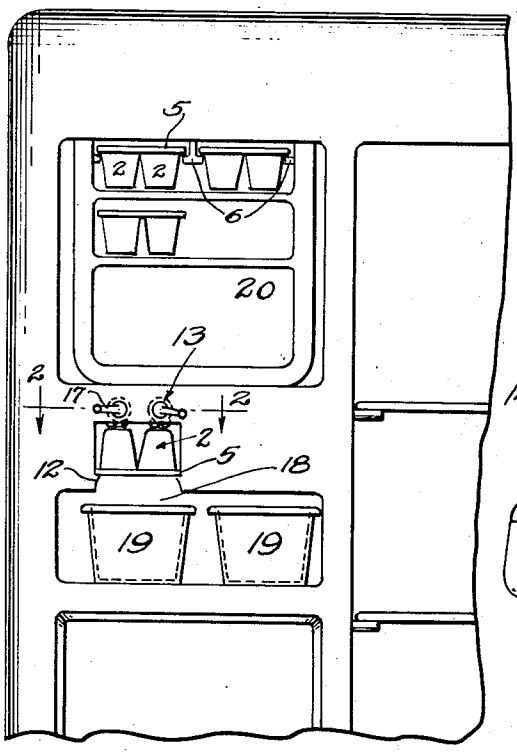
Oct. 15, 1940. H. Y. JENNINGS ET AL 2,217,681

REFRIGERATING APPARATUS

Filed Feb. 13, 1937

Fig. 1



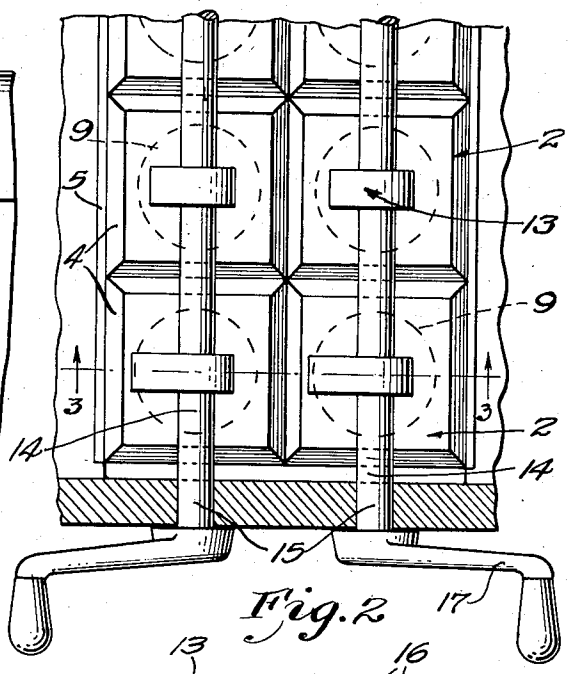


Fig. 2

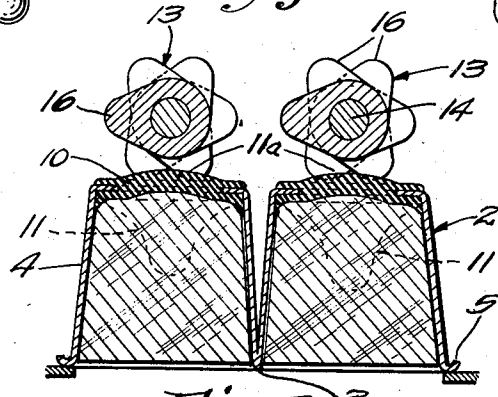


Fig. 3

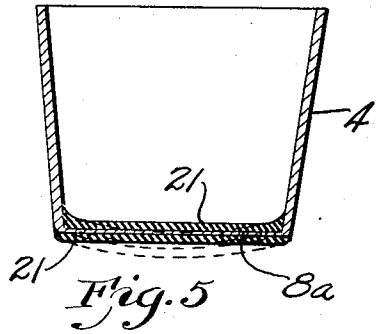


Fig. 5

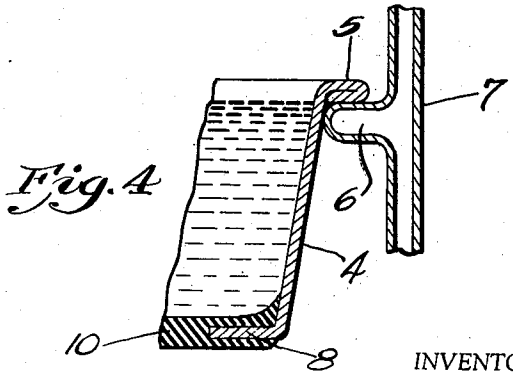


Fig. 4

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REFRIGERATING APPARATUS

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9 Claims. (Cl. 62—105.5)

This invention relates to refrigerating apparatus, and more particularly to freezing and dispensing structure such as for forming and dispensing ice cubes in domestic refrigerators.

During the last eight years, many improvements have been made on the structure and arrangement of ice cube trays for the freezing and releasing of so called ice cubes; many of these improved methods are built around the rubber ice cube tray; many improvements have to do with means for accelerating the freezing but still utilizing the rubber or equivalent surface as the greater surface of the ice cube forming compartment. Another type of freezing and dispensing structure centered about flexible metal trays where the ice is broken away from the metal surface by flexing or distorting; and still a third type or class of apparatus for freezing and dispensing has attempted to utilize the expansive force of freezing liquids to break the adhesion between the frozen ice cube and the metallic walls of the metal tray.

The present invention falls generally in the class of freezing apparatus of the type making use of the expansive force of freezing liquids; however, this expansive force of freezing liquids is combined with novel freezing compartments in such a manner that very efficient and unusual freezing and dispensing effects are obtained. More specifically, in carrying out the present invention, particular use is made of the fact that the expansion in the actual changing from water to ice at zero° C. is about seven hundred times greater than the expansion of liquid (water) cooling from 4.0° C. to zero° C.

An important feature of the present invention contemplates the freezing of ice cubes in a relatively short period of time, automatically and partially releasing the ice cubes as an inherent result of the freezing action and then quickly and easily releasing the already partially displaced cubes for storage purposes, all this taking place within the refrigerator and resulting in the production of a large number of cubes with a small freezing space. Still more specifically, this invention contemplates ice cube compartments so constructed that freezing takes place from the top of each compartment, means are provided for partial displacement of one wall of the compartment and the utilization of the final expansion as a result of the change of liquid to ice to displace the frozen cube from the side walls of the compartments. The frozen cubes are not completely released from the compartments so that the complete unit may be inverted without the cubes dropping out. Use is made of the displacement of one wall of the compartment so that when the unit is inverted, one or a plurality of the frozen cubes may be easily dispensed; the dispensing taking place within the refrigerator cabinet and into a storage compartment maintained at a temperature which will keep the dispensed cubes in what is known as a "dry" condition.

Other features of the invention, including details of the ice cube forming unit and the dispensing unit will be more clearly brought out in the specification and claims.

In the drawing:

Fig. 1 is a fragmentary elevation of a domestic refrigerator cabinet embodying the features of the present invention.

Fig. 2 is a sectional plan view taken on line 2—2 of Fig. 1 and showing particularly the means for progressively dispensing ice cubes.

Fig. 3 is a sectional view taken on line 3—3 of Fig. 2 and illustrating the arrangement of the dispensing fingers and also the shape of the bottom wall, and the relative position of the ice cubes after expansion and partial release due to freezing has taken place.

Fig. 4 is a sectional view illustrating the preferred manner of supporting the sharp freezing unit so as to obtain freezing from the top down.

Fig. 5 illustrates a modified design of an ice cube forming compartment wherein insulating means is formed on both sides of a metallic bottom wall.

In carrying out the present invention, combined use is made of many different elements and forces and efficient freezing and dispensing depends upon the materials used, the shape of the containers, the combination of rigid and flexible walls, and the correlation of heat conduction and insulation. Referring to the drawings, the sharp freezing unit is made up of a series of compartments 2 joined together at the top as at 3 and having converging side walls 4 of uniform slope, so that the main body portions of each compartment are spaced or separated. No definite form or contour of the side walls is necessary as the compartment and resulting ice block may take a round, oval, square and rectangular form, as long as the relative sizes of the top and bottom are maintained. The outer edges of each compartment are preferably turned over as at 5 so as to form supporting means for the sharp freezing unit, and in general application, the top edges 5 are designed to rest upon suitable ledges 6 forming a part of a cooling unit 7; the idea here

being that conductivity takes place between the refrigerant backed ledges 6, the turned over members 8 and the side walls of the compartment.

The side walls of the compartment of the sharp freezing units are preferably formed of a metal of relatively high conductivity, and the interior surfaces of the side walls are preferably coated with wax or the type of coating disclosed in the patent to Hawthorne #1,932,731 which coating forms a permanent part of the interior surface of the walls and assists in the removing of the frozen ice cubes. The bottom wall 8 of each compartment 2 is apertured as best shown at 9 in Fig. 2, and it will be understood that the turned in portion 8 of the bottom wall is a very important feature of the present invention. The sealing bottom for each compartment preferably consists of a disc or insert 10 formed of rubber or similar non-conductive material, and is at least slightly flexible. The edge of the insert may be grooved so as to fit around the inwardly projecting metallic portions 8 of the bottom wall, or the non-conductive bottom walls may be molded into position. In other words, it is important that the bottom portion 8 be of a material of relatively poor conductivity to insure the freezing of the water within the container from the top and, secondly, it must have some flexibility so as to be distorted by the displacement of liquid caused by freezing and expansion of the top portion of the body of liquid.

It will be understood here that when the liquid freezes at the top and adheres to the side walls of the individual compartments that there will be some expansion; this expansion of the liquid must result in some displacement and the flexible bottom wall not only takes care of this displacement but utilizes the same for a beneficial result. Although it is not necessary that the side walls 4 be of a highly conductive material, it is desirable that the conductivity thereof is greater than the bottom wall 10.

In carrying out the first part of the present invention, the individual compartments of the sharp freezing unit are filled with water and the sharp freezing unit inserted so that the flange 5 is supported by ledges 6 of the cooling unit (see Figs. 1 and 4). Freezing takes place at the top and sides and as freezing progresses downwardly, obviously some expansion takes place, and inasmuch as the top surface is frozen to the side walls of the compartments this displacement must be downwardly. Until the frozen liquid assumes substantially the contour shown by the dotted lines 11 in Fig. 3, this displacement is taken care of by the distortion of the flexible bottom wall 10. However, when freezing beyond the dotted lines 11 takes place, the inturned walls 8 receive the brunt of this greatly increased expansion so that when the final change from the liquid to the solid state takes place at the bottom of each compartment, the pressure against the flanges 5 is so great as to release the ice from the side walls 4 and force the ice cubes upwardly; as shown in Fig. 3, the partially released cubes are spaced from the side walls 4. There is still some small adhesion between the ice and the bottom wall 10, as shown in Fig. 3, and after the ice cube settles in position there is usually some adhesion between the cube of ice and some point or portion of one or more of the side walls of the compartment. At this point it will be seen that, if desired, the sharp freezing unit may be removed from the cooling unit and by simple pressure upon the distorted bottom portion 11*a*, removal of one or more cubes is a very simple matter as the general adhesion between the cube and the side walls has been broken.

In the preferred form of the invention a distinctive use is made of the fact that there is still a small degree of adhesion between the cube and one or more walls of each compartment. Whenever the cubes of ice have been frozen in the compartments and partially released by the expansive action in passing from liquid to the solid state, the sharp freezing unit may be removed, inverted, and inserted in another part of the cooling unit, or at least a part of the refrigerator that is maintained at or below freezing temperature. The flanges 5 of the inverted sharp freezing unit may contact with suitable turned in portions 12 of the cooling unit and the bottom walls 10 and the distorted portions thereof 11* are then located beneath the dispensing means generally designated 13. The dispensing means are preferably in duplicate, due to the fact that the compartments 2 are preferably formed in two longitudinal rows. Each dispensing unit comprises a shaft 14, each end of which is suitably journaled as at 15. Cam members 16 are secured to and spaced longitudinally of the shaft so as to correspond with the spaced compartments 2 and these cam members 16 are so arranged annularly about the shaft that rotation of the shaft by means of a suitable handle 17 will cause the successive contact between the cams and the distorted portions 11* of the longitudinally spaced compartments. Thus if the handle 17 is just given a quarter of a turn (depending upon the number of compartments) only one ice cube will be ejected, but if the handle is given a complete revolution all the ice cubes in a longitudinal row of compartments will be ejected.

It will thus be seen that by inverting the sharp freezing unit and placing the same beneath the dispensing units 13 that one or all of the cubes may be quickly and easily dispensed while still in their cold dry form. The compartment 18 is preferably maintained at or below freezing so that when the ice cubes are dispensed into suitable storage chambers 19 it will be seen that they will be maintained in dry condition so as not to stick to each other.

In Figs. 3 I have illustrated the relative position of the ice cubes after they have been released from the side walls of the compartments; here there is some adhesion between the ice and the bottom walls and there also will be some adhesion at one or more points between the ice cubes and the side walls, as it is unlikely that the ice cube when released by the expansion action will be absolutely centered within the compartment. The main point is that the greater amount of adhesion between the ice cube and the side walls is broken, but that when the unit is inverted the compartment receiving the inverted units is of such a temperature as to cause the cubes to remain in position even though the adhesion between the cube and the compartment is relatively small.

When it is known that a large number of ice cubes will be required for an evening party or the like, the sharp freezing unit filled with water may be inserted in the cooling unit and when the housewife uses the refrigerator for any reason she merely has to remove the sharp freezing unit, insert the same in the dispensing compartment, turn the levers 17 to dispense the cubes into storage chambers and then refill the sharp freez-

ing unit. In this manner several large storage chambers filled with dry ice cubes can be obtained during the day. The embodiment illustrated has capacity for freezing an unusually large amount of ice cubes as the storage compartments 18 as filled may be positioned in the lower compartment 20 of the sharp freezing unit proper. It being understood that the compartment 18 and the dispensing compartment may be cooled by conductivity or by refrigerated walls. Ordinarily one sharp freezing compartment for receiving two sharp freezing units such as shown at the top of the cooling unit in Fig. 1 will be sufficient as each cooling unit can be frozen and emptied several times during the day to fill up storage compartments.

In the modification illustrated in Fig. 5, the metallic bottom wall 8a of the compartment extends all the way across the bottom. The side wall 4 in this modification is preferably of the same construction as the side wall 4 shown in Fig. 4 and is rigid enough so as not to be distorted by the expanding action of the change from liquid to a solid. The bottom wall 8a, however, is preferably much thinner and, in other words, is flexible enough to be distorted by the water while freezing. Retarding action may be obtained by suitable material 21 at the top and bottom of the wall 8a. This material, like the bottom member 10, is preferably of rubber, and the side wall 4 may be of any material from plastics to metal of relatively high conductivity.

What we claim is:

1. Freezing and dispensing means for domestic refrigerator cabinets comprising an evaporator for receiving an ice cube tray formed of individual molds, the bottom walls of said molds being flexible, a dispensing compartment in said evaporator for receiving the ice cube tray in inverted position, a storage compartment beneath the dispensing compartment, and manually actuated means located in a wall of said dispensing compartment for contacting the tray in stationary inverted position and moving the flexible bottom of one or more molds to eject one or more ice cubes into the storage compartment.

2. Freezing and dispensing means for refrigerator cabinets comprising an ice cube tray formed of individual molds, the bottom walls of said molds being formed of flexible non-conductive material whereby to cause the liquid in the mold to freeze from the top down and cause said bottom wall to bulge outwardly due to the expansive force of the freezing liquid, a dispensing compartment for receiving the ice cube tray in inverted position, a storage compartment beneath the dispensing compartment, and manually actuated means mounted within the dispensing compartment for contacting and moving the flexible bottom of one or more molds to eject one or more ice cubes into the storage compartment.

3. Freezing and dispensing means for refrigerator cabinets comprising an ice cube tray formed of individual molds, the bottom walls of said molds being formed of flexible non-conductive material whereby to cause the liquid in the mold to freeze from the top down and cause said bottom walls to bulge outwardly due to the expansive force of the freezing liquid, a dispensing compartment for receiving the ice cube tray in inverted position, a storage compartment beneath the dispensing compartment, and manually actuated means mounted within the dispensing compartment and operable from without said compartment for contacting and moving the buldged out portion of the flexible bottom of one or more molds to eject one or more ice cubes into the storage compartment.

4. Freezing and dispensing means for refrigerator cabinets comprising an ice cube tray formed of individual molds, the bottom walls of said molds being formed of flexible non-conductive material and reinforcing means whereby to cause the liquid in the mold to freeze from the top down and cause said bottom walls to bulge outwardly due to the expansive force of the freezing liquid, and the expansive force created by the change from liquid to a solid reacting against said reinforcing portion to break the adhesion between the blocks of ice and the side walls, there being sufficient adhesion, however, that the blocks of ice do not drop out when the tray is inverted, a dispensing compartment for receiving the ice cube tray in inverted position, a storage compartment beneath the dispensing compartment, and manually actuated means mounted in the walls of said dispensing compartment for contacting and moving the flexible bottom of one or more molds to eject one or more ice cubes into the storage compartment.

5. Freezing and dispensing means for refrigerator cabinets comprising an ice cube tray formed of individual molds, the bottom walls of said molds being formed of flexible non-conductive material and reinforcing means whereby to cause the liquid in the mold to freeze from the top down and cause said bottom walls to bulge outwardly due to the expansive force of the freezing liquid, and the expansive force created by the change from liquid to a solid reacting against said reinforcing portion to break the adhesion between the blocks of ice and the side walls, there being sufficient adhesion, however, that the blocks of ice do not drop out when the tray is inverted, a dispensing compartment for receiving the ice cube tray in inverted position, said dispensing compartment being maintained at or below freezing temperatures, a storage compartment beneath the dispensing compartment, and manually actuated means mounted in a wall of said dispensing compartment for contacting and moving the flexible bottom of one or more molds to eject one or more ice cubes into the storage compartment.

6. Freezing and dispensing means for refrigerator cabinets comprising an ice cube tray formed of individual molds, the bottom walls of said molds being formed of flexible non-conductive material and reinforcing means whereby to cause the liquid in the mold to freeze from the top down and cause said bottom walls to bulge outwardly due to the expansive force of the freezing liquid, and the expansive force created by the change from liquid to a solid reacting against said reinforcing portion to break the adhesion between the blocks of ice and the side walls, there being sufficient adhesion, however, that the blocks of ice do not drop out when the tray is inverted, a dispensing compartment for receiving the ice cube tray in inverted position, said dispensing compartment being maintained at or below freezing temperatures, a storage compartment beneath the dispensing compartment, said storage compartment being maintained at or below freezing temperatures, and manually actuated means mounted within the dispensing compartment for contacting and moving the flexible bottom of one or more molds to eject one or more ice cubes into the storage compartment.

7. In a refrigerating mechanism, the combina-

tion of a sharp freezing chamber in an evaporator for freezing water retained in a tray, an auxiliary compartment maintained at a temperature below the freezing point of water for receiving a tray with ice therein with the tray in inverted position, means mounted to cooperate with the tray when inverted within the evaporator for mechanically loosening said ice from said inverted tray, and a compartment maintained below the freezing point of water for receiving the loosened ice from said inverted tray.

8. In a refrigerating mechanism, the combination of a sharp freezing chamber in an evaporator for freezing water retained in a tray, means maintained at a temperature below the freezing point of water for receiving a tray with ice therein with the tray in inverted position, means mounted within the evaporator and operable from without for mechanically loosening said ice in a dry frozen state from said inverted tray, and a compartment maintained below the freezing point of water for receiving the loosened ice from said inverted tray and maintaining it in its dry frozen state.

9. In a refrigerator, a cooling unit having a sharp freezing chamber for receiving a portable unitary container in which ice cubes are adapted to be frozen, a storage compartment in thermal conducting relation with the cooling unit and maintained at or below the freezing temperature of water, means positioned in dispensing relation to said storage compartment and also maintained at or below the freezing temperature of water for receiving said container filled with ice cubes in inverted position, and means mounted in a wall of said compartment for positively ejecting the ice cubes in their dry frozen state from the inverted container into the storage compartment.

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