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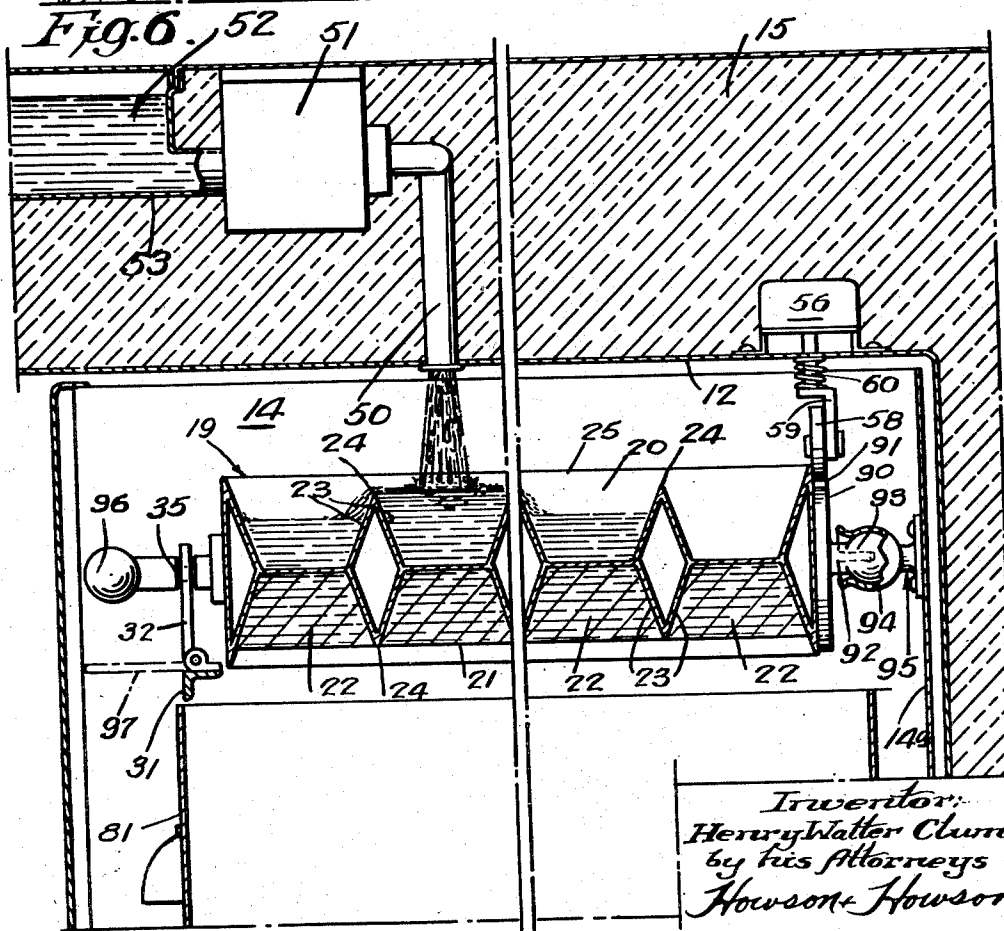
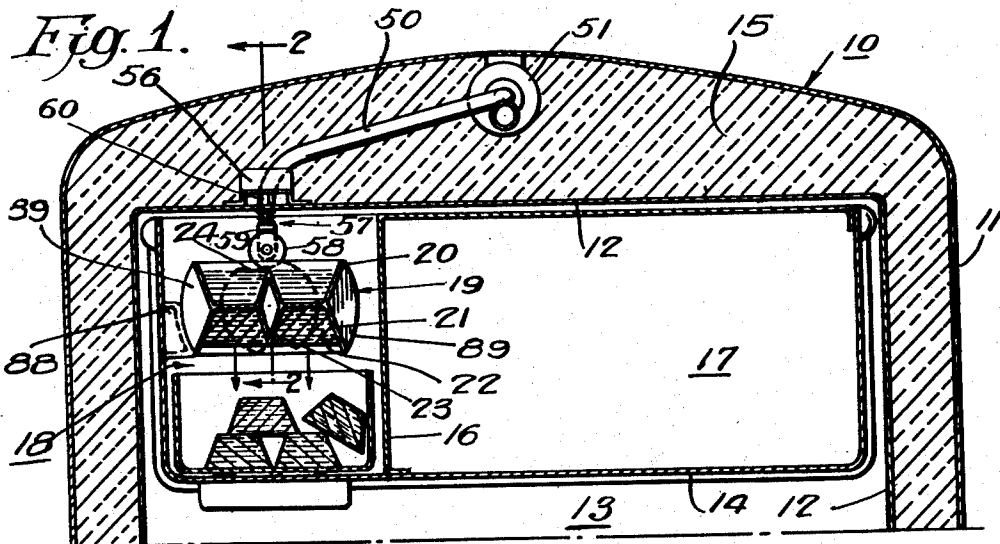
H. W. CLUM

2,407,058

FREEZING APPARATUS

Filed Sept. 30, 1944

3 Sheets-Sheet 1



Sept. 3, 1946.

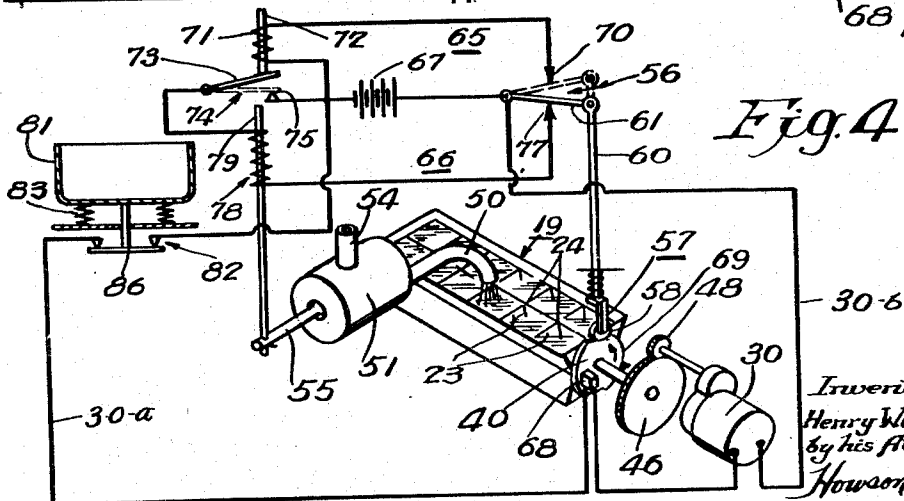
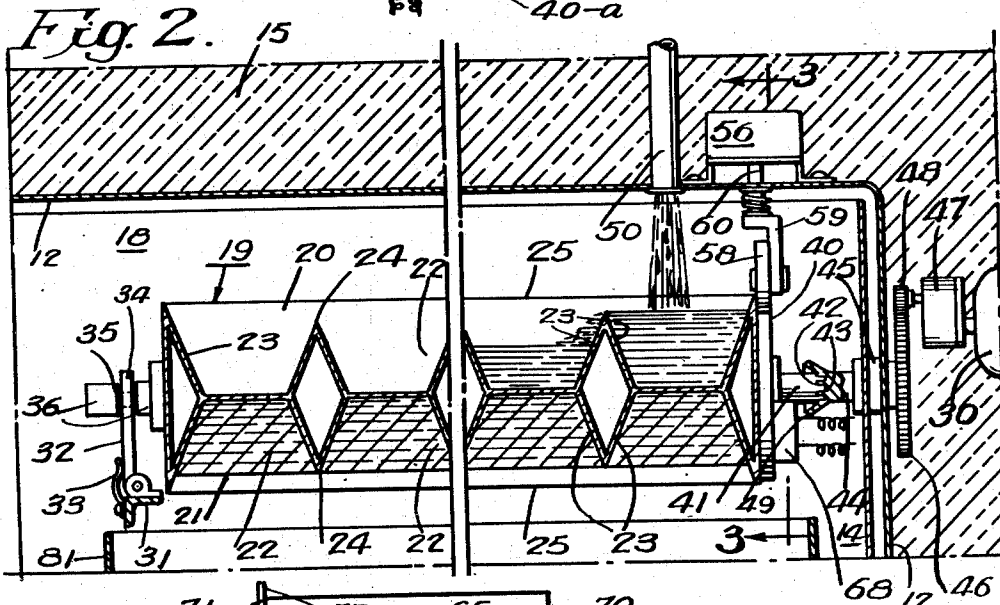
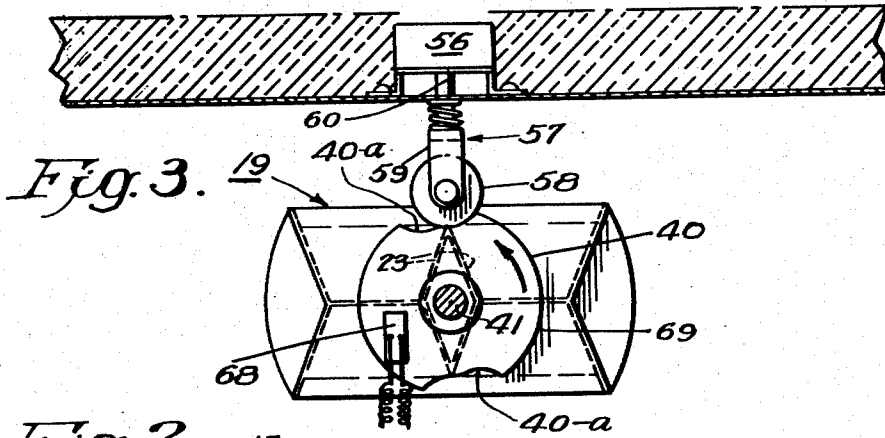
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FREEZING APPARATUS

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3 Sheets-Sheet 2



Inventor:—
Henry Walter Clum
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FREEZING APPARATUS

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3 Sheets-Sheet 3

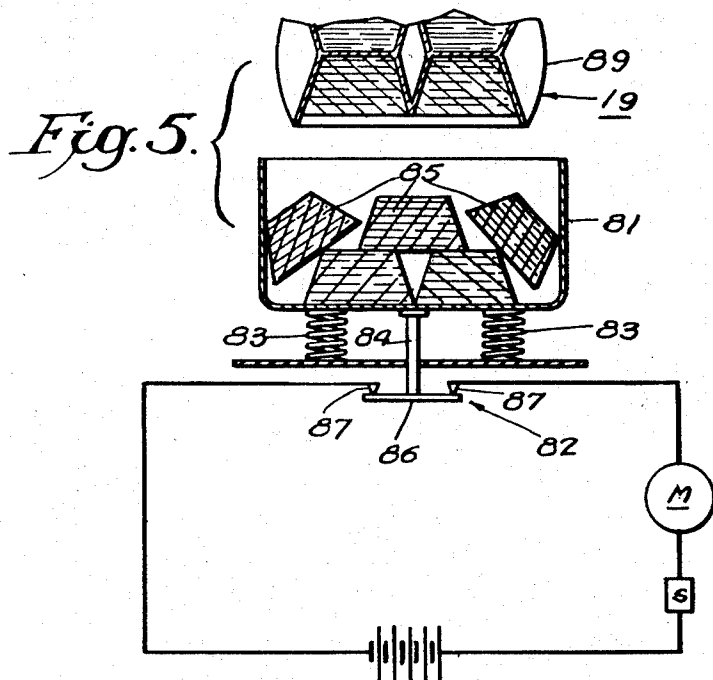
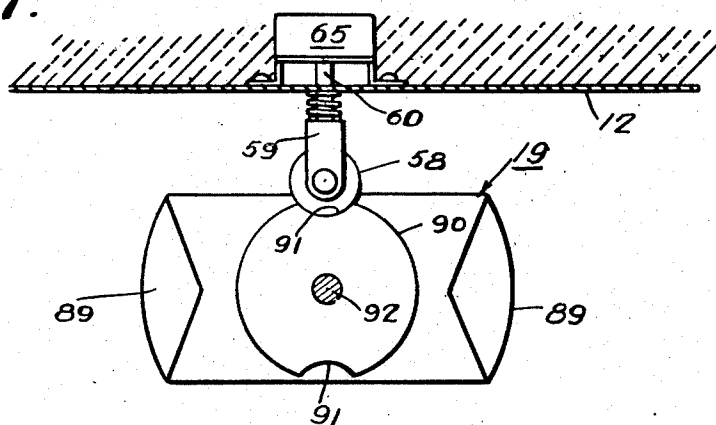


Fig. 7.



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UNITED STATES PATENT OFFICE

2,407,058

FREEZING APPARATUS

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Application September 30, 1944, Serial No. 556,594

16 Claims. (Cl. 62-2)

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This invention relates to refrigerating apparatus and more particularly to refrigerators embodying ice making mechanism.

One important object of the invention is the provision in a refrigerator of a novel mechanism for manufacturing and storing ice masses or cubes, so called.

Another important object of the invention is to provide an ice cube manufacturing mechanism which is operable in an automatic manner.

Further, an object of the invention is to provide means for storing the manufactured cubes in a manner whereby individual cubes are available for immediate use without necessity for removing the mold structure from the refrigerator, or for manually freeing the cubes from the mold.

It is also an object of the invention to provide mechanism of the stated type that will be characterized by simplicity of operation, economical construction, and adaptation for mass production.

In the drawings:

Figure 1 is a front sectional view of the upper portion of a refrigerator equipped with a fully automatic embodiment of the invention;

Figure 2 is a fragmentary sectional view taken substantially along a plane indicated by line 2-2, Figure 1;

Figure 3 is a sectional view taken substantially in the plane indicated by line 3-3, Figure 2;

Figure 4 is a diagrammatic view of the fully automatic embodiment of the invention, removed from the refrigerator;

Figure 5 is a diagrammatic view of a fragmentary portion of the invention;

Figure 6 is a sectional side view similar to Figure 2 but illustrating a semi-automatic embodiment of the invention, and

Figure 7 is a fragmentary view of a modified element of the apparatus illustrated in Figure 6.

With reference to the fully automatic embodiment of the invention as illustrated in Figures 1, 2, 3 and 4, the numeral 10, Figure 1, designates the upper portion of a refrigerator cabinet including an outer shell 11, and an inner liner 12. Liner 12 forms a food storage compartment 13, in which is housed an evaporator 14 which is connected to a suitable refrigerating system (not shown). The shell and liner are spaced and insulated from each other, as indicated at 15, according to well-known construction methods. The evaporator is divided by a wall 16 into a compartment 17 for frozen storage, and a compartment 18 for housing the ice forming apparatus of the instant invention.

In accordance with the present invention, and

with reference to Figures 1 and 2, a mold 19 is provided in the upper portion of compartment 18, said mold having liquid-receiving receptacles, 20 and 21 respectively, which face in opposite directions so that when one of the receptacles is in an upright or liquid-retaining position the other receptacle will be in a position for gravity discharge of its contents. Each of the receptacles is divided into a plurality of substantially cubic compartments 22 having outwardly converging side walls 23 interconnected at terminal points 24 beneath the outer rim 25 of each receptacle 20 and 21, the purpose of which will be explained hereinafter.

The mold is mounted horizontally within compartment 18 for periodic rotational movements through angles of 180° to positionally reverse said receptacles, and to this end a motor 30 is provided which responds to certain predetermined temperature conditions in the mold. The mounting includes, adjacent the front end of the mold, a transverse angle support 31 having its ends secured to the walls of the evaporator, and upon which is mounted a hinged bearing 32, said bearing being urged into a normal vertical position (Figure 2) by suitable means, such, for example, as leaf spring 33 one end of which is anchored to the angle 31. The upper end of bearing 32 is provided with a slot 34 adapted to receive a short axial shaft or trunnion 35 projecting from the front end of mold 19 and having enlarged portions 36 on either side of the bearing to prevent accidental displacement of the shaft from the slot.

The rearward end of the mold is provided with a cam 40 from which extends a short shaft or trunnion 41 preferably co-axial with forward trunnion 35 and having a splined clutch face 42 adapted to intermesh with a similar clutch face 43 on a short shaft 44 journaled in a bearing 45 in the walls of evaporator 14 and liner 12. The rearward or right hand end of shaft 44, as viewed in Figure 2, is provided with a large gear 46 adapted to be slowly rotated by motor 30 through a suitable reduction gear 47 and pinion 48 when the said motor is in operation. It will be noted that the inner end of shaft 44 has been provided with a cone-like flange 49 to facilitate intermeshing of the clutch faces 42 and 43 when positioning the mold within the evaporator.

As illustrated in Figures 1 and 2, water is supplied to the upper tray through an open ended tube 50 which is connected to a convenient water supply source through a valve 51.

As illustrated in connection with the semi-automatic embodiment, Figure 6, the said source

in either of the embodiments may consist of a reservoir 52 located within the top of the refrigerator, which may comprise a covered trough or container 53 adapted to hold a measured quantity of water, or it may consist of a direct connection to the water supply pipe 54 (Figure 4) of the residence or building in which the refrigerator is located.

Valve 51 is of the type designed to release from the said source a measured quantity of water each time the valve is tripped, as by a handle 55, Figure 4. Valves of this type are well known and a detailed description herein is deemed unnecessary. For example, the "royal flush valve" of the Sloan Valve Company is a valve of this general type. However, the invention is not to be considered as limited to valves of this type as it may utilize valves of many well known types.

As illustrated more clearly in Figure 3, an electric switch 56, located within the insulation above cam 40, is adapted to be actuated by a cam follower 57, said follower comprising a roller 58 journaled in a half yoke 59 secured to the lower end of a depending switch-actuating shaft 60.

With particular reference to Figure 4, the movable switch arm 61 of switch 56 is connected alternately in series with first and second electric circuits 65 and 66, respectively, including a common source of electrical energy, which, for convenience, is indicated as a battery 67. Motor 30 is also connected to the battery in circuit with a thermostatic switch 68, located in thermal transfer relation with mold 19 whereby actuation of said switch is responsive to thermal conditions of said mold. The switch 68 is regulated so as to close when its temperature is reduced to the point at which water in the mold would be completely frozen, while it remains open at temperatures above this point. Closing of the switch energizes motor 30 to rotate tray 19.

It will be noted that cam 40 (Figure 3) is provided with oppositely arranged elongated recesses 40a within one end of which cam roller 58 normally rests when the tray is in its normal horizontal position as illustrated.

In the operation of this fully automatic embodiment of the invention, let us assume the refrigerator has just been installed and connected to a suitable source of electrical energy, with the temperature throughout the cabinet relatively high. Mold 19 is facing upwardly, but empty, because no water has as yet been released by valve 51. Cam roller 58 is resting in the right hand end of recess 68 of cam 40, as viewed in Figure 3.

As the temperature of the refrigerator is reduced by the refrigerating system the temperature of mold 19 will lower to the point at which water in the mold will have been completely frozen. At this point thermostatic switch 68 closes thereby energizing motor 30 through a circuit which includes conductors 30a and 30b, to start rotation of the mold in a counter-clockwise direction, as indicated by the arrows on cam 40 in Figure 3. Immediately upon initiation of this rotation, roller 58 is cammed upwardly out of recess 40a to the high side 69 of the cam, moving arm 61 of switch 56 upwardly into contact with stationary switch contact point 70 (Figure 4) to complete first circuit 65 containing a solenoid 71 which then acts to draw core 72 thereof downwardly to move switch arm 73 of switch 74 into contact with a stationary switch contact point 75 of second circuit 66, as indicated by the broken

line positions of the movable switch arms 61 and 73.

The position now of the various elements of the mechanism is as follows; tray 19 is being slowly rotated by motor 30; cam roller 58 is riding on the high portion 69 of cam 40; first circuit 65 is closed and arm 73 of switch 74 is in its closed position relative to second circuit 66, but this circuit is open because of the raised position of switch arm 61 of switch 56.

The above condition prevails until tray 19 has been rotated through slightly less than 180° at which position roller 58 drops into the left hand end of cam recess 40a (Figure 3) which action moves switch arm 61 back to its normal position contacting stationary switch contact point 77, thus breaking the first circuit and permitting core 72 of solenoid 71 to return to its normal position out of contact with switch arm 73. Switch 74 is preferably of the over-center type so that switch arm 73 remains in contact with switch contact point 75 of circuit 66. Second circuit 66 is thus completed through battery 67 and solenoid 78, which solenoid, when thus energized, moves its core 79 upwardly, as seen in Figure 4. The lower end of core 79 is attached to handle 55 of valve 51, which handle is drawn upwardly by the above described upward movement of core 79 to trip valve 51 releasing from the water supply a quantity of water sufficient to fill upper receptacle 20 to the level of juncture 24 of dividing walls 23 thereof when the mold is in a level condition.

As clearly seen by reference to Figures 2 and 6, the water flowing into the upwardly facing receptacle first fills one of said cubic compartments from which it overflows into and fills the adjacent compartments until all are filled to the level of the terminal point 24 of walls 23. The side walls of the receptacle are raised sufficiently above terminal point 24 to prevent the water from flowing over rim 25 of the receptacle.

Upward movement of core 79 also moves switch arm 73 of switch 74 away from contact with point 75 to break the second circuit 66 thereby permitting core 79 of solenoid 78, and handle 55 of valve 51 to return to their normal position, as illustrated, thus resetting the mechanism for a subsequent cycle.

Water is preferably, but not necessarily, released into mold 19 at a point adjacent the position of thermostatic switch 68 whereby heat from the water may be quickly conducted to the switch. This heat causes the switch to open, breaking the motor circuit at the time roller 58 enters the leading end of recess 40a and tray 19 is in its normal level condition.

This condition of the mechanism remains until the water in receptacle 20 is completely frozen at which time thermostatic switch 68 closes to initiate another cycle, as described. At the completion of this succeeding cycle ice occupies the downwardly facing receptacle and water fills the upwardly facing receptacle. It should be particularly noted that the water now contained in the upper receptacle 21 is above freezing temperature which results in a flow of heat through the metal wall of the receptacle. This heat melts a thin film of ice where the latter contacts the surfaces of the receptacle, thereby breaking the bond between said surfaces and the ice and permitting the cubes to drop into a storage container 81 located in the lower portion of compartment 18 below the receptacle.

The above described cycling of the fully automatic embodiment of the invention will continue

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until the water supply is either exhausted or completely cut off. It is evident that by preventing operation of motor 30 the supply of water will be cut off, as operation of valve 51 is dependent upon rotation of cam 40 by the motor.

When this fully automatic mechanism is directly connected to the water supply pipe 54 of the building in which the refrigerator is installed, and it is desired to discontinue operation of the mechanism after completion of a desired number of cycles, say, for example, four, it is necessary to provide some means to break the motor circuit. This may be accomplished in any of various ways, such, for example, as illustrated in Figure 5, wherein the motor circuit has been provided with a circuit breaking switch 82 responsive to a predetermined weight of ice cubes within container 81. By thus breaking the motor circuit the thermostatic switch 68 is rendered ineffective to close the motor circuit. Container 81 is supported within compartment 18 on coil springs 83 in a position somewhat spaced above the compartment floor. Container 81 has depending therefrom switch arm 84 of the circuit breaking switch 82. Springs 83 are designed so that they will retain container 81 in the illustrated position while under the load of a predetermined weight of ice, say, for example, that corresponding to the contents of three receptacles. In operation, container 81 receives the successively deposited ice cubes 85 while remaining in the illustrated position until the fourth load, for example, is deposited, at which time it will move downwardly to an extent moving contact cross bar 86 away from stationary contact points 87 to break the motor circuit and thereby prevent further cycling of the mechanism until such time that cubes are removed from the container. Removal of a sufficient number of cubes from the container will lighten the load upon springs 83 to an extent permitting them to raise the container and close the switch 82, thus automatically resuming normal cycling of the mechanism to replenish the depleted supply of cubes.

Removal of mold 19 from the evaporator may be accomplished by raising the forward end thereof upwardly to an extent releasing trunnion 35 from slot 34, then drawing the tray forwardly out of its engagement with clutch shaft 44. Replacement is made by reverse procedure.

Mold 19 has no direct connection with evaporator 14 except through its end bearings, and in order to facilitate more rapid freezing of the water in the uppermost receptacle a portion 88 (Figure 1) of the evaporator wall has been shaped to conform with a radius substantially equal to the distance from the section of the tray to the rim 25 thereof, and the sides of the tray may be provided with a plurality of fins 89 for conducting heat from the tray to the evaporator.

Figure 6 illustrates a modified, semi-automatic form of the invention in which rotation of mold 19 is effected manually. In this form the mold is provided at its rearward end with a cam 90 (Figure 7) having opposed arcuate recesses 91 of substantially the same radius as cam roller 58. Extending rearwardly of cam 90 is a short stub shaft 92 terminating in a ball 93 snugly embraced, for rotational movement, by resilient fingers 94 of a socket 95 secured to the rear wall 14a of evaporator 14. The forward shaft 35 has been provided with a handle 96 for manually rotating the tray.

As in the previously described embodiment, release of water from reservoir 52, or other suitable

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source of water supply, into tray 19 is dependent upon rotation of the tray and its associated cam. Therefore, when it is initially desired to fill the receptacle 20, handle 96 is grasped by the operator and rotated through 180°. Initiation of such rotation completes the first circuit 65 to prepare second circuit 66 to act as described above in connection with the preferred embodiment. At the completion of 180° rotation, roller 58 will drop into recess 91, completing the second circuit 66, tripping valve 51, and thereby releasing sufficient water to fill receptacle 21 which is now uppermost. The water subsequently freezes, but in this case the mechanism remains in the same state until the tray is again manually turned through 180° at which time water is released into receptacle 20 to break the bond between the ice and tray and to permit the cubes to drop into container 81, as described above. It may be noted that in this embodiment there is no need for the special mounting of container 81 as the motor and associated mechanism and circuit have been removed. There is also no need for leaf spring 33 to urge the tray rearwardly as socket 95 holds the tray in position during normal operation of the device. Removal of the tray is accomplished in the same manner as heretofore described in connection with the preferred embodiment. Drawing the tray forwardly, after its removal from slot 34 in bearing 32, springs fingers 94 outwardly and releases their grip upon ball 93. Bearing 32 drops out of the path of removal into the position illustrated by broken lines 97 (Figure 6).

From the above detailed description it is evident that the invention provides a novel ice manufacturing and storing mechanism adapted for automatic operation and characterized by simplicity, economy, and adaptability to mass production.

I claim:

1. In a device of the character described, a mold having oppositely facing receptacles in thermal transfer relation with each other, associated temperature reducing means, liquid supply means, means for rotating the mold to bring said receptacles successively into position to receive liquid from said supply means, and means responsive to the rotation of the mold for actuating the supply means to deliver liquid to the receptacles.

2. In a device of the character described, a mold having oppositely facing receptacles, associated temperature reducing means, liquid supply means, an electric motor for rotating the mold to bring said receptacles successively into position to receive liquid from said supply means, a source of electrical energy, temperature responsive means in association with the mold for connecting and disconnecting the motor with said source, and means responsive to rotation of the mold for actuating the supply means to deliver liquid to the receptacles.

3. In a device of the character described, a mold having oppositely facing receptacles, associated temperature reducing means, liquid supply means, motor means for rotating the mold to bring said receptacles successively into position to receive liquid from said supply means, temperature responsive means in association with the mold for controlling operation of the motor, and means responsive to the rotation of the mold for actuating the supply means to deliver liquid to the receptacles, said receptacles being in thermal transfer relation with each other whereby a relatively elevated temperature in the liquid

delivered to one receptacle may act to release the relatively cool solidified contents of the other receptacle.

4. In an ice making machine, a mold having oppositely facing receptacles, temperature reducing means operatively associated with said mold, liquid supply means, means for rotating the mold to bring said receptacles successively into position to receive liquid from said supply means, temperature responsive means in association with the mold for controlling operation of the motor, and means responsive to the rotation of the mold for actuating the supply means to deliver liquid to the receptacle, said receptacles being in thermal transfer relation with each other whereby a relatively high temperature in the liquid delivered to one receptacle may act to release the frozen contents of the other receptacle.

5. In an ice making machine, a mold having oppositely facing receptacles, associated temperature reducing means, liquid supply means, means responsive to mold temperature for rotating the mold to bring said receptacles successively into position to receive liquid from said supply means, and means responsive to the rotation of the mold for actuating the supply means to deliver liquid to the receptacles, said receptacles being in thermal transfer relation whereby the liquid delivered to one of the receptacles may act to release the frozen contents of the other receptacle.

6. In a device of the character described, a mold having oppositely facing receptacles, associated temperature reducing means, liquid supply means, means responsive to the temperature of the mold for rotating the mold through an angle of 180° to bring one of said receptacles into position to receive liquid from said supply means and to invert the other of said receptacles, and means responsive to the rotation of the mold for actuating the supply means to deliver liquid to the receptacles.

7. In an ice making device, a mold having oppositely facing receptacles, associated temperature reducing means, liquid supply means, means responsive to mold temperature for rotating the mold through an angle of 180° to bring one of said receptacles into position to receive liquid from said supply means and to invert the other of said receptacles, and means responsive to the rotation of the mold for actuating the supply means to deliver liquid to the receptacles, said receptacles being in thermal transfer relation whereby the liquid entering one of said receptacles may reduce the temperature of the walls of the other receptacle to an extent freeing frozen contents from the latter.

8. In a device of the character described, a mold having oppositely facing receptacles, associated temperature reducing means, liquid supply means, temperature responsive means operatively associated with the mold for rotating the mold to bring one of said receptacles into an upright position for reception of liquid from said supply means and to invert the other of said receptacles, means responsive to the rotation of the mold for actuating the supply means to deliver liquid to the said upright receptacle, a container positioned for reception of the contents of the inverted receptacle, and means responsive to a predetermined weight of said contents in said container for rendering said rotating means inoperative.

9. In an ice making machine, a mold having oppositely facing receptacles, temperature re-

ducing means associated with said mold, liquid supply means, means responsive to mold temperature for rotating the mold to bring one of said receptacles into upright position for reception of liquid from said supply means and for inverting the other of said receptacles, means responsive to the rotation of the mold for actuating the supply means to deliver liquid to the said upright receptacle, the temperature of the delivery of liquid transferring through said mold to the cold surfaces of the inverted receptacle to release the ice contents therefrom, a container positioned to receive said ice, and means responsive to a predetermined weight of ice in said container for rendering said rotating means inoperative.

10. In a device of the character described, a mold having oppositely facing receptacles, associated temperature reducing means, liquid supply means, motor means for rotating the mold to bring said receptacles successively into position to receive liquid from said supply means, temperature responsive means in association with the mold for actuating the motor when the mold temperature reaches a predetermined minimum and for interrupting the operation of the motor when the temperature of the mold exceeds said minimum, and means responsive to the rotation of the mold for actuating the supply means to deliver liquid to the receptacles.

11. In a device of the character described, a mold having oppositely facing receptacles, temperature reducing means operatively associated with the mold, liquid supply means, means for rotating the mold through successive angles of 180° to bring one of said receptacles into an upright position for reception of liquid from said supply means and to invert the other of said receptacles, means responsive to a predetermined minimum mold temperature for actuating the said rotating means, and for rendering said means inoperative when the temperature of the mold exceeds said minimum, and means responsive to the rotation of said mold for actuating the supply means to deliver liquid to the receptacles.

12. In ice making apparatus, a mold having oppositely facing receptacles, temperature reducing means operatively associated with the mold, liquid supply means, mechanism operative only when the temperature of the mold is below a predetermined minimum for rotating the mold through angles of 180° to bring one of said receptacles into position to receive liquid from said supply means and to invert the other of said receptacles, and means responsive to the rotation of the mold for actuating the supply means to deliver liquid to the upright receptacle, said liquid elevating the temperature of the mold above said predetermined minimum to thereby render the rotating means inoperative and to break the bond between the frozen contents of the inverted receptacle and the surfaces of the latter so as to release the said contents from the receptacle.

13. An automatic ice making mechanism including a rotatable mold comprising oppositely facing receptacles, liquid supply means comprising a source of liquid and a control valve which when actuated delivers a predetermined quantity of liquid, means for rotating said mold to bring one of said receptacles into position to receive liquid from said supply means and to invert the other of said receptacles, and cam means associated with said mold in a manner responsive to the rotation thereof for actuating said valve

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to deliver said quantity of liquid to the upwardly facing receptacle.

14. An automatic ice making mechanism including a mold comprising oppositely facing receptacles each of said molds being divided into a plurality of cubicles having outwardly diverging side walls, a liquid supply means comprising a source of liquid and a control valve adapted when actuated to deliver a predetermined quantity of liquid, motor means for rotating said mold to bring one of said receptacles into position to receive liquid from said supply means and to invert the other of said receptacles, and cam means associated with said mold and responsive to the rotation thereof to actuate said valve.

15. An automatic ice making mechanism including a mold comprising oppositely facing receptacles each of said molds being divided into a plurality of cubicles having outwardly diverging side walls, a liquid supply means comprising a source of liquid and a control valve adapted when actuated to deliver a predetermined quantity of liquid, motor means for rotating said mold to bring one of said receptacles into position to

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receive liquid from said supply means and to invert the other of said receptacles, cam means associated with said mold and responsive to the rotation thereof to actuate said valve, and means responsive to temperature conditions within the mold for controlling the operation of said motor.

16. In a device of the character described, a mold having a plurality of receptacles, temperature reducing means operatively associated with said mold, liquid supply means, mechanism for intermittently moving the mold to bring said receptacles successively into position to receive liquid from said supply means and subsequently into a position for gravity discharge of the contents thereof, and means responsive to the movement of the mold for actuating the supply means to deliver liquid to the receptacles, said receptacles being in thermal transfer relation with each other so that the liquid received in one of said receptacles may effect an elevation of temperature in the walls of another of the receptacles to thereby aid in discharge of the contents of the latter.

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