

Oct. 29, 1968

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3,407,619

ICEMAKER

Filed Nov. 21, 1966

3 Sheets-Sheet 1

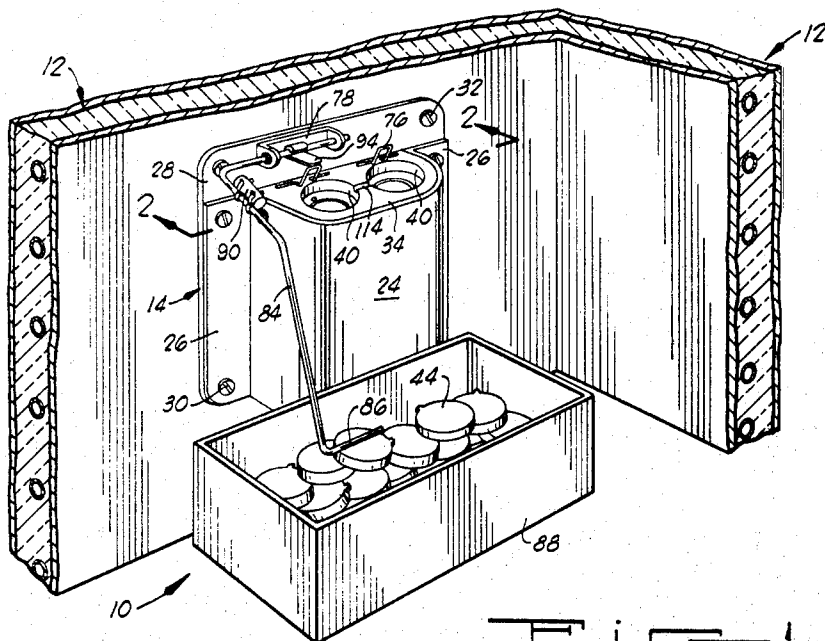


FIG. 1

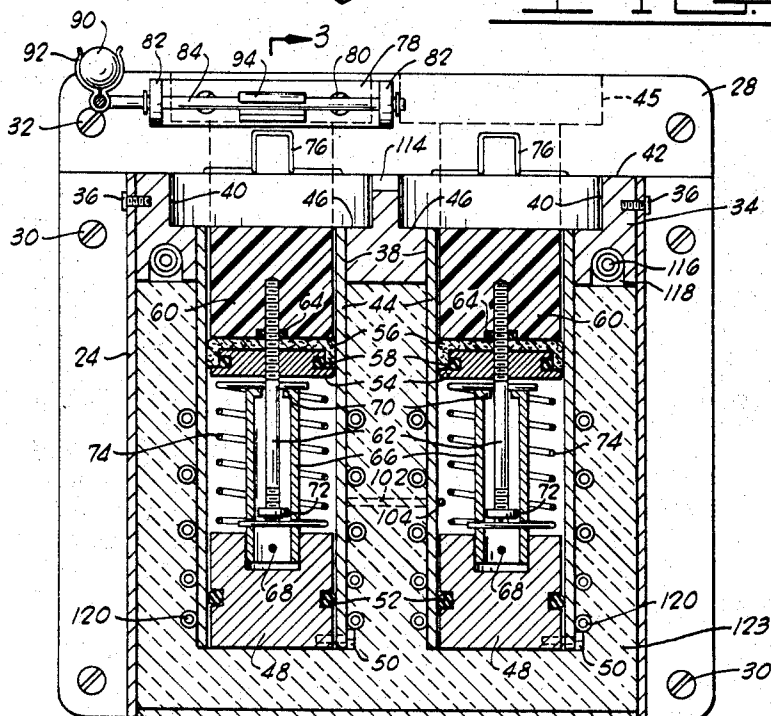


FIG. 2

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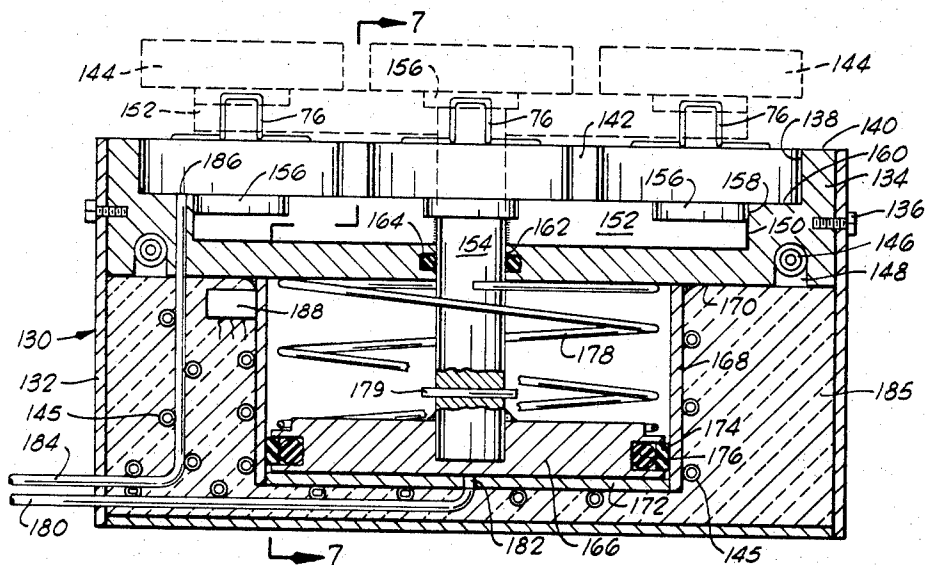
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ICEMAKER

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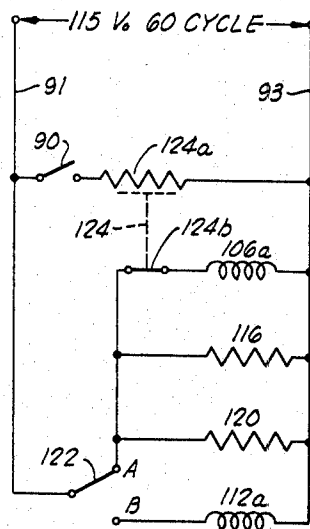
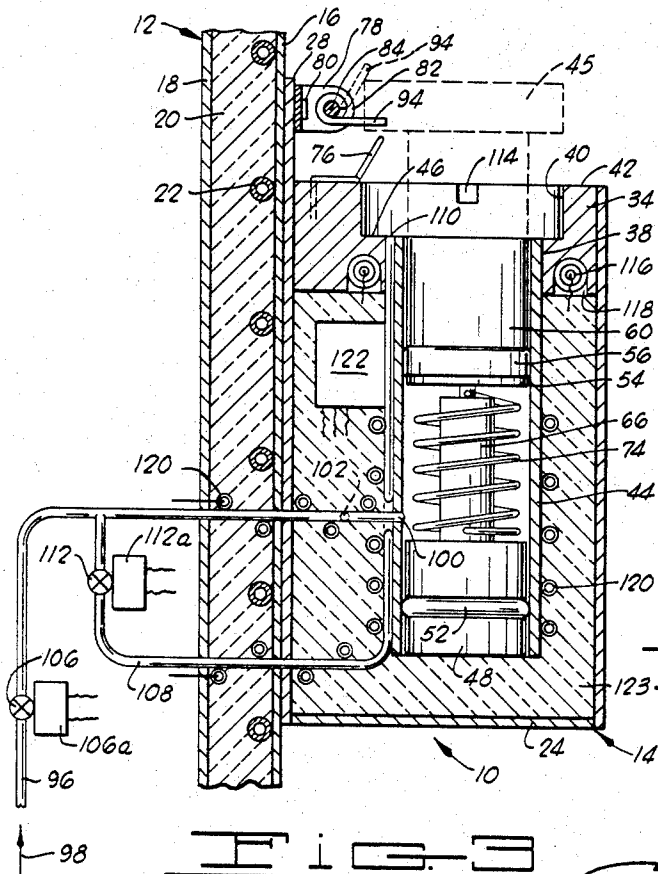


Fig. 4

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3 Sheets-Sheet 3

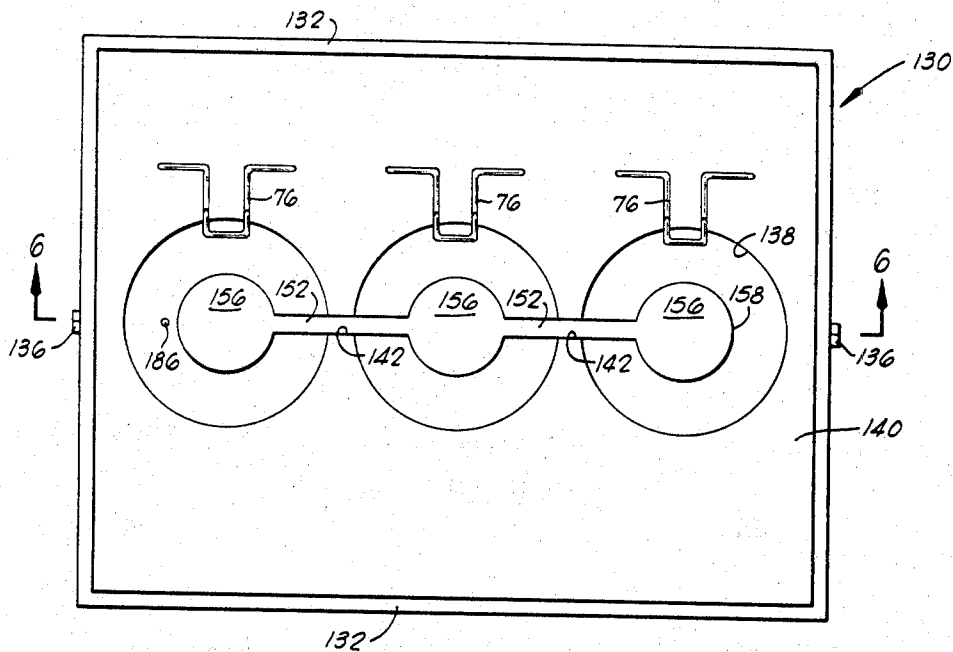


FIG. 5

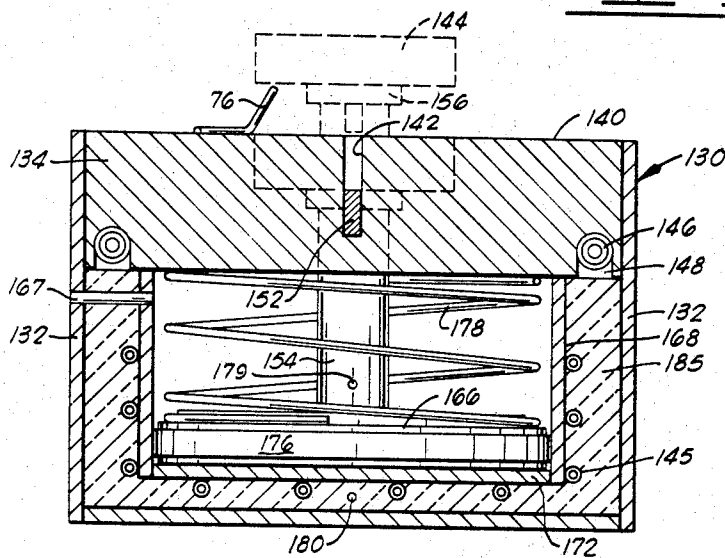


FIG. 7

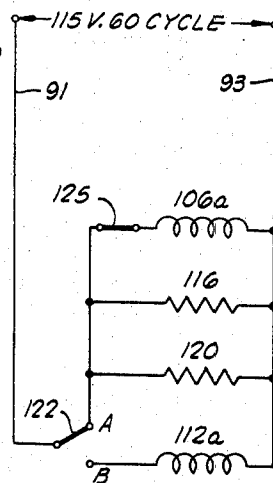


FIG. 8

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3,407,619

ICEMAKER

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Continuation-in-part of application Ser. No. 544,608,
Apr. 22, 1966. This application Nov. 21, 1966, Ser.
No. 595,853

5 Claims. (Cl. 62—137)

ABSTRACT OF THE DISCLOSURE

An automatic icemaker for producing ice cubes in household refrigerators or the like. The ice cubes are ejected from the molds by pistons actuated by the household water supply, and the water used for powering the pistons is then directed into the molds for formation of additional ice cubes. Each piston raises its ice cube above the mold against a spring-loaded finger and then lowers the ice cube against the finger until the finger breaks the ice cube away from the piston, whereby the ice cube is pushed from above the mold to fall freely into an ice container positioned alongside the mold.

This is a continuation-in-part of applicant's copending application, entitled Hydraulic Ice Maker, Ser. No. 544,608, filed Apr. 22, 1966, now abandoned.

This invention relates to improvements in icemakers of the type powered by a source of water under pressure, such as a household water supply system.

An icemaker, such as an icemaker of the type installed in a refrigerator or freezer, has been designed in the past to utilize the pressure of a water supply for partially powering the device. However, such prior device requires the use of a harvester powered by a separate energy source in order to provide a complete icemaking operation. Further, the prior icemaking device utilizes pressurized water applied directly to the bottom of the ice formed in a mold to eject the ice partially from the mold; whereupon the ejected portion of the ice is harvested by the above mentioned harvester. As will be appreciated by those skilled in the art, ice formed in a mold must be partially thawed in order to be ejected from the mold with a reasonable amount of force, and such thawing produces a space between the outer periphery of the ice and the inner periphery of the mold. When the pressurized water is applied directly to the bottom of the ice for ejection from the mold, the water tends to bypass the ice, resulting in either no ejection of the ice or an inefficient and incomplete ejection of the ice. In fact, such a system is normally designed to provide only a partial ejection of the ice from the mold in an effort to minimize the spraying of water into the refrigerator or freezer.

The present invention contemplates a novel icemaker which may be equipped with its own refrigeration system or which may be installed in a relatively large refrigerated compartment, such as a home refrigerator or freezer. Stated broadly, the present invention comprises a mold for containing the water to be frozen, and an ejector for contact ejection of the ice from the mold when the ice is partially thawed and released from the mold. The ejector is motivated by the pressure of the water supply, and subsequently, the quantity of water used for operating the ejector is rerouted to refill the mold. The body of ice ejected from the mold is harvested by a simple spring-loaded finger energized, first by the ejector through the medium of the ejected ice body, then, pressed against the lower side of the ice body by an ejector recoil means, to harvest the ice body into a receiving bin, such that the motivating power used for operating the device is derived

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solely from the pressurized water supply. The electric power required is for energizing the control system used for making the device automatic and rendering the device inoperative when the desired amount of ice has been produced.

An object of the invention is to provide an icemaker motivated solely by the pressure of the supply water used for forming the ice, to harvest the ice and refill the mold, as contrasted with an icemaker requiring an electric motor or the like for operating power.

Another object of the invention is to automatically produce uniformly formed ice bodies with a minimum possibility of spraying water into the refrigerated space in which the ice bodies are being produced.

Another object of this invention is to automatically provide a supply of uniform ice bodies in an ice bin and automatically replenish such supply when the ice bodies are removed from the bin.

A further object of this invention is to provide an icemaker which may be constructed in varying sizes to produce a single or any number of ice bodies during each cycle of operation.

A still further object of this invention is to provide an icemaker which is economical in construction and will have a long service life.

Other objects and advantages of the invention will be evident from the following detailed description, when read in conjunction with the accompanying drawings which illustrate the invention.

In the drawings:

FIG. 1 is a perspective view of a portion of a refrigerated space illustrating my novel icemaker installed therein.

FIG. 2 is a vertical sectional view taken substantially along lines 2—2 of FIG. 1.

FIG. 3 is a sectional view taken substantially along lines 3—3 of FIG. 2 with portions of the parts shown in elevation for clarity of illustration.

FIG. 4 is a wiring diagram of the control system utilized in the icemaker shown in FIGS. 1—3.

FIG. 5 is a plan view of a modified icemaker.

FIG. 6 is a vertical sectional view of the modified icemaker taken substantially along lines 6—6 of FIG. 5.

FIG. 7 is a sectional view taken substantially along lines 7—7 of FIG. 6.

FIG. 8 is an alternate wiring of the control system utilized in the icemaker shown in FIG. 1—3.

Referring to the drawings in detail, and particularly FIG. 1, reference character 10 generally designates the refrigerated space of a refrigerator or freezer having typical side walls 12 and containing the novel icemaker 14 of this invention secured to one of the side walls 12.

As shown in FIG. 3, a typical refrigerator side wall 12 comprises an inner wall 16 and an outer wall 18 separated by a suitable insulation 20. The pipes or conduits 22 of the refrigeration system for the refrigerator or freezer are normally embedded in the side wall 12 adjacent the inner wall 16 for maintaining the space 10 at a temperature below freezing.

The icemaker 14 comprises a housing 24 (FIG. 1) open at its upper end and formed out of a sheet of suitable heat conducting metal, such as aluminum, to provide mounting flanges 26 on the opposite sides thereof. The flanges 26 are suitably secured to a mounting plate 28 by screws or the like 30. The mounting plate 28 is also formed out of a heat conducting metal, such as aluminum, and is suitably secured to the inner wall 16 of the side wall 12 by screws 32 or the like.

As shown in FIGS. 2 and 3, a head piece or mold member 34, conforming in size and shape to the interior of the housing 24, is secured in the upper end of the housing by suitable screws 36. The head piece 34 is

formed of a metal having a high heat conductivity, such as aluminum, and is provided with a pair of bores 38 extending vertically therethrough in side-by-side, but spaced relation. A counterbore 40 is formed in the upper end 42 of the head piece 34 in communication with each of the bores 38, but slightly eccentrically with respect to the center line of the respective bore 38. The eccentricity of each counterbore 40 is shown in FIG. 3 where it will be observed that the center line of the counterbore 40 is closer to the mounting plate 28 than is the center line of the respective bore 38. Each counterbore 40 forms the portion of a mold cavity which receives the water to be frozen into an ice body 45, as will be more fully set forth below.

A sleeve or cylinder 44 made of suitable metal, such as aluminum, is suitably secured in each bore 38 with the upper end of the respective cylinder 44 terminating even with the bottom 46 of the respective counterbore 40. Each cylinder 44 extends a substantial distance below the head piece 34 and effectively forms a continuation of the mold formed by the respective counterbore 40. The lower end of each cylinder 44 is closed by a plug 48 secured therein by one or more screws 50. Each plug 48 is provided with a suitable O-ring seal 52, such as neoprene, in a mating groove around the outer periphery of the plug to assure that the lower end of each cylinder 44 is liquid pressure tight, for purposes to be described.

A piston 54, formed of metal or the like, is reciprocally disposed in each cylinder 44 and is slidably sealed to the inner periphery of the respective cylinder by a downwardly facing leather cup 56 urged outwardly by an O-ring 58, formed of neoprene or the like, mounted in a mating groove around the outer periphery of the piston 54. Each piston 54 is also provided with an ice ejecting portion 60 on the upper end thereof. Each ice ejecting portion 60 extends from the respective leather cup 56 upwardly to the level of the bottom 46 of the respective counterbore 40 when the piston is in its lowermost position as illustrated in FIG. 2 to effectively form a continuation of the bottom 46 of the respective counterbore 40 in this position of the piston. It should also be pointed out that each ice ejecting portion 60 is preferably formed of a material having a lower thermal conductivity than the head piece 34. Teflon has been found to be a suitable material for each ice ejecting portion 60. Each piston 54 and its associated cup 56 and ice ejecting portion 60 are held in assembled relation by a rod 62 threaded to these members and extending downwardly from the respective piston 54. It may also be noted that an O-ring 64, of Neoprene or the like, is provided in a mating groove in the lower end of each ice ejecting portion 60 around the respective rod 62 to minimize the possibility of fluid leakage between the adjacent parts.

Each rod 62 extends partially through a guide tube 66 anchored in a mating recess in the upper end of the respective plug 48 by means of cross pins 68 or the like. The upper end of each guide tube 66 is provided with an inwardly extending flange 70 of a size to engage a head 72 secured on the lower end of the respective rod 62 and thereby limit the upward movement of the respective piston 54 to a point within the upper end of cylinder 44, as will be more fully set forth below. A helical tension spring 74, formed from stainless steel or the like, surrounds each guide tube 66 for the purpose of continually urging the respective piston 54 downwardly in the respective cylinder 44, as will be set forth more fully below. The upper end of each spring 74 extends through a mating aperture in the guide rod 62, to thereby be effectively secured or anchored to the respective piston 54, and the lower end of each spring 74 extends through a mating aperture in the guide tube 66 to thereby anchor the lower end of the respective spring in a fixed position and also provide a stop for the lower end of the respective rod 62 to limit the downward movement of the respective piston 54.

A U-shaped, spring-loaded finger 76 is anchored to the top 42 of the head piece 34 adjacent each of the counterbores 40. It will be observed that each finger 76 is positioned between the respective counterbores 40 and the support plate 28 and extends from the top 42 of the head piece 34 upwardly at an angle to position the upper end of the finger over the respective counterbore 40 when the finger is in a relaxed position as illustrated in each of FIGS. 1, 2 and 3. Each finger 76 is positioned to be actuated by the upward and downward movement of an ice body 45 ejected from the respective counterbore 40 to harvest the ice body, as will be set forth more fully below.

A bracket 78 is secured to the support plate 28 by suitable screws or the like 80 and is provided with arms 82 at the opposite ends thereof extending outwardly from the support plate 28 on opposite sides of one of the counterbores 40. A rod 84 is journaled in the bracket arms 82 and extends from one of the arms 82 outwardly and then downwardly at an angle. The lower end 86 (FIG. 1) of the rod 84 is turned horizontally at substantially 90° and is positioned in an ice receiving bin 88 suitably supported in the refrigerated space 10. A mercury bin switch 90 is mounted on the rod 84 by suitable clips 92 in a position to close a circuit and render the icemaker 14 inoperative at certain times, as will be set forth more fully below. Also, an arm 94 is secured to the rod 84 in a position to slightly project over one of the counterbores 40 to be engaged and raised, as indicated by dashed lines, by an ice body 45 ejected from the respective counterbore 40 for operation of the respective switch 90, as will be set forth more fully below.

As shown in FIG. 3, a conduit 96, connected to a source of water under pressure schematically indicated by the arrow 98, extends through the side wall 12 of the refrigerator or freezer into connection with a port 100 formed in one of the cylinders 44 between the respective plug 48 and the lowermost position of the respective piston 54 to direct the water supply into the respective cylinder 44 and raise the respective piston 54 during a portion of one cycle of operation of the icemaker 14, as will be described. A branching conduit 102 is connected to the conduit 96 adjacent the port 100 and extends into connection with a port 104 (FIG. 2) located in a similar position in the other cylinder 44, such that the same water supply pressure will be simultaneously applied to both of the pistons 54. A control valve 106, operated by a solenoid 106a, is interposed in the conduit 96 upstream from the connection of the branching conduit 102 to control the application of the water supply pressure through the conduits 96 and 102.

A second branching conduit 108 is connected to the conduit 96 between the valve 106 and the branching conduit 102. The branching conduit 108 extends through the side wall 12 of the refrigerator or freezer and then upwardly along the side of one of the cylinders 44 into connection with a port 110 located at the bottom 46 of one of the counterbores 40. A control valve 112, controlled by a solenoid 112a, is also interposed in the conduit 108. It will thus be seen that when the valve 112 is open, the valve 106 is closed, and the pistons 54 are moved downwardly by the springs 74, water will be forced from the cylinders 44 through the branch conduit 102, the conduit 96 and the conduit 108 upwardly into one of the counterbores 40. Water flows from this counterbore 40 through a channel 114 formed in the top of the head piece 34 into the other counterbore 40. It should at this point be noted that the relative sizes of the cylinders 44 and counterbores 40 are such that the volume of water displaced by the complete downward movement of each piston 54 is less than the volume of the respective counterbore 40. The excess volume of counterbore 40 over the cylinder displacement is provided for the residual water remaining from the previous ice thawing and ejection cycle. Thus, the amount of water displaced from the

cylinder 44 by the downwardly moving pistons 54, plus the residual water remaining in the counterbore 40, substantially refills the counterbores for a subsequent freezing portion of each cycle, and no water is spilled into the refrigeration space 10. The control circuitry for the solenoid valves 106 and 112 will be described below.

As shown in both FIGS. 2 and 3, an electric heater 116, preferably of the cartridge type, is suitably secured in a mating slot 118 in the bottom of the head piece 34. The heater 116 extends around both of the bores 38 a sufficient extent to effectively heat the walls of the counterbores 40 and the upper end portions of the cylinders 44 by conduction through the material of the head piece 34 when the heater is energized and thereby partially thaw and release ice formed in the counterbores 40, as well as release the ejecting portions 60 and pistons 54, as will be set forth more fully below. Another electric heater 120 is wound around the lower end portions of the cylinders 44, as well as around the conduits 96, 102 and 108, to prevent water freezing in these portions of the icemaker 14 and thus fouling operation of the device. A thermostat 122 is suitably secured to the side of one of the cylinders 44 along an intermediate portion of the cylinder below the head piece 34 to control the operation of the solenoid valves 106 and 112 and the heaters 116 and 120 to provide an automatic cycling of the device. The thermostat 122 may be a conventional SPDT bi-metallic disc-type which provides immediate change from one pole to the other in response to sensing predetermined temperature levels. This type of thermostat is readily available on the market.

Suitable insulating material 123 fills the remainder of the housing 24 between the head piece 34 and the bottom of the housing.

The various control components are connected through lines 91 and 93 to an electrical source such as a conventional household power supply, as illustrated in FIG. 4. The solenoid 112a is connected in series with one terminal B of the thermostat 122. The thermostat 122 switches to the terminal B when heated to a predetermined temperature and switches to terminal A when cooled to a predetermined temperature. The solenoid 106a and the heaters 116 and 120 are connected in parallel with the terminal A of thermostat 122. The bin switch 90 is connected in shunt around the thermostat 122 and the shunt contains a heater coil 124a arranged to open a heat responsive bimetallic leaf type switch 124b connected in series with the solenoid 106a after a predetermined delay following closure of the bin switch 90, as will be described below. The combination of heater coil 124a and switch 124b form a conventional thermal delay switch 124, readily available on the market. It may be noted at this point, however, that the thermal delay switch 124 is operative only to control the flow of current through the solenoid 106a and has no effect on the operation of the heaters 116 and 120.

Operation

In reviewing the operation of the icemaker 14, let it be assumed that the pistons 54 are in their lowermost positions as illustrated in FIGS. 2 and 3; ice has been frozen in each of the counterbores 40, and the thermostat 122 has just reached a sufficiently cold temperature to switch to terminal A as shown in the wiring diagram of FIG. 4. Thus, the heaters 116 and 120 are energized to thaw any possible ice which may have formed in the lower portions of the cylinders 44 or in the various conduits associated with the heater 120, as well as partially thaw and release the ice from the walls of the counterbores 40. Simultaneously, it will be observed that the solenoid 112a is de-energized to provide a closing of the control valve 112, and the solenoid 106a is energized to open the control valve 106. Thus, the pressure of the water supply 93 is exerted through the conduit 96 and the branching conduit 102 into the cylinders 44 through the respective ports 100

and 104 below the pistons 54. As soon as the ice is released from the walls of the counterbores 40, the pistons 54 will be raised by the supply water pressure to move the ice upwardly to become ice bodies 45, shown as dashed lines in FIGS. 2 and 3. It may also be noted at this point that the upward movement of pistons 54 is stopped within the upper end of cylinders 44 when the head 72 on each rod 62 engages the respective flange 70 at the upper end of the respective guide tube 66.

During the upward movement of each ice body 45, the ice body deflects the respective spring-loaded finger 76 toward the mounting plate 28 until the ice body clears the finger 76. The spring-loaded spring 76 then regains its relaxed position beneath the ice body 45, as shown in FIGS. 2 and 3. The above action is made possible by virtue of the fact that the piston ejector portions 60 are not heated to the same degree as the walls of the counterbore 40 due to the thermal characteristic differences of the materials. Therefore, the ice bodies 45 tend to adhere to the piston ejector portions 60, after being ejected from the counterbores 40.

As one of the ice bodies 45 moves past its respective finger 76, it engages and raises the arm 94 to turn the rod 84, as indicated by the dashed lines in FIG. 3. Thus, as the ice bodies 45 are raised above the fingers 76, the bin switch 90 is closed to energize the heater coil 124a shown in the wiring diagram of FIG. 4. However, the time delay required for the heat produced by the heater coil 124a to open the switch 125b is normally longer than the length of time the ice bodies 45 will be held in their upper positions, as will be set forth more fully below.

During the ejection of the ice bodies 45, the heaters 116 and 120 continue to be energized to further raise the temperature of the cylinder 44 and the thermostat 122. The thermostat 122 is adjusted to where it will not switch to terminal B until after the ice bodies 45 have had sufficient time to be raised to the positions shown in dashed lines in FIG. 2 and 3. When the thermostat 122 does switch to terminal B, it will be observed that the solenoid 106a is de-energized to close the control valve 106 and thereby stop the further application of the water supply pressure to the pistons 54. Simultaneously, the heaters 116 and 120 are de-energized, and the solenoid 112a is energized to open the control valve 112. Thus, the return springs 74 will start moving the pistons 54 downwardly and force water from the cylinders 44 through the conduit 96 and the branching conduit 102 into and through the branching conduit 108. The water thus forced through the conduit 108 will flow into one of the counterbores 40 and start filling this counterbore during the downward movement of the pistons 54. When the water level in the counterbore 40 associated with the conduit 108 is partially filled, water will start flowing through the channel 114 into the other counterbore 40. As previously stated, when the pistons 54 reach their lowermost positions, which may be governed either by the upper end of each spring 74 contacting the upper end of the respective guide tube 66 or the lower end of each rod 62 contacting the lower end of the respective spring 74, the counterbores 40 will both be substantially filled with water for a new freezing cycle. It may also be noted at this point that the upper end of each piston ejector portion 60 stops at a level with the bottom 46 of the respective counterbore 40 to provide a continuation of the bottom of the respective counterbore and thus form a uniform shaped ice body therein.

As the ice bodies 45 are lowered through the lowering of the pistons 54 as previously described, each ice body 45 will engage the upper, free end of the respective spring-loaded finger 76 and deflect the fingers 76 downwardly. As previously mentioned, each ice body 45 will tend to adhere to the upper end of the respective piston ejector portion 60 and thus provide a moderate amount of force on the springs 76. However, the tension of each spring-loaded finger 76 is adjusted to break the respective ice body 45 from the upper surface of the respective piston

ejector portion 60 sometime during the downward deflection of the fingers. The fingers 76 will then effectively throw the ice bodies 45 away from the top 42 of the head piece 34. The ice bodies 45 will therefore be harvested into the bin 88 as shown in FIG. 1.

When the pistons 54 have reached their lower positions as illustrated in FIGS. 2 and 3, it will be recalled that the heaters 116 and 120 are de-energized, such that the water in the counterbores 40 will be frozen by virtue of the refrigeration in the refrigerated space 10. When the thermostat 122 is cooled to a predetermined temperature below freezing by heat conduction through cylinder 44, the thermostat 122 will again switch to terminal A and the cycle of ejection, harvesting and freezing will be started again.

When the bin 88 has been filled with ice bodies 45, they will prevent return of the rod 84 to its normal lower position by virtue of the contact between the lower end 86 of the rod and the ice bodies 45. When this occurs, the bin switch 90 will be retained in a closed position to energize the heater coil 124a (FIG. 4) a sufficient period of time to heat and open the switch 124b. The switch 124b will be retained in an open position until ice bodies 45 are removed from the bin 88, which assures that the solenoid 106a will not be energized to open the control valve 106 and impose the pressure of the supply water on the lower ends of the pistons 54. Thus, even though the thermostat 122 will continue cycling the heaters 116 and 120, the ice maker 14 will be retained in an inoperative condition. As soon as ice bodies 45 are removed from the bin 88, allowing the end 86 of rod 84 to swing downwardly a sufficient distance to again open the bin switch 90, which in turn closes thermal switch 124, again placing solenoid 106a in the circuit with the heaters 116 and 120, the ice maker 14 will resume normal cycles of freezing, ejection and harvesting of ice bodies.

As previously mentioned, the heater coil 124a is normally not heated to a sufficient degree to open the switch 124b unless the bin switch 90 is retained closed by the filling of the bin 88 with ice bodies 45. Thus, the switch 124b will normally not be opened when the ice maker 14 is in the process of producing ice. However, a momentary opening of the switch 124b would not interfere with the operation of the icemaker, since the switch 124b will not be opened until after the ice bodies 45 are raised above the spring-loaded fingers 76. The shunt circuit with bin switch 90 and thermal switch 124 is preferred in my icemaker when it is designed to produce two or more ice bodies at a time. However, I have obtained good results with an alternate arrangement as shown in FIG. 8, by using a normally closed mercury switch 125 mounted on arm 84 in place of switch 90 shown in FIGS. 1, 2 and 3. With this arrangement, the last fraction of an inch of upward movement of the ice body 45 moves the arm 94 and rod 84 to open mercury switch 125 and de-energize the solenoid 106a to open valve 106. Since this action occurs after the ice bodies 45 are raised above the spring-loaded fingers 76, the balance of the ejection cycle continues in a normal manner as previously described. Similarly to the use of the bin switch 90, when the bin 88 has been filled with ice bodies 45, they will prevent return of the rod 84 to its normal lower position by virtue of the contact between the lower end 86 of the rod and the ice bodies 45. When this occurs, the bin switch 125 will be retained in an open position to de-energize the solenoid 106a and prevent valve 106 from opening, rendering the icemaker inoperative until ice bodies 45 are removed from the bin 88 and allow arm 86 and rod 84 to resume normal position.

Embodiment of FIGS. 5, 6 and 7

The modified icemaker 130 illustrated in FIGS. 5, 6 and 7 comprises a housing 132 of suitable material, such as a metal of high heat conductivity, suitably shaped for mounting on the side wall of a refrigerator or freezer,

as in the embodiment previously described, or may be simply placed on the bottom of a refrigerated space. The housing 132 contains a head piece or mold member 134 in the upper end thereof which is secured in the housing in the desired position by screws or the like 136. The mold member 134 is formed of a metal of high thermal conductivity, such as aluminum, and is provided with a plurality of mold cavities 138 in the top 140 thereof. The cavities 138 may be of any desired configuration, such as circular as shown, and are interconnected by slots or channels 142 for purposes to be described. Also, a spring-loaded finger 76 of the design previously described is secured in the top 140 of the mold member 134 adjacent one side of each cavity 138 to harvest ice pieces 144 formed in the cavities 138 as well be described. A heater 146, preferably a cartridge type electric heater, is mounted in a mating slot 148 in the mold member 134 for periodically partially thawing the ice bodies 144 and releasing the ice bodies from the walls of the cavities 138 similarly to the heater 116 described in the previous embodiment.

An elongated slot 150 is formed in the mold member 138 in a direction to extend underneath each of the cavities 138. The slot 150 slidably receives an arm 152 which extends horizontally and is suitably secured on the upper end portion of a piston rod 154. Also, an ice-ejecting plate or disc 156 is secured on the arm 152 in alignment with each of the cavities 138, and each of the discs 156 is received in a correspondingly shaped opening 158 at the lower end of each cavity 138, such that the top of the discs 156 come to rest at a level with the bottom 160 of the respective cavities when the arm 152 is in its lowermost position as illustrated in FIG. 6 to form a continuation of the bottom of the respective cavities. It may also be noted at this point that each disc 156 is substantially smaller in diameter than the respective cavity 138, and the slots or channels 142 are wider than the arm 152, such that the arm 152 and the discs 156 may be moved upwardly to above the top 140 of the mold member 134 as illustrated in dash lines in FIG. 6, and as will be further described.

The piston rod 154 extends through a mating aperture 162 in the lower central portion of the mold member 134 and is sealed to the walls of the aperture 162 by a suitable O-ring 164 of neoprene or the like. A piston 166 is secured on the lower end of the piston rod 154, as by welding, and is reciprocally disposed in a cylinder 168 suitably secured as by welding, to the lower end 170 of the mold member 134. The bottom of the cylinder 168 is closed by a head or wall 172. The piston 166 is slidably sealed to the walls of the cylinder 168 by means of a piston ring 174, formed of Teflon or the like, urged outwardly by an O-ring 176 of neoprene or the like mounted in a mating groove in the outer periphery of the piston. The piston 166 is continually urged in a downward direction by a helical compression spring 178 of stainless steel or the like having its upper end in engagement with the bottom 170 of the mold member 134 and its lower end anchored to the piston 166. It may also be noted that a pin 179 extends transversely through the piston rod 154 to contact the lower end 170 of the mold member 134 to limit the upward movement of the piston, as will be described. A vent line 167 provides air pressure equalization with the atmosphere at all times in cylinder 168 above piston 166.

A conduit 180 extends from a source of water under pressure into connection with a port 182 in the wall 172, and a second conduit 184 extends from outside of the housing 132 into connection with a port 186 formed in the bottom of one of the cavities 138. The conduits 180 and 184 are interconnected and provided with control valves in the same manner as the conduits 96 and 108 in the icemaker 14, such that the piston 166 can be raised by the pressure of the water supply and the water used for raising the piston 166 can be conducted through the

conduit 184 to refill the cavities 138. The cylinder 168 and conduits 180 and 184 are surrounded by an electric heater 145 periodically energized to prevent fouling of the device.

Suitable insulation 185 is deposited in the housing 132 around the cylinder 168.

In operation of the icemaker 130, let it be assumed that ice has been formed in the cavities 138 and the water supply has been stopped to the conduit 180, but the conduits 180 and 184 are in communication. A suitable thermostat 188 attached to the side of the cylinder 168 functions to reverse the control valves connected to the conduits 180 and 184 and turn on the heaters 145 and 146 in the same manner as described in the control system of the icemaker 14.

When the heater 146 has operated sufficiently to heat the mold member 134 and partially thaw and release the ice from the walls of the cavities 138, the supply water then being directed into the lower end of the cylinder 168 raises the piston 166 in opposition to the force of the spring 178. As the piston 166 is being raised, the discs 156 will eject the ice bodies 144 from the cavities 138 to the positions shown in dash lines in FIG. 6. It may also be noted that ice will be formed in the slots or channels 142, as well as the cavities 138, but the walls of the slots 142 will also be heated by the heater 146 to release the ice therein, such that the cross arm 152 may be easily moved upwardly by the upward movement of the piston rod 154 and piston 166 to eject the ice bodies 144 and the thin strip of ice which will be formed in the slots 142 between the adjacent ice bodies.

When the mold member 134 has been heated sufficiently to release the ice and the ice bodies 144 have been ejected as just described, the thermostat 188 will switch to turn off the heaters 145 and 146 and switch the control valves connected to the conduits 180 and 184. Thus, the bottom of the cylinders 168 is placed into communication with one of the cavities 138 through the conduits 180 and 184, such that the water in the lower end of the cylinder 168 will be used for refilling the cavities 138. It may be noted again that the water flowing through the port 186 into one of the cavities 138 will also flow through the slots 142 into the remaining cavities 138. The power required for moving the water from the bottom of the cylinder 168 into the cavities 138 is provided by the spring 178. It may also be noted at this point that the volume of water introduced into the lower end of the cylinder 168 to raise the piston 166 during the ejection portion of the cycle previously described is less than the combined volume of all of the cavities 138 and the slots 142. However, this volume of water plus the residual water due to the ice thawing mentioned above, is such that the cavities 138 will be filled or substantially filled when the piston 166 has moved downwardly to the lowermost position in cylinder 168, and yet no water will be sprayed into the refrigeration space in which the icemaker 130 is used.

During the downward movement of the piston 166, the ice bodies 144 will be carried downward by adhesion to discs 158. However, the ice bodies 144 will engage the spring-loaded fingers 76 and thereby be harvested in a manner similar to that previously described for the icemaker 14. At this point it may be noted that the discs or plates 156 may be formed of a material having a lower thermal conductivity than the mold member 134, in order that the ice bodies 144 will tend to adhere to the discs 156 in the same manner that the ice bodies 45 adhere to the upper end of the piston ejector portions 60 in the embodiment previously described.

As previously indicated, the icemaker 130 may be mounted on the wall of a refrigerator or freezer as in the embodiment previously described. In such an event, a rod 84, arm 94 and bin switch 90 will be provided in association with one of the cavities 138 in the same

manner as in the previous embodiment. It will also be understood that the icemaker 130 utilizes a control circuit of substantially the same construction as that schematically illustrated in FIGS. 4 or 8, and previously described to provide an automatic operation and a ceasing of operations when the desired amount of ice bodies have been produced.

Although both of the embodiments have been illustrated and described in association with a refrigeration space of an existing refrigerator or freezer, it will be readily understood by those skilled in the art that the icemaker of this invention may be installed in its own individual refrigerated space and thereby provide simply an ice making device, in the event a purchaser did not desire a complete refrigerator or freezer.

From the foregoing it will be apparent that the present invention provides an ice maker which is motivated solely by the pressure of the supply water used for forming the ice. Although the supply water is used for both ejecting and harvesting the ice bodies, there is a minimum possibility of spraying water into the refrigerated space in which the ice maker is used. The ice bodies are made automatically and the supply of ice bodies is automatically replenished when the ice bodies are removed from the bin. It will also be apparent that the present ice maker may be constructed to provide either a single or any desired number of ice bodies during each cycle of operation. Finally, it will be apparent that the present icemaker is economical in construction and will have a long service life.

Changes may be made in the combination and arrangement of parts or elements as heretofore set forth in the specification and shown in the drawings, it being understood that changes may be made in the embodiments disclosed without departing from the spirit and scope of the invention as defined in the following claims.

What is claimed is:

1. Apparatus for producing ice from a source of water under pressure, comprising:

a vertically oriented mold for containing the water to be frozen and being open at its upper end;

a piston reciprocally disposed in the mold between an upper position and a lower position and slidably sealed to the walls of the mold, the upper end portion of said piston being formed of a material of low thermal conductivity compared with the thermal conductivity of the mold;

means for freezing water in the mold above the piston when the piston is in its lower position;

a heater associated with the mold above the piston when the piston is in its lower position for partially thawing and releasing ice from the mold;

conduit means connecting the source of water under pressure to the mold below the piston and interconnecting the upper and lower portions of the mold;

control valves in said conduit means; and

control means connected to said valves and said heater for releasing the ice from the mold and directing water under pressure below the piston to raise the piston and eject the ice from the upper end of the mold, and, alternatively, de-energizing the heater, directing water from below the piston to above the piston and lowering the piston in the mold for the freezing of another quantity of water in the mold.

2. Apparatus as defined in claim 1 wherein said low thermal-conductivity material is Teflon.

3. Apparatus for producing ice from a source of water under pressure, comprising:

a vertically oriented mold for containing the water to be frozen and being open at its upper end;

a piston reciprocally disposed in the mold between an upper position and a lower position and slidably sealed to the walls of the mold;

means for freezing water in the mold above the piston when the piston is in its lower position;

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- a heater associated with the mold above the piston when the piston is in its lower position for partially thawing and releasing ice from the mold;
- conduit means connecting the source of water under pressure to the mold below the piston and inter-connecting the upper and lower portions of the mold;
- a first solenoid valve in the conduit means for controlling the flow of water from the source to the mold below the piston, and
- a second solenoid valve in the conduit means for controlling the flow of water from the lower to the upper portion of the mold;
- a thermostatically operated switch positioned adjacent an intermediate portion of the mold having a first contact made when the temperature of the mold reaches a predetermined low temperature and a second contact made when the temperature of the mold reaches a predetermined higher temperature;
- first circuit means connecting said first contact to the coil of the first solenoid valve and said heater to release ice in the mold and raise the piston to eject ice from the mold in one position of said thermostatically operated switch; and
- second circuit means connecting said second contact to the coil of said second solenoid valve to transfer water in the mold from below the piston to above the piston in the alternate position of said thermostatically operated switch.
4. Apparatus as defined in claim 3 characterized further to include third circuit means including a normally open bin switch, positioned to be closed on the production of a predetermined amount of ice, and a heater coil therein; and
- wherein said first circuit means includes a normally closed switch operably associated with said heater coil and connected in series with said first solenoid

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- valve coil to stop operation of the apparatus when a predetermined amount of ice has been produced.
5. An icemaker, comprising:
- a container having a mold cavity therein to receive the water to be frozen;
- means for freezing water in the mold cavity into an ice body;
- power means extending vertically into the mold cavity adapted to engage and raise and lower the ice body relative to the mold cavity for removal of the ice body from the mold cavity;
- control means connected to the container responsive to predetermined temperature levels of the container for controlling the operation of the power means; and
- a spring-loaded finger mounted on the container in a position to be deflected and then move under the ice body as the ice body is raised by the power means, whereby said finger is again deflected upon downward movement of the ice body, and disengages the ice body from the power means to harvest the ice body.

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