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2,569,113

AUTOMATIC ICE CUBE PRODUCING AND STORING APPARATUS

Filed Sept. 21, 1948

3 Sheets-Sheet 1

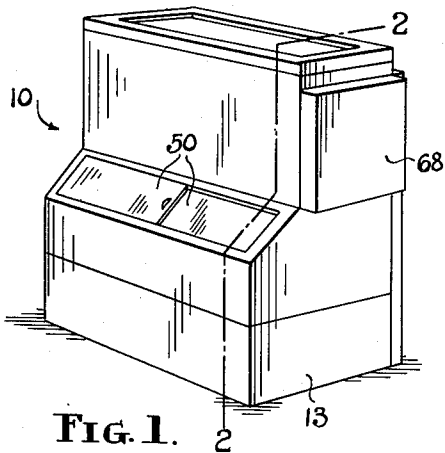


FIG. 1.

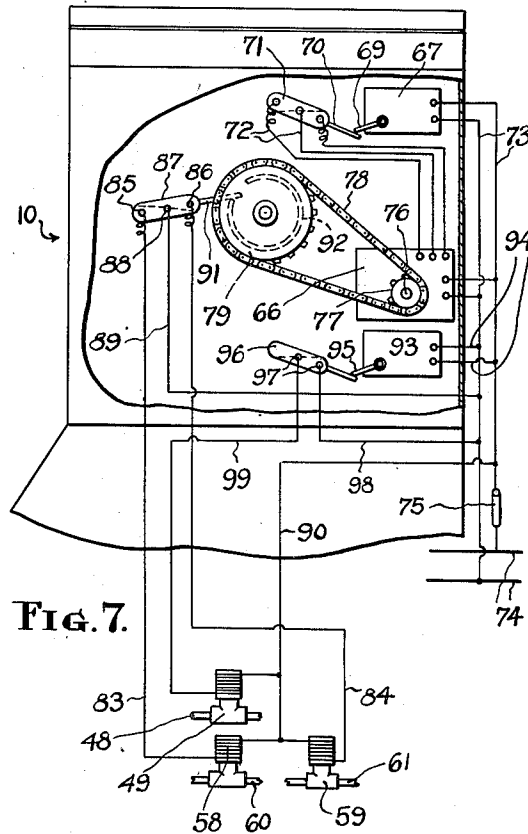


FIG. 7.

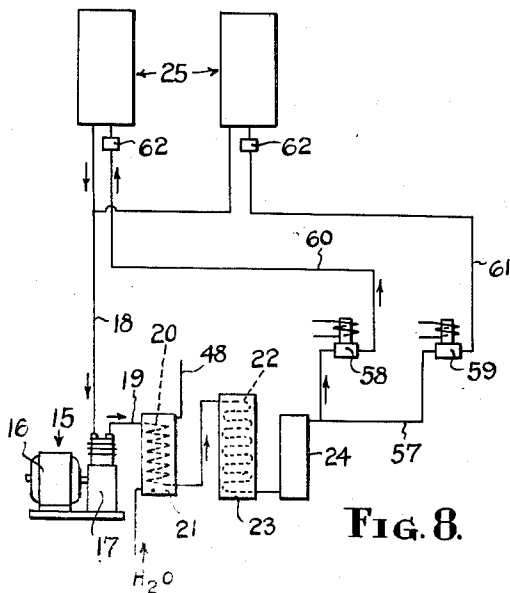


FIG. 8.

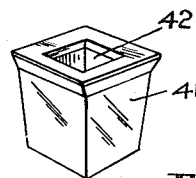


FIG. 9.

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AUTOMATIC ICE CUBE PRODUCING AND STORING APPARATUS

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3 Sheets-Sheet 2

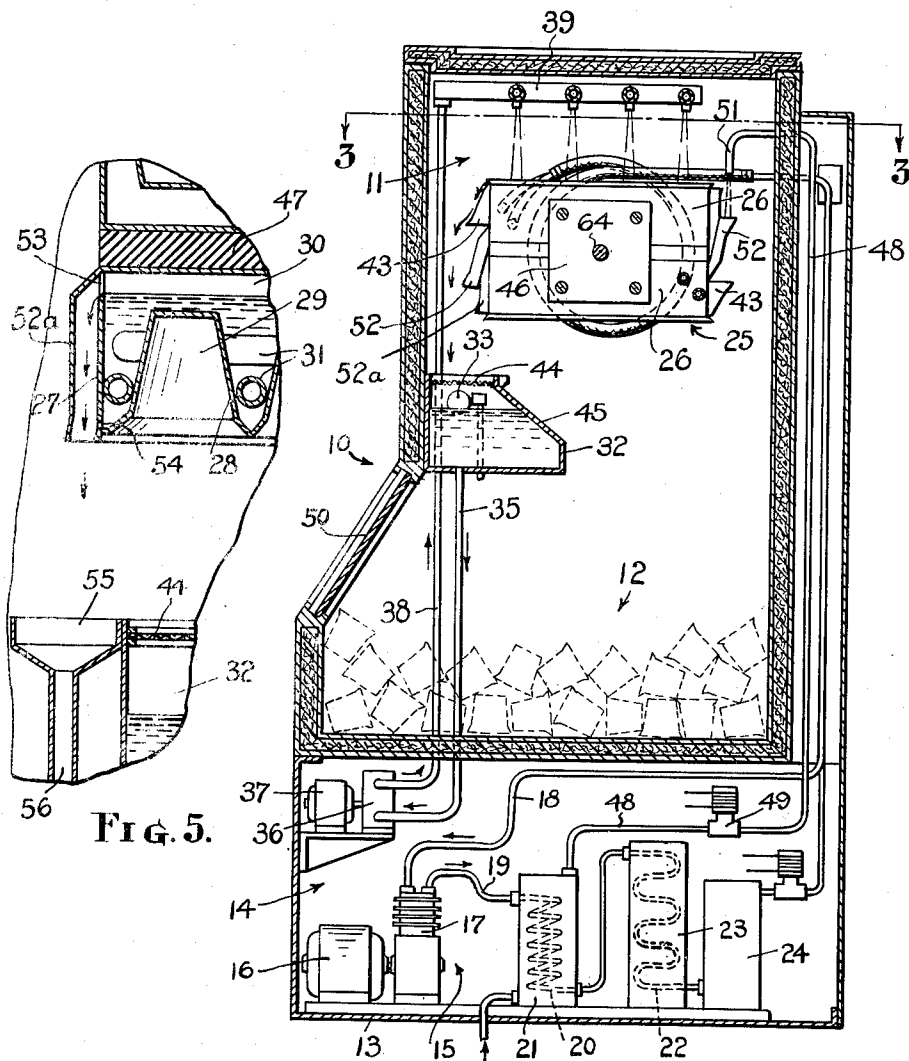


FIG. 5.

FIG. 2.

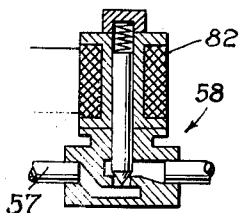


FIG. 6.

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AUTOMATIC ICE CUBE PRODUCING AND STORING APPARATUS

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3 Sheets-Sheet 3

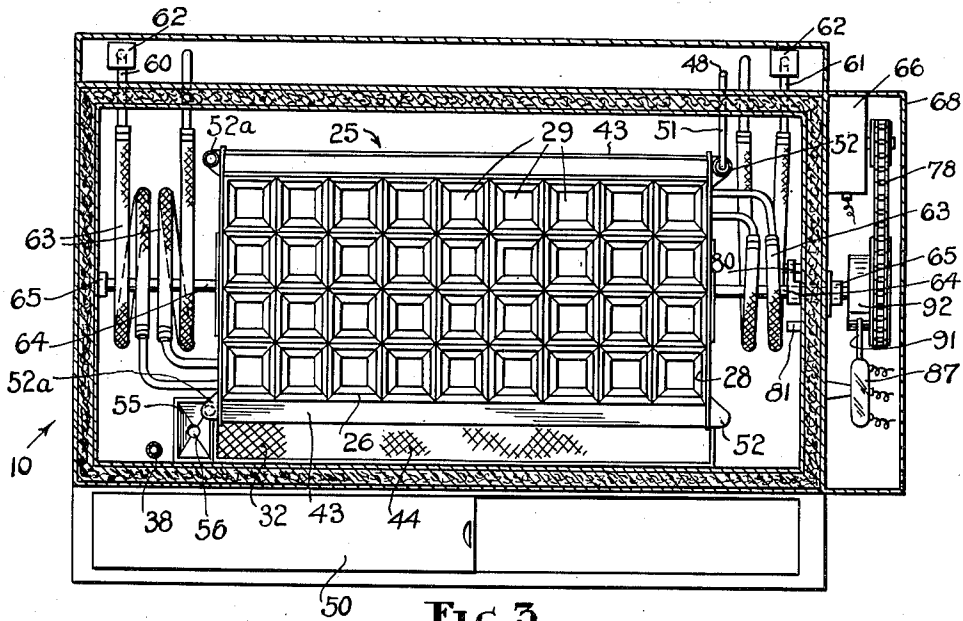


FIG. 3.

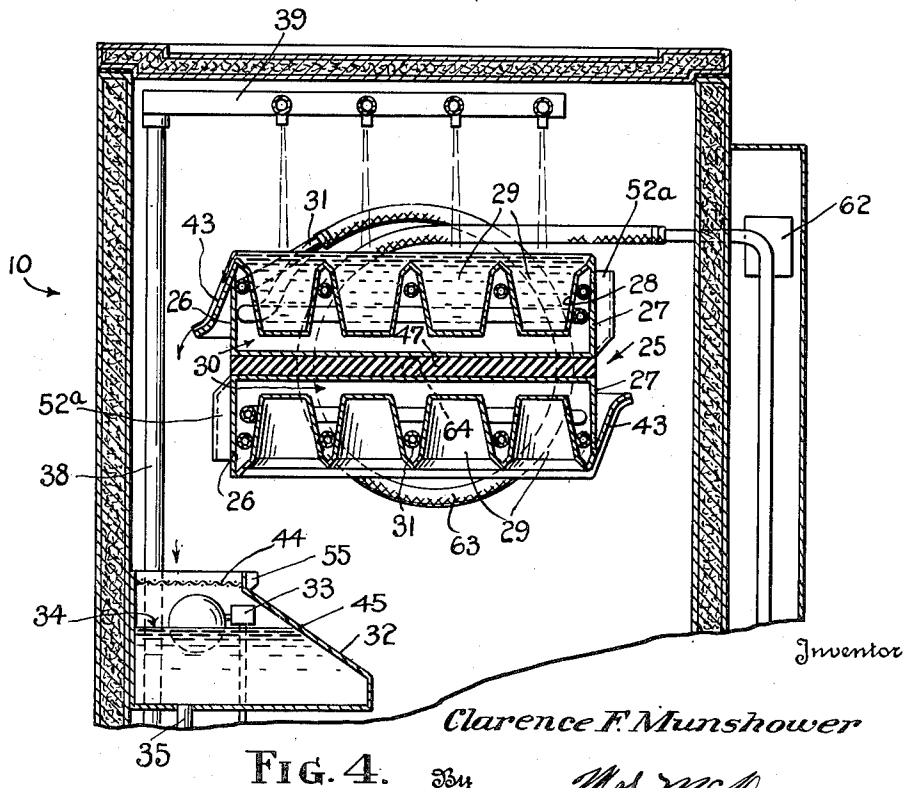


FIG. 4.

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2,569,113

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Application September 21, 1948, Serial No. 50,264

4 Claims. (Cl. 62—2)

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This invention relates to ice-freezing and storage apparatus and, more particularly, is concerned with an ice-making machine adapted for the freezing of small blocks or bodies of ice of the type known generically as "ice cubes," the same being employed particularly in drinking glasses for the cooling of beverages.

In hotels, restaurants and bars, there is a very considerable demand for such ice cubes. While standard domestic refrigerators of the mechanically operated types are provided with means for producing ice cubes, nevertheless, their cube-forming capacity is so restricted that such refrigerators are unsuitable for use in commercial establishments of the character indicated.

Accordingly, it is an object of the present invention to provide an improved machine adapted specifically for the purpose of forming small blocks of ice rapidly, efficiently and economically. Another object is to provide in such a machine improved means for releasing frozen blocks or cubes of ice from the freezing pockets or cavities of a movable pan or tray, which is adapted to be subjected to ice-freezing temperatures.

It is another object of the invention to provide an improved ice-cube-forming machine having a mold mounted for rocking movement about a centrally disposed longitudinally extending axis, the mold being formed to provide a pair of pans or receptacles having cube-freezing pockets or cavities, the cavities of one tray or pan being disposed in oppositely facing order with respect to the pockets or cavities in the other pan or tray, automatic means being provided for applying freezing temperatures to the trays when the pockets or cavities thereof are disposed with their open ends facing upwardly.

Another object is to provide a cube-forming machine in which the mold is rotated or rocked on its axis to bring a cube-containing pan or tray to a position in which the pockets or cavities thereof face downwardly, so that the frozen cubes may be discharged from the mold to a position of access and storage within the confines of the machine cabinet or casing.

It is another object of the invention to provide a cube-forming machine of the character indicated in which the oppositely facing pans or trays of a rotatable or oscillatory mold structure are maintained out of thermal or heat-conducting relationship with respect to each other by the provision of insulating means arranged between and separating the dual pans or trays of the mold structure, and wherein provision is made for circulating a heating medium through an inverted pan or tray to effect the release of frozen cubes therein from their normally adhering engagement with the wall surfaces of the pan pockets or cavities.

Still a further object of the invention is to

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provide means for circulating a heated fluid through the hollow body of a mold pan to heat the walls of such a pan to a cube-releasing temperature.

Another important object of the present invention is to provide in an ice-making machine a cube-forming mold structure having walls which are chilled or refrigerated to freezing temperatures by means of coils or chambers through which a fluid refrigerant is circulated, the coils or chambers being arranged in close intimate relationship with the walls of the cube-forming pockets provided in the mold structure and wherein the mold structure includes oppositely facing pans or trays in one of which, during any particular period of operation of the machine, freezing takes place and from the other formed cubes are released, the arrangement being such that a substantially uniform load condition is maintained at all times on the refrigerating coil or coils of the mold structure in which the cubes are frozen, reducing to a minimum intermittent or irregular loading on the associated mechanical refrigerating unit.

Other objects of the invention are: to provide a machine of the character indicated which is automatic in its operation and requires no manual attention other than the removal of formed cubes from the cube-storage compartment of the machine; to provide a storage compartment of ample capacity or volume so that during periods of light or no demand for ice cubes, the supply of such cubes in the storage compartment may be built up for the purpose of providing an adequate supply of cubes, consistent with the machine's capacity during periods of increased or heavy demand for the cubes.

For a further understanding of the invention, including additional advantages and constructional details, reference is to be had to the following description and the accompanying drawings, in which:

Fig. 1 is a perspective view disclosing the exterior configuration of the cabinet in which the ice cube-forming mechanism comprising the present invention is housed;

Fig. 2 is a vertical transverse sectional view taken through the cabinet on the line 2—2 of Fig. 1;

Fig. 3 is a horizontal sectional view, the plane of the figure being indicated by the line 3—3 of Fig. 2;

Fig. 4 is a fragmentary vertical sectional view on an enlarged scale with respect to that of Fig. 2, disclosing more particularly the transverse configuration of the rotatable mold structure utilized by the present invention with its spaced oppositely facing pans;

Fig. 5 is a similar view disclosing the overflow

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means for removing heated cube-freezing fluid from an inverted mold pan;

Fig. 6 is a detail vertical sectional view taken through one of the solenoid valves utilized by the present invention;

Fig. 7 is a diagrammatic view of the automatic electric-actuated controls utilized in part by the present invention;

Fig. 8 is a similar view disclosing other co-operative controls supplementing those of Fig. 7, and illustrating the refrigerant-flow circuit;

Fig. 9 is a detail perspective view of an ice cube formed by the present invention.

Referring more particularly to the drawings, the numeral 10 designates a cabinet in which my improved ice-freezing mechanism is controlled and supported. The cabinet is formed, in this instance, to embody outer walls of the type customarily found in refrigerator construction, the same being suitably insulated against heat-transmission losses. The walls of the cabinet are arranged to form internally, in the upper part of the cabinet, a mold chamber 11 and in the bottom of the cabinet a cube-receiving chamber 12 possessing storage capacity. Also, the bottom of the cabinet provides a sub-base 13, which includes a space 14 for the reception of any suitable type of a refrigerating or ice-producing unit 15.

Usually, such a unit embodies a source of power in the form of an electric motor 16, which drives a compressor 17. The head of the compressor is formed to receive an inlet pipe 18, by which a normally gaseous refrigerant, such as the gas known commercially as Freon, is introduced into the cylinder, and a discharge pipe 19, by means of which the refrigerant in a compressed state is discharged from the cylinder.

The pipe 19 leads to a coil 20 of a primary condenser 21. The outlet of the coil 20 is joined with the coil 22 provided in a second condenser 23, the coil 22 discharging the compressed refrigerant into an accumulator or other holder 24 for the refrigerant. It will be understood that any other standard ice-freezing unit may be employed in lieu of the conventional unit shown and described, whether of the motor or heat-actuated types.

The unit 15 is employed to freeze water introduced into the pockets or cavities of a turnable mold structure, indicated generally by the numeral 25, arranged in the mold chamber 11 of the machine cabinet. The mold structure comprises a pair of rigidly united oppositely facing metallic receptacles or pans 26. Each of the pans is formed to include an outer wall structure 27 and an inner wall structure 28. The inner wall structure, as shown more particularly in Figs. 3 and 4, is shaped to provide a plurality of relatively closely adjoining yet spaced pockets or cavities 29 into which water is adapted to be introduced, in a manner to be presently described, for cube-forming purposes.

The inner and outer wall structures are relatively spaced to form a chamber 30 therebetween. Arranged in the chamber of each pan in closely adjoining relationship with the walls of the pockets or cavities 29 is an expansion coil 31 in which the refrigerant obtained from the unit 15 is passed following expansion thereof to produce refrigerating temperatures.

It will be noted that the receptacles or pans 26 are arranged in oppositely disposed order; that is, when the pockets or cavities 29 of one pan are arranged in an upright position to receive water,

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the complemental pockets or cavities 29 in the other of said pans will be arranged in an inverted order, so that formed cubes may be released therefrom.

To supply running or flowing water to the pockets or cavities arranged in upright order, I employ a vessel 32 which, as shown particularly in Fig. 4, includes a float-actuated valve mechanism 33 by which a given water level 34 is maintained in said vessel. Water thus introduced in said vessel is withdrawn from the bottom of the vessel by way of a pipe line 35, the latter extending to the inlet side of a pump 36 which is driven by an electric motor or its equivalent 37. A pipe 38 extends from the outlet side of the pump 36 to a manifold 39 stationarily mounted in the top of the cabinet 10 above the mold structure 25. The manifold is connected with a plurality of parallel pipes 40, these pipes being provided with spaced perforations which are disposed in registration with the pockets or cavities disposed in an upright pan, whereby when the pump 36 and its motor 37 are in operation, water is forced through the manifold 39 and its pipes 40 for delivery to the cube-freezing pockets or cavities of the mold structure.

It is desirable in a machine of this character to produce ice cubes or blocks characterized by their clarity and freedom from opaqueness. In an ordinary domestic refrigerator, the water undergoing freezing is maintained in a static condition in the pans or receptacles in which it is frozen. Air bubbles present in the water serve upon the congealing of the latter to form small voids which, it is believed, are accountable for the relative opaqueness of the ordinary ice cube. When, however, the water is constantly activated by air, circulated or maintained in a state of motion while it is being frozen, as in the present invention, the formation of the air pockets or voids is prevented and ice cubes of crystal-like clearness are formed.

It is also desirable in such a machine to produce ice cubes, as indicated at 41 in Fig. 9, having bodies in which are formed open ended bores or openings 42, whereby the surface area of each cube or block is increased, so that the cubes will more quickly chill or cool a liquid in which they are immersed. These properties in ice cube formation are attained in the mechanism provided by the present invention.

Thus, as shown in Fig. 4, the adjoining inner walls of the pockets or cavities 29 terminate below the marginal edges of the outer walls which join with the walls of the outer wall structure 27. These outer walls are formed with an angularly directed water-discharging spout or lip 43 which, when a given pan is in an upright position, is disposed over the screened open top 44 of the vessel 32, so that water overflowing said pans will be caught or trapped in the vessel. This is desirable, since it will be noted that such overflowing water will have been subjected to refrigerating temperatures and it is advantageous, therefore, to trap such chilled water for immediate re-use. Such re-use is provided for by the operation of the pump 36, which returns the water to the manifold 39 and its associated pipes 40. At this juncture, it might be noted that the top wall 45 of the vessel 32 is inclined or sloped in a downwardly and angularly direction to facilitate discharge therefrom of any formed ice cubes which may be dropped on the vessel as a result of the inversion of mold structure pans.

In accordance with the present invention, the

5 pans 26 of the mold structure are supported in thermally spaced relationship. This may be accomplished by uniting the pans 26 at their ends with rectangular plates 46 which may be composed of a plastic material such as Bakelite, or an equivalent material resistant to heat transmission. Additionally, adjacent panels of the outer wall structures 27 of the pans have arranged between them a pad 47 of rubber, cork or the like. With the pans so heat-insulated from each other, the present invention provides means for circulating a heated fluid in the space or chamber 30 formed between the wall structures of said pans. Thus, as indicated in Fig. 2, a fluid such as water is forced through the casing of the primary condenser 21 and around the exterior of the heated coil 22 therein, the said coil being heated as a result of the compression of the refrigerant compressed in and released from the compressor 17 of the refrigerating unit. This waste heat is used advantageously to free the frozen cubes from the pan members. Therefore, the top of the casing of the condenser 21 is joined with a pipe line 48 in which is included a solenoid-actuated valve 49.

Through suitable switch mechanism, hereinafter described, when the mold structure 25 is revolved to bring one of the pans 26 to its inverted cube-discharging position, the valve 49 is energized so that the fluid heated by contact with the condenser coil 22 may flow through the pipe line 48 for delivery to the chamber or space 30 in the inverted pan, the heated fluid circulating freely through said space around the refrigerant coils 31 and in intimate contact with the walls forming the pockets or cavities 29.

The pipe line 48 terminates in the top of the cabinet in a downturned extension 51 which is arranged over and in vertical registration with a filling spout 52 formed on the side of each of the pans 26. The opposite marginal walls of the pans 26, as shown in Fig. 5, are each formed with a second spout 52a having a large overflow orifice 53 and a small drain orifice 54. The orifice 53 is of such diameter as to remove from the chamber 30 all water or other fluid capable of being delivered thereto by the line 48, and the drain orifice is provided in the pan structure to remove water or other fluid from the chamber 30 after water ceases flowing into said chamber from the downturned end 51 of the pipe line 48. The outlet of the spout communicating with both orifices 53 and 54 is arranged over the enlarged funnel-shaped top 55 of the drain pipe 56, which leads to any suitable source, not shown, of exterior fluid disposal.

In this manner, positive heat is applied quickly to the inverted pan so that the frozen cubes may be released therefrom and dropped gravitationally into the storage chamber 12. The cabinet is formed with sliding doors 58 which when opened provide convenient access to the chamber 12 for the purpose of removing manually formed cubes therefrom.

Since the freezing action in the formation of the cubes takes place in an inward direction, that is, inwardly from the walls of the pockets or cavities 29, the openings 42 are formed axially in the frozen cubes by controlling the duration of the freezing period. This freezing period is initiated and discontinued automatically by providing the holder or accumulator 24 with an outlet pipe 57 which is branched to extend to the inlet sides of a pair of flow-controlling solenoid actuated valves 58 and 59, which may be of the

type indicated in Fig. 6. From the outlet sides of these valves, pipe lines 60 and 61 extend to pressure-releasing or expansion valves 62, where the pressure on the refrigerant is released or lowered so that the refrigerant expands, extracting heat from the walls of the coils 31, thus producing a refrigerating effect which is adequate to freeze water introduced into the mold pockets 29. The outlets of the expansion valves 62 are connected with flexible coils or rings 63, which are disposed in concentric relationship to the journaling trunnions 64 carried by the end plates 46 of the mold structure 25, the trunnions being suitably supported in bearings 65 carried by the walls of the cabinet 10. The outlets of the coils or rings 63 are joined with the inlets of the mold structure coils 31. It will be understood that the coils 63 permit the mold structure to rotate or oscillate about its longitudinal axis provided by the trunnion 64, thereby compensating for the turning movement of the mold structure with respect to the stationary cabinet walls with which the fluid-conducting lines are connected.

To rotate or oscillate the mold structure through an arc of substantially 180 degrees, I employ a three-pole reversible electric motor 66. In association with this motor, I utilize an electrically actuated synchronous timing device 67, which is mounted on one side of the cabinet 10 and enclosed in a removable boxing 68. The timing device includes a crank arm 69 arranged to oscillate at definite time intervals in response to alternating current flowing through the timing device 67.

The outer end of the arm 69 is arranged to engage a rigid extension 70 provided upon an oscillating mercury-type switch 71. This switch is provided with three terminals, two of which being immersed at one time, depending upon the operating position of the switch and the mercurial body contained therein. From the terminals of the switch 71, conductors 72 lead to the conductor terminals of the motor 66. Trunk conductors 73 extend from a commercial energy source 74 to the inlet terminals of the timing device 67. In one of the conductors 73, a manually operated control switch 75 may be installed, by which the operation of the machine may be started or terminated at any time under manual regulation.

The operation of the timing device 67 is such that the motor 66 is energized to rotate the mold structure about 180 degrees from a given position, thereby inverting a pan of the mold structure containing frozen ice cubes and disposing the oppositely facing pan of said mold structure in an upright position so that it may be filled with water and its contents frozen to cube formation. Thereafter, the timing device 67 operates to reverse the direction of the motor 66 so as to bring the pan containing the frozen cubes into an inverted or downwardly facing position for discharge of its contents.

The armature shaft 76 of the motor is provided with a sprocket 77 over which passes an endless chain 78, the latter being also trained over a larger sprocket 79 which is fixed to one of the trunnions 64 of the mold structure to rotate in unison with the latter. It will be understood that the motor 66 is of a type which may stall when energized without injury thereto. The trunnion 64 may be provided with a stop crank 80 arranged to engage with relatively spaced stop members 81 mounted in connection with the cabinet walls. The motor 37 of the pump

36 may be energized concurrently with the motor 66.

To govern the alternate flow of the fluid refrigerant to the dual expansion coils of the mold structure, use is made of the solenoid valves 58 and 59. The field coils 82 of these valves are joined with conductors 83 and 84 which extend to terminals 85 and 86 provided in the ends of the tube of a pivoted mercury switch 87. The third or intermediate terminal 88 of this switch is joined with a conductor 89 which leads to one of the trunk conductors 73. A return conductor 90 also leads from the coils of the solenoid valves to one of the trunk conductors 73.

The switch 87 includes at one end a fixed longitudinally directed tongue 91 which engages with a cam 92 formed in connection with the sprocket 79. The action of the cam 92 on the tongue 91 is such as to oscillate the switch 87 and maintain the same for definite intervals of time in its extreme positions of oscillation, thus enabling the refrigerant to flow to and through the expansion coils 31 of the pans 26 when the latter are facing upwardly, that is, when in cube-freezing positions.

To control the operation of the solenoid valve 49, which is utilized in delivering heated water or other fluid to the pans of the mold structure while the latter are inverted, use is made of a second electrically actuated synchronous timing device 93, which is energized through leads 94 connected with the trunk conductors 73. The device 93 includes an oscillating arm 95 which at definite intervals oscillates to control the operating positions of a mercury tube switch 96. This switch includes a pair of spaced terminals 97, one of which being joined by a lead 98 with one of the trunk conductors 73. The second of the terminals 97, as shown in Fig. 7, is joined at one end of a conductor 99 which leads to the field coil of the solenoid valve 49, the opposite side of said field coil being joined with the return conductor 90. With the switch 96 positioned, as shown in Fig. 7, the field coil of the solenoid valve 49 is energized to open said valve and thereby provide for the flow of hot water or the like from the casing of the primary condenser 21 to an inverted pan of the mold structure.

In view of the foregoing, it will be seen that the present invention provides an automatically operating ice-making machine which may be readily installed in restaurants, bars, or the like for producing small ice blocks in requisite quantities for beverage and other cooling purposes. The machine when properly adjusted will successfully carry out its automatic working cycles without requiring manual attention. By forming the machine with the compartment 12, it possesses a sizeable storage capacity so that ice cubes may be frozen in quantity during periods of low demand therefor and thus be available at periods when the demand for ice cubes exceeds the producing capacity of the machine.

I claim:

1. Automatic ice-cube-freezing and storing apparatus comprising: a cabinet having thermally insulated walls defining a freezing and cube-storage chamber, a mold supported in the upper part of said chamber for turning movement about a substantially horizontal axis, said mold including a plurality of oppositely facing cube-freezing receptacles, heat-insulating means disposed between said receptacles to effect thermal spacing thereof, liquid-supply means in the upper part of said chamber in registration with an

upwardly facing receptacle of said mold, mechanically actuated means for circulating a fluid refrigerant through an upwardly facing receptacle of said mold, means for circulating a heated fluid through a downwardly facing receptacle of said mold to release ice cubes from adherence with the walls thereof, means for imparting turning movement to said mold including a reversible electric motor having an operating circuit, and a time-controlled switch means in said circuit for governing the reversal of said motor.

2. In water-freezing apparatus, a mold embodying oppositely facing receptacles composed of heat-conducting materials adapted to receive a liquid to be frozen therein, means for circulating a fluid refrigerant through said mold, means for passing a heated fluid through said receptacles to release ice cubes therefrom, heat-insulating means separating said receptacles and removing the same from heat-exchanging relationship, a pivotal support providing for turning movement of said mold about a substantially horizontal axis, and time-controlled motor-actuated means for imparting intermittent turning movement to said mold.

3. In water-freezing apparatus, a mold embodying oppositely facing receptacles composed of heat-conducting materials adapted to receive a liquid to be frozen therein, means for circulating a fluid refrigerant through said mold, means for passing a heated fluid through said receptacles to release ice cubes therefrom, heat-insulating means separating said receptacles and removing the same from heat-exchanging relationship, a pivotal support providing for turning movement of said mold about a substantially horizontal axis, time-controlled motor-actuated means for imparting intermittent turning movement to said mold, means for introducing a circulating body of water into said receptacles when the same are in an upwardly facing position, said water circulating means including a tank, and over-flow devices on said receptacles for directing water overflowing the same into said tank.

4. In automatic ice-cube-freezing apparatus, a cabinet having thermally insulated walls defining an internal chamber, a mold supported in said chamber for turning movement about a substantially horizontal axis, said mold including a plurality of oppositely facing cube-freezing receptacles, each of said receptacles having inner and outer walls providing therebetween an internal receptacle chamber, the inner of said walls being formed to provide a multiplicity of spaced cube-freezing cavities, coils for the passage of a fluid refrigerant positioned in the internal chambers of said receptacles, mechanically actuated means for circulating a fluid refrigerant through said coils, said means including rigid walled conduits, and flexible conduits uniting said rigid walled conduits with the refrigerant-circulating coils of said receptacles.

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