

March 28, 1944.

L. L. MALLARD

2,345,206

ICE MOLD WITH POSITIVE ATMOSPHERIC RELEASE

Filed Dec. 4, 1941

Fig. 1.

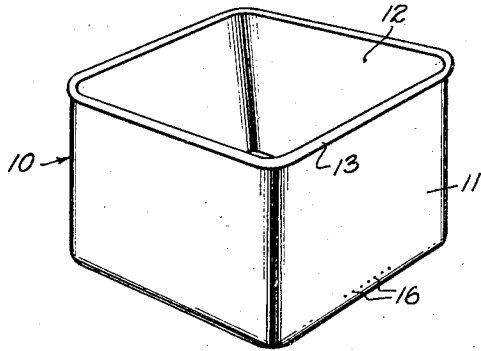


Fig. 2.

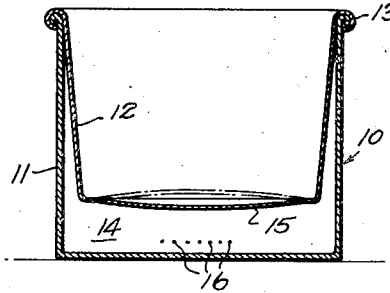


Fig. 3.

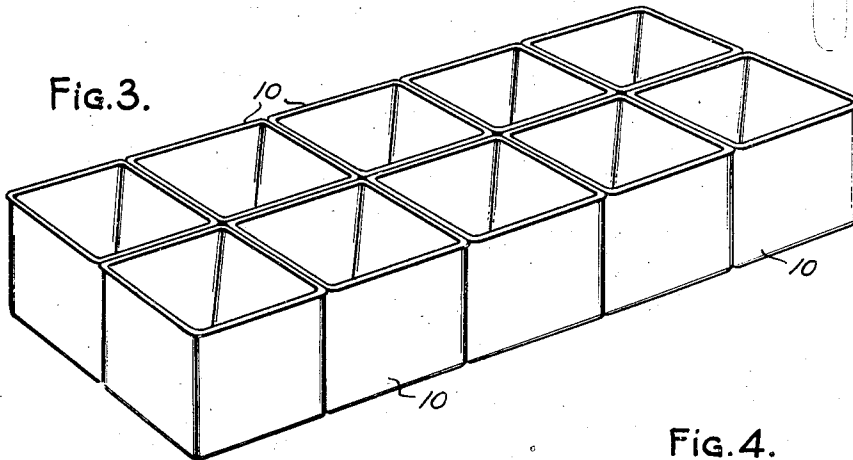


Fig. 4.

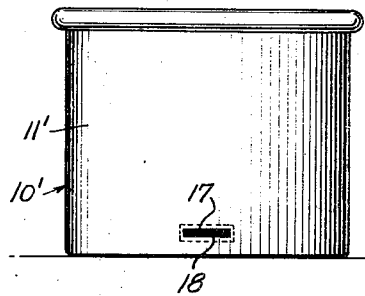


Fig. 5.

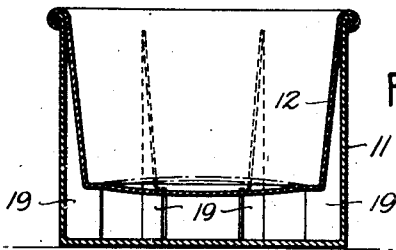
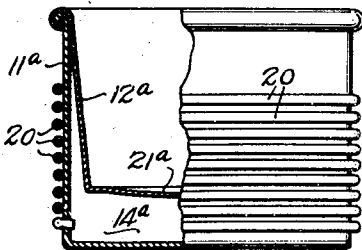


Fig. 6.



Inventor
LOGAN L. MALLARD,

By

A. Gates Dowell,
Attorney

UNITED STATES PATENT OFFICE

2,345,206

ICE MOLD WITH POSITIVE ATMOSPHERIC
RELEASE

Logan L. Mallard, Norfolk, Va.

Application December 4, 1941, Serial No. 421,648

10 Claims. (Cl. 62—108.5)

This invention relates to ice-forming apparatus or ice molds or trays in which water or other substance to be frozen or congealed is placed and subjected to cooling. The invention is particularly, but not necessarily, concerned with devices used in domestic or household types of refrigerators for preserving comestibles and wherein considerable difficulty is experienced in removing frozen or congealed matter from the tray in which it has been refrigerated.

The problem of removing ice or the like from ice trays has been long recognized and numerous efforts have been made to solve this problem, including the utilization of various types of trays such as rubber, metal and the like and grids of flexible, partially flexible or rigid construction. Ice within the cells of the tray becomes securely united with the tray and the grid or partition structure that divides the tray into cells. In addition to utilizing trays and grids of rubber or the like substance, mechanical means of various types including levers, cams, etc., have been used, all of which however, have been subject to certain objections.

It is an object of the invention to provide an apparatus or device of the character described which will operate automatically and which is of simple, inexpensive and durable construction, free of levers, cams or other mechanical means which require manual operation.

The invention is primarily concerned with means operable to dislodge or remove ice or the like from the cell or cells of the mold or tray in which they are formed as a result of change in temperature when the tray is removed from its freezing compartment and is subjected to room or atmospheric temperature and which change causes an increase in pressure of fluid, such as air or the like, entrapped in a hollow portion of the tray and consequent movement of the cell wall or other movable member to eject the ice.

Other objects of the invention will become apparent in view of the following description taken in conjunction with the drawing, wherein:

Fig. 1 is a perspective view of a single cell ice mold illustrating one method of carrying out the inventive concept;

Fig. 2, a transverse vertical section of Fig. 1;

Fig. 3, a perspective view of a multiple cell tray or mold particularly adapted for use in the freezing unit of a domestic refrigerator;

Fig. 4, a front elevation of a single cell mold illustrating a modification; and

Figs. 5 and 6, transverse vertical sectional views illustrating other modifications.

Referring to the drawing in detail, and first to Figs. 1 and 2, the mold here shown is generally designated at 10 and comprises an outer shell or container 11 and an inner container or mold proper 12 connected in sealed relation at their upper marginal edges by interlocking beads as indicated at 13. However, the connection at this point may be made in any suitable manner, as by welding, soldering or the like, the object being to connect or join the outer and inner containers in substantially fluid-tight relation. The mold proper 12 is provided with a flexible or movable ice-dislodging or ejecting member in the form of a diaphragm 15 so constructed as to normally assume its "down" position as shown in Fig. 2.

The outer container 11 has formed in one of its walls a series of breathing vents or perforations 16 which constitute air inlet and exhaust means. These holes may be formed in any suitable manner, but in any event they should be of such capacity as to block the escape of air when the latter is subjected to expansion and at the same time permit intake of air over a period of time which is relatively long compared to the expansion period.

Another method of providing these breathing vents or pores is illustrated in Fig. 4 wherein the wall of the outer container indicated at 11' is formed with a slot 17 having secured thereover a fine wire gauze screen 18. Examples of the type of screen used for this purpose are wire mesh screens, fabrics or fibrous material capable of filtering or separating fluids of different specific gravity, as for example, gasoline from water.

Irrespective of the type of materials used, it is desirable that the capacity of the intake and exhaust vents be such as to permit breathing of air into the chamber 14 while at the same time preventing infiltration of condensed moisture or water, and which might otherwise take place in the event the unit is immersed in water for cleaning or sterilizing purposes.

The outer shell 11 is preferably made of somewhat heavier gage of sheet metal or material than the inner container or mold 12 to thereby better withstand service. The diaphragm 15 may be produced as an integral part of the mold 12, or it may be made of a piece of metal and suitably connected to said mold. Diaphragms of this nature are often made of thin copper sheeting provided with concentric corrugations to facilitate flexing.

The following description of operation of the mold is based on conclusions arrived at through experimentation and use and is not to be held

as restrictive, since such experimentation and use has definitely established the operativeness and practicability of the mold irrespective of the theory of operation:

The inner cell or mold proper 12 may be filled with water or other fluid to be frozen and placed in the freezing unit or chamber of a refrigerator. In domestic refrigerators the freezing temperature is adjusted over different ranges depending upon the habits or desires of the person owning or operating the unit. Usually, however, the freezing temperatures are adjusted to in the neighborhood of 20 to 22° F. During the time the mold is being handled and also during part of the freezing process, air in the chamber 14 undergoes a drop in temperature, of for example from 70 to 20° F. The result is that the air in said chamber contracts and its density increases, the reduction in volume being compensated for by "breathing" through the vents or pores 16. Not only is the temperature of the air in the chamber 14 influenced by the outside atmosphere, but it is also subjected to the temperature of the water in the mold 12, and which when originally poured into the mold may be approximately 70° F.

As long as the mold remains in the freezing unit or evaporator, the volume of air in the chamber 14, once contracted or having attained a given density, remains substantially stable, but as soon as the mold is removed from the freezing unit and subjected to atmospheric or room temperatures, expansion takes place with such rapidity as to create pressure in the chamber which pressure is exerted on the diaphragm 15 to dislodge or eject the ice mass in the mold 12, the pressure however being gradually relieved by escape of air through the vents 16. This relief, however, is not sufficiently rapid to prevent generation of the required pressure. Another phase which influences the operation of the mold is vapor pressure resulting from the intake of a certain amount of moisture with the air, and this moisture or vapor when subjected to a drop in temperature freezes and creates a vacuum in chamber 14 which in turn increases the intake through the pores or vents 16.

Observations have also disclosed that the breather vents may become frosted over and partly or wholly sealed at a certain stage of the freezing process. However, this sealing of the breather vents is gradual and apparently does not take place until there is a substantial contraction and increase in density of the volume of air in the chamber 14. Thus the air in the chamber 14 becomes "sealed" in as the temperature falls, and when the mold is removed and subjected to a rise in temperature, the air in the chamber 14 is partly or wholly blocked against escape, with the result that the expansion pressure is exerted wholly upon the diaphragm 15. This closing of the breather vents through the normal use of the mold avoids the necessity of any fine tolerance in the capacity of the breather vents, and in fact experiments have shown that these vents may have a capacity varying over a relatively wide range without rendering the mold inoperative.

Fig. 3 illustrates how a plurality of the individual molds 10 may be assembled to provide a multiple cell tray of suitable dimensions for use in the freezing compartment of a domestic refrigerator. These cells may be united by welding, soldering or brazing, or an entire series of molds may be stamped out of a piece of sheet

metal and assembled in sealed relation with an outer container and united at their upper marginal edges. In a tray of this type, the air chambers 14 may be individually partitioned from each other, or they may be in communication or comprise one complete chamber operating on the entire group of cells.

Fig. 5 illustrates a mold wherein the rate of heat exchange between the walls of the outer container 11 and the cell or mold proper 12 may be accelerated by the provision of heat-conducting fins 19 which are positioned so that they do not interfere with the action of the diaphragm. In this instance, parts which correspond to those previously described are given like reference numerals, with the exception that primes have been added.

Fig. 6 illustrates a method of increasing the capacity of the air chamber of the mold. In this instance the outer shell is indicated at 11a, the inner freezing cell at 12a and the expansion chamber at 14a. A coil 20 is wound around the outer shell and has its inner end projected into the chamber 14a, the inner end of the coil being open and the outer end closed. When the mold is removed from its freezing chamber or evaporator, not only does the air within the chamber 14a expand and exert its influence on the movable diaphragm 21a, but the air in the coil 20 also expands and acts in conjunction with the air in the chamber 14a. By regulating the capacity of the coil 20, the expansive force acting on the diaphragm 21a may also be regulated.

It will be understood that the foregoing description and accompanying drawing are for illustrative purposes only and are not restrictive only insofar as defined by the appended claims.

What is claimed is:

1. An ice mold having a mold cavity and a movable ice-dislodging member located adjacent the mold cavity, means forming a substantially sealed chamber in pressure communication with said member, and means permitting restricted "breathing" or intake of air into and exhaust of air from said chamber, whereby atmospheric air may be drawn into the chamber during an increase in density over a range of temperature drop and when suddenly subjected to a higher temperature and thus caused to expand and exerts pressure on said ice-dislodging member before the air can escape from said chamber.

2. An ice mold having a mold cavity and a movable ice dislodging member located adjacent the bottom of the mold cavity, means forming a substantially sealed chamber in pressure communication with said member, said chamber having a wall formed with one or more restricted air intake and exhaust pores or vents of such capacity as to permit a gradual increase in density of the air in the chamber over a range of temperature drop and to retard exhaustion of the air from said chamber when suddenly subjected to a higher temperature and cause the expanded air to exert pressure on and actuate said dislodging member.

3. Ice forming apparatus including means providing a cell for receiving fluid to be frozen, means forming a chamber exteriorly of said cell, there being a wall between the cell and the chamber capable of being distorted, and means permitting restricted intake of atmospheric air to and retarded exhaustion of air from said chamber whereby the atmospheric air in the chamber upon expansion due to change in tem-

perature between the ice freezing compartment and the atmosphere will actuate said wall for releasing the ice before it can escape from said chamber.

4. Ice forming apparatus including a mold having an inner freezing cell and an outer shell surrounding said cell and spaced from the latter providing a substantially sealed pressure chamber therebetween, said cell having a bottom wall provided with a normally downwardly-bowed movable diaphragm, said shell being provided with one or more restricted air intake or exhaust pores or vents of such capacity as to permit a gradual increase in density of the air in the chamber over a range of temperature drop and to retard exhaustion of the air from said chamber when suddenly subjected to a higher temperature and cause the expanded air to exert pressure on and actuate said diaphragm.

5. Ice forming apparatus comprising a mold having an inner freezing cell or compartment and an outer shell, said shell and cell being connected at their upper marginal edges, with the bottom portions thereof spaced from one another to provide a substantially sealed pressure chamber therebetween, the bottom wall of said cell being provided with a normally downwardly-bowed diaphragm and said shell having one or more intake and exhaust pores or vents of such capacity as to permit a gradual increase in density of the air in the chamber over a range of temperature drop and to retard exhaustion of air from said chamber when suddenly subjected to a higher temperature and cause the expanded air to exert pressure on and actuate said diaphragm.

6. An ice mold comprising an outer shell and an inner cell spaced from said outer shell and secured in substantially sealed relation with respect thereto, said cell having a movable bottom wall, means providing a chamber in pressure-communication with said movable wall, means permitting restricted intake of air into and exhaust of air from said chamber, whereby atmospheric air is "breathed" into the chamber over a range of temperature drop and when suddenly subjected to a higher temperature and thus caused to expand exerts pressure on said movable wall, and heat transfer means interconnecting the outer shell with the inner cell.

7. An ice mold comprising an inner cell and an outer shell arranged in spaced relation with a substantially sealed chamber therebetween, the bottom of said inner cell being provided with a diaphragm which normally assumes a downwardly-bowed position, means permitting restricted intake of air into and exhaust of air from said chamber whereby atmospheric air may

be "breathed" into the chamber during an increase in density over a range of temperature drop and when suddenly subjected to a higher temperature and thus caused to expand exerts pressure on said diaphragm, and means exposed to the temperature exterior of the mold and communicating with said chamber operating to increase the volume of air subjected to expansion in said chamber.

8. An ice mold comprising an inner cell and an outer shell arranged in spaced relation to provide a substantially sealed chamber therebetween, the bottom of said inner cell being provided with a diaphragm which normally assumes a downwardly-bowed position, means providing restricted intake of air into and exhaust of air from said chamber whereby atmospheric air may be "breathed" into the chamber during an increase in density over a range of temperature drop and when suddenly subjected to a higher temperature and thus caused to expand exerts pressure on said diaphragm, and a coil surrounding said shell and having its outer end closed and its inner end communicating with said chamber and whereby the expansive capacity of said chamber is increased.

9. A mold in which a body of fluid may be congealed, comprising a rigid container having a flexible bottom wall and an opening opposite said wall for the removal of said body in its congealed state, structure forming a substantially sealed chamber adjacent the under side of said wall, and means providing restricted inlet of air to said chamber upon a decrease of temperature therein, said means being effective to sufficiently retard the outlet of air from said chamber upon a subsequent increase of temperature therein to cause the resultant expansion of the air therein to elevate said flexible wall and thereby act to release the congealed body from said mold.

10. A multiple mold in which separate bodies of fluid may be congealed, comprising a series of rigid containers each having a flexible bottom wall and an opening opposite said wall for the removal of the fluid body in its congealed state, structure forming a substantially sealed chamber adjacent the under sides of said walls and means for providing restricted inlet of air to said chamber upon a decrease of temperature therein, said means being effective to sufficiently retard the outlet of air from said chamber upon a subsequent increase of temperature therein to cause the resultant expansion of air therein to elevate said flexible walls and thereby act to release the congealed bodies from said containers.

LOGAN L. MALLARD.