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HOME APPLIANCE, ICE MAKER

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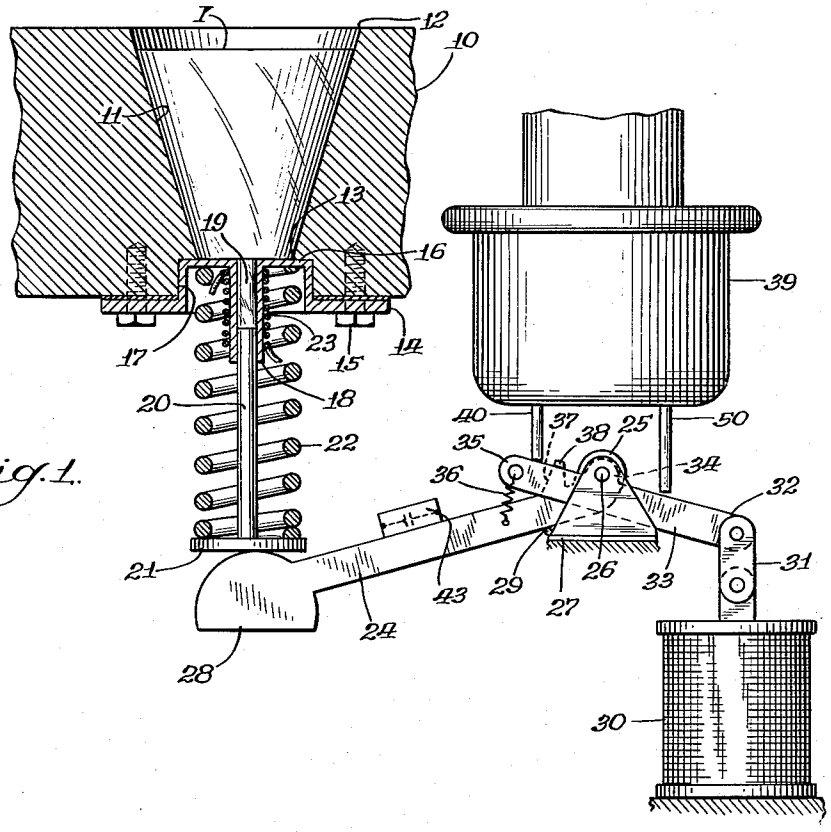


Fig. 1.

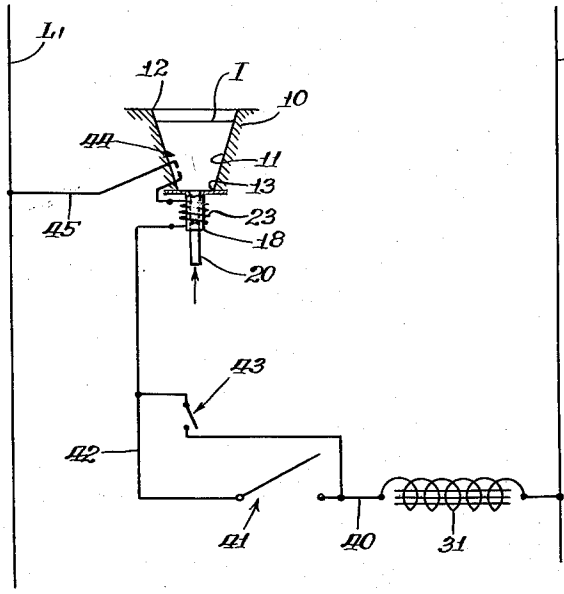


Fig. 2.

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HOME APPLIANCE, ICE MAKER

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This invention relates to an ice maker and in particular to means for ejecting an ice body in an automatic ice maker.

In ice body makers of the type disclosed in copending Robert W. Fink application Serial No. 609,623, filed September 13, 1956, and owned by the common assignee, ice bodies are formed in a mold having an inverted frusto-conical cavity. To eject the ice body from the cavity, upon completion of the freezing process, a force is applied through the lower end of the cavity to the lower end of the ice body. As the ice bodies tend to adhere to the walls of the cavity, a substantial impact force is conventionally employed. Such a method of ejecting the ice body has the disadvantage of a bothersome noise, particularly where the device is used in a home refrigerator. Further, such an impact force delivers a substantial shock to the mechanism, substantially reducing the useful life of the elements. Where the impact force is directly mechanically delivered to the ice body, an appreciable percentage of the ice bodies is broken during the ejection process. One solution to the problem has been to use special linings to reduce the force with which the ice body is held by the cavity walls. The use of linings poses the additional problems of the cost thereof and necessary periodic replacement thereof.

Another disadvantage of known ejection means of this type is that relatively expensive means, such as a motor and associated gearing, have been required to provide the necessary ejection force. Additionally, the known ejection means have had the disadvantage of relatively large size.

The principal feature of the instant invention is the provision of a new and improved means for ejecting an ice body from a mold cavity avoiding the above discussed disadvantages.

Another feature of the invention is the provision of a new and improved ejecting means arranged to eject the ice body by an application of fluid pressure thereon.

A further feature of the invention is the provision of such means wherein the fluid pressure means is arranged to effect a forced multiplication whereby a substantial force applied to the ice body is produced by a small input force.

Still another feature of the invention is the provision of such means wherein a chamber is provided communicating with the small end of the cavity and means are provided for melting, when desired, the portion of the frozen body of water in the chamber and in the cavity adjacent the small end thereof to provide a force transmitting body of fluid in the chamber and confronting the ice body at the lower end.

A still further feature of the invention is the provision of such means including a piston rod movable through the chamber to develop a fluid pressure in the body of fluid sufficient to break the ice body free of the cavity walls.

A further feature of the invention is the provision of such means having new and improved means for controlling the operation thereof.

Other features and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawing wherein:

FIG. 1 is an elevational view partially in section and

with portions thereof shown fragmentarily, of an apparatus embodying the invention; and

FIG. 2 is a diagrammatic and schematic view of the control means thereof.

Referring now more particularly to FIG. 1 of the drawing, a mold **10** is provided with an inverted frusto-conical cavity **11** having a large, open upper end **12** and a small, open lower end **13**. A plate **14** is secured to the underside of mold **10** by suitable means such as screws **15** and is provided with a circular, transverse mid-portion **16** received in a downwardly opening recess **17** coaxial of cavity **11**. Mid-portion **16** is provided, at its center, with a depending tubular portion **18** which defines a chamber **19** communicating at its upper end with cavity **11** through the small, lower end **13** of the cavity. A piston rod **20** is sealingly slidingly movable through tubular portion **18** and is provided at its lower end with an enlargement **21**. A helical coil spring **22** extends concentrically of piston rod **20** between mid-portion **16** of plate **14** and enlargement **21** to bias the piston rod downwardly relative to chamber **19**. Concentrically mounted on tubular portion **18** in heat transfer association therewith is a helical heater coil **23** which, when energized, delivers heat through tubular portion **18** to chamber **19**, and through circular mid-portion **16** of plate **14** to the lower end of cavity **11**.

Piston rod **20** is urged upwardly by a lever **24** pivoted at one end **25** on a shaft **26** carried by a support **27**, and provided at the opposite end with an enlarged bearing portion **28** which engages the underside of piston enlargement **21**. Coil spring **22** urges enlargement **21** downwardly to pivot lever **24** to an extreme counterclockwise position, as seen in FIG. 1, wherein the lever abuts a stop **29**.

A clockwise movement of lever **24** to effect a movement of piston rod **20** through chamber **19** is effected by a solenoid **30** having its plunger **31** connected to one end **32** of a lever **33**. The mid-portion **34** of lever **33** is pivotally mounted on shaft **26** and the opposite end **35** of lever **33** is connected to lever **24** by a spring **36**. A lug **37** upstands from lever **24** adjacent end **25** and is provided with a turned shoulder **38** which is engaged by lever **33** when lever **33** is pivoted by solenoid **30** in a clockwise direction, as seen in FIG. 1. This causes lever **24** to be pivoted in a clockwise direction and urge piston rod **20** upwardly to effect an ejection operation as will be described more fully hereinafter.

Automatic filling of cavity **11** with water, subsequent to the ejection of a previously formed ice body I therefrom, is effected by a slug-type water valve **39** having an inlet plunger **40** and an outlet plunger **50**. When solenoid **30** is energized to actuate piston rod **20**, a measured amount of water is admitted to valve **39** by the operation of inlet plunger **40** as a result of the upward movement thereof by lever **33**. When solenoid **30** is de-energized, upon completion of the ejection cycle, lever **33** pivots in a counterclockwise direction to release inlet plunger **40** and operate outlet plunger **50** to discharge the measured quantity of water from valve **39** through open top **12** of cavity **11** by suitable conduit means (not shown).

Referring now more specifically to FIG. 2, the operation of the instant ice body ejecting apparatus may be seen. Electrical power is supplied to the apparatus from a first lead L1 and a second lead L2. One side of solenoid **31** is connected to lead L2 and the other side of the solenoid is connected in series through a lead **40**, a switch **41** arranged to be open whenever a predetermined amount of ice bodies has been made in the apparatus and not removed therefrom, a lead **42**, heater **23**, a thermostat switch **44** sensing the temperature within cavity **11** and arranged to close when the freezing of ice body I has been

completed, and a lead 45 to lead L1. In parallel with switch 41 is a holding switch 43 which is mounted on arm 24 and arranged to maintain the circuit during a momentary opening of switch 41, as during a determination of the number of ice bodies formed and ejected from cavity 11 but not removed from the apparatus.

The measured quantity of water is delivered from valve 39 to cavity 11 with piston rod 20 in the withdrawn position, as seen in FIG. 1. Thus, the water completely fills cavity 11 and the portion of chamber 19 above the withdrawn piston rod. The water is then frozen in each of cavity 11 and chamber 19 by suitable means (not shown) such as disclosed in the above indicated Fink application. When the water has been frozen to form an ice body I, thermostat switch 44 automatically closes. Assuming that the quantity of ice bodies previously made and not removed from association with the apparatus is less than the maximum desired, switch 41 is closed and, thus, solenoid 31 and heater 23 are concurrently energized. The energization of solenoid 30 immediately pivots lever 33 against the action of spring 36 into abutment with shoulder 38 on lever 24. This urges bearing portion 28 of lever 24 upwardly against enlargement 21 of piston rod 20 and tends to move the piston rod upwardly through chamber 19. When sufficient heat has been transferred from heater coil 23 to the ice within chamber 19 and the lower portion of cavity 11 adjacent end 13 thereof, that portion of the ice melts and the resultant body of water hydrostatically transfers the upward urging force of piston rod 20 to the bottom of ice body I. The cross sectional diameter of chamber 19 is substantially smaller than the cross sectional diameter of lower end 13 of cavity 11 and, resultingly, a substantial force multiplication is obtained whereby a small force delivered from lever 24 produces a large force on the bottom of ice body I sufficient to break the ice body free of the wall of cavity 11. Illustratively, chamber 19 may have a $\frac{5}{32}$ inch diameter and end 13 of the cavity may have a $\frac{25}{32}$ inch diameter giving a hydraulic force multiplication of 25.

Once ice body I is broken free of the wall of cavity 11, spring 36 moves lever 24 in a clockwise direction, urging piston rod 20 through chamber 19 and lower end 13 of cavity 11 to the dotted position of FIG. 1. This movement occurs relatively rapidly and causes ice body I to be ejected upwardly through open end 12 of the cavity. The heat of coil 23 subsequently opens thermostat switch 44, thereby de-energizing solenoid 30, whereupon spring 22 forces piston rod 20 downwardly and restores lever 24 to the position of FIG. 1. The downward movement of lever 24 causes spring 36 to urge lever 33 in a counterclockwise direction into substantial alignment with lever 24. In this position, lever 33 urges outlet plunger 50 upwardly to open the outlet and deliver the measured charge of water to the now empty cavity 11. At the same time, inlet plunger 40 is permitted to move downwardly and close the inlet to valve 39. Valve 39 is maintained thusly until a succeeding ejection cycle wherein the inlet and outlet plungers are operated as described above to measure a predetermined quantity of water, and deliver it to the cavity 11 subsequent to the ejection of the newly formed ice body I therefrom.

As the breaking of the ice body I from the walls of cavity 11 is effected by the hydrostatic pressure, only a slight noise is produced at that time. Severe impact shocks are avoided, thereby substantially increasing the useful life of the apparatus and reducing the maintenance thereof. As a uniform distribution of pressure is applied to the bottom of the ice body I, a substantial elimination of breakage of the ice bodies during the ejection cycle is obtained. Further, a relatively small and inexpensive force producing means may be utilized, permitting a reduction in the space requirements of the apparatus and effecting a substantial saving in the cost thereof. The apparatus is completely automatic and, as a result of its simple construction, assures substantial trouble-free life.

While we have shown and described one embodiment of our invention, it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as defined in the appended claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. Apparatus for ejecting an ice body from a mold cavity tapering from a large end to a smaller end, comprising: means defining a chamber communicating with the small end of the cavity; means for providing a fluid in the chamber and confronting the ice body at the small end of the cavity to have at least a portion of the fluid frozen in the chamber; means for converting the frozen fluid to liquid fluid; and means developing, when desired, a pressure in the converted liquid fluid sufficient to break the ice body free of the wall of the cavity and urge the ice body outwardly through the large end of the cavity.

2. The apparatus of claim 1 wherein said last named means comprises a hydraulic piston means arranged to cause the force applied to the ice body to be a multiple of an input force delivered thereto.

3. Apparatus for ejecting an ice body from a mold cavity tapering from a large end to a smaller end, comprising: means defining a chamber communicating with the small end of the cavity; means for providing a fluid in the chamber and confronting the ice body at the small end of the cavity to have at least a portion of the fluid frozen in the chamber; means for converting the frozen fluid to liquid fluid; and means extendible into said chamber, when desired, for displacing a portion of the converted liquid fluid therein and thereby developing a pressure therein sufficient to break the ice body free of the wall of the cavity and urge the ice body outwardly through the large end of the cavity.

4. Apparatus for forming an ice body in and ejecting the ice body from a mold cavity tapering from a large end to a small end, comprising: means defining a chamber communicating with the small end of the cavity; means for delivering a body of water to the cavity and chamber; means for freezing the body of water in the cavity and chamber; means for melting, when desired, the portion of the frozen body of water in the chamber and in the cavity adjacent the small end, the remaining portion of the frozen body of water comprising the ice body to be ejected; and means developing, when desired, a pressure in the melted portion of the body of water sufficient to break the ice body free of the wall of the cavity and urge the ice body outwardly through the large end of the cavity.

5. Apparatus for forming an ice body in and ejecting the ice body from a mold cavity tapering from a large end to a small end, comprising: means defining a chamber communicating with the small end of the cavity; means for delivering a body of water to the cavity and chamber; means for freezing the body of water in the cavity and chamber; means for melting, when desired, the portion of the frozen body of water in the chamber and in the cavity adjacent the small end, the remaining portion of the frozen body of water comprising the ice body to be ejected; and means extendible into said chamber, when desired, for displacing a portion of the fluid therein and thereby developing a pressure in the melted portion of the body of water sufficient to break the ice body free of the wall of the cavity and urge the ice body outwardly through the large end of the cavity.

6. Apparatus for forming an ice body in and ejecting the ice body from a mold cavity tapering from a large end to a small end, comprising: means defining a chamber communicating with the small end of the cavity; means for delivering a body of water to the cavity and chamber; means for freezing the body of water in the cavity and chamber; means for melting, when desired, the portion of

the frozen body of water in the chamber and in the cavity adjacent the small end, the remaining portion of the frozen body of water comprising the ice body to be ejected; and a rod movable sealingly through the means defining the chamber for displacing a portion of the fluid therein and thereby developing a pressure in the melted portion of the body of water sufficient to break the ice body free of the wall of the cavity, and rod having an inner end movable through the small end of the cavity to engage the freed ice body and expel it from the cavity.

7. Apparatus for forming an ice body in and ejecting the ice body from a mold cavity tapering from a large end to a small end, comprising: means defining a cylindrical chamber communicating with the small end of the cavity, the transverse cross section of the chamber having an area substantially smaller than the transverse area of the small end of the cavity; means for delivering a body of water to the cavity and chamber; means for freezing the body of water in the cavity and chamber; means for melting, when desired, the portion of the frozen body of water in the chamber and in the cavity adjacent the small end, the remaining portion of the frozen body of water comprising the ice body to be ejected; and a rod movable sealingly through the means defining the chamber for displacing a portion of the fluid therein and thereby developing a pressure in the melted portion of the body of water sufficient to break the ice body free of the wall of the cavity, the force applied to the rod being multiplied and directed against the ice body adjacent the small end of the cavity.

8. Apparatus for forming an ice body in and ejecting the ice body from a frusto-conical cavity tapering from a large upper end to a small lower end, comprising: a member adapted to extend transversely across the open end of the cavity and provided with a central depending tubular portion having a diameter smaller than the diameter of the lower end of the cavity; a piston rod having a sealing sliding fit in the tubular portion; means biasing the piston rod to a withdrawn position; means for delivering a body of water to the cavity and tubular portion; means for freezing the body of water in the cavity and tubular portion; means for heating the member to melt ice formed in the tubular portion and below the ice body at the lower end of the cavity; and means for forcing the piston rod upwardly through the tubular portion, when desired, to develop a fluid pressure in the melted ice sufficient to break the ice body free of the wall of the cavity and urge the ice body outwardly through the large end of the cavity.

9. Apparatus for forming an ice body in and ejecting the ice body from a frusto-conical cavity tapering from a large upper end to a small lower end, comprising: a member adapted to extend transversely across the open end of the cavity and provided with a central depending tubular portion having a diameter smaller than the diameter of the lower end of the cavity; a piston rod having a sealing sliding fit in the tubular portion; means biasing the piston rod to a withdrawn position; means for delivering a body of water to the cavity and tubular portion; means for freezing the body of water in the cavity and tubular portion; means for heating the member to melt ice formed in the tubular portion and below the ice body at the lower end of the cavity; and solenoid operated means for forcing the piston rod upwardly through the tubular portion, when desired, to develop a fluid pressure in the melted ice sufficient to break the ice body free of the wall of the cavity and urge the ice body outwardly through the large end of the cavity.

10. The method of providing ice bodies, comprising the steps of: freezing an ice body in a cavity of a mold having an open end; melting a portion of the ice body in contact only with a portion of the mold opposite the open end; and causing a fluid pressure to be built up in the melted portion of the ice body sufficient to break the ice ice body free from the mold and permit removal of the ice body from the mold.

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