

AUTOMATIC ICE MAKING APPARATUS AND REFRIGERATOR**FIELD OF THE INVENTION**

The present invention relates to an automatic ice making
5 apparatus for supplying water into an ice making tray and
producing ice therein, and a refrigerator with the automatic ice
making apparatus provided therein.

BACKGROUND OF THE INVENTION

10 A conventional type of automatic ice making apparatus is
disclosed, for instance, Japanese Patent Laid-Open Publication
No.300402/1994. Fig. 35 shows an external appearance of a
refrigerator in which the conventional type of automatic ice
making apparatus is applied, Fig. 36 is a general block view
15 illustrating the conventional type of automatic ice making
apparatus, and Fig. 37 is a detailed cross-sectional view
illustrating a key section of the conventional automatic ice
making apparatus. In Fig. 35, a refrigerator 1 with freezing
chamber comprises a cold chamber 2, and a freezing chamber 3
20 provided under the cold chamber 2. And provided in a lower
section of the cold chamber 2 is a water supply tank corner 4,
while an ice making corner 5 is provided in an upper section of
the freezing chamber 3 and an automatic ice making apparatus is
provided between a water supply tank corner 4 and an ice making
25 corner 5.

As shown in Fig. 36, a ~~water~~ water supply tank 40 is installed in the water supply tank corner 4, and a mounting port 41 with a diameter larger enough for an grip to be inserted therein is provided under the water supply tank 40. A quantifying room 42 is set in this mounting port 41. The quantifying room 42 comprises, as shown in Fig. 37, cap 44 having cap 44 screwed into the mounting port 41 and having an outlet port 43 at a center thereof, an internal case 45 having an inlet port 46 in an upper section thereof, and an upper case 47 having activated carbon 48 therein. A control valve 49 for opening or closing the outlet port 43 as well as the inlet port 46 is set to the outlet port 43 of the cap 44. The control vale 49 has an outlet valve 50 for clogging the outlet port 43 and an inlet valve 51 for clogging the inlet port 46, and is energized downward in the figure by a spring 52. Namely, if a power is not loaded from under the control valve 49, the control valve 49 is lowered by the spring 52, so that the inlet port 46 is opened and the outlet port 43 is closed.

Also the internal case 45 is fixed to the cap 44 by means of screwing or engagement, and an air vent 45a is provided in an upper section thereof. The upper case 47 is mounted on this internal case 45 by means of screwing or engagement to make water in the water supply tank 40 flow into the quantifying room 42 via the activated carbon 48.

A receiving tray 54 is provided under the mounting port 41

with the quantifying room 42 set therein, and a driving mechanism 55 as a drive unit is set in a water supply path 53 provided in this receiving tray 54 and inclined downward. The driving mechanism 55 moves up and down an operating shaft 56 by means of an electromagnetic effect of an electromagnetic solenoid provided therein and pushes the control valve 49 in the quantifying room 42 upward with an umbrella 57 mounted onto a tip of the operating shaft 56. The umbrella 57 is used to prevent water coming from the outlet port 43 into an mounting hole 53a of the water supply path 53, and is made from a silicon-based material. With this function, the driving mechanism 55 is operated with the operating shaft 56 moved upward, when the control valve 49 is pushed upward, the outlet port 43 is opened and also the inlet port 46 is closed with the inlet valve 51.

A feed pump 58 is provided, as shown in Fig. 36, on the receiving tray 54 with the driving mechanism 55 set thereon, and a push-out hose 59 is attached to an upper edge of this feed pump 58. This push-out hose 59 extends up to the ice making corner 5 of the freezing chamber 3, and its tip reaches onto the ice making tray 27 in the ice making corner 5. It should be noted that the feed pump 58 is not based on a spiral system but on a self-contained system. In a self-contained system, a rotational speed of the pump motor is proportional to a discharge flow rate, so that a feed rate of water to the ice

making tray can be controlled by adjusting a period of time in which the pump motor is driven.

Next, a description is made for operations. In a state where the driving mechanism 55 is not operated, only a downward energizing force generated by a spring 52 is loaded to the control valve 49 in the quantifying room 42, so that the outlet port 43 is closed by the outlet valve 50 and the inlet port 46 is kept in a state where it is opened. For this reason, in this state, water in the water supply tank 40 goes through the activated carbon 48 into the upper case 47 and also goes through the inlet port 46 into the internal case 45, thus the quantifying room 42 being filled with water. The water smoothly flows into the internal case 45 due to effects by the air vent 45a.

Then, when the driving mechanism 55 is operated, the operating shaft 56 goes upward, and the umbrella 57 pushes a lower edge of the control valve 49 against the energizing force generated by the spring 52. As a result, the outlet port 43 is opened, while the inlet port 46 is closed with the inlet valve 51, so that water in the internal case 45 flows from the outlet port 43 into the receiving tray 54. Water in this receiving tray 54 is supplied from the push-out hose 59 into the ice making tray 27 due to effects by the feed pump 58. Then the inlet port 46 has been closed, so that a quantity of water flown into the receiving tray 54 is equal to a volume of the internal case 45.

For this reason, water is supplied to the ice making tray 27 by a quantity corresponding to a volume of the internal case 45. It should be noted that the outlet port 43 does not have a hole for air ventilation, so that a period of time when water flows out is not fixed and also a water level in the receiving tray 54 changes, but the water is immediately sucked by the feed pump 58 based on the self-contained system, so that no water remains in the receiving tray 54. Namely, even if a period of time when water flows out fluctuates, water does not remain in the receiving tray 54 and is supplied to the ice making tray 27 at a constant rate.

Fig. 38 is a general block diagram showing a control board for controlling operations of the driving mechanism 55 as well as of the feed pump 58, and Fig. 39 and Fig. 40 are the time charts each showing timing of the operations. A control board 60 is provided in refrigerator 1 with freezing chamber and is connected to the driving mechanism 55 as well as to the feed pump 58. It should be noted that the reference numeral 61 indicates a power supply unit for the control board 60.

As shown in Fig. 39, when a water supply start signal is outputted from this control board 60, the driving mechanism 55 is switched from OFF to ON state, and the ON state is kept for a specified period of time. Then, timing is set so that the feed pump 58 is switched from the OFF state to ON state in t1 seconds and the ON state will be kept for a specified period of

time. Also as shown in Fig. 40, the timing may be set so that the feed pump 58 is switched from the OFF state to ON state in t2 seconds after the driving mechanism 55 is turned ON and the ON state will be kept for a specified period of time.

5 The water stored in the receiving tray 54 according to an operation of the driving mechanism 55 as described above is sucked by the feed pump 58 and the receiving tray 54 becomes empty. It should be noted that a gear box 28 for rotating the ice making tray 27 to separate ice therefrom is provided at the
10 side of the freezing chamber 3, where a quantity of ice stored in an ice storage box is detected and a water supply start signal is outputted from the control board 60 when a quantity of ice is short.

15 In the conventional type of automatic ice making apparatus, the water supply tank corner 4 or ice making corner 5 projecting into the cold chamber 2 or into the freezing chamber 3 is provided as described above, so that a space for storing foods therein is disadvantageously reduced. Also an independent case is required as the water supply tank corner 4, which
20 results in cost increase. Also, if a user fixes the internal case 45 to the cap 44 loosely, inlet port 46 or the outlet port 43 is not closed tightly, which makes it impossible to supply water to the ice making room 27 at a constant rate. Furthermore water may remain in the push-out hose 59 or the water supply
25 tank 40, and if the water is biologically contaminated, also

inside of the hose may be contaminated.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a low cost automatic ice making apparatus in which it is possible to substantially suppress reduction of a space for storing foods due to incorporation of an automatic ice making apparatus as well as to insure a constant water supply rate without causing a fatal failure even if a user commits a mistake in operating the system and also it is possible with a simple construction to easily check whether water is present in the water supply tank with any water not left in the piping. It is another object of the present invention to provide a refrigerator in which a space can effectively be utilized.

With the automatic ice making apparatus according to the present invention, a water supply tank is installed in a well formed in a partition wall partitioning a space of a refrigerator into a plurality of storage chambers, so that a case made with other component for installing therein a water supply tank is not required to be provided, and a space for storing food products is not reduced.

With the automatic ice making apparatus according to the present invention, by bending a partition wall so that a well will be formed in one surface of the partition wall and a raised

section will be formed in the other surface of the partition wall, an ice making tray is provided in the side of the raised section formed by the partition wall, so that even in a storage chamber in which the ice making tray is provided a space for storing food products is not reduced.

With the automatic ice making apparatus according to the present invention, the well in the partition wall in which a water supply tank is installed is formed in a side where a door of the refrigerator is opened or closed, and an ice making tray is installed in the back of the raised section in the partition wall so that the water supply tank installed in the well formed by the partition wall and the ice making tray are superimposed in the right and left direction as well as in the vertical direction, and for this reason a space for storing food products is not reduced, and a water supply tank is easily be installed.

With the automatic ice making apparatus according to the present invention, the plant comprises a water supply tank having a main chamber and an auxiliary chamber separated from each other with a perforated partition plate, an ice making tray for generating ice therein, and a feed pump for pumping up water stored in the auxiliary chamber of the water supply tank and supplying the water into the ice making tray, and a capacity of the auxiliary chamber of the water supply tank is smaller than that of the ice making tray, so that a quantity of water flowing

thereinto from the small holes provided in the partition plate is smaller than that flowing out of the auxiliary chamber, and for this reason, a quantity of water can be supplied to the ice making tray at a substantially constant level.

With the automatic ice making apparatus according to the present invention, a feed pump is driven in the reverse direction when power is turned ON, so that, even in a case where power supply is disconnected due to a power failure during operation of the feed pump, water does not remain in a pipe between the water supply tank and the ice making tray, and a quantity of water can be supplied to the ice making tray at a substantially constant level, which makes it possible to prevent a capacity of an ice making tray from overflowing.

With the automatic ice making apparatus according to the present invention, the plant comprises a water supply tank for storing water provided in the well, an ice making tray for generating ice therein, and a feed pump for pumping up water in the water supply tank and supplying the water into the ice making tray, and the feed pump is driven in the regular direction for a specified period of time and then driven in the reverse direction for a specified period of time, so that the space therein can effectively be utilized, and water does not remain in a pipe between a water supply tank and an ice making tray, which makes it possible to prevent the pipe from being contaminated.

With the automatic ice making apparatus according to the present invention, the feed pump is a self-priming pump, so that connection of wiring is not required when the water supply tank is attached to or detached from the well, and a quantity of water supply into an ice making tray can be controlled according to a period of time for driving a feed pump, which makes it possible to supply water into an ice making tray at a substantially constant level.

With the automatic ice making apparatus according to the present invention, a suction pipe and a feed pipe are connected simultaneously when the water supply tank is installed in the well formed by the partition wall, so that a water supply tank and a feed pipe can easily be connected.

With the automatic ice making apparatus according to the present invention, a cover made from a soft material for covering an opening section of the feed pipe is provided when the suction pipe and the feed pipe are not connected to each other, which makes it possible to prevent foreign materials from coming into the feed pipe, and also to prevent a feed pump from being locked or the pipe from being clogged.

With the automatic ice making apparatus according to the present invention, an opening section of the suction pipe connected to the feed pipe is located above a maximum water level in the water supply tank, so that, even if the water supply tank

is detached during operation of the feed pump, a quantity of water flowing from the water supply tank can be suppressed at a minimum level.

With the automatic ice making apparatus according to the present invention, the water supply tank is made from a transparent material, so that a quantity of water in the water supply tank can easily be checked.

With the automatic ice making apparatus according to the present invention, a water level gauge is provided on a wall surface of the well provided on the partition wall in which the water supply tank is installed, so that a quantity of water in the water supply tank can easily be checked with a low-cost configuration.

With the automatic ice making apparatus according to the present invention, the plant comprises a water supply tank installed in a refrigerator for storing water therein, a pump installed within the water supply tank for discharging water stored in the water supply tank into an ice making tray, and a drive unit installed outside the water supply tank for driving the pump above, and the drive unit delivers a torque for driving the pump to the water supply tank in a non-contact mode, so that a user can freely wash almost all the paths for water supply including the feed pump, and as far as electrical and structural aspects are concerned, the drive unit has no connection with the motor, and for this reason safety and silence of the motor can be achieved.

With the automatic ice making apparatus according to the present invention, a torque is delivered by providing a magnet in the pump and also providing another magnet provided in the drive unit at a position opposite to the magnet provided in the pump, so that a motor and a feed pump can be constructed in a non-contact mode, and a safety and high-reliability device can be achieved.

With the automatic ice making apparatus according to the present invention, the drive unit is attached to a tank supporting means provided on a wall of a refrigerator or in a refrigerator for mounting thereon the water supply tank having no connection with the water supply tank through water, so that, because the motor is fixed to a tank holder so that no water around the water supply tank reaches the motor which is an electrical component, a positioning between the motor and a water supply tank to be set in the tank holder can precisely and easily be achieved.

With the automatic ice making apparatus according to the present invention, a water receiving section is provided between the water supply tank and the ice making tray, and a discharge port of a discharge pipe connected to a pump for discharging water into the water receiving section is allocated above the maximum after level within the water supply tank as well as under an upper edge section of the water receiving section, so that water runs out at the edge of the discharge

port when the feed pump is stopped, and at the same time water does not overflow out of the water receiving section.

With the automatic ice making apparatus according to the present invention, a movable section of the pump is removably provided in a casing which is an enclosure for accommodating the movable section of the pump therein, so that a user can clean even the internal section of a feed pump.

With the automatic ice making apparatus according to the present invention, a filter is removably provided on a pump suction port provided in the water supply tank, so that such big a refuse that may lock the impeller section can be prevented from reaching the impeller section, and the filter section can be cleaned.

With the automatic ice making apparatus according to the present invention, the plant comprises a tank supporting means provided on a wall of a refrigerator or in a refrigerator for mounting the water supply tank thereon, and a positioning means for fixing positions of the water supply tank in three directions by partially contacting the water supply tank thereto, so that a step-out phenomenon of a magnet does not easily occur.

With the automatic ice making apparatus according to the present invention, one edge of a rotary shaft of a pump is rotatably supported by a pump bearing with the other edge rotatably supported by an impeller, so that a number of

components when disassembled can be decreased.

With the automatic ice making apparatus according to the present invention, a bank section higher than a partition wall and partitioning a surface of the partition wall in the lateral direction is provided around a periphery of a groove in the concave section provided on the partition wall, so that a spill from food dropped onto the partition wall can be prevented from flowing into the plant.

With the automatic ice making apparatus according to the present invention, a large flange ^{is} covering the entire periphery of the groove in the well provided on the partition wall, and larger than a gap generated between the flange and a corner for the water supply tank is provided in the water supply tank, which makes it possible to cover the gap, and also to prevent foreign materials from flowing into the corner for the water supply tank.

With the automatic ice making apparatus according to the present invention, a water level display window enabling visual check of a water level in the water supply tank is provided in an upper section of the water supply tank, so that, even if water drops are adhered to the wall surface of the water supply tank, user can check a water level at a boundary section between a group of water drops and the water.

With the refrigerator according to the present invention, the plant comprises a partition wall partitioning a space in a

refrigerator into a plurality of storage chambers, a well formed on this partition wall and accommodating therein the water supply tank, and an ice making tray provided in a storage chamber different and separated with a partition wall from the storage chamber with the water supply tank provided therein for receiving water supplied from the water supply tank and generating ice therein, so that a space therein can effectively be utilized.

With the refrigerator according to the present invention, a bank section is provided along an edge of the well provided on the partition wall, so that a spill from food or the like dropped onto the partition wall can be prevented from its flowing thereinto.

With the refrigerator according to the present invention, a projection for positioning a position of a bottom of water supply tank is provided on the bottom section of the well provided on the partition wall, so that even if a space between the partition wall and the water supply tank is generated and a small quantity of foreign materials is flown thereinto, the water supply tank can be set easily without any inconvenience.

With the refrigerator according to the present invention, a heat transfer conducting means for conducting heat from a cooling medium condensing pipe provided on an edge face of the partition wall is provided near the well provided on the partition

wall, so that temperature of the water supply tank does not lower because the corner for water supply tank is always heated by heat transferring thereto along a heat transfer conducting tape.

With the refrigerator according to the present invention, a heater for warming up the water supply tank is provided near the well provided on the partition wall and the heater is turned ON or OFF in reverse synchronism to the refrigerator, so that, by re-utilizing heat from the condensing pipe for warming up the water supply tank and turning ON or OFF the cord heater, energy-saving can be achieved.

With the refrigerator according to the present invention, a door pocket for shutting off cool air is provided in the bottom section of the door body of the refrigerator above the well provided on the partition wall so that cool air will not directly come onto the water supply tank, so that water in the water supply tank can be prevented from being frozen, and at the same time a spill from food in the door pocket can be prevented from dropping onto the water supply tank.

With the refrigerator according to the present invention, a cool air shut-off means closely adhering to the partition wall is provided in the bottom section of the door pocket, so that space between the door pocket and the water supply tank is formed as a heat insulation with air by using a packing, which

makes it possible to keep warming up a water supply tank with a small quantity of energy.

5 With the automatic ice making apparatus according to the present invention, a positioning means for positioning in the thrust direction as well as in the radial direction is provided in an L-shaped angle monolithically provided in a feed pump, and an engaging section for engaging and fixing the positioning means is provided on a water supply tank, so that the feed pump can closely be fixed to the water supply tank.

10 With the automatic ice making apparatus according the present invention an air-vent hole having a diameter which is substantially the same as that of a discharge port is provided in an upper section of a casing for a feed pump at a position in a rotated direction from the discharge port, so that
15 fluctuation of a water flow rate due to presence of air is eliminated and the water supply rate is stabilized.

Other objects and features of this invention will become understood from the following description with reference to the accompanying drawings.

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BRIEF DESCRIPTION OF THE INVENTION

Fig. 1 is a transverse cross-sectional view showing a refrigerator with freezing chamber in which an automatic ice making apparatus according to the present invention is applied;

25 Fig. 2 is a cross-sectional view showing an automatic ice

making apparatus according to Embodiment 1 of the present invention;

Fig. 3 is a general view showing a control board applied to Embodiment 1 of the present invention;

Fig. 4 is a time chart showing operations of a feed pump according to Embodiment 1 of the present invention;

Fig. 5 is a flow chart showing a control for an automatic ice making apparatus according to Embodiment 2 of the present invention;

Figs. 6A and 6B are cross-sectional views showing a refrigerator with freezing chamber in which a position of an automatic ice making apparatus to be installed is changed according to Embodiment 3 of the present invention;

Fig. 7 is a cross-sectional view showing an automatic ice making apparatus according to Embodiment 4 of the present invention;

Fig. 8 is a time chart showing operations of a feed pump according to Embodiment 4 of the present invention;

Figs. 9A and 9B are views each showing a state of a water supply tank before and after inserted into the well of a partitioning wall according to Embodiment 5 of the present invention;

Fig. 10 is a perspective view showing a water supply tank according to Embodiment 6 of the present invention;

Fig. 11 is a cross-sectional view showing a water supply

tank according to Embodiment 6 of the present invention;

5 Figs. 12A and 12B are perspective views each showing a water supply tank according to Embodiment 6 of the present invention when the tank is full of water and when the tank is short of water;

Fig. 13 is a cross-sectional view showing an automatic ice making apparatus according to Embodiment 7 of the present invention;

10 Fig. 14 is an enlarged view of a key section of the configuration of Fig. 13.

Figs. 15A to 15C are cross-sectional views showing a feed pump according to Embodiment 7 of the present invention;

Fig. 16 is view showing a control section of the feed pump according to Embodiment 7 of the present invention;

15 Fig. 17 is a time chart showing operations for the feed pump according to Embodiment 7 of the present invention;

Fig. 18 is a perspective cross-sectional view showing an automatic ice making apparatus according to Embodiment 8 of the present invention;

20 Fig. 19 is a perspective view showing an automatic ice making apparatus according to Embodiment 9 of the present invention;

Fig. 20 is a partial cross-sectional view showing the automatic ice making apparatus according to Embodiment 9 of the present invention;

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Fig. 21 is a cross-sectional view showing a feed pump according to Embodiment 10 of the present invention;

Fig. 22 is a perspective cross-sectional view showing an automatic ice making apparatus according to Embodiment 11 of the present invention;

Fig. 23 is a perspective cross-sectional view showing an automatic ice making apparatus according to Embodiment 12 of the present invention;

Fig. 24 is a transverse cross-sectional view showing an automatic ice making apparatus according to Embodiment 13 of the present invention;

Fig. 25 is a transverse cross-sectional view showing an automatic ice making apparatus according to Embodiment 14 of the present invention;

Fig. 26 is a timing chart showing operations for the automatic ice making apparatus according to Embodiment 14 of the present invention;

Fig. 27 is a transverse cross-sectional view showing an automatic ice making apparatus according to Embodiment 15 of the present invention;

Fig. 28 is a perspective view showing a water supply tank according to Embodiment 16 of the present invention;

Fig. 29 is a transverse cross-sectional view showing the water supply tank according to Embodiment 16 of the present invention;

Fig. 30 is a cross-sectional view showing a method of forming the water supply tank according to Embodiment 16 of the present invention;

Fig. 31 is a perspective view showing another example according to Embodiment 16 of the present invention;

Fig. 32 is a perspective appearance view showing the automatic ice making apparatus according to Embodiment 17 of the present invention;

Fig. 33 is a cross-sectional view showing a feed pump according to Embodiment 18 of the present invention;

Fig. 34 is a perspective appearance view showing inside of a casing for the feed pump according to Embodiment 18 of the present invention;

Fig. 35 is an appearance view showing a refrigerator with freezing chamber in which a conventional type of an automatic ice making apparatus is applied;

Fig. 36 is a general cross-sectional view showing the conventional type of automatic ice making apparatus;

Fig. 37 is a detailed cross-sectional view showing a key section of the conventional type of automatic ice making apparatus;

Fig. 38 is a general view showing a control board used in the conventional type of automatic ice making apparatus;

Fig. 39 is a time chart showing operations for a drive unit and a feed pump with a control board in an example based on

the conventional technology; and

Fig. 40 is a time chart showing another operations for a drive unit and a feed pump with the control board in an example based on the conventional technology.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Description is made hereinafter for embodiments according to the present invention with reference to the related drawings. Fig. 1 is a transverse cross-sectional view showing a refrigerator in which an automatic ice making apparatus according to the embodiment of the present invention is applied, and Fig. 2 is a transverse cross-sectional view showing the automatic ice making apparatus according to the embodiment of the present invention. In Fig. 1, a refrigerator 1 with freezing chamber comprises a cold chamber 2 and a freezing chamber 3 provided under this cold chamber 2. A water supply tank corner 4 is provided in a well formed by bending a partition wall partitioning a space in a refrigerator into the cold chamber 2 and the freezing chamber 3, an ice making corner 5 is provided in the back space of the raised section in the freezing chamber 3 generated thereby.

As shown in Fig. 2, a water supply tank 10 is attached to inside for the water supply tank corner 4 provided on the partition wall 6 partitioning the space thereof into the cold chamber 2 and the freezing chamber 3, and an opening section in

an upper section of the water supply tank 10 is closed by a cover 12 having a vent hole 34 having a small diameter with a packing 11 provided between the cover and the tank. An auxiliary chamber 17 for measuring a specified quantity of water formed monolithically with the water supply tank 10 is provided inside the water supply tank 10, and an opening section of the auxiliary chamber 17 is obstructed by a pipe unit with a packing B16 provided between the pipe unit and the auxiliary chamber. The pipe unit is formed monolithically with a flange 18 as a partition plate closing the opening section of the auxiliary chamber 17 and partitioning a space inside the water supply tank 10 into a main chamber 30 and the auxiliary chamber 17, a packing B16 attached onto a periphery of this flange 18, a suction pipe 13 sucking water to outside of the water supply tank 10, an air vent 14, and a small-diameter hole 15 introducing water from the main chamber 30 of the water supply tank 10 to the auxiliary chamber 17. The suction pipe 13 and the air vent 14 are communicated to the outside of the water supply tank 10, and an activated carbon water purifying filter 23 is fixed by using a filter fixing member 33 in the side of the main chamber 30 from the small-diameter hole 15 of the pipe unit. Also, the auxiliary chamber 17 is formed so that the capacity thereof is slightly smaller than that of an ice making tray 27.

The suction pipe 13 extending to outside of the water supply

tank 10 runs above the water supply tank in a state where it does not project from an upper surface of the partition wall 6, a waterway turns to lower direction, and is connected to an inlet pipe 22 fixed to the partition wall 6. A packing C21 is
5 attached between the suction pipe 13 and the inlet pipe 22, and a latch 20 for improving adhesion of the three to each other is fixed to the inlet pipe 22 with a coil spring 32. An edge section 13a in the side of inlet pipe 22 of the suction pipe 13 should always be located in the upper side than the water level
10 indicated when the water supply tank 10 is filled with water.

The reference number 24 indicates a self-priming pump for supplying water from the water supply tank 10 to the ice making tray 27, and a self-priming pump is used in this embodiment. A spiral type of pump may be used for that, but if
15 the self-priming pump is used, wiring executed when the water supply tank 10 is attached or removed becomes easier. A sub-pipe 25 molded with a material which is soft as well as allowed by the Food Sanitation Act is provided between the inlet pipe 22 and the self-priming pump 24. The sub-pipe is also used in
20 the discharge side of the self-priming pump 24. With this sub-pipe 25, vibration generated by the self-priming pump 24 is prevented from being delivered to the inlet pipe 22 and a discharge pipe 26. The discharge pipe 26 is connected to the sub-pipe 25 in the discharge side, and water is introduced from
25 the discharge pipe 26 to the ice making tray 27 located in the

freezing chamber 3. The inlet pipe 22, sub-pipe 25, and discharge pipe 26 penetrate the partition wall 6, and are connected to each other to form a supply pipe which is a pipe for supplying water to the ice making tray 27. The ice making tray 27 is fixed to the partition wall 6 with a gear box 28 providing a torsional moment to the ice making tray 27 and separating the ice from the tray. A raised section 29 provided on the partition wall in the side of freezing chamber 3 of the partition wall 6, ice making tray 27, and gear box 28 are superimposed to each other in the right and left directions as well as in the vertical direction. Also the water supply tank 10, ice making tray 27, and gear box 28 are superimposed to each other in the right and left direction as well as in the vertical direction.

Attaching the water supply tank 10 to the water supply tank corner 4 is executed by putting water into the water supply tank 10 and then setting the pipe unit, packing 11, and the cover 12 to the water supply tank 10. Installation of the water supply tank 10 is performed from the upper direction of the partition wall 6, and simultaneously when installation is executed, the suction pipe 13 fixed to the side of water supply tank 10 is connected to the inlet pipe 22 fixed to the partition wall 6.

When the suction pipe 13 is started to be inserted to the inlet pipe 22, the latch 20 fixed to the inlet pipe 22 is pushed back against spring tension of the coil spring 32. The

suction pipe 13 compresses the packing C21 fixed in the inlet pipe 22 to provide air-tightness, then the latch 20 goes over a stopper 19 for the suction pipe 13 and fixed the suction pipe 13 and the inlet pipe 22 in the axial direction. As described above, the water supply tank 10 is installed in the water supply tank corner 4 which is a well provided on the partition wall 6 in a state where the tank is completely sunk therein. For removing the water supply tank 10 therefrom, the reversed operations to that described above is executed, and the suction pipe 13 and the inlet pipe 22 are disconnected from each other by removing the water supply tank 10.

Next, a description is made for operations of supplying water from the water supply tank 10 to the ice making tray 27. The auxiliary chamber 17 in the water supply tank 10 is filled with water when the automatic ice making apparatus is in the stand-by state. When the automatic ice making apparatus starts its operation and goes into a stage for supplying water, gears of the self-priming pump 24 are started to rotate with engaging each other in the direction of water sent to the side of ice making tray 27. Quantity of water in the auxiliary chamber 17 decreases in proportion to a rotational speed of the self-priming pump 24. However, in this step, the quantity of water flowing into the auxiliary chamber 17 becomes less compared to a quantity of water pumped out from the auxiliary chamber 17 by the self-priming pump 24 because the water flows

into the auxiliary chamber 17 only through the small-diameter hole 15. The self-priming pump 24 is rotated until a water level in the auxiliary chamber 17 lowers to a level substantially close to zero and water does not remain in the suction pipe 13, inlet pipe 22, self-priming pump 24, and discharge pipe 26, and then rotation of the self-priming pump 24 is stopped and water supply to the ice making tray 27 is finished.

Description is made for this operation with reference to Fig. 3 and Fig. 4. Fig. 3 is a general view showing a control board for controlling operations of the self-priming pump 24, and Fig. 4 is a time chart thereof. In Fig. 3, the reference number 50 indicates a control board with the self-priming pump 24 and the power supply unit 51 connected thereto, and is provided in the refrigerator 1 with freezing chamber. The gear box 28 detects a quantity of ice stored in the ice storage, and if it is detected that a quantity of ice is short, a water supply start signal is outputted from the control board 50. When the water supply start signal is outputted from the control board 50, the self-priming pump 24 is switched from OFF state to ON state and the ON state is kept for a specified period of time. As soon as the self-priming pump 24 is actuated, water in the auxiliary chamber 17 in the water supply tank 10 is sucked by the self-priming pump 24 and is supplied to the ice making tray 27. In this operation, the auxiliary

chamber 17 becomes empty, but water comes into the auxiliary chamber 17 through the small-diameter hole 15 at a very slow speed, and then the auxiliary chamber 27 is filled with water again. Then when a quantity of ice is short again, the self-priming pump 24 is actuated, water is supplied to the ice making tray 27, and the operations described above are repeated.

As described above, with the automatic ice making apparatus according to the embodiment of the present invention, the water supply tank 10 is installed in the water supply tank 10 formed into a well provided on the partition wall 6 so that the upper surface of the tank and the upper side of the partition wall are provided in the same plane, so that a case movable to and fro can be put on the floor surface of the cold chamber 2, namely on the upper surface of the partition wall 6, thus the full width of the cold chamber being effectively utilized. Also the construction insures supply of water at a constant rate and the pipes no residual water at any point of time during the operation, so that contamination inside the pipes due to spoiled water can be suppressed, and water can be supplied to the ice making tray 27 always at a constant rate. Because the edge section of the suction pipe 13 in the discharge side thereof attached to the water supply tank 10 is located above the water level indicated when the water supply tank 10 is filled with water, even if the water supply tank 10 is removed during operation of the self-

priming pump 24 and also the suction pipe 13 and the inlet pipe 22 are disconnected from each other, a quantity of the water flowing out to the outside of the water supply tank 10 can be suppressed at a minimum level, which makes it possible to prevent an accident where flow of water from the water supply tank 10 can not be stopped. Furthermore vibration generated by the self-priming pump 24 is prevented from being delivered to the refrigerator 1 with freezing chamber, so that a system with a small operating sound can be constructed.

It should be noted that, in Embodiment 1 according to the present invention as described above, by bending the partition wall 6 so that a well is formed in the top section of the partition wall and the raised section is formed in the bottom section thereof, but a well may be formed only on the top surface of the partition wall 6. Also a well may be formed in the bottom section of the partition wall, and in this case the water supply tank 10 may be attached from the lower side.

In Embodiment 1 of the present invention, water is put into the water supply tank 10, and then the pipe unit is set thereto, but a water supply port may be provided on the cover 12, and after the pipe unit, packing 11, and cover 12 each are set in the water supply tank 10, water may be put into the water supply tank 10 through the water supply port. In this

case the water supplied from the water supply port into the main chamber 30 goes into the auxiliary chamber 17 through the small-diameter hole 15, while air in the auxiliary chamber 17 is discharged to outside the water supply tank 10 through the air vent 14. Also, when water is supplied into the water supply tank 10, air is discharged through the air hole 34 provided in the cover 12.

An automatic ice making apparatus according to Embodiment 2 of the present invention has the same configuration as that in Embodiment 1 excluding the point that a control system thereof is different from that in Embodiment 1. Description is made for operations in this embodiment of the present invention with reference to a flow chart in Fig. 5. When power is turned ON, at first the self-priming pump 24 is driven in the reverse direction for a specified period of time, any water left in the pipes is discharged to the side of water supply tank 10. Then, when it is detected by the gear box 28 that there is not enough ice therein, the self-priming pump 24 is driven in the regular direction for a specified period of time, and water is supplied to the ice making tray 27 thereby. When any water in the pipes is discharged into the water supply tank 10, the water in the water supply tank 10 does not leak to the outside through the air vent 14 having a larger diameter.

With this embodiment according to the present invention, even in a case where power supply to the refrigerator 1 with

freezing chamber is terminated due to power failure or other reasons during operation of the self-priming pump 24, and some water is still left in the pipes such as the suction pipe 13, inlet pipe 22, self-priming pipe 24, and discharge pipe 26, any water left in the pipes is discharged to the side of water supply tank 10 by being driven in the reverse direction by the self-priming pump 24 when power is turned ON again, so that no water is left in the pipes, which makes it possible to always supply water at a constant rate to the ice making tray 27. Also to prevent a quantity of water supplied thereto from surpassing a capacity of the ice making tray 27.

Figs. 6A and 6B are general transverse cross-sectional views showing a refrigerator 1 with freezing chamber incorporating therein an automatic ice making apparatus installed at a position different from that in Embodiment 1 of the present described above. As shown in Fig. 6A, a freezing chamber 3 may be provided in an upper section of the cold chamber 2 and a vegetable chamber 36 may be provided in a lower section thereof, and also as shown in Fig. 6B, a freezing chamber 3 may be provided in an upper section of cold chamber 2 and a chilled chamber 35 or vegetable chamber 36 may be provided in a lower section thereof. Namely if the water supply tank corner 4 is provided in the storage chamber kept under a positive temperature with the ice making corner 5 provided in the freezing chamber, effects like those in the embodiments of the

present invention are provided. It should be noted that the piping, not shown herein, connecting the water supply tank 10 to the ice making tray 27 is provided therein and penetrates the partition wall, and a rear surface or side surface of the basic body of refrigerator.

Fig. 7 is a transverse cross-sectional view showing configuration of the water supply tank 10 applied to the automatic ice making apparatus according to Embodiment 4 of the present invention, and Fig. 8 is a time chart for controls according to Embodiment 4 of this invention. In Embodiment 4 of this invention, the points that an auxiliary chamber 17 is not provided in the water supply tank 10 and a different control for the self-priming pump 24 is employed are different from those in Embodiment 1 of the invention. It should be noted that, in the self-priming pump, a rotational speed of a pump motor and a discharging flow rate are proportional to each other, so that a supply rate of water to the ice making tray can be controlled according to a driving period of time by the pump motor.

In Fig. 7, the water supply tank 10 comprises a cover 12, a packing 11 provided between the water supply tank 10 and the cover 12, a suction pipe 13 formed monolithically with the cover 12, a filter fixing member 33 fixing the suction pipe 13 to a tip of the water supply tank 10, and an activated carbon water purifying filter 23. Components other than those described

above are the same as those in Embodiment 1 of the present invention.

Next, a description is made for operations in this embodiment. When a water supply start signal is outputted from the control board 50, the self-priming pump 24 is switched from OFF state to ON state and the ON state is kept for a specified period of time until the ice making tray is filled with water. Then the pump is driven in the reverse direction for a specified period of time, and thus the operation for ice making is completed. Operations other than those described above are the same as those in Embodiment 1 according to the invention, so that description thereof is omitted herein.

As described above, with the automatic ice making apparatus according to the embodiment of the present invention, any water is not left in the pipes between the water supply tank 10 and the ice making tray 27, which makes it possible to suppress contamination in pipes due to spoiled water.

Figs. 9A and 9B are cross-sectional views showing a pipe connecting section in the automatic ice making apparatus according to the embodiment of the present invention. Fig. 9A is a view showing a state of the water supply tank 10 before inserted into the well provided on the partition wall, while Fig. 9B is a view showing a state of the water supply tank 10

after inserted into the well provided on the partition wall. In this embodiment of the present invention, a cover 37 preventing a foreign substance from coming into the side of the inlet pipe 22 is provided at the connecting section between the suction pipe 13 fixed to the water supply tank 10 and the inlet pipe 22 fixed to the partition wall 6 in the configuration according to Embodiments 1 to Embodiment 4.

In Fig. 9, the cover 37 is at rest horizontally above the inlet pipe 22 in a state where the water supply tank 10 fixed to the partition wall 31 has not been installed. The cover 37 is made from a soft material, so that the cover 37 is deformed by the suction pipe 13 in the side of the water supply tank 10 simultaneously when the water supply tank 10 is inserted to the well provided on the partition wall, which makes the space above the inlet pipe 22 opened, and then the suction pipe 13 and the inlet pipe 22 are connected to each other thereby. The suction pipe 13 is inserted into the inlet pipe 22 because of its smaller diameter than that of the inlet pipe 22. It should be noted that, when the suction pipe 13 is removed, the cover 37 returns to the original horizontal position by its own elasticity.

There are some cases where the self-priming pump 24 is locked because, if a foreign substance intrudes into the inlet pipe 22, the gear becomes disabled to rotate due to being

stuck with the foreign substance, but with the embodiment of the present invention, intrusion of a foreign substance to the inlet pipe 22 does not occur even when the water supply tank 10 is removed, which make it possible to prevent the self-priming pump 24 from being locked or the pipes from being stuck.

Fig. 10 is a perspective view showing key configuration of the water supply tank 10 as well as the water supply tank corner 4 in which the water supply tank 10 for the automatic ice making apparatus according to Embodiment 6 of the present invention is provided. In this embodiment, the water supply tank 10, in the automatic ice making apparatus according to Embodiment 1 to Embodiment 5 of the invention, is molded with a transparent material, and a water level gauge 38 is provided on the wall surface of the water supply tank corner 4 provided outside of the water supply tank 10 so that the position of the gauge is visible from the front side of the refrigerator 1 with freezing chamber.

In Fig. 10, the water supply tank corner 4 is provided monolithically with the partition wall 6 by forming the well on the partition wall 6, and the water supply tank 10 is installed in the water supply tank corner 4. The water level gauge 38 is provided at the position on the partition wall 6 shown in the figure, and as shown in Fig. 11, a user can visually check it. When the water supply tank 10 stores water therein, if a water level positions at a certain height of the water level gauge 38, an image of the water level gauge 38 under the water level is invisible because of the difference of

a refractive index between the water above the level and that under the level. If an indicator such as "water supply" indicating that a water supply is required at the point of time when the water level is lowering to the bottom of the tank is provided on the water level gauge 38 by using this refractive index of water, a user can realize a timing for water supply to the water supply tank 10. The operations described above are shown in Figs. 12A and 12B, and Fig. 12A is a view showing a state of the tank being full of water, while Fig. 12B is a view showing a state of the tank running out of water.

As described above, with the embodiment according to the present invention, a user can easily check a level of water in the water supply tank 10, and the level of water therein is directly indicated without using a LED or a read switch for a run-out-of-water indication, which makes it possible to obtain a high-reliability and low-cost water-level indicating system.

Next, a description is made for an embodiment of the present invention with reference to related drawings. Fig. 13 is a lateral cross-sectional view showing an automatic ice making apparatus according to Embodiment 7 of the present invention, and Fig. 14 is an enlarged view showing a key section of the automatic ice making apparatus shown in Fig. 13. In Fig. 13, a feed pump 69 and a water supply tank 10 with a discharge port 68 connected to the feed pump 69 are set in a water supply tank

corner 4 provided on a partition wall 6 separating the cold chamber 2 from the freezing chamber 3, and the discharger port 68 is inserted into a water receiving section 70 monolithically formed with the water supply tank corner 4. In the water receiving section 70, an outlet port 71 monolithically formed therewith is provided so that it penetrates through the cold chamber 2 and the freezing chamber 3, and an ice making tray 27 is positioned in front of the outlet port 71. The tip of the discharge port 68 is above the maximum water level in the water supply tank 10, but under an upper edge section of the water receiving section 70.

Next, a description is made for a feed pump 69 and a section around the feed pump 69 with reference to Fig. 14. In the feed pump 69, a magnet 73, a magnetic plate 74, and an impeller 77 having a shaft 75 made from SUS 303 and a ball 76 made from SUS 304 are rotatably supported by a bearing 78 monolithically formed with the feed pump 69 with the shaft 75 inserted thereinto. The feed pump 69 has a suction port 79 in the side of the bearing, and a mesh filter 111 is attached to a tip thereof. The feed pump 69 also has a discharge port 68 of a discharge pipe in the peripheral direction of the feed pump 69. The balls 76 are fixed to a bearing side of the feed pump 69 and in the opposite side, and contact a casing of the feed pump 69.

Next, a description is made for operations with reference

to Figs. 15A to 15C, Fig. 16 and Fig. 17. Figs. 15A to 15C are views showing an operating state of the feed pump 69, and Fig. 15A is a view showing the feed pump 69 when viewed from the direction of the shaft, while Fig. 15B is a lateral cross-sectional view of a motor 72, and Fig. 15C shows magnets 73, 80 each formed into a flat plate shape with two or more poles. Fig. 16 is a general block diagram showing a control board for controlling operations of the motor 72, and Fig. 17 is a time chart showing the operations.

10 In Fig. 16, the reference numeral 82 indicates a control board with the motor 72 and a power supply unit 83 connected thereto and is provided in the refrigerator 1 with freezing chamber. The gear box 28 detects a quantity of ice stored in an ice storage box, and when it detects shortage of a quantity of
15 ice, a water supply start signal is outputted from the control board 82. When a water supply start signal is outputted from the control board 82, the motor 72 is switched from the OFF state to ON state and the ON state is maintained for a specified period of time. When the motor 72 is turned ON, the
20 magnetic plate B81 connected to the motor 72 and a magnet B80 adhered to the magnetic plate B81 start rotation. The magnet B80 and a magnet 73 in the side of the feed pump 69 form a magnetic field and attract each other with magnetism, so that the magnet B80 and the magnet 73 rotate at the same rotational
25 speed, and also the impeller 77 with the magnet 73 attached

thereto rotates at the same rotational speed. When the impeller 77 rotates in the direction as shown in Fig. 15A, water flows out from a discharge port 68 and also water in the water supply tank 10 is sucked from the suction port 79, but in the water supply tank 10, objects each having a size of 0.4 mm x 0.4 mm or more are held on a surface of the mesh filter 111.

On the other hand, water flowing out from the discharge section 68 is supplied via a water receiving port 70 and the outlet port 71 to the ice making tray 27.

The magnets 73, 80 are formed into a flat plate shape with two or more poles as shown in Fig. 15C, and a material for the magnets is selected from ferrite-based materials or rare earth metals.

The water supply tank 10 is inserted into the water supply tank corner 4 formed into a well, and the construction allows insertion of the water supply tank 10 with a clearance of only several millimeters. On the other hand, in a state where the feed pump 69 has been inserted into the water supply tank 10, a position of the feed pump 69 within the water supply tank 10 is decided according to a position of a discharge port inserting position of a cover for the water supply tank, but because of attraction by magnetism, no effect is given to rotation of the pump even if a casing of the pump contacts a wall of the tank.

Namely, the balls exist between the impeller 77 and the

casing, and in addition, when the pump rotates, the impeller is attracted to the side of the bearing 78 due to a negative pressure generated by the pump, so that friction between the rotating bodies, namely the balls 76 and a casing which is a fixed portion is suppressed. The tank is made from plastics or non-magnetic materials such as stainless steel or glass with a thickness of 2 mm.

Also a fully large clearance is provided between a magnet 80 in the side of motor 72 and the tank to prevent them from contacting each other directly or to provide a partition wall therein. By locating ferrite magnets 73, 80 at positions opposing to each other via an entire clearance with the width of around 10 mm including backlash, a torque generated by a motor is delivered to a pump, and a user can easily dismount a tank from the well or remove a pump or discharge port from inside of the tank without being interfered by the magnetism.

Also the fact that a pump has been set at a specified position can be detected because the pump is magnetically attracted.

Also an area around the water supply tank can easily be cleaned after the tank including the discharge port has been taken out from the well.

The filter 111 is inserted into the pump with pressure, and can be cleaned after having been pulled off from the pump.

Also the pump and the discharge port can be cleaned from the inlet/outlet ports without disassembling them.

As described above, with the automatic ice making apparatus according to this embodiment of the present invention, as the
5 feed pump 69 is installed in the water supply tank 10, a user can freely clean the feed pump 69 according to the necessity. In addition, a discharge port 68 and a water receiving section 70, an outlet port 71, and an ice making tray 27 are located as shown in the figure, so that a seal or the like is not required
10 between the receiving port 70 and the discharge port 68.

Furthermore, the motor 72 and the feed pump 69 do not contact each other, so that a quite silent system can be constructed, and as the mesh filter 111 is attached to the suction port 79, intrusion of a foreign substance is suppressed, so that the
15 impeller is not locked.

It should be noted that, although the water supply tank 10 is set in the water supply tank corner 4 provided in the partition wall in Embodiment 7 described above, the water supply tank corner 4 may be installed externally.

20 A method for mounting the water supply tank corner 4 in Embodiment 8 is different from that in Embodiment 7. In Embodiment 7, the motor 72 is located on a surface the water supply tank corner 4 in the contrary side of the water supply tank, and the water supply tank corner 4 and the partition wall
25 6 are formed monolithically. In this configuration, the motor

72 (generally) having a shorter service life as compared to that of the refrigerator 1 with freezing chamber can not be replaced with a new one. So a tank holder 84, in which the water supply tank corner 4 is separated from the partition wall 6, is provided, and the motor 72 fixed to a motor case 85 is attached to a rear side of the tank holder 84 as shown in Fig. 18. And, the tank holder 84 is attached to the partition wall 6 adhering a seal 86 along the entire periphery thereof. The tank holder 84 is fixed to the partition wall 6 with, for instance, screws, claws, rivets or the like which can easily be removed or used again for fixing the tank holder 84. The seal 86 should have water-tightness.

In this embodiment, as the tank holder 84 is separated from the partition wall 6, the motor 72 can easily be replaced with a new one, and in addition as the seal 86 having water-tightness is provided between the tank holder 84 and the partition wall 6, water is prevented from coming into the motor section 72.

An automatic ice making apparatus according to Embodiment 9 of the present invention is the same as those according to Embodiments 7 and 8 excluding the fact that several considerations are taken for a positional precision of the feed pump 69. In Fig. 19, the reference numeral 88 indicates a guide monolithically formed with the feed pump 69, and is engaged in a guide receiver 89 for controlling positional displacement of

the feed pump 69 in the thrust direction as well as in the radial direction shown in the figure. Also a guide 90 is provided in the water supply tank 10, and the guide 90 is engaged with the tank holder 84 or a guide receiver 91 provided in the water supply tank corner 4 for controlling positional displacement in the two directions shown in the figure. As shown in Fig. 20, the discharge port 68 of a discharge pipe from the feed pump 69 is engaged in a flange hole section 110 of the water supply tank 10.

10 As shown in Fig. 20, there is a cover 12 in an upper section of the water supply tank 10, and the discharge port 68 of a discharge pipe is fixed with a pressing section 12b monolithically formed with the cover 12 to control positional displacement of the feed pump 69 in the direction shown in the figure.

15 In this embodiment of the present invention, positional displacement of the feed pump 69 as well as of the water supply tank 10 is prevented by the guide 88 and the guide receiver for the guide 88 and the pressing section 12b provided on the cover 12, and also positional displacement of the water supply tank 20 10 and the tank holder guide 84 is prevented by the guide 90 and the guide receiver 91, so that positional displacement between magnets generated when the motor 72 is mounted on the tank holder 84 in Embodiment 8 can be prevented, and a driving force 25 can accurately be delivered without stepping out.

Configuration of the automatic ice making apparatus according to Embodiment 10 of the present invention is the same as that in Embodiment 7 excluding that construction of the feed pump 69 has been changed. In Fig. 21, designated at the reference numeral 92 is an impeller cover, at 93 a cap, and at 87 a screw section monolithically formed with the feed pump 69. A shaft 75 having a flange, a ball 76, an magnetic plate 74, and a magnet 73 are attached to the impeller 77 and are completely shielded by the impeller cover 92. The impeller cover 92 is adhered to the impeller 77 and in the case where a material of the impeller cover 92 is plastic resin, it is completely welded to the impeller by means of, for instance, thermal welding. A shaft 75 of the impeller 77 having the construction as described above is inserted into the bearing 78 of the feed pump 69, and an open section in the side contrary to the bearing 78 is closed with the cap 93 and is tightened with the screw section 87.

Also when the motor 72 is driven, the impeller 77 rotates. Then, the shaft 75 and balls 76 are rotatably held by the impeller and supported by the bearing 78.

With this embodiment of the present invention, the cap 73 can freely be removed and a space inside the feed pump 69 is divided to several zones, so that, even if a foreign material comes into the feed pump 69, the foreign material can be cleaned or washed off.

Fig. 22 is a perspective cross-sectional view of the automatic ice making apparatus according to Embodiment 11 of the present invention. In Fig. 22, the water supply tank 10 is set in the water supply tank corner 4 in a state where the water supply tank 10 is completely buried in the water supply tank corner 4. Along the full length of a groove of the water supply tank corner 4, a bank section 110 partitioning in the lateral direction and having a length in a range from 1 mm to 5 mm is provided monolithically with the partition wall 6.

With the automatic ice making apparatus according to this embodiment of the present invention, a bank section 130 having a length from 1 mm to 5 mm is provided along the full length of the groove of the water supply tank corner 4, so that foreign materials such as spill of food onto the partition wall 6 can be prevented from coming into the water supply tank corner 4, which makes it possible to build up a clean system.

In Fig. 23, a flange B131 larger than a clearance generated when the water supply tank 10 is set in the water supply tank corner 4 is provided monolithically with the water supply tank 10 along the entire periphery of the water supply tank 10 in an upper section thereof. A clearance between the water supply tank corner 4 and the water supply tank 10 is completely shielded by this flange B131.

With this embodiment of the present invention, even in a case where spill of food or dust is dropped onto the partition

wall 6, as a clearance between the water supply tank 10 and the water supply tank corner 4 is completely shielded, foreign materials such as spill of food or dust can be prevented from coming into the clearance, which makes it possible to build up a clean construction.

Configuration of the automatic ice making apparatus according to Embodiment 13 of the present invention is the same as that in Embodiment 11 or 12 excluding the point that some elements have been added to the construction. In Fig. 24, a partial projection 112 is provided in a bottom section of the water supply tank corner 4.

With this embodiment of the present invention, a space having a required size can be generated between the projection 112 provided at a bottom of the water supply tank corner 4 and the water supply tank 10 according to the necessity, so that, even if a foreign material flows into the water supply tank corner 4, the foreign material is stored in the space 113. Because of this construction, a failure in setting of the water supply tank 10 due to intrusion of a foreign material cannot be generated.

Fig. 25 is a transverse cross-sectional view showing a hot instruction structure for a water supply tank applied to the automatic ice making apparatus according to Embodiment 14 of the present invention. In this figure, designated at the reference numeral 102 is a front cover, at 103 a condensing

pipe, at 104 a cushion tightly contacting the condensing pipe 103 to the front cover 102, at 107 a thermal conductive tape made from a material having a high thermal conductivity such as an aluminum tape for delivering heat in the condensing pipe 103 to the water supply tank corner 4, and at 108 a cord heater, and it should be noted that the partition wall 6 is based on a sandwich construction in which the upper and lower external sections are made from plastics and the space between them is filled with PS-FO or hard polyurethane foam.

Next, a description is made for operations in this embodiment. Fig. 26 is a timing chart showing operations of the cord heater 108 shown in Fig. 25 with reference to a cooling operation in a refrigerator 1 with freezing chamber. In a case where a compressor (not shown herein) is operating and an open/close damper (not shown) controlling supply of cool air to the cold chamber 2 for cooling down the cold chamber 2 is open, the cord heater 108 is turned ON and the open/close damper is switched from the above-described state to the closed state, and in a case where supply of cool air to the cold chamber 2 is stopped, a high temperature and high pressure cooling medium having been compressed by a compressor is condensed in the condensing pipe 103, when the heat is delivered through the thermal conductive tape 107 and heats the water supply tank corner 4, so that temperature of the water supply tank 10 does not lower anymore. So in this state, the cord heater 108 is

turned OFF.

Then in a case where the compressor is turned OFF, a pressure balance in the refrigeration cycle changes in a direction in which the pressure balance will be stabilized at a constant level, so that a quantity of heat radiated from the condensing pipe 103 becomes smaller by and by. In this step, cool air inside the cold chamber 2 deprives the water supply tank 10 of its heat, and the water supply tank 10 may be cooled excessively, and for this reason, the cord heater 108 is kept ON only for a specified period of time (t_1), and when the specified period of time (t_1) has passed, the cord heater 108 is again turned OFF. And when the compressor is turned ON again due to temperature increase in the refrigerator with freezing chamber, heat emission from the condensing pipe 103 is resumed, so that the cord heater 108 is not turned ON and kept OFF. And when the open/close damper is opened again, the cord heater 108 is again turned ON. Subsequently this cycle is repeated according to the same sequence.

With this embodiment of the present invention, temperature in the water supply tank 10 is always kept at a constant level, and waste heat from a refrigerator can effectively be utilized by using heat of condensation emission from a cooling medium as a heat source, and energy saving can be achieved by turning ON/OFF the cord heater 108 according to an operating state of the refrigerator.

Figs. 27A and 27B show automatic ice making apparatus having the same configuration as that in Embodiment 14 of the present invention excluding the point that certain new elements have been added to the construction. In Figs. 27A and 27B, a cool
5 chamber door 100a and a freezing chamber door 100b used for closing the cold chamber 2 and the freezing chamber 3 respectively are provided via a magnet gasket 101 in front of the partition wall 6, and a door pocket 105 for storing food therein is attached to the cold chamber door 100a. A packing
10 109 as a shut-off means for cooling which is tightly contacted to the partition wall 6 when the cold chamber door 100a is kept in the closed state is attached to a depth of a lower section of the door pocket 105. Also a vent hole 115 for air circulation is provided in a surface of a wall at a depth of
15 the door pocket 105.

Next, a description is made for operations in this embodiment. There is a space between the door pocket 105 and the partition wall 6, and a temperature in this space is controlled according to a state of cooling operation for the
20 cold chamber 2. Herein by closely contacting the packing 106 provided in the door pocket 105 to the partition wall 6 to make up a closed space therein, an air insulating layer is realized. With this configuration, a temperature in the space is hardly effected by a state of cooling operation for the cold chamber
25 2. The cooling air used for cooling food in the door pocket

105 is circulated through The vent hole 115.

With this embodiment of the present invention, a space above the water supply tank 10 functions as an air insulating layer, so that the water supply tank 10 is hardly deprived of heat, and
5 also the performance for cooling food can be maintained because a vent hole 115 for circulation of cool air is provided.

Also foreign materials such as spill from food stored in the door pocket 105 do not drop onto the water supply tank 10 because the door pocket 105 for shutting off the cool air is
10 provided.

Fig. 28 is a perspective appearance view showing construction of the water supply tank 10 for an automatic ice making apparatus according to Embodiment 16 of the present invention, while Fig. 29 is a cross-sectional view showing a
15 key section thereof. Fig. 30 is a cross-sectional view illustrating a method of manufacturing a construction body according to this embodiment of the present invention. In Figs. 27A and 27B, a water level display window 120 made from a transparent material is provided in the water supply tank 10,
20 and the water level display window 120 inclining in a direction allowing visual check by a user from the front side extends to a position near a bottom section of the water supply tank 10 as shown in Fig. 29. As shown in Fig. 30, the water level display window 120 is welded to a rear side of an upper section of the
25 water supply tank 10 by means of thermal welding, and in this

step a cover 121 is inserted between the water supply tank 10 and the water level display window 120 being engaged in a hole section of the water supply tank 10 for locking the water level display window 120. It should be noted that the welded section
5 extends along an entire periphery of the hole section of the water supply tank 10.

The water level display window 120 may be provided in a cover section 122 formed as a separated upper section of the water supply tank 10 so that the cover can be opened or closed
10 according to the necessity. The construction is shown in Fig. 31.

With this embodiment of the present invention, even if water drops adhere to an internal wall surface of the water supply tank 10, a border between an image of a water drop and an image
15 of water stored in the water supply tank 10 is displayed in the water level display window 120, so that an user can accurately check a quantity of water stored in the water supply tank 10.

Fig. 32 shows a perspective appearance view showing construction of the water supply tank 10 for the automatic ice
20 making apparatus according to Embodiment 17 of the present invention as well as of the feed pump 69 therein. An L-shaped angle 201 monolithically molded with the feed pump 69 is provided, a hole 202 is provided in the L-shaped angle 201, and the feed pump 69 is fixed to the water supply tank 10 by
25 positioning the L-shaped angle 201 in an engaging section

between a screw cap section 203 and a screw section 206 of the water supply tank 10.

Fig. 33 shows an operating state of the feed pump 69, and Fig. 34 is a perspective appearance view illustrating inside of a casing for the feed pump 69. When the impeller 77 rotates, a liquid gathers around an external periphery thereof with air concentrated in the section indicated by an arrow mark in Fig. 24, namely at a center of the shaft 75, and when the operation is stopped, the air is concentrated in an upper section of the casing. With repetition of the operations described above, air inside the casing is not discharged and an air residing section 205 is generated. For this reason, by providing an air-vent hole 204 having a diameter, which is substantially the same as that of a discharge port, is provided in an upper section of the casing for the feed pump 69 at a position rotated from the discharge port, so that fluctuation of a water flow rate according to presence of air is eliminated and the water supply rate is stabilized.

Although the invention has been described with respect to a specific embodiment for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art which fairly fall within the basic teaching herein set forth.



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WHAT IS CLAIMED IS:

1. An automatic ice making apparatus comprising:
a water supply tank installed in a refrigerator for storing water therein;
a pump installed within the water supply tank for discharging water stored in said water supply tank into an ice making tray; and
a drive unit installed outside said water supply tank for driving the pump above;
wherein the drive unit delivers a torque for driving said pump to said water supply tank in a non-contact mode.
2. An automatic ice making apparatus according to claim 1, wherein a torque is delivered by providing a magnet in said pump and also providing another magnet provided in the drive unit at a position opposite to the magnet provided in the pump.
3. An automatic ice making apparatus according to claim 1 or claim 2, wherein the drive unit is attached to a tank supporting means provided on a wall of a refrigerator or in a refrigerator for mounting thereon the water supply tank having no connection with said water supply tank through water.

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4. An automatic ice making apparatus according to claim 1, 2 or 3, wherein a water receiving section is provided between said water supply tank and said ice making tray, and a discharge port of a discharge pipe connected to a pump for discharging water into said water receiving section is allocated above the maximum after level within said water supply tank as well as under an upper edge section of said water receiving section.

5. An automatic ice making apparatus according to claim 1, 2, 3 or 4, wherein a movable section of the pump is removably provided in a casing which is an enclosure for accommodating the movable section of the pump therein.

6. An automatic ice making apparatus according to claim 1, 2, 3, 4 or 5, wherein a filter is removably provided on a pump suction port provided in the water supply tank.

7. An automatic ice making apparatus according to claim 1, 2, 3, 4, 5 or 6 further comprising:

a tank supporting means provided on a wall of a refrigerator or in a refrigerator for mounting the water supply tank thereon; and

a positioning means for fixing positions of said

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water supply tank in three directions by partially contacting the water supply tank thereto.

8. An automatic ice making apparatus according to claim 1, 2, 3, 4, 5, 6 or 7, wherein one edge of a rotary shaft of a pump is rotatably supported by a pump bearing with the other edge rotatably supported by an impeller.

9. An automatic ice making apparatus according to claim 1, wherein a bank section higher than the partition wall and partitioning a surface of the partition wall in the lateral direction is provided around a periphery of a groove in the concave section provided on the partition wall.

10. An automatic ice making apparatus according to claim 1, wherein a flange covering the entire periphery of the groove in the concave section provided on the partition wall is provided in said water supply tank.

11. An automatic ice making apparatus according to claim 1, wherein a water level display window enabling visual check of a water level in said water supply tank is provided in an upper section of said water supply tank.





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12. An automatic ice making apparatus according to claim 1, wherein a positioning means for positioning in the thrust direction as well as in the radial direction provided in an L-shaped angle monolithically provided in a feed pump, and an engaging section for engaging and fixing said positioning means on a water supply tank.

13. An automatic ice making apparatus according to any of claims 1, 2, 3, 4 and 5 comprising an air-vent hole having a diameter which is substantially the same as that of a discharge port provided in an upper section of a casing for a feed pump at a position in a rotated direction from the discharge port.

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