July 27, 1965 D. S. REYNOLDS 3,196,624

METHOD AND APPARATUS FOR MAKING, STORING OR DISPENSING ICE CUBES

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FIG. 1

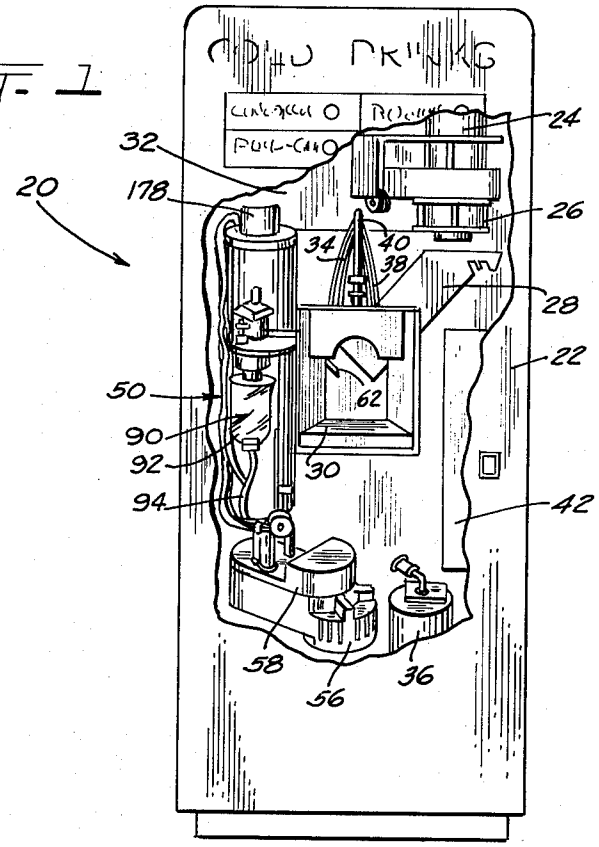
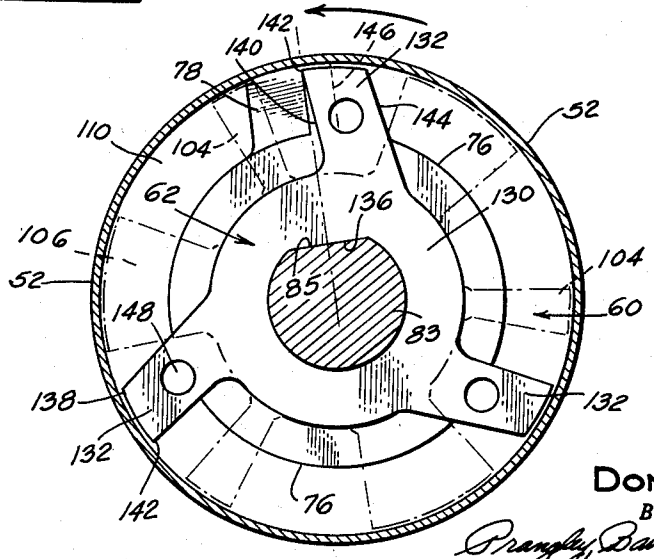


FIG. 3



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FIG. 2

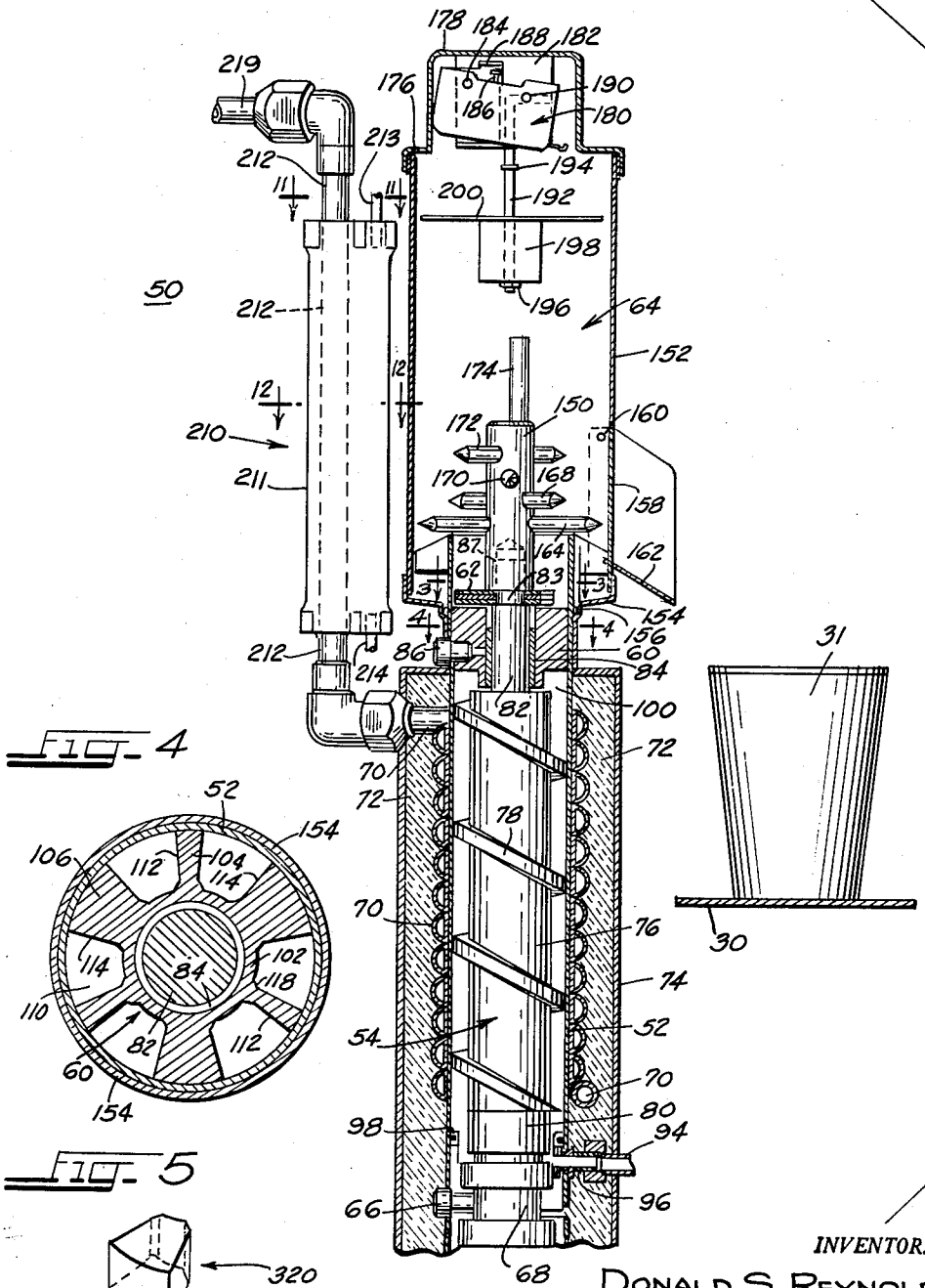


FIG. 4

FIG. 5

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FIG. 6

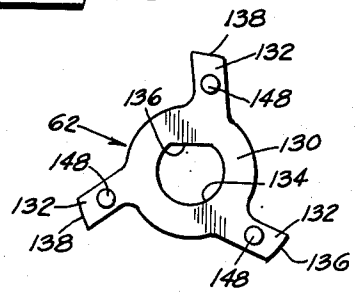


FIG. 7

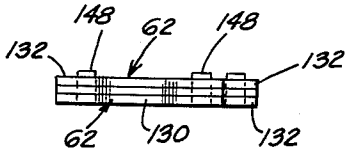


FIG. 8

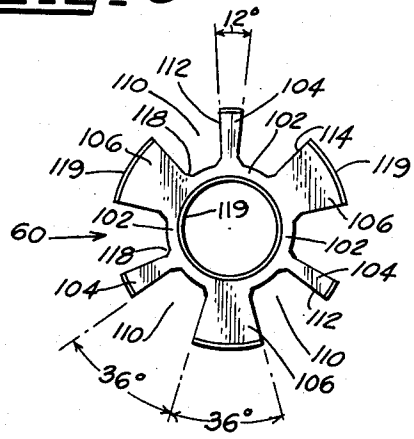


FIG. 9

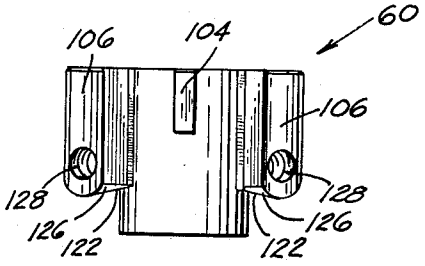


FIG. 11

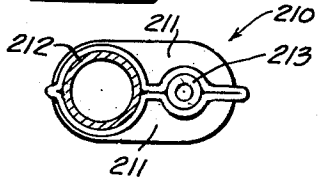


FIG. 10

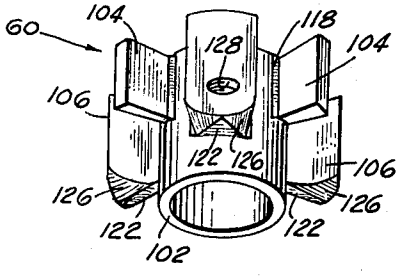
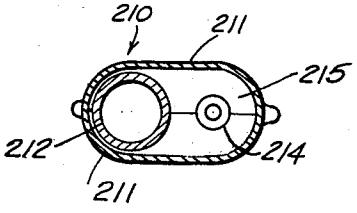


FIG. 12



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FIG. 13

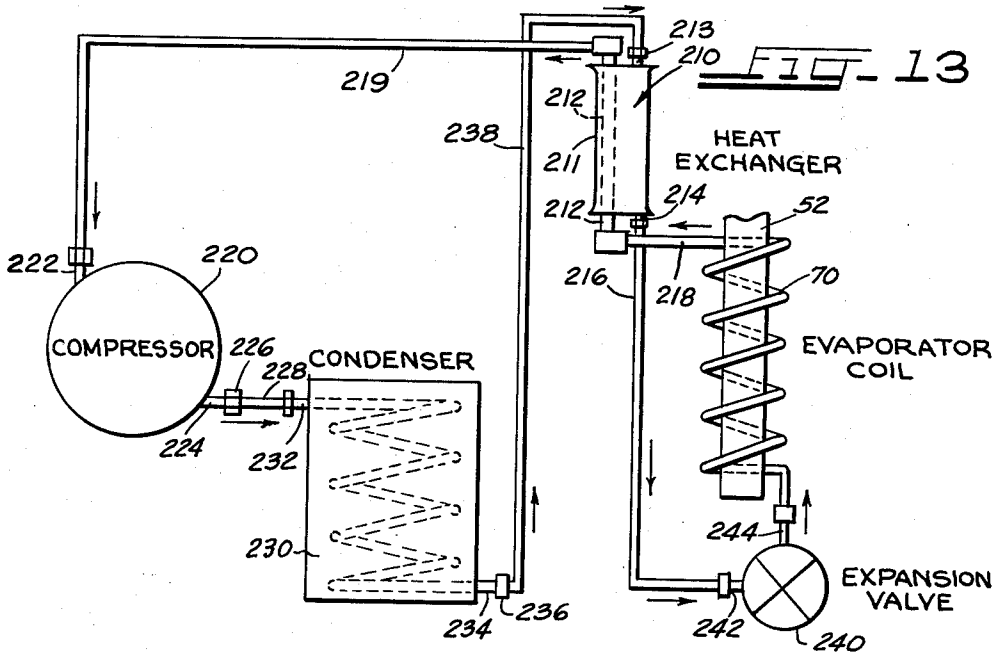
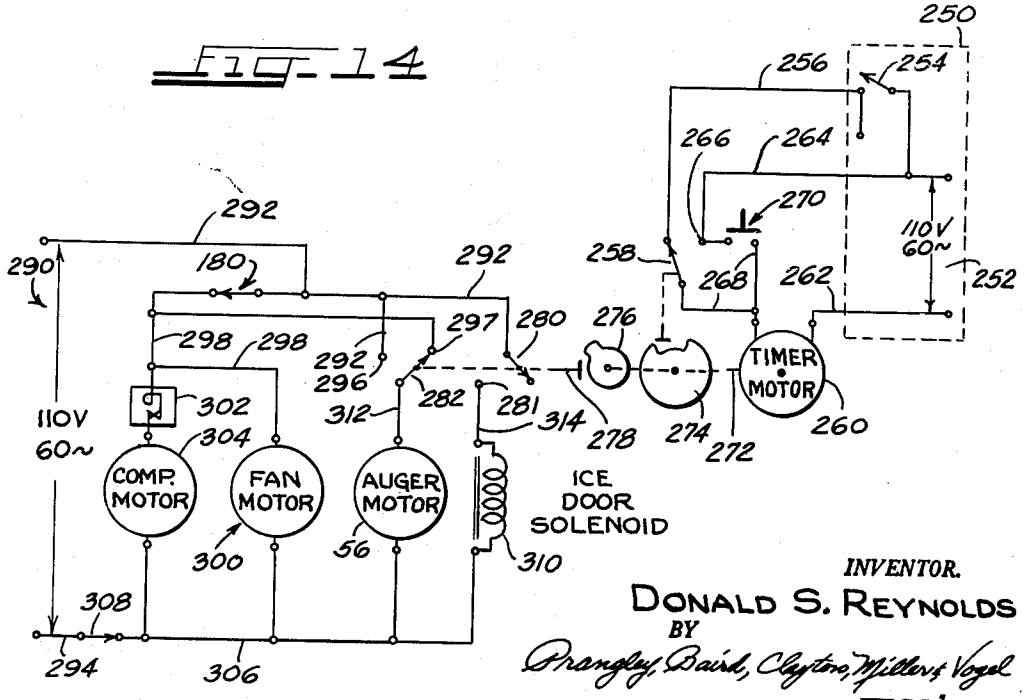


FIG. 14



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United States Patent Office 3,196,624 Patented July 27, 1965

3,196,624

METHOD AND APPARATUS FOR MAKING, STORING OR DISPENSING ICE CUBES

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Filed June 29, 1961, Ser. No. 120,574
20 Claims. (Cl. 62—71)

This invention relates to ice making machines and particularly to automatic ice cube making machines and parts therefor and the method of operation thereof.

Although the ice making machine of the present invention has general utility, it is particularly useful when used in combination with and as a part of a soft drink dispensing machine of the type wherein cups, flavor concentrates or syrups and sources of water and carbonation are maintained within the dispensing machine and upon insertion of a coin in the control circuit therefor, a cup is placed in position to receive the flavor concentrate and water, including carbonated water if desired, therein. In such soft drink dispensing machines it is also desirable to place a small quantity of ice in the drink since the public generally desires to have ice in its soft drink, despite the fact that the components of the soft drink are maintained at temperatures near the freezing point. Prior ice making machines and the ice products therefrom have been unsatisfactory when incorporated in soft drink dispensing machines for the principal reason that the form of ice produced is not well suited for incorporation in automatically dispensed soft drinks. More specifically, the quantity of water and flavored syrup and carbonation are carefully calculated and dispensed and the proportions therebetween maintained constant by the automatic dispensing mechanism. The ice machines available heretofore have generally produced "flaked ice" which has a substantial surface area in proportion to the volume thereof and which is "wet," i.e., contains substantial amounts of entrained and non-frozen water, and in which the quality and consistency thereof are not constant from one dispensing operation to the next. The prior flaked ice therefore tends to dilute the soft drink and thus destroy the carefully calculated proportions among the ingredients thereof; the sharp edges and large surface areas on the flaked ice have tended to cause a loss of the carbon dioxide gas from the dispensed drink to produce a "flat" product; and the ice because of its large surface area in relation to its volume has been quickly melted and dissipated so that there was no ice present in the cup during the consumption of the last portion of the drink.

The type of ice desirable in an automatic soft drink dispensing machine is the type prepared in refrigerators and other large refrigerating machines wherein water is frozen to a solid condition in the form of a "cube" whereby the surface area of the ice cube is small relative to the volume thereof, there is substantially no entrained ice therein and the ice is hard, compact and dense. It is to be understood that when the term "cube" is used throughout this specification that a unitary mass or block of ice is meant. The term is not to be construed in its geometric sense and is merely used as a convenient nomenclature to distinguish the compacted unitary ice mass produced by the instant invention from the flaked ice or small pieces of ice of the prior art. Such an ice cube is ideal for use in an automatic soft drink dispensing machine since the hard dry character thereof does not dilute the drink and thus does not destroy the carefully maintained and dispensed proportions, among the ingredients of the drink, the small surface area thereof relative to the volume and the lack of a large number of sharp edges minimizing the loss of carbonation from the soft drink and the ice cube lasting throughout the normal consumption time of the drink due to its hard compact character. The ice cubes to be used in a soft drink dispensing machine must however be small and substantially smaller than those produced heretofore and, furthermore, it is desirable that the ice cubes be produced substantially continuously during the operation of the automatic soft drink dispensing machine and further that the ice making apparatus be contained within the physical confines of the cabinet of the soft drink dispensing machine without changing the external configuration thereof. Prior ice making machines which will fit within the confines of the cabinet of the soft drink dispensing machine have not produced the ice cubes desired and those that produced ice cubes of the character desired have not been sufficiently small to fit within the cabinet of the soft drink dispensing machine or have not been substantially continuous in their operation.

Another serious limitation placed upon ice making machines to be used in conjunction with soft drink dispensing machines results from the fact that there is no substantial space for the storage of ice within the cabinet of the soft drink dispensing machine and therefore the ice making machine must produce ice of the desired character at least as fast as soft drinks can be dispensed from the dispensing machine and further the ice making machine must be sufficiently small as is pointed out above to fit within the cabinet of the soft drink dispensing machine but still produce the large amount of refrigeration necessary to manufacture ice cubes at the rate required.

Accordingly, it is an important object of the present invention to provide an improved ice making machine and particularly an improved machine that can make hard, dense and compact ice cubes.

Another object of the invention is to provide an improved ice cube making machine which can produce ice cubes of the desired quantity and possessing the desired characteristics substantially continuously and at a high rate.

Yet another object of the invention is to provide an ice cube making machine of the type set forth which is small and compact relative to its high ice producing capacity, and specifically to provide an improved ice cube making machine that can fit within the cabinet of soft drink dispensing machines now in common use.

Still another object of the invention is to provide an improved ice cube making machine of the type set forth which utilizes a cold wall and auger arrangement to produce flaked ice and thereafter converts the flaked ice into compact rods of ice which can be broken into compact ice cubes of the desired size and quality.

Yet another object of the invention is to provide in an ice cube making machine of the type set forth an improved apparatus for receiving and storing the ice cubes as they are made and automatic apparatus for stopping operation of the ice making machine when the storage chamber has been filled to a predetermined level.

In connection with the foregoing object, it is another object of the invention to provide an improved structure for dispensing ice cubes from the storage chamber in an ice cube making machine of the type set forth.

A further object of the invention is to provide an improved electrical control system for the operation of the ice cube making machine of the present invention and for co-ordinating the operation thereof with an associated soft drink dispensing machine.

A still further object of the invention is to provide an improved method of making ice cubes and an improved method of operating the ice cube making machine of the present invention.

Further features of the invention pertain to the particular arrangement of the parts of the ice cube making machine and to the particular method of making ice cubes, whereby the above outlined and additional operating features are attained.

The invention, both as its organization and method of operation together with further objects and advantages thereof will best be understood by reference to the following specification taken with the accompanying drawings, in which:

FIGURE 1 is a front elevational view of a soft drink dispensing machine having a portion of the front cover thereof broken away to disclose the various operating parts thereof including an ice cube making machine made in accordance with and embodying the principles of the present invention therein;

FIG. 2 is a fragmentary view, partly in vertical section, of the ice cube making machine of the present invention;

FIG. 3 is a view in horizontal section on an enlarged scale substantially as seen in the direction of the arrows along the line 3—3 in FIG. 2 and illustrating the relationship between the upper end of the auger flight and the ice cutter, the extruding head between the auger and the ice cutter being shown in dashed lines for increased clarity of illustration;

FIG. 4 is an enlarged view in horizontal section through the ice cube making machine of FIG. 2 substantially as seen in the direction of the arrows along the line 4—4 thereof;

FIG. 5 is a perspective view of a typical ice cube made by the machine and in accordance with the method of the present invention;

FIG. 6 is a plan view of the ice cutter forming a part of the present invention;

FIG. 7 is a side view showing three ice cutters in stacked and assembled relationship as used in the ice making machine of the present invention;

FIG. 8 is a plan view of the extruding head forming a part of the ice making machine of the present invention;

FIG. 9 is a side elevational view of the extruding head illustrated in FIG. 8;

FIG. 10 is a perspective view as seen from below of the extruding head illustrated in FIGS. 8 and 9;

FIG. 11 is a view in horizontal section of a portion of the refrigerating system illustrated in FIG. 2 substantially as seen in the direction of the arrows along the line 11—11 thereof;

FIG. 12 is a view in horizontal section through the heat exchanger in FIG. 2 substantially as seen in the direction of the arrows along the line 12—12 thereof;

FIG. 13 is a diagrammatic view of the refrigeration system of the ice cube making machine of the present invention; and

FIG. 14 is a schematic electrical diagram of the control circuit of the ice cube making machine of the present invention and the interconnection thereof with the control circuit of an associated soft drink dispensing machine.

Referring to FIG. 1 of the drawings, there is shown a front elevational view of a soft drink dispensing machine generally designated by the numeral 20, the front door 22 of the casing of the machine 20 having been broken away to reveal certain of the operating components thereof. More specifically, there is provided within the machine 20 means for storing cups generally designated by the numeral 24 and having associated therewith a cup dispensing mechanism 26 by which cups can be removed one at a time from the storage area 24 and dropped through a chute 28 to a platform 30, a typical cup 31 landing on the platform 30 in an upright and centered position as is illustrated diagrammatically in FIG. 2 of the drawings. There also is disposed within the cabinet of the machine 20 a plurality of flavored syrup storage compartments 32 with individual plastic dispensing hoses 34 provided for conveying syrup from

the storage compartments 32 into the cup 31 on the platform 30. A connection is made to a water supply and water is conveyed from the supply to a filter 36 from which the water can be fed directly through a conduit 38 to a cup positioned upon the platform 30 in those instances where no carbonation is desired. In the event carbonation is desired, the water from the filter 36 is conveyed to carbonating equipment (not shown) and thence through a stainless steel pipe 40 to the cup 31 positioned upon the platform 30. Suitable refrigeration equipment (not shown) is also provided to refrigerate the syrup and the water, including the carbonated water, prior to injection thereof into the cup 31 on the platform 30 so that the dispensed drink within the cup 31 is at a palatable temperature. Furthermore, the mechanism for dispensing the water or the carbonated water and the syrup is carefully designed and operated to dispense predetermined quantities of all items so that the resultant drink has a predetermined desired proportion of the various ingredients therein and in the case of a carbonated drink there is a predetermined amount and form of carbonation. In a typical dispensing machine 20, a cup 31 is first placed on the platform 30 after which the flow of carbonated water is begun and continues to the end of the dispensing cycle, the flow of syrup through one of the conduits 34 beginning after the flow of the carbonated water has begun and stopping before the flow of the carbonated water to insure proper mixing of the syrup in the final drink.

In accordance with the present invention, there is disposed within the housing of the soft drink dispensing machine 20 an ice cube making machine generally designated by the numeral 50 including generally a refrigerated cylinder 52 (see FIG. 2 also) having disposed therein an auger 54 driven by a motor 56 through a gear reducer 58 and driving ice through an extruding head 60 past ice cutters 62 and into an ice storage compartment generally designated by the numeral 64. Referring specifically to FIGS. 2, 3 and 4 of the drawings, it will be seen that the cylinder 52 is arranged generally vertically and has the lower end thereof connected by means of a bolt 66 to a rigid part 68 to hold the cylinder 52 from rotation with respect to the soft drink dispensing machine 20. Wrapped about the outer surface of the cylinder 52 and making good thermal contact therewith throughout substantially the entire length thereof is a refrigerator coil 70 which is connected in a refrigeration system that will be described more fully hereinafter. Disposed about the refrigerator coil 70 and about the major portion of the cylinder 52 is a quantity of heat insulating material 72 that is held in operative position by means of a housing or casing 74.

The auger 54 has a cylindrical body 76 about which is disposed a helical blade 78, the lower end of the auger 54 being supported by a bearing 80 and connected to the output of the gear reducer 58 whereby the auger 54 is rotated by operation of the drive motor 56. The upper end of the auger 54 is provided with a reduced shaft portion 82 which is received within a pilot bearing 84 that is in turn held and press fitted into a cylindrical opening in the center of the extruding head 60. The extruding head 60 in turn is fixedly mounted with respect to the cylinder 52 by means of a bolt 86.

The cylinder 52 during operation of the ice making machine 50 is supplied with water from a level maintaining mechanism 90 (see FIG. 1) which includes a receptacle 92 having therein a float operated valve having the inlet thereto connected to the water filter 36. Water for forming the ice is fed under a constant head from the water mechanism 90 through a conduit 94 to a connection 96 communicating with interior of the cylinder 52 adjacent to the lower end thereof. A watertight condition for the lower end of the cylinder 52 is maintained by a watertight seal 98 extending therearound.

As the water from the inlet pipe 96 rises in the refrig-

erated cylinder 52, heat is extracted therefrom by means of the refrigerating coil 70 and a layer of ice is formed on the inner wall of the cylinder 52 that is scraped therefrom by the auger blade 78 and is thrust upwardly in a continuous manner along the cylinder 52 and into a collecting chamber designated by the numeral 100 and disposed between the upper end of the auger blade 78 and the lower surface of the ice extruding head 60. The specific construction of the extruding head 60 can best be seen in FIGS. 4 and 8 to 10 of the drawings wherein it will be seen that it comprises generally a hollow cylinder 102 within which is press fitted the pilot bearing 84 receiving the auger shaft 82 as has been described above. Extending radially outwardly from the cylinder or hub 102 are two sets of arms including a narrower set 104 and a wider set 106. The arms 104 are positioned between adjacent ones of the arms 106 and spaced equidistantly therefrom, there being three arms 104 equiangularly disposed apart 120° and three arms 106 also equiangularly disposed apart 120°. The outer surfaces of the arms 106 are curved and in fact the outer surfaces thereof are sections of the walls of a cylinder, the extruding head 60 in practice being formed from a cylindrical piece of metal in which are formed flutes 110 or ice passages between adjacent arms 104 and 106, the angular extent of the flutes 110 being 36°, the angular extent of the narrower arms 104 being 12° and the angular extent of the broader arms 106 being 36°. The six flutes 110 thus formed provide ice receiving compacting and extruding passages in combination with the inner wall of the cylinder 52 as may be best seen in FIG. 4 of the drawings. The arms 104 have side walls 112 and the arms 106 have the side walls 114 which actually lie along radii through the center of the extruding head 60 and extend radially from the cylindrical hub 102 outwardly to the end of the arms 106, respectively, the junction between the hub 102 and the sides 112 and 114 being chamfered as at 118.

The upper surface of the extruding head 60 is formed substantially flat with chamfers 119 formed on the outer ends of the arms 104 and 106 and on the periphery of the opening through the center of the extruding head 60. The lower end of the extruding head 60 is best illustrated in FIGS. 9 and 10 of the drawings wherein it will be seen that the vertical extent of the arms 104 and 106 is substantially less than the vertical extent of the hub 102, the arms 104 having a vertical extent even less than that of the arms 106. Furthermore, each of the arms 106 has a lower surface 122 which is beveled inwardly and upwardly in order to direct flaked ice to the inner portions of the ice passages 110 as will be described more fully hereinafter. The surfaces 122 on the arms 106 are rounded as at 126, the outer end of each of the arms being formed substantially semicircular and the rounding diminishing toward and substantially terminating at the chamfer 118. Each of the thicker arms 106 is also provided with a threaded opening 128 therein disposed substantially perpendicular to the longitudinal axis of the extruding head 60 to receive therein the positioning bolts 86 described above, and it is for this reason that the three arms 106 are formed with a greater angular extent than the three arms 104.

In a preferred construction, there are six of the ice passages 110 as has been explained above and furthermore the total cross sectional area of the ice passages 110 is substantially equal to 60% of the cross sectional area of the flaked ice collecting chamber 100 that is disposed between the upper end of the auger blade 78 and the lower portion of the arms 104 and 106 on the extruding head 60. It has been found in practice that the cross sectional area represented by the combined flutes or ice passages 110 may vary from about 45% to about 75% of the transverse cross sectional area of the ice collecting chamber 100 and still obtain satisfactory operation of the ice cube making machine 50. The vertical extent of the ice passages 110, i.e., the distance from the surface 122 to the top of the extruding head 60, is preferably at least about one and one-half times the major transverse dimension of the passage 110, the major transverse dimension in the form of the invention illustrated being from the juncture of the outer edge of a side wall 112 with the cylinder 52 to the juncture of the outer edge of the adjacent side wall 114 with the cylinder 52. When the extruding head 60 is shaped as illustrated and described and when it has the relations among the dimensions noted, a firm coherent and compact ice rod is formed therein during operation of the ice cube making machine 50 as will be described more fully hereinafter.

The reduced shaft portion 82 at the upper end of the auger 84 has a further reduced portion 83 thereon which also is provided with a flat 85 thereon, see particularly FIG. 3. Disposed upon the shaft portion 83 are ice cutters 62, the construction thereof being best illustrated in FIGS. 3, 6 and 7 of the drawings. More specifically, each of the ice cutters 62 includes a hub 130 from which extend outwardly three ice cutting or breaking arms 132 that are equiangularly disposed about the hub 130 and extending outwardly therefrom. The hub 130 has a D-shaped opening 134 therein including a flat 136 thereon, the opening 134 being shaped and arranged to receive the auger shaft portion 83 as is best illustrated in FIG. 3 of the drawings. The outer end of each of the arms 132 is rounded as at 138 and in use the cutter 62 rotates in the direction of the arrow in FIG. 3 and the leading edge 140 thereof is cut back away from a line through the center of the shaft portion 83 inwardly toward the center of the shaft portion 83, whereby the outer point 142 on each arm 132 is the first to contact a rod of ice and thereafter the leading edge 140 progressively engages the rod of ice, the line of engagement moving inwardly toward the center of the ice cutter 62. The trailing edge 144 of each of the arms 132 is formed substantially parallel to the leading edge 140 and, accordingly, the arms 132 point forwardly in the direction of rotation of the cutter 62.

It further has been found that it is desirable to maintain a particular relationship between the auger 54 and the leading point 142 on the outer end of the arm 132 that overlies the upper end of the auger blade 78. More specifically, the line interconnecting the point 142 and the center of the shaft portion 83 lies along the center line of the outer surface of the auger blade 78 that is transverse to the axis of rotation thereof and, furthermore, the trailing edge 146 of the auger blade 78 is cut away along a plane parallel to the axis of rotation of the auger 54 and parallel to the line interconnecting the point 142 and the axis of rotation of the auger 54, the plane of the trailing edge 146 being disposed from the point 142 a distance equal to one-fourth of the surface of the auger blade 78 transverse to the axis of rotation of the auger 54. It has been found that this relationship permits ready feeding of ice upwardly through the ice passages 110 in the extruding head 60 with a minimum of interference of such movement of the ice by the cutters 62.

In order to simplify the fabrication of the cutter 62, it is formed as three separate identical parts from sheet metal such as by stamping and there further are formed on each of the arms 132 a projection 148 on one surface thereof and a corresponding depression in the other surface thereof, whereby the three cutters 62 can be stacked as illustrated in FIGS. 2 and 7 of the drawings. The projections 148 in the corresponding recesses of each of the arms 132 and the flat 136 on the D-shaped opening 134 engaging the flat 85 on the shaft portion 83 serve to hold the three cutters 62 in proper alignment.

The outermost end of the shaft portion 83 is threaded as at 87 (see FIG. 2) and threadedly receives thereon an upstanding hub 150 having an internally threaded opening to receive the threaded shaft portion 87. More specifically, the hub 150 threads downwardly upon the threaded portion 87 and clamps the cutter 62 against the

shoulder formed at the junction of the shaft portions 82 and 83. As the ice cubes are broken into final shape by the cutter 62, they pass upwardly and beyond the upper edge of the cylinder 52 and into the storage chamber 64 which is generally cylindrical in shape and includes an outer cylindrical wall 152 having the lower end thereof connected in a watertight manner to the cylinder 52 by means of a coupling member 154 and an O-ring seal 156. In the lower portion of the cylinder 152 is an opening closed by a solenoid operated door 158 hingedly mounted as at 160 and opening into a chute 162 which directs ice from the storage chamber 64 into a cup 31 on the platform 30, the door 158 being operated electrically as will be described more fully hereinafter.

As ice accumulates and begins to melt within the storage chamber 64, there may be a tendency for the ice cubes to coalesce, and in order to counteract such a tendency, a stirring mechanism has been provided which includes the hub 150 having a plurality of outstanding stirring arms 164, 168, 170 and 172 thereon and extending outwardly therefrom, the outer end of these stirring arms being pointed. There also is an upwardly extending stirring arm 174 positioned on the hub 150 eccentric with respect to the axis of rotation thereof. As the auger 54 is operated, it drives the hub 150 and moves the various stirring arms 164 through 174 to agitate the ice within the storage chamber 64 and thus to prevent coalescing thereof.

As the ice cube making machine 50 operates, and if there is no demand for ice therefrom, the storage chamber 64 proceeds to fill and eventually the entire storage chamber would fill and would even overflow. Means is provided to stop operation of the ice cube making machine 50 when the storage chamber 64 becomes filled and to accomplish this the upper end of the cylinder 152 receives a cover 176 having a dome 178 thereon. Disposed within the dome 178 is a microswitch 180 pivotally mounted on a bracket 182 about the pivot point 184 and having a switch actuator 186 arranged to be moved against an abutment 188 when the switch is rotated in a counterclockwise direction about the pivot point 184. Pivotally connected to the switch 180 as at 190 is a depending actuating rod 192 having a pair of spaced apart abutments 194 and 196 thereon. A weight 198 is provided having an opening therethrough to receive the rod 192, the weight 198 being disposed between the abutments 194 and 196 on the rod 192. Mounted on the upper end of the weight 198 is a circular plate 200 having a diameter slightly less than the diameter of the housing 192 and adapted to be contacted by ice within the storage chamber 64 and to be lifted by the ice into engagement with the abutment 194 on the rod 192. The continued lifting of the plate 200 by ice thereunder serves then to move the switch 180 about the pivot point 184 and to move the switch actuator 186 into engagement with the abutment 188 thus actuating the switch 180 to the open position thereof. As will be described more fully hereinafter, actuation of the switch 180 to the open position stops operation of the ice making machine 50. As ice is dispensed from the chamber 64 or as ice melts in an amount equal to four servings of ice cubes, the plate 200 and the weight 198 fall to the position illustrated and move the switch 180 to the closed position, the switch being held in the open position by structure not shown until the weight 198 contacts the abutment 196 on the rod 192.

The refrigeration system for freezing the water within the cylinder 52 is best illustrated in FIGS. 2 and 13 of the drawings, FIG. 13 being a diagrammatic representation of the entire refrigeration system. As has been explained above, the evaporator coil 70 is wrapped tightly around the cylinder 52 and in the system the coil 70 is connected in circuit with a heat exchanger 210, a compressor 220, a condenser 230 and an expansion valve 240, the refrigerant in the system being one of the Freons. The compressor 220 serves in its usual capacity to compress refrigerant gas received at its inlet 222 in a low pressure state and to discharge the refrigerant gas through an outlet 224 under high pressure and in a heated condition. The outlet 224 is connected by means of a coupling 226 to a conduit 228 which in turn is connected to the inlet connection 232 for the condenser 230. The heated refrigerant gas in the condenser 230 is cooled by air blown over the coils thereof (by a fan, not shown) and the refrigerant in a liquified condition and at a high pressure exits through the outlet 234 which is connected by a coupling 236 to a conduit 238 connecting with one of the inlet to the heat exchanger 210.

The details of construction of the heat exchanger 210 can be best seen from FIGS. 2, 11 and 12 of the drawings wherein it will be seen that the heat exchanger includes generally an outer wall 211 which is generally elliptical in cross section (see FIG. 12) and has a conduit 212 extending completely therethrough, the conduit 212 being circular in cross section and disposed to one side of the outer wall 211 and having an external diameter slightly less than the minor transverse dimension of the outer wall 211. Connection is made to the space 215 between the inner surface of the wall 211 and the outer surface of the conduit 212 by means of an inlet pipe 213 and an outlet pipe 214, the pipes 213 and 214 extending only a short distance into the outer wall 211 as can be best seen from FIG. 2 of the drawings. In order to increase the heat exchange capacity of the heat exchanger 210, the conduit 212 and the pipes 213 and 214 are formed of copper and connection is made between the outer wall 211 and the conduit 212 and the pipes 213 and 214 by flattening the ends of the outer wall 211 as is illustrated in FIG. 11 to close the ends of the outer wall 211 about the conduit 212 and the pipes 213 and 214, the joints so formed being closed by silver brazing or the like to form a pressure tight unit operable well above the refrigerant pressures in the system and operable, for example, at 250 p.s.i.

The conduit 238 is connected to the inlet pipe 213 so that the liquified refrigerant is admitted into the chamber between the outer wall 211 and about the conduit 212 and flows from the heat exchanger 210 to the outlet pipe 214 that is connected to the conduit 216 communicating with the inlet connection 242 for the expansion valve 240. The liquid refrigerant is expanded and cooled through the expansion valve 240 and leaves through an outlet connection 244 that is connected to the lower end of the evaporator coil 70. The upper end of the evaporator coil 70 is connected by a conduit 218 to the lower end of the conduit 212 going through the heat exchanger 210, the upper end of the conduit 212 being connected by a conduit 219 to the inlet 222 for the compressor 220.

In operation, the refrigerant system of FIG. 13 has warm gas at low pressure in the conduit 219 which is received through the inlet 222 for the compressor 220 and the compressor 220 compresses the gas which leaves through the outlet connection 224 and enters the condenser 230 as a hot gas at high pressure. The refrigerant is cooled and liquified in the condenser 230 and leaves the condenser 230 as a hot liquid and is carried by the conduit 238 to the inlet 213 for the heat exchanger 210. The liquid refrigerant which is hot compared to the refrigerant leaving the upper end of the evaporator coil 70 fills the space 215 within the heat exchanger 210 and between the outer wall 211 and the conduit 212 thereby to heat the material within the conduit 212 and to be cooled thereby. The cooled liquid refrigerant is fed from the heat exchanger 210 by the conduit 216 and through the expansion valve 240 which admits the refrigerant under low pressure to the bottom of the evaporator coil 70. In accordance with the present invention, the evaporator coil 70 is operated substantially in the flooded condition whereby to give maximum heat transfer from the evaporator coil 70 to the cylinder 52 and through the cylinder

52 to the water contained therein. The evaporator coil 70 can be operated in this condition since any liquid which flows therefrom into the heat exchanger 210 is immediately gasified by accepting heat from the liquid refrigerant within the heat exchanger 210 whereby the refrigerant entering the conduit 219 is in a gaseous state and has a sufficiently high temperature such that it will not be condensed to a liquid because of the pressure applied thereto by the compressor 220, thereby protecting the compressor 220 at all times.

It will be seen therefore that the refrigeration system described above has important advantages in that the maximum amount of refrigeration can be derived from the evaporator coil 70 since the coil can be operated in the substantially flooded condition thus giving a liquid heat exchange surface with the cylinder 52 and particularly at the upper end thereof where the flaked ice is being removed by the auger 54. This manner of operation of the coil 70 is achieved without the use of a large refrigerant receiver, the heat exchanger 210 providing the necessary receiver capacity for the system and also insuring that the refrigerant in the conduit 219 is gaseous and has a sufficiently high temperature to insure that it will not be liquified when passing through the compressor 220. The system also permits the use of a small charge of refrigerant and also permits rapid restart of the refrigerant system without injury to the compressor 220. More specifically, if the refrigerant system is in operation and is turned off for a short period of time and then rapidly restarted, the system tends to cavitate and to flash gas from the coil 70 to the compressor 220, but the presence in the system of the heat exchanger 210 insures that the gas thus flashed has sufficient temperature to prevent liquification thereof within the compressor 220. The heat exchanger 210 also rids the system of a surface on which condensate can collect, there being no tendency to collect condensate on the exterior surface of the heat exchanger 210 because of the warm liquid refrigerant contained therein and disposed against the inner surface of the outer wall 211.

A suitable electrical control system is provided for the various part of the ice cube making machine 50 and, furthermore, interconnection is made with the control circuit of the coin operated dispensing machine 20. In general, the machine 20 will be provided with a coin receiving and actuating mechanism 42 (see FIG. 1) which insures that coins of the proper type and value are inserted, after which suitable electrical circuitry is actuated to cause proper operation of the dispensing machine 20. As has been outlined above, the dispensing machine 20 ordinarily is operated in a manner such that a cup 31 is first fed from the storage chamber 24 thereof onto the platform 30 after which injection of refrigerated water or carbonated water, as the case may be, is begun and then a syrup pump is actuated to begin injection of syrup from a storage compartment into the cup 31. The control circuit including the coin mechanism 42 is diagrammatically illustrated within the dashed line area 250 in FIG. 14 of the drawings, there also being shown therein a source of suitable operating potential 252 and a diagrammatic representation of a switch 254 for controlling the operation of the syrup pump as explained above, all of which is conventional. The conventional circuitry has been modified in accordance with the present invention to provide a line 256 from the stationary contact of the switch 254 to a normally closed holding switch 258 which in turn connects to one terminal of a timer motor 260. The other terminal of the timer motor 260 is connected by a line 262 to one side of the potential source 252. A holding circuit for the timer motor 260 is provided to the other terminal of the source 252 through a line 264, a contact 266 of the holding switch 258 and a line 268 to a terminal of the timer motor 260. A service or test switch 270 is also provided to close a circuit from the line 264 to the line 268 to energize the timer motor 260, the switch 270 also being useful if it is desired only to dispense a portion of ice with no syrup or water into a cup 31 on the platform 30.

The timer motor 260 is provided with an operating shaft 272 carrying thereon two cams 274 and 276, the cam 274 operating the holding switch 258 into the holding position to provide a circuit from the line 264 to the line 268, and the cam 276 having an actuator 278 operating a pair of switches 280 and 282 which will be described more fully hereinafter.

The ice cube making machine 50 is powered from a source 290, a suitable electrical potential which may or may not be identical to the source 252 described above, the source 290 including a pair of input lines 292 and 294. The line 292 is connected directly to the movable contact of the switch 280 which is normally in the open position and also to a stationary contact 296 of the switch 282. The line 292 also connects with one terminal of the ice level switch 180 described above which is normally closed and when closed serves to connect the line 292 to a line 298, the line 298 being connected directly to a contact 297 of the switch 282. The line 298 also is connected to one terminal of a fan motor 300 which is used to blow air across the condenser 230 when energized and also to one terminal of a heat overload switch 302 protecting the compressor motor 304 that drives the compressor 220 described above. More specifically, the other terminal of the heat overload switch 302 is connected to one of the input terminals of the compressor motor 304 and the other terminal of the compressor motor 304 is connected to a line 306.

The main input line 294 connects to a normally closed low water switch 308 which is closed as long as the water level within the cylinder 52 is adequate and which is opened when the water level falls to a predetermined value to interrupt operation of the refrigeration system. When closed, the switch 308 connects the input line 294 with the line 306 which in addition to being connected to the compressor motor 304 is also connected to the fan motor 300, the auger motor 56 and the ice door solenoid 310. The other terminal of the auger motor 56 is connected by a line 312 to the movable contact on the switch 282 and the other terminal on the ice door solenoid 310 is connected by a line 314 to a stationary contact 281 for the switch 280.

The various methods of operation of the electrical control circuit of FIGURE 14 will now be described. Assuming first that no coin has been inserted in the coin mechanism 42 (see FIG. 1) and further assuming that the ice level switch 180 is in the closed position, the compressor motor 304 and the fan motor 300 and the auger motor 56 will all be energized to cause operation of the ice cube making machine 50, thus producing ice cubes that are forced upwardly into the storage chamber 64. As the ice accumulates and eventually moves the plate 200 upwardly, the switch 180 will eventually open and will stop operation of each of the motors 56, 300 and 304. As the ice within the storage chamber 64 melts and permits the plate 200 to drop, the switch 180 will eventually be closed and will restart operation of the motors 56, 300 and 304 to again cause production of ice cubes and feeding thereof into the storage chamber 64.

If a coin is now placed in the coin control mechanism 42 (see FIG. 1), the syrup pump switch 254 will eventually be closed and a circuit made for the timer motor 260 from the source 252 through the switch 254, the line 256, the switch 258 and the line 268 to one terminal of the timer motor, the other terminal of the timer motor being connected to the other side of the source 252 through the line 262. As the timer motor 260 operates, the holding cam 274 actuates the switch 258 to move the movable contact thereof against the stationary contact 266 to form a bypass circuit about the syrup pump switch 254 to insure a full cycle of opera-

tion of the ice dispensing mechanism, the circuit being from the line 264 through the switch 258 and the line 268 to the timer motor 260. Continued operation of the timer motor 260 will cause the cam 276 to contact the actuator 278 which first operates the switch 282 to move the movable contact thereof from the stationary contact 297 to the stationary contact 296 thereby connecting the auger motor 56 directly to the main line 292 of the potential source 290. This immediately begins operation of the auger motor and the stirring arms 164 to 174 are operated. Shortly after the above described operation of the switch 282, the actuator 278 operates the switch 280 to place the movable contact thereof in connection with the stationary contact 281 so as to energize the ice door solenoid 310 to open the door 158 and to dispense a portion of the ice from the storage chamber 64 into the cup 31 on the platform 30 (see FIG. 2). It will be noted that the stirring arms are being operated by the auger due to the operation of the auger motor 56 thus to insure that ice cubes are moved from the storage chamber 64 down the chute 162 and into the waiting cup 31.

The above described operation of the circuit of FIG. 14 in dispensing ice cubes from the storage chamber 64 will occur regardless of the state of operation of the ice making machine 50 prior to the beginning of the dispensing cycle. More specifically, if the ice level control switch 180 is closed so that the auger motor 56 is already operating at the time a coin is inserted into the control mechanism 42, the switch 282 is still actuated so as to bypass the switch 180 at the proper point in the dispensing cycle so as to insure the dispensing of a portion of ice from the storage chamber 64 regardless of the condition of operation of the ice making machine 50.

The overall operation of the dispensing machine 22 will now be described in detail. The cup storage compartment 24 and the syrup storage tanks 32 are filled and the operating potentials are applied to the sources 252 and 290 to energize the various control circuits. A water connection has been made so that a suitable level of water is present in the water level control mechanism 90 so as to provide water under the proper pressure through the line 94 to the connection 96 at the bottom of the cylinder 52. Because of the food use of the ice to be produced in the machine 50, the cylinder 52 must be made of stainless steel, and because of the relatively poor heat conduction through stainless steel, the cylinder 52 is made as thin as possible and various of the features described above are provided specifically to remove mechanical stresses from the cylinder 52. The water rises within the cyclinder 52 to the prescribed level slightly below the upper level of the auger 54 and since there is no ice in the storage chamber 64, the switch 180 is closed and each of the motors 56, 300 and 304 is energized.

As the compressor 220 operates to provide refrigerant in the proper physical state to the evaporator coil 70, the water within the cylinder 52 begins to freeze upon the inner surface thereof. Operation of the auger 54 scrapes the ice from the inner wall of the cylinder 52 by pushing it upwardly therealong and there is formed an upstanding cylinder of mushy flaked ice that is fed into the collecting chamber 100. In the absence of the extruding head 60, the cylinder of flaked ice would continue to rise until the height was too great to be supported by the relatively small structural strength thereof.

With the extruding head 60 in position and held stationary with respect to the cylinder 52, the flaked ice is forced into and substantially fills the collecting chamber 100 and the upwardly and inwardly directed lower surfaces 120 and 122 on the extruding head 60 aid in forcing the flaked ice inwardly toward the axis of rotation of the auger 54 and away from the cylinder 52 to relieve the cylinder 52 of a portion of the ice pressure thereon. The auger 54 operates with substantial torque in the order of 1,000 inch pounds and is thus able to force the flaked ice into the ice passages 110 through the extruding head 60 across the rounded surfaces 124 and 126 thereby completely to fill the ice passages 110 and to compress and to compact the flaked ice therein. Sufficient pressure is provided by the auger 54 and sufficient resistance to the passage of the ice through the ice passages 110 is provided by the extruding head 60 so that a solid rod of ice is formed in each of the six ice passages 110. In order to achieve this compacting of the flaked ice into a solid rod, a high torque is required from the auger 54 and in addition the transverse cross sectional area provided by the passages 110 must constitute from about 45% to about 75% of the transverse cross sectional area of the collecting chamber 100 and further the length of each of the passages 110 must be at least one and one-half times the major transverse dimension thereof, namely, the distance between the outer ends of the walls 112 and 114 defining the passage 110.

As a result of the above described construction and operation of the machine, a solid, dense and compact rod of ice issues from each of the ice passages 110 and if the ice cutter 62 and the stirring arms 164 to 172 are removed, these rods of ice will rise for a substantial distance, for example, several inches above the upper surface of the extruding head 60. To form a useful product it is necessary to break the ice by means of the ice cutters 62 as it issues from the extruding head 60 and the ice cutters 62 are arranged as has been described in detail above with reference to FIG. 3 in a manner such that the arms 132 contact an associated rod of compact ice first at the outer edge 142 and progressively force and break the ice toward the shaft of the auger 54 along the line 140 to form ice cubes that are dense, dry and compact. Each of the ice cubes formed has a transverse cross section generally like the transverse cross section of the ice passages 110 which can be best seen in FIG. 4 of the drawings, although occasionally the impact of the cutters 62 against the rod of ice will split the rod along a longitudinally extending plane as well as along a transverse plane. The length of each ice cube is dependent upon the rate at which the rod of compact ice issues from the associated passage 110, the ice cubes being longer when the rate of movement of the ice rod is greater and, vice versa, the length of the ice cube being shorter when the rate of movement of the ice rod is less. The rate of movement of the ice rod through the ice passage 110 is in turn dependent upon the amount of refrigeration produced by the refrigeration system and more specifically upon the rate at which flaked ice is produced by the auger 54 in the cylinder 52.

There is shown in FIG. 5 of the drawings an idealized representation of an ice cube of the type produced by the machine 50, the ice cube being designated by the numeral 320. The ice cube 320 has been illustrated as having a transverse cross section identical to that of the ice passage 110 and having a length equal substantially to a radial dimension thereof, the top and bottom surfaces of the ice cube 320 being illustrated as planes substantially parallel to each other. The ice cube making machine 50 does produce ice cubes as illustrated in FIG. 5, but other forms of ice cubes are also produced. The action of the cutter arms 132 upon a rod of ice issuing from an ice passage 110 is actually in the form of an impact blow which may shatter the ice rod along planes other than those transverse to the direction of movement thereof. More specifically, the ice rod may be shattered along planes generally parallel to the direction of movement or along planes that are at a skew angle with respect to direction of movement of the ice rod. As has been described above, the length of each ice cube in the direction of movement of the ice rod is also variable and is generally proportional to the rate at which flaked ice is produced and forced through the extruding head 60. In all cases, however, the ice cubes produced are dense and compact in character and whereas flaked ice produced by machines available heretofore may have a density or specific volume such that one ounce of the ice occupies 3.6 cubic inches the ice cube made in

accordance with the present invention has a density such that one ounce thereof occupies 2.75 cubic inches, one ounce of water for reference occupying 1.8 cubic inch. It will be seen therefore that the ice produced by the machine **50** of the present invention is substantially more dense than ice produced by machines available heretofore for use with soft drink dispensing machines. It further has a density approaching that of water. In addition the ice cubes **320** are substantially dry and contain little or no entrained water therein or therewith, the water being effectively removed by the "squeezing" action to which the flaked ice is subjected as it is forced through the extruding head **60**.

The ice cubes **320** thus formed are readily stored within the storage chamber **64** and are prevented from coalescing by the action of the stirring arms **164** to **174**. As the level of ice increases within the storage chamber **64**, the upper surface of the stored ice eventually contacts the plate **200** and lifts the plate **200** to a point to open the microswitch **180** (see FIG. 14) thus removing the operating potentials from the auger motor **54**, the fan motor **300** and the compressor motor **304**. If thereafter four portions of ice are dispensed or if an equivalent amount of ice melts, the plate **200** is dropped so as to close the microswitch **180**, thus to energize the motors **54**, **300** and **304** to begin again the manufacture of ice cubes.

If a coin is placed in the control mechanism **42** of the machine **20** while the microswitch **180** is closed and therefore while the ice cube making machine **50** is operating, the following sequence of operation is initiated. The circuits within the machine **20** and diagrammatically illustrated at **250** in FIG. 14 are operated to place a cup **31** on the platform **30** and thereafter to begin injection of water or carbonated water thereinto, and shortly thereafter the switch **254** controlling the syrup pump is closed. Closure of the switch **254** then completes the circuit to the timer motor **260** so that the cam **274** moves the holding switch **258** to the holding position thereof and the cam **276** operates the switches **280** and **282** to the other positions thereof. The switch **282** is actuated a short time interval before the closure of the switch **280**, this action of the switch **282** momentarily interrupting the operation of the auger motor **56**. The closure of the switch **280** a short time thereafter energizes the ice door solenoid **310** thus to open the door **158** in the storage compartment **64**. The stirring arms **164** to **172** kick or expel ice cubes from the storage chamber **64** and down the chute **162** into the cup **31**, this dispensing of the ice cubes being preferably accomplished prior to the end of the water injecting cycle. By the time the timer motor has completed one cycle of rotation of the cams **274** and **276**, the switch **254** should be open and movement of the switch **258** to the left-hand position stops the timer motor **260** and at this time the switches **280** and **282** have also been moved to the position illustrated in FIG. 14 of the drawings, thus terminating an ice dispensing cycle.

Should a coin be inserted into the mechanism **42** when the microswitch **180** is open, i.e., when the storage chamber **64** is substantially full of ice cubes and the auger motor **56** is de-energized, the above described cycle of operation is repeated except in this case the auger motor **56** is energized when the movable contact of the switch **282** is placed against the contact **296**. Accordingly, although there is no refrigeration taking place in the ice cube making machine **50**, the auger **52** is rotated so that the stirring arms **164** to **172** are operated prior to the opening of the door **158** to insure that a proper portion of ice cubes is dispensed from the storage chamber **64** into the cup **31**.

In yet another mode of operation, the service switch **270** can be closed without closing the switch **254** thus initiating an ice cube dispensing cycle, whereby only ice is dispensed into the cup **31** on the platform **30**. In this mode of operation of the machine **50**, ice is dispensed whether ice is being manufactured or not in a manner similar to that described above when the syrup pump switch **254** is closed to initiate the ice cube dispensing cycle.

It will be seen that there has been provided an ice cube making machine which fulfills all of the objects and advantages set forth above and further that there has been provided an improved heat exchanger and an improved refrigeration system to be incorporated in the ice cube making machine. There likewise has been provided an improved method of making ice cubes of a type particularly suited for use in soft drinks dispensed by automatic machines available on the market today. While there has been described what at present is believed to be a preferred embodiment of the invention, it is to be understood that various changes and modifications may be made therein without departing from the true spirit and scope of the invention and it is intended to cover in the appended claims all such changes and modifications which fall within the true scope of the invention.

I claim:

1. An ice cube making machine comprising mechanism for producing flaked ice and having a flaked ice outlet therefor, an extruding head positioned adjacent to said flaked ice outlet and having a plurality of ice compressing and ice shaping passages therethrough, feed mechanism for moving flaked ice from said outlet of said flaked ice mechanism into and through said ice passages in said extruding head to compress and to congeal the particles of said flaked ice to form in said passages rods of compact and coherent ice, and an ice cutter having an arm mounted adjacent to the discharge end of said ice passages and driven by said feed mechanism over said ice passages to block said passages as the arm moves thereacross to assist in compressing the flaked ice into rods in said passages and for breaking the rods of compact ice into individual compact ice cubes as the rods issue from said ice passages.

2. An ice cube making machine comprising mechanism for producing flaked ice including an upstanding cylindrical freezing chamber, means for supplying water to said freezing chamber, means for cooling said freezing chamber, and an upstanding auger for delivering flaked ice to the upper end thereof and to the outlet of said flaked ice mechanism, an extruding head positioned above and spaced from the upper end of said auger and having an ice passage therethrough, drive mechanism for operating said auger to force the flaked ice from said flaked ice mechanism through said ice passage in said extruding head to compress and to congeal the individual ice particles to form a rod of compact and coherent ice, ice breaking means disposed above said extruding head and connected to said drive mechanism for breaking the rod of compact ice into individual compact ice cubes as it issues from said ice passage, an ice cube holding chamber mounted above said extruding head and in general axial alignment with said auger and having an inlet thereto communicating with the upper end of said ice passage to receive and to store the ice cubes produced by said ice breaking means, stirring mechanism in said storage chamber for agitating the ice cubes therein to prevent coalescing thereof, and a door in the side wall of said storage chamber opposite said stirring mechanism, whereby upon opening of said door said stirring mechanism serves to discharge ice cubes from said storage chamber.

3. An ice cube making machine comprising mechanism for producing flaked ice including an upstanding cylindrical freezing chamber, means for supplying water to said freezing chamber, means for cooling said freezing chamber, and an upstanding auger for delivering flaked ice to the upper end thereof and to the outlet of said flaked ice mechanism, an extruding head positioned above and spaced from the upper end of said auger and having an ice passage therethrough, drive mechanism for operating said auger to force the flaked ice from said flaked ice mechanism through said ice passage in said extruding head to compress and to congeal the individual ice par-

ticles to form a rod of compact and coherent ice, ice breaking means disposed above said extruding head and connected to said drive mechanism for breaking the rod of compact ice into individual compact ice cubes as it issues from said ice passage, an ice cube holding chamber mounted above said extruding head and in general axial alignment with said auger and having an inlet thereto communicating with the upper end of said ice passage to receive and to store the ice cubes produced by said ice breaking means, and control means actuated by the level of ice in said storage chamber for operating said flaked ice mechanism and said drive mechanism to maintain the level of ice cubes in said storage chamber within predetermined bounds.

4. An ice cube making machine comprising an elongated freezing chamber having an inside freezing wall, means for supplying water to the interior of said freezing chamber, means for cooling at least a portion of said freezing wall comprising a refrigerator coil and a compressor and a condenser and an expansion valve connected in series, a first drive motor for driving said compressor, an upstanding auger disposed in said freezing chamber for scraping ice from said freezing wall and for delivering flaked ice to the upper end of said freezing wall, an extruding head positioned above said auger and having an ice passage therethrough, a second drive motor for driving said auger to force the flaked ice through said ice passage to form a rod of compact ice, ice breaking means driven by said auger rotating means and disposed above said extruding head for breaking the rod of compact ice into individual ice cubes as it issues from said ice passage, an ice cube holding chamber mounted above said extruding head to receive and to store said ice cubes, stirring mechanism in said storage chamber driven by said auger for agitating the ice cubes therein to prevent coalescing thereof, a door in the side wall of said storage chamber opposite said stirring mechanism, electrically operated actuator means for opening said door, first control means operatively associated with said chamber and responsive to the level of ice therein, a second coin operated control means, and a control circuit including a source of operating potential and connecting said drive motors and said control means, said control circuit energizing said first and second drive motors in response to a level of ice in said chamber actuating said first control means to indicate a demand therefor, said second control means actuating said second drive motor and said electrically operated actuator means upon the receipt of a proper coin therein to dispense a portion of ice from said chamber.

5. The ice cube making machine set forth in claim 4, wherein said second control means is operated first to energize said second drive motor and thereafter to energize said electrically operated actuator means.

6. The method of making ice cubes comprising preparing flaked ice, collecting the flaked ice in a chamber, forcing the flaked ice from the chamber through a plurality of ice passages having a total cross sectional area equal to from about 45% to about 75% of the cross sectional area of said chamber and having a length equal to at least about one and one-half times the greatest transverse dimension thereof to compress and to congeal the particles of flaked ice into compact and coherent rods of ice, and breaking the compact and coherent rods of ice to form individual compact and coherent ice cubes.

7. An ice cube making machine comprising mechanism for producing flaked ice including an upstanding cylindrical freezing chamber, means for supplying water to said freezing chamber, means for cooling said freezing chamber, a flaked ice collecting chamber above said freezing chamber, and an upstanding auger in said freezing chamber for delivering flaked ice to the flaked ice collecting chamber, an extruding head positioned above and spaced from the upper end of said auger above said collecting chamber and having an ice compressing and ice shaping passage therethrough, the cross sectional area of said ice passage being substantially less than the cross sectional area of said flaked ice collecting chamber, drive mechanism for operating said auger to force the flaked ice from said flaked ice collecting chamber through said ice passage in said extruding head to compress and to congeal the individual ice particles into a rod of compact and coherent ice, and an ice cutter having an arm thereon mounted adjacent to the discharge end of said ice passage and driven by the said drive mechanism for breaking the rod of compact and coherent ice into individual compact and coherent ice cubes as the rod issues from said ice passage, said arm partially blocking said ice passage during movement thereacross to assist in compressing the flaked ice therein.

8. An ice cube making machine comprising mechanism for producing flaked ice and having a flaked ice outlet therefor, an extruding head positioned adjacent to said flaked ice outlet and having an ice compressing and ice shaping passage therethrough, feed mechanism for moving flaked ice from said outlet of said flaked ice mechanism into and through said ice passage in said extruding head, an ice blocking member driven by said feed mechanism for periodically substantially blocking the outlet of said ice passage to compress and to congeal the particles of flaked ice therein to form in said ice passage a rod of compact and coherent ice, and an ice cutter driven by said feed mechanism for breaking the rod of compact and coherent ice into individual compact and coherent ice cubes as the rod issues from said ice passage.

9. The ice cube making machine set forth in claim 8 wherein said ice blocking member and said ice cutter are integral.

10. An ice cube making machine comprising mechanism for producing flaked ice and having a flaked ice outlet therefor, an extruding head positioned adjacent to said flaked ice outlet and having a plurality of ice compressing and ice shaping passages therethrough, feed mechanism for moving flaked ice from said outlet of said flaked ice mechanism into and through said ice passages in said extruding head, and an ice blocking and cutting member mounted for rotation adjacent to the outlet of said ice passage to sequentially substantially block and alternately fully open the ice passages to compress and to congeal the particles of flaked ice therein sequentially to form in said ice passages rods of compact and coherent ice and thereafter sequentially to break the rods of ice into individual compact and coherent ice cubes as the rods issue from said ice passages.

11. An ice cube making machine comprising an upstanding cylindrical freezing chamber having an outlet at the upper end thereof, means for supplying water to said freezing chamber, means for cooling said freezing chamber, an upstanding auger in said freezing chamber for scraping flaked ice therefrom and for delivering the flaked ice to said outlet, an extruding head positioned above and spaced from the upper end of said auger and having a plurality of ice compressing and ice shaping passages therethrough, drive mechanism for operating said auger to force the flaked ice from said outlet into and through said ice passages, and an ice blocking and cutting member mounted for rotation adjacent the outlet of said ice passage to sequentially substantially block and alternately fully open each of the outlets of said ice passage to compress and to congeal the particles of flaked ice therein sequentially to form in said ice passages rods of compact and coherent ice and thereafter sequentially to break the rods of ice into individual compact and coherent ice cubes as the rods issue from said ice passages.

12. The method of making compact ice cubes comprising, preparing flaked ice, forcing flaked ice simultaneously through a plurality of ice passages, sequentially substantially blocking the outlets of said ice passages to compress and to congeal the particles of flaked ice therein into

compact and coherent rods of ice, and thereafter sequentially breaking the rods of ice to form individual compact and coherent ice cubes as the rods issue from said ice passages.

13. The method of making compact ice cubes comprising freezing water on a refrigerated surface to form ice, removing the ice from said refrigerated surface to form flaked ice, forcing the flaked ice through a plurality of ice passages, sequentially substantially blocking the outlets of said ice passages to compress and to congeal the particles of flaked ice therein sequentially to form in said ice passages rods of compact and coherent ice, and thereafter sequentially breaking the rods of ice to form individual compact and coherent ice cubes as the rods issue from said ice passages.

14. An ice cube making mechanism comprising a cold wall refrigerating cylinder, means for supplying to said cylinder water to be frozen on said wall, mechanism for scraping flaked ice from said wall, means forming a flaked ice collecting chamber in communication with said refrigerating cylinder, an extruding head positioned adjacent to said flaked ice collecting chamber and having an ice compressing and ice shaping passage therethrough, said mechanism including means for forcing the flaked ice into said collecting chamber and thereby forcing the flaked ice from said collecting chamber into and through said ice passage in said extruding head to compress and to congeal the particles of flaked ice to form in said passage a rod of compact and coherent ice, and means adjacent to said extruding head and driven by said mechanism for breaking the rod of compact and coherent ice into compact and coherent ice cubes as the rod issues from said ice passage.

15. An ice cube making machine comprising mechanism for producing flaked ice and having a flaked ice outlet therefor, an extruding head positioned adjacent to said flaked ice outlet and having a plurality of ice compressing and ice shaping passages therethrough, feed mechanism for moving flaked ice from said outlet of said flaked ice mechanism into and through said ice passages in said extruding head, and an ice blocking member mounted for sequential movement over the outlets of said passages one after the other for sequentially substantially blocking and alternately fully opening the outlets of said ice passages one after the other to compress and to congeal the particles of flaked ice therein to form in said ice passages rods of compact and coherent ice.

16. An ice cube making machine comprising mechanism for producing flaked ice and having a flaked ice outlet therefor, an extruding head positioned adjacent to said flaked ice outlet and having a plurality of ice compressing and ice shaping passages therethrough, feed mechanism for moving flaked ice from said outlet of said flaked ice mechanism into and through said ice passage in said extruding head, an ice blocking member mounted for sequential movement over the outlets of said passages one after the other for sequentially substantially blocking and alternately fully opening the outlets of said ice passages one after the other to compress and to congeal the particles of flaked ice therein to form in said ice passages rods of compact and coherent ice, and an ice cutter for sequentially breaking the rods of ice to form individual compact and coherent ice cubes as the rods issue from said ice passages.

17. An ice cube making machine comprising mechanism for producing flaked ice and having a flaked ice outlet therefor, an extruding head positioned adjacent to said flaked ice outlet and having an ice compressing and ice shaping passage therethrough, feed mechanism for moving flaked ice from said outlet of said flaked ice mechanism into and through said ice passage in said extruding head, and an ice blocking member mounted for movement over the outlet of said passage and fixedly connected to and driven by said feed mechanism for periodically substantially blocking and alternately fully opening the outlet of said passage to compress and to congeal the particles of flaked ice therein to form in said ice passage a rod of compact and coherent ice.

18. An ice cube making machine comprising mechanism for producing flaked ice and having a flaked ice outlet therefor, an extruding head positioned adjacent to said flaked ice outlet and having an ice compressing and ice shaping passage therethrough, feed mechanism for moving flaked ice from said outlet of said flaked ice mechanism into and through said ice passage in said extruding head, drive mechanism, an ice blocking member mounted for movement over the outlet of said passage and driven by said drive mechanism for periodically substantially blocking and alternately fully opening the outlet of said passage to compress and to congeal the particles of flaked ice therein to form in said ice passage a rod of compact and coherent ice, and an ice cutter mounted for movement over the outlet of said ice passage and driven by said drive mechanism for breaking the rod of compact and coherent ice into individual compact and coherent ice cubes as the rod compressed and congealed by said blocking member in said ice passage issues from said ice passage when fully open.

19. An ice cube making machine comprising an upstanding cylindrical freezing chamber having an outlet at the upper end thereof, means for supplying water to said freezing chamber, means for cooling said freezing chamber, an upstanding auger in said freezing chamber for scraping flaked ice therefrom and for delivering the flaked ice to said outlet, an extruding head positioned above and spaced from the upper end of said auger and having a plurality of ice compressing and ice shaping passages therethrough, drive mechanism for operating said auger to force the flaked ice from said outlet into and through said ice passages, an ice blocking member mounted for movement adjacent to the outlets of said ice passages for sequentially substantially blocking and alternately fully opening the outlets of said ice passage to compress and to congeal the particles of flaked ice therein to form in said ice passages rods of compact and coherent ice, means for moving said ice blocking member, and an ice holding chamber mounted above said extruding head and in general axial alignment with said auger and having an inlet thereto communicating with the upper ends of said ice passages.

20. The method of making compact ice cubes comprising, continuously preparing flaked ice, continuously forcing flaked ice simultaneously through a plurality of ice passages, sequentially substantially blocking the outlets of said ice passages one after the other to compress and to congeal the particles of flaked ice therein into compact and coherent rods of ice, and forcing the rods of ice from said ice passages.

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