Nov. 9, 1971 D. N. TOMA 3,618,335

AUTOMATIC ICEMAKER

Filed Sept. 17, 1969 2 Sheets-Sheet 1

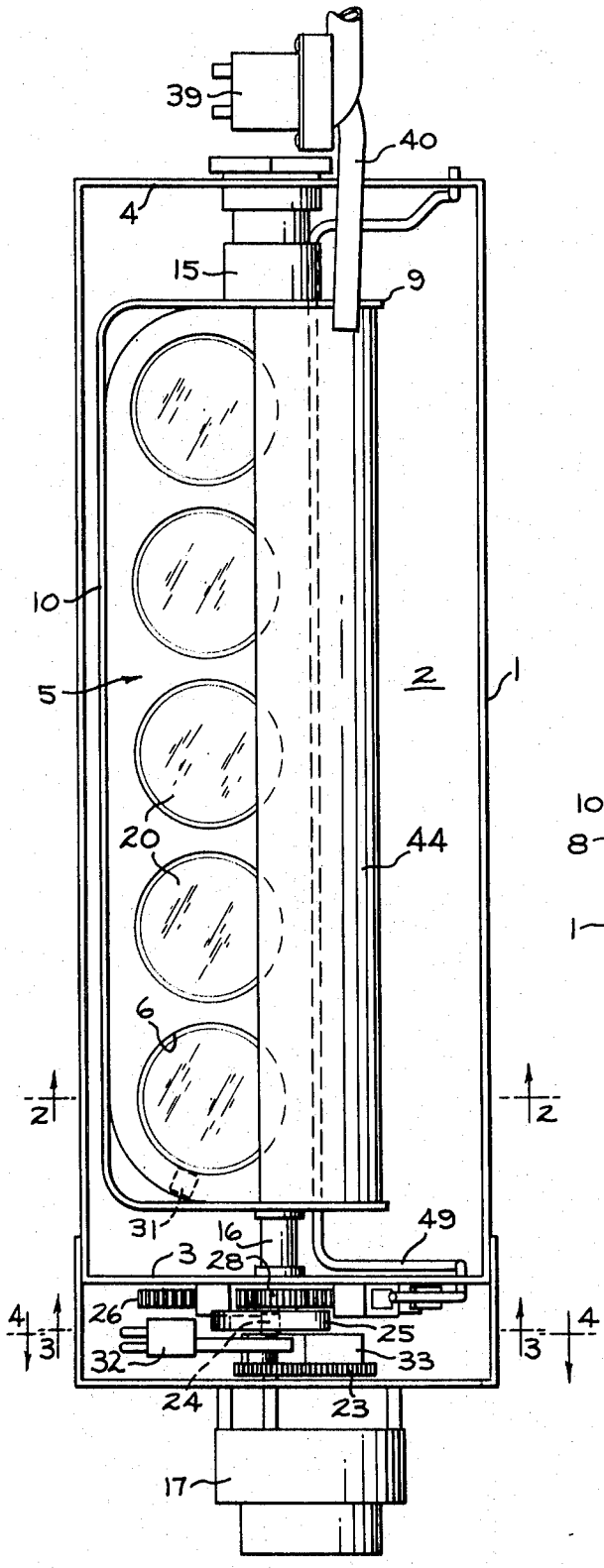


FIG. 1

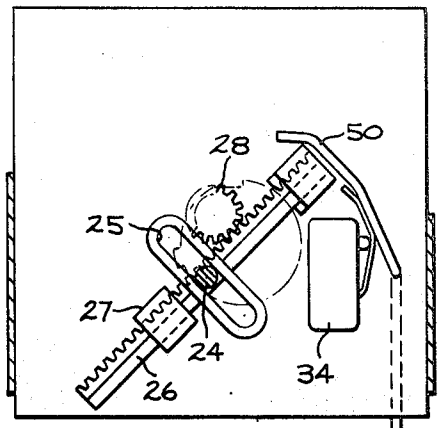


FIG. 3

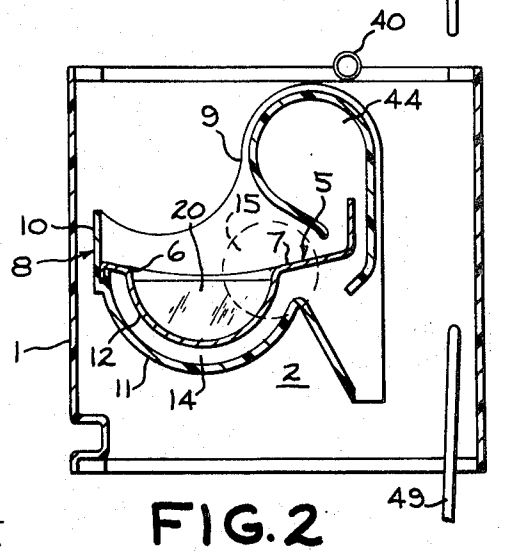


FIG. 2

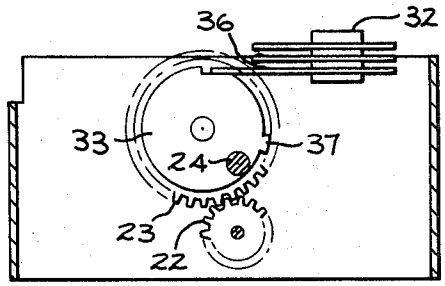


FIG. 4

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AUTOMATIC ICEMAKER

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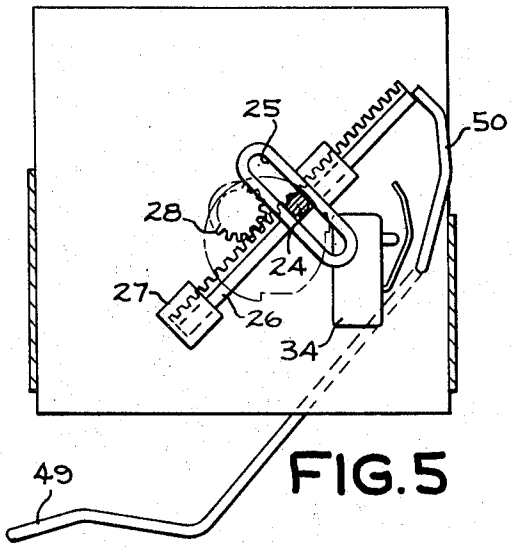


FIG. 5

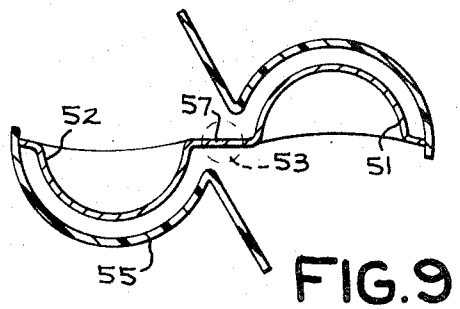


FIG. 9

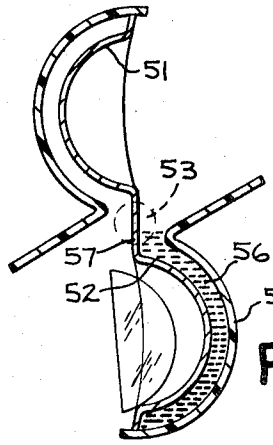


FIG. 10

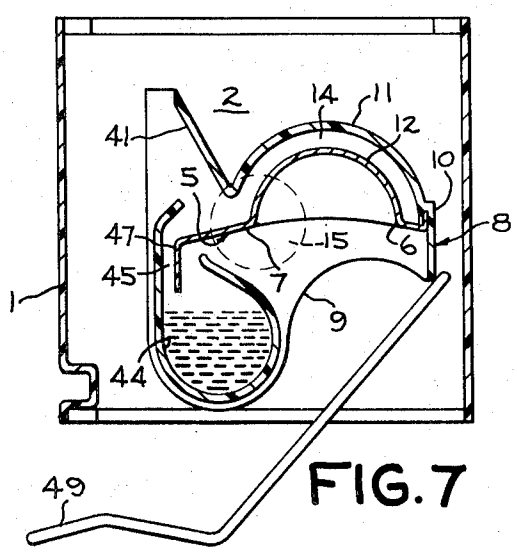


FIG. 7

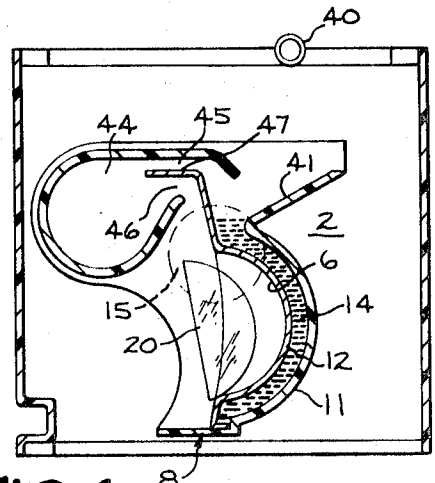


FIG. 6

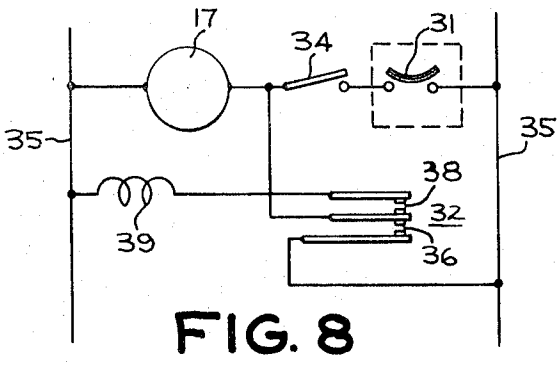


FIG. 8

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3,618,335

AUTOMATIC ICEMAKER

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Int. Cl. F25c 1/10
U.S. Cl. 62—349 2 Claims

ABSTRACT OF THE DISCLOSURE

An automatic icemaker of the type including a rotatable mold containing cavities in which a measured charge of water is frozen and from which ice pieces are heat released for gravity discharge by the warming action of a subsequent charge of water. The mold is so designed that during rotation thereof the subsequent water charge is first confined in direct contact with all of the mold walls from which ice pieces are to be released and is thereafter transferred to mold cavities for the freezing thereof. In one embodiment of the invention, the subsequent charge is transferred to the same mold cavities from which ice pieces have been released by its warming action. In another embodiment, the mold comprises two sets of cavities and the water used to heat release ice pieces from one set is thereafter transferred to the other set of cavities.

BACKGROUND OF THE INVENTION

Many attempts have been made to provide automatic icemakers for home refrigerators from which ice pieces are released by the heat of a fresh charge of water which is then to be frozen. The operating concept in all of these icemakers has been to provide rotatable molds comprising two or more sets of cavities with the walls of one set of cavities common to or in heat transfer relationship with the walls of the other set whereby the heat of the water introduced into one set will heat release previously formed ice pieces from the other set. For example, Clum Pat. 2,407,058 issued Sept. 3, 1946, discloses a rotatable ice maker of this type in which the bottom walls of the cavities of each set are common and therefore in heat transfer relationship. In Pat. 2,939,298, Bauerlein, issued June 7, 1960, three sets of triangular shaped cavities are angularly arranged about the axis of rotation so that the cavities receiving a fresh charge of water have one side wall in common with the cavities from which ice pieces are to be heat released. In Pat. 3,075,365, Hall, issued Jan. 29, 1963, two sets of oppositely facing cavities are formed by a common undulating wall so that one-half of the cavity side walls form direct heat transfer surfaces.

None of these designs are considered satisfactory for the production and bulk storage of ice pieces at the below freezing temperatures of a household refrigerator freezer compartment at least in part due to the non-uniform heating of the ice containing cavity walls. The common wall portions which are directly contacted by the fresh charge of water are warmed at a faster rate and to a higher temperature than the remaining wall portions. Since the ice pieces cannot be gravity discharged until all of the ice piece surfaces have been heat released, this results in a substantial melting of some of the ice piece surfaces with the resultant discharge of "wet" ice pieces which freeze into clusters or clumps in the storage receptacle.

The present invention has as its principal object the provision of a rotary icemaker of the heat release and the gravity discharge type so designed that the charge of water employed to heat release previously formed batch of ice pieces contacts in direct heat exchange relationship all of the cavity walls from which ice pieces are to be discharged.

Another object of the present invention is to provide a rotatable mold including means for confining a charge of incoming water in direct heat exchange relationship with mold cavities from which ice pieces are being released and thereafter transferring this charge of water, during further rotation of the mold, to cavities in which it is then frozen to form the next batch of ice pieces.

SUMMARY OF THE INVENTION

In accordance with the present invention, there is provided an automatic icemaker including a mold including a plurality of mold cavities, the mold being rotatable from a normal position in which ice is formed by freezing of water contained in at least some of the cavities to the discharge position in which the formed ice pieces can be heat and gravity released from the mold. For heat releasing the ice pieces, means are provided for confining a fresh charge of water in direct heat transfer relationship with ice engaging cavity walls while these cavities are in their discharge position and for thereafter transferring this charge of water to mold cavities during rotation of the mold from its discharge position to a freezing position.

In accordance with one embodiment of the invention, the mold comprises a single cavity or set of cavities formed of sheet material, preferably of metal, having good heat conducting or transfer properties. A second wall structure, spaced from the exterior surface of the cavity walls forms with these walls a chamber for receiving the subsequent charge of water. This chamber has a volume such that the fresh charge of water is confined in direct contact with all of the ice-containing cavity wall portions thereby assuring a rapid and uniform warming thereof. The mold further includes a transfer chamber adapted upon further rotation of the mold to the normal or liquid-retaining position of the cavities to transfer this charge of water to the mold cavities.

In accordance with the second illustrated embodiment of the invention, the mold comprises two sets of cavities on opposite sides of the axis of rotation of the mold and spaced 180° from one another. Ice is alternately formed in these sets of cavities. The mold in the area of each set is of a double walled construction forming chambers for alternately receiving the fresh charges of water. These chambers are so constructed that during rotation of the mold the fresh charge of water employed to heat release ice pieces from one set of cavities when the mold is in a discharge position will be transferred to the other set of cavities as the mold rotates to a position in which this other set of cavities are in a liquid retaining or upwardly facing position.

BRIEF DESCRIPTION OF THE DRAWING

In the accompanying drawing:

FIG. 1 is a plan view of an automatic icemaker including a mold structure incorporating one embodiment of the present invention;

FIG. 2 is a transverse sectional view of the icemaker of FIG. 1 along line 2—2 of FIG. 1;

FIG. 3 is transverse sectional view taken along line 3—3 of FIG. 1;

FIG. 4 is a transverse sectional view along line 4—4 of FIG. 1;

FIG. 5 is a sectional view similar to FIG. 3 showing certain operating components in a second position of operation;

FIG. 6 is a sectional view similar to that of FIG. 2 showing the ice mold in its ice discharge position;

FIG. 7 is a view similar to FIGS. 2 and 6 illustrating another position of the ice mold during rotation thereof;

FIG. 8 is a wiring diagram illustrating the essential

control components for controlling the operation of the automatic icemaker;

FIG. 9 is a transverse sectional view of a second embodiment of the present invention; and

FIG. 10 is a view of the embodiment of FIG. 9 in an ice discharge position.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With initial reference to FIGS. 1 and 2 of the accompanying drawing, there is illustrated one embodiment of the icemaker of the present invention comprising a rectangular frame member **1** adapted to be supported on a side wall of a household refrigerator freezer compartment above an ice storage receptacle (not shown).

A rotatable ice mold, generally indicated by the numeral **2** is privotally suported on the end walls **3** and **4** of the frame **1**. The mold component **2** comprises a mold member **5** of the sheet metal formed to include a plurality of hemispherical ice pockets or cavities **6**; the upper surfaces **7** of the mold member **5** being slightly concave or in other words sloping in the direction of the cavities **6**. The mold member **5** is supported in a cradle **8** preferably formed of a plastic sheet material to include end walls **9** and a side wall **10** engaging and supporting the corresponding end and side walls of the mold member **5**. This cradle **10** also includes an arcuate wall portion **11** substantially coextensive with and spaced from the outer surfaces **12** of the cavities **6**. This arcuate portion **11** forms with the outer surfaces of the walls of the cavities **6** a chamber **14** extending substantially the full length of the mold member **5**. A stud **15** extending from the rear wall **9** of the cradle pivotally supports the rear end of the mold on the frame end member **4** while a drive shaft **16** secured to the front end of the cradle **10** in axial alignment with the stud **15** pivotally supports the front end of the mold.

The icemaker also includes means for periodically rotating the mold from its normal position through a harvesting cycle including the heat release and gravity discharge of ice pieces and a return of the mold to its normal position with a transfer of the heat releasing charge of water to mold cavities.

The illustrated connection to provide the desired rotary movement of the mold component **2** includes a driving gear **22** (FIG. 4) forming part of the motor and speed reduction drive means **17** meshing with a driven gear **23**. The gear **23** carries a drive pin **24** which is received in a cross yoke **25** forming part of a motion translating device including a rack **26** slidably supported in guides **27**. The yoke **25** extends transversely or perpendicular to the rack **26** as shown in FIG. 3 of the drawing and in rigidly secured thereto. The rack **26** is connected to shaft **16** through a gear **28** carried by shaft **16** and meshing with the rack.

This mechanism provides a 270° rotation of the mold, first in a counterclockwise direction as viewed in FIG. 2 of the drawing and thereafter in a clockwise direction to return the mold to its position shown in FIG. 2. Its operation is best described with reference to FIGS. 3 and 5 of the drawing. During one half revolution of the gear **23** carrying the drive pin **24**, the drive pin **24** moves from its centered position within the yoke **25** as shown in FIG. 3 of the drawing to one end of the yoke **25** and then back to the mid-point. This results, as shown in FIG. 5, in a linear movement of the rack **26** from its one extreme position to the other for rotation of the shaft **16** through an angle of 270° in a counterclockwise direction. During the next half revolution of the gear **23** carrying the pin **24**, the pin moves to the opposite end of the yoke **25** and again to its mid-position for reverse rotation of the mold back to its normal position illustrated in FIG. 2 of the drawing.

Additional components for effecting an automatic operation of the icemaker include a mold thermostat **31**

sensing the temperature of the contents of the cavities **6**, cam operated switch means **32** operated by a cam **33** associated with the gear **23** and a switch **34** adapted to interrupt the automatic operation of the icemaker whenever the receptacle receiving ice pieces produced by the icemaker is filled.

The remaining element of the mold component **2** will be described with reference to the automatic operation of the icemaker by the control circuitry illustrated in FIG. 8 of the drawing. When the thermostat **31** senses a below freezing temperature of the contents of the cavities **6**, it closes to complete an energizing circuit through the closed switch **24** for the drive means **17**. The switch cam **33** driven by the drive means **17** then rotates in a counterclockwise direction as viewed in FIG. 4 of the drawing to initially close a switch **36** establishing a second energizing circuit connecting the drive means **17** across the supply lines **35**. At the point that the mold has rotated about 90° to its position shown in FIG. 6 of the drawing, an elevation **37** on the cam **33** closes a switch **38** for opening a solenoid controlled water valve **39** to supply a measured charge of water to the icemaker through a supply tube **40**. As shown in FIG. 6 of the drawing this supply tube **40** is positioned above the mold component **2** so that the charge will flow into the flared inlet **41** of the chamber **14**. The shape or configuration of wall **11** of the chamber **14** is such that a water charge of a volume required to fill all of the cavities **6**, will be confined within the chamber **14** in engagement with substantially all of the walls of the cavities **6** so that it is in direct heat exchange relationship with the ice cavity walls engaged by ice pieces **20**. Once the bond between the ice pieces and cavity walls are broken and during continued rotation of the mold in a counterclockwise direction, the released ice pieces freely drop into the storage receptacle. In order to transfer the charge of water from the chamber **14** to the cavities **6** as the mold continues its rotation in a counterclockwise direction and then in a clockwise direction, there is provided a transfer chamber **44** of generally C-shaped cross section extending between the opposite ends **9** of the cradle **10** and formed to include an inlet passage **45** and an outlet passage **46** on opposite sides of a lip or flange **47** forming an extension of the adjacent side wall of the mold member **5**. Mor specifically, as the mold continues to rotate from the position shown in FIG. 6 of the drawing to that shown in FIG. 7, the water flows from the chamber **14** over the outer surface of the mold member **5** and through the inlet passage **45** into the transfer chamber **44**. When the mold reaches its extreme position shown in FIG. 7, all of this water is contained within the chamber **44**. Thereafter during return of clockwise rotation of the mold, more specifically after it has passed the discharge position illustrated in FIG. 6 of the drawing, the water stored in the transfer chamber flows outwardly through the outlet **46** onto the upper surface of the mold member **5** and into the cavities **6**. During this sequence of operations the relatively warm charge of water has reset, in other words opened, the thermostat switch **31** so that when the cam reaches its original position illustrated in FIG. 4 of the drawing to open switch **36**, the drive means **17** is de-energized until the thermostat switch **31** again senses a below freezing temperature to the mold.

In order to stop the automatic operation of the icemaker whenever the receptacle is filled, means are provided for sensing that ice level and maintaining switch **34** in an open position so that closing of the thermostat switch **31** cannot energize the drive means **17**. The illustrated means is the usual switch operating feeler arm structure comprising a depending portion **49** extending into the storage receptacle. The feeler arm **49** is raised during each harvesting cycle to open the switch **34** and when the accumulated ice in the receptacle prevents it from returning to its normal or depending position, to again close the switch **34**, further automatic operation of

the icemaker is prevented. In the adaptation of this feeler arm control to the present invention, the feeler arm is provided with an extension **50** which is engaged by the rack **26** during the harvesting cycle for raising and lowering the feeler arm **49** and which also operates switch **34**.

In the embodiment of the invention illustrated in FIGS. 9 and 10 of the drawing, the sheet metal mold member is formed to include two sets of oppositely facing cavities **51** and **52** in substantially the same plane and the mold is pivotally supported for rotational movement about an axis **53** between the two sets of cavities. In the normal position the mold in which one set of cavities such as the set **52** in FIG. 9 of the drawing is in upright position, ice pieces are formed in these cavities. For the purpose of heat releasing and gravity ejecting these ice pieces, the mold structure is rotated about it supporting axis **53** in a counterclockwise direction for 90° to the position shown in FIG. 10. Each set of mold cavities is provided with wall members **55** spaced from the outer surfaces of the walls of the ice cavities **51** and **52** and forming with these cavity walls reservoirs **56** one or the other of which is adapted, when the mold is in the position illustrated in FIG. 10, to receive the next batch or charge of water. This water warms the entire outer surfaces of the cavities containing the ice pieces to heat release these ice pieces. The mold is then rotated another 90° in a counterclockwise direction to return the previously empty set of cavities **51** to its second horizontal and upright position in which the other set of cavities are upright. During this rotation, the water contained in the reservoir or chamber **56** flows along the then upper surface of the mold member and into the cavities **51**.

In this embodiment, it will be seen that ice pieces are ejected from one set of cavities and the charge of water employed for heat releasing these ice pieces is transferred to the other set of cavities in one half revolution of the mold structure.

From the above description, it will be seen that the present invention differs from prior rotary icemakers in which the ice pieces are released from mold cavities by the heat supplied from a fresh charge of water primarily in the fact that the present invention provides means for assuring a direct heat exchange contact of the fresh charge of water with all the ice cavity contacting walls thereby assuring a quick and uniform heating of these surfaces to quickly melt the bond between the ice pieces and the cavity walls. With this direct heat transfer to all ice contacting surfaces, gravity discharge of the ice pieces with a minimum melting of the surface of the ice pieces is assured. A further distinguishing feature of the present invention is the means for transferring this water upon further rotation of the mold structure to mold cavities for the subsequent formation of another batch of ice pieces. In the first embodiment of the invention, this means for transferring the charge of water to mold cavities includes the transfer reservoir **44**. In the second embodiment of the invention, this means comprises the intermediate section **57** between the two sets of cavities **51** and **52**. In both embodiments, the volume of the enclosure for confining the measured charge of water in warming engagement with the ice containing cavities has a volume such that this charge of water is confined in engagement with all of the ice containing cavity surfaces.

It should be apparent to those skilled in the art that

while there has been described what, at present, is considered to be the preferred embodiments of this invention in accordance with the patent statutes, changes may be made in the disclosed invention without actually departing from the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A rotatable icemaking mold, said mold comprising:

at least one cavity for containing a charge of water to be frozen, said cavity having a heat-conductive wall;

means for supporting said mold for rotation of said mold about a horizontal axis between a freezing position in which said cavity is upright, and a discharge position in which an ice piece upon heat release thereof from said cavity can be gravitationally discharged from said cavity;

heat release chamber means adjacent said wall of said cavity and operable in said mold discharge position for receiving a fresh charge of water and confining said fresh charge in heat conductive contact with said wall to heat release an ice piece from said cavity;

generally C-shaped transfer chamber means disposed proximate both sides of said wall, and operable in a predetermined first mold position to receive said fresh charge by gravitational transfer from said heat release chamber means via one side of said wall, and operable in a predetermined second mold position to deliver said fresh charge by gravitational transfer to said cavity via the other side of said wall.

2. An icemaker comprising:

a rotatable mold including first and second oppositely facing cavities for alternatively containing a charge of water to be frozen, said cavities having heat conductive walls;

means for supporting said mold for rotation of said mold about a horizontal axis between a first freezing position in which said first cavity is upright and a second freezing position in which said second cavity is upright and including first and second discharge positions in which an ice piece upon heat release thereof from said first cavity and said second cavity respectively can be gravitationally discharged therefrom;

first and second reservoir means operable in said first and second discharge position respectively for receiving a fresh charge of water and confining said fresh charge in contact with the outer surfaces of said first and second cavities to release an ice piece therefrom; and

transfer means comprising a surface of said rotatable mold and cooperating with said first reservoir means and with said second cavity for gravitationally transferring said fresh charge from said first reservoir means to said second cavity, upon rotation of said mold from said first discharge position to said second freezing position.

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WILLIAM E. WAYNER, Primary Examiner