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(54) **REFRIGERATOR**

(57) A refrigerators, an ice making device (30) of the refrigerator (10) comprises a water supply tank (31), an ice making tray (32), an ice storage container (33), a water supply pump (34), a water supply pipe (35) and a heating portion (36). The control portion (40) judges whether there is water in the water supply tank (31) via an infrared sensor (44), and variably controls the energization rate of the heating portion (36) according to the judgement result. According to this structure, bacteria are prevented from growing in the water remaining in the water supply pipe, and the suppression of the power consumption of the refrigerator (10) is achieved.

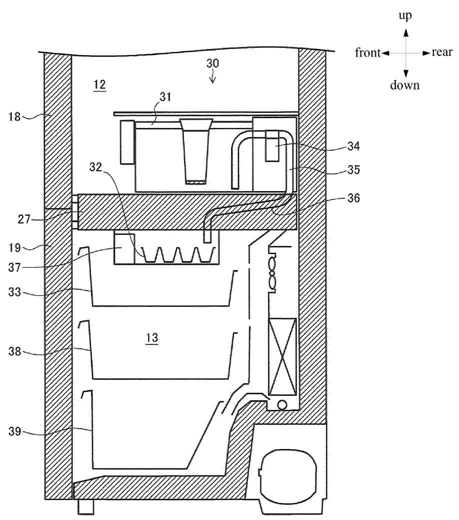


Fig.2 (A)



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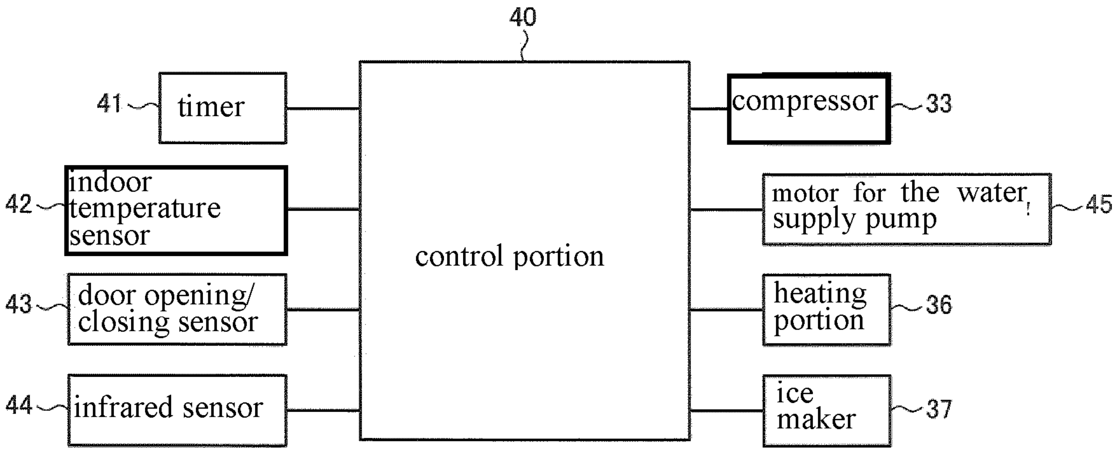
40
41
timer
42
indoor temperature sensor
43
door opening/ closing sensor
44
infrared sensor
control portion
compressor
33
motor for the water supply pump
45
heating portion
36
ice maker
37

**Fig.2（B）**

## Description

### TECHNICAL FIELD

**[0001]** The present invention relates to a refrigerator having an ice making device, and particularly to a refrigerator which prevents residual water in a water supply pipe of the ice making device from freezing and blocking the water supply pipe, and suppresses power consumption by variably controlling an energization rate of a heating portion of the ice making device.

### BACKGROUND

**[0002]** Patent Document 1-Japanese Patent Publication No. 4740072 discloses a conventional refrigerator. The refrigerator has an ice making device which comprises: a water supply tank configured in a refrigerating chamber; an ice making tray and an ice bin disposed in an ice making chamber; and a water supply pump and a water supply pipe supplying water from the water supply tank to the ice making tray.

**[0003]** In the ice making device, a driving current is applied to the water supply pump, and the water sucked from the water supply tank is supplied to the ice making tray through the water supply pipe. Furthermore, a pipe heater as a heating device is arranged in a portion of the water supply pipe located in the ice making chamber to prevent the residual water in the water supply pipe from freezing inside the water supply pipe.

### SUMMARY

**[0004]** As stated above, in a conventional refrigerator, a microcomputer detects whether there is water in a water supply tank, operates a pipe heater in a case that there is water in the water supply tank, and stops the pipe heater in a case that the water supply tank is empty. Thus, the power consumption of the refrigerator can be suppressed by appropriately operating the tube heater.

**[0005]** However, in the conventional refrigerator, when water is present in the water supply tank, the pipe heater starts to operate. Furthermore, it is difficult to reduce power consumption by making the pipe heater operate more than necessary, as long as the water supply pipe is in a through state at least before the water supply operation to the ice making tray is started.

**[0006]** In addition, since the pipe heater operates more than necessary, the water supply pipe becomes a high temperature state, the temperature of the water remaining in the water supply pipe increases, and there is a risk of bacterial growth.

**[0007]** The present invention has been completed in view of the above situations, and provides a refrigerator that prevents water remaining in a water supply pipe of an ice making device from freezing and clogging the water supply pipe, and that suppresses power consumption by variably controlling an energization rate of a heating portion of the ice making device.

**[0008]** The refrigerator according to the present invention comprises: a water supply tank that stores water; an ice making tray that makes ice from the water; an ice maker that removes the ice made in the ice making tray; a water supply pump that pumps the water in the water supply tank; a water supply pipe that supplies the water pumped by the water supply pump to the ice making tray; a heating portion that heats the water supply pipe; and a control portion that judges whether there is water in the water supply tank and variably controls an energization rate to the heating portion, wherein the control portion makes the energization rate to the heating portion before the water supply pump operates higher than the energization rate to the heating portion after the water supply pump operates.

**[0009]** In addition, in the refrigerator of the present invention, the control portion judges for a first time that the water supply tank is in an empty state, causes the energization rate to the heating portion to decrease after a certain time elapses after the energization rate to the heating portion is maximized, and judges for a second time whether there is water in the water supply tank.

**[0010]** In addition, in the refrigerator of the present invention, the control portion judges that the water supply tank is in the empty state twice in succession, and further stops the power supply to the heating portion after judging that a heat insulating door that blocks a chamber in which the water supply tank is disposed in a freely openable and closeable manner does not perform an opening action.

**[0011]** In addition, in the refrigerator of the present invention, the control portion judges that the water supply tank is in the empty state twice in succession, and further judges that a heat insulating door that blocks a chamber in which the water supply tank is disposed in a freely openable and closeable manner performs an opening/closing action, and then causes the energization rate to the heating portion to decrease after a certain time elapses after the energization rate to the heating portion is maximized, and then drives the water supply pump.

**[0012]** In addition, the refrigerator of the present invention comprises a compressor constituting a refrigeration cycle, and the control portion increases the energization rate to the heating portion when the compressor is operating, as compared to the energization rate when the compressor stops.

**[0013]** In addition, in the refrigerator of the present invention, when the water supply pump is driven, the control portion initially makes the motor driving the water supply pump operate in a reverse rotation direction, then operate in a forward rotation direction, and finally operate in the reverse rotation direction again.

**[0014]** In the refrigerator of the present invention, the control portion makes the energization rate to the heating portion before the operation of the water supply pump higher than the energization rate to the heating portion after the operation of the water supply pump, and allows the energization rate to the heating portion to be a low energization rate to an extent that the water in the water supply pipe is not frozen, in a period of time after the operation of the water supply pump. By this control method, the water remaining in the water supply pipe can be prevented from freezing and clogging the water supply pipe, and the power consumption of the refrigerator can be suppressed.

**[0015]** In addition, in the refrigerator of the present invention, the control portion judges for a first time that the water supply tank is in the empty state, and heats the water supply pipe by maximizing the energization rate to the heating portion. According to this control method, even in a case where the water in the water supply pipe freezes and the water supply pipe is clogged due to assembling fluctuations of parts of the refrigerator, the ice can also be melted and the water supply operation to the ice making tray can also be implemented.

**[0016]** In addition, in the refrigerator of the present invention, after the control portion judges for a first time that the water supply tank is in the empty state, the control portion judges that the water supply tank is in the empty state for two consecutive times after maximizing the energization rate to the heating portion, and stops the power supply to the heating portion under a certain condition of the control. According to this control method, the control portion can suppress power consumption of the refrigerator by judging that the water supply pipe is not in the clogged state and the water supply tank is in the empty state.

**[0017]** In addition, in the refrigerator of the present invention, after judging that the water supply tank is in the empty state twice in succession, and further judging that a heat insulating door that blocks a chamber in which the water supply tank is disposed in a freely openable and closeable manner performs an opening/closing action, the control portion causes the energization rate to the heating portion to be maximized and then after the lapse of the certain time, causes the energization rate to the heating portion to decrease and then drives the water supply pump. In this way, clogging due to freezing of the water in the water supply pipe is prevented, and water remaining in the water supply pipe is suppressed from being in a high-temperature state, whereby bacterial growth in the water can be prevented.

**[0018]** In addition, in the refrigerator of the present invention, by reducing the amount of heat supplied to the water supply pipe when the compressor stops as compared to the amount of heat when the compressor operates, water remaining in the water supply pipe is suppressed from being in a high temperature state, and thereby bacteria are prevented from growing in the water.

**[0019]** In addition, in the refrigerator of the present invention, when the water supply pump is operated, the control portion enables the driving motor to operate in the order of the reverse rotation direction, the forward rotation direction, the reverse rotation direction and the reverse rotation direction. According to this control method, in a case where water resulting from the melting of ice by the heating of the heating portion remains in the vicinity of a front end of the water supply pipe due to surface tension, the driving motor is initially operated in the reverse rotation direction to suck up the water in the vicinity of the front end of the water supply pipe, thereby preventing the phenomenon that the water at the front end suddenly splashes boilingly to the ice making tray.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0020]**

FIG 1(A) is a perspective view of a refrigerator according to an embodiment of present embodiment as viewed from the front;
FIG 1(B) is a side cross-sectional view of a refrigerator illustrating an embodiment of the present invention;
FIG 2(A) is a side cross-sectional view illustrating an ice making device of the refrigerator according to an embodiment of the present invention;
FIG 2(B) is a block diagram illustrating an overview of the ice making device of a refrigerator according to an embodiment of the present invention;
FIG 3 is a table illustrating an ice making operation of the refrigerator according to an embodiment of the present invention;
FIG 4 is a flowchart illustrating an ice making operation of a refrigerator according to an embodiment of the present invention;
FIG 5 is a flowchart illustrating an ice making operation of a refrigerator according to an embodiment of the present invention.

## DETAILED DESCRIPTION

**[0021]** A refrigerator 10 in the present embodiment will be described in detail below with reference to figures. In addition, in the following depictions, an up-down directions represents a height direction of refrigerator 10, a left-right direction represents a width direction of refrigerator 10 as viewed from the front, and a front-rear direction represents a depth direction of refrigerator 10. In addition, upon depicting the present embodiment, in principle, the same member is denoted by the same reference number, and repeated depictions are omitted.

**[0022]** FIG 1(A) is a perspective view of a refrigerator 10 according to the present embodiment as viewed from the front. FIG 1(B) is a side cross-sectional view of the refrigerator 10 in the present embodiment. FIG 2(A) is a side cross-sectional view illustrating an ice making device 30 of the refrigerator 10 according to the present embodiment. FIG 2(B) is a block diagram illustrating the ice making device 30 of the refrigerator 10 according to the present embodiment. In addition, in FIG 1(B), arrows are used to indicate the flow of cold air.

**[0023]** As shown in FIG 1(A), an interior of a heat insulating cabinet 11 of refrigerator 10 serves as a storage chamber, which is divided into a refrigerating chamber 12 (see FIG 1(B)) and a freezing chamber 13 (see FIG 1(B)) by a heat insulating partition wall 27 (see FIG 1(B)). A front surface opening of refrigerating chamber 12 is freely opened and closed by a heat insulating door 18, and a front surface opening of the freezing chamber 13 is freely opened and closed by a heat insulating door 19. The heat insulating doors 18 and 19 are rotatable doors, and their right ends can be rotatably supported on the heat insulating cabinet 11 via a shaft. In addition, the heat insulating doors 18 and 19 may also employ drawer-type doors or side-by-side doors.

**[0024]** As shown in FIG 1(B), a cooling chamber 21 is formed in the rear of the freezing chamber 13, and an evaporator 20 is disposed in the cooling chamber 21. In addition, a machine room 14 is formed in the lowermost rear of the heat insulating cabinet 11, and a compressor 23 is disposed in the machine room 14. The evaporator 20 and the compressor 23 are connected to an expansion unit and a condenser not shown via a refrigerant pipe, forming a vapor compression refrigeration cycle. In addition, a defrosting heater 26 is disposed below the evaporator 20 to melt the frost on the evaporator 20.

**[0025]** A blower 25 is disposed in an upper portion of the cooling chamber 21. The cold air in the interior of the cooling chamber 21 cooled by the evaporator 20 is blown to the refrigerating chamber 12 and the freezing chamber 13 via the blower 25. A damper 24 is disposed in an air path towards the refrigerating chamber 12.

**[0026]** Here, a control portion 40 (see FIG 2(B)) uses a temperature sensor 42 (see FIG 2(B)) in the refrigerating chamber 12 to detect the temperature in the refrigerating chamber 12, and controls the opening and closing of the damper 24. Furthermore, the control portion 40 adjusts the flow of cold air to the refrigerating chamber 12 to maintain the temperature in the refrigerating chamber 12 constant. Furthermore, through the above control of the control portion 40, the refrigerating chamber 12 is cooled to a refrigerating temperature range. Through the same control, the freezing chamber 13 is cooled to a freezing temperature range. In addition, the cold air that cools the refrigerating chamber 12 and the freezing chamber 13 returns to the cooling chamber 21 via an air return path.

**[0027]** In addition, as shown in the figures, the heat insulating cabinet 11 mainly comprises an outer shell made of a steel plate forming an external shape of the refrigerator 10; an inner shell 16 made of a box-shaped synthetic resin plate formed inside the outer shell 15; and a heat insulating material 17 disposed between the outer shell 15 and the inner shell 16. The heat insulating material 17 for example employs polyurethane foam.

**[0028]** FIG 2 (A) shows a state in which the ice making device 30 of the refrigerator 10 is disposed into the refrigerating chamber 12 and the freezing chamber 13. In addition, an ice storage container 33 and receiving containers 38 and 39 are disposed in the freezing chamber 13 in three sections in a height direction of the freezing chamber 13. Furthermore, for example, frozen food or the like is received in the receiving containers 38, 39, and the frozen food in the receiving containers 38, 39 can be taken out by slidingly moving the receiving containers 38, 39 in a depth direction of the freezing chamber 13.

**[0029]** As shown in the figure, the ice making device 30 mainly comprises a water supply tank 31, an ice making tray 32, an ice storage container 33, a water supply pump 34, a water supply pipe 35, a heating portion 36, and an ice maker 37. Furthermore, the water supply tank 31 stores water supplied to the ice making tray 32, and is disposed on an upper surface of the heat insulating partition wall 27 of the refrigerating chamber 12. The user opens the heat insulating door 18, takes out the water supply tank 31 as needed, and supplies water into the water supply tank 31.

**[0030]** In addition, the water supply pump 34 is also provided in the refrigerating chamber 12 near the water supply tank 31, and a motor 45 for the water supply pump (see FIG 2 (B)) is controlled by a control portion 40. Upon a usual ice-making operation, for example, the water in the water supply tank 31 is sucked and supplied to the ice making tray 32 at an interval of 120 minutes in a cycle.

**[0031]** The ice maker 37 is disposed above the ice storage container 33 of the freezing chamber 13, and configured to have a rotation twisting portion (not shown) that enables ice made in the ice making tray 32 to automatically drop into the ice storage container 33 (not shown); and an ice storage amount detection portion (not shown) that detects the amount of ice stored in the ice storage container 33. In addition, as shown, the ice making tray 32 is disposed in the ice maker 37, for example, below the heat insulating partition wall 27 and above the ice storage container 33.

**[0032]** The water supply pipe 35 is connected to the water supply pump 34, and is disposed from the refrigerating chamber 12 to the freezing chamber 13 through the interior of the heat insulating partition wall 27. Furthermore, a pipe heater serving as the heating portion 36 is disposed on an outer circumferential surface of the water supply pipe 35 to prevent the residual water in the water supply pipe 35 from freezing. In addition, as will be described later in detail, the power consumption of the refrigerator 10 can be suppressed by appropriately variably controlling the energization rate of the heating portion 36 through control by the control portion 40.

**[0033]** The control portion 40 constitutes an electronic control portion (ECU) that executes various operations for controlling the refrigerator 10 to control the ice-making operation of the ice making device 30. Furthermore, the control portion 40 is connected to a timer 41, an indoor temperature sensor 42, a door opening/closing sensor 43, an infrared sensor 44, the compressor 23, the motor 45 for the water supply pump 34 (hereinafter referred to as "motor 45"), the heating portion 36, and the ice maker 37 etc.

**[0034]** The timer 41 measures an operation time or a stop time of various devices constituting the refrigerator 10, such as the compressor 23 and the ice making device 30, etc. In addition, the indoor temperature sensor 42 measures the indoor temperature of the refrigerating chamber 12 or the freezing chamber 13. In addition, the door opening/closing sensor 43 detects an open/closed state of the heat insulating doors 18, 19 of the refrigerating chamber 12 or the freezing chamber 13. In addition, the infrared sensor 44 detects a bottom surface temperature of the ice making tray 32.

**[0035]** In addition, the control portion 40 executes a predetermined operation process based on input information from the timer 41, the indoor temperature sensor 42, the door opening/closing sensor 43, or the infrared sensor 44, and controls the operation or stop of the compressor 23, the water supply pump 34, the heating portion 36, and the ice maker 37 based on the operation process.

**[0036]** FIG 3 is a table for illustrating a case where an energization rate of the heating portion 36 is variably controlled in the ice making operation of the ice making device 30 of the refrigerator 10 in the present embodiment. FIG 4 is a flowchart illustrating an ice making operation of the ice making device 30 of the refrigerator 10 in the present embodiment, and is a flowchart corresponding to an energization rate A and an energization rate D of FIG 3. FIG 5 is a flowchart illustrating an ice making operation of the ice making device 30 of the refrigerator 10 in the present embodiment, and is a flowchart corresponding to an energization rate B and an energization rate C of FIG 3. In addition, upon describing FIG 3 through FIG 5, reference is appropriately made to FIG 1 and FIG 2 and the depictions thereof.

**[0037]** As shown in FIG 3, condition 1 in the ice making operation is "an operation condition in which the cooling intensity of the freezing chamber 13 is 7 or more out of 10 stages or a quick ice making mode or a quick freezing mode and the temperature of the freezing chamber 13 is lower than-18°C". Condition 2 in the ice making operation is "an operation condition after the first detection of whether the water supply tank 31 is empty". Condition 3 in the ice-making operation is "an operation condition other than the above conditions 1 and 2". Furthermore, in the ice making device 30 of the refrigerator 10, in the operating conditions of the refrigerator 10 from Condition 1 to Condition 3, the energization rate of the heating portion 36 is variably controlled depending on whether the compressor 23 operates or stops.

**[0038]** In addition, the quick ice making mode is a mode in which ice making is performed in one cycle shorter than a normal ice making operation time, and the quick freezing mode is a mode in which the freezing chamber 13 is cooled abruptly in preference to the refrigerating chamber 12.

**[0039]** As shown in the figures, in the present embodiment, there are four modes of the energization rate A to the energization rate D in the operating conditions of the refrigerator 10 from Condition 1 to Condition 3. The energization rates A to C are shown in FIG 3, while the energization rate D means that the door of the refrigerating chamber 12 is open in an empty state (empty detection) of the water supply tank 31, and the energization rate goes as follows after the door is closed: 100% energization rate in 15 minutes, and then 50% energization rate in 30 minutes.

**[0040]** Furthermore, in the modes of the energization rate A to the energization rate D, when the compressor 23 is in the operating state, the energization rate for the heating portion 36 is higher than the energization rate when the compressor 23 stops.

**[0041]** When the compressor 23 is operating, the blower 25 operates, and the cold air inside the cooling chamber 21 circulates inside the chamber, so that the water supply pipe 35 is also cooled at this time. As a result, the amount of heat generated from the heating portion 36 is increased to heat the water supply pipe 35, thereby preventing the water in the water supply pipe 35 from freezing.

**[0042]** On the other hand, when the compressor 23 stops, the blower 25 also stops, and the water supply pipe 35 is at least harder to cool than the indoor temperature. Therefore, the amount of heat generated from the heating portion 36 is reduced, and the water supply pipe 35 is prevented from being brought into a high temperature state more than necessary. This control method may prevent bacterial growth due to an increase in the temperature of the water remaining in the water supply pipe 35 when the compressor 23 stops, and meanwhile may reduce the power consumption of the refrigerator 10.

**[0043]** Here, under the normal ice making operation of the ice making device 30, the water supply pump 34 is operated at an interval of 120 minutes in one cycle, water is sucked from the water supply tank 31, and supplied to the ice making tray 32. Furthermore, in the normal ice making operation, the following control is performed: 70 minutes starting from the last supply of water from the water supply tank 31 is taken as a benchmark, after the 70 minutes have elapsed, making the energization rate of the heating portion 36 until the start of next supply of water from the water supply tank 31 higher than the energization rate of the heating portion 36 starting from the start of the last supply of water from the water supply tank 31 until the above 70 minutes. In addition, the above-described 70 minutes is one example of the present embodiment, and any design change may be made depending on the model of the refrigerator 10, the procedure of the ice making operation, and the like.

**[0044]** Furthermore, among the four patterns of the energization rates A to D, the energization rate of an appropriate stage is selected from levels of the energization rate set in four stages according to the filling condition of the water in the water supply tank 31 or the elapsed time upon the ice making operation.

**[0045]** In the first stage, the energization rate when the compressor 23 operates is 15%, and the energization rate when the compressor 23 stops is 10%. In the second stage, the energization rate when the compressor 23 operates is 30%, and the energization rate when the compressor 23 stops is 25%. In the third stage, the energization rate when the compressor 23 operates is 10%, and the energization rate when the compressor 23 stops is 40%. In the fourth stage, the energization rate is 100% when the compressor 23 operates and stops.

**[0046]** First, a method of controlling the energization rate A of the refrigerator 10 will be described using FIG 4. As shown in the figure, the control method of the energization rate A is a case where the control portion 40 detects that the water supply tank 31 is empty twice in succession by the infrared sensor 44 after the previous water supply operation. Then, steps S10 to S16 of FIG 4 belong to the control method at the energization rate A.

**[0047]** In step S10, in "NO" in step S61 (see FIG 5), where the control portion 40 judges according to a detection signal from the infrared sensor 44 that the water supply to the ice making tray 32 is not performed twice in succession, the control portion 40 determines that the water supply tank 31 is in a no-water state, that is, a so-called empty state.

**[0048]** In step S11, the control portion 40 judges whether the heat insulating door 18 of the refrigerating chamber 12 performs an opening action according to a detection signal from the door opening/closing sensor 43. Then, in "YES" of step S11, where the control portion 40 receives the detection signal and judges that the heat insulating door 18 of the refrigerating chamber 12 is open, the process proceeds to step S17, and the control portion 40 starts the control of the energization rate D.

**[0049]** On the other hand, in "NO" of step S 11, where the control portion 40 does not receive the above detection signal, the control portion 40 judges that the heat insulating door 18 of the refrigerating chamber 12 is not open, and in step S12, the control portion 40 judges whether the operating condition of the refrigerator 10 satisfies the above Condition 1.

**[0050]** In "YES" of step S12, where the control portion 40 judges that the operating condition of the refrigerator 10 satisfies the Condition 1, the process proceeds to step S13 to determine whether the compressor 23 is operating. In addition, in "NO" of step S12, where the control portion 40 judges that the operating condition of the refrigerator 10 does not satisfy the above Condition 1, the process proceeds to step S16, and the control portion 40 stops energizing the heating portion 36 and the process returns to step S11.

**[0051]** In "YES" of step S13, where the control portion 40 judges that the compressor 23 is operating, in step S14 the control portion 40 decreases the energization rate of the heating portion 36 to 30% to continue energization, and the process returns to step S11.

**[0052]** On the other hand, in "NO" of step S13, where the control portion 40 judges that the compressor 23 stops, in step S15 the control portion 40 decreases the energization rate of the heating portion 36 to 25% to continue energization, and the process returns to step S11.

**[0053]** Next, a method of controlling the energization rate D of the refrigerator 10 will be described using FIG 4. As shown in the figure, the energization rate D is controlled in such a manner that the user might have supplied water to the water supply tank 31 after the control portion 40 detects that the water supply tank 31 is in the empty state after the last water supply operation to the ice making tray 32. Then, steps S17 to S21 of FIG 4 belong to the control method at the energization rate D.

**[0054]** In step S17, judgement is made, according to the detection signal from the door opening/closing sensor 43, as to whether the heat insulating door 18 of the refrigerating chamber 12 performs a closing action. Then, in "YES" of step S17, where the control portion 40 judges that the heat insulating door 18 of the refrigerating door 12 is closed, the control portion 40 increases the energization rate of the heating portion 36 to 100% and continues energization in step S18.

**[0055]** In addition, in "NO" of step S17, where the control portion 40 judges that the heat insulating door 18 of the refrigerating chamber 12 is not closed, the control portion 40 continues to judge the closing operation of the heat insulating door 18 of the refrigerating chamber 12 according to the detection signal from the door opening/closing sensor 43.

**[0056]** In step S19, judgment is made, according to the detection signal from the timer 41, as to whether 15 minutes have elapsed after the heat insulating door 18 of the refrigerating chamber 12 is closed. Then, in "YES" of step S19, where the control portion 40 judges that 15 minutes have elapsed after the heat insulating door 18 of the refrigerating chamber 12 is closed, the control portion 40 reduces the energization rate of the heating portion 36 to 50% and continues energization in step S20.

**[0057]** In addition, in "NO" of step S19, where the control portion 40 judges that 15 minutes have not elapsed since the heat insulating door 18 of the refrigerating chamber 12 is closed, the control portion 40 continues to judge the elapse of the 15 minutes based on the detection signal from the timer 41.

**[0058]** In step S21, the control portion 40 judges according to the detection signal from the timer 41 whether 45 minutes have elapsed after the heat insulating door 18 of the refrigerating chamber 12 is closed. Then, in "YES" of step S21, where the control portion 40 judges that 45 minutes have elapsed after the heat insulating door 18 of the refrigerating chamber 12 is closed, the process proceeds to step S30, and the control portion 40 starts the control of the energization rate B.

**[0059]** In addition, in "NO" of step S21, where the control portion 40 judges that 45 minutes have not elapsed since the heat insulating door 18 of the refrigerating chamber 12 is closed, the control portion 40 continues to determine the elapse of the 45 minutes based on the detection signal from the timer 41.

**[0060]** Next, a control method of the energization rate B of the refrigerator 10 will be described using FIG 5. As shown in the figure, the control method of the energization rate B is a case where the water supply tank 31 is in the empty state and the operation condition of the refrigerator 10 is the above-mentioned Condition 1 or Condition 3. Then, steps S30 to S49 of FIG 5 belong to the control method at the energization rate B.

**[0061]** In step S30, the control portion 40 judges whether the ice in the ice storage container 33 is full via an ice storage amount detection portion of the ice maker 37 which is not shown. In "NO" of step S30, where the control portion 40 judges that the ice in the ice storage container 33 is not full, the control portion 40 performs an ice removal, operation of the ice making tray 32 and then performs a water supply operation to the ice making tray 32 in step S31.

**[0062]** In step S32, the control portion 40 judges according to the detection signal from the infrared sensor 44 whether the first water supply operation to the ice making tray 32 has been performed. Then, in "NO" of step S32, where the control portion 40 judges that the first water supply operation to the ice making tray 32 has not been performed, the process proceeds to step S50, and the control portion 40 starts the control of the energization rate C.

**[0063]** On the other hand, in "YES" of step S32, where the control portion 40 judges that the first water supply operation to the ice making tray 32 is performed, in step S33 the control portion 40 starts the ice making operation in the ice making tray 32, and in step S34 the control portion 40 judges whether the operating condition of the refrigerator 10 satisfies the above Condition 1.

**[0064]** In "YES" of step S34, where the control portion 40 judges that the operation condition of the refrigerator 10 satisfies the Condition 1, the process proceeds to step S35 to judge whether the compressor 23 is operating. Then, in "YES" of step S35, where the control portion 40 judges that the compressor 23 is operating, in step S36 the control portion 40 maintains the energization rate of the heating portion 36 at 50% and continues energization.

**[0065]** On the other hand, in "NO" of step S35, where the control portion 40 judges that the compressor 23 stops, in step S37 the control portion 40 decreases the energization rate of the heating portion 36 to 40% and continues energization.

**[0066]** In "NO" of step S34, where the control portion 40 judges that the operating condition of the refrigerator 10 does not satisfy the above Condition 1, the process proceeds to step S38 to judge whether the compressor 23 is operating. Then, in "YES" of step S38, where the control portion 40 judges that the compressor 23 is operating, in step S39 the control portion 40 reduces the energization rate of the heating portion 36 to 15% and continues energization.

**[0067]** On the other hand, in "NO" of step S38, where the control portion 40 judges that the compressor 23 stops, in step S40 the control portion 40 decreases the energization rate of the heating portion 36 to 10% and continues energization.

**[0068]** In step S41, the control portion 40 judges whether 70 minutes have elapsed since the start of water supply to the ice making tray 32 in the previous time in step S32, according to the detection signal from the timer 41. Then, in "YES" of step S41, where the control portion 40 judges that 70 minutes have elapsed since the start of the water supply, the process proceeds to step S42, and the control portion 40 judges whether or not the compressor 23 is operating.

**[0069]** Then, in "YES" of step S42, where the control portion 40 judges that the compressor 23 is operating, in step S43 the control portion 40 increases the energization rate of the heating portion 36 to 50% and continues energization. On the other hand, in "NO" of step S42, where the control portion 40 judges that the compressor 23 stops, in step S44 the control portion 40 increases the energization rate of the heating portion 36 to 40% and continues the energization.

**[0070]** In step S45, the control portion 40 judges whether a set time has elapsed since the start of ice making in step S33 according to the detection signal from the timer 41. Then, in "YES" in step S45, where the control portion 40 judges that the set time has elapsed since the start of ice making, the process returns to step S30. Furthermore, in "NO" in step S45, where the control portion 40 judges that the set time has not elapsed since the start of ice making, the process returns to step S42.

**[0071]** Here, in "YES" of step S30, where the control portion 40 judges that the ice in the ice storage container 33 is full, the process proceeds to step S46 to judge whether the compressor 23 is operating. Then, in "YES" of step S46, where the control portion 40 judges that the compressor 23 is operating, in step S47 the control portion 40 increases the energization rate of the heating portion 36 to 50% and continues energization.

**[0072]** On the other hand, in "NO" of step S46, where the control portion 40 judges that the compressor 23 stops, in step S49 the control portion 40 increases the energization rate of the heating portion 36 to 40% and continues energization.

**[0073]** Thereafter, in step S48, the control portion 40 judges whether a preset time, for example, one hour, has elapsed since the detection of full ice in the ice storage container 33 in step S30, according to the detection signal from the timer 41. Then, in "YES" of step S48, where the control portion 40 judges that the preset time has elapsed since the detection of full ice, the process returns to step S30. In addition, in "NO" of step S48, where the control portion 40 judges that the preset time has not elapsed since the detection of full ice, the process returns to step S46.

**[0074]** In addition, in "NO" in step S41 where the control portion 40 judges that 70 minutes have not elapsed from the start of the water supply, the process returns to step S33.

**[0075]** Next, a control method of the energization rate C of the refrigerator 10 will be described using FIG 5. As shown in the figure, the energization rate C is controlled in such a manner that the water supply tank 31 is the empty state and the operating condition of the refrigerator 10 belongs to the above-mentioned Condition 2. Then, steps S50 to S62 of FIG 5 belong to the control method at the energization rate C.

**[0076]** In step S50, the control portion 40 judges that the first water supply operation to the ice making tray 32 is not performed according to the detection signal from the infrared sensor 44. Then, in step S51, the control portion 40 judges whether the heat insulating door 18 of the refrigerating chamber 12 has performed the opening action according to the detection signal from the door opening/closing sensor 43.

**[0077]** In "NO" of step S51, where the control portion 40 does not receive the above detection signal and judges that the heat insulating door 18 of the refrigerating chamber 12 is not opened, the control portion 40 judges whether the compressor 23 is operating in step S52.

**[0078]** In "YES" of step S52, where the control portion 40 judges that the compressor 23 is operating, in step S53 the control portion 40 sets the energization rate of the heating portion 36 to 30% for energization. On the other hand, in "NO" of step S52, where the control portion 40 judges in step S52 that the compressor 23 stops, in step S54 the control portion 40 sets the energization rate of the heating portion 36 to 25% for energization.

**[0079]** In step S55, the control portion 40 judges whether 70 minutes have elapsed since the start of the water supply to the ice making tray 32 in the previous time according to the detection signal from the timer 41. Then, in "YES" in step S55, where the control portion 40 judges that 70 minutes have elapsed since the start of water supply to the ice making tray 32 in the previous time, the process proceeds to step S56, and the control portion 40 increases the energization rate of the heating portion 36 to 100% and continues energization.

**[0080]** In step S57, the control portion 40 judges whether 85 minutes have elapsed since the start of water supply to the ice making tray 32 in the previous time according to the detection signal from the timer 41. Then, in "YES" in step S57, where the control portion 40 judges that 85 minutes have elapsed since the start of water supply to the ice making tray 32 in the previous time, the process proceeds to step S58, and the control portion 40 reduces the energization rate of the heating portion 36 to 50% and continues energization.

**[0081]** In step S59, the control portion 40 judges whether a set time (120 minutes in one cycle) has elapsed since the start of the water supply to the ice making tray 32 in the previous time according to the detection signal from the timer 41. Then, in "YES" in step S59, where the control portion 40 judges that the set time has elapsed since the start of the water supply to the ice making tray 32 in the previous time, the process proceeds to step S60, and the control portion 40 performs an ice detection operation in the ice storage container 33 or an ice removal operation from the ice making tray 32 via the ice maker 37, and then performs the water supply operation to the ice making tray 32.

**[0082]** On the other hand, in "NO" of step S59, where the control portion 40 judges that the set time has not elapsed since the start of the water supply to the ice making tray 32 in the previous time, in "NO" of step S55 where the control portion 40 judges that 70 minutes have not elapsed since the start of the water supply to the ice making tray 32 in the previous time, or in "NO" of step S57 where the control portion 40 judges that 85 minutes have not elapsed since the start of the water supply to the ice making tray 32 in the previous time, the process returns to step S51.

**[0083]** In step S61, the control portion 40 judges whether the second water supply operation to the ice making tray 32 has been performed according to the detection signal from the infrared sensor 44. Then, in "NO" of step S61 where the control portion 40 judges that the second water supply operation to the ice making tray 32 is not performed, the process proceeds to step S10, and the control portion 40 starts the control of the energization rate A.

**[0084]** In "YES" of step S61, where the control portion 40 judges that the water supply operation to the ice making tray 32 has been performed, the process proceeds to step S33, and the control portion 40 starts the ice making operation by controlling the energization rate B.

**[0085]** In addition, in "YES" of step S51, where the control portion 40 judges that the heat insulating door 18 of the refrigerating chamber 12 is open, the process proceeds to step S62 and the control portion 40 judges whether the heat insulating door 18 of the refrigerating chamber 12 performs the closing action according to the detection signal from the door opening/closing sensor 43. Then, in "YES" of step S62 where the control portion 40 judges that the heat insulating door 18 of the refrigerating chamber 12 is closed, the process proceeds to step S33, and the control portion 40 starts the ice making operation by controlling the energization rate B. In addition, in "NO" in step S62, the control portion 40 continues to judge the closing action of the heat insulating door 18.

**[0086]** As stated above, in the refrigerator 10 of the present embodiment, in the control method for the energization rate A, in the case where the control portion 40 judges that the above Condition 3 is satisfied after judging that the water supply tank 31 is detected to be empty twice in succession, the control portion 40 judges that the water supply tank 31 is in a no-water state, so-called an empty state, without performing the water supply operation to the ice making tray 32 twice in succession despite heating the water supply pipe 35. In this case, since the ice making operation is not performed before the user supplies water to the water supply tank 31, the power supply to the heating portion 36 is stopped, thereby suppressing power consumption of the refrigerator 10.

**[0087]** Furthermore, in the control method of the energization rate D, in a case where the opening or closing action of the heat insulating door 18 of the refrigerating chamber 12 is detected, since the user might supply water to the water supply tank 31, power is supplied to the heating portion 36 at a high energization rate in a short period of time to prevent the freezing of the water supply pipe 35, and clogging due to freezing of water in the water supply pipe 35 is prevented during the water supply operation.

**[0088]** In addition, in the method for controlling the energization rate B, the energization rate to the heating portion 36 is lowered to such an extent that the water in the water supply pipe 35 does not freeze until 70 minutes have passed after the water supply operation to the ice making tray 32, and the energization rate to the heating portion 36 is increased again after 70 minutes have passed from the water supply operation to the ice making tray 32. By this control method, the heating portion 36 is continuously energized, thereby preventing clogging due to freezing of water remaining in the water supply pipe 35. Furthermore, the energization rate of the heating portion 36 is temporarily low, the water supply pipe 35 does not maintain a high temperature state, bacterial growth in the water remaining in the water supply pipe 35 is prevented, and power consumption of the refrigerator 10 is suppressed.

**[0089]** In addition, in the control method of the energization rate C, after the first empty detection of the water supply tank 31 is performed, and after the energization rate of the heating portion 36 is maximized at one time, the energization rate of the heating portion 36 is decreased after 15 minutes. Then, in the manufacturing process of the refrigerator 10, the freezing of the water in the water supply pipe 35 may cause clogging due to various factors such as the assembling position of the water supply pipe 35 and the heating portion 36, a fluctuation in a length of the water supply pipe 35 or an assembling fluctuation of components of the refrigerator 10, or an amount of residual water into the water supply pipe 35 upon the ice making operation.

**[0090]** By the above control method, even though the water in the water supply pipe 35 freezes, the ice may be melted by maximizing the energization rate of the heating portion 36. Then, the water supply tank 31 is filled with water, but the water supply pipe 35 is blocked due to freezing of the water, thereby causing a phenomenon that the water cannot be supplied to the ice making tray 32. On the other hand, the control portion 40 can judge that it is not the freezing of the water supply pipe 35 that causes the clogging, and instead that the water supply tank 31 is in the empty state. In addition, the suppression of the power consumption of the refrigerator 10 is achieved by preventing the energization rate of the heating portion 36 from being maximized for a long period of time, and by preventing the above growth of bacteria.

**[0091]** Finally, as shown in FIG 2(A) and FIG 2(B), in the water supply operation to the ice making tray 32 of the present embodiment, the control portion 40 operates the motor 45 in the reverse rotation direction, then in the forward rotation direction, and finally in the reverse rotation direction, whereby the water supply pump 34 sucks up water from the water supply tank 31 and then supplies the sucked-up water to the ice making tray 32 via the water supply pipe 35.

**[0092]** According to this control method, in a case where water resulting from the melting of ice by the heating of the heating portion 36 remains in the vicinity of a front end of the water supply pipe 35 due to surface tension before the water supply operation, the motor 45 is initially operated in the reverse rotation direction to suck up the water in the vicinity of the front end of the water supply pipe 35 and make the interior of the water supply pipe 35 in an air-conducting state. Then, when the motor 45 is operated in the forward rotation direction, the air in the interior of the water supply pipe 35 is compressed, thereby preventing the phenomenon that the water at the front end suddenly splashes boilingly to the ice making tray 32. Finally, the siphon phenomenon can be prevented from occurring by operating the motor 45 in the reverse rotation direction.

**[0093]** In addition, in the present embodiment, the case has been described in which the temperature of the bottom surface of the ice making tray 32 is detected by the infrared sensor 44, and the control portion 40 judges whether there is water in the water supply tank 31 according to the above detection signal, but the present invention is not limited this case. For example, after a waveform of the current of the water supply pump 34 is detected, the waveform of the current is converted into a voltage value via a resistor, and the voltage value is compared with a predetermined threshold value. Furthermore, the control portion 40 may also detect whether water is discharged from the water supply pump 34 according to a comparison result, and judges whether there is water in the water supply tank 31 according to the above detection signal. In addition, various changes may be made without departing from the scope of the spirit of the present invention.

## Claims

**1.** A refrigerator, wherein the refrigerator comprises:

a water supply tank that stores water;
an ice making tray that makes ice from the water;
an ice maker that removes the ice made in the ice making tray;
a water supply pump that pumps the water in the water supply tank;
a water supply pipe that supplies the water pumped by the water supply pump to the ice making tray;
a heating portion that heats the water supply pipe; and
a control portion that judges whether there is water in the water supply tank and variably controls an energization rate to the heating portion, the control portion makes the energization rate to the heating portion before the water supply

pump operates higher than the energization rate to the heating portion after the water supply pump operates.

2. The refrigerator according to claim 1, wherein the control portion judges for a first time that the water supply tank is in an empty state, causes the energization rate to the heating portion to decrease after a certain time elapses after the energization rate to the heating portion is maximized, and judges for a second time whether there is water in the water supply tank.

3. The refrigerator according to claim 2, wherein the control portion judges that the water supply tank is in the empty state twice in succession, and further stops the power supply to the heating portion after judging that a heat insulating door that blocks a chamber in which the water supply tank is disposed in a freely openable and closeable manner does not perform an opening action.

4. The refrigerator according to claim 2, wherein the control portion judges that the water supply tank is in the empty state twice in succession, and further judges that a heat insulating door that blocks a chamber in which the water supply tank is disposed in a freely openable and closeable manner performs an opening/closing action, and then causes the energization rate to the heating portion to decrease after a certain time elapses after the energization rate to the heating portion is maximized, and then drives the water supply pump.

5. The refrigerator according to any of claims 1-4, wherein

   the refrigerator further comprises a compressor constituting a refrigeration cycle, and
   the control portion increases the energization rate to the heating portion when the compressor is operating, as compared to the energization rate when the compressor stops.

6. The refrigerator according to claim 5, wherein when the water supply pump is driven, the control portion initially makes the motor driving the water supply pump operate in a reverse rotation direction, then operate in a forward rotation direction, and finally operate in the reverse rotation direction again.

7. The refrigerator according to claim 1, wherein an interior of a heat insulating cabinet of refrigerator serves as a storage chamber which is divided into a refrigerating chamber and a freezing chamber by a heat insulating partition wall;
upon judging the ice making operation satisfies Condition 1 and the compressing is operating, the control portion controls the energization rate to the heating portion to reduce to 30% and continues energization, and the Condition 1 is an operation condition in which a cooling intensity of the freezing chamber is 7 or more out of 10 stages or a quick ice making mode or a quick freezing mode and the temperature of the freezing chamber is lower than-18 °C .

8. The refrigerator according to claim 7, wherein upon judging the ice making operation satisfies Condition 1 and the compressing is not operating, the control portion controls the energization rate to the heating portion to reduce to 25% and continues energization.

9. The refrigerator according to claim 7, wherein upon judging the heat insulating door of the refrigerating chamber is closed, the control portion increases the energization rate of the heating portion to 100% and continues energization.

10. The refrigerator according to claim 9, wherein upon judging that 15 minutes have elapsed after the heat insulating door 18 of the refrigerating chamber 12 is closed, the control portion decreases the energization rate of the heating portion to 50% and continues energization.

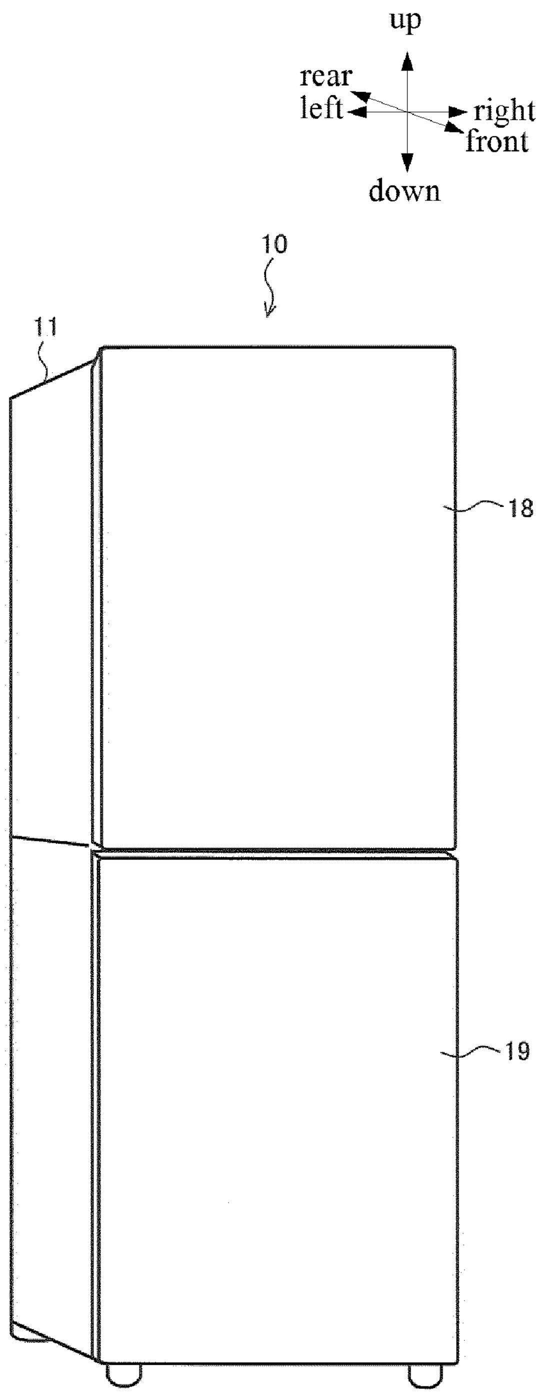


Fig.1（A）

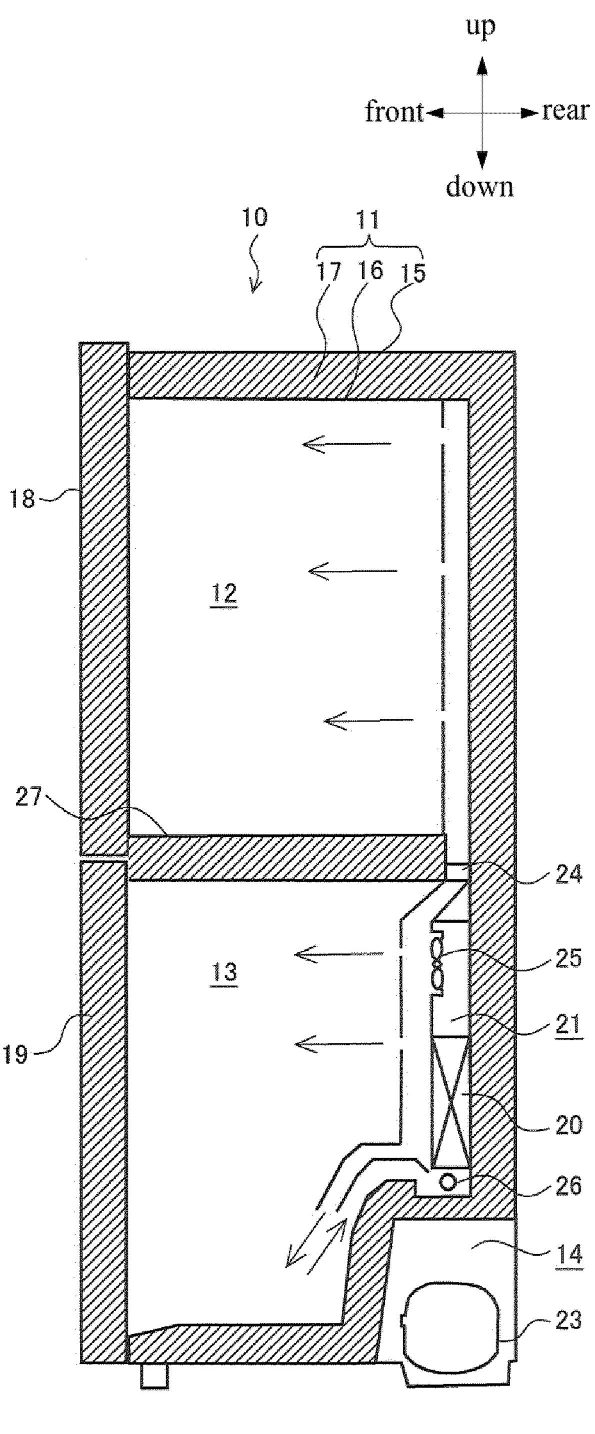


Fig.1（B）

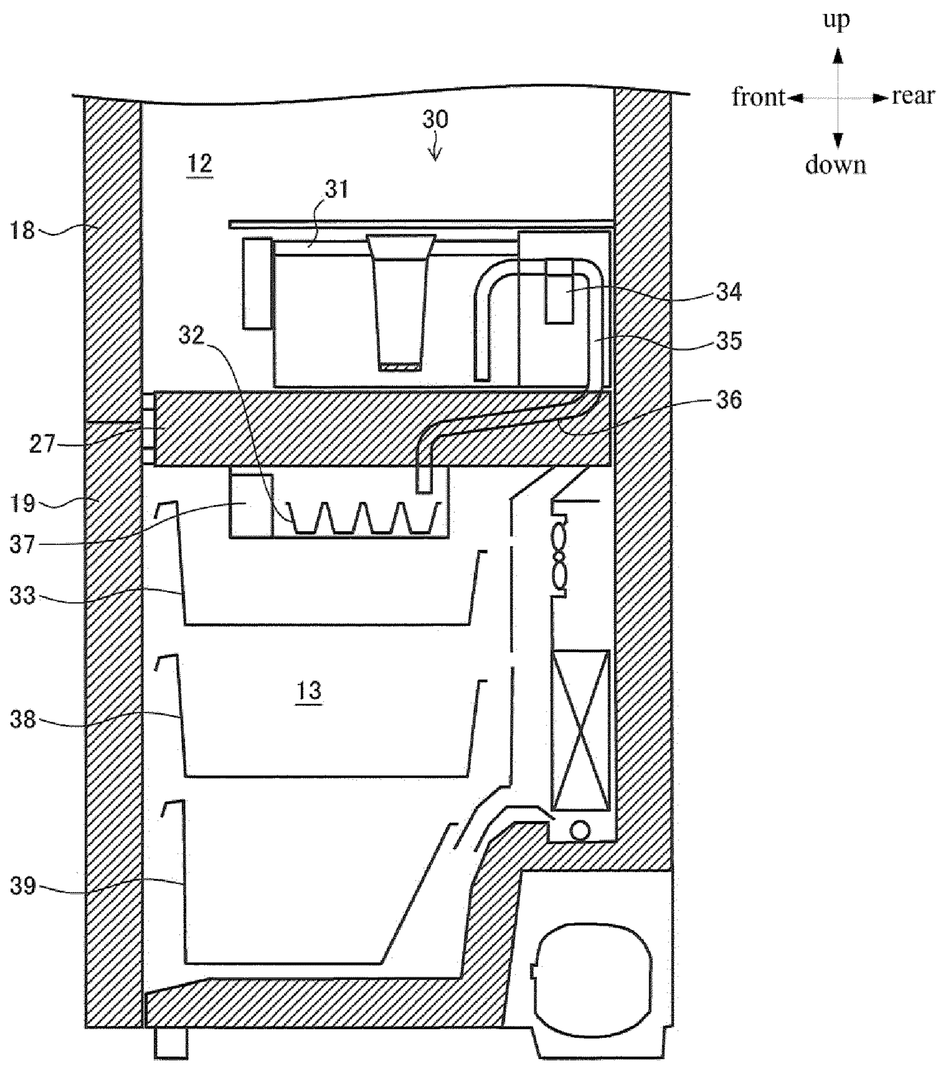
up
front
rear
down
30
12
31
18
34
35
32
36
27
19
37
33
13
38
39

Fig.2 (A)

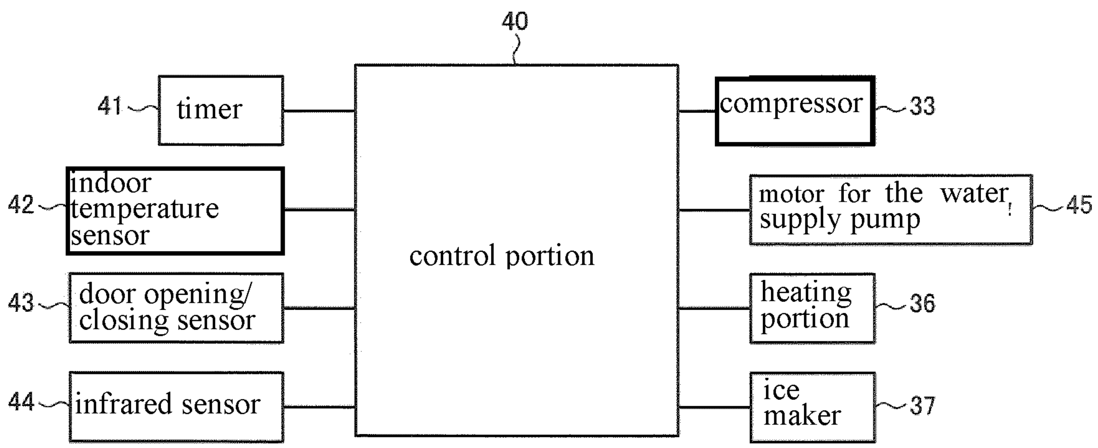
40
41 timer
42 indoor temperature sensor
43 door opening/ closing sensor
44 infrared sensor
control portion
compressor 33
motor for the water supply pump 45
heating portion 36
ice maker 37

Fig.2 (B)

| | the water supply tank 31 is empty | | usually（water supply ~70minutes） | | usually（water supply 70 minutes later or judges that water is full） | |
|---|---|---|---|---|---|---|
| | compressor 23 is ON | compressor 23 is OFF | compressor 23 is ON | compressor 23 is OFF | compressor 23 is ON | compressor 23 is OFF |
| Condition 3 | energization rate A | | energization rate B | | | |
| | 0% | 0% | 15% | 10% | 50% | 40% |
| Condition 1 | 30% | 25% | 50% | 40% | 50% | 40% |
| Condition 2 | - | - | energization rate C | | | |
| | | | 30% | 25% | 100%（70 minutes ~85 minutes）<br>50%（85 minutes later） | |

**Fig.3**

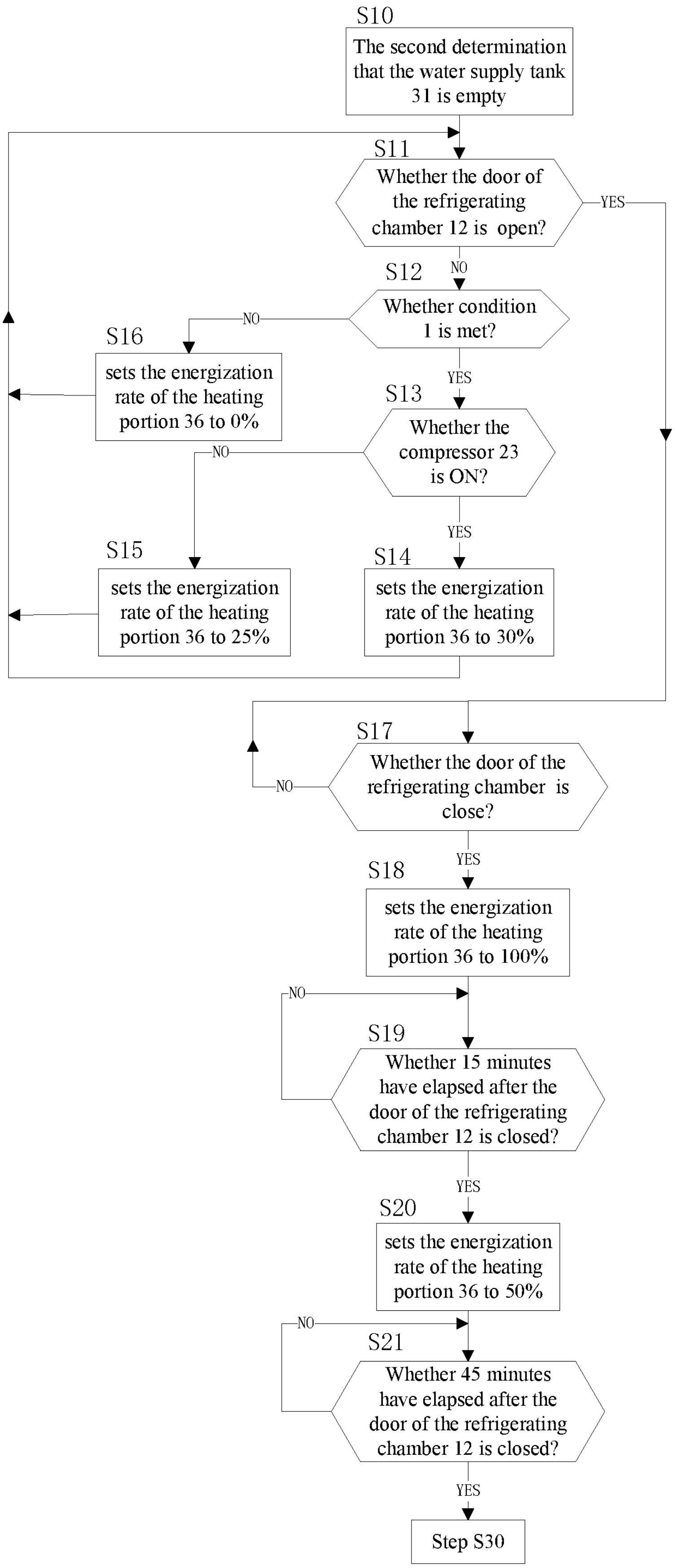
S10
The second determination that the water supply tank 31 is empty
S11
Whether the door of the refrigerating chamber 12 is open?
YES
NO
S12
Whether condition 1 is met?
NO
S16
sets the energization rate of the heating portion 36 to 0%
YES
S13
Whether the compressor 23 is ON?
NO
YES
S15
sets the energization rate of the heating portion 36 to 25%
S14
sets the energization rate of the heating portion 36 to 30%
S17
Whether the door of the refrigerating chamber is close?
NO
YES
S18
sets the energization rate of the heating portion 36 to 100%
NO
S19
Whether 15 minutes have elapsed after the door of the refrigerating chamber 12 is closed?
YES
S20
sets the energization rate of the heating portion 36 to 50%
NO
S21
Whether 45 minutes have elapsed after the door of the refrigerating chamber 12 is closed?
YES
Step S30

Fig.4

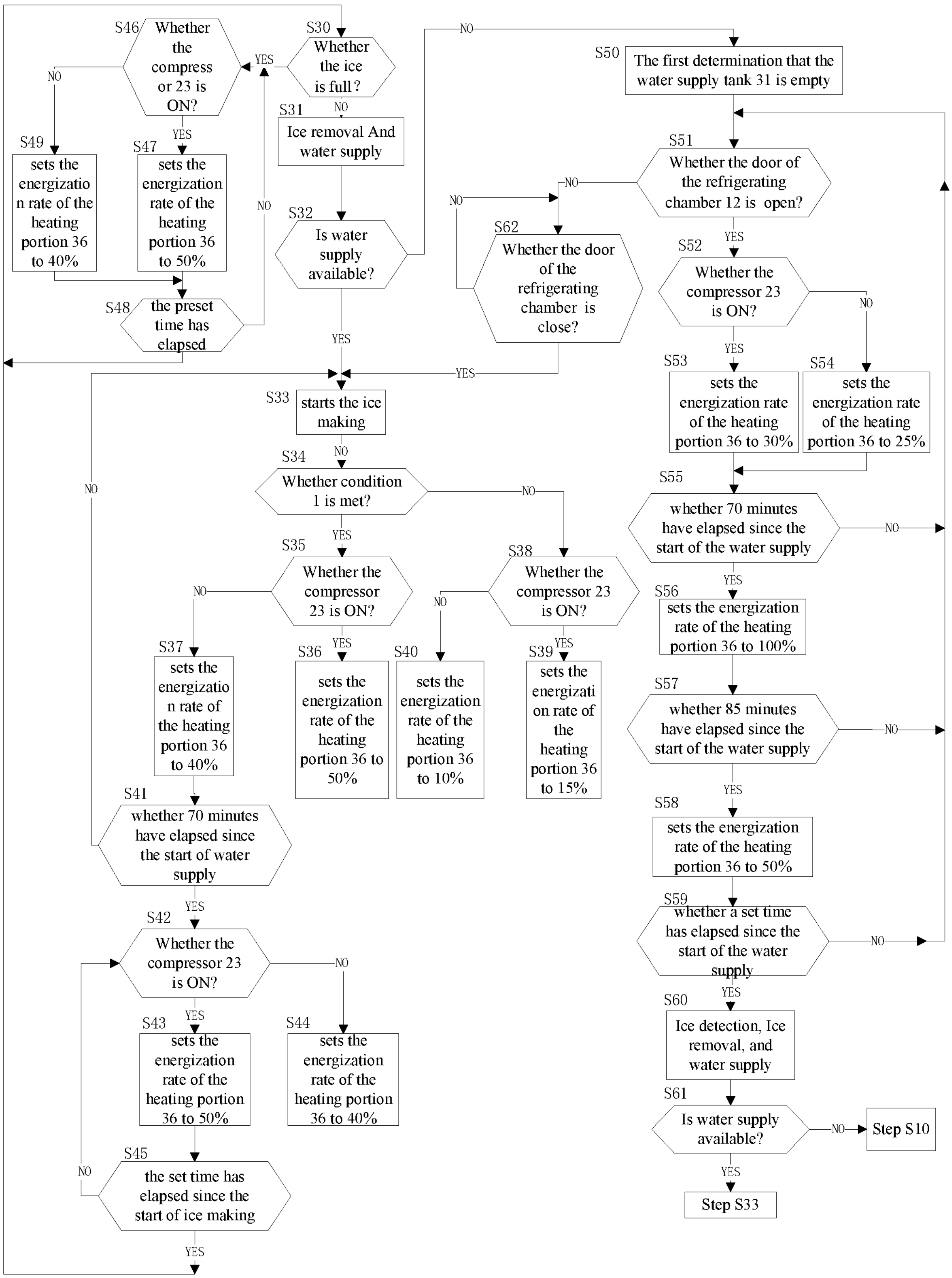
S30
Whether the ice is full?
S31
Ice removal And water supply
S32
Is water supply available?
S33
starts the ice making
S34
Whether condition 1 is met?
S35
Whether the compressor 23 is ON?
S36
sets the energization rate of the heating portion 36 to 50%
S37
sets the energization rate of the heating portion 36 to 40%
S38
Whether the compressor 23 is ON?
S39
sets the energization rate of the heating portion 36 to 15%
S40
sets the energization rate of the heating portion 36 to 10%
S41
whether 70 minutes have elapsed since the start of water supply
S42
Whether the compressor 23 is ON?
S43
sets the energization rate of the heating portion 36 to 50%
S44
sets the energization rate of the heating portion 36 to 40%
S45
the set time has elapsed since the start of ice making
S46
Whether the compressor 23 is ON?
S47
sets the energization rate of the heating portion 36 to 50%
S48
the preset time has elapsed
S49
sets the energization rate of the heating portion 36 to 40%
S50
The first determination that the water supply tank 31 is empty
S51
Whether the door of the refrigerating chamber 12 is open?
S52
Whether the compressor 23 is ON?
S53
sets the energization rate of the heating portion 36 to 30%
S54
sets the energization rate of the heating portion 36 to 25%
S55
whether 70 minutes have elapsed since the start of the water supply
S56
sets the energization rate of the heating portion 36 to 100%
S57
whether 85 minutes have elapsed since the start of the water supply
S58
sets the energization rate of the heating portion 36 to 50%
S59
whether a set time has elapsed since the start of the water supply
S60
Ice detection, Ice removal, and water supply
S61
Is water supply available?
S62
Whether the door of the refrigerating chamber is close?
Step S10
Step S33
YES
NO

Fig.5

**INTERNATIONAL SEARCH REPORT**

International application No.
**PCT/CN2021/141986**

**A. CLASSIFICATION OF SUBJECT MATTER**

F25D 29/00(2006.01)i; F25C 1/00(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)

F25D29/00; F25D23/12; F25D23/10; F25D23/00; F25C1/00; F25D11/00; F25D13/00

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

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

CNABS, CNTXT, CNKI, VEN: 制冰, 冰箱, 加热, 供水管, 结冰, 通电率, 功率, 电流; ICE, MAKER, REFRIGERATOR, HEAT, DOOR, PIPE, TUBE, ELECTRIC+, POWER

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
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| Y | CN 1435617 A (LG ELECTRONICS (TIANJIN) ELECTRICAL APPLIANCES CO., LTD.) 13 August 2003 (2003-08-13)<br>description, page 4 | 1-10 |
| A | CN 112066623 A (XI'AN JIAOTONG UNIVERSITY) 11 December 2020 (2020-12-11)<br>entire document | 1-10 |
| A | CN 110145907 A (HEFEI MIDEA REFRIGERATOR CO., LTD. et al.) 20 August 2019 (2019-08-20)<br>entire document | 1-10 |
| A | CN 113340047 A (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI) 03 September 2021 (2021-09-03)<br>entire document | 1-10 |
| A | CN 111912150 A (QINDAO HAIER REFRIGERATOR CO., LTD. et al.) 10 November 2020 (2020-11-10)<br>entire document | 1-10 |

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| **09 March 2022** | **29 March 2022** |

| Name and mailing address of the ISA/CN | Authorized officer |
|---|---|
| **China National Intellectual Property Administration (ISA/CN)**<br>**No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088, China** | |
| Facsimile No. **(86-10)62019451** | Telephone No. |

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**INTERNATIONAL SEARCH REPORT**

International application No.
**PCT/CN2021/141986**

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | CN 106091557 A (QINDAO HAIER REFRIGERATOR CO., LTD.) 09 November 2016 (2016-11-09)<br>entire document | 1-10 |

Form PCT/ISA/210 (second sheet) (January 2015)

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

International application No.
**PCT/CN2021/141986**

| Patent document cited in search report | Publication date (day/month/year) | Patent family member(s) | Publication date (day/month/year) |
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| CN 112066623 A | 11 December 2020 | None | |
| CN 110145907 A | 20 August 2019 | WO 2020232764 A1 | 26 November 2020 |
| | | AU 2019299869 A1 | 10 December 2020 |
| | | AU 2019299869 B2 | 06 May 2021 |
| | | EP 3767205 A1 | 20 January 2021 |
| | | EP 3767205 A4 | 23 June 2021 |
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| CN 111912150 A | 10 November 2020 | None | |
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Form PCT/ISA/210 (patent family annex) (January 2015)

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