Nov. 29, 1932. G. H. KENNEDY, JR 1,889,481

ICE TRAY FOR MECHANICAL REFRIGERATORS

Filed Oct. 3, 1929 3 Sheets-Sheet 1

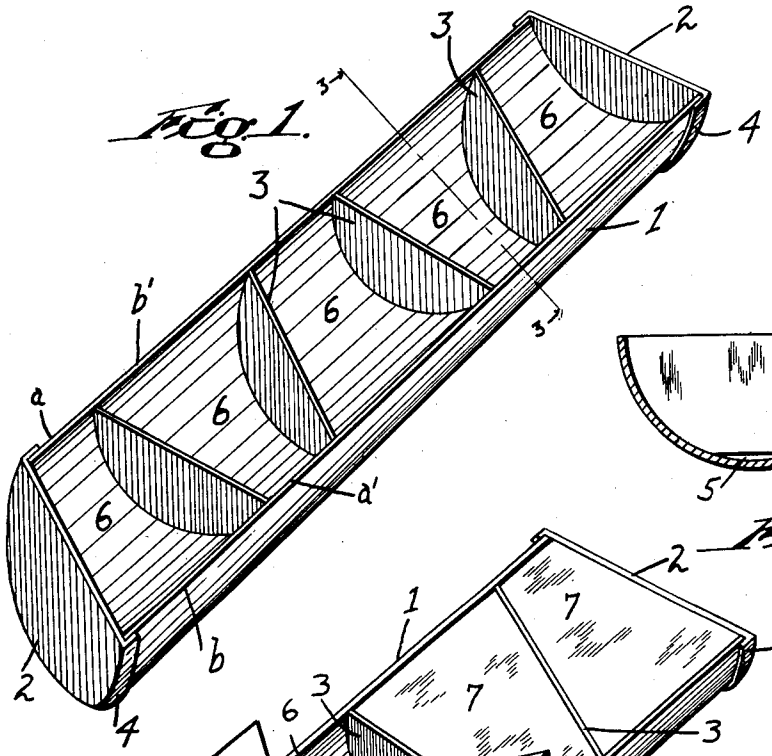


Fig. 1.

Fig. 3.

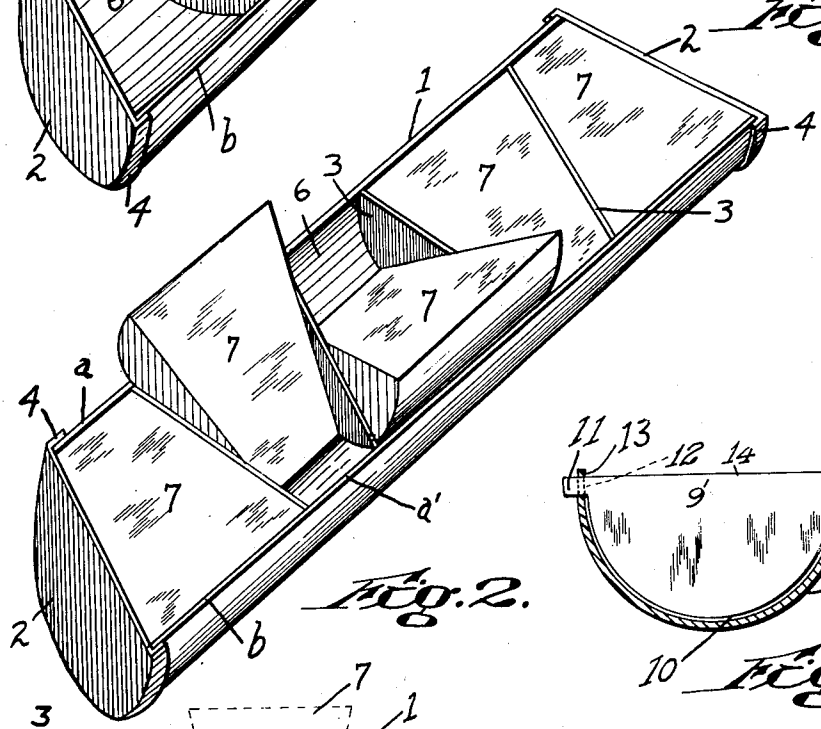


Fig. 2.

Fig. 4.

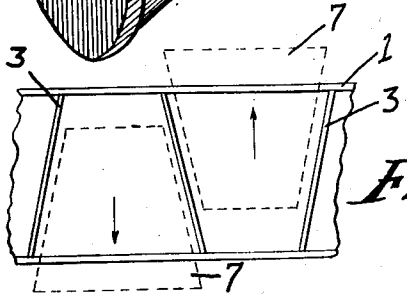


Fig. 5.

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ICE TRAY FOR MECHANICAL REFRIGERATORS

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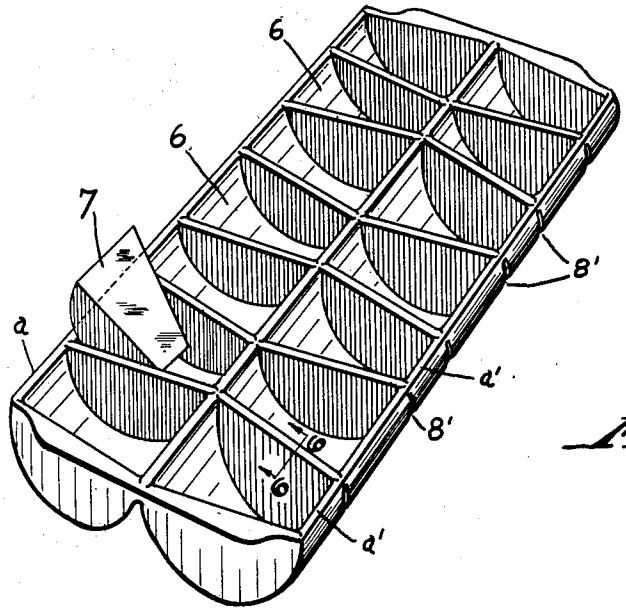


Fig. 6.

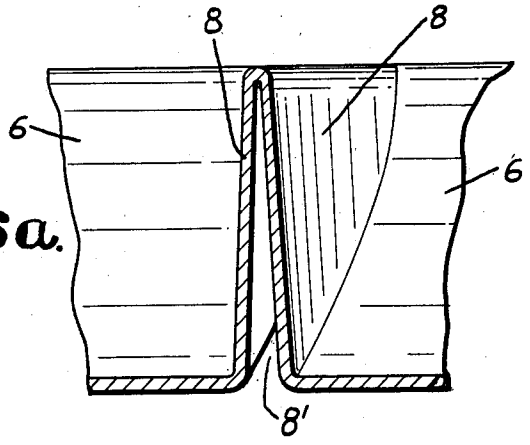


Fig. 6a.

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ICE TRAY FOR MECHANICAL REFRIGERATORS

Filed Oct. 3, 1929 3 Sheets-Sheet 3

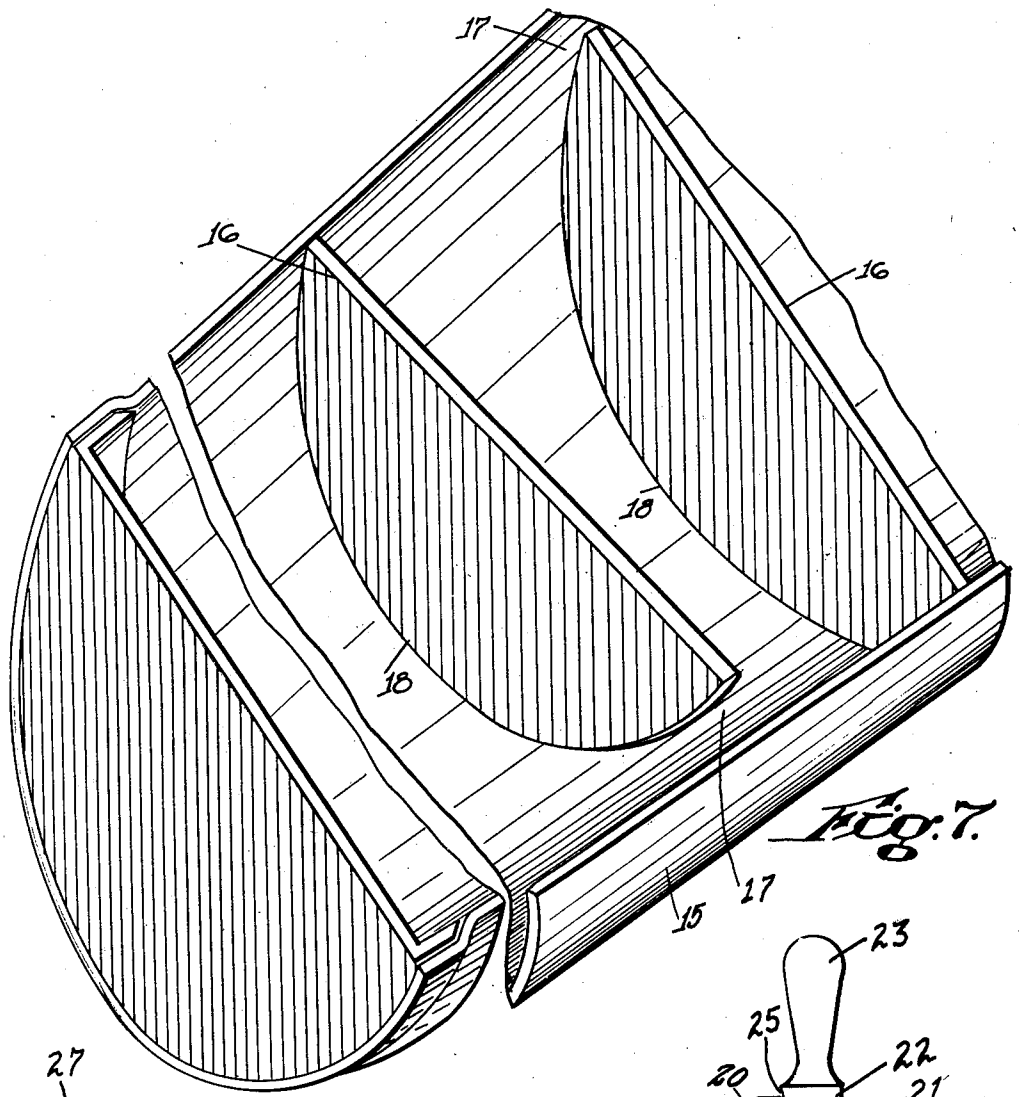


Fig. 7.

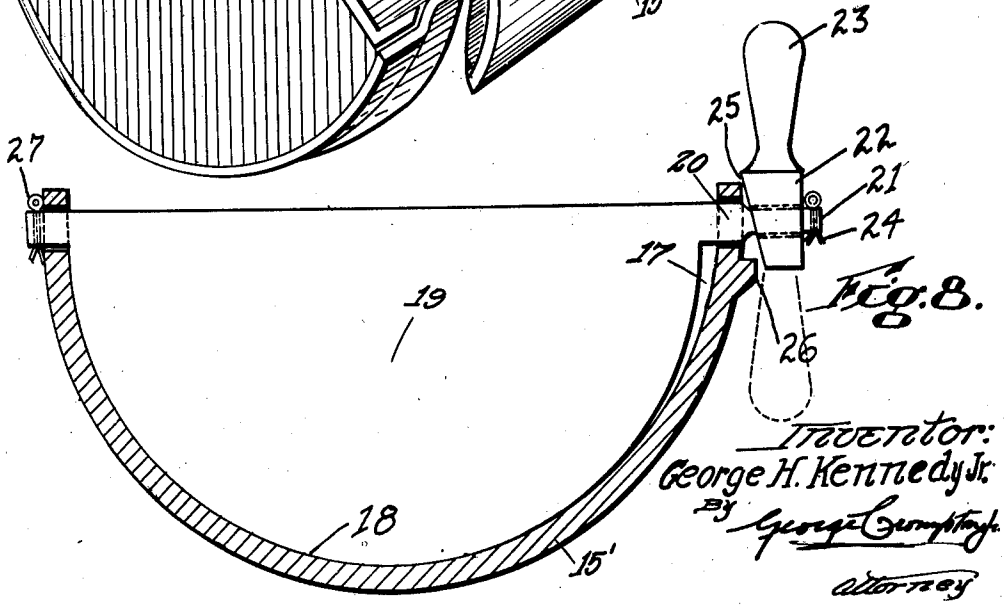


Fig. 8.

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Patented Nov. 29, 1932

1,889,481

UNITED STATES PATENT OFFICE

GEORGE H. KENNEDY, JR., OF WORCESTER, MASSACHUSETTS

ICE TRAY FOR MECHANICAL REFRIGERATORS

Application filed October 3, 1929. Serial No. 397,085.

The present invention relates to ice trays, as commonly used in domestic mechanical refrigerators. The invention involves among other things certain improvements in an ice tray of the type and principle described and claimed in my United States Letters Patent No. 1,868,503, dated July 26, 1932, wherein each of the several ice cavities is so shaped as to permit the removal of its contained ice block by a simple turning or rocking movement in the absence of inverting the tray, to dump out its contents. According to the present invention, this removal movement of the ice block is greatly facilitated, by a construction which not only reduces the tendency of the freezing operation to produce adhesion or sticking, but which permits such sticking as may occur to be readily overcome; furthermore the invention very markedly facilitates the production of ice cavities so shaped as to permit said removal movement, while at the same time enabling said removal operation to overcome at its very beginning any tendency of the ice block to bind. Other and further objects and advantages of the invention will be made apparent by the following detailed description thereof, taken in connection with the accompanying illustrative drawings, in which—

Fig. 1 is a perspective view of an ice tray embodying my invention.

Fig. 2 is a similar view, illustrating the act of removing the ice blocks formed in such a tray.

Fig. 3 is a sectional view on the line 3—3 of Fig. 1.

Fig. 4 is a view similar to Fig. 3, showing a modification of the construction.

Fig. 5 is a diagrammatic view, showing a feature of the removal action.

Fig. 6 is a perspective view of an ice tray having an advantageous form of partition structure made possible by the invention, and

Fig. 6a is a large scale fragmentary sectional view on the line 6—6 of Fig. 6.

Fig. 7 is a fragmentary perspective view, and Fig. 8 a sectional view, both illustrative of a special feature of my invention.

Like reference characters refer to like parts in the different figures.

The manufacture of an ice tray having cavities of concave substantially semi-cylindric form, in accordance with my aforesaid Letters Patent, is very materially simplified by utilizing for the material of each tray body, or section of body, a suitable length of tubular metal stock which is divided longitudinally, as by sawing through an approximate diametric plane thereof, to form the concave tray body of half-circular section, indicated at 1 in the drawings. Such tubing of brass, steel, or other suitable material, is available commercially in a variety of suitable sizes and gauges, and the finish and accuracy of its interior surface is entirely adequate for the purposes of my invention. A tray body, or section of tray body, thus constituted only requires for its completion the addition of end closures 2, 2 and suitably spaced transverse partitions 3, 3; these parts, according to my invention are constructed, arranged and attached in the novel manner hereinafter described in detail.

It is commonly known that water, in the act of freezing, or solidifying, undergoes an expansion in volume of approximately 10%. The ice cube trays ordinarily used with domestic mechanical refrigerators are made of relatively thin gauge metal of high heat conductivity, and it is observable, in most cases, that the formation of ice crystals takes place in a progressive manner in each of the tray cavities; that is, the ice crystals form initially in thin layers against the bottom and side walls of the cavity and also across the exposed top surface of the contained water, these layers gradually building up in thickness, toward the inner portion of the space. Under these circumstances, the effect of the expansion produced by complete solidification, especially with the substantially cubical blocks that are formed in the ice trays now in ordinary use, is conducive to the production of a very strong adhesion between each ice block and the confining walls of its space; this is because the four surrounding walls of the cubical space or cavity present pairs of surfaces in direct opposition to each other, and therefore having the maximum susceptibility to the heavy lateral pressures from the

interior of the space that force the side layers of ice into intimate contact with said walls. In an ice space or cavity of the form shown in my aforesaid Letters Patent, the effect of this expansion, so far as sticking is concerned, is considerably reduced, because there are only two pressure-receiving surfaces, i. e., the vertical ends of the cavity, in direct opposition to each other.

According to the present invention, the partitions 3, 3 and end closures 2, 2, instead of occupying a series of spaced parallel planes, all at right angles to the axis of curvature of the cavity bottoms, are arranged, as shown in Fig. 1, at acute angles to said axis, so that deflection from right angle relation, for successive partitions and closures, is first in one direction and then in the other direction. That is to say, two adjacent partitions 3, 3 or a partition 3 and an end closure 2, are disposed in slightly divergent relation, so that the space or cavity which they define, in conjunction with the body portion 1 of the tray to tray section, will have along one edge of said body a short side *a* and along the other side of the said body a long side *b*. The next adjacent space or cavity, by this arrangement, will have in alinement with the short side *a* of the first cavity a long side *b'*, and in alinement with the long side *b* of the first cavity, a short side *a'*,—and so on for the entire length of the tray or tray section.

The ends 2, 2 and partitions 3, 3 may be secured to the shell or body 1 in any suitable way; in Figs. 1 and 2, I have shown the ends in the form of caps, having flanges 4, 4 which snugly embrace the outside surface of the shell, so as to permit a permanent water tight joint to be made, as by welding, soldering, brazing or the like. The partitions 3, 3 along their curved edges in contact with the concave inner surface of the shell may, as shown in Fig. 3, be welded, soldered, brazed, or otherwise fastened in place, and preferably each line of juncture thus formed will have its continuity broken for a short distance, as indicated in exaggerated fashion by the gap 5 in Fig. 3, to provide for the desired seepage of water from one compartment to another, whereby equalization of the water level throughout the tray is obtained.

In consequence of the above described divergent arrangement of parts 2, 2 and 3, 3, the lateral forces set up by the expansion occurring with solidification of the contained water in any cavity are not exerted against surfaces directly opposed to each other, but against surfaces which are in divergent relation; it follows therefore that when final solidification is occurring in each of the several cavities 6, 6, the forces tending to press the ice into close intimate contact with the partitions 3, 3 or the ends 2, 2, are very largely absorbed and rendered impotent by the divergent arrangement of these parts that is characteristic of each cavity. Hence, the tendency of the ice blocks 7, 7 to stick, in resistance to the turning or rocking movements of removal, illustrated by Fig. 2, is very much decreased by the present invention. These turning movements can take place as soon as the ice has thawed slightly, or, even in the absence of thawing, any adhesive tendency between the blocks 7, 7 and their respective cavities can be quickly and completely overcome simply by slightly warping or twisting the tray as it is held by its ends in the two hands of the user, this causing a slight momentary distortion of the thin walls of each cavity that is sufficient to loosen the adhesion thereto of said ice blocks. In each case of course, the turning or rocking removal movement will be initiated, owing to the divergent arrangement above described, by thumb or finger pressure against that portion of the ice block's upper surface that is adjacent to the short side *a*, or *a'* etc., of the cavity; as shown in Fig. 2, this affords the utmost in convenience of handling the tray and removing the blocks therefrom, since the user, by grasping the tray in his two hands from opposite sides thereof, can readily exert with one thumb a pressure along the short side *a* of one cavity, and with the other thumb an opposite pressure along the short side *a'* of the adjacent cavity, for the removal of one block or of two blocks simultaneously.

Of particular importance, in connection with the action illustrated by Fig. 2, is the fact that at the very outset of the movement, the contact of one or both of the ice-block sides with the adjacent partition 3 or end 2 is immediately broken; this feature, best illustrated by the diagram of Fig. 5, allows the turning or rocking movement to take place with the utmost freedom, since it relieves the ice block at once of any friction with, or pressure from, the side walls of the cavity.

Other advantageous results of even greater importance obtained by the above-described skewing of the partitions, relative to the longitudinal axis of the intervening concave surfaces, are as follows:—Whereas with partitions that go straight across, at right angles to the opposite upper edges of the concave surface, there is inevitably an impedance and obstruction of the removal movement of the ice block unless the surfaces of said partitions are exactly perpendicular to said longitudinal axis, by the present invention, the necessity for such perpendicularity is wholly eliminated. In other words, partitions that go straight across at right angles give no opportunity or latitude whatsoever for variation, at any point, in the width of such a cavity; if such partitions have even the slightest inward slope toward the cavity bottom, the latter, being thereby

made narrower than the cavity top, will not permit the block to turn, as described in my aforesaid Letters Patent. On the other hand, with skewed or divergent partitions, an appreciable inward slope toward the bottom is always permissible, as shown for example at 8 in Fig. 6*a*; the reason being that, notwithstanding the decreased width of the cavity at its bottom, the ice block 7 formed therein is nevertheless turnable by pressure against its shorter edge *a* because, owing to the divergent relation of the partitions, the width of said bottom at every point, is greater than the length of said edge *a*.

This ability of a cavity to have its opposite walls slightly convergent downwardly permits the entire tray or tray section, partitions included, to be made if desired from a single piece of sheet material, such as thin metal or the like, by suitable pressing, stamping, or drawing operations which are adapted, as shown in Fig. 6*a*, to produce between adjacent cavities 6, 6 an integral partition of inverted V form, the opposite sides of which are separated by a space 8′ which opens on the bottom surface of the tray. This construction of a tray from sheet material, by stamping, drawing, or the like, which makes each compartment or cavity wholly independent and exposed on all three surfaces or sides, is only possible when the partitions are arranged in the aforesaid skewed relation, since it is impracticable and virtually impossible by drawing, stamping, or the like, to obtain the exact perpendicular relation between the upright and curved surfaces that would be required with any other arrangement of partitions. A tray of the independent-cavity construction, as shown in Fig. 6, is particularly susceptible to the slight flexure that is desirable and sometimes necessary in order to overcome the tendency of an ice block 7 to stick, by the act of freezing, to the cavity walls.

The modification shown by Fig. 4 provides a means of partition attachment which does away with the need for soldering, bracing, welding and the like, which are relatively expensive manufacturing methods, and which are apt to produce roughness, or interior surface projections that may interfere with the removal action illustrated by Fig. 2. As shown in Fig. 4, each partition 9 may be so constructed that its curved edge 10 will exactly fit the concave inner surface of the tray body 1′ when the opposite extensions or lugs 11, 11 are sprung into the corresponding rectangular slots or apertures 12, 12 that are spaced at appropriate points in close proximity to the longitudinal edges of said body. Said slots 12, 12 are preferably punched or cut in the material of the tray body, said material for this purpose being extended at the points selected, as shown at 13, 13, to embrace slightly more than 180°. The above described retention of a partition 9, by the cooperating lugs 11 and slots 12, and in the absence of soldering, welding, or the like, not only insures the absolute smoothness of the ice cavity surfaces, and the desired seepage from one cavity to another, but, of course, greatly facilitates the ease and cheapness with which the tray may be assembled, and secures absolute accuracy in the positioning of the partitions; the latter, assuming the slots 12, 12 to be accurately located and formed are bound to be exactly upright and also exactly at the correct angle to the longitudinal axis of the tray body.

Any slight play that the lugs 11 may have in the slots 12, 12 is immaterial from the standpoint of this accuracy, since upon filling of the cavities with water, the pressures on opposite sides of each partition 9 will equalize and thereby automatically center and aline said partition. Furthermore, any such looseness or play can be availed of, when necessary, to overcome any undue adhesion between ice block and partition, as by shaking or rocking the partition slightly through pressure of thumb or finger on its exposed upper edge 14; such action will likewise quickly destroy any thin film of ice that may form in the practically infinitesimal seepage crack between the curved edge 10 of a partition 9 and the concave surface of the tray body 1′. It is to be noted further that the removal action shown by Fig. 2, involving opposite turning movements of adjacent ice blocks, will in every case result in the prompt destruction of any ice film that forms beneath a partition 3 or 9.

A further refinement of my invention, as shown in Figs. 7 and 8, adopts essentially the features of construction above described, and also incorporates a new principle by which any temporary adhesion of the ice blocks in their respective cavities is automatically overcome, so that the removal action is never impeded or delayed. In accordance with this new principle, the tray body, which may be of substantially the same form as the bodies 1 or 1′ hereinbefore described, is constituted from sheet material, preferably metal, having a high degree of elasticity, particularly as regards its ability to undergo temporary flexure or distortion from a given shape, and its very strong tendency to resume or spring back to such given shape, when the distorting or flexing influences are removed. In the utilization of this characteristic, the freezing operation, to solidify the water with which the tray is filled, is carried out while the tray is under the influence of devices which hold it in a distorted or flexed condition; upon the release of these devices, after the ice is formed, the natural spring or elasticity of the tray material comes into play in an effective manner to restore the normal shape,—the result of

this, in effect, being to forcibly reposition the confining surfaces of each ice block by pulling said surfaces away from the corresponding surfaces of said block; in this way, any tendency of the blocks to stick in said cavities is entirely overcome, before the above described removal action is initiated.

Referring to Fig. 7, I have shown a tray body 15 of suitable elastic material, such as stainless steel, or the like, whose mid-sectional area, in the normal condition of said body, is somewhat in excess of the area of the partitions 16, 16 in the same proximity; that is to say, said partitions, from end to end of the tray, are of substantially equal areas, but the tray body from its ends toward its center has a slight outward flare, such that one upper corner of each partition for a short distance along the curved edge thereof is spaced, as shown at 17, from the concave surface of the tray body. The remainder of said curved edge, as shown at 18, is suitably attached, as by welding, soldering, brazing, or the like, to the concave surface of the tray body 15, so that each partition 16 is directly united to the tray body, in such a manner as not to obstruct an inward flexure or contraction of the body, particularly along its edges, for the substantial closure of the spaces 17, 17. As shown, the partitions 16, 16 are preferably so arranged and attached that successive spaces or gaps 17, 17 occur alternately on opposite sides of the longitudinal axis of the body 15; hence, when the tray body, having been held in its contracted position during the freezing of the contained water, is freed from the contracting influences, the natural spring of its material, counteracting, in whole or in part, the adhesion of the ice to the cavity walls, will not only enlarge the transverse sectional area of each cavity, but will also pull the two side walls of said cavity in opposite directions, thus tending to free the contained ice block completely, before the removal action illustrated by Fig. 2 is initiated.

Fig. 8 illustrates the action of one of a series of contracting devices, for the purposes above described, which are applied to a tray of the general characteristics of Fig. 7. As shown, each partition 19, similar to the partition 9 of Fig. 4, has rectangular extensions 20 and 20′ at its upper corners, for reception in rectangular slots of the tray body 15′, and the extension 20 at that corner which overlies the gap 17 has a round shaft projection 21, whereon is journalled the hub 22 of an arm 23. Any suitable means, such as a pin 24, may be employed to prevent outward movement of the hub 22 on the shaft 21. The inner surface of said hub provides an annular cam face 25 adapted for cooperation with an adjacent projection 26 on the outside surface of the tray body 15′. When the arm 23 is rocked or turned into the broken line position of Fig. 10, (in which position said arm may conveniently serve as a leg or support for the tray, to keep it level), the high portion of cam 25 is brought into opposition to the projection 26, and this movement forces or crowds the wall of the body 15 inwardly to substantially close the gap or space 17. Similar operation of corresponding arms 23, arranged alternately on opposite sides of the tray in connection with a plurality of adjacent partitions at or near the mid-section, completes the desired contraction of the structure, as will be well understood. After the freezing operation has taken place, with the tray in this contracted position, the rocking of the several arms 23, 23 to dispose the lower or inoperative portions of the cams 25, 25 in opposition to the projections 26, 26, will allow the tray material, by its natural spring, or with the assistance of slight distending pressure by the user, to assume its normal distended position, (Fig. 8), thus to free the contained ice blocks in the manner above described. The partitions 19 may have their curved edges welded at 18 to the concave body surface, except at the gaps 17, or may be otherwise or additionally held against lateral displacement, as by use of a pin 27 through the extension 20′, exteriorly of the tray body wall.

It is to be understood, of course, that my invention is not in any sense limited to the use of metal as the material for the tray body, but that it contemplates for this purpose any suitable material.

I claim,

1. An ice tray for mechanical refrigerators, having ice block cavities each bounded by a surface of revolution and by two substantially upright surfaces whose upper edges are non-parallel.

2. An ice tray for mechanical refrigerators, having ice block cavities each bounded by a surface of revolution and by two substantially upright surfaces that make acute angles with the axis of said surface of revolution.

3. An ice tray for mechanical refrigerators, having ice block cavities each bounded by a surface of revolution and by two substantially upright surfaces in divergent planes.

4. An ice tray for mechanical refrigertors, providing a cavity wherein the ice block, by pressure against one edge of its exposed surface, may be turned, to project its opposite edge above the level occupied by said surface, the side walls of said cavity being divergent toward said last-named edge, whereby initiation of said turning relieves the contact of the ice block with one of said walls.

5. An ice tray for mechanical refrigerators, in the form of a half-tubular section closed at its ends, and providing a plurality of cross partitions, each of which has its upper edge

extended to project through the material of said section.

6. An ice tray for mechanical refrigerators, in the form of a half-tubular section closed at its ends, and providing a plurality of cross partitions, which are successively skewed, first in one direction and then in the other, from the axis of said half-tubular section.

7. An ice tray body of elastic material presenting a row of cavities, and means for distorting said material to contract temporarily the cross-section of said tray preliminary to the freezing operation therein, whereby, upon release of said means, following said freezing operation, the tray will enlarge to its normal cross section and free its walls of contact with the solidified contents of said cavities.

8. An ice tray providing a series of cross partitions to divide its space into a plurality of cavities, means for contracting the cross-section of said tray, preliminary to the freezing operation therein, and means, responsive to the release of said contracting means, for pulling adjacent partitions in opposite directions.

9. An ice tray of distortible cross-section, means for holding said tray in a contracted condition during the freezing of water therein, and means for releasing said holding means to permit resumption of the normal cross-section after the formation of ice therein.

10. An ice tray whose body is subject to contraction, to permit of expansion to a larger section after the formation of ice therein, and a series of partitions dividing said body and attached alternately to opposite sides thereof, whereby adjacent partitions of said series will be pulled in opposite directions, when said expansion occurs.

11. An ice tray of elastic material, subject to distortion to contract its section and adapted to spring back to normal section after the formation of ice therein, a series of partitions dividing said tray, and means associated with said partitions for securing the contraction of the tray section.

12. As a new article of manufacture, an ice tray whose cavities secure segregation of their contents when said tray is filled with water, each of said cavities being bounded by a bottom surface of revolution and by two substantially upright side walls, the outer surfaces of said side walls being exposed.

13. As a new article of manufacture, an ice tray having a plurality of cavities, each securing segregation of its contents when said tray is filled with water, certain of said cavities being bounded by a bottom surface of revolution and by two side walls that are downwardly convergent.

14. As a new article of manufacture, an ice tray providing cavities each having a bottom surface of revolution, to permit the turning movement of the ice block formed therein by downward pressure against an edge of the top surface of said block, the tray material being formed to provide downwardly opening spaces between the side walls of adjacent cavities, to permit limited flexure of said tray.

15. An ice-making container for domestic mechanical refrigerators, comprising a tray and partitions dividing the tray into compartments for forming ice blocks, the opposite partitions of each compartment being downwardly convergent, and also being convergent toward one of the other sides of said compartment.

16. As a new article of manufacture, an ice tray providing cavities each adapted for the turning movement of the ice block formed therein by downward pressure against an edge of the top surface of said block, the opposite walls of each cavity being downwardly convergent, and also convergent toward the edge of said cavity corresponding to the above-mentioned top edge of the contained ice block.

17. As a new article of manufacture, an ice tray providing a row of cavities each bounded by a bottom surface of revolution, and by two side walls that are downwardly convergent, the upper edges of said side walls being skewed alternately in opposite directions to the axis of said surface of revolution.

18. As a new article of manufacture, an ice tray of elastic material, having releasable means for contracting the cross-section of said tray by distortion of said material, whereby, upon release of said means after freezing of water in said tray, the forces tending to restore said tray to its normal section are exerted to overcome the adhesion of the ice to the confining walls of the tray.

19. As a new article of manufacture, an ice tray of elastic material and of concave cross-section, means for holding said tray, preparatory to the freezing operation therein, in distorted form, to impart to its cross-section a curvature other than the normal curvature, and means for releasing said holding means following the freezing operation, to permit the forces tending to restore said normal curvature to overcome the adhesion between the ice and the confining tray surfaces.

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