

May 13, 1958

W. J. JAEGER

2,834,189

ICE CUBE MAKING MACHINE

Filed May 27, 1955

4 Sheets-Sheet 1

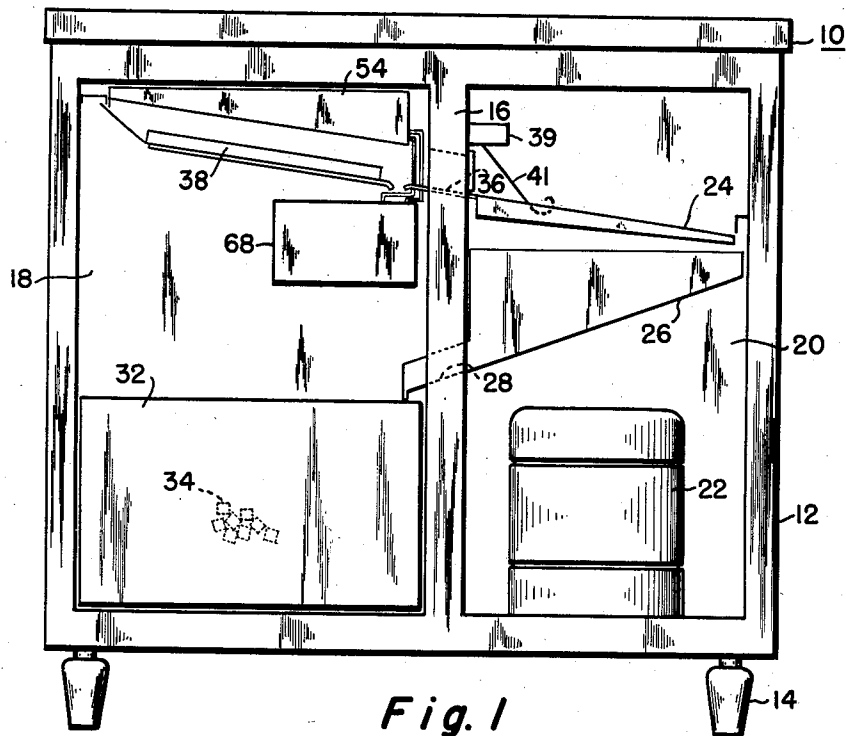


Fig. 1

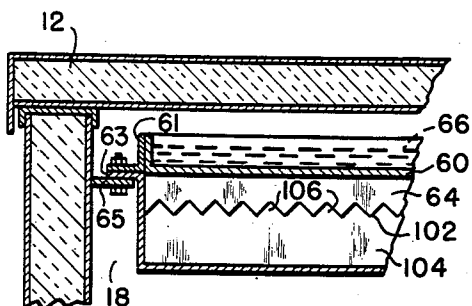


Fig. 4

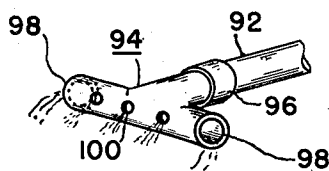


Fig. 3

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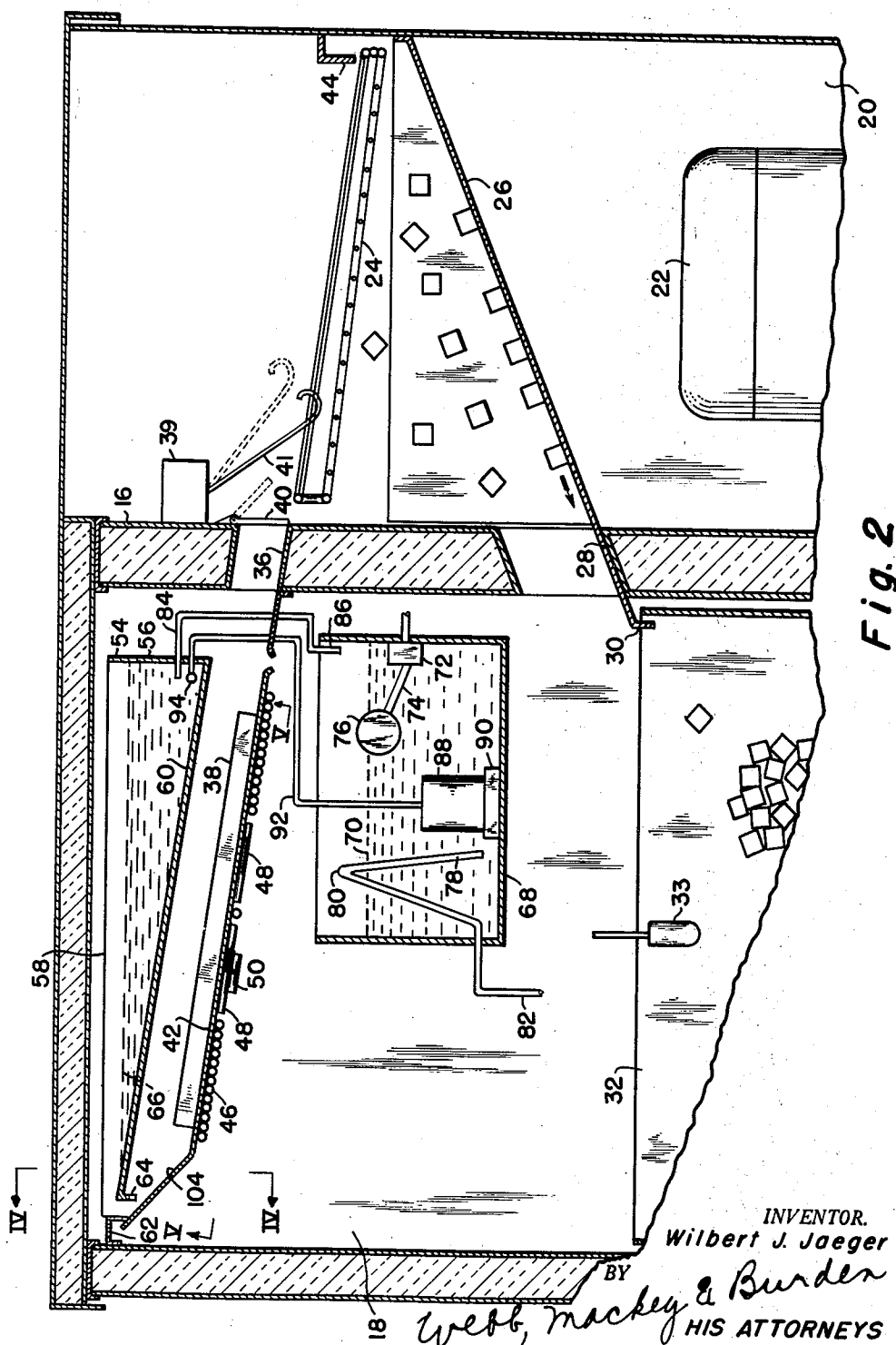
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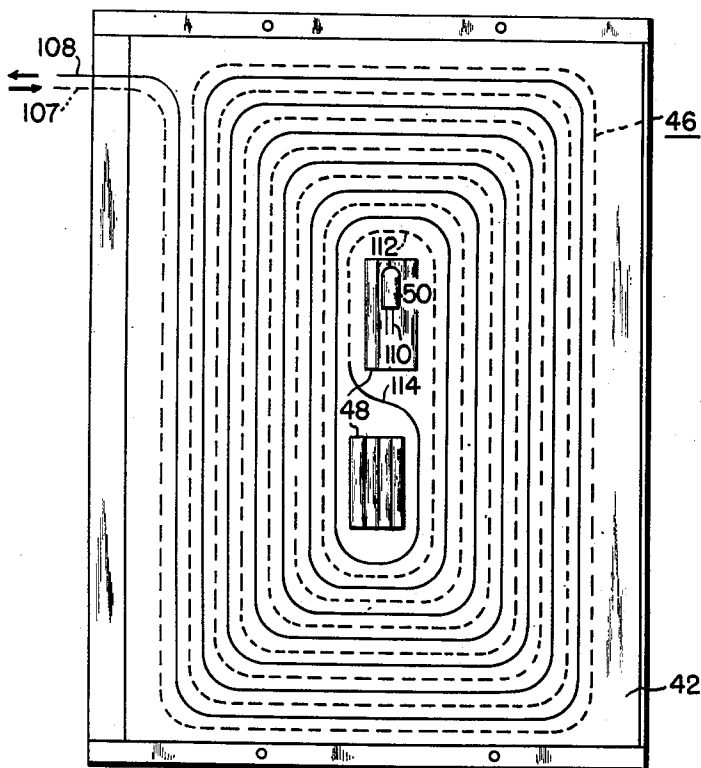


Fig. 5

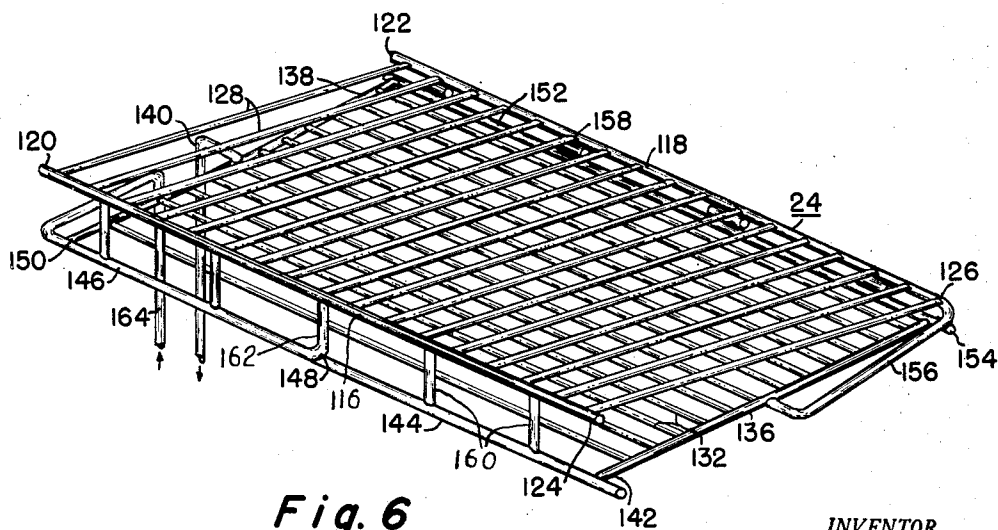


Fig. 6

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4 Sheets-Sheet 4

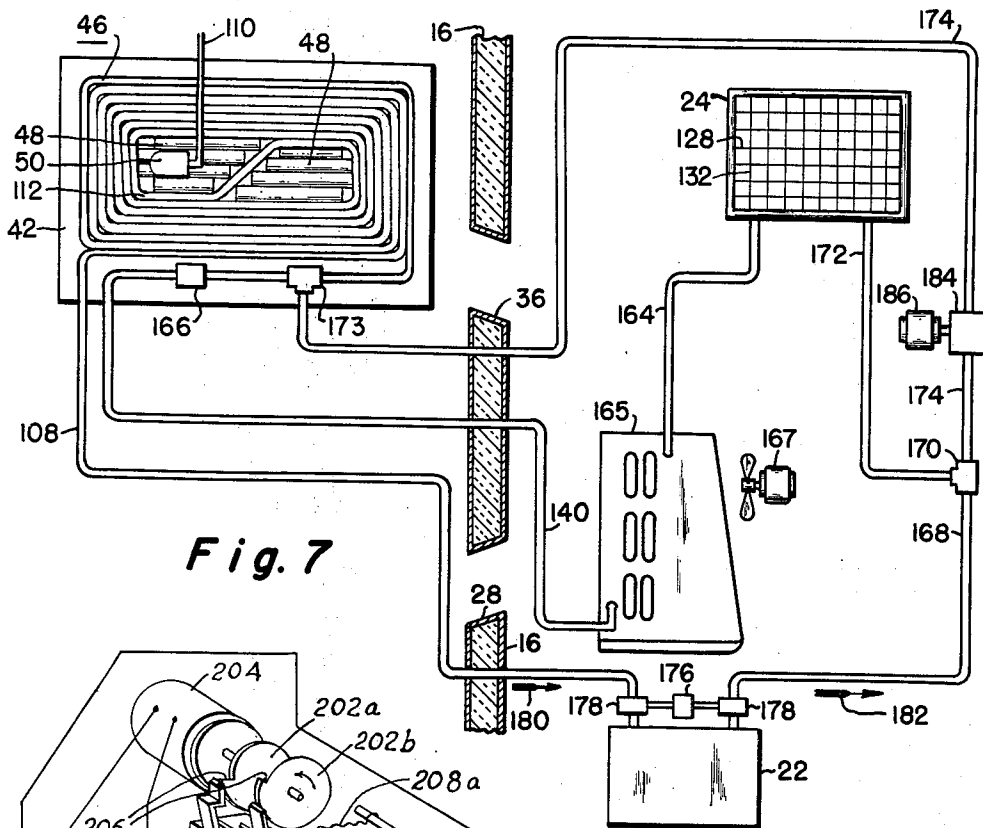


Fig. 7

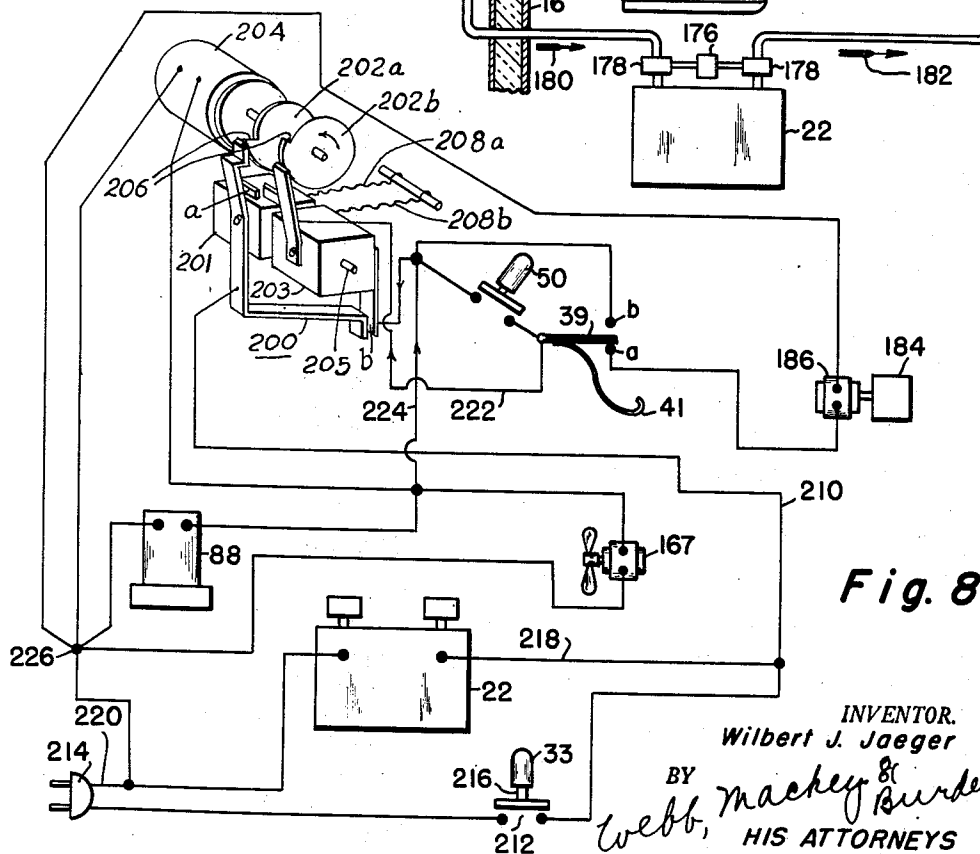


Fig. 8

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2,834,189

ICE CUBE MAKING MACHINE

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Application May 27, 1955, Serial No. 511,674

16 Claims. (Cl. 62—7)

This invention relates to an ice cube making machine, and more particularly, to an ice cube making machine in which the cubes undergo three steps in the making thereof; first, the step of the formation of an ice slab to be cubed, second, the step of dividing the ice slab into cubes, and third, the step of storing the cubes in an insulated bin.

Hitherto known ice freezing and ice cube making machines conventionally employ a series of cooperating components principally consisting of an aerator tank in which water to be frozen is relieved of dissolved gases, a chilled evaporator plate over which the aerated water is flowed to build up to an ice slab, a cube former which usually involves hot cutters for dividing the slab into separate cubes, and finally, a bin in which the resulting cubes are stored. One or several distinct disadvantages are present in the usual ice cube making machine, the first of which, in standpoint of the sequence of components above enumerated, is the plugging of the water supply between the aerator and the evaporator plate. Jets and other water distributing means for flowing water in an even film over the evaporator plate have been found susceptible to plugging, probably as the result of improper filtering of the water prior to admission of the same to the distributing jets or other distributing means. Another disadvantage is that the conventional evaporator plate, which normally must be periodically defrosted in order to free the produced slabs of ice therefrom, requires excessive heat for defrosting during certain atmospheric and temperature conditions which is unavailable in conventional machines which, therefore, have a limited range of operation geographically. A further disadvantage of conventional machines is a second heat problem wherein the cube cutters must be heated by some means in order to divide the pieces of ice into cubes and the means for heating the cutters ordinarily is an external source of power, for instance, electric power, which causes the cube cutting operation to be expensive and wasteful in energy. The latter heating process by means of the cube cutter heating means is carried on in a compartment ordinarily somewhat warm in view of being occupied by a hot refrigeration compressor for compressing and circulating refrigerant to the evaporator plate, and also, this same compartment is the one wherein the resulting cubes are stored, thus presenting the problem of having a hot operating cutter body or a compressing machine, or both, confined in an area normally occupied by stored frozen cubes.

Another characteristic attendant with conventional ice cube making machines is that the slab freezing and cube cutting operation has a cycle period based on the attainment of a predetermined slab thickness rather than on a pure time clock basis with the result that under some atmospheric and temperature conditions which are not conducive to slab-making, the slab forming and cube cutting cycle never reaches a complete state, in view of the fact that ice acts as its own best insulator and prevents a slab from being built up to sufficient thickness to proceed to the cutting stage necessary in the latter phase of the cycle.

An object of the present invention is the provision of

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an ice cube making machine which materially reduces or largely eliminates the foregoing disadvantages and objections and which greatly increases the geographic range of operation for ice cube making machines as a consumer article. Specifically, it is an object of the present invention to provide aerator and evaporator units in an ice cube making machine which communicate with one another through a novel sheet metal tooth construction acting as its own water filter and being practically nonsusceptible to plugging. Another object of the present invention is to provide, in a machine having an evaporator freezing plate operating in conjunction with a hot tube cutter, a means for diverting the refrigerant gases while in hot state into the cutter so as to store energy therein useful in subsequently shaping the slabbed ice into cubes. A further object of the invention is to divide an ice making machine of the character herein referred to into a freezing and storage area separate from the compressor and the heated cube cutter area.

It is still a further object of the present invention to provide an ice cube making machine having an evaporator plate and having a hot cube cutter operating in conjunction therewith, in which the hot cube cutter, in shaping the slabs from the evaporator into cubes, simultaneously serves as the condenser in the refrigeration cycle so as to be chilled by the slab to function very effectively as a condenser and improve the efficiency of the evaporator after the latter is defrosted, and thus materially reduce the temperature pull-down time in the evaporator in restoring it to its freezing state from its defrosted state.

Further features, objects and advantages will either become apparent or be specifically pointed out when, for a better understanding of the invention, reference is made to the following drawings in which:

Figure 1 is a front elevational view of the present ice cube making machine;

Figure 2 is an enlarged fragmentary view in front elevation corresponding to Figure 1;

Figure 3 is an enlarged perspective view of a header appearing in the upper central portion of Figure 2;

Figures 4 and 5 are sectional views taken along the lines IV—IV and V—V of Figure 2;

Figure 6 is a perspective view of the hot tube cutter appearing in the upper right-hand side of Figure 2;

Figure 7 is a schematic refrigerant circuit diagram of the machine of Figure 1; and

Figure 8 is a schematic electric circuit diagram of the machine of Figure 1.

In more particular reference to Figures 1, 2, 3 and 4 of the drawings, an ice cube making machine 10 is shown, having a generally upright cabinet 12 of rectangular shape supported at each of its lower four corners by means of a corresponding number of legs 14. The cabinet 12 is of the compartmented type, being divided by means of a thick, insulated, vertically extending wall 16 into a relatively cool insulated rectangular compartment 18 on the left-hand side and a ventilated, compressor containing compartment 20 which is preferably uninsulated and which is on the right-hand side of the wall 16, as viewed in Figures 1 and 2. The ventilated compressor containing compartment 20, in addition to containing a preferably hermetically sealed, electric motor driven compressor and condenser unit 22 at the bottom of the compartment, includes a hot tube cutter 24 in the upper portions of the compartment for cutting slabs of ice into cubes which, under gravity, strike upon and slide down an inclined ice slide 26 having a pair of vertically disposed side walls at opposite sides of the body of the slide for guiding the cubes and having a chute portion 28 extending downwardly to the left through a horizontally disposed slot

formed in the division wall 16. The underside of the ice slide 26, owing to the inclination of the latter, serves to deflect the upwardly rising heat from the compressor unit 22 in a direction diagonally away from the slot in the division wall through which the chute portion 28 extends. Further, the underside of the slide 26 cooperates with the noted side walls of the latter to block off the naturally upwardly convected compressor heat from any tendency to find its way through the chute slot and into the refrigerated compartment 18. The chute end portion of the ice cube slide 26 has a depending lip 30 over which the sliding ice cubes pass in falling into an ice cube bin 32 disposed in the bottom of the cooler left-hand compartment 18 in the cabinet 12.

The bin 32 which, in the illustrated embodiment of the invention, holds approximately 125 pounds of ice cubes, has a thermostat capsule 33 therein and has an access door (not shown) by means of which the resultant stored cubes at 34 may be removed from the cabinet 12. At a level vertically above the horizontal chute slot 28 in the divisional wall 16, the wall 16 is formed with another chute 36 which is inclined downwardly and to the right, as viewed in Figures 1 and 2, so as to slope oppositely from the chute portion 28. The hot tube cutter 24 is disposed on a level between the two vertically spaced apart chute slots 28, 36 and is arranged to receive and operate upon individual slabs of ice as shown at 38 passing by gravity down the incline through the chute 36, which may be controlled by a gravity returned deflectable insulating door 40 normally obstructing the path of travel of the slab of ice 38. The door 40 acts as a trap door separating the refrigerated compartment 18 from the warmer ventilated compartment 20. Located above the door 40 on the same side of the insulating wall 16 therewith, there is provided a microswitch 39 having a diagonally depending pivoted arm 41 adapted to be deflected and held upwardly in a counterclockwise direction when a slab of ice enters by gravity onto the hot tube cutter framework 24. When the slab of ice sinks in the framework 24 during cutting, the arm 41 is restored to its unactuated downward position.

The slab of ice at 38 is formed on a refrigerator evaporator plate 42 located in the colder compartment 18 to the left in Figure 2, and is inclined at an angle substantially in the common plane of the inclined chute 36 and the upper surface of the hot tube cutter 24 which are similarly inclined. The evaporator plate 42 is a one-piece metal sheet, preferably stainless steel, whose heat transfer characteristics are not exceptional compared to copper, silver and other more efficient heat conductors but whose other properties, including resistance to corrosion, render it a widely accepted and used material for refrigerative purposes. The gravity induced travel of the plate frozen slab of ice to the right from the plate 42 is progressively and gradually brought to a shock-free halt by means of a springy bent steel bumper 44 provided at the outer side of the upper level of the hot tube cutter 24. The evaporator plate 42 is refrigerated by means of a spirally formed evaporator coil 46 forming a uniplanar tube bundle within the coils of which there is located a pair of spaced apart spacer blocks which may preferably comprise two solid, generally rectangular blocks of heat conductive metal but which, as illustrated, are constituted by a series of short open copper tubes disposed side by side and silver solder sweated together. One of said blocks 48 has a heat sensitive thermostat capsule element 50 mounted in the illustrated case to one of the open copper tubes thereof in heat transfer relationship so as to be sensitive to the temperature of the evaporator plate 42. The capsule element 50 is a sealed container connected by means of an outlet capillary tube to an appropriate thermostatic switch operated thereby in conventional fashion.

An upwardly open aerator tank 54 is located immediately above the evaporator plate 42 and has perpen-

dicular front and side walls 56, 58, respectively, and further has an inclined bottom wall 60 which is secured to the front and side walls in watertight joint connections and which, together therewith, forms a rearwardly open-ended tank having its open end adjacent a rear bracket 62 to which the tank side walls 58 and the adjacent walls of the compartment 18 are mutually connected. An angle member 61 extending along each one of the opposite sides 58 of the tank is rigidly affixed to the adjacent side 58 thereof and rests on a flange portion 63 extending integrally from the sides of the evaporator plate 42, Figure 4. A strip 65 secured to each of the opposite inside walls of the compartment 18 supports the angle member 61 and the flange portion 63 one above the other and is secured thereto by means of a suitable screw fastener. The rear end of the sloping wall 60 which inclines upwardly at the rear has a downturned portion 64 for forming a series of weirs in a manner hereinafter more fully set forth.

The aerator is adapted to contain a predetermined level of reservoir supplied water 66 suitable, following aeration, for freezing and ice cube making purposes. Below the evaporator plate 42 in the colder compartment 18, there is provided an upwardly open rectangular reservoir tank 68 having a level of water 70 maintained therein at substantially a constant value by means of a water inlet valve 72 controlled by a float arm 74 which carries a water level sensing float 76 at its outer end. A siphon tube 78 arranged in the form of an inverted V in the reservoir tank 68 has a crook portion 80 extending a slight distance above the normal level of the water 70 in the reservoir. One end of the siphon tube is connected to a drain line 82 suitably communicating with a sewage system and the other end is open and disposed an inch or so above the bottom of the reservoir tank 68. A spill line 84 connected to the front end of the aerator tank at a slight distance above the bottom 60 is connected by means of an overflow discharge spout 86 so as to constantly discharge water in a path of circulation from the upper aerator tank into the lower reservoir tank 68. A circulating pump 88 spaced by means of a two-inch supporting spacer block from the floor of the tank 68 pumps water from the reservoir upwardly through a pump discharge pipe 92 into the front end of the aerator through a manifold header fitting 94 adjacent the spill connection 84. The pump 88 may be appropriately provided with a pump suction filter screen, not shown.

In normal operation of the water system according to Figure 2, the pump 88 forces reservoir water through the pipe 92, which may be $\frac{3}{8}$ " copper tubing, upwardly into the aerator tank and a portion of the thus supplied water passes over the rear spillway at the rear open end of the aerator tank, and another portion returns by gravity directly to the reservoir through the spill line 84. Water leaving the system by evaporation and by adhering by freezing to the refrigerator plate 42 is supplemented by means of the float valve 72 which is connected to a pressurized water source, such as a city water supply, and which tends to maintain the level 70 constant during the normal freezing operation of the present apparatus.

During the previously referred to defrosting operation of the plate 42, which in the usual circumstance takes about two minutes' time, the water circulating pump 88 is deenergized in a manner hereinafter more fully set forth. Through retrograde action in the pump discharge pipe 92 and supplemented in effect by means of the constant spill of water through the spill line 84, the body of water in the aerator tank is rapidly transferred by gravity downwardly into the reservoir tank 68 so as to raise the level 70 a slight amount above and immerse the crook portion 80 of the siphon tube 78. The thus immersed siphon tube 78 completely fills with water and immediately forms a water escape path so as to commence to empty the normal water in the reservoir tank

68 supplemented by the newly added body of water being emptied out of the aerator tank. In the illustrated embodiment of the invention, the single siphon tube 78 is a $\frac{5}{8}$ " copper tube and serves rapidly to start emptying the reservoir 68, even though retrograde water tends to flow by gravity in two separate streams from the two aerator connected pipes 92, 86. After the manner of a charged siphon, the siphon tube 78 thereafter continues to draw water out of the reservoir tank until the end of the siphon tube 78 uncovers to break the siphon, even though during the stage of a dropping water level in the reservoir, the float controlled valve 72 automatically begins to open. The capacity of the siphon tube 78 is far in excess of the capacity of the inlet water valve 72 and the tank 68 is capable of being refilled to the level 70 only after the siphon effect is broken in the siphon tube 78. On being thus refilled, the tank 68 contains only fresh water for the restarting of the freezing cycle.

The manifold header fitting 94 appears more particularly in Figure 3. The pipe 92 carrying pump discharge is received in the stem portion at 96 of the manifold header fitting 94 which may be a T. The opposite arms of the T are open-ended at 98 and the arms intermediate their opposite ends may be formed with a series of lateral water spray openings 100 through which water is admitted in the aerator tank in an agitated state conducive to accelerating and accentuating the aeration thereof. The major portion of the pumped water, however, is admitted to the aerator tank through the opposite open end portions 98 of the arms of the T-fitting. The thus aerated water admitted through the T-shaped header fitting 94 at the front of the aerator tank proceeds through the tank to the open rear end thereof and spills down after the manner of water spilling over a dam and past the downturned weir constructed portion 64.

The weir construction just referred to is more clearly seen in Figure 4. The upwardly inclining bottom 60 of the tank which holds the aerated water 66 has the downwardly bent portion 64 thereof notched in the edge with triangular indentations to form a series of triangular teeth 102, the cusps of which overlie the evaporator plate 42 along a line slightly spaced above a slanted rear end portion 104 of the latter. The cusps of the teeth 102 evenly distribute the aerated water over the evaporator plate 42 and, at the same time, due to the slight spacing above the portion 104, the teeth are nonsusceptible to the clogging experienced with other forms of water distributing means, such as jets and spray nozzles commonly used in ice making machines. The resulting evenly distributed water in individual streams from the teeth 102 reunites upon or slightly below the slanted rear end portion 104 to form a flowing film across the upper surface of the refrigerated evaporator plate 42 and then adheres thereto by freezing so as gradually to build up into a cake or slab of ice 38. The refrigerating of the plate and the consequent freezing of the slab of ice by heat removal is accomplished by means of the refrigerating coil 46.

The refrigerating coil 46 under the plate 42 includes an inlet tube portion 107 shown in dotted lines in Figure 5 and an outlet tube portion 108 shown diagrammatically in a solid line in Figure 5. The inlet and outlet tube portions 107, 108 are arranged with their corresponding coil portions side by side and parallel with one another and the tube portions spiral rectangulary inwardly together in ever diminishing dimensions of area encompassed, to a point adjacent the pair of spaced apart rectangular blocks 48 whose position limits the minimum radius of curvature of the tube portions and prevents too abrupt a bend which might tend to weaken or rupture a wall of the tube portions. The thermostatic capsule element 50 mounted to the upper block 48 is connected by means of an outlet capillary tube 110 to an appropriate thermostatic switch operated thereby

in conventional fashion. Adjacent their ends innermost of the spiral, the inlet tube portion 107 and the outlet tube portion 108 have a common integral portion 112, at which they are physically spaced apart or separated from one another and which encircles the upper one of the spacer blocks 48 carrying the capsule 50 and at one corner of which the two tubes come together side by side at a point 114, from which they proceed to encircle the lower spacer block 48 and commence their outwardly directed spiral together. The tube portions 107, 108 of the coil 46 and the blocks 48 are firmly secured in contiguous heat transfer relationship to one another and to the bottom of the evaporator plate 42 by being silver solder sweated thereto or otherwise secured in suitable heat conducting relationship.

By reason of the physical limitations of the tube portions 107, 108 in the matter of the permissible sharpness or abruptness of bends of the same adjacent the center of the spiral, there is a resulting, otherwise unoccupied space at the center of the spiral which the blocks 48 occupy to good advantage. These blocks 48 conduct heat from the otherwise unserved or dead portions of the adjacent surface of the plate 42 directly into the surface of the internally cooled tube portions 107, 108 of the spiral coil 46. For this reason, the blocks 48 are preferably formed of metal having better heat conducting characteristics than the stainless steel plate 42, and the evidence of the effectiveness of these conductive blocks 48 is manifested in illustrated embodiment of the machine in that it freezes ice substantially as rapidly on the plate 42 in the area immediately above the blocks 48 as it does elsewhere over the coil contacting area of the plate 42. In a manner to be hereinafter described, the spiral tube portions 107, 108 may, in addition to having refrigerant in an evaporative liquid state passed therethrough for cooling in order to cool the plate 42, also have the refrigerant in its hot compressed gaseous state circulated therethrough instead, so as to heat the plate 42 and cause a slab 38 of ice frozen thereto to loosen and slide off by gravity onto the hot tube cutter 24 referred to.

The hot tube cutter 24 is internally heated by means of hot compressed refrigerant and appears more particularly in a perspective view in Figure 6. In essentials, the hot tube cutter 24 includes a rectangular lower pipe framework from which a pair of generally horizontally disposed hollow manifold pipes is supported in spaced apart relationship to one another, of which one of the pipes is indicated at 116 by means of a lead line at the midportion thereof, and the other of the pipes is indicated at 118 by means of a lead line at the midportion thereof. The pipes 116, 118 are coplanar in an inclined plane such that the pipe 116 is horizontal but on a slightly higher level than the companion horizontal manifold pipe 118. The manifold pipes 116, 118 are plugged at their corresponding left end portions at 120, 122, respectively, and the upper manifold pipe 116 is also plugged at its right end portion 124. The lower manifold pipe 118 has a curved discharge end portion 126 at its right end. Between the thus spaced apart parallel manifold pipes 116, 118, there is preferably provided in the plane thereof a series of laterally spaced apart longitudinally extending hot slicing or cutter tubes which are hollow and which communicate at their opposite ends with the interior of the hot gas charged manifold pipes 116, 118. Accordingly, when a slab of ice presses by gravity onto the gas heated tubes 128, it is divided into longitudinal strips from which the ultimate cubes 34 are made. Inasmuch as the manifold pipe 116 is at a higher level than the coplanar pipe 118, the cutter tubes slope at an inclination downwardly toward the lower pipe 118. A slab of ice which passes transversely across the upper pipe 116 slides by gravity along the slicing tubes 128 toward a resting point adjacent the lower pipe 118 and becomes heated by the slicing tubes 128 along straight lines whereby it is sliced into

strips after it comes to rest. This slicing is the natural consequence of the intensified localized line contact stress of the cutting tubes 128 on the underside of the slab of ice due to its own weight but is greatly accentuated in rate of cutting due to the heat conducted from the hot refrigerant within the tubes 128 through the walls of the tubes to the ice, the tubes being of conductive metal. In one physically constructed embodiment of the invention, the tubes 128 were of stainless steel having an internal diameter of .048" and the manifold header pipes 116, 118 to which they are connected were $\frac{5}{16}$ " inside diameter stainless steel tube.

The lower surfaces of the ice strips either before they are separated from one another, or during their severing by virtue of the cutting tubes 128 come to rest preferably upon another series of hot cutter tubes 132 which are spaced apart from one another and which are transversely disposed with respect to the longitudinal tubes such that in the plan view the longitudinal and transverse tubes 128, 132 produce a staggered level grid effect. The latter transverse cutting tubes 132 sever the ice strips by another division process into cubes 34 in which form the ice cubes fall onto the ice slide 26, Figure 2. The transverse cutting tubes 132, according to the showing of Figure 6, are communicatively connected at their opposite ends in vapor conducting relationship to a pair of longitudinally extending manifold pipes indicated in the lower frame by means of the reference numerals 136, 138 at their respective midportions. The latter manifold pipe 138 is connected at its midportion to a downwardly directed refrigerant return conduit 140. The companion longitudinal pipe 136 in the lower frame is slightly inclined so as to have a relatively higher upper end portion 142, which is rigid with, but blocked off from communication with, a two-section piece of pipe comprising a first blocked-off section 144 and a second section 146 which is communicatively blanked off from the section 144 but which is directly affixed to and structurally rigid with the section 148.

In one physically constructed embodiment of the invention, the transverse tubes 132 were of stainless steel having an inside diameter of .048" whereas the longitudinal pipes 136, 138 were stainless steel tubing having a $\frac{5}{16}$ " inside diameter. The latter longitudinal pipe 138 is blanked off from the second section 146 but is rigidly secured thereto at 150. The longitudinal pipes 136, 138 in the lower frame serve as spacer members to space apart the two-section pieces and a single opposite piece of pipe 152 in the lower framework. The pipe 152 is horizontally disposed and has a right end portion which is blanked off at 154 from the manifold pipe 136 in the lower framework and has a left end portion similarly blanked off from, but rigid with, the manifold pipe 138 in the lower framework. The midportion of the longitudinal pipe 136 is communicatively connected by means of a downwardly pitched pipe 156 to the curved discharge end portion 126 of the upper frame manifold pipe 118. The latter pipe is fixedly secured by means of four or more spacers 158 to the lower frame pipe 152. Two sets of spaced apart pairs of parallel vertical pipes shown at 160 physically support the upper manifold pipe 116 from the respective first and second sections 144, 146 of the two-section piece of pipe, but they are blanked off from the manifold pipe 116. A vertically disposed pipe 162 between the two sets of support pipes 160 communicatively connects the second section 146 of the two-section piece of pipe and the upper pipe 116. The second section 146 of the two-section pipe is supplied with hot gas refrigerant through a vertically upwardly extending supply conduit 164 which is parallel to the vertically extending discharge conduit 140. In the illustrated embodiment of the invention, the cube forming time for the slicing tubes 132, 128 is two minutes per slab of ice under usual conditions in the cycle.

Circulation of hot refrigerant in the hot tube cutter, 75

Figure 6, is in accordance with the following path. From the inlet vertical pipe 164, the compressed refrigerant vapor passes through the second section 146 of the two-section pipe in the lower framework and proceeds upwardly through the vertical pipe 162 to the uppermost pipe 116 in the upper framework. The refrigerant then passes from the pipe 116 internally through the series of longitudinal cutter tubes 128 into the lower pipe 118 in the upper framework. From the latter pipe 118, the refrigerant is discharged through the curved discharge portion 126 at the right end into the downwardly pitched pipe 156 connected to the midportion of the longitudinally extending pipe 136 in the lower framework. Refrigerant in the longitudinal pipe 136 is conducted through the series of transverse cutter tubes 132 across the lower framework to the longitudinally extending header pipe 136 and is collected at the midportion thereof and discharged downwardly through the discharge tube 140. The foregoing pipes and tubes included in the hot gas circuit form a rigid hot tube cutter framework constituting one of the two bundles of tubes through which the hot refrigerant vapor passes.

In Figure 7, a schematic refrigerant circuit diagram is shown which applies to the structure of the illustrated embodiment of the invention and which includes both of the bundles of tubes just referred to. Although the compressor 22 is preferably a hermetically sealed combined compressor and condenser unit, in the interests of clarity, the condenser section has been broken out in Figure 7 as a separate element 165 which forms the second tube bundle connected in tandem with the first tube bundle 24. The first and second tube bundles may be connected in the opposite order, 165 to 24, if desired, but preferably are arranged in the particular series sequence illustrated at 24, 165. Both bundles serve the same purpose from standpoint of the refrigerant cycle, namely, that of reducing the temperature of the hot compressed gas delivered by the compressor 22 so as to condense it into liquid state suitable for appropriate expansion in the spiral refrigerating coil 46. The intake pipe 164 for the second tube bundle 165 in the condenser section is connected to and supplied from the first tube bundle 24, and the outlet pipe 140 from the second tube bundle 165 is connected to the refrigerating coil 46 through an expansion valve 166. The expansion valve 166 may be a commercially secured product of standard design comprising a thermostatic capsule, a normal bleed-through control valve, and a short connecting capillary tube between the capsule and the valve causing them to cooperate in a manner whereby warming of the capsule generates internal pressure to force the bleed-through valve to open and accelerate the expansion of the refrigerant in the coil 46 and whereby excessive cooling of the capsule causes the bleed-through valve to return merely to bleed-through position to restrict the rate of expansion of the refrigerant. The capsule in the expansion valve 166 is preferably calibrated to produce an average refrigerating plate freezing pressure of 29° approximately. Connected in series with the expansion valve 166, but posterior thereto in the coil 46, there is provided a T-connection 173. The second tube bundle 165 has sets of interposed metal cooling fans over which air is circulated by means of an electric fan 167.

The compressor 22 discharges highly compressed hot refrigerant vapor through a pump discharge pipe 168 which delivers gas to a T-connection 170, the latter being connected by means of a first pipe 172 to the inlet side of the first bundle of tubes forming the hot tube cutter 24. A second pipe 174 is also connected to the T 170 and to the T 173 which is posterior to the expansion valve 166 under the evaporator plate 42. A compressor unloader valve 176 is connected across and provides a by-pass return between a pair of check valves 178 provided at the respective discharge and inlet sides of the compressor 22 which serve to prevent the compressed gases from going

in a direction other than the one desired indicated by the arrows 180, 182. The left-hand check valve 178 at the inlet or suction side of the pump is connected to the outlet pipe 108 of the spiral refrigerating coil 46 so as to draw expanded refrigerant vapor therefrom.

Included in the second pipe 174 and in series with the pump discharge line 168, there is a solenoid controlled by-pass valve 184 which is controlled by an electrically actuated plunger type solenoid 186 so as to open the valve 184 and to by-pass series connected first and second tube bundles 24, 165 and the expansion valve 166. Such actuation of the solenoid 186 by electrical energization causes the diverted hot gases to be delivered by the compressor 22 directly into the T-connection 173, supplemented in quantity by the volume of pressurized gases stored in the first and second tube bundles 24, 165, and naturally seeking a path of escape through the open valve 184. It is to be understood that the expansion valve 166 normally maintains the first and second tube bundles and the pump discharge line 168 under considerable back pressure, which may be of the order of 280 or more p. s. i. Reduction of this back pressure upstream of the restriction 166, as a result of opening the valve in the by-pass line at 184, is sufficient to permit a considerable amount of stored vapor in the bundles 24, 165 to expand backwardly through the pipe 172 and into the stream of flow of gas through the by-pass pipe 174.

The normally operating refrigerant cycle, beginning in the compressor 22 proceeds in a fashion whereby the hot highly compressed refrigerant is pumped through the pump discharge pipe 168 and through the T 170 into the first and second tube bundles 24, 165 which may be connected in the reverse order 165, 24 if preferable. Following the condensation process occurring in these tube bundles 24, 165, the refrigerant, which may be Freon 22, for instance, is conducted through the pipe 140 to the expansion valve 166 substantially in liquid state for subsequent expansion. In passing to the lower pressure area at the posterior side of the expansion valve 166, the liquid refrigerant begins to vaporize in the spiral refrigerator coil 46 due to absorbing heat of the evaporator plate 42 and is returned through the pipe 108 in substantially a low pressure gaseous state in which it is received for recompression by the compressor 22.

The function of the microswitch 39, along with other components of the control circuit, is best understood from the diagrammatic electrical showing of Figure 8. The microswitch 39 has a normally closed lower contact *a* and a normally open upper contact *b* which selectively open and close in dependence on the operation of the operating arm 41 connected to the microswitch. The lower contact *a* has connected in series therewith at the right, the by-pass valve controlling solenoid 186 for controlling the by-pass valve 184. The microswitch 39 is selectively energized or deenergized under the exclusive control of a double-throw time clock switch 200 having a set of normally open cam finger contacts *a* and a lower set of normally closed rocking contacts *b*. The contacts *a* rock open and closed respectively to energize and deenergize the microswitch 39.

The double-throw switch 200 is cam driven by means of a pair of substantially identical driving cams 202*a* and 202*b* which are uniformly rotated together by means of a constant speed time clock motor 204. At one point on the periphery of each of the driving cams 202*a* and 202*b* which are otherwise substantially circular, there is provided a notch 206 presenting a shoulder off which a cam finger carrying one of two contacts *a* rides to go into the notch. The respective notches 206 are occupied once each during one full revolution of the cams 202*a* and 202*b* which extends over approximately a 55-minute period in one physically constructed embodiment of the invention. The notches are slightly out of phase with one another such that the notch 206 on

the cam 202*a* is approximately 8 seconds timewise in advance of the corresponding notch 206 on the cam 202*b*.

The cam finger contacts *a* and the lower contacts *b* in the time clock switch 200 are carried in the usual way by a set of metal strips mounted to a pair of independently rocking blocks 201 and 203 of insulating material having a common fixed mounting shaft 205. The rocking blocks 201 and 203 have a set of respective biasing springs 208*a* and 208*b* which act in tension to rotate the blocks clockwise as viewed in Figure 8 so as to bias the cam fingers carrying the cam finger contacts *a* in continual engagement with the driving cams 202*a* and 202*b* respectively. Under continued rotation of the driving cams 202*a* and 202*b* in the counterclockwise direction indicated in Figure 8, the cam fingers ride so as to be held outwardly in the counterclockwise direction as viewed in Figure 2, keeping the normally open contacts *a* separated. The cam surfaces are so developed that they hold the contacts *b* closed during this period. The notch 206 on the cam 202*a* is the first to register with its adjacent cam finger, enabling the spring 208*a* to bias the rocking block 201 clockwise as viewed in Figure 8 so as to close the normally open contacts *a* and to open the normally closed lower set of contacts *b*. Normally motion of the driving cams 202*a* and 202*b* stops at this point in a manner hereinafter more fully described, but in any case in 8 seconds after restarting, the notch 206 on the cam 202*b* registers with the cam finger associated therewith so as to enable the biasing spring 208*b* to rock the block 203 clockwise as viewed in Figure 8 thereby reopening the cam finger contacts *a* and reclosing the normally closed lower rocking contacts *b*. A long sloping ramp surface on the edge of each of the notches 206 thereafter is effective to gradually rock the blocks 201 and 203 into the counterclockwise position in which they are normally held. The double throw switch 200 is energized by means of a conductor 210 which is connected through a thermostatically controlled line switch 212 to a two-conductor electrical plug 214 of conventional construction. The plug 214 is adapted to be inserted in any convenient electrical power outlet. The line switch 212 is controlled by means of the bin thermostat 33, Figure 2, which is connected by means of a capillary tube 216 to the switch 212 for operating the same, Figure 8.

A full bin 32 of ice is sensed by the thermostat capsule 33 which is cooled by the ice to open-circuit the line switch 212 and cause the freezing operation of the refrigeration apparatus to cease. A conductor 218 is connected to the conductor 210 in parallel therewith for supplying the electric motor driven compressor 22 with electricity and a return conductor 220 completes the circuit between the compressor 22 and the two-conductor plug 214. It is apparent that the compressor 22 ceases to function under only two circumstances, namely, that the two-conductor plug 214 is disconnected from a power source, or that the bin thermostat 33 senses a full bin of ice and thereby retracts to open-circuit the electrical supply conductors 210, 218 by opening the line switch 212. When the normally open lower contacts *a* of the plunger switch 200 are closed, the conductor 210 is connected thereby to a conductor 222 leading to the microswitch 39, which, in its lowermost unactuated position energizes the solenoid 186 in circuit therewith to open the solenoid controlled by-pass valve 184.

In the 55-minute cycle referred to, the usual time that the just noted circuit through the solenoid 186 is thus energized amounts to approximately two minutes, which is the time required to defrost the evaporator plate 42, Figure 7, so as to free ice therefrom. The freed ice in negotiating its path of travel by gravity to the hot tube cutter framework 24 strikes the arm 41 of the microswitch 39 so as to shift the same into its upper

position to activate the microswitch upper contact *b* and open the lower contact *a*. Thus, the by-pass valve controlling solenoid 186 is deenergized and a conductor 224 is energized through the microswitch 39 which is connected respectively to the time clock motor 204, to the condenser cooling fan 167, and to the water circulating pump 88, all of the latter being connected to a common return junction 226. The return junction 226 is appropriately connected to the conductor 220 of the two-conductor plug 214.

The microswitch 39 in its operation continues to remain upwardly so as to energize its upper contact *b* so long as a slab of ice continues to remain above the level of the cutter framework 24 and continues to hold the actuating arm 41 upwardly. Inasmuch as the compressor is continuously energized during this time, and inasmuch as the fan 167 and the water pump 88 are reenergized at this time, the refrigeration cycle commences and, simultaneously, the time clock motor 204 recommences operation. Resumption of operation causes the notch 206 in the cam 202*b* to approach registration with the adjacent cam finger and, in the progress of approximately 8 seconds time, the notch 206 in the cam 202*b* is occupied in the same manner as the other notch 206, enabling the biasing spring 208*b* to close the lower set of rocking contacts *b* and open the normally open set of cam finger contacts *a*. Accordingly, the electrical conductor 224 which energizes the units 88, 167 and 204 respectively is connected to the supply conductor 210 through the upper contacts *b* of the switch 200 and the previous circuit completed through the microswitch 39 is open-circuited due to the opening of the lower set of contacts *a* of the plunger switch 200. After approximately a one minute time period following the energization of the time clock motor 204 and the components 88 and 167, the slab of ice in the cutter framework is divided into cubes by the cutter and enters the storage bin 32 and, at this time, the unsupported arm 41 supporting the microswitch 39 in its upper position is restored to its lower position so as to reclose the lower contact *a* of the microswitch 39 and prepare the circuit 222 for subsequent completion by the normally open contacts *a* of the double throw switch 200.

Means is provided whereby the refrigeration cycle is reinitiated automatically in the event of a power failure at the precise time at which the microswitch 39 is ordinarily forced into its upper position by a slab of ice so as to close the upper contact *b* thereof and energize a circuit. Illustrative of one form of the automatic reinitiation means is the thermostatic capsule 50 connected to a switch, Figure 8, in parallel to the contact *b* of the microswitch 39 for controlling the same through a pressure actuated capillary tube 110, Figure 7. The thermostatic capsule 50 may be calibrated for a closing temperature of approximately 50° F. The thermostatic capsule 50 expands to close the switch controlled thereby, Figure 8, and to reinitiate the freezing operation of the machine by energizing the conductor 224 in spite of the lack of effectiveness of operation of the microswitch 39.

It is immaterial to the cycle of operation of the apparatus of Figures 1 through 8 so far as the time at which the plug 214 is connected or disconnected to a power supply source, and the controls never become confused as to how they should operate or how the cycle should be resumed. The plug 214 may be disconnected when either cam finger on the double throw switch 200 occupies the notch 206 of the cam 202*a* or cam 202*b* or else is entering or leaving that notch 206. It is immaterial whether the microswitch 39 occupies its lowermost or uppermost position and it is immaterial whether or not the switch controlling thermostat capsules 33, 50 have their particular switches in the open

or closed positions. In the most usual case, the plug 214 will be disconnected at a time at which the cam fingers of the double throw switch 200 is riding on the circular outer periphery of the cams 202*a* and 202*b*. Reconnection of the connector 214 at some subsequent time will find the normally closed upper contacts *b* closed in the switch 200 so as to reenergize the components 88, 167, and 204 to resume a freezing operation. In case the plug 214 is disconnected while the first-acting cam finger on the switch 200 is received in the notch of the cam 202*a*, then, depending on whether or not the microswitch 39 is actuated by a slab of ice at the time of reconnection of the plug 214, a circuit is established through the contacts *a* of the switch 200, thence through the conductor 222, thence through the microswitch 39 or the evaporator thermostat capsule switch at 50 to energize the conductor 224 and reestablish a freezing cycle. In the event that the plug 214 is disconnected at the time just before a freed slab of ice strikes the actuating arm 41 of the microswitch 39, a suitable period of time delay must then be allowed for, following reconnection of the plug 214, before the machinery will reactivate itself. This period of time delay is the period necessary for the evaporator plate thermostat capsule 50 to warm up sufficiently to close the switch in parallel circuit with the microswitch between the conductor 222 and the conductor 224.

In the operation of the apparatus of Figures 1 through 8, the driving cam assembly 202*a* and 202*b*, in moving ultimately into its solid line position shown in Figure 8, is slowly rotated by the drive motor 204 and gradually forces the rocking blocks 201 and 203 in the switch 200 counterclockwise, the normally closed contacts *b* being simultaneously closed when the normally open set of contacts *a* initially opens so as to shift the path of connection between the conductors 210, 224 from the microswitch upper contact *b* to the upper contacts *b* in the plunger switch 200. Therefore, the microswitch conductor 222 is deenergized and when the microswitch 39 resumes its normally lower position, the circuit for the solenoid 186 is merely prepared thereby for reenergization, but is not energized. The cam assembly 202*a* and 202*b* continues to rotate for approximately a 55-minute freezing operation of the apparatus after which time the notch in the cam 202*a* is reoccupied by the cam finger on the block 201 so as to open-circuit the refrigerating components and close the normally open set of contacts *a* in the plunger switch 200.

In the foregoing freezing, cubing, and storing operations, the time cycle roughly amounts to one hour. During any one freezing operation necessary for a harvest of ice, the first tube bundle 24 forming the hot tube cutter becomes considerably warm and, at the same time, the spiral tube bundle 46 becomes considerably chilled. Defrosting of the system occurring at predetermined time periods due to the operation of the time clock motor 204 results in the heating of the freezing coil 46 for a two-minute period, during which period the compressor 22 is continually operated. In the initial phases of this period, perhaps fifteen seconds, the accumulated high pressure gas stored in the hot tube cutter 24 and in the condenser 165 bleeds back in retrograde action in to the T 170 and passes through the open by-pass valve 184 to supplement and add to the defrosting heat being generated in the refrigerating coil 46. The two-minute defrost results in an ice slab 38 thawing loose and clearing the evaporator plate 42 to take up a position on the already hot tube cutter framework 24. This action trips the microswitch 39 and results in a restoration of the freezing cycle whereby water is restarted to circulate and again passes over the plate 42 and whereby the by-pass valve 184 closes and restores the hot refrigerant to its initial path including the hot tube cutter 24, the condenser 165, and the expansion valve 166, so as to chill the evaporator plate 42. In the

meantime, the slab of harvested ice released by the evaporator plate 42 rests on the slicing tubes of the hot tube cutter 24 and the hot tube cutter begins to divide the ice into pieces while simultaneously the heat being lost from the cutter to the ice causes the cutter 24 to drop in temperature so as to greatly improve its characteristics as a refrigerant vapor condenser. This increase in efficiency of the condenser component in the freezing system causes a consequent improvement in efficiency in the evaporator plate 42 such that the evaporator plate rapidly recools to its freezing temperature without necessarily overloading the compressor 22, Figure 7, at the outset of the freezing operation when it resumes. Moreover, it will be noted that the hot tube cutter 24 and the condenser 165 are interposed in the conduit 140 anterior to the expansion valve 166 and posterior to the T 170, which also supplies the by-pass valve 184. Accordingly, the tube cutter 24 and the condenser 165 serve as a heat storage bank or vapor accumulator for assistance in rapidly defrosting the evaporator plate 42 as soon as the by-pass valve is caused to open, thus supplying the same with backed-up pressure in the expansion valve controlled conduit 140. The efficiency is thereby improved in the heat-up time necessary to defrost the evaporator plate and elevate the temperature thereof from a freezing temperature to a defrosting temperature sufficient to free the slab 38 of frozen liquid thereon. Finally, the vapor heated hot tube cutter framework 24 eliminates the need for a so-called hot gas receiver or accumulator in the refrigerating system, inasmuch as the internal volume of the hot tube cutter is of such a magnitude to be sufficient to act as a hot reservoir or receiver.

It will be apparent from the foregoing novel construction of the spiral evaporator tube bundle 46 and the association of the hot tube cutter 24 therewith that the presently disclosed apparatus can produce thicker ice in less time than produced by conventional machines and that it offers a decided improvement in lowering the defrosting time of the spiral evaporator coil 46, in lowering the temperature pull-down time thereof following defrosting, and in lowering the slab freezing time of the same. By reason of the improved Weir arrangement presently disclosed between the evaporator plate 42 and the aerator thereabove, it is apparent that plugging of the aerated water supply is effectually eliminated.

Variations within the spirit and scope of the invention described are equally comprehended by the foregoing description.

I claim:

1. In an ice cube making machine, a multi-compartment cabinet divided into adjacent compartments having a common vertical division wall, said wall having vertically spaced apart chutes formed therein connecting the compartments, an ice slab cuber in one compartment disposed at a level between the chutes for receiving slabs to be cubed from one of the chutes and discharging the cubes into the other of the chutes, said one chute having a deflectable door in the path of the ice slabs and normally effective to keep the chute closed, and a separate slab freezing and cube storing units in the adjacent compartment, said slab freezing unit confronting said one chute for discharging slabs thereinto and said cube storing unit being disposed in the path of the cubes discharged from the other chute.

2. In an ice cube making machine, a multi-compartment cabinet divided into adjacent compartments having a common vertical division wall, said wall having vertically spaced apart chutes formed therein connecting the compartments, a heated slab cuber in one compartment disposed at a level between the chutes for receiving in one direction slabs to be cubed from the upper chute and discharging the cubes in a reversed direction into the lower chute, and separate slab freezing and cube storing units in the adjacent compartment, said slab freezing unit confronting the upper chute for discharging slabs thereinto and

said cube storing unit being disposed in the bottom of the other compartment in the path of cubes discharged from the lower chute.

3. An ice cube making machine having a partition therein provided with sloping chutes traversing the same at different levels and sloping in opposite directions, a normally refrigerated compartment at one side of the partition having hollow, internally passaged ice freezing means disposed therein substantially at the level of one chute and having bin means toward which the chute at the other level slopes, and a normally warmer compartment at the opposite side of the partition having a hollow, internally passaged hot cuber disposed generally between the levels of the chutes and operative while cooling hot refrigerant in the internal passages thereof for delivery to the passages of the freezing means, to divide the ice received from said one sloping chute into pieces and discharge the same through the other sloping chute into the bin means.

4. In an ice cubing machine, an insulative partition having an inclined chute therethrough, a refrigerated compartment disposed on one side of the partition so as to be adjacent the lower end of the chute, and having a bin disposed therein at the foot of the chute, a compressor compartment at the opposite side of the partition and having a cube cutter at the head of the chute, a second chute in the partition inclined in the opposite direction from the first-named chute and arranged with said cube cutter disposed at the foot thereon, and a sloping freezing plate in said refrigerator compartment having the foot thereof in registry with the head of the second chute.

5. In combination, vertically and laterally spaced apart freezing plate and cutter units, said units having hollow internally passaged portions and said cutter unit having the passage portions thereof adapted to transmit and be heated by means of hot refrigerant, means forming a path for the flow of refrigerant including the respective internally passaged portions of the cutter and freezing plate units serially arranged in that order relative to one another, and means forming a gravity slide path between the units including a chute sloping downwardly for transferring frozen liquid from the freezing plate unit to the cutter unit so as to absorb cutting heat from the flowing refrigerant transmitted through the latter and at the same time chill the flow for subsequent use as a refrigerant.

6. In combination, spaced apart freezing plate and cutter units, said units having hollow internally passaged portions and said cutter unit having the passage portions thereof adapted to transmit and be heated by means of hot refrigerant, means forming a path for refrigerant including the respective internally passaged portions of the cutter and freezing plate units serially arranged in that order relative to one another, and means forming a path between the units for transferring frozen liquid from the freezing plate unit to the cutter unit so as to absorb cutting heat from the refrigerant.

7. In an aerator and freezing plate arrangement, means for directing aerated water across the upper surface of the freezing plate, and a spiral wound refrigerator coil construction affixed to the undersurface of the plate, said construction including block means and a pair of similarly convoluted inflow and outflow tubes arranged with their coils touching side by side and spiraling inwardly into contiguous relationship with the block means in loops of diminishing size, said tubes having a common looped portion adjacent the center of the spiral and separating from one another at the loop such that the loop encircles the block means.

8. In an aerator and freezing plate arrangement, means for directing aerated water across the upper surface of the freezing plate, and a spiral wound refrigerator coil construction affixed to the undersurface of the plate, said construction including spaced apart block means and a pair of similarly convoluted inflow and outflow tubes arranged with their coils touching side by side in a common plane with the plane of the block means and spiral-

ing inwardly toward the block means in loops of diminishing size, said coils having a common looped portion adjacent the center of the spiral and separating from one another at the loop such that the loop contiguously encircles at least one of the block means.

9. In an aerator and freezing plate arrangement, means for directing aerated water across the upper surface of the freezing plate, and a spiral wound refrigerator coil construction affixed to the undersurface of the plate, and comprising a pair of similarly convoluted inflow and outflow coils in plane with one another and having a common central looped portion, said coils spiraling outwardly in continuous contact side by side from their common central looped portion so as to define a path traversing essentially a complete undersurface portion of the freezing plate.

10. A refrigerating system for an ice cube making machine comprising condenser means including a tube bundle forming a hot tube cutter framework, a refrigerating tube bundle, conduit means including an expansion valve connecting the two bundles, conduit means through which a flow of hot compressed refrigerant normally passes into the condenser means for subsequent expansion from condensed state by the expansion valve so as to cool the refrigerating tube bundle, a by-pass interconnecting the two conduit means, and valve means in the by-pass effective to temporarily divert flow of the hot compressed refrigerant to the refrigerating tube bundle for defrosting purposes by by-passing the flow from the hot tube cutter framework.

11. In an ice freezing and cutting type refrigerant system, condenser means including a hot tube cutter in which hot compressed refrigerant is condensed, a freezing plate means connected to the cutter and having a cycle whereby it normally loses heat to the condensed refrigerant as the latter reexpands for freezing ice on the plate, means for interrupting the cycle for defrosting ice from the plate, means for reinitiating the freezing cycle of the plate, and means whereby the ice freed by defrosting is delivered to a position on the hot tube cutter, thereby cooling the same and initially accelerating the condensation rate in the cycle to compensate for the heavy initial load on the system drawn by the defrosted plate in being rechilled to normal freezing temperatures immediately following reinitiation of the freezing cycle.

12. A refrigeration system for an ice cube making machine, comprising first and second tube bundles connected in that order and jointly forming a condenser means, a refrigerating tube bundle, conduit means including an expansion valve connecting the second tube bundle and the refrigerating tube bundle, said first tube bundle comprising a hot tube cutter framework, conduit means through which a flow of hot compressed refrigerant normally passes into the hot tube cutter framework in the condenser means for subsequent expansion from condensed state by the expansion valve so as to cool the refrigerating tube bundle, a by-pass interconnecting the first and second named conduit means, and valve means controlling the by-pass to heat the refrigerating tube bundle temporarily by bleeding off the hot compressed refrigerant accumulated in the hot tube cutter framework and also diverting the normal flow of hot compressed refrigerant into the refrigerating tube bundle for defrosting purposes.

13. Refrigerating apparatus comprising a refrigerating plate, pumping means for delivering hot compressed refrigerant vapor to the plate, conduit means including a vapor heated cube cutter and a condenser and an associated conduit control valve connected in that order and forming a first refrigerant path between the pumping means and the refrigerating plate, by-pass pipe means connected in parallel to the first path between the pumping means and the refrigerator plate, a control valve included in said by-pass pipe means and being normally closed whereby in normal operation to cooperate with

the expansion valve to maintain high vapor pressure in the cube cutter which acts as hot vapor accumulator, and means for opening said control valve so as to release said pressure and divert at least a major portion of the flow of refrigerant into the second path thereby to subject the refrigerating plate to a defrosting action supplemented by the accumulated heat of the vapor in the hot cube cutter.

14. The method of utilizing waste heat in reducing the temperature pull-down time of an ice freezing refrigerator plate in a machine having a hot tube cutter bundle included in the heat dissipating refrigerant condensing section thereof, comprising the steps of storing heat of condensation of the refrigerant in the hot tube cutter bundle during the normal freezing operation of the refrigerator plate resulting from expanding the condensed refrigerant, temporarily diverting the flow of hot refrigerant directly into the refrigerator plate supplemented by bleeding off the refrigerant accumulated in the cutter bundle and employing the same to defrost and separate ice from the refrigerator plate, hot cutting the separated ice into pieces in the hot tube cutter due initially to the stored heat therein, and simultaneously reinitiating the normal freezing operation of the refrigerator plate with a minimum of temperature pull-down time due to increased capacity of condensation of the refrigerant occurring in the hot tube cutter while concurrently cutting the ice.

15. The method of utilizing waste heat in reducing the pull-down time of an ice freezing refrigerator plate in a machine having a hot tube cutter bundle included in the heat dissipating refrigerant condensing section thereof, comprising the steps of storing heat of condensation of the refrigerant in the hot tube cutter bundle during the normal freezing operation of the refrigerator plate which is characterized by expanding the condensed refrigerant, diverting at least a portion of the flow of hot refrigerant so as to employ the same to defrost and separate ice from the refrigerator plate, hot cutting the separated ice into pieces in the hot tube cutter due principally to the stored heat therein, and simultaneously reinitiating the normal freezing operation of the refrigerator plate with a minimum of temperature pull-down time due to increased capacity of condensation of the refrigerant occurring in the hot tube cutter while concurrently cutting the ice.

16. An improved method of operating a hot cutter tube type cubing machine in which, in the normal freezing cycle, the hot cutter tubes form at least part of a condenser bundle for delivering expansible refrigerant in condensed state to a refrigerator plate in the machine for freezing ice slabs on the same, comprising the steps of defrosting the freezing plate so as to separate a frozen slab from the plate, reinitiating the freezing cycle of the refrigerator plate so as to reduce the temperature thereof and freeze more ice, and simultaneously hot cutting the previously separated slab within the hot cutter tube bundle so as to reduce the temperature reduction time of the refrigerator plate due to the increased capacity of condensation of the refrigerant occurring in the hot tube cutter while concurrently cutting the slab.

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