July 2, 1968 W. C. MORELAND II, ETAL 3,390,543

ICE CUBE MAKER

Filed July 12, 1967

FIG. 1

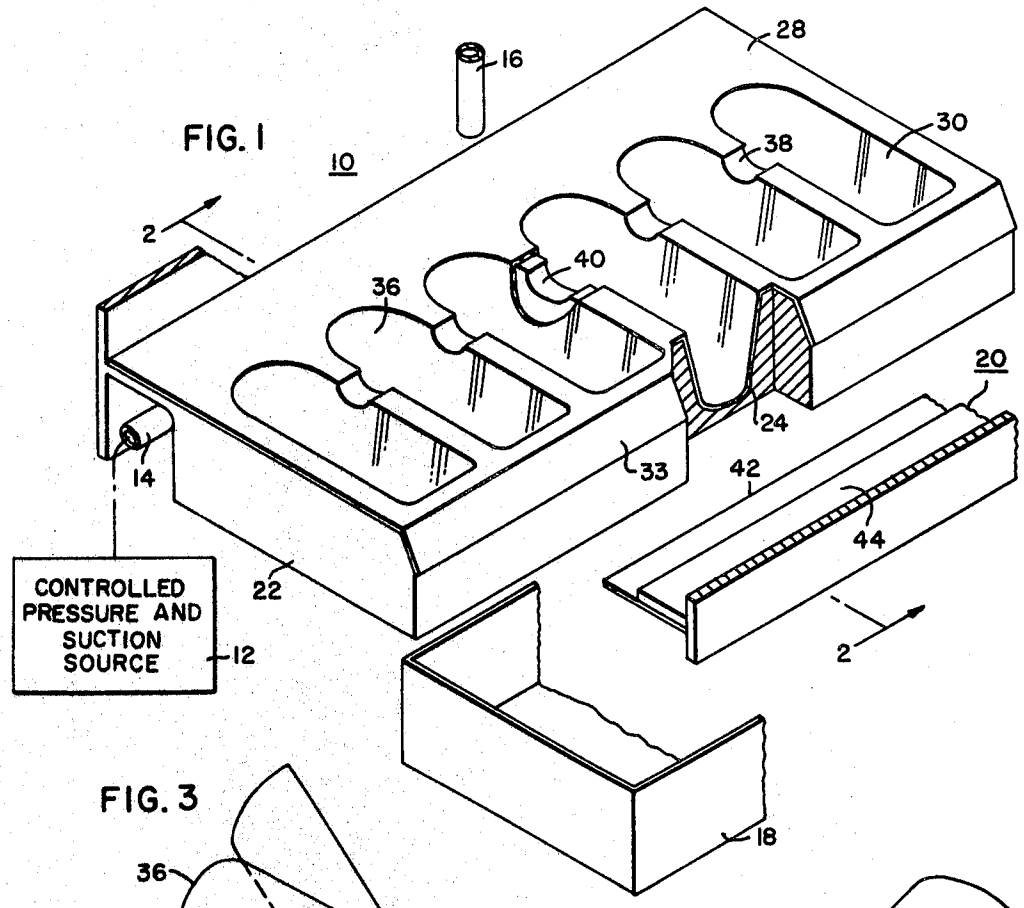


FIG. 3

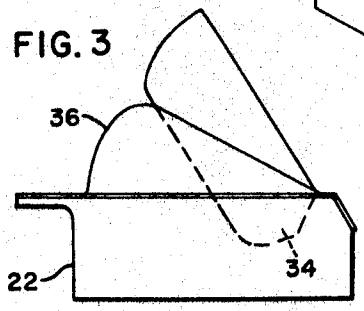


FIG. 4

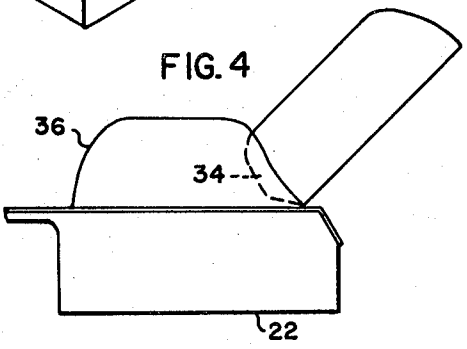
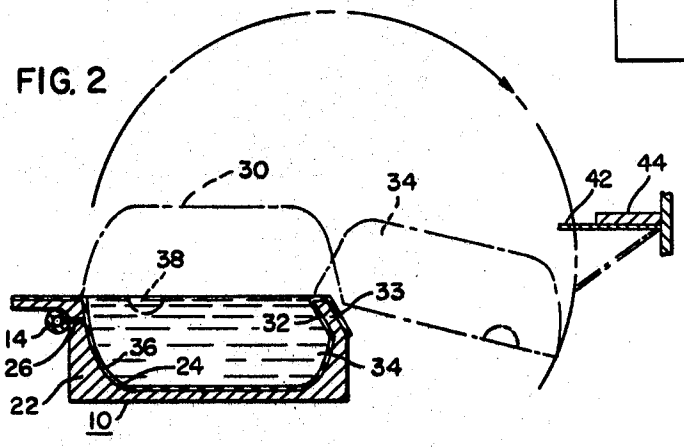


FIG. 2



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ICE CUBE MAKER

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6 Claims. (Cl. 62—353)

ABSTRACT OF THE DISCLOSURE

Automatic ice maker apparatus of the character having a flexible wall mold provided with ice cube pockets from which the tubes are ejected by inverting the pockets through gradual pressurization of the space underlying the mold, the ice cube pockets being formed with an overlying shoulder along one side to provide constraint therealong during inversion of the pockets and ejection of the cubes to ensure the progressive stripping of the cubes from the pocket and to direct the cubes uniformly over the projecting shoulder during harvesting. Subsidiary arrangements include interconnecting channels between adjacent cube pockets to provide an ice connection between cubes so that unusually adherent cubes may be freed through the aid of adjacent cubes, and an arrangement in which final adherence is broken by restraining the return of a cube back into the pocket when the pockets are being drawn back to their water receiving condition.

BACKGROUND OF THE INVENTION

Field of the invention

The field of art to which the invention pertains is that of automatic ice cube making and harvesting and particularly to means for insuring stripping and directional ejection of cubes from invertible pocket ice molds.

Description of the prior art

Part of the teachings in the patent art on the subject of invertible pocket automatic icemakers deal with arrangements for achieving the controlled stripping of the ice cubes from the pockets during inversion. One example is found in U.S. Patent 2,918,803 which teaches the provision of a mold pocket in which one wall portion is provided with ribs or other wall stiffening means to provide differences in the degree of flexibility of different parts of the pocket wall to obtain controlled and directed ejection. Another arrangement for example is shown in U.S. Patent 2,969,651 in which a scavenging bar is physically moved across the inverted pockets to ensure that the cubes are released before the pockets are drawn back to their water receiving condition. The arrangement of the first noted patent, while superficially based upon a sound approach, is considered to have missed the simple, straightforward solution to the problem of ejecting ice cubes, as will be further treated herein, and to have self-imposed penalties stemming from the approach. As to the latter patent, the provision of a mechanically operated scavenging bar coordinated in its operation with the operation of the remainder of the ice maker is somewhat self-defeating from the standpoint of complexity and required parts.

SUMMARY OF THE INVENTION

The approach we consider best, and which permits the use of light gauge, easily invertible and stretchable material with its attendant advantages, is to provide a restraint at one edge of the cube which is structurally accomplished as distinguished from a mold wall characteristic (stiffened or thickened) restraint. This approach recognizes that adherence of a cube to the mold or pocket wall will typically vary as to extent and location from pocket to pocket, and from time to time. In other words, one cube may adhere to one part of the wall in the pocket, while the next cube may adhere to a different part of the wall of the same pocket, and to a greater or lesser extent than the first cube. The approach also recognizes that stretching of the mold wall relative to the facing surface of the ice cube is also material in stripping the cube, and that the pocket wall portion of normally last adherence should preferably be as easily stretchable as, or more so, than any other pocket wall portion.

To carry out this approach in accordance with our invention, the improved arrangement for ensuring controlled and easy stripping of the cube includes a pocket which has most of its flexible walls arranged in generally diverging relation in an upward direction but with one wall portion along an edge of the tray over which the cube is to be ejected underlying means such as a tray shoulder preventing the direct upward movement of the cube along that edge. The cube, during pocket inversion, is forced to pivot upwardly and over the shoulder and accordingly be progressively stripped from the side of the mold opposite the shoulder during the ejection process. With this arrangement the flexible wall mold may be of thin, easily stretchable material of uniform thickness throughout or, in a preferred embodiment, the pocket portion underlying the shoulder is of thinner material than the rest. The underlying supporting tray may be provided with cavities shaped generally to accommodate the respective pockets in nested relation.

In a further embodiment of the invention, the release of the cubes from the pocket may be promoted by providing the liner with molded interconnecting channels between adjacent pockets. These channels distribute the water to the various pockets and also hold water which freezes to provide an ice connection between adjacent cubes. The interconnecting ice pieces permit adjacent cubes in a multiple pocket tray to aid each other in breaking loose from the pockets during pocket inversion.

In another modification, flexible means are located to engage a part of the cube during ejection to prevent the return of the cube back into the pocket during the pocket return movement. Such flexible means may take the form of a flap which yields more readily in the direction of cube movement during ejection than the return direction of the cube back toward a seated position in the pocket as the pocket is being drawn back to a water receiving condition.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a partly-broken isometric view of an icemaker assembly connected to a diagrammatically represented control according to the invention;

FIG. 2 is a vertical sectional view corresponding to one taken along the line II—II of FIG. 1 and illustrating in dash-lines both the complete inversion of a mold pocket and the position of an ice cube immediately prior to full release from the pocket;

FIG. 3 is an outline view illustrating a cube and mold pocket at an early stage during ejection; and

FIG. 4 is an outline view similar to FIG. 3 illustrating the mold pocket and cube at a later stage during ejection.

PREFERRED EMBODIMENTS

As shown in FIGS. 1 and 2, an arrangement embodying the invention includes as main parts a tray and mold assembly **10**, a controlled pressure and suction source **12** connected by pressure control line **14** to the tray and mold assembly, a water supply outlet **16** for charging the mold pockets, a cube receiving bucket **18**

into which the cubes from the tray and mold assembly are ejected and stored, and a stripping section **20** adapted to insure final release of the cubes from the mold pockets when the mold pockets are being returned to their water receiving condition. All of the parts except the pressure suction source **12** are located in a freezing environment such as the freezing compartment of a domestic refrigerator, or a domestic freezer.

The tray part **22** of the tray and mold assembly **10** is a rigid pan formed with a series of adjacent, parallel, upwardly-open cavities **24**, each of which is in communication with the line **14** through branch lines **26** (FIG. 2). The liner **28** which overlies the entire top of the tray **22** is a sheet of flexible material molded with a series of upwardly open pockets **30** having a relaxed configuration such that when the liner is installed on the tray, each pocket nests in and closely conforms to the shape of its respective tray cavity. The liner **28** is sealed to the top peripheral edge of the tray **22** and preferably between each of the cavities **24**. Thus when the space between the cavities and pockets is pressurized, each pocket is gradually inverted to assume the inflated position illustrated by the dash-line outline in FIG. 2.

The preferred cavity and pocket configuration according to the invention will now be considered. The pockets are substantially longer than they are wide. With the pocket in a water receiving condition, which is maintained during the cube freezing period, the walls generally taper inwardly from top-to-bottom, save for the end wall **32** at the edge of the tray over which the cubes are to be ejected. This forward end wall **32** has its top portion inclined inwardly, and is backed up by the conformingly sloped tray shoulder **33** also overlying the forward end or nose **34** of the cube. The opposite or rear end wall **36** of each pocket, it will be noted from FIG. 2, has an overall slope which is steeper than the slope of the shoulder **33** so that the pocket must begin its inversion at the rear end. It will be appreciated that while only the pocket shape has been described in some detail, the cavity shape generally follows the pocket shape. It is noted however that the pockets and cavities need not nest closely since the mold liner has some self support in its molded configuration.

Since the nose **34** of the cube underlying the shoulder **32** is restrained from direct upward motion as the space between the cavity and pocket is pressurized, the upward movement of the pocket **30** must begin at the opposite end **36**, and the pocket is moved into inverted condition progressively from rear to front. Thus the cube is also progressively stripped from the pocket walls from rear to front as illustrated in FIGS. 3 and 4. When the cube reaches its dash-line position as shown in FIG. 2, with the pocket fully inverted, it will be seen that any unusual adherence between the nose **34** of the ice cube and the retroverted nose of the pocket will normally be broken by the lever action exerted by the cube.

The means for applying the controlled pressure and suction to invert and draw back the pockets may take various forms. One arrangement is that disclosed in commonly assigned Moreland U.S. patent application Ser. No. 637,232 entitled, "Automatic Ice Maker," filed simultaneously herewith. Other arrangements may also be used of course. However, it is to be noted that one distinct advantage of a tray assembly arrangement according to our invention is that relatively low pressures may be used to invert and strip the cubes. Upon beginning the inversion, an effectively infinite restraint is afforded at the nose end of the cube by the overlying shoulder structure. The degree of resistance to inversion at the other end of the cube is a function of the adsehence between cube and pocket there and in the areas between the ends. Even if the adherence of a given cube is greatest at the end **36** opposite the nose, the resistance to stripping at that end **36** is negligible compared to the structural restraint provided by the shoulder, and the design pressure need only be that sufficient to overcome that maximum resistance at end **36**. Then, to facilitate breaking final adherence at the nose **34** end, the pocket wall portion **32** may, in a preferred embodiment, be thinner so that it stretches more readily under given pressure than the other wall portions. Since breaking adherence is in large part a function of degree of relative movement between adhering wall and cube, this thinner wall arrangement follows that we have recognized as the best approach.

The structural arrangement according to the invention may also be advantageously used where pre-stripping is effected in accordance with the noted Moreland patent application teachings, and, directional ejection is the main object, along with follow up stripping of those cubes not completely pre-stripped.

With our arrangement, using flexible wall mold liners of a styrene butadiene copolymer material, or of an ethylene vinyl acetate copolymer material, of thicknesses in the order of 15 to 25 mils, pressures in the order of 1–5 p.s.i.g. above and below atmosphere are adequate to effect inversion and return of the pockets.

Additional refinements according to the invention for promoting the release of ice cubes from the pockets are illustrated in FIGS. 1 and 2. By forming the liner **28** with integrally molded channels **38** interconnecting the top portions of the pockets **30**, and providing conformingly shaped channels **40** in the tray structure underlying the liner channels, a water distribution path between adjacent cubes is provided. Then by charging the pockets with a sufficient quantity of water that water remains in the channels during freezing adjacent cubes are rigidly connected by the ice pieces in the channels. When the pockets are inverted, isolated cubes tending to exhibit unusual adherence to the respective pocket may be aided in obtaining release by adjacent cubes. The mutual assistance of adjacent cubes in freeing each other from their respective pockets accordingly enhances the likelihood that during each ejection cycle all of the cubes will be released from their pockets, and a given water charge will not overfill the liner.

The arrangement provided to insure the final release of the cubes from the pockets includes a stripping section **20** located apart from the tray but in the path of movement of the rear end of the cube. The stripping section includes a flexible flap **42** which is deflected downwardly to its broken-line position as the rear end of the cube moves by, and then springs back to its horizontal position closely underlying a stiffener **44** of less width than the flap. Accordingly, if the cube should not be fully released from the retroverted nose portion of the pocket **30** as it moves past the flap, the reverse pivoting of the cube back toward a seated position in the pocket moves it back into engagement with the flap. However the flap does not yield upwardly as willingly as it yielded downwardly because of the stiffener. Accordingly, this restraint will further tend to strip any final remaining adherence between the cube **34** and the retroverted nose of the pocket.

We claim as our invention:

1. In an ice cube maker:

a flexible wall ice cube mold of the character in which the mold is inverted to eject the cubes from individual pockets therein;

a tray underlying said mold and providing a series of individual cavities into which said pockets of said flexible wall mold nest to receive water for freezing;

each said pocket defining a cube freezing space having walls generally tapering inwardly from top to bottom save for the wall of each pocket along the edge of said tray over which said cubes are to be ejected,

said walls along said edge projecting inwardly over the underlying cube space, and

said tray including means defining a shoulder engaging said inwardly-projecting wall to prevent the direct upward movement of said cube at said edge wall so that said cube, during inversion of said pocket, is pro-

gressively moved out of said pocket from the side opposite said edge wall toward said edge wall.

2. In an ice cube maker according to claim 1:

said shoulder is inwardly slanted with a shallower slope than the slope of the pocket wall opposite said inwardly-projecting pocket wall so that said cube initially pivots about said shoulder during ejection.

3. In an ice cube maker according to claim 2:

said mold includes interconnecting channels between adjacent pockets for distributing water between said pockets during charging, and for providing a solid interconnection between cubes in adjacent pockets after freezing so that cubes which tend to be retained in their respective pockets during ejection are subject to being pulled along and out of the pockets by an adjacent cube.

4. In an ice cube maker according to claim 1 including:

flexible means located in the arcual path of movement of the first loosened end of said cube as said cube is pivoted about said shoulder, said flexible means yielding more readily in an ejection direction of movement of said cube than in a cube return direction to break any adherence of said cube to said pocket upon the return of said pockets to a cube freezing position.

5. In an ice cube maker of the type in which ice cubes

frozen in flexible wall pockets are ejected by inverting the pockets:

mold means providing a series of said pockets, each pocket including wall portions generally tapering inwardly from top to bottom save for one end wall portion having an oppositely directed taper; and

rigid structural means, independent from said pocket, abutting said one end wall portion for preventing direct upward movement of said one end wall portion during inversion of said pocket so that an ice cube being ejected from said pocket must be first raised out of said pocket at the end opposite said one end wall portion.

6. In an ice cube maker according to claim 5:

said one end wall portion is more readily stretchable than the remainder of said pocket wall portions.

References Cited

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