Aug. 2, 1960 H. E. ROEDTER 2,947,156

AUTOMATIC ICE MAKER

Filed May 2, 1957

4 Sheets-Sheet 1

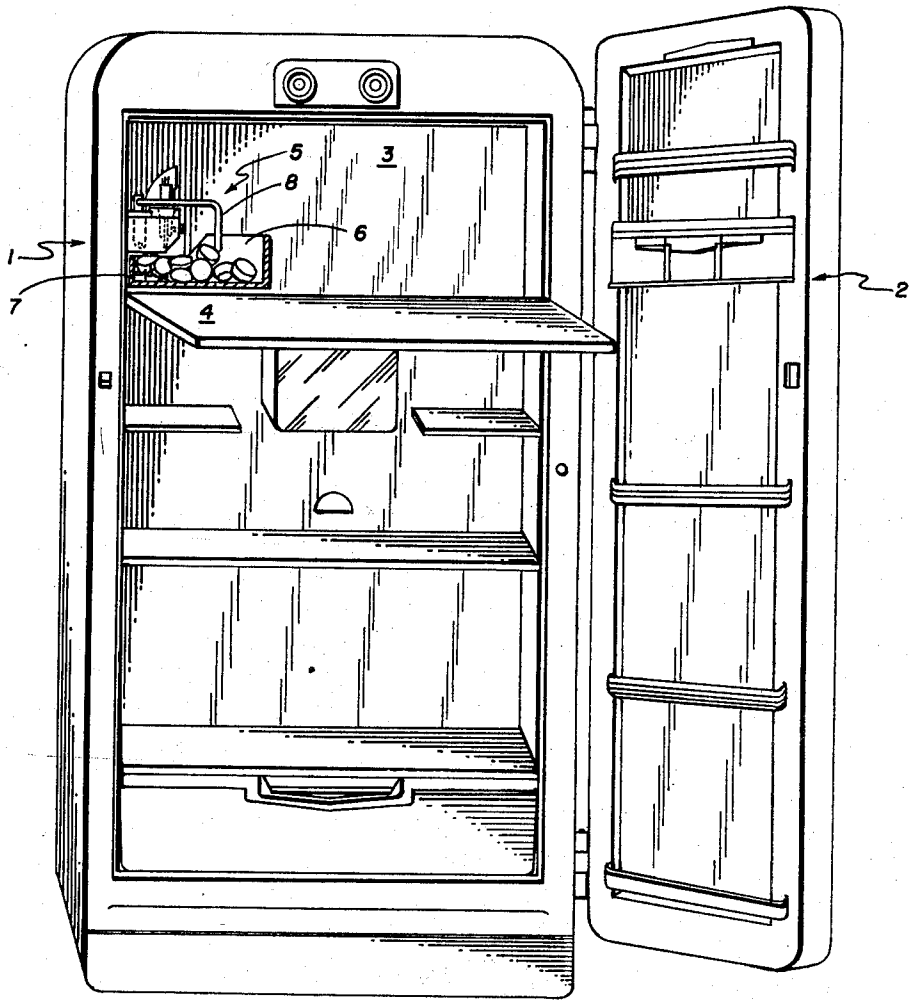


Fig 1

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AUTOMATIC ICE MAKER

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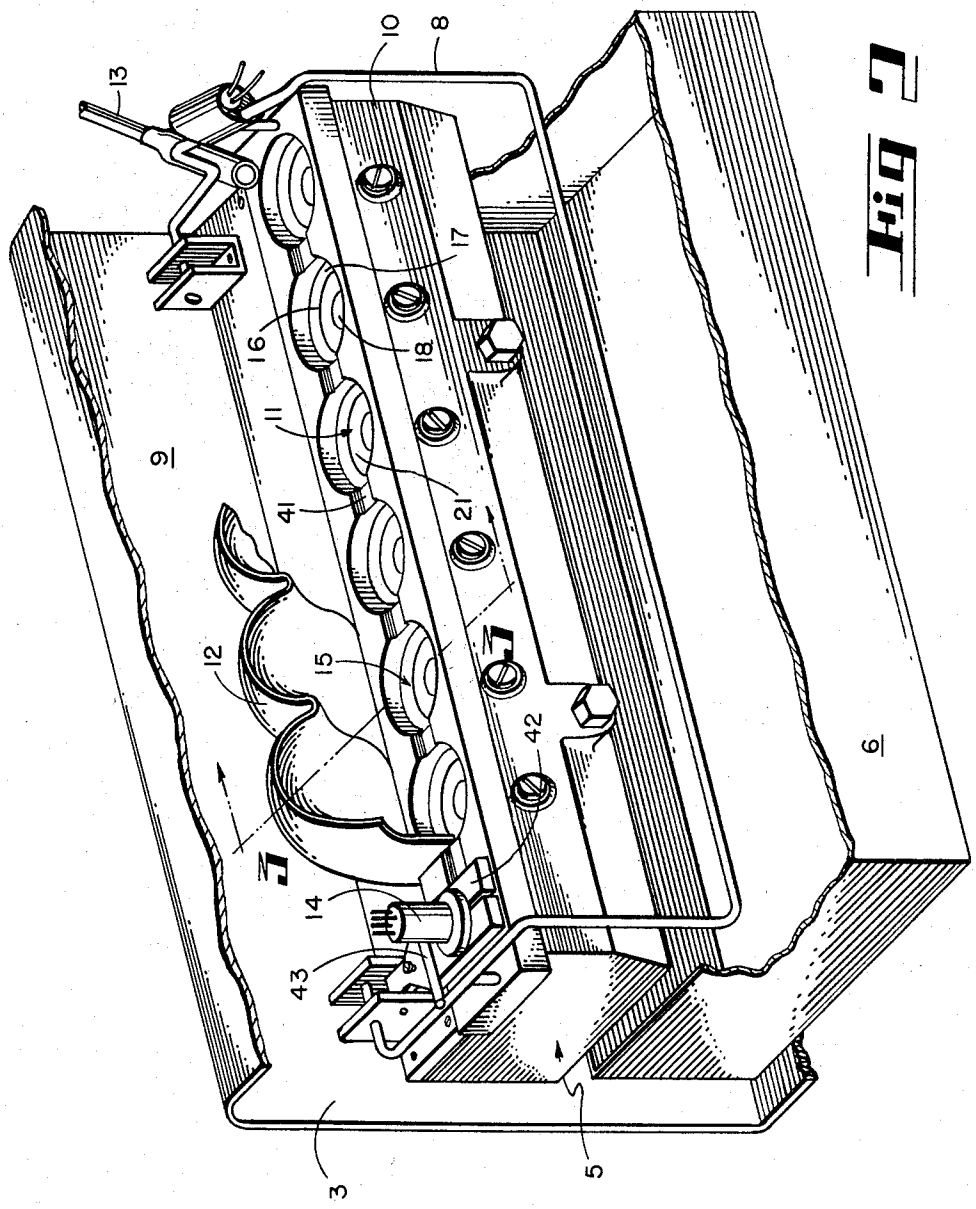


Fig. 4

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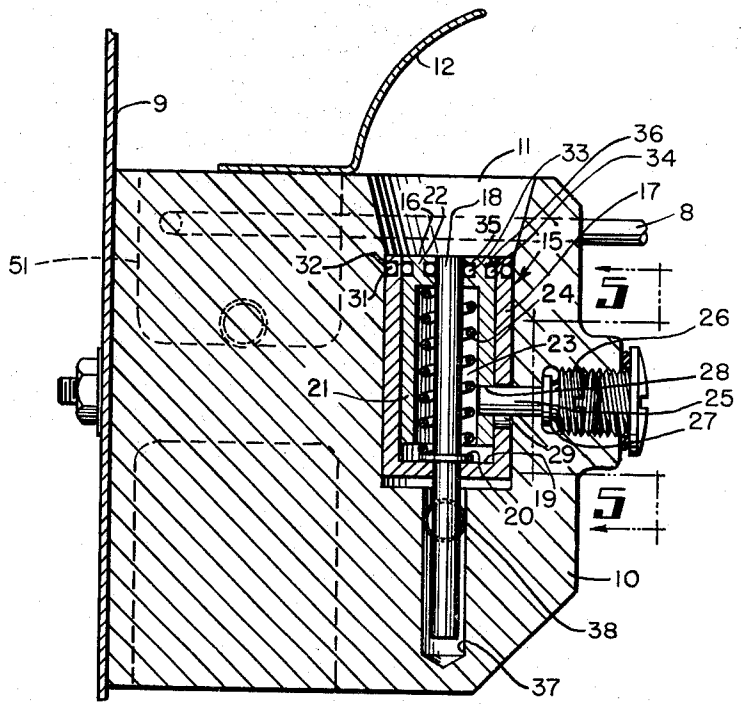


Fig 3

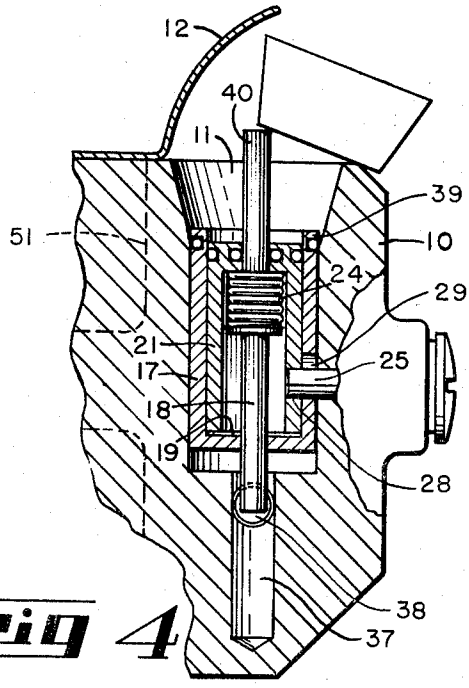


Fig 4

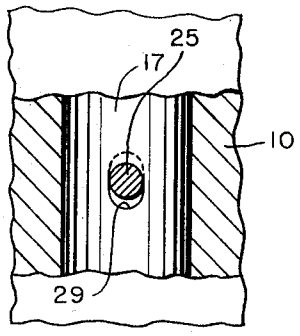


Fig 5

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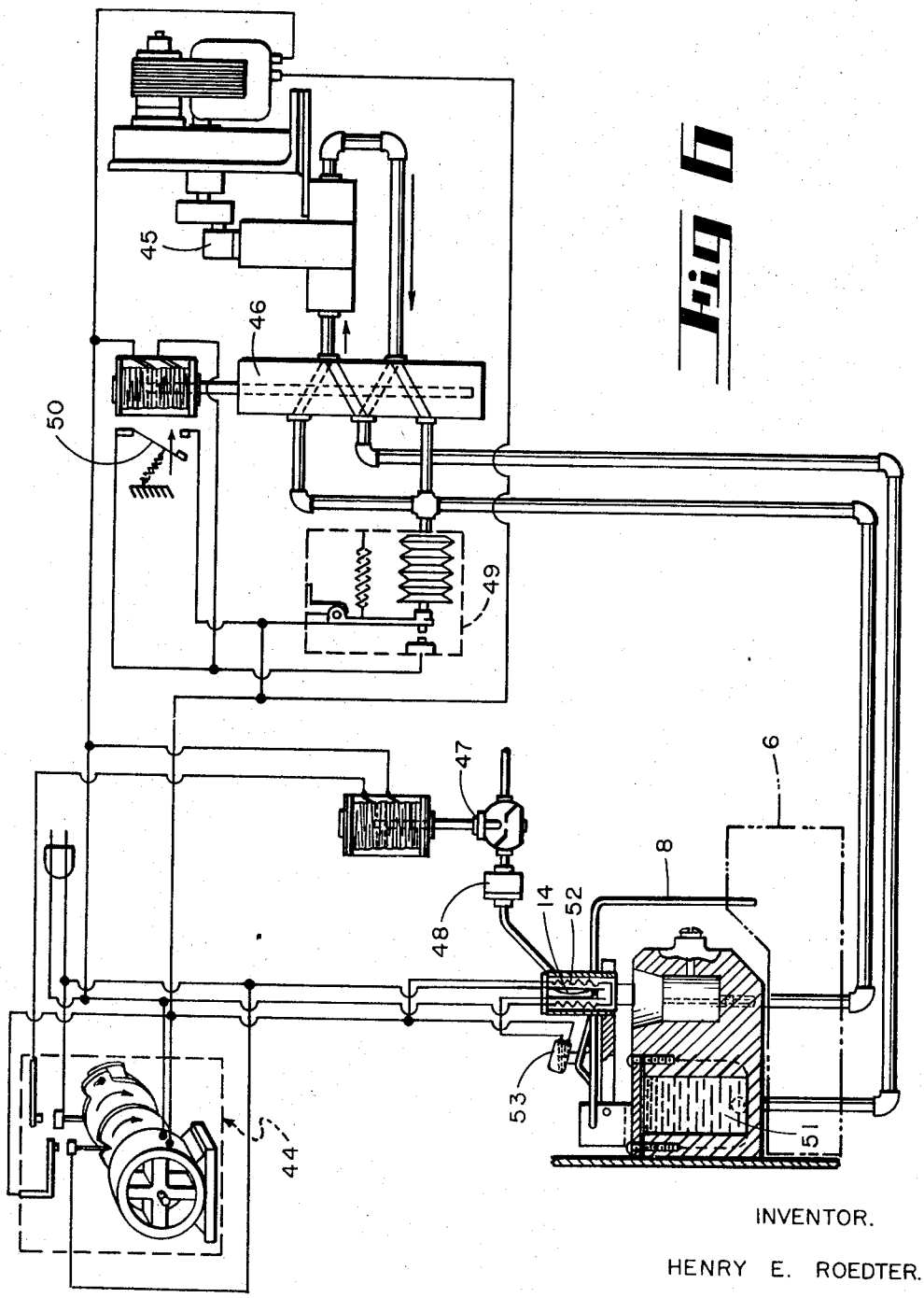
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AUTOMATIC ICE MAKER

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Fig 6



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United States Patent Office 2,947,156
Patented Aug. 2, 1960

2,947,156

AUTOMATIC ICE MAKER

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Filed May 2, 1957, Ser. No. 656,548

10 Claims. (Cl. 62—353)

The present invention relates broadly to a mechanism for making ice, and concerns more specifically an automatic ice maker adapted for installation and use in a domestic refrigerator or home freezer.

The present invention relates to that class of equipment which includes a mold for freezing liquid, such as water, which, after being frozen solid, is harvested or ejected from the mold which is subsequently filled with fresh liquid in preparation for another harvesting cycle. Ejection of solids, and filling of the mold with liquid, are automatically controlled in the present invention by an electrical system.

Briefly stated, the present invention comprises a mold which is secured to one wall of a cooled surface, such as an evaporator. The mold defines a plurality of cavities with which are associated concentric pistons forming the bottoms of the cavities. Water supplied to the cavities eventually freezes solid because of heat transfer through the mold to the cooled surface. After the ice has frozen, a thermostat makes electrical contact and energizes a pumping system which forces fluid under pressure against the pistons, thereby displacing them into the mold cavities and ejecting the ice. Guides are provided adjacent the mold cavities to direct the ice into a receptacle where it accumulates until a pivoted detector arm, associated with the automatic control system, detects that the receptacle is substantially full, at which time operation of the ice maker is terminated. The mechanism will resume operation as soon as the detector arm senses that ice has been removed from the receptacle.

After the masses of ice are ejected, the pistons are retracted to their original positions and fresh water is supplied to the cavities under the control of an electric timer.

In view of the foregoing, it will be appreciated that a fundamental object of the present invention is to provide an improved automatic ice maker, particularly one which is well adapted for use in domestic refrigeration units.

A somewhat more specific object of the invention is the provision of automatically controlled means for producing discrete masses of ice which are stored within a refrigerated unit, the means being energized automatically to maintain a constant supply of ice.

A featured object of the invention is the provision of extensible pistons which define the bottoms of mold cavities and may be extended thereinto to eject masses of ice therefrom.

A specific object of the invention is the provision of means for ejecting ice from molds which does not require application of heat to free the ice from the molds. In this connection, it is also an advantage of the invention that the ice when ejected from the molds has a dry surface so that subsequent air drying is not required.

Another specific object of the invention is to provide a pair of concentric pistons, the larger-diameter one of which develops a great force during actuation of a fluid pressure system for breaking ice loose from an associated mold cavity, the smaller-diameter one developing a lesser force for physically ejecting the ice.

A still further object comprises provision of concentric pistons, the outer one of which executes a relatively small stroke for breaking ice loose from an associated mold cavity while the inner one executes substantially greater travel for ejecting the ice from the cavity.

The novel features that I consider characteristic of my invention are set forth in the appended claims; the invention, itself, however, both as to its organization and advantages thereof, will best be understood from the following description of a specific embodiment when read in conjunction with the accompanying drawings, in which:

Figure 1 is a front elevational view of a domestic refrigerator showing my novel ice maker installed within the evaporator;

Figure 2 is a perspective view of a section of the evaporator showing the mold assembly attached thereto;

Figure 3 is a cross-sectional view through a mold cavity taken on plane 3—3 of Figure 2, showing the pistons in retracted position;

Figure 4 is a cross-sectional view taken on the same plane as Figure 3 but showing the pistons associated with the mold cavity in an extended position for ejecting ice from the cavity;

Figure 5 is a fragmentary sectional view taken on plane 5—5 of Figure 3, showing a stationary stop pin for limiting movement of the outer concentric piston; and

Figure 6 is a schematic view of the control system in association with the mold assembly.

General organization of the invention

With particular reference to Figure 1, the present invention finds utility in a domestic refrigerator, generally indicated by the reference numeral 1, although it should be understood that the invention may also be used in a home freezer or any other type of refrigerated unit in which below-freezing temperatures are attained. As illustrated in Figure 1, the refrigerator includes an access door 2 and a horizontal evaporator 3 having a separate horizontally hinged door 4 secured near its lower edge. The mold assembly of the automatic ice maker is secured at the left of the evaporator, as generally indicated at 5. It will be noted that the ice maker is positioned above a receptacle or tray 6 which receives the discrete ice masses 7 as they are ejected from the ice maker. A detector arm 8 is provided on the ice maker for detecting that the receptacle 6 is filled with ice at which time the detector arm suspends operation of the ice maker, such operation not being again resumed until ice is withdrawn from the receptacle.

Attention is now directed to Figure 2 which shows the mold assembly 5 secured to the left wall 9 of the evaporator 3. The assembly includes a mold 10 defining a plurality of cavities, generally designated 11, in which ice is frozen through heat transfer through the mold 10 to wall 9 of the evaporator. An ice guide 12 is positioned above the mold to deflect ice, ejected from the mold cavities, as will be explained, into the receptacle 6.

After ice has been ejected, which may be conveniently termed "harvested," a measured quantity of fresh water is introduced to the mold cavities through an incoming water line 13.

The fact that the water has frozen is detected by a thermostat 14 provided adjacent a mold cavity.

Structural details of the mold assembly

The structural details of the mold assembly may best be understood from a study of Figures 2 through 5.

First, with reference to Figure 2, it will be noted that each mold cavity **11** has associated with it a piston assembly, generally designated **15**. As illustrated in Figures 3 and 4, the piston assemblies serve as the bottom surfaces **16** of the mold cavities. As will be explained in greater detail later, the piston assemblies are extensible for ejecting the ice masses, but when retracted to the position illustrated in Figure 3, aid in defining the mold cavities, which have the shape of truncated cones. The conical side walls of the cavities provide sufficient draft to assure that the ice masses can be broken free from the cavities and will not be locked therein. The shape of the ice masses imparted by the cavities is pleasing and makes them well adapted for domestic use, for example, in chilling beverages.

Directing attention particularly to Figure 3, it will be noted that each piston assembly comprises an outer piston **17** and an inner concentric piston **18**. Piston **17** has an inwardly extending concentric flange **19** which is formed with a central circular aperture through which piston **18** projects. Flange **19** normally engages an outwardly extending flange **20** integrally formed on piston **18**. Disposed between the pistons is a stationary cylindrical sleeve **21**. The sleeve is formed with an inwardly extending annular flange **22** defining a central aperture which slidably engages piston **18**. Thus the sleeve and the outer piston provide spaced bearing surfaces for guiding the linear axial movement of piston **18**.

Sleeve **21** defines a cylindrical cavity **23** within which is disposed a compression coil spring **24** which bears at its lower end against flange **20** and at its upper end against flange **22**. The compressive force of this spring tends to retract piston **18** within the piston assembly at all times.

Attention should now be directed to stop pin **25** which is threadedly engaged with the mold **10** at **26**. The stop pin is formed with a flange **27** which limits its penetration into piston assembly. From a close inspection of Figure 3, it will be noted that the reduced extended portion of the stop pin tightly engages sleeve **21** at **28** and holds it stationary. In contrast, the stop pin passes freely through a vertically elongated slot **29** formed in one side wall of piston **17**. This is illustrated in detail in Figure 5. A consideration of Figures 3 and 5 will make it clear that piston **17** is limited in its vertical movements by the extent of the elongated slot **29**. The purpose of providing this slot will be discussed more fully later in the specification.

Attention may now be turned to a plurality of seal rings which mutually seal the pistons **17** and **18** with respect to the sleeve **21** and mold proper, thereby making it possible for the piston assembly to serve as the watertight bottom of the mold cavity. These seal rings may take the form of rubber rings, or O rings as they are conventionally identified. Outer ring **31**, which seats against the mold, is fitted within annular groove **32** of piston **17** whereas inner ring **33** and intermediate ring **34** are fitted within annular grooves **35** and **36**, respectively, of the sleeve. Ring **33** makes sealing engagement between piston **18** and flange **22** while ring **34** makes sealing engagement between sleeve **21** and the interior surface of piston **17**. Through provision of these seal rings the outer and inner pistons may execute vertical movements without leakage of water or actuating fluid past their sealing surfaces.

It will be noted that the lower end of piston **18** extends with clearance down into a cylindrical passage **37** to which fluid under pressure may be introduced through port **38**. By virtue of the clearance between piston **18** and passage **37** fluid may flow to the lower ends of both pistons **17** and **18**.

As will be described more fully, water may be supplied to the mold cavity where it will freeze to a solid mass. During the time period required for freezing, the piston assembly reposes in the position shown in Figure 3. At the end of the freezing period, the pistons **17** and **18** may be vertically extended to eject the ice mass, as will now be described in connection with Figure 4.

When ice is to be ejected from the mold cavity, fluid is supplied to passage **37** by way of port **38** (Figure 3). The fluid, which is under substantial pressure, acts on the lower ends of both pistons **17** and **18**. Since a relatively large surface is presented by piston **17** against which the fluid may act, very substantial forces are generated for breaking the ice loose from its cavity. When this phase of operation is occurring, pistons **17** and **18** are elevated simultaneously by an amount equal to the elongation of slot **29** in excess of the diameter of stop pin **25**. The extent of vertical movement of piston **17** is indicated at **39** (Figure 4). During this movement, flange **19** of piston **17** engages flange **20** of piston **18** and assures conjoint movement of the pistons. Thereafter, however, piston **17** can move no further because of the engagement of the bottom of slot **29** with the stop pin. The forces acting on the lower end of piston **18** continue to impart vertical movement to it thereafter until it is extended well into and above the mold cavity, as indicated at **40** in Figure 4. This movement of the inner piston forcibly and completely ejects the ice from the cavity. During the latter part of such movement the ice engages the guide **12** and falls free of the mold and into tray **6**. During upward movement of piston **18**, spring **24** is gradually compressed to its solid height, which limits further upward movement of the piston.

When the fluid pressure is relieved from beneath the pistons, spring **24**, acting on flange **20**, and thereby on flange **19**, retracts the pistons to their initial positions illustrated in Figure 3.

Certain features of the piston operation should be emphasized. For one thing, the size of the large piston **17** makes it possible to develop large forces for breaking the ice mass loose from the mold cavity. This is of basic importance since the ice may be tightly adhered to the surfaces of the cavity. The compelling forces that are available through use of the large piston make it unnecessary to apply heat to the mold cavities to free the ice as is required in other types of automatic ice makers. Secondly, by limiting the upward travel of the large piston after the ice is broken loose from the mold, working fluid is conserved, and it is merely necessary to pump a relative small quantity into passage **37** to extend piston **18** for fully ejecting the ice. Of course, relatively smaller forces are available because of the smaller area of piston **18**, but these forces are ample for ejecting the relatively light mass of ice. Thus, in summary, the piston assembly executes the necessary movement and is designed to generate large forces for breaking the ice loose and small forces for ejecting the ice, all with efficient use of the actuating fluid.

Control system

The control system does not constitute any part of the present invention and hence will be briefly described. A more detailed explanation of a system suitable for use with the present invention may be found in my United States Letters Patent 2,770,102 which isssued on November 13, 1956, entitled "Automatic Ice Maker."

In preface to the description of the over-all operation of the control system, attention is called to incoming water line **13** shown in Figure 2. It will be noted that the water line delivers water to the first mold cavity, after which the water flows through successive channels **41** to the other mold cavities, each mold cavity being completely filled before water flows into the next cavity. In this way, the cavities are filled sequentially and, after all of them are filled, the flow of water through line **13** is cut off.

Thermostat **14** is an important component of the control system since it senses that the water within its associated mold cavity is frozen and that the ice is ready for harvesting. As illustrated in Figure 2, thermostat **14** may be conveniently supported by a pivoted arm **42** di-

rectly above one of the mold cavities. When the arm is in its lowermost position, the lower end of the thermostat projects into the water content of the mold cavity so that it directly senses the water temperature. At the time the ice is ejected, the arm is cammed upward as the ice emerges from its associated mold cavity. During this movement, the arm engages a horizontal projection **43** of detector arm **8** which is pivotally secured to the mold **10**. The detector arm is first lifted and then lowered by arm **42** to assure that it comes to rest substantially on the top of the ice supply within tray **6**. After ejection of the ice, the arm resumes a normal horizontal position and the detector arm is dropped to a position resting on the ice supply. As will be explained later, the inclination of the detector arm indicates that a suitable supply of ice has been collected and is instrumental in terminating operation of the apparatus until ice is removed from the tray and further operation of the ice maker is required.

Although use of the pivoted arm **42** as a support for thermostat **14** is convenient, it is not necessary and it should be understood that the thermostat could be directly engaged with the mold **10** closely adjacent to one of the mold cavities. Heat transfer from water within the cavity would be sufficiently rapid to assure that the thermostat correctly senses temperature conditions prevailing therein. In such case arm **42** may be retained, nevertheless, for imparting movement to the detector arm **8** through projection **43**.

Briefly, the control system includes a motor driven timer **44**, a motor driven pump **45**, and a solenoid operated two-position valve **46**. This valve has a piston-supply position in which it permits the passage of fluid to the passage **37** beneath the ice-ejecting pistons, and a fluid-return position in which it permits the return of fluid to the reservoir **51**. In addition, a solenoid valve **47** for controlling admission of water to the mold cavities and a water pressure regulator **48** are provided. Also provided are a pressure switch **49** and an electrical interlock **50**, all of which elements are illustrated in Figure 6.

Harvesting of ice is initiated when thermostat **14** detects a temperature of 25° F. or less, signifying that the water has completely frozen within the cavities. When the normally open thermostat closes, the timer **44** is energized, which, in turn energizes pump **45**, which withdraws operating fluid from reservoir **51**, located in the mold **10**. The operating fluid may be a 50% solution of water and glycerine, which has a sufficiently low freezing point to assure satisfactory operation. With the valve **46** in its piston-supply position, operating fluid is withdrawn from the reservoir and pumped directly beneath the plurality of piston assemblies **15**. As has been explained, this forces the pistons into the mold cavities, breaking the ice masses loose and ejecting them into tray **6**.

During this phase of the operating cycle, heater **52** adjacent thermostat **14** raises the temperature of the thermostat and causes its contacts to open for a purpose to be described shortly.

When the pistons **17** and **18** are fully extended, pressure rises in the system until the normally open pressure switch **49** closes. This completes an electrical circuit through the solenoid of the two-position valve **46** shifting it to its dashed line position and causing the pump **45** to pump fluid from beneath the piston assemblies back into the reservoir **51**. Since this immediately relieves the pressure in the system, electrical interlock **50** is provided to hold the two-position valve in its energized dashed line position. That is to say, the interlock functions as a holding expedient to maintain the two-position valve in the fluid return position to which it was displaced by the action initiated by the momentary closure of switch **49**.

Continued operation of timer **44** energizes water control valve **47** which admits water to the mold cavities as has been explained. The solenoid of the water valve is energized only for a limited predetermined time period

and hence the flow of incoming water through regulator **48** is a function of time.

Continued operation of the timer eventually deenergizes the entire system and permits the two-position solenoid valve to return to its original piston-supply position under the influence of gravity.

Attention is now called to mercury switch **53** associated with detector arm **8**. In order for the harvesting cycle to be initiated by the closing of thermostat **14**, it is necessary for the detector arm to be in a substantially horizontal position, as will be the case if there is little or no ice in tray **6**; however, if a significant quantity of ice has accumulated the detector arm will be inclined and the mercury switch will remain open, preventing energization of the system.

Assuming that tray **6** is relatively empty, the detector arm will return to a horizontal position as soon as the ice has been ejected from the mold. If heater **52** were not provided to open thermostat **14**, the ejection cycle would be immediately repeated while water was present in the mold cavities. The heater prevents such premature operation by raising the temperature of the thermostat quickly above 25° F. and opening its electrical contacts.

Attention is called to the fact that a substantial volume of the mold cavities remains even after the piston assemblies are extended upwardly thereinto. For this reason, water can be introduced even before the pistons are fully retracted and for this reason initial energization of the water control valve **47** is not critical.

Mention has been made of spring **24** for retracting the associated pistons. In addition to the spring force, the space beneath the piston assemblies is evacuated by continued operation of the pump after the two-position solenoid valve is energized into the dashed line position. In this way, complete retraction of the pistons is assured.

It will be noted that the system has been described with reference to use of liquid. Attention is called to the fact that the system will also operate if no liquid is present. For instance, the reservoir **51** can be dry and air may be used for extending the pistons. Thus, the relatively dry air in the reservoir can be pumped beneath the pistons to extend them. Since the air within a refrigerator evaporator is normally extremely dry, use of such air will minimize condensation problems within the valve and piston assemblies.

By disposing the reservoir directly in the mold, the operating fluid, be it a liquid or dry air, is maintained at a low temperature and heating of the mold cavities and ice is avoided. This, of course, improves operating efficiency and assures that the ice ejected from the cavities will be dry so that fusion of ice stored within tray **6** will not occur.

After a harvesting cycle has been completed, the system remains inactive until the water supplied to the mold cavities again freezes and reduces the temperature of thermostat **14** to approximately 25° F., at which time the entire cycle is repeated. It will be noted that repetition of the cycle is dependent upon two factors: the temperature of the thermostat must be reduced sufficiently to close its electrical contacts; mercury switch **53** must be in a closed position which is established when the detector arm **8** is horizontal. When sufficient ice has accumulated to hold the detector arm in an inclined position, the mercury switch is tilted, breaking its circuit, and it is not possible to energize the system to harvest additional ice. Only by removal of some of the accumulated ice from tray **6** and the lowering of the detector arm can harvesting again be effected.

It is important to note that through use of the present invention an ice maker can be disposed within a refrigerator without any necessity for passing shafts through the rear wall of the cabinet as required in other prior art devices. Another feature resides in the fact that the time for freezing ice is relatively short because of the excellent heat transfer through the mold to the evaporator,

This is due to the direct contact of the water with the surfaces of the mold cavity and to the fact that the mold is made from highly conductive material, such as aluminum.

From the foregoing description of my invention, it will be appreciated that there is provided a novel form of ice maker which is simple to construct and efficient in operation. By use of this invention, a supply of ice can be readily kept on hand in a domestic refrigerator or home freezer and the need for conventional ice trays is eliminated.

Having described a preferred embodiment of my invention, I claim:

1. In an automatic ice maker of the type defining a mold cavity in its upper portion, the improvement comprising, in combination: A piston assembly disposed beneath and adjacent the mold cavity defining the bottom surface thereof, said piston assembly comprising an outer piston slidably retained by the mold and an inner piston concentrically positioned within said outer piston, said outer piston including an integral inwardly extending flange in sliding engagement with said inner piston, a sleeve disposed closely within said outer piston and having an integral inwardly extending flange at its upper end in slidable engagement with said inner piston, a stationary stop pin secured to the mold and projecting through a vertically elongated slot formed in said outer piston and into stationary engagement with said sleeve, said sleeve defining a cylindrical cavity around said inner piston, an outwardly extending flange formed integrally on said inner piston in bearing engagement with the upper face of said integral flange of said outer piston, a compression coil spring within the cylindrical cavity extending between said flange of said sleeve and said flange of said inner piston, seal rings disposed in grooves formed in said sleeve and said outer piston for sealing the relatively sliding surfaces between said outer piston and the mold, and between said sleeve and said inner and outer pistons, and means for supplying fluid pressure beneath said pistons for extending them into the mold cavity, said spring retracting said pistons out of the mold cavity upon release of the fluid pressure.

2. In an automatic ice maker of the type defining a mold cavity in its upper portion, the improvement comprising, in combination: A piston assembly disposed beneath the mold cavity, the upper end of said piston assembly constituting the bottom wall of the mold cavity, said piston assembly comprising an outer large piston and a concentric inner small piston, a stationary sleeve disposed between said pistons and formed to define guiding and sealing surfaces therefor, a compression coil spring surrounding said inner piston and exerting upward force on said stationary sleeve and downward force on said inner piston, means for transferring downward forces from said inner piston to said outer piston, means for supplying fluid under pressure beneath said pistons, and means for limiting upward movement of said large piston under the influence of fluid pressure.

3. A piston assembly for use in an automatic ice maker comprising an outer piston formed with an inwardly extending flange at its lower end, a concentric smaller inner piston in guided engagement with the flange of said outer piston, a stationary sleeve disposed between said inner and outer pistons and defining a cylindrical cavity immediately adjacent said inner piston, said sleeve having at its upper end a flange extending into guiding engagement with said inner piston, an outwardly extending flange on said inner piston normally engaging the upper face of said inwardly extending flange of said outer piston, and a compression coil spring disposed in the cylindrical cavity and bearing at its upper end against the flange of said sleeve and its lower end against said flange of said inner piston.

4. Apparatus as defined in claim 3, and in addition, resilient seal rings fitted to said flange of said sleeve and making sealing engagement with the adjacent surfaces of said inner and outer pistons.

5. In an automatic ice maker of the type defining a mold cavity in its upper portion to which water is supplied for freezing into a discrete ice mass, the improvement comprising, in combination: A piston assembly disposed immediately beneath the mold cavity, the upper end of said piston assembly comprising at least a portion of the bottom of the mold cavity, said piston assembly comprising an outer piston and a concentric inner piston, means for supplying fluid under pressure beneath said pistons to extend them into the mold cavity, means for limiting movement of the outer piston after it has broken the ice mass loose from the mold cavity, means for limiting extension of the inner piston after it has ejecting the ice from the mold cavity, and means for retracting said pistons after ejection of the ice mass.

6. In combination, a mold defining a mold cavity in its upper portion, a piston assembly directly beneath said mold cavity the upper face of which defines at least in part the bottom wall of the mold cavity, said piston assembly comprising an outer piston and an inner piston, means for supplying fluid under pressure beneath said pistons to extend them into the mold cavity, means for differentially limiting movement of said pistons upwardly into the mold cavity, and means for retracting the pistons out of the mold cavity.

7. An ice-ejector for an ice-making machine comprising, in combination: a mold defining a mold cavity within which water is frozen into a solid mass, a major ice-breaking piston formed with a piston-embracing aperture, a minor piston formed with a solid ice-ejecting end and slidably centrally positioned in said aperture, a stop for limiting relative displacement of the pistons away from a normal positional relationship, means for biasing said pistons into such relationship, said pistons defining a surface of said cavity, and means for supplying fluid under pressure to extend the pistons into the cavity, the last mentioned means applying fluid directly to said pistons.

8. In a machine for making ice cubes, said machine being of the type which includes an evaporator, the combination of: a mold in heat transfer relationship with said evaporator and defining a plurality of mold cavities within which water is frozen into solid masses, each mold cavity being formed with an open upper portion, means for introducing into said cavities and through said upper portions water to be frozen, a plurality of ice ejecting pistons individually mounted for movement in relation to the mold cavities and retractably positioned to constitute a fractional portion of the bottom surface of each mold cavity, individual concentric means constituting the remaining portion of the bottom surface of each mold cavity for water-tightly but slidably sealing the pistons, each piston being formed on one side with a closed surface and on the other side with a surface, isolated from the associated cavity, to which fluid under pressure is directly applied, means for supplying such fluid, and means for sensing the presence of frozen cubes in the cavities and actuating the supply means.

9. In an ice cube making machine, the combination in accordance with claim 8 in which each piston has a projected position extending into its associated cavity and a retracted position, individual means for normally biasing each piston into its retracted position, and stop means for limiting the projection of the piston into the associated cavity.

10. In a machine for making ice cubes, said machine being of the type which includes an evaporator, the combination of: a mold in heat transfer relationship with said evaporator and defining a plurality of mold cavities within which water is frozen into solid masses, each mold cavity being formed with an open upper portion, means for introducing into said cavities and through said upper portions water to be frozen, a plurality of pistons in-

dividually mounted for movement in relation to the mold cavities and retractably positioned to constitute a fractional portion of the bottom surface of each mold cavity, individual concentric means constituting the remaining portion of the bottom surface of each mold cavity for water-tightly but slidably sealing the piston means, each piston means being formed on one side with a closed surface and on the other side with a surface, isolated from the associated cavity, to which fluid under pressure is directly applied, and means for supplying such fluid.

References Cited in the file of this patent

UNITED STATES PATENTS

1,870,370 Marchaut ---------- Aug. 9, 1932
2,138,058 Bauer ---------- Nov. 29, 1938
2,374,997 Hill ---------- May 1, 1945
2,471,655 Rundell ---------- May 31, 1949
2,488,581 Cherry et al. ---------- Nov. 22, 1949
2,522,651 Van Vleck ---------- Sept. 19, 1950
2,639,594 Watt ---------- May 26, 1953
2,763,996 Lees ---------- Sept. 25, 1956
2,770,102 Roedter ---------- Nov. 13, 1956
2,799,144 Barton ---------- July 16, 1957
2,808,707 Chase ---------- Oct. 8, 1957