

July 21, 1953

M. G. LEESON

2,645,910

ICE-MAKING APPARATUS AND METHOD

Filed Dec. 9, 1949

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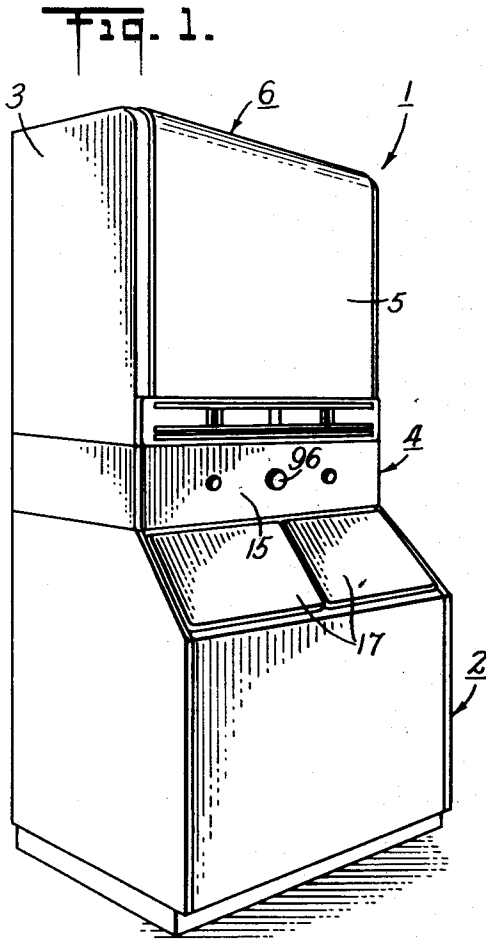
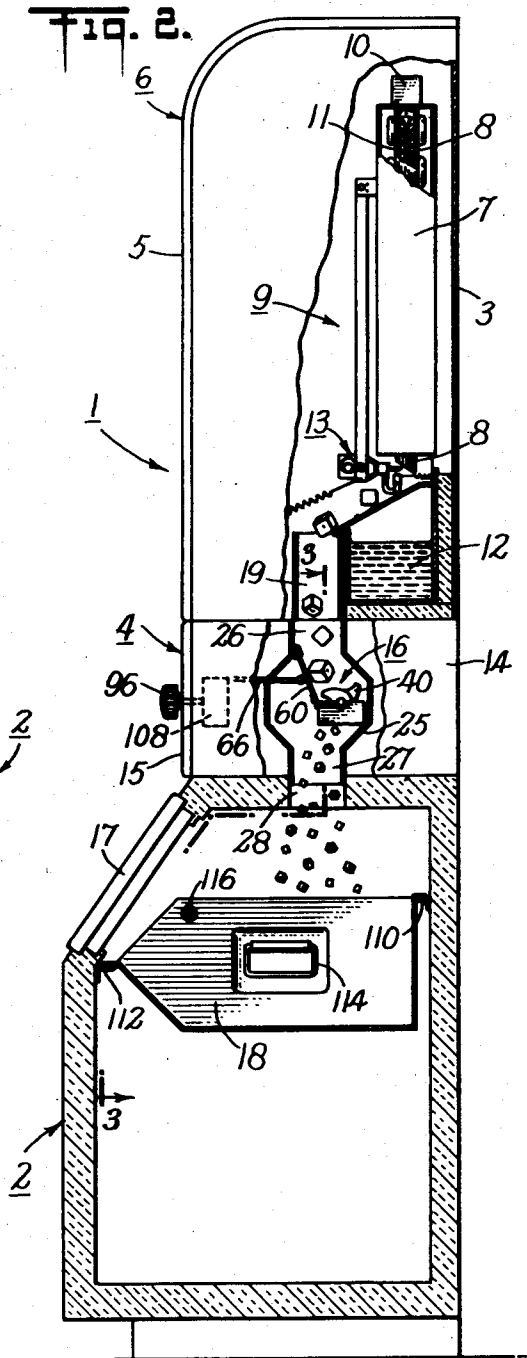
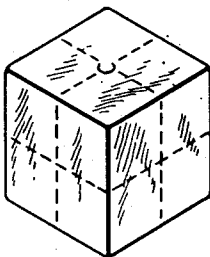


Fig. 2A.



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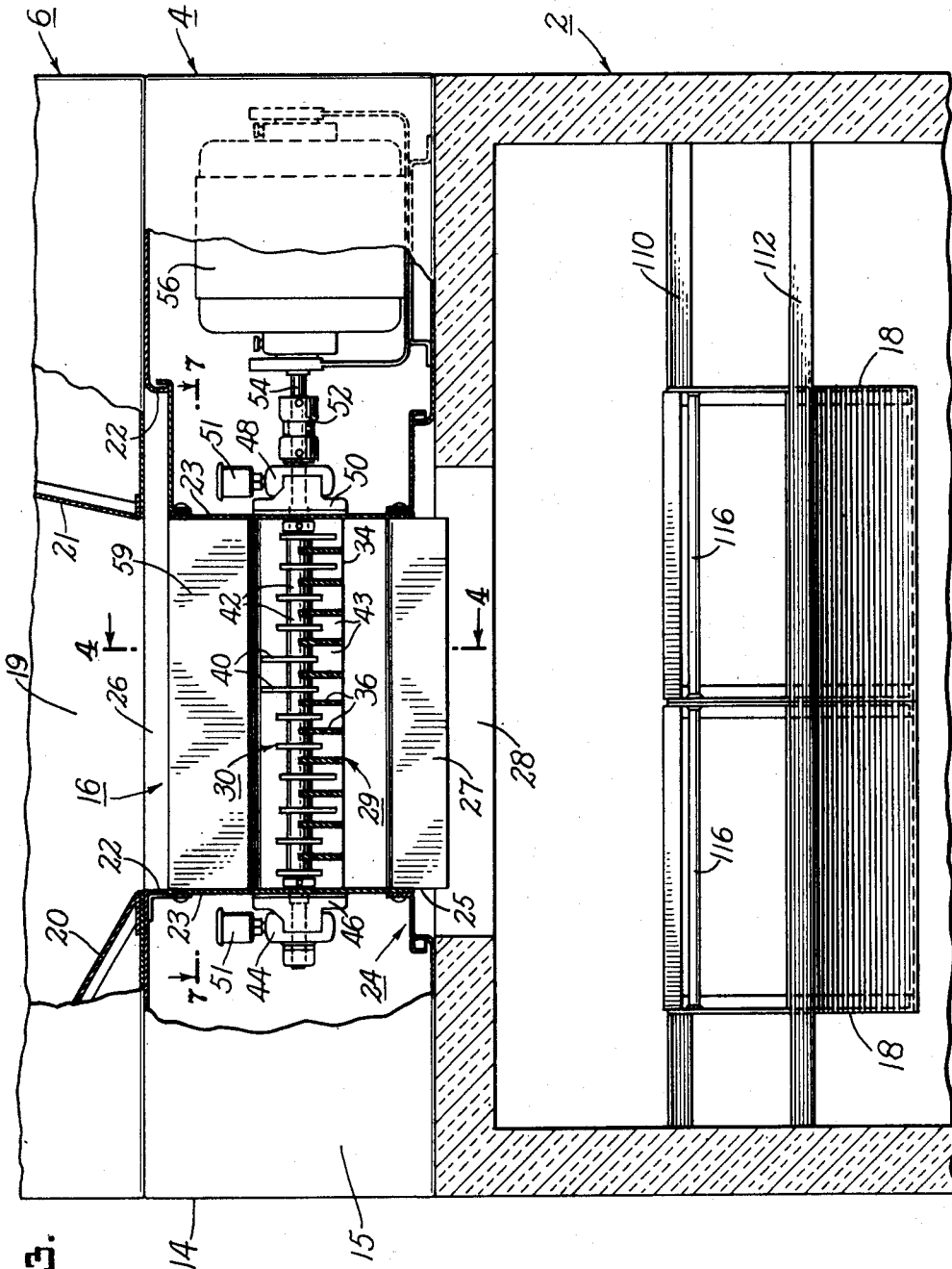


Fig. 3.

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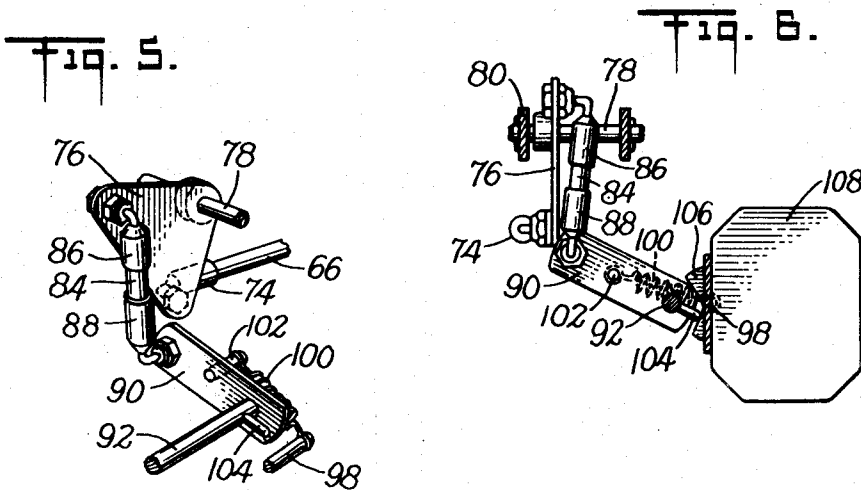
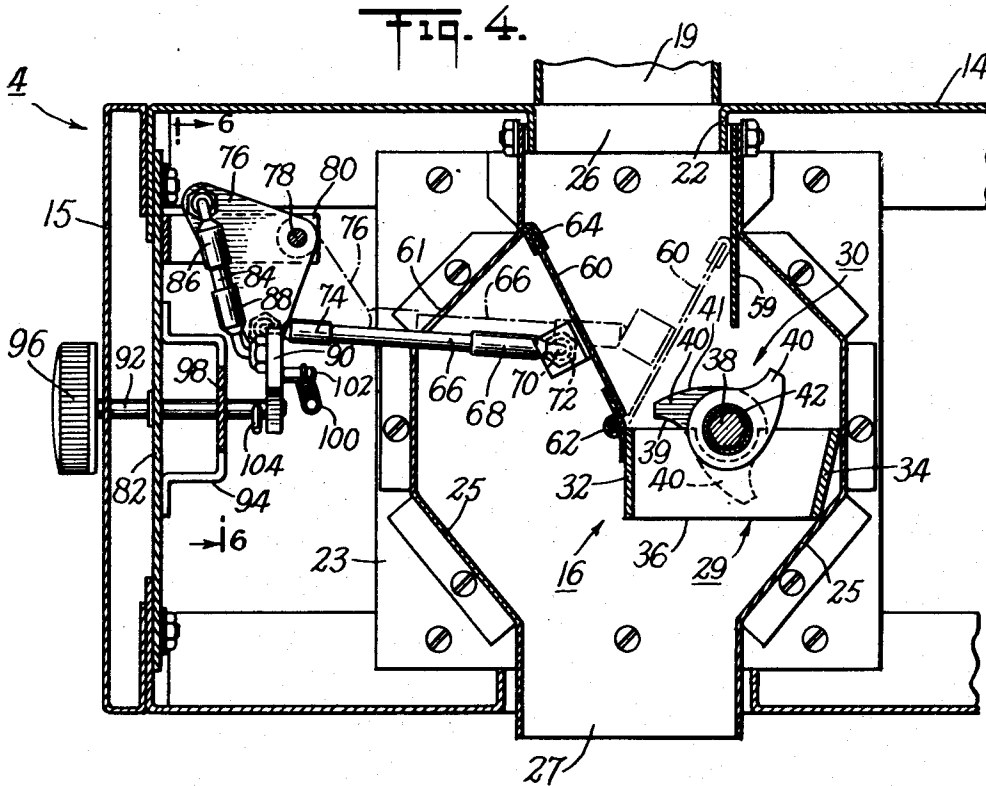
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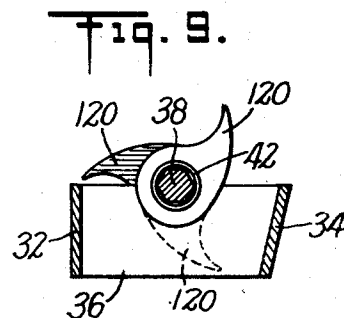
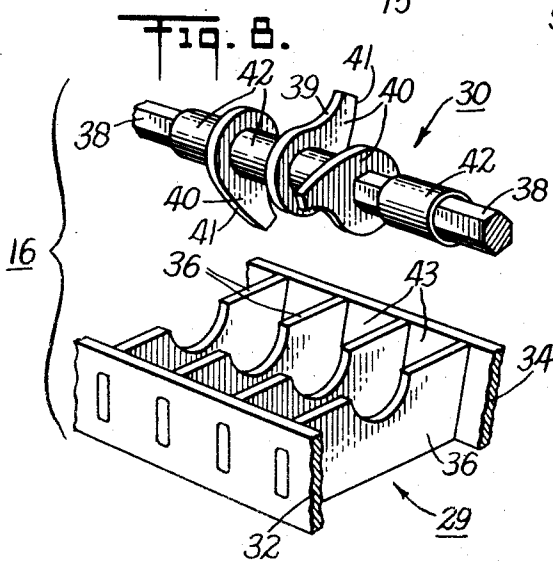
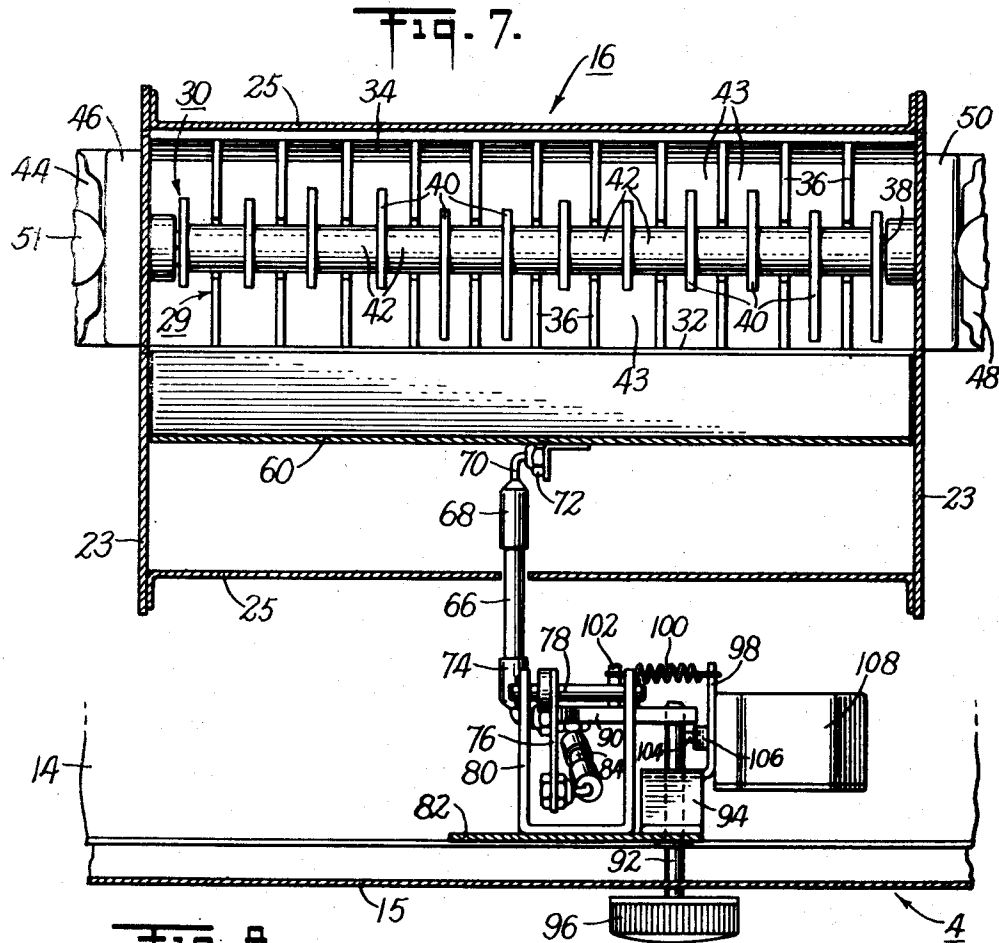
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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,645,910

ICE-MAKING APPARATUS AND METHOD

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Application December 9, 1949, Serial No. 132,039

26 Claims. (Cl. 62—107)

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This invention relates to ice-making, and more in particular to making small pieces of ice of relatively uniform size. The present invention is related to my copending applications Serial No. 573,939, filed January 22, 1945, now Patent No. 2,524,815, Serial No. 686,021, filed July 21, 1946, now Patent No. 2,549,747, and Serial No. 83,603, filed March 26, 1949; and, also, to copending application Serial No. 57,158, now Patent No. 2,593,874, filed October 29, 1948.

The above-identified copending applications disclose machines and apparatus, including automatic ice-making units, and methods of operating the same, by means of which ice of high quality is formed in an efficient and dependable manner. The ice-making machines disclosed produce ice in the form of long columns or sticks, which are square in cross-section and which may have a longitudinal hole therethrough. These columns are severed or cut into lengths to produce cubes, and the cubes are deposited into a storage chamber beneath the ice-making and severing apparatus. The holes in the cubes are cylindrical and they may vary some in size, depending upon the conditions of operation of the apparatus, particularly, the structure and adjustment of the control system which automatically controls the ice-making and harvesting operations.

With ice-making units such as those referred to above, it is possible to produce ice of exceptionally high quality in the form of cubes of a desired size, and they may be produced with cylindrical holes of a given diameter therethrough. Furthermore, with other types of apparatus, ice may be produced in the form of thin wafer-like pieces which are of relatively uniform size, and which are free-flowing. However, it is at times desirable to provide ice in sizes intermediate the cube and wafer sizes, such as, crushed ice. In the past, ice has been produced in large blocks, and then crushed or chipped to the sizes desired; but, the crushing or chipping of ice blocks produces many ice fragments of widely varying sizes so that if ice of a particular size is desired, the crushed product must be sifted or otherwise processed to remove the small fragments. This is quite wasteful, not only because much of the ice is wasted, but also, because it is inefficient to produce ice in large blocks and then break it up into small pieces.

It is an object of the present invention to produce ice of extremely high quality in pieces which are of relatively uniform size, particularly, crushed ice somewhat intermediate the usual size of ice cubes and the usual size of ice wafers or the like. It is a further object to provide a

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method and apparatus for carrying out the above in a simple and efficient manner. Another object is to provide such apparatus which is simple and sturdy in construction, inexpensive to manufacture and maintain, and dependable in use. These and other objects will be in part obvious and in part pointed out below.

The invention, accordingly, consists in the features of construction, combinations of elements, arrangements of parts and in the several steps and relation and order of each of the same to one or more of the others, all as will be illustratively described herein, and the scope of the application of which will be indicated in the following claims.

In the drawings:

Figure 1 is a perspective view of an ice-making machine constituting one embodiment of the invention;

Figure 2 is an enlarged vertical section of the machine of Figure 1;

Figure 2A is a perspective view of an ice cube produced in the machine;

Figure 3 is a further enlarged vertical section on the line 3—3 of Figure 2;

Figure 4 is an enlarged vertical section on the line 4—4 of Figure 3;

Figure 5 is a fragmentary perspective view of a portion of the apparatus of Figure 4;

Figure 6 is a section of the line 6—6 of Figure 4;

Figure 7 is a view on the line 7—7 of Figure 3;

Figure 8 is an exploded view of crusher parts; and,

Figure 9 is a vertical section of another ice crusher.

In the illustrative embodiment of the present invention, ice is produced in columns and severed into cubes, one of which is shown in Figure 2A, and then crushed ice may be formed by subjecting the cubes to a break operation. Each of the columns of ice is of the type referred to above, having a square outside cross-section and it may have a small cylindrical longitudinal hole therethrough. As indicated above, each column of ice is built up by flowing water in a thin layer down the inner surface of a refrigerated tube; the rate of flow is such that clear ice is built up without any visible stratification. However, the ice is unique in that it is extremely hard and it tends to break only along definite transverse planes or lines (such as those indicated in broken lines in Figure 2A), each of which extends transversely of the plane in which the ice was formed. The ice wall surrounding the center of the column is of greater thickness at the corners of the column than it is at the longitudinal zones

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intermediate the corners, that is, at the zones which extend along the centers of the flat sides of the column. As a result of this, each of the cubes tends to have four zones of minimum thickness along the longitudinal central lines of the four sides which are parallel to the axis of the hole. In accordance with the present invention, the ice cubes are produced as indicated, and they are then subjected to a breaking operation whereby each of them is broken with a tendency to break along these four zones of minimum thickness and also along the transverse planes and lines referred to above. This produces pieces of ice which are smaller than the cubes, and yet many of the pieces of ice are of somewhat the same size and general configuration.

Referring particularly to Figure 1 of the drawings, an ice-making machine 1 has at the bottom a base formed by a storage compartment 2, a central ice crusher section 4, and, at the top, an ice-making unit 6. The ice storage compartment and the ice-making unit will be discussed in the present application to the extent necessary to the understanding of the present invention, and such structure as is not discussed in detail is identical with that shown in my copending application, Serial No. 686,021, now Patent No. 2,549,747, filed July 21, 1946. Therefore, that application is incorporated herein, and reference may be had thereto for details of the structure or mode of operation not herein disclosed. The ice-making unit is enclosed in a casing 3 having a removable front panel 5; and, within this casing there is a motor driven refrigerant compressor, a condenser and other elements of a refrigeration system, indicated at 9.

The evaporator of the refrigeration system is shown in part at 7 and is formed by two evaporator sections positioned along the opposite sides of a bank of vertical freezing tubes 8. Each of the evaporator sections is formed by a plurality of serially-connected evaporator tube runs which are horizontal and are interconnected at their ends to form a continuous evaporator passageway at each side of the bank of freezing tubes. The freezing tubes are square in cross-section, and they form with the evaporator an ice freezing assembly which is covered with heat insulation and within which water is frozen into columns 11 of clear, hard ice; and, the ice columns are then harvested by passing hot refrigerant gas into the evaporator. Water flows into the freezing tubes from a header 10, and it flows through the tubes at a very rapid rate so as to produce clear, hard ice, and the water in excess of that frozen in the tubes falls into a sump tank 12 and is recirculated by a pump (not shown).

The ice-making unit is operated in accordance with the disclosure of the copending application Serial No. 57,158, filed October 29, 1948, now Patent No. 2,593,874, and the operation is controlled automatically in accordance with a predetermined ice-making and harvesting cycle. Specifically, the ice-making or freezing operation is carried on until ice builds up to close, or substantially restrict, one or more of the openings through the columns of ice. The ice is then harvested, that is, the ice columns are melted free and drop from the bottom ends of the freezing tubes. At the bottom of the freezing tubes there is an ice cutter or chopper assembly 13 which cuts each of the ice columns into lengths as it emerges from the bottom of its freezing tube; these lengths of the ice columns are substantially equal to the transverse dimension or

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width of the columns so that ice cubes are formed of substantially equal dimensions throughout. As discussed above, the ice forming the columns tends to break along transverse planes or lines so that the cubes are even and uniform. However, as indicated, certain of the columns of ice may have longitudinal center holes therein, so that each cube formed therefrom has a hole through it extending from the centers of two opposite sides and parallel to the other four sides; and, the ice forming the cubes is extremely hard, clear and brittle, as it contains substantially no precipitated salts and air.

The central ice crusher section 4 has a rigid casing 14 with a removable front panel 15, and within this casing is the ice crusher unit, and the details of which are shown in Figures 2 to 8. The ice crusher unit 16 (see Figure 2) is provided with an ice-directing chute and baffle structure, whereby the ice cubes are received, and may be diverted directly to the ice storage compartment 2; or they may be crushed and then the crushed ice is passed on to the ice storage compartment. Access may be had to the ice storage compartment for removal of ice by lifting either of a pair of swinging lids 17. As will be explained more fully below, slidably mounted in the upper portion of the ice storage compartment 2 are two baskets 18 which may be used to catch the ice, or the baskets may be slid to the side so that the ice falls into the bottom of the storage compartment. Thus, the baskets may be used to catch and store either ice cubes or crushed ice, and the other product may be stored in the bottom of the compartment. The baskets may be removed through the front opening which is normally closed by lids 17.

As shown best at the upper portions of Figures 3 and 4, the ice cubes of the type shown in Figure 2A pass from the upper ice-making section 6 through an elongated rectangular opening 19 into the ice crusher section 4. At the ends of this opening there are diverting baffles 20 and 21 (Figure 3) which divert the cubes from the ends of the ice-making section toward the center and cooperate with the parallel side walls of the chute to provide, in a sense, a hopper which feeds the cubes to the ice crusher unit. Thus, during operation, a substantial body of ice cubes may be accumulated in this chute or hopper. Opening 19 is surrounded by a downwardly directed flange structure 22 (see Figure 4) to which is bolted the chute and baffle structure referred to above. This structure comprises a pair of end plates 23 (Figure 3) which are rectangular and are fixed at the top to the flange structure 22, and at the bottom to a similar structure generally indicated at 24. Extending between end plates 23 and bolted thereto, are two side plates 25 (Figure 4) which extend in parallel relationship and have the cross-sectional configuration shown with flat vertical portions at the top and bottom forming with the end plates a rectangular top inlet chute 26 beneath opening 19, and a bottom outlet chute 27 (see Figures 2 and 3) in alignment with a rectangular opening 28 in the top wall of the ice storage compartment 2. Between the inlet and outlet chutes the two side plates 25 are formed into somewhat arcuate form so that they define a substantially cylindrical crushing and bypass zone between chutes 26 and 27. Rigidly mounted at the right-hand side of this crushing and bypass zone is the ice crusher 28, formed by a stationary grid assembly 29 and a rotating crushing rotor 30, and the details of which are shown best in Figures 7 and 8. The stationary grid assem-

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ably 29 comprises two longitudinal side bars 32 and 34 and eleven cross bars 36; each of bars 36 has an end portion which projects through a rectangular opening in each of the side bars and welded so as to rigidly connect each of the cross bars to each of the side bars. Each of the side bars has similar projections on its ends which project through its end plates 23 and are welded thereto; thus, the bars 32, 34 and 36 and the end plates 23 form a rigid grid structure.

The crushing rotor 30 comprises a hexagonal shaft 38 which carries twelve spaced crushing arms 40, each of which has a hexagonal opening through which the shaft extends with a snug fit, and between each of the crushing arms and the next there is a spacer sleeve 42. Each of the crushing arms has a leading edge 39 which extends somewhat spirally and outwardly in the direction of rotation, and there is a trailing edge 41 which is somewhat of the same configuration. The central portion of each of the cross bars 36 has a semicircular recess 43 which permits the rotor to be positioned with its axis in alignment with the plane of the top of the cross grids. The left-hand end of shaft 38 (Figures 3 and 7) is journaled in a bearing assembly 44 supported by a bracket 46 clamped to the end wall 23, and the right-hand end is supported by a similar bearing assembly 48 similarly mounted in a bracket 50 on the end wall. The bearing assemblies are lubricated by oil cups 51. Shaft 38 projects (see Figure 3) to the right beyond the bearing assembly 48 and is connected through a flexible coupling 52 to the shaft 54 of an electric motor 56. Motor 56 is mounted securely by a flexible support on bottom wall of the casing 14. The crushing arms 40 are positioned in staggered relationship (see Figures 4 and 8) with each arm being spaced 120 degrees radially from the next; there are twelve arms so that the crusher rotor formed by the shaft, the crushing arms and the spacer sleeves 42 is a balanced unit which rotates counterclockwise (Figure 4). Each of the crusher arms is positioned in a plane which bisects one of the spaces or vertical passageways formed by the crossbars 36; thus, the grid forms, in effect, an anvil assembly which intercepts and stops the ice cubes as they pass downwardly and then holds the cubes while they are crushed by the crushing arms 40. As explained above, the ice cubes are formed in vertical freezing tubes and may have a hole therethrough; the breaking tends to be along lines and planes which extend radially from the hole or line which was the axis of the column from which the cube was severed. It has been found that, particularly with the apparatus shown, cubes of this type are crushed with great facility into crushed ice which has a relatively low percentage of small or splintered ice and a relatively high percentage of large somewhat cubical pieces.

As pointed out above, shaft 38 is hexagonal and the openings through the crushing arms 40 are of the same shape and snugly receive the shaft, and the arms are staggered so that each of the crushing arms is spaced arcuately one-hundred twenty degrees from the next adjacent arms. Thus, the arms are positioned in three rows, angularly disposed as shown in Figure 4 with there being four arms in each row. During operation, as the crushed rotor is turned counterclockwise (Figure 4) the three rows of the crushing arms are effective in succession with the crushing arms of one row, first moving downwardly between the respective crossbars 36 of the grid, and then they

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are followed by the crushing arms of the next row and later by the crushing arms of the other row.

The crushing action takes place through a rather wide range of arcuate movement of the rotor so that the load on the motor is relatively constant. Furthermore, the rotor itself and the rotor of the motor have sufficient momentum at the relatively high speed to impact the ice cubes with crushing forces. Thus, the crushing action is quite efficient because it depends upon an impacting action as distinguished from a cutting or shearing action. As indicated above, the cubes may pile up above the crusher and this tends to keep the crushing zone filled with cubes until they are all crushed. The ice particles which are of relatively uniform size drop through the spaces between the crossbars 36 and fall through the outlet chute 27 (see Figure 2) into the storage compartment. With the baskets positioned as shown, the crushed ice falls into the baskets. Referring again to Figure 4, directly above the crushing rotor there is flexible rubber baffle 59 which is clamped at its upper edge to the casing at the inlet opening 26 and hangs downwardly. This flexible baffle 59 tends to stop flying particles of ice and tends to direct the cubes of ice toward the left-hand portion of the crushing unit.

The crusher assembly is so arranged that the ice cubes may be diverted past the ice crusher and, therefore, directed to the storage compartment intact. This is performed (see Figure 4) by a rectangular baffle 60 which is hinged at its lower edge by a hinge 62 to the upper edge of side bar 32 of the grid assembly 29. Baffle 60 extends between the end plates 23 and swings between the full line and broken line positions of Figure 4. The upper edge of the baffle is covered by a rubber strip or bead 64 which acts as a resilient bumper and seal. When the baffle is in the full line position, its upper edge rests against the left-hand side plate at the lower end of chute 26 with the result that ice cubes passing downwardly from the ice-making unit are diverted to the right to the ice crusher. When the baffle is swung to the right to the broken line position, its upper edge engages the right-hand side wall at the lower end of chute 26, and diverts the ice cubes to the left. The ice cubes therefore pass down at the side of the ice crusher and thence through chute 27 to the ice storage compartment. As will be explained more fully below, the ice crusher is operated whenever baffle 60 is in the full line position, and is not operated when the baffle is in the broken line position.

Baffle 60 is swung between its two positions by a manually operated mechanism acting through an operating rod 66, which projects through an opening 61 in side plate 25, and has on its right-hand end a pivot assembly, including a cap 68 (see also Figure 7). Cap 68 is threaded onto rod 66 and has an integral elbow pin 70, the end of which has a ball thereon which is pivotally held by a socket cap 72 threaded onto a boss welded to baffle 60. The other end of rod 66 carries a similar pivot assembly, including cap 74, by means of which it is pivotally secured to a triangular plate 76 (see also Figures 5 and 6). Plate 76 is pivoted on a shaft 78 which is supported (Figure 4) by a U-bracket 80, welded to a mounting plate 82. Mounting plate 82 is in turn bolted to the front wall of the casing and frame 14.

Baffle 60 is swung between its two positions by rocking the triangular plate 76 between the full line and broken line positions of Figure 4, and

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this rocking movement is transmitted to the plate by an operating rod 84 (Figure 5) which is similar to rod 66, but shorter in length. Rod 84 has threaded on to its ends a pair of caps 86 and 88 similar to cap 68 and each forming part of a pivot assembly, by which cap 86 is pivotally secured to plate 76 and cap 88 is pivotally secured to an operating arm 90 which is carried by and rigidly fixed to a shaft 92. Referring to Figure 4, shaft 92 projects through the front wall of the casing and is pivotally mounted in plate 82 and a bracket 94 welded to the plate. The left-hand end of shaft 92 has mounted thereon and keyed thereto, an operating knob 96 which is grasped by the operator and turned back and forth to swing the baffle between its two positions. This movement of knob 96 is transmitted to the baffle (see Figure 4) by shaft 92, arm 90, rod 84, triangular plate 76, and rod 66; and, the movement of the knob is limited to that necessary to swing the baffle between its two extreme positions.

It is important that baffle 60 be at rest only in one of its two extreme positions and, therefore, bracket 94 carries an extension 98 to which is hooked a tension spring 100, the other end of which is carried by a pin 102 rigidly mounted on arm 90. Extension 98 and pin 102 are so related that the distance between them increases as arm 90 is swung from either of its two positions; and, therefore, spring 100 tends to move the arm to one or the other of these positions. Thus, when the baffle is in either of the extreme positions the spring acts through arm 90 to exert a seating pressure and, at the same time, lost motion is taken up.

As indicated above, the ice crusher motor 56 is turned on whenever baffle 60 is positioned to pass ice cubes through the ice crusher, and it is turned off when the baffle is positioned to divert the cubes around the ice crusher. Accordingly (see Figure 6), shaft 92 carries a switch operating pin 104 which swings with the shaft and operates a push button switch 106 which projects from a switch casing 108 mounted on bracket 98. The arrangement is such that switch 106 is closed when baffle 60 is in the full line position of Figure 4 and the crusher motor is turned on. When the operator decides to discontinue the crushing operation and thereby to produce only cubes, he turns knob 96 and this simultaneously stops the crusher motor and swings baffle 60 to its broken line position of Figure 4.

As indicated above, the ice storage compartment 2 has two baskets 18 which are slidably mounted so that they may be used to catch the ice as it falls into the compartment. Referring particularly to Figure 2 these baskets are mounted at the rear of the compartment on an angle bracket 110 and at the front of the compartment on a similar angle bracket 112. Each basket has a pair of handles 114 on its sides and (see Figure 3) near the front side of each basket there is a rod 116 which provides reinforcement for the basket and also may be grasped to lift the basket from the ice storage compartment. The baskets are generally rectangular with a slanting front wall which provides a pouring spout and also provides for access from the front of the compartment.

When positioned as shown in the drawings the ice entering the compartment from chute 27 is deposited in the baskets but, when desirable, the baskets can be separated by sliding them apart towards the opposite ends of the compart-

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ment and the ice then falls to the bottom of the compartment. The baskets will hold a substantial amount of ice but their capacity is much less than that of the remainder of the compartment. Therefore, assuming that the machine is used to make ice cubes and crushed ice, the operator collects the kind of ice which he uses least of in the baskets, and the other type is stored in the bottom of the compartment.

Figure 9 shows another ice crusher unit which is identical with that of the embodiment of Figures 1 to 8, except for the crusher arms. In Figure 9 each of the crusher arms 120 extends to a point so that the arms project further from the center of the rotor and, therefore, produce a more vigorous crushing. This crusher has greater capacity than that shown in Figures 1 to 8, although the crushed ice is of substantially the same high quality.

As many possible embodiments may be made of the mechanical features of the above invention and as the art herein described might be varied in various parts, all without departing from the scope of the invention, it is to be understood that all matter hereinabove set forth, or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. In ice-making apparatus, the combination of: a casing structure comprising, a base portion forming an ice storage compartment, and a top construction providing an enclosure; an ice-making unit positioned within said enclosure and including, a bank of vertical freezing tubes mounted in parallel relationship, means to refrigerate said freezing tubes and means to circulate water through said freezing tubes whereby ice is formed in said freezing tubes and is then harvested, said unit being adapted to produce ice in the form of cubes where the freezing operation is carried on transversely of the walls of the freezing tubes; an ice crusher positioned to receive the ice cubes from said ice-making unit and to crush the ice cubes into crushed ice having a substantially small proportion of small particles, said ice crusher being adapted to pass the crushed ice to said storage compartment; and means to pass the ice cubes directly from the ice-making unit to the storage compartment.

2. In ice-making apparatus, the combination of: a casing construction having a relatively large base portion which is adapted to act as an ice storage compartment, and a top portion projecting above said base portion and providing an enclosure; an ice-making unit positioned within said enclosure and including means to freeze ice in the form of cubes having a tendency to break along definite planes transverse to the planes in which the ice was formed, and an ice crusher positioned at the lower portion of said enclosure and adapted to receive the ice cubes from said ice-making unit and discharge crushed ice into the ice storage compartment, said ice crusher comprising stationary anvil means upon which the ice cubes may rest and impacting means which is adapted to impact the ice cubes and sever them into crushed ice.

3. Apparatus as described in claim 2 wherein said ice crusher comprises, an anvil portion formed by a rigid stationary grid which includes, a plurality of parallel anvil bars having spaces therebetween and an impacting means comprising, a rotor having crusher arms which are adapted to move from an upper position down-

wardly into the spaces between said anvil bars, thereby to crush the ice and cause it to fall through said spaces.

4. Apparatus as described in claim 3 wherein each of said crusher arms has a leading impacting surface which projects spirally outwardly in the direction of rotation and a trailing surface of substantially similar characteristics.

5. Apparatus as described in claim 4 wherein each of said crusher arms has its leading edge extending from one side of the axis and its trailing edge extending from the other side of the axis, and wherein each of said crusher arms has a hole in the shape of a polygon or the like.

6. Apparatus as described in claim 3 wherein said rotor comprises a hexagonal shaft having a plurality of crusher arms mounted thereon each of which has a hexagonal hole therethrough, said crusher arms being axially and radially spaced from one another to provide a balanced rotor structure which effects a substantially continuous crushing operation, and a plurality of sleeve spacers positioned respectively between said crusher arms.

7. Ice-making apparatus as described in claim 6 wherein said stationary grid is formed by a pair of substantially vertical parallel spaced side plates and a plurality of anvil bars rigidly mounted thereon and extending therebetween, each of said anvil bars comprising, a rigid plate having a semi-circular recess substantially at the center of its upper edge, said rotor having its axis substantially at the plane of the upper edges of said anvil bars.

8. Apparatus as described in claim 7 which includes, a chute structure having an inlet passageway at the top and an outlet passageway at the bottom which are substantially rectangular in horizontal section, and having an enlarged central portion with said ice crusher positioned at one side of said central portion whereby a vertical passageway is provided at the other side of said central portion, and a baffle hinged at substantially the center of said central portion and adapted to swing between an ice crushing position wherein it closes said vertical passageway and an ice-diverting position wherein it diverts the ice from said ice crusher.

9. Apparatus as described in claim 8 which includes, operating means to swing said baffle between its two positions which comprises, an operating arm connected to said baffle at one end, a triangle plate pivoted at one corner and pivotally connected to the other end of said rod at another corner, a connecting link connected at one end to the other corner of said plate, an operating arm connected to the other end of said link, an operating shaft pivotally mounting said operating arm and a spring which is adapted to bias said baffle alternatively in one of its two positions.

10. Apparatus as described in claim 9 which includes, an electric motor to drive said rotor, an electric switch connected to control the operation of said motor, and means operatively connected to said operating shaft and adapted to close said switch when said baffle is moved to said ice-crushing position.

11. Apparatus as described in claim 8 which includes, a basket slidably mounted in said storage compartment and adapted to move to and from a position wherein it receives ice from said outlet passageway.

12. Apparatus as described in claim 11 wherein said basket is mounted on a pair of angle bars

and is removable from the storage compartment.

13. Apparatus as described in claim 8 which includes, a baffle of flexible sheet material clamped at one edge substantially in said inlet opening directly above said ice crusher, and having its lower edge adjacent the path of movement of said crusher arms.

14. In ice-making apparatus of the character described, a crusher assembly comprising, a casing and chute construction providing vertical inlet and outlet passageways and an enlarged passageway therebetween each of which is substantially rectangular in cross section, an ice crusher unit mounted in said enlarged passageway at one side thereof and occupying substantially one-half of the cross sectional area, said ice crusher unit comprising, a grid formed by side plate means positioned in parallel relationship and a plurality of parallel spaced cross bars extending therebetween and fixed thereto, and a rotor comprising, a shaft structure and a plurality of crushing arms rigidly mounted thereon and adapted to move during the rotation of the rotor from an upright position downwardly through a portion of the space immediately over said grid.

15. Apparatus as described in claim 14 wherein each of said cross bars comprises, a plate positioned vertically and having a substantially semi-circular recess at its upper edge, said rotor having said shaft structure positioned partially within said recesses.

16. In ice-making apparatus, the combination of, a casing construction; an ice-making unit enclosed in said casing construction and forming ice cubes of the type having four planes of minimum thickness along which breakage tends to occur; and an ice crusher enclosed in said casing construction and positioned to receive ice cubes from said ice-making unit, said ice crusher comprising, structure forming anvil means against which the cubes may rest and movable crushing means which severs the cubes along said planes of minimum thickness into crushed ice of a size and configuration substantially one-eighth that of said cubes.

17. In ice-making apparatus, the combination of, a casing construction which includes means forming an ice storage compartment; an ice-making unit enclosed in said casing construction and freezing ice transversely of the freezing surface to form cubes; an ice crusher enclosed in said case construction and positioned to receive ice cubes from said ice-making unit, said ice crusher comprising, structure forming anvil means against which the cubes may rest and movable crushing means which severs the cubes into crushed ice; and means for delivering the ice produced to said ice storage compartment.

18. In the art of making crushed ice, the steps of, freezing ice in a closed passageway from the walls of the passageway whereby ice builds up without visible stratification, and crushing the ice so that it breaks substantially transversely of the planes of formation.

19. In the art of making ice, the steps of, freezing ice on surfaces by refrigerating the surfaces and flowing water in a thin stream at such a rapid rate as to cause ice to build up without visible stratification and without a milky appearance, removing the ice from the surfaces, and breaking the ice along lines and planes which extend substantially transversely of the ice sur-

faces which were parallel to the surfaces upon which the ice was formed.

20. In ice-making apparatus, the combination of: a casing structure; ice-forming means comprising, a bank of freezing tubes, means to refrigerate said freezing tubes, means to circulate water to be frozen through said freezing tubes at a rate in excess of the rate of freezing, whereby ice is frozen transversely of the walls of said freezing tubes, and harvesting means to release the ice formed; and an ice crusher adapted to receive said ice and including, stationary anvil means upon which the ice rests, and means to impact the ice thereby to crush it into crushed ice having a substantially small portion of small particles.

21. In ice-making apparatus, the combination of: a casing structure comprising a storage compartment and an ice-making compartment; an ice-making unit positioned within said ice-making compartment including a bank of substantially square freezing tubes mounted in vertical parallel relationship, means to refrigerate said freezing tubes, means to circulate water through said freezing tubes whereby columns of ice are formed therein, means to harvest said columns of ice, and means to sever said columns of ice into substantially uniform cubes; and an ice crusher positioned to receive the ice cubes from said ice-making unit and to crush the ice cube into crushed ice forming a substantially small proportion of waste fine ice, said ice crusher including a stationary anvil portion formed by a plurality of parallel anvil bars having spaces therebetween, and a rotor having crusher arms adapted to move into the spaces between said anvil bars thereby to impact and crush the ice and cause it to fall through said spaces.

22. In ice-making apparatus of the character described: a crusher assembly comprising, a casing and chute construction having an upper inlet passageway and a lower outlet passageway which are substantially rectangular in horizontal section, and having an enlarged central passageway therebetween; an ice crusher unit mounted in said enlarged passageway and adapted to crush ice passing through the ice crusher unit but said passageway being such as to permit ice to pass through it without passing through the ice crusher unit, said ice crusher unit comprising, a stationary anvil portion having a plurality of parallel anvil bars, and impacting means comprising a hexagonal rotor shaft having a plurality of crusher arms mounted thereon, each of said crusher arms having a leading impacting surface which projects spirally outwardly in the direction of rotation and a trailing surface of substantially similar characteristics, said crusher arms being axially and radially spaced from one another to provide a balanced rotor section which effects a substantially continuous crushing operation; and a baffle hinged substantially at the center of said enlarged central passageway to selectively and alternatively close off the passage of ice to the ice crusher unit or the passage of ice past the ice crusher unit.

23. In ice-making apparatus, the combination of, a casing construction having a relatively large base portion which is adapted to act as an ice storage compartment and a top portion projecting above said base portion and providing an enclosure, an ice-making unit positioned within said enclosure and including means adapted to form ice in the form of cubes or the like, an ice crusher adapted to receive and crush the ice from

said ice-making unit, a chute structure inter-connecting said ice storage compartment and said upper enclosure having an inlet passageway at the top and an outlet passageway at the bottom, said chute construction having an enlarged central portion within which said ice crusher is positioned with an ice bypass passageway extending past the ice crusher through said central portion whereby ice may pass to said outlet passageway without being crushed, and ice-directing means at said central portion and adapted to move between an ice-crushing position wherein it directs the ice to said ice crusher and an ice-diverting position wherein it diverts the ice past said ice crusher and through said ice bypass passageway.

24. Apparatus as described in claim 23 wherein said ice-directing means comprises, a baffle, and operating means to swing said baffle between its two positions, said operating means including an operating arm connected at one end to said baffle, a triangle plate mounted on a pivot at one corner and pivotally connected at another corner to the other end of said operating arm, a connecting link connected at one end to the other corner of said triangle plate, a second operating arm connected to the other end of said link, an operating shaft pivotally mounting said second operating arm, and a spring which is adapted to bias said baffle alternatively in one of its two positions.

25. In ice-making apparatus, the combination of, a casing construction providing an enclosure, an ice-making unit positioned within said enclosure and including means to freeze ice in the form of cubes or the like having definite breakage planes transverse to the outer surfaces thereof, an ice crusher positioned to receive the cubes of ice formed by said ice-making unit and to crush the cubes along said breakage planes without substantial splintering, a chute construction to receive the ice cubes after they are formed and to direct the cubes toward said ice crusher and thence alternatively through said ice crusher or to a discharge by-pass passageway without passing through said ice crusher, and ice-directing means mounted in said chute construction and mounted to move between an ice crushing position wherein the ice is directed through said ice crusher and an ice by-pass position wherein the ice is directed through said by-pass passageway.

26. In ice-making apparatus of the character described, a crusher assembly comprising, a casing and chute construction providing inlet and outlet passageways for ice, an ice crusher unit mounted between said passageways and comprising, a grid formed by a pair of parallel side plates and a plurality of parallel spaced cross bars extending between said side plates and fixed thereto, and a rotor comprising a shaft and a plurality of crushing arms rigidly mounted thereon with the axis of the shaft parallel to said side plates and with the crushing arms extending radially with paths of movement extending between said cross bars with the arms being adapted to impact ice and to crush it while directing it between said cross bars.

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