Dec. 6, 1960 M. A. BARTELS 2,962,869

CRUSHED ICE MAKING MACHINE

Filed Sept. 12, 1957 3 Sheets-Sheet 1

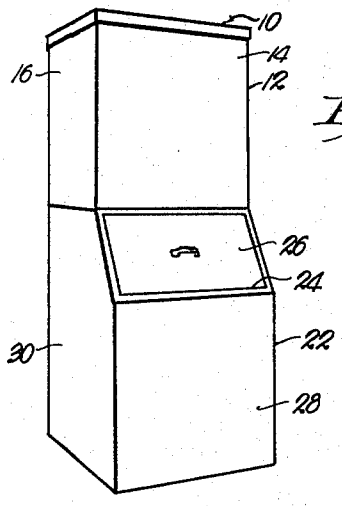


Fig. 1.

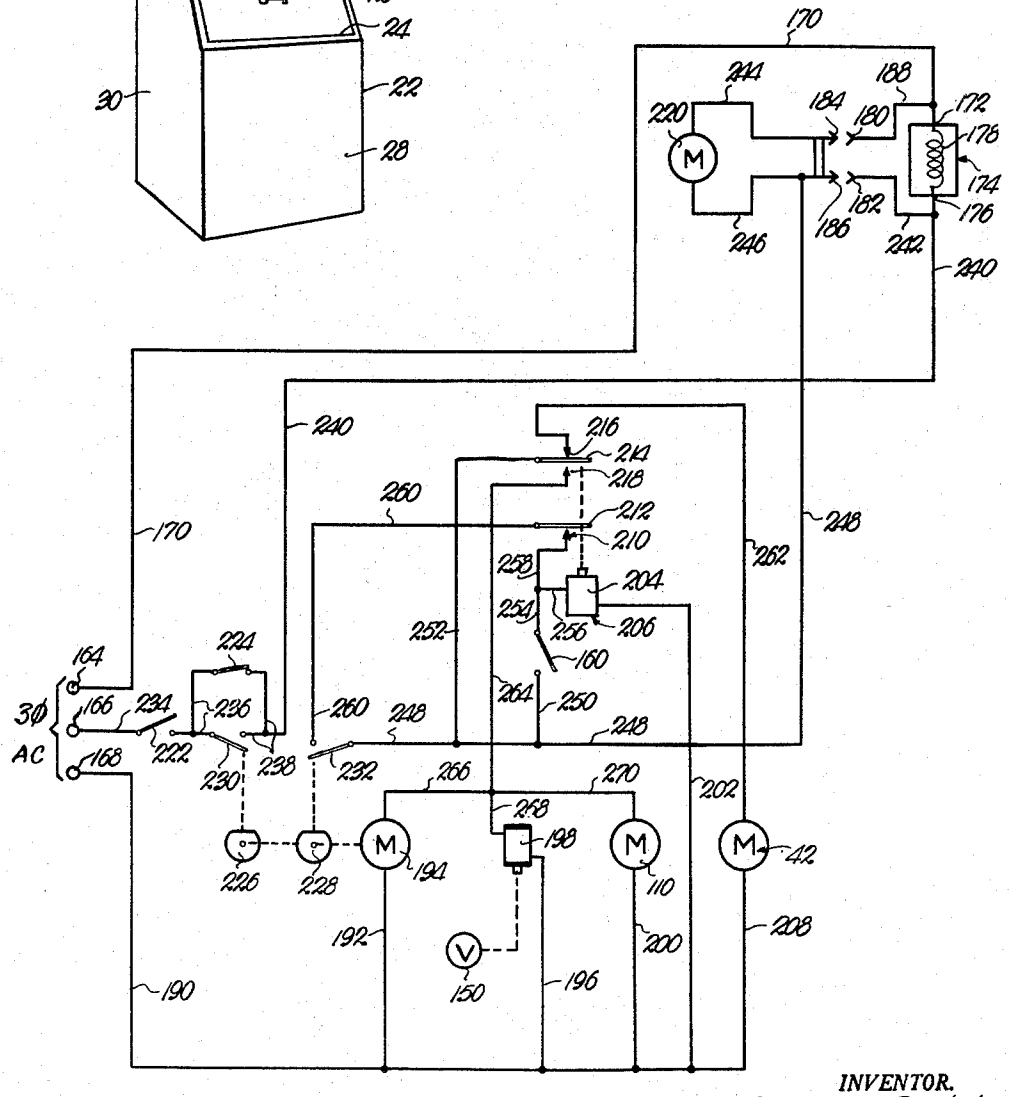


Fig. 6.

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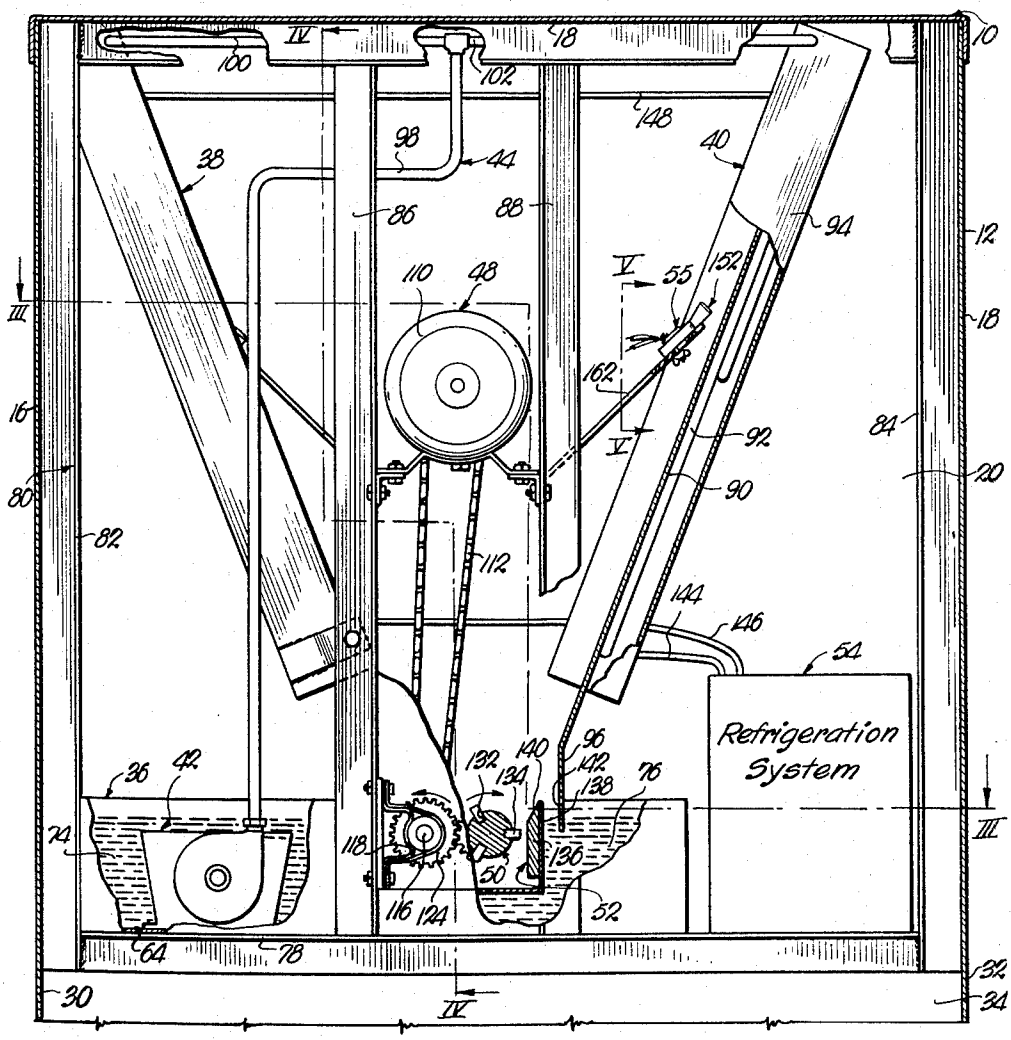


Fig. 2.

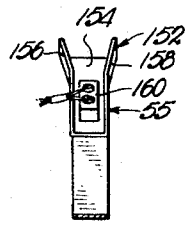


Fig. 5.

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CRUSHED ICE MAKING MACHINE

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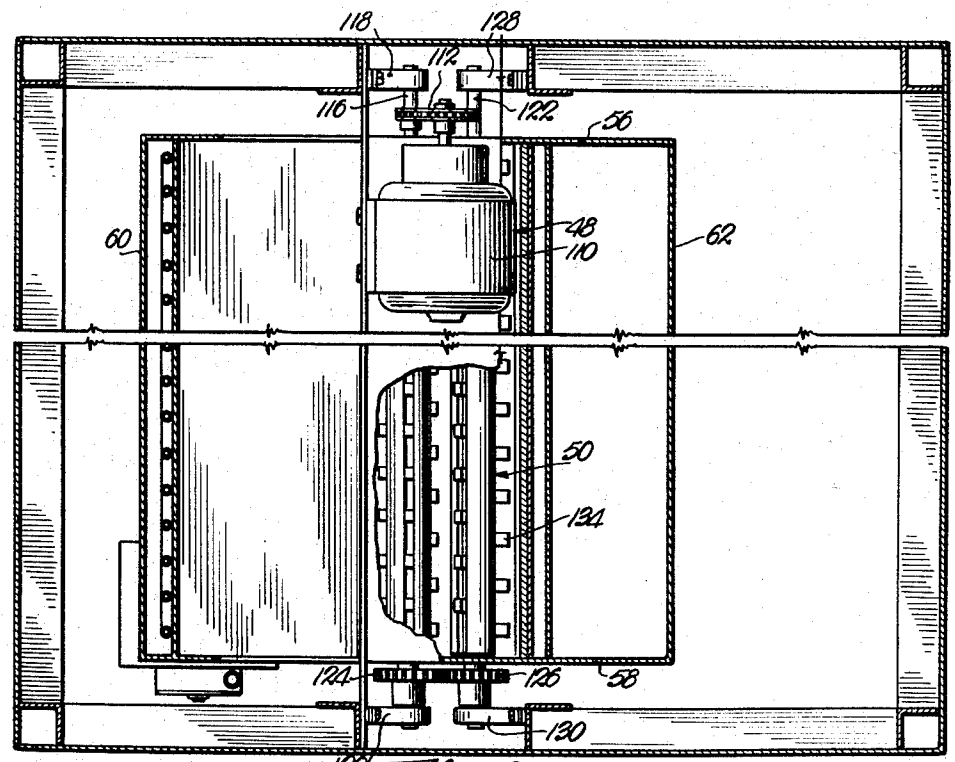


Fig. 3.

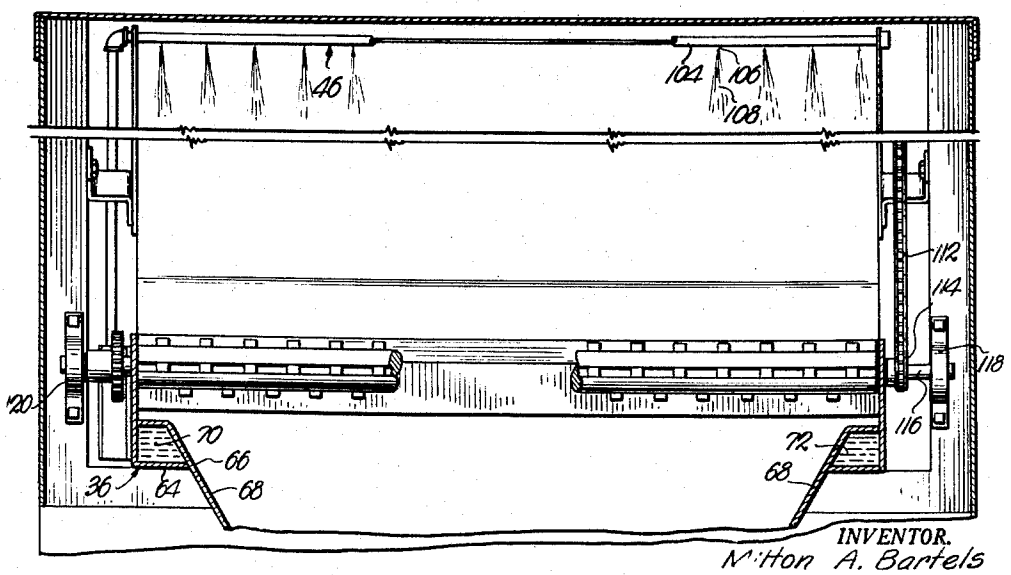


Fig. 4.

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2,962,869

CRUSHED ICE MAKING MACHINE

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4 Claims. (Cl. 62—138)

This invention relates to improved apparatus for use in manufacturing and storing until required for use commercial quantities of crushed ice such as would be required in restaurants, hotels or the like.

It is an important object of the invention to provide apparatus for the mentioned type having improved electrical control circuitry and components by which the apparatus is rendered automatically operable to maintain at all times a predetermined quantity of crushed ice available for use.

It is another important object of this invention to provide in such apparatus improved means for forming and crushing the ice, including a number of evaporator assemblies provided with sloping, heat conductive plates onto which water may be sprayed for freezing thereof, together with means for reversing the action of the refrigeration system to heat the evaporator assembly and said plate, whereby ice formed on the latter in a sheet will be loosened therefrom and moved by the action of gravity into the crushing mechanism of the apparatus.

It is another important object of the invention to provide such apparatus in which is incorporated an improved form of ice crushing mechanism utilizing crushing rollers and cooperating fracturing bars associated with each evaporator assembly, with the crushing rollers being of improved construction increasing the strength and resistance to wear thereof.

Another important object of this invention is the provision in the means for controlling the automatic operation thereof of a novel type of thermostatic switching assembly including a temperature responsive electrical switch mounted within a scoop in turn disposed in predetermined spaced relationship to the plate of an evaporator assembly in such manner that, as the thickness of ice being formed upon such plate increases, water being sprayed upon the plate above the scoop assembly will ultimately commence to pass over such scoop assembly and into contact with the temperature responsive switch, thereby actuating the latter whenever the thickness of ice on the evaporator assembly plate reaches a predetermined thickness.

Still other important objects of the invention, including a number of significant details of construction, will be made clear or become apparent as the following description of the invention progresses.

Reference is made to the accompanying drawings wherein:

Figure 1 is a perspective view of a housing such as has been found suitable for containing the apparatus contemplated by the invention;

Fig. 2 is a fragmentary cross-sectional view of the upper portion of the apparatus taken from a plane immediately to the rear of the front wall of the housing and looking rearwardly therefrom, parts being broken away and shown in section for clarity of illustration;

Fig. 3 is a cross-sectional view of the apparatus taken on irregular line III—III of Fig. 2;

Fig. 4 is a fragmentary cross-sectional view of the apparatus taken on line IV—IV of Fig. 2;

Fig. 5 is a detailed, perspective view of the scoop and thermostatic switching assembly per se; and

Fig. 6 is a schematic diagram showing the cooperative relationship between various working and control components of the apparatus and the refrigeration system forming a part thereof.

Referring first particularly to Fig. 1, there is illustrated a housing generally designated 10 suitable for containing the apparatus contemplated by the invention, such housing 10 having an upper portion 12 defined by a front wall 14, a pair of opposed side walls 16 (see Fig. 2), a top wall 18 (see Fig. 2) and a rear wall 20 (see Fig. 2); and a lower housing portion 22 having an access opening 24 therein normally closed by a door or lid 26 and otherwise enclosed by a front wall 28, a pair of side walls 30 and 32, a rear wall 34 and a bottom wall (not specifically illustrated). It will be understood that the lower portion 22 of housing 10 constitutes or contains structure presenting a bin for the storage of crushed ice theretofore prepared by the apparatus, access to such stored product being had through the opening 24.

Reference is next made particularly to Figs. 2, 3, 4 and 5 of the drawings. From these figures it will be seen that the major portion of the working parts of the apparatus of the invention are housed within the upper portion 12 of the housing 10 and include a water tank generally designated 36, a pair of sloping evaporator assemblies generally designated 38 and 40, a pump generally designated 42 within the water tank 36, pipe means generally designated 44 coupling the pump 42 with spray means 46 provided within each of the evaporator assemblies 38 and 40, a prime mover generally designated 48, a pair of crushing rollers generally designated 50 in cooperative relationship with a pair of fracture bars generally designated 52, a refrigeration system generally designated 54 and including the remaining components of the refrigeration part of the apparatus used in conjunction with the evaporator assemblies 38 and 40, and a thermally responsive, ice thickness detecting device generally designated 55.

The water tank 36 includes a pair of opposed side walls 56 and 58, a pair of opposed end walls 60 and 62, a bottom wall 64 having a central, elongated opening 66 therein extending transversely of the tank 36, a chute 68 extending around the periphery of the opening 66 and joining with the side walls 56 and 58 in such manner as to present intercommunication conduits 70 and 72 extending between a pair of main water containing chambers 74 and 76 adjacent opposite ends of tank 36 and separated, except for the hydraulic connection therebetween by conduits 70 and 72, by the central opening 66 in bottom wall 64 defined by the chute 68. The tank 36 is mounted upon a horizontal frame member 78 of frame structure generally designated 80 internal to the upper portion 12 of housing 10 which also includes a pair of outer, upright frame members 82 and 84 and a pair of spaced, central, upright frame members 86 and 88.

The evaporator assemblies 38 and 40 may be identical and include a heat conductive metallic plate 90, a spiral coil 92 mounted in heat exchanging relationship upon the underside of the plate 90 and an enclosure 94. The assemblies 38 and 40 are mounted in any suitable manner upon the frame 80 so as to dispose the plates 90 in opposed, spaced relationship with the planes thereof sloping inwardly and downwardly and converging as the lowermost extremities thereof are approached. Each of the plates 90 preferably includes a lowermost vertical portion 96 extending into the top of the tank 36 for purposes which will hereinafter be made clear.

The pump 42, which is electrically driven by a self-contained motor, is disposed within the chamber 74 of tank 36 and adapted to pump water from the latter into

the pipe means 44. Pipe means 44 include an upwardly extending stretch 98 for carrying water from the tank 36 to a point adjacent the top of the upper portion 12 of housing 10, whereat the flow is split into oppositely directed conduits 100 and 102 leading to the spray means 46 in each of the assemblies 38 and 40 respectively. The spray means 46 in each of the assemblies 38 and 40 may comprise a laterally extending horizontal pipe 104 having spaced perforations 106 therein for directing streams 108 of water onto the corresponding plate 90 adjacent the top thereof.

The prime mover 48 preferably comprises an electric motor 110 coupled by endless chain means 112 to a sprocket 114 adjacent one end of a horizontal shaft 116, which is mounted for rotation by bearing bracket means 118 upon one of the uprights 86 of the internal frame 80, the other end of shaft 116 being similarly mounted by bracket means 120. The shaft 116 is disposed to extend across the top of the opening 66 and discharge chute 68 provided centrally of the water tank 36. A second shaft 122 is mounted in spaced parallelism to the shaft 116 in transversely extending relationship across the top of opening 66 and is operably coupled with the driven shaft 116 for rotation by the latter by means of pinions 124 and 126 on the shafts 116 and 122 respectively. Bearing means 128 and 130 similar to the bearing brackets 118 and 120 are provided for rotatably mounting the shaft 122 upon the frame 80.

Each of the shafts 116 and 122 carries or is formed intermediate its extremities to present the elongated, generally cylindrical crushing rollers 50. Each of such rollers 50 is provided with a plurality, three being found satisfactory, of longitudinal grooves 132 therein, into each of which grooves is fitted and secured, by press fitting, welding or both, a plurality of crushing teeth 134 which are spaced longitudinally from each other along the particular groove 132. If desired, the teeth 134 of the two crushing rollers 50 may be relatively offset longitudinally of the latter for corresponding rows thereof. The ice crushing machine provided in the apparatus further includes a fracture bar 52 for each of the rollers 50, which fracture bars 52 comprise elongated, horizontal members 136 of hard metal spaced outwardly from the corresponding crushing roller 50 by a predetermined distance slightly greater than the distance which the teeth 134 extend radially from the roller 50. The fracture members 136 are mounted upon a sub-frame 138 within the water tank 36 in such disposition that an upper beveled surface 140 of each member 136 is in substantial alignment with an extension of the sloping upper side of the corresponding plate 90. Such members 136 are slightly spaced, however, from the vertical, lowermost portion 96 of the plates 90 in order to provide an opening as at 142 for the return of water running over the plate 90 and not frozen upon the latter into the corresponding chamber 74 or 76 of the tank 36.

The refrigeration system 54 is essentially conventional in character and is not illustrated in detail. It will be understood, however, that it is coupled with the evaporator assemblies 38 and 40 as by conduit means 144, 146 and 148 and that it includes a suitable compressor, electric motor for driving the compressor, condenser and other associated, conventional parts, none of which are shown in mechanical detail. As will hereinafter be more fully explained in connection with the schematic diagram of Fig. 6, the refrigeration system 54 also includes a valve 150 adapted for reversing the connections between the refrigeration system 54 and the assemblies 38 and 40 in such manner that either a cooling medium may be passed through the coils 92 to render the assemblies 38 and 40 operable as evaporators or, alternately, hot gases may be delivered to the coils 92 to render the assemblies 38 and 40 operative as the condenser portion of the refrigeration system 54, as will hereinafter be further explained.

The ice thickness detecting device includes a water scoop generally designated 152 having a bottom wall 154 and a pair of opposed, flared side walls 156 and 158. Within the scoop 152 is mounted a thermally responsive electric switch 160 adapted to be actuated when cool water is passed thereby through the scoop 152. The device 55 is adjustably mounted upon a bracket element 162 secured to the frame members 88 adjacent the mounting of the motor 110 to the latter, such device 55 being adjustable relative to the plate 90 of the assembly 40 so that no water running downwardly upon the plate 90 will pass through the scoop 152 until a layer of ice of predetermined thickness has been formed upon the plate 90, whereupon water will pass through the scoop 152 to actuate the switch 160. The device 55 thus provides a simple, convenient and advantageous means of deriving a controlled switching function dependent upon the thickness of ice formed upon the plate 90.

Referring now to the schematic diagram of the apparatus shown in Fig. 6, there is illustrated a plurality of terminals 164, 166 and 168 adapted for connection with an electrical power source such as a three-phase alternating current supply main, it being understood, however, that the circuitry could be arranged for single phase operation, if desired, by one skilled in the art without departing from certain of the basic principles and improvements incorporated in the invention. The terminal 164 is coupled by conductive means 170 with one terminal 172 of a standard magnetic starter generally designated 174 having an opposite terminal 176 between which is coupled a magnetic coil 178. The starter 174 is also provided with a pair of stationary contacts 180 and 182 adapted to be respectively engaged by a pair of movable contacts 184 and 186 when the coil 178 is energized. The power terminal 164 is also coupled by conductive means 170 and conductive means 188 with the stationary contact 180.

The power terminal 168 is coupled by conductive means 190 and conductive means 192 with one terminal of an electric timing motor 194, which may complete a single revolution per minute, by conductive means 190 and 196 with one terminal of a solenoid 198 operably coupled with the valve 150 for operating the latter, by conductive means 190 and 200 with one terminal of the crusher motor 110, by conductive means 190 and 202 with one side of the coil 204 of a control relay generally designated 206, and by conductive means 190 and 208 with one terminal of the motor of water pump 42.

The relay 206 includes a normally open, single pole, single-throw switch having a stationary contact 210 and a movable pole piece 212 adapted to engage the contact 210 when the coil 204 is energized, and a single pole, double-throw switch having a movable pole piece 214 normally in engagement with a stationary contact 216 and adapted to shift out of engagement with the latter and into engagement with a stationary contact 218 when the coil 204 is energized. The compressor motor forming a part of the refrigeration system 54 is designated in Fig. 6 by the numeral 220. An on and off switch for manual control of operation of the apparatus is provided and designated 222. A switch disposed within the lower portion of the housing 10, which is normally closed but adapted to be opened upon the quantity of ice stored within the bin space in the lower portion of housing 10 reaching a predetermined level is provided and designated 224, it being clear to those skilled in the art that the particular physical form of the switch 224 may be varied. Associated with the timer motor 194 for rotation thereby are a pair of cams 226 and 228. There is operably associated with the cam 226 a normally open full-cycle switch 230 which is adapted to be closed upon energization and operation of the motor 194 and to remain closed until the cam 226 has completed one revolution, whereupon the full-cycle switch 230 automatically reopens. Associated with the cam 228 is a relay holding

switch 232, which is normally open but adapted to be closed and remain closed upon energization of the motor 194 and commencement of rotation of the cam 228 until the latter has completed one revolution, whereupon the holding switch 232 automatically reopens.

Power terminal 166 is coupled by conductive means 234 through the on-off switch 222 with conductive means 236 coupled with one side of each of the bin switch 224 and the full-cycle switch 230. Conductive means 238 connected to the other side of switches 224 and 230 couples the same in parallel, and conductive means 240 couples the conductive means 238 with the other terminal 176 of starter 174 and, through conductive means 242, with the other stationary contact 182.

Movable contact 184 of starter switch 174 is coupled with one side of the compressor motor 220 by conductive means 244. The other movable contact 186 is coupled by conductive means 246 with the other side of the compressor motor 220 and, by conductive means 248 with one side of the relay holding switch 232, by conductive means 248 and 250 with one side of the thermostatically responsive, ice thickness detecting switch 160, and by conductive means 248 and 252 with the relay switch pole 214. The other side of the thermostatically responsive switch 160 is coupled by conductive means 254 and 256 with the other side of relay coil 204 and by conductive means 254 and 258 with the stationary relay switch contact 210. Relay switch pole piece 212 is coupled by conductive means 260 with the remaining side of the holding switch 232. Stationary relay switch contact 216 is coupled by conductive means 262 with the pump 42, that is, the electric motor portion thereof. Stationary relay switch contact 218 is coupled by conductive means 264 and 266 with the other terminal of the timer motor 194, by conductive means 264 and 268 with the other side of the valve operating solenoid 198, and by conductive means 264 and 270 with the other terminal of the crusher motor 110.

The various switches, cams, and the like shown in Fig. 6 are illustrated in their respective conditions as would exist prior to closure of the on-off switch 222.

Operation

In operation, assuming that the water tank 36 is provided with a suitable quantity of water therein, closure of the on-off switch 222 completes an electric circuit from power terminal 166 through on-off switch 222 and normally closed bin switch 224 to terminal 176 and stationary contact 182 of the starter switch 174, thereby energizing the coil 178 by virtue of the coupling of the other terminal 172 of the starter 174 with power terminal 164 through the conductive means 170. Energization of coil 178 results in shifting and engagement of the movable contacts 184 and 186 with the stationary contacts 180 and 182 respectively. The closing of the double pole switch 180—182—184—186 energizes the compressor motor 220 and places the refrigeration system 54 in operation, it being understood that as long as the solenoid 198 remains deenergized the valve 150 will supply cooling medium to the coils 92 for operation of the assemblies 38 and 40 as evaporators. The closing of starter switch 180—182—184—186 also completes a circuit to energize the water pump 42 which may be traced from the movable contact 186 through conductive means 248 and 252, the pole piece 214 and contact 216 of the double-throw relay switch, and the conductive means 262 to the pump 42, which is oppositely connected by conductive means 208 and 190 with the power terminal 168.

Accordingly, closure of the on-off switch 222 results in water commencing to spray from the spray means 46 upon the upper sides of sloping plates 90 of the assemblies 38 and 40 and the cooling of such plates 90 by the evaporator action of the cooling medium from the refrigeration system 54 passing through the coils 92. A layer of ice of gradually increasing thickness will thereby be formed upon each of the plates 90, with the excess water from spray means 46, if any, running down the plates 90 and passing through the openings 142 for return into the water tank 36 from which the same may be further recirculated up onto the plates 90. Such condition of operation will continue until the thickness of ice upon the plate 90 of the assembly 40 is such that water emanating from the spray means 46 will commence to run through the scoop 152 of device 55. Such water, having been cooled by its travel across the ice on the plate 90 of the assembly 40 above the device 55 will act upon the thermostatically responsive switch 160 to actuate the latter to a closed position.

Closure of the thermostatically responsive switch 160 completes an energizing circuit for the coil 204 of relay 206 which is traceable from the energized shiftable contact 186 associated with starter 174 through conductive means 248 and 260, then closed switch 160, and conductive means 254 and 256 to one side of the coil 204 whose other side is coupled with power terminal 168 through conductive means 202 and 190. Energization of the relay coil 204 results in closure of the relay switch pole piece 212 with the relay contact 210 and further results in the breaking of the normal connection between relay switch pole piece 214 and relay contact 216 and the making of a circuit between the pole piece 214 and the stationary contact 218. Closure of pole piece 212 with contact 210 completes a holding circuit for the relay coil 204 including the conductive means 258, the relay switch 210—212, the conductive means 260, the holding switch 232 and the conductive means 248 back to the then energized starter contact 186. It will be noted that this holding circuit for the relay coil 204 is not fully made until the holding switch 232 has been closed by the cam 228 associated with the timer motor 194. However, upon shifting of the relay pole piece 214 into engagement with the relay contact 218 the timer motor 194 is energized through a circuit traceable from conductive means 248 through conductive means 252, relay switch 214—218, conductive means 264 and conductive means 266 to the timer motor 194, which is oppositely coupled with the power terminal 168 through conductive means 192 and 190. Completing such energizing circuit for the timer motor 194 immediately rotates the cam 228 sufficiently to close the holding switch 232, which then remains closed maintaining the holding circuit for the relay coil 204 completed until the cam 228 has completed a full revolution.

Energization of the relay contact 218 by engagement therewith of the relay pole piece 214 upon energization of coil 204 results, simultaneously with the energization of the timer motor 194, in energization of the crushing motor 110 and the valve operating solenoid 198, thereby activating the motor 110 to rotate the crusher rollers 50 and actuating the solenoid 198 to operate the valve 150 to a condition passing hot gases, rather than cooling fluid, from the refrigeration system 54 through the coils 92 of the assemblies 38 and 40, which then are acting as the condenser portion of the refrigeration system 54. It may be noted that as the relay pole piece 214 shifts into engagement with the stationary contact 218, its theretofore existing, normal engagement with the stationary contact 216 is broken, resulting in immediate deenergization of the electrically operated pump 42 and, therefore, interruption of the supply of water streams 108 onto the plates 90 by the spray means 46.

With the supply of water to the plates 90 cut off and a layer of ice of predetermined thickness sufficient to actuate the device 55 formed on the upper side thereof, the passage of hot gases from the refrigeration system 54 through the coils 92 will result in ice adhering to the plates 90 being melted adjacent the latter to free the elongated sheet of ice theretofore formed on each of the plates 90 for sliding movement downwardly and off of the plates 90 into the space between the corresponding

crushing roller **50** and its fracture bar **52**, where such sheet of ice will be crushed and thereupon fall by gravity through the openings **66** and the chute **68** into the storage bin space in the lower portion **22** of the housing **10**.

In the event that the thermostatically responsive switch **160** should reopen before a predetermined period of time sufficient to permit completion of the crushing operation, the holding switch **232** will maintain the apparatus in its condition of crushing operation. Moreover, should the crushed ice being delivered to the bin storage space fill the latter to an extent causing opening of the bin switch **224** before the end of such predetermined period, the full-cycle switch **230** in parallel with the bin switch **224** will assure that the apparatus is maintained in a condition of crushing operation until the full period of such operation determined by the timer motor **194** and its associated cam **226** has elapsed.

By the time of completion of one revolution or cycle of the timer motor **194**, the thermostatically responsive switch **160** will have opened and, at the completion of such cycle, the cams **226** and **228** will also permit the full-cycle switch **230** and the holding switch **232** respectively to open. Upon the opening of the holding switch **232**, the coil **204** of relay **206** is deenergized and the relay switches return to their normal positions illustrated in Fig. 6, thereby deactivating the timer motor **194** and the crusher motor **110**, activating the electrically operable water pump **42**, and deenergizing the solenoid **198** so that the valve **150** will operate to again cause the passage of cooling medium through the coils **92** for the formation of another sheet of ice upon each of the plates **90**. Such cycle of operation obviously then repeats itself automatically as long as the on-off switch **222** remains closed until the bin space in the lower portion **22** of the housing **10** has filled sufficiently to open the bin switch **224** and maintain the same open. When bin switch **224** is thus opened it will be apparent that the circuit through the conductive means **240** for energizing the starter switch **176** will be broken and that the starter switch **180—182—184—186** will be open to deactivate the apparatus until the removal of ice from the bin storage space has permitted bin switch **224** to reclose.

It will now be apparent that this invention is adapted for achieving all of the specifically above mentioned and other desirable objects. It will also be clear to those skilled in the art, however, that a number of minor modifications or changes could be made in certain details of construction without departing from the true spirit and intention of the invention. Accordingly, it is to be understood that the invention shall be deemed limited only by the scope of the claims that follow.

Having thus described the invention what is claimed as new and desired to be secured by Letters Patent is:

1. In apparatus for making crushed ice, an assembly having a sloping plate and coil means in heat exchanging relationship with the underside of the plate; means for supplying water to the upper side of the plate; means for supplying the coil with a cooling medium; means for supplying the coil with a warming medium; an inclined, hollow water scoop having an inlet extremity disposed in spaced relation to said upper side of said plate at a zone of the latter below the upper extremity thereof, whereby water running by gravity down the plate will enter said scoop only when ice formed on said plate above said inlet extremity of the scoop has reached a predetermined thickness; thermostatically responsive, electrical switch means disposed in said scoop and operably coupled with said pair of medium supplying means for rendering the latter alternately operable responsive to a predetermined thickness of the ice formed on the upper side of the plate, said ice at the predetermined thickness forming a path for the flow of water through said scoop and over said thermostatically responsive, electrical switch means to thereby effect closing of said thermostatically responsive, electrical switch means until the ice is displaced from said plate whereby flow of water through said scoop is discontinued and the thermostatically responsive, electrical switch means is opened; an elongated, generally cylindrical member mounted for rotation upon its longitudinal axis adjacent the lower longitudinal edge of the plate and having a plurality of longitudinal grooves therein, a plurality of crushing teeth elements received and secured within each groove respectively in spaced relationship to each other; an elongated, horizontal fracture bar laterally spaced from the member a predetermined distance and having its longitudinal axis parallel to said axis of the member, said elements extending radially from the member a lesser distance; and electrically actuated prime mover means operably coupled with the member for rotating the same in opposite directions, and electrical control means operably connected to said prime mover for energizing the latter immediately upon closing of said thermostatically responsive, electrical switch means and for maintaining the prime mover in an energized condition for a predetermined period only, after opening of said thermostatically responsive, electrical switch means.

2. Apparatus as set forth in claim 1 wherein is provided electrical holding switch means, electrical circuitry coupling said holding switch means in parallel with said thermostatically responsive switch means, electrically operable timer means adapted to operate for a predetermined period of time upon each actuation thereof, operably coupled with the holding switch means, for actuating the latter during said period of time upon each actuation of the timer means, and electrical circuitry operably coupling the thermostatically responsive switch means with the timer means for actuation of the latter upon each actuation of the thermostatically responsive switch means.

3. Apparatus as set forth in claim 2, wherein is provided a bin space disposed for receiving ice crushed by the crushing means, electrical bin switch means associated with said space and arranged for actuation thereof whenever ice within the bin space reaches a predetermined level of filling of said space, electrical circuitry coupling the bin switch means with the thermostatically responsive switch means and arranged upon actuation of the bin switch means to render actuation of the thermostatically responsive switch means ineffective, full-cycle switch means, electrical circuitry coupling said full-cycle switch means in parallel with said bin switch means, and means operably coupling the full-cycle switch means with the timer means for actuation of the full-cycle switch means during substantially said period of time upon each actuation of the timer means.

4. Apparatus as set forth in claim 3, wherein is provided electrically operable valve means arranged for alternately coupling the pair of medium supplying means with the coil, said water supplying means includes electrically responsive structure for controlling the operation thereof, said crushing means includes electrically responsive mechanism for controlling the operation thereof, and there is provided electrical circuitry operably coupling the thermostatically responsive switch means with the valve means, the structure and the mechanism, the valve means being actuated to operate the cooling medium supplying means and the structure being operable to operate the water supplying means when the thermostatically responsive switch means and the holding switch means remain unoperated, the valve means being actuated to operate the warming medium supplying means and the mechanism being operable to operate the crushing means when one of the thermostatically responsive switch means and the holding switch means are actuated.

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