Feb. 25, 1936. A. M. BARRETT ET AL 2,031,812

METHOD OF AND APPARATUS FOR MAKING ICE

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Fig. 1.

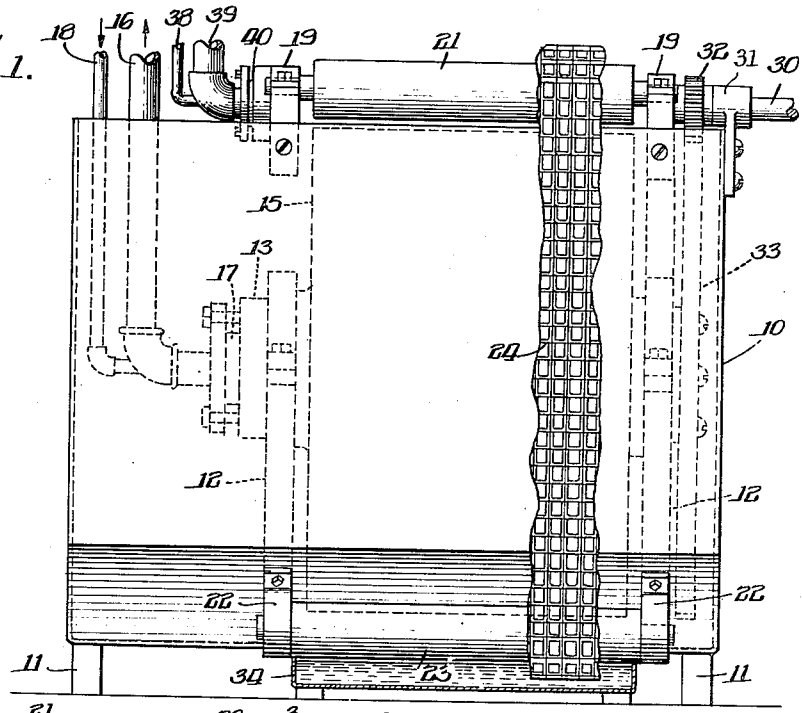
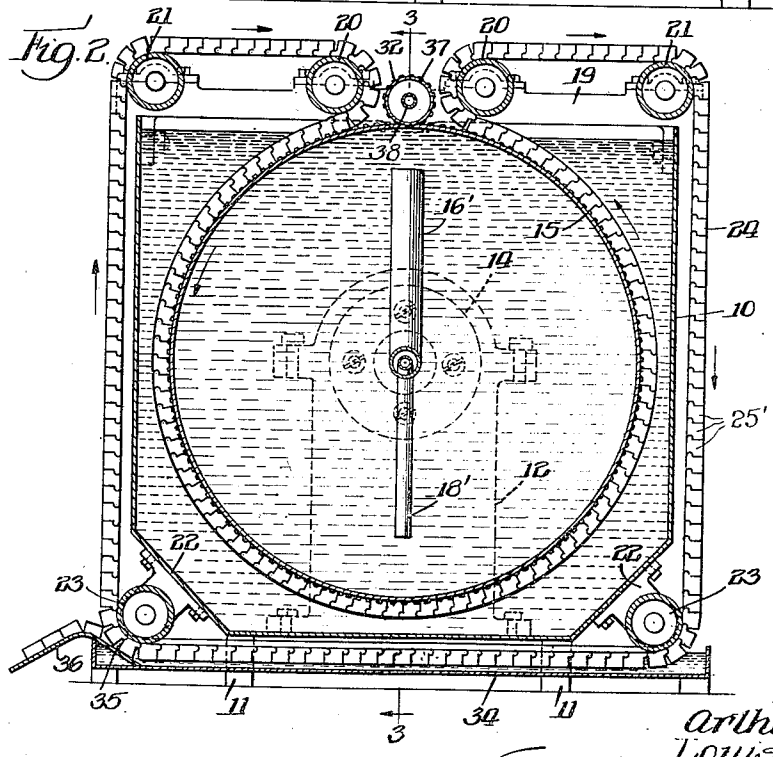


Fig. 2.



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Fig. 3.

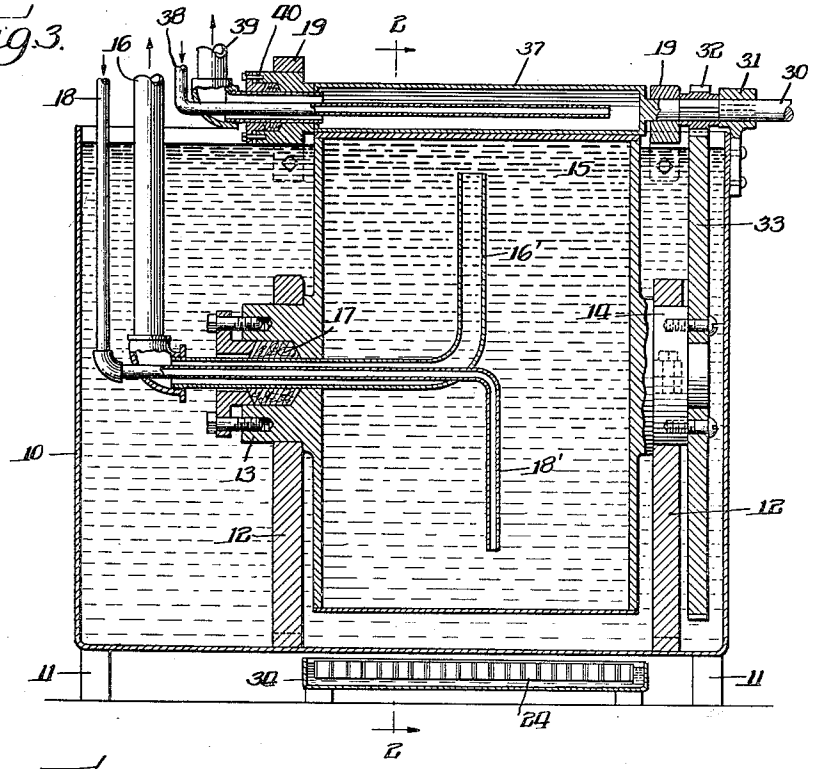


Fig. 5.

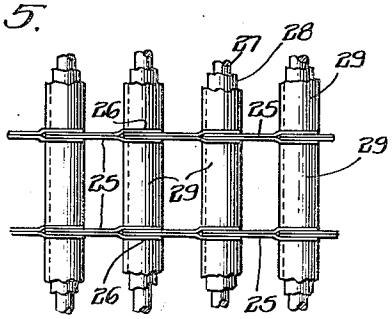


Fig. 6.

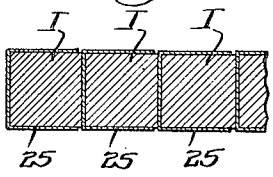
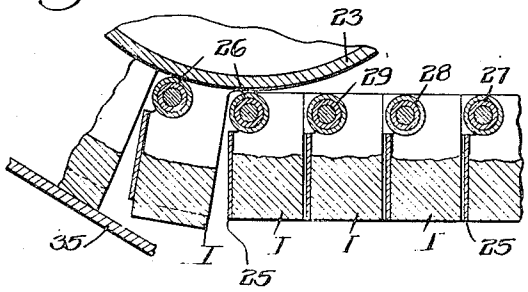


Fig. 4.



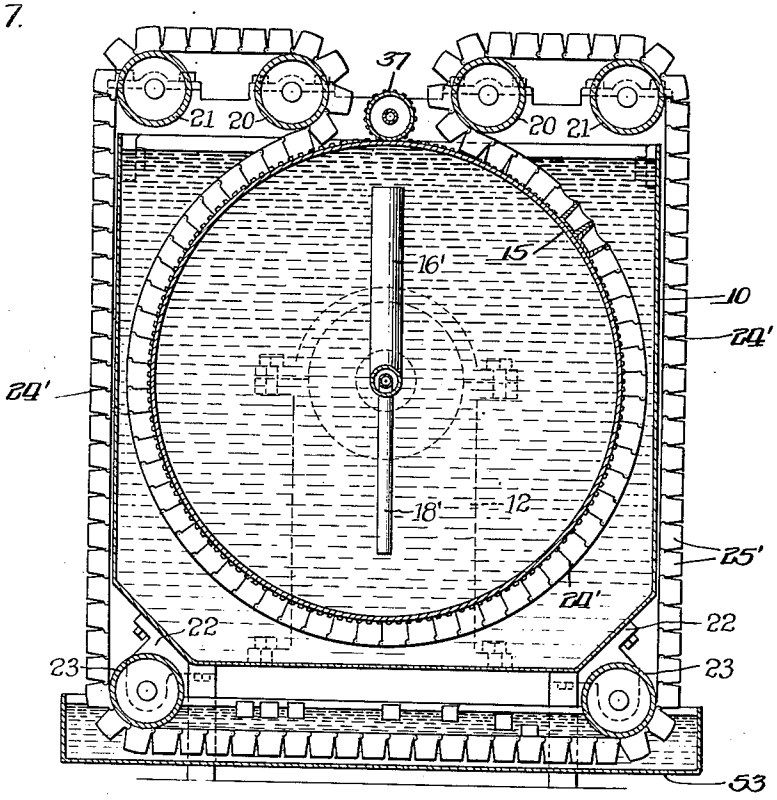
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Fig. 7.



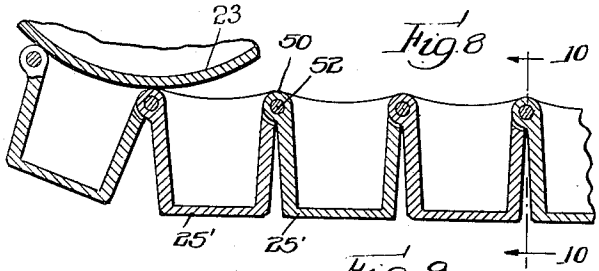


Fig. 8

Fig. 9.

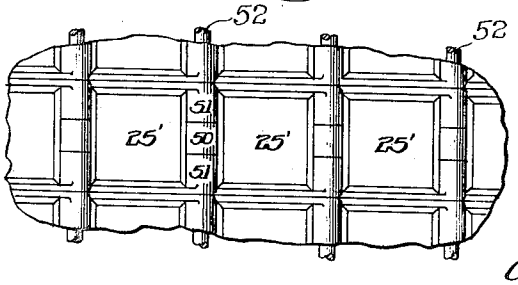
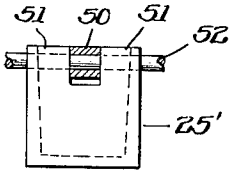


Fig. 10.



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UNITED STATES PATENT OFFICE

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METHOD OF AND APPARATUS FOR MAKING ICE

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Application May 15, 1933, Serial No. 671,022

16 Claims. (Cl. 62—106)

This invention relates to ice making methods and machines, and has reference more particularly to an improved method of and apparatus for making ice in comparatively small blocks or cubes. The demand for ice in this form is very extensive, and is served to a considerable extent by the cellular freezing pans of the well known domestic refrigerating cabinets.

The general object of our present invention is to provide a method of and machine for forming in a continuous operation and in substantial quantities such ice blocks, cubes or chips which are very extensively used in the manufacture of ice cream and analogous frozen products, for icing beverages, and for many other purposes.

The improved ice making method and apparatus forming the subject matter of this invention is based on the novel principle of freezing the ice within a cell-like container traveling through a body of water and during such travel subjected to the action of a freezing agent which lowers the temperature of the walls of the container sufficiently to cause a block or chip of ice to build up within the container. In one form of the invention herein presented the container has separable walls on which the ice congeals and builds up in the form of a block or cube; these walls being maintained in fixed relation to each other during the ice-forming period, and then separated, whereby the block of ice is forcibly pulled away from one of the walls of the container, the block being subsequently released from the other portion of the container preferably by a surface thawing operation. In one practical embodiment of this principle, which we have illustrated in the accompanying drawings and later fully described, a large number of connected individual cell-like containers are employed, and each container comprises a section of the periphery of a continuously rotating horizontal drum immersed nearly to its top in a body of water and cooled to a freezing temperature, the other section of the container comprising an open-ended cell-like structure that travels through the body of water with its inner open end in contact with the periphery of the drum thus receiving a freezing temperature from the latter. An endless band of connected cells is so guided that, as each cell or transverse row of cells emerges from the water, it diverges from the periphery of the drum, so that the block of ice formed in each cell is forcibly separated or disrupted from the surface of the drum, and, during the further travel of the cell, the walls of the latter are sufficiently warmed to free the ice block therefrom.

In another form of the invention which we have herein shown and described, each container consists of a generally cup-shaped structure having a bottom wall that, during the travel of the container through the body of water, lies in direct contact with the surface of the drum or other member through which the freezing temperature is imparted to the walls of the container. In this form of the invention the bottom wall of the container, rather than the block or chip of ice formed in the container, is forcibly separated or disrupted from the surface of the drum as it emerges from the water, and the ice block formed therein may then be freed by warming the walls of the container, preferably by subjecting the container to a warming bath so that the ice rises through the open end of the container by flotation.

Apparatus, which in actual practice has been tested and found to operate successfully for the manufacture of ice blocks or cubes in accordance with the method of operation outlined above, is illustrated in the accompanying drawings, in which—

Fig. 1 is a side elevation of an apparatus embodying the first described form of the invention, partly broken away and in vertical section.

Fig. 2 is a vertical transverse section taken on the line 2—2 of Fig. 3.

Fig. 3 is a vertical longitudinal section taken on the line 3—3 of Fig. 2.

Fig. 4 is an enlarged detail vertical section of the lower portion of one of the guide pulleys and a fragment of the endless cellular band cooperating therewith.

Fig. 5 is a fragmentary plan view of the endless cellular band.

Fig. 6 is a fragmentary horizontal section through several of the cellular structures of the band.

Fig. 7 is a view similar to Fig. 2 illustrating a slightly modified apparatus embodying the second described form of the invention.

Fig. 8 is a view similar to Fig. 4, showing a fragment of the endless band of cup-shaped containers passing over one of the guide pulleys.

Fig. 9 is a view similar to Fig. 5, showing a manner of hinging together adjacent cup-shaped containers.

Fig. 10 is a fragmentary cross section on the line 10—10 of Fig. 8.

Describing now in detail the structural features of the embodiment of the invention illus-

trated in Figs. 1 to 6 inclusive and its mode of operation, 10 designates a rectangular tank supported on legs 11, and designed to be filled with water to about the level indicated in Figs. 2 and 3. Within the tank 10 are a pair of spaced uprights 12, in and between which are suitably journaled the trunnions 13 and 14 of a large hollow drum 15 designed to contain a body of freezing fluid. Means for maintaining a continuous circulation of the freezing fluid through the drum comprise an outflow pipe 16 extending into the drum through a stuffing box 17 in the trunnion 13 and formed with an upwardly bent inner portion 16' extending nearly to the top of the drum, and an inflow pipe 18 leading into the drum through the horizontal section of the outflow pipe 16 and having a downwardly bent inner end portion 18' extending nearly to the bottom of the drum.

Extending across the top of the tank 10 and supported on and suitably secured to opposite walls of the latter are a pair of spaced bars 19 carrying journal bearings for a pair of intermediate guide pulleys 20 and a pair of end guide pulleys 21. Opposed lower corners of the tank 10 are chamfered, as shown in Fig. 2, and to the chamfered surfaces are attached brackets 22, in and between which are journaled lower guide pulleys 23. Trained over the drum 15 and the guide pulleys 20, 21 and 23 is an endless band or mat that is made up of a large number of open-ended articulated freezing cells, preferably of sheet metal. This endless band is designated as an entirety by 24, only a fragment thereof being shown in Fig. 1, but, as shown in Fig. 3, this band has a width co-extensive with that of the drum 15 and the guide pulleys 20, 21 and 23. Referring to Figs. 4, 5 and 6, which best show the detail structure of the band, 25 designates each of the individual cells, which, as shown in Fig. 6, is a three-sided rectangular structure formed on one end with a pair of spaced laterally offset ears 26 that overlap the opposite side walls of an adjacent cell, and through these ears and side walls extends a pivot rod 27 and a wear sleeve 28, by which adjacent transverse rows of cells are articulated to each other. Spacing sleeves 29 mounted on the sleeves 28 maintain accurate longitudinal alignment of longitudinally adjacent cells, in an obvious manner. Of course, each cell might be made four-sided, but space and metal are saved by utilizing the intermediate wall of each cell as the fourth wall of an adjacent cell in the manner clearly shown in Fig. 6.

As above stated, this endless band or mat of inter-articulated freezing cells is trained over the drum and guide pulleys, with the free open ends of the cells lying in contact with the peripheral surface of the drum 15, and the articulated ends of the cells lying in contact with the guide pulleys. The direction of rotation of the drum 15 and the direction of travel of the endless band are shown by arrows in Fig. 2.

For imparting a drive to the drum and band, we show in Fig. 3, a drive shaft 30 journaled in a bearing bracket 31 attached to the upper end of one end wall of the tank 10 and having keyed on its inner end a pinion 32 in mesh with a large spur gear 33 suitably secured to the drum trunnion 14. The frictional contact of the periphery of the drum is ample to transmit a traveling movement to the endless band 24.

Describing the operation of the apparatus as thus far disclosed, with the tank 10 filled with water to approximately the top of the periphery of the drum 15, a suitable fluid freezing medium is circulated by means of the pipes 18 and 16 through the interior of the drum whereby the peripheral walls of the latter are cooled to an ice-forming temperature. Power being applied through the shaft 30, the drum slowly rotates in the body of water, causing a correspondingly slow travel of the endless band. The inner open ends of the cells of the band that are in contact with approximately the entire periphery of the drum transmit the freezing temperature of the drum to the walls of the cells, so that a block or cube of ice, such as we have indicated at I in Figs. 4 and 6, gradually builds up in each cell, adhering, of course, to the peripheral portion of the drum covered by the cell, the three walls of the cell, and the intermediate or transverse wall of an adjacent cell. From the time each cell comes into contact with the periphery of the drum to the time it leaves the latter, these walls remain substantially stationary relatively to each other, and the temperature of the freezing medium and the rate of travel are so controlled that a block or cube of substantial depth is built up in the cell during such travel. As the band leaves the periphery of the drum and passes over one of the intermediate guide pulleys 20, the block or cube of ice is forcibly pulled or torn away from the periphery of the drum, by reason of the fact that the area of adhesion within the cell is considerably in excess of the area of adhesion to the drum. As the band travels over the said guide pulley 20, it is sharply flexed, and the block of ice is pulled away from the wall of the adjacent cell by reason of its superior area of adhesion to the walls of its own cell, thus permitting the easy passage of the band over the guide pulley.

Underlying the tank 10 is a shallow pan 34 containing a body of water through which the lower horizontal limb of the band travels, the water being at a temperature well above the freezing point, so that, as the loaded cells travel through this water, their walls are sufficiently warmed to free the ice blocks therefrom. In the discharge end of the pan is located a ramp 35, onto which the loosened blocks of ice drop and are pushed upwardly by the trasverse walls of the immediately following cells. The upper end of the ramp 35 merges into the upper end of a downwardly sloping discharge platform 36, down which the ice blocks slide in a continuous discharge line.

Practical experiments with the apparatus have shown that, when the ice blocks are ripped away from the peripheral surface of the drum as the band leaves the latter and rounds the guide pulley 20, small fragments of the blocks sometimes are left on the periphery of the drum. We have accordingly provided a simple device for ridding the drum periphery of these fragments before the empty cells re-engage the periphery, the means herein shown consisting of a hollow cylinder 37, best shown in Fig. 3, that is journaled in the cross bars 19 across and in rolling contact with the periphery of the drum 15. Warm water or any other heating medium is circulated through the drum 37 by means of inflow and outflow pipes 38 and 39 communicating with the interior of cylinder 37 through one end of the latter, the outflow pipe 39 being packed against leakage by a stuffing box 40. In lieu of the cylinder 37 a stationary hollow member in sliding contact with the periphery of the drum might be employed, to the same end. This device effectively cleans the periphery of the drum preparatory to the re-

engagement therewith of the empty cells which, as will be seen by reference to Fig. 2, come into full engagement with the drum practically at the top of the body of water in the tank, so that they are at once filled with the water.

From the foregoing description it will be seen that each individual block-freezing unit consists of a container having separable walls, one wall being a section of the periphery of the drum, and the remaining walls being the walls of the cells 25. While the freezing operation is going on, these walls are relatively fixed or stationary. But when the cellular band diverges on a tangent from the drum periphery, the blocks in the cells are forcibly pulled away from the periphery of the drum, and travel with the cells down to and through the thawing pan 34, in which latter they are thawed loose from the walls of the cell, and successively discharged over the ramp 35 and platform 36 in the manner already described.

We have not encumbered the drawings with illustration of any means for maintaining the volume of water in the tank 10 during a continuous operation of the machine, since it is obvious that additional water may be supplied from time to time by hand, or a practically continuous supply controlled by an ordinary float valve may be used. Depending, of course, upon the two factors of the cooling capacity of the freezing medium employed within the drum and the speed of movement, it is manifest that with an apparatus of the capacity indicated in the drawings, a large volume of ice blocks or cubes can be manufactured and delivered in a comparatively short time, the operations all being entirely automatic.

In Figs. 7 to 10 inclusive we have illustrated an embodiment of the second form of the invention hereinabove referred to. This form follows the general organization and arrangement shown in the form previously described, differing mainly in that the cells of the endless band or mat 24' are closed at the ends thereof which come in contact with the freezing drum 15. As best shown in Fig. 8, these cells 25' are generally cup-shaped, preferably being slightly tapered, and are articulated by interfitting, laterally extending hinge ears 50 and 51 engaged by a hinge pintle 52. The arrangement of the band guiding pulleys is the same as that previously shown and described, and the thawing pan 53, which receives the bottom horizontal lap of the band, is somewhat deeper than the thawing pan 34, so that, as the blocks or cubes of ice are loosened from the walls of the cells they rise by flotation, as indicated in Fig. 7, and can be skimmed or raked off, the pan 53 being made sufficiently wider than the width of the cellular band to permit such removal of the formed blocks or cubes. In this construction, no fragments or chips of the blocks or cubes are left adhering to the surface of the drum 15, but the thawing roll 37 is preferably employed with this form of the device in order to clear the periphery of the drum of any films or fragments of ice that may form between the bottoms of the cells and the periphery of the drum.

It will be obvious that the operating principle of the method of freezing and delivering the product may be embodied in apparatus more or less differing in specific details from the forms of apparatus herein shown and described. Hence, we do not limit the invention to the particular embodiments thereof herein presented for purposes of illustration, but reserve all such variations, modifications and mechanical equivalents as fall within the spirit and purview of the appended claims.

We claim:

1. A method of making ice, which consists in moving a cold-conducting cell-like container through a body of water and in separable contact with a cold-conducting member containing a freezing medium for a sufficient time to form a block of ice within said container.

2. A method of making ice blocks, which consists in moving a band of cold-conducting cell-like containers through a body of water and in contact with a cold-conducting member containing a freezing medium for a sufficient time to form blocks of ice within said containers, and then subjecting said containers outside said body of water to a thawing temperature to free the ice blocks therefrom.

3. A continuous method of making ice blocks, which consists in passing an endless band of cold-conducting cell-like containers through a body of water and in contact with a cold-conducting member containing a freezing medium for a sufficient time to form blocks of ice within said containers, and then passing said band through a thawing bath whereby to free the ice blocks therefrom.

4. A continuous method of making an ice block, which consists in moving through a body of water a container having separable walls and simultaneously maintaining said walls in fixed relation to each other, subjecting said walls to a water-freezing temperature during their travel through said water to thereby build up a block of ice in said container, and then forcibly separating said walls, whereby to rip the block away from one of said walls.

5. A continuous method of making an ice block, which consists in moving through a body of water a container having separable walls and simultaneously maintaining said walls in fixed relation to each other, subjecting said walls to a water freezing temperature during their travel through said water to thereby form within said container a block of ice adhering to said walls, then forcibly separating said walls as the container emerges from said water whereby to rip the block away from one of said walls, and then subjecting the other of said walls to a bath of fluid at a temperature above freezing to free the block therefrom.

6. Apparatus for making ice blocks, comprising, in combination, a water tank, two members mounted to move through a body of water in said tank, said members formed with walls cooperating to form a plurality of freezing cells, means for subjecting the walls of said cells to a water-freezing temperature, and means for separating the walls of each freezing cell after a block of ice has formed therein.

7. Apparatus for making ice blocks, comprising, in combination, a water tank, two members mounted to move through a body of water in said tank, said members formed with walls cooperating to form a plurality of freezing cells, means for subjecting the walls of said cells to a water-freezing temperature, and means for causing one of said members to diverge from the other as the cell walls thereof emerge from said body of water thereby freeing the ice blocks formed in said cells from the cell walls of the other member.

8. Apparatus for making ice blocks, comprising, in combination, a water tank, two members mounted to move through a body of water in said tank, said members formed with walls cooperat-

ing to form a plurality of freezing cells, means for subjecting the walls of said cells to a water-freezing temperature, means for causing one of said members to diverge from the other as the cell walls thereof emerge from said body of water thereby freeing the ice blocks formed in said cells from the cell walls of the other member, and means for then freeing the ice blocks from the cell walls of said diverging member.

9. Apparatus for making ice blocks, comprising, in combination, a water tank, a hollow drum journaled to revolve in a body of water in said tank, means for conducting a freezing agent through said drum, guide pulleys grouped around said tank, a flexible endless band comprising connected freezing cells in which ice is formed trained over said drum and pulleys, said cells having open ends traveling in contact with the periphery of said drum, and means for driving said drum and band.

10. Apparatus for making ice blocks, comprising, in combination, a water tank, a hollow drum journaled to revolve in a body of water in said tank, means for conducting a freezing agent through said drum, guide pulleys grouped around said tank, an endless band comprising pivotally connected transverse rows of open-ended freezing cells in which ice is formed trained over said drum and pulleys, said cells having their inner ends traveling in contact with the periphery of said drum, and means for driving said drum and band.

11. Apparatus for making ice blocks, comprising, in combination, a water tank, a drum journaled to revolve in a body of water in said tank, means for imparting an ice-forming temperature to the periphery of said drum, guide pulleys, a flexible endless band of freezing cells in which ice is formed trained over said drum and pulleys, said cells at one end traveling in contact with the periphery of said drum, means for driving said drum and band, and means for imparting a thawing temperature to the loaded cells of said band after the latter has emerged from the water in said tank.

12. Apparatus for making ice blocks, comprising, in combination, a water tank, a drum journaled to revolve in a body of water in said tank, means for imparting an ice forming temperature to the periphery of said drum, guide pulleys grouped around said tank, a flexible endless band of freezing cells in which ice is formed trained over said drum and pulleys, said cells at one end traveling in contact with the periphery of said drum, means for driving said drum and band, and a thawing member in contact with the periphery of said drum between the tangent points of said band on the drum.

13. Apparatus for making ice blocks, comprising, in combination, a water tank, a drum journaled to revolve in a body of water in said tank, means for imparting an ice-forming temperature to the periphery of said drum, guide pulleys grouped around said tank, an endless band of freezing cells trained over said drum and pulleys, said cells at one end traveling in contact with the periphery of said drum, means for driving said drum and band, a thawing member in contact with the periphery of said drum between the tangent points of said band on the drum, and a thawing member beneath said tank in the path of travel of the bottom limb of said band.

14. Apparatus for making ice blocks, comprising, in combination, a water tank, a drum journaled to revolve in a body of water in said tank, means for imparting an ice-forming temperature to the periphery of said drum, guide pulleys grouped around said tank, an endless band of freezing cells trained over said drum and pulleys, said cells having open ends traveling in contact with the periphery of said drum, means for driving said drum and band, a thawing cylinder in surface contact with the periphery of said drum between the tangent points of said band on the drum, a thawing pan underlying said tank in the path of travel of the bottom limb of said band, and means beyond said pan cooperating with said band in effecting delivery of ice blocks from said cells in a continuous discharge line.

15. Apparatus for making ice blocks, comprising, in combination, a water tank, a drum journaled to revolve in a body of water in said tank, means for imparting an ice-forming temperature to the periphery of said drum, guide pulleys, an endless band of cup-shaped freezing cells trained over said drum and pulleys, said cells having their closed ends traveling in contact with the periphery of said drum, and means for driving said drum and band.

16. Apparatus for making ice blocks, comprising, in combination, a water tank, a hollow drum journaled to revolve in a body of water in said tank, means for conducting a freezing agent through said drum, guide pulleys grouped around said tank, an endless band comprising pivotally connected cup-shaped freezing cells trained over said drum and pulleys, said cells having their closed ends traveling in contact with the periphery of said drum, and means for driving said drum and band.

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