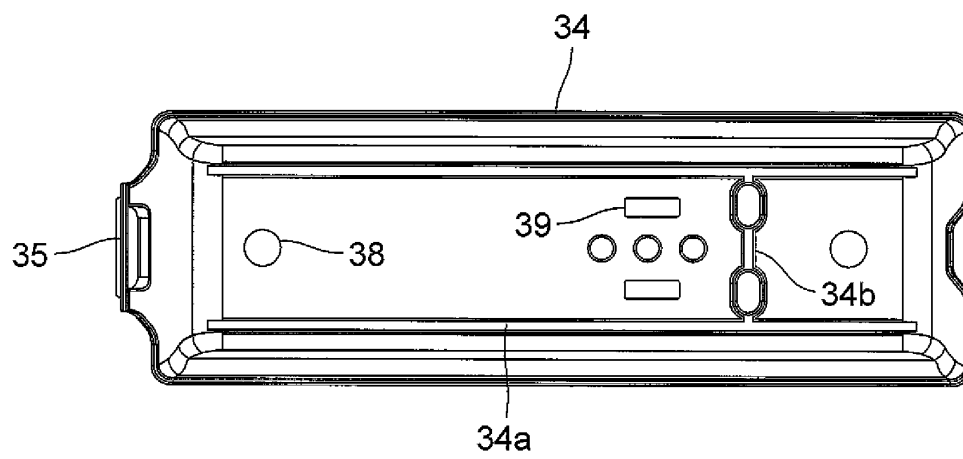


FIG.9

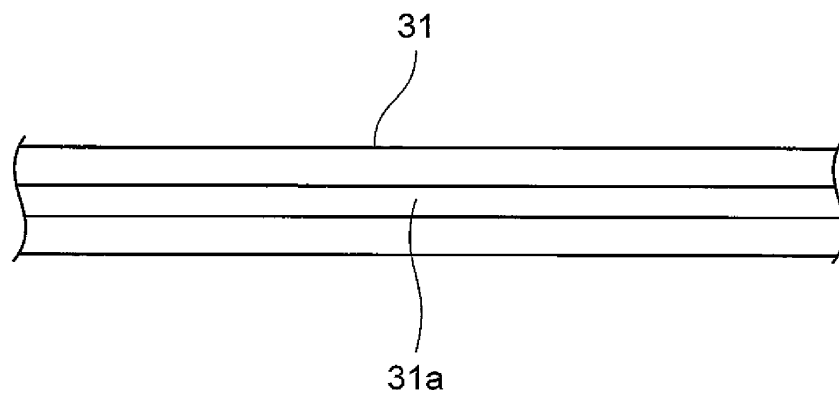


FIG.10

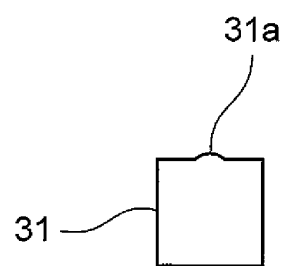


FIG.11

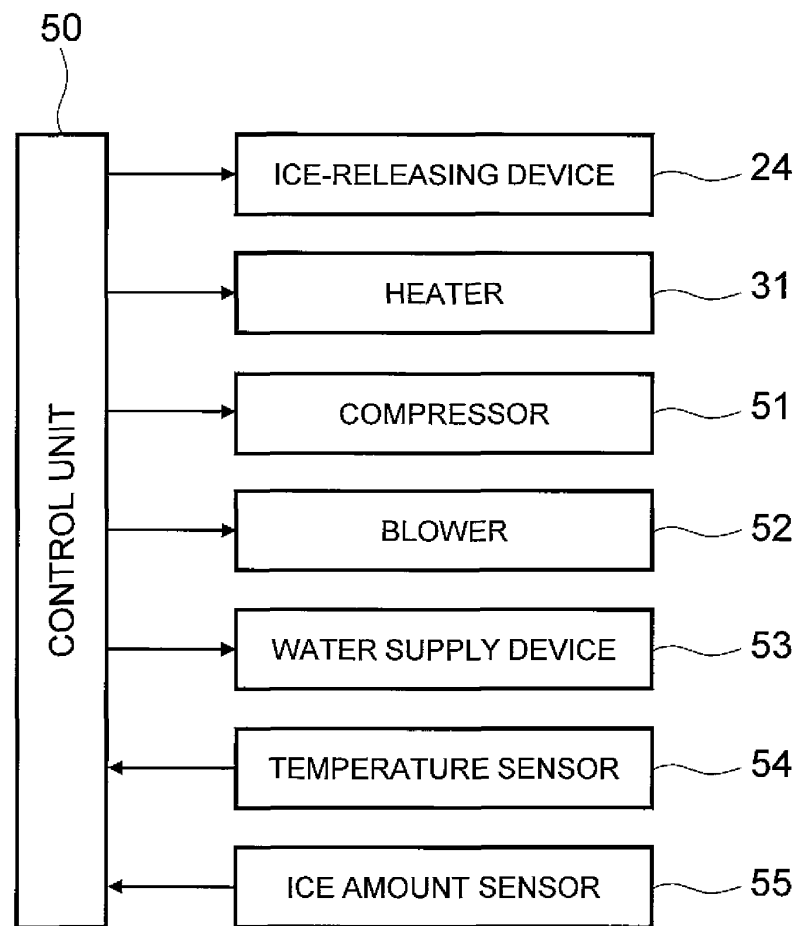


FIG.12

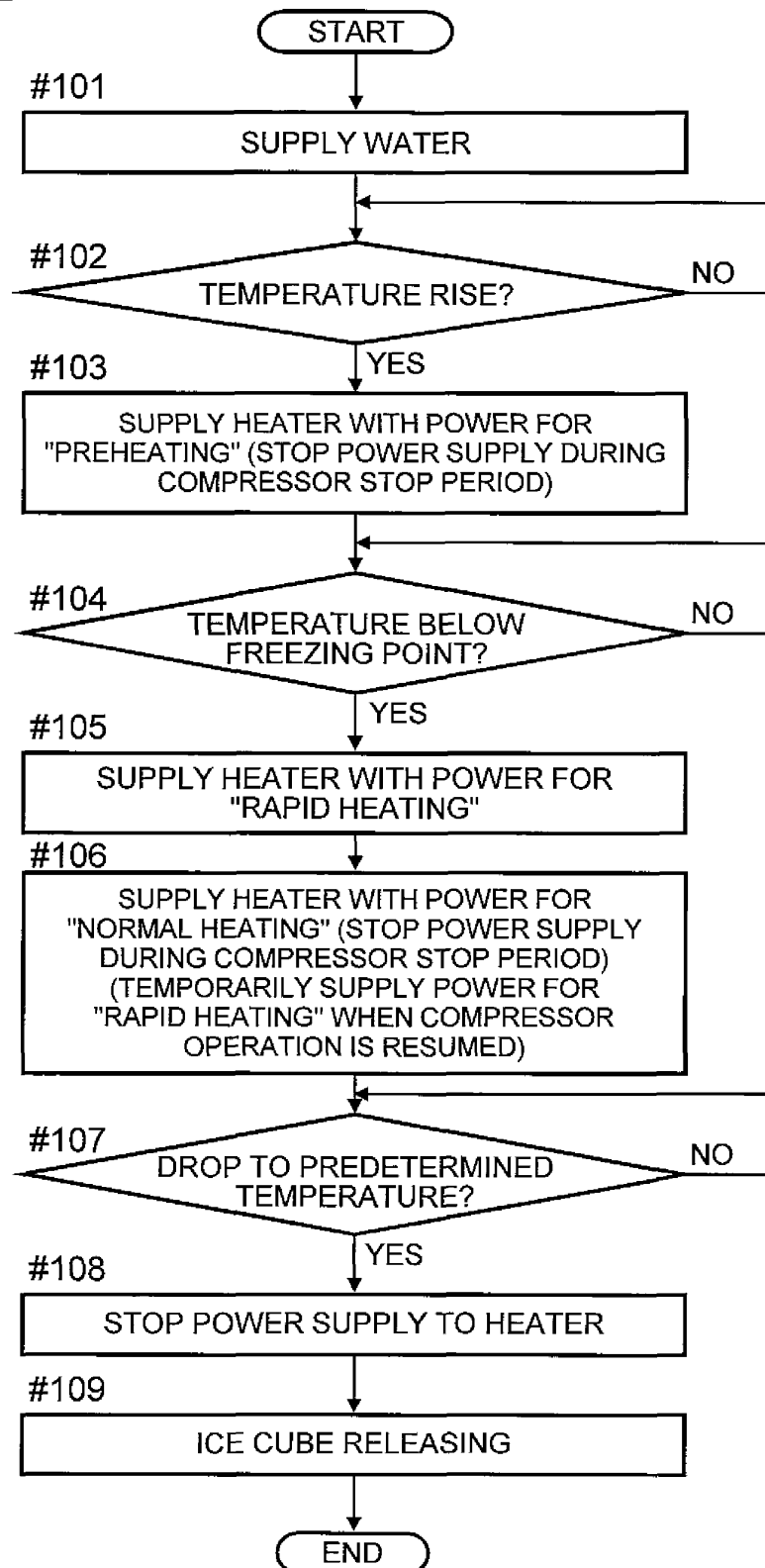
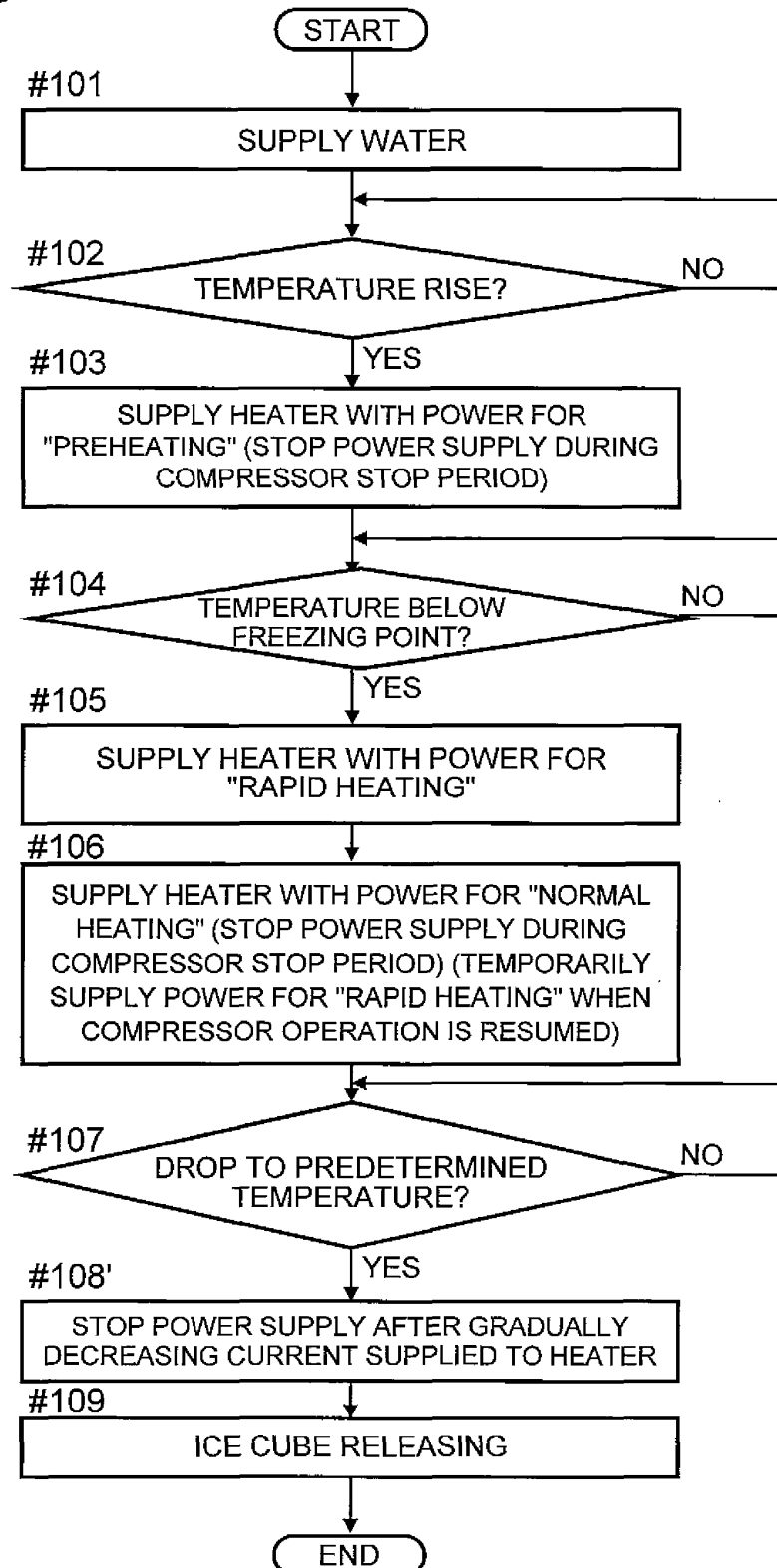


FIG.13



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2011/056232

A. CLASSIFICATION OF SUBJECT MATTER

F25D17/08(2006.01) i, F25C1/24(2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F25D17/08, F25C1/24

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2011
Kokai Jitsuyo Shinan Koho	1971-2011	Toroku Jitsuyo Shinan Koho	1994-2011

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2005-90801 A (Mitsubishi Electric Corp.), 07 April 2005 (07.04.2005), fig. 2, 4, 7; paragraphs [0001], [0017] to [0021], [0043], [0048] (Family: none)	1, 3, 5, 6
Y	JP 2003-56966 A (Fujitsu General Ltd.), 26 February 2003 (26.02.2003), fig. 2; paragraphs [0014] to [0015] (Family: none)	1, 3, 5, 6
Y	JP 2006-46749 A (Matsushita Electric Industrial Co., Ltd.), 16 February 2006 (16.02.2006), fig. 5 & WO 2006/011284 A1	5

☒ 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
12 May, 2011 (12.05.11)Date of mailing of the international search report
24 May, 2011 (24.05.11)Name and mailing address of the ISA/
Japanese Patent Office

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2011/056232

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2006-57970 A (Sharp Corp.), 02 March 2006 (02.03.2006), entire text; all drawings (Family: none)	1-10

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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- JP 51963311 A [0006]
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- JP 2007232336 A [0006]
- JP 2008151504 A [0006]
- JP 2008157619 A [0006]