May 2, 1961 R. R. DAHL 2,982,111

ICE LEVEL SENSING MECHANISM

Filed Oct. 28, 1959 3 Sheets-Sheet 1

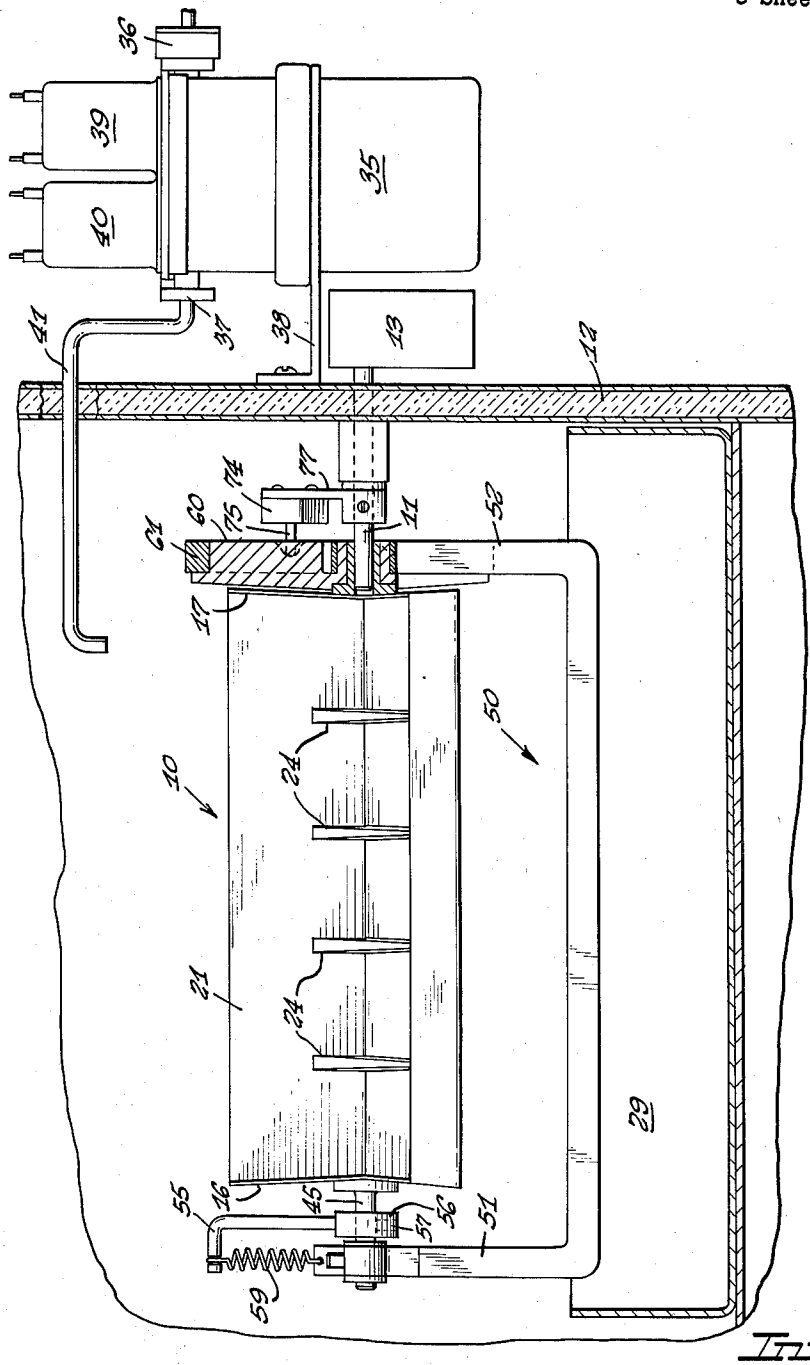


FIG. 1

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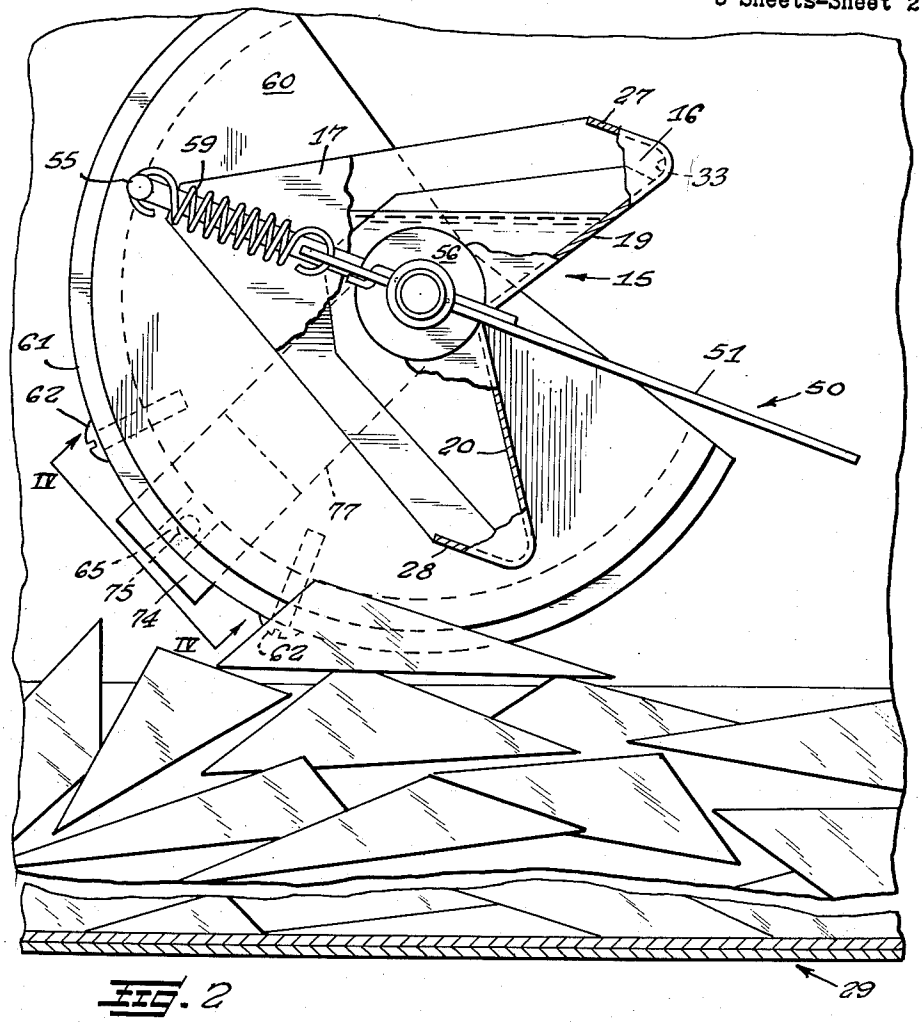


Fig. 2

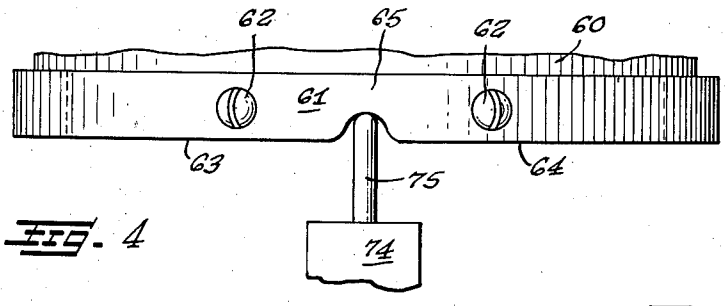


Fig. 4

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ICE LEVEL SENSING MECHANISM

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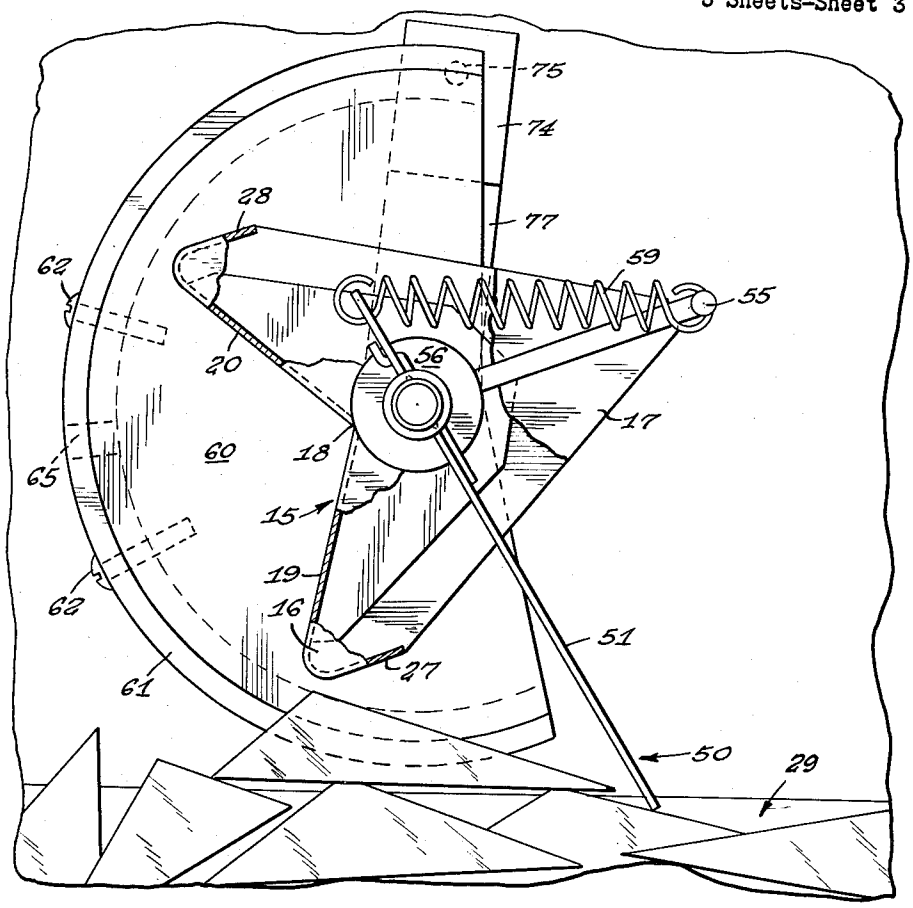


Fig. 3

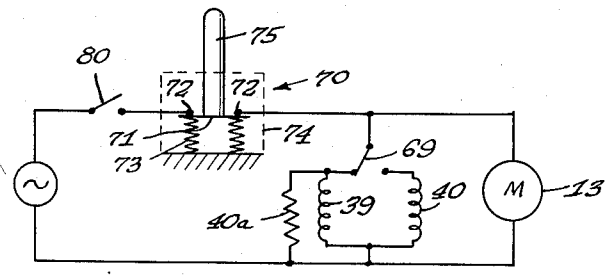


Fig. 5

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2,982,111

ICE LEVEL SENSING MECHANISM

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4 Claims. (Cl. 62—137)

This invention relates to automatic ice making devices of the type which are adapted to be installed within the freezing compartments of usual household refrigerators and more particularly relates to a mechanism for controlling the cyclic operation of such an ice making device as a function of the level of frozen ice blocks disposed within a collection tray.

This invention is directed to an improvement in a pivotal or rotatable type of ice tray such as the type wherein the ice tray is constructed with a plurality of ice molds formed therein facing in different directions and having common walls which are so arranged that upon filling of an upwardly facing mold with relatively warm water, heat will be transferred from the water filling the upwardly facing mold to the surfaces of a downwardly facing mold through the heat conducting walls of the ice tray to effect gravitational ejection of the ice blocks from the downwardly facing molds.

The ice block sensing mechanism, to which this invention is especially directed, comprises generally a sensing lever which is pivotally mounted on the shaft upon which the ice tray itself is rotated, which is adapted to have relative movement on the shaft with respect to the ice tray. Connected to the ice sensing lever for corotatable movement therewith is a cam which, in turn, is cooperable with the depressible plunger of an electrical switch to actuate the switch upon rotation of the cam.

A spring serves to interconnect the ice tray with the ice sensing lever so that the two members normally move corotatably with one another. The sensing lever is, however, so arranged that when the ice blocks within the collection tray reach a predetermined level, the ice sensing lever will be prevented from rotating even though urged to do so through the spring means interconnecting the lever with the rotating ice tray. Such relative movement between the sensing lever and the ice tray is operable to position the cam to move the plunger of the electrical switch to a depressed position thereby preventing subsequent energization of the motor for rotating the ice tray and energization of the electrically controlled valve means for filling the upwardly facing molds within the ice tray. The switch which is actuated upon relative movement of the sensing arm relative to the ice tray does, in fact, constitute a line switch; the actuation of which controls the energization of the entire ice making apparatus.

It is therefore a principal object of the present invention to provide an improved means of controlling the cyclic operation of an automatic ice making apparatus as a function of the level of ice blocks within an ice block collection tray.

Another object of the invention resides in the provision of an ice level sensing arm which is normally corotatable with a rotatable or pivotal type of ice tray and in which relative movement of the ice tray and the sensing arm caused by abutment of the sensing arm with ice blocks at a predetermined level is operable to actuate an electrical switch to deenergize the entire ice making assembly.

Yet another object of the invention is the provision of a device which is operable to control the operation of an ice making apparatus as a function of the level of ice blocks within an ice block collection tray wherein the sensing member is disposed out of the path of movement of ice blocks being ejected from the ice tray.

These and other objects of the invention will become apparent from time to time as the following specification proceeds and with reference to the accompanying drawings, wherein:

Figure 1 is a side elevational view of an ice making apparatus constructed in accordance with the principles of the present invention which, for clarity, shows some of the parts in vertical section;

Figure 2 is a vertical sectional view through the ice tray and the associated ice level sensing member in a first position;

Figure 3 is a vertical sectional view through the ice tray and its associated ice level sensing member which illustrates the position of the associated components when the ice blocks within the collection tray have reached the level at which it is desired to discontinue operation of the ice making assembly;

Figure 4 is a view taken in the direction of lines IV—IV of Figure 2 which illustrates the cam surface operable to control the operation of the switch means for energizing and deenergizing the entire ice maker assembly; and

Figure 5 is a schematic circuit diagram of an electrical circuit such as might be employed in controlling the operation of such an ice making apparatus.

Referring initially to Figures 1 and 2, a pivotal ice tray **10** is mounted on a shaft **11** for corotatable movement therewith, which shaft is in turn journalled for pivotal movement in an insulated side wall **12** of a freezing compartment of the usual household refrigerator or the like. A motor or power means **13** is diagrammatically illustrated as being connected to the input end of the shaft **11** and may be of any suitable type which can effect a preselected angular movement of the shaft **11** and tray **10** at preselected intervals of time.

The ice tray **10** comprises generally a confining wall **15** which has outwardly turned ends **16** and **17** formed integrally therewith and at opposite ends thereof and which is bent along its longitudinal axis as at **18** to form two elongated oppositely facing legs **19** and **20**.

A common wall **21** (so called because it is common to ice molds formed on opposite sides thereof as will hereinafter be more clearly described) constitutes an obtuse bisectrix of the elongated legs **19** and **20** and extends from the vertex **18** of those legs and is secured at opposite ends thereof to the upstanding end walls **16** and **17**.

The common wall **21** has elongated slots formed therein (not shown) which fit within grooves (not shown) formed in a plurality of equally spaced upstanding partitioning walls or fins **24**, which, in turn, seat upon the legs **19** and **20** and which serve to divide the ice tray **10** into a plurality of separate ice molds.

It will be understood that in the class of ice trays to which this invention is directed, it is desirable to form each of the components of the ice tray of a good heat conducting material inasmuch as ejection of ice blocks from a plurality of downwardly facing molds is effected by breaking the bond between those ice blocks and the walls of their respective molds by heat transmitted thereto through the walls of the ice tray from the relatively warm water filling an upwardly facing mold.

Elongated retaining walls **27** and **28** are formed along the outer longitudinal edges of the legs **19** and **20** and lie substantially in planes parallel to the plane of the common wall **21**. These elongated retaining walls in cooperation with the legs **19** and **20** constitute drip retainers for containing drops of water running off the ice blocks subsequent to the melting of the surfaces of those blocks for preventing this water from flowing to the ice

block collection tray and to thereby prevent sticking of the ice blocks subsequent to their ejection into the collection tray. The collection tray is fragmentarily illustrated in Figure 2 at **29** and may comprise any suitable storage basket which may be positioned beneath the ice tray **10** to collect the ice blocks ejected therefrom.

The edge portions of the partitioning walls **24** lie substantially along planes parallel to but spaced from the planes of the edge portions of the ends **16** and **17** of the pivotal ice tray but are inturned and meet at a vertex spaced a substantial distance from the outer longitudinal edge of the common wall **21**. Also, the edges of the partitioning walls are cut back adjacent the drip retainers so that water dripping off each of several ice blocks in a downwardly facing mold will be comingled with water dripping from each of the other blocks. Furthermore, in order to facilitate gravitational ejection of the frozen ice blocks from their respective molds the side walls of the fins **24** taper outwardly on each side of the ice molds.

Thus, when water is directed to a single ice mold, water will flow around the partitioning walls **24** in the trough **33** formed intermediate the inturned edge portions of the partitioning walls **24** and the outer longitudinal edge of the common wall **21** to thereby fill each of the upwardly facing molds communicable with the mold initially filled, through the troughs.

Assuming that the ice tray **10** is initially disposed in the position illustrated in Figure 2 with the leg **19** disposed at approximately 40° with respect to the horizontal, the ice tray **10** can be rotated in a clockwise direction through the power source **13** until the ice tray is disposed in the position illustrated in Figure 3 wherein the leg **20** is disposed at an angle of approximately 40° with respect to the horizontal. At such time filling of the upwardly facing bank of ice molds might be effected by directing relatively warm water to those molds in a manner which will hereinafter be described. Heat will then be transmitted from the water in the upwardly facing molds through the common wall **21** to melt the surfaces of the ice blocks bonded thereto and will also be conducted through the partitioning walls **24** and the end walls **16** and **17** and further through the leg **19** of the confining wall **15** so that the bond between the ice blocks and the walls of the individual downwardly facing molds will be broken to permit their gravitational ejection.

Upon melting of the ice blocks within the respective downwardly facing molds, the ice blocks will cease to adhere to the walls of the ice tray and will fall by the force of gravity from the ice tray into the collection tray **29**. Drops of water flowing from the surfaces of the ice blocks, subsequent to the melting thereof, will flow to the drip retainer **27** where they will be retained and prevented from dripping to the ice block collection tray **29**.

Upon freezing of the water in the upwardly facing molds **25** into ice blocks the cycle can then be repeated and the ice can then similarly be rotated in a counterclockwise direction until the leg **19** is again disposed at an angle of approximately 40° with respect to the horizontal. Subsequent to rotation of the ice tray in this manner the water disposed within the drip retainer **27** will freeze and will then flow back into the bottom of the individual upwardly facing ice molds upon melting thereof by the water filling those molds where it will again be refrozen along with the water used to fill the upwardly facing bank of ice molds.

The device used for filling the upwardly facing bank of ice molds comprises a slug valve **35** having an inlet **36** and an outlet **37**. The slug valve is mounted on the side wall **12** of the freezing compartment by means of a bracket **38** which is connected to that wall and which is similarly secured to the slug valve **35**. A pair of solenoids **39** and **40** are mounted on the slug valve **35** and are operable to control fluid flow through the inlet **36** and outlet **37**, respectively. Upon energization of the inlet solenoid **39** pressurized fluid is permitted to enter a measuring chamber of desired volumetric capacity within the slug valve body through the inlet **36**. Thereafter, by deenergizing the solenoid **39** to close the inlet port and by energizing the solenoid **40** to open the outlet **37** and thereafter decreasing the volumetric capacity of the fluid chamber within the slug valve body fluid will be forced through the outlet **37**. Since the particular manner in which the slug valve functions constitutes no part of the present invention the slug valve is neither shown nor described in detail. It will be noted, however, that a filler spout **41** is communicable with the outlet **37** from the slug valve **35** and extends through the side wall **12** and terminates at a point above the ice tray **10** to provide a means for filling the tray with a measured quantity of liquid.

For the sake of clarity, Figure 1 illustrates the ice tray **10** and its associated components in a position wherein the common wall **21** is disposed in a vertical position.

In that view the ice tray **10** is shown as having a shaft **45** affixed thereto for corotatable movement therewith which is disposed at the outer end of the tray **10** and which is coaxially aligned with the drive shaft **11**.

An ice sensing arm or lever **50** depends from the ice tray **10** and has a pair of outwardly extending legs **51** and **52** which are rotatably mounted on the shafts **45** and **11**, respectively. It will be noted that the sensing arm **50** is so disposed with respect to the collection tray **29** that the lowermost edge of the sensing arm is movable through the upper portion of the collection tray. The sensing arm **50** may, however, be positioned closer to or farther away from the surface of the collection tray **29** as desired; the relative position of the arm with respect to the tray being determinative of the level of ice blocks to be dumped into the tray as will hereinafter become more fully apparent.

As shown most clearly in the wiring diagram illustrated in Figure 5, energization of the motor **13**, solenoids **39** and **40**, and the water heater coil **40***a* (disposed within the slug valve) is effected through a master switch **70**. The heater coil, not heretofore mentioned, is utilized to heat the water prior to its delivery to the ice tray and is additionally energized through a selector switch **69**. The switch **69** is also operable to control energization of the slug valve solenoids **39** and **40** to control the delivery of water to the ice tray **10**.

The switch **70** has a movable contact **71** which is normally biased into engagement with a pair of stationary contacts **72** by means of one or more compression springs **73**. The switch **70** is contained within a casing **74** and has a plunger **75** slidably mounted within the casing and extending exteriorly thereof which is connected to the movable contact **71** and which is operable, upon depressional movement thereof, to move the contact **71** out of engagement with stationary contacts **72** to break the circuit through the switch.

An arcuately shaped cam support **60** is rotatably mounted on the shaft **11** and is keyed to the sensing arm **50** for corotatable movement with the sensing arm. A cam **61**, arcuately shaped in side elevation, is affixed to the cam support **60** by means of a pair of screws **62** and, as shown in Figure 4, has high plateaus **63** and **64** disposed on opposite sides of a recess **65**.

The casing **74** of the electrical switch **70** is mounted by means of a bracket **77** to the output shaft **11** of the power source **13** for corotatable movement therewith so that the switch will rotate with the ice tray **10**. The switch **70** is so disposed that the outermost end of the plunger **75** is disposed in juxtaposition to the cam **61** so that pivotal movement of the cam relative to the switch will be effective to longitudinally move the plunger **75** to operate the switch.

It will be understood that during the normal cyclic operation of the ice making apparatus, the ice tray **10** will pivotally move from the position illustrated in Fig-

ure 2 to the position illustrated in Figure 3 and thence back again to the position illustrated in Figure 2. Such oscillatory movement of the ice tray may be controlled through operation of a switch **80** as is illustrated in Figure 5.

As is clearly illustrated in Figures 1 and 4, the tension spring **59** normally tends to maintain the sensing arm **50** in a coplanar position with respect to the common wall **21** and similarly is effective to maintain the cam **61** in a position such that the plunger **75** is disposed within the recess **65**. Thus, due to the bias of the tension spring **59** the sensing arm **50**, ice tray **10**, and switch **70** will normally remain in the relative positions illustrated in Figures 1, 2 and 4.

However, when the ice blocks within the collection tray **29** have reached the level illustrated in Figure 3, rotatable movement of the sensing arm **50** from one extreme position to the other will be prevented inasmuch as ice blocks lie in the path of its rotary movement.

Upon energization of the motor **13**, pivotal movement of the ice tray **10** and the sensing arm **50** through their prescribed arc will be initiated. When the sensing arm **50** moves into engagement with ice blocks disposed within the collection tray **29**, further pivotal movement thereof will be prevented although the ice tray **10** will continue to rotate. Such relative movement between the ice tray **10** and the sensing arm **50** will act to move the plunger **75** of the switch **70** out of the recess **65** in the cam **61** and onto one of the high plateaus of the cam to depressionally move the plunger **75** with respect to the switch casing **74**. Such depressional movement of plunger **75** will act to move the movable contact **71** out of engagement with stationary contacts **72** to break or open the energizing circuit through the switch. When the circuit through the switch **70** is broken the motor **13** will be deenergized and further rotation of the ice tray **10** will be prevented.

It will, however, be understood that if the motor used for effecting rotatable movement of the ice tray **10** and its associated components comprises a heat motor or any other similar power source which is hysteretically operable subsequent to the deenergization of its control means, the tray **10** and the associated switch **70** might continue to rotate to an extreme rotated position as is illustrated in Figure 3. If, on the other hand, a simple synchronous motor is used for effecting rotatable movement of the tray **10** and its associated components, pivotal movement of the tray **10** will cease almost at the movement that the circuit through the switch **70** is broken. It will be understood, however, that neither the particular means for effecting rotatable movement of the ice tray or the means for filling the tray with relatively warm fluid constitute elements of the present invention and so they are not herein shown or described in detail.

It will further be understood that this embodiment of the invention has been used for illustrative purposes only and that various modifications and variations in the present invention may be effected without departing from the spirit and scope of the novel concepts thereof.

I claim as my invention:

1. In combination with an ice making assembly including a support having an ice tray pivotally mounted thereon and disposed within a freezing compartment, control means for rotating the ice tray and ejecting ice blocks therefrom, a collection tray for collecting ice blocks ejected from the ice tray, the improvement of means for operating the control means as a function of the level of ice blocks within the collection tray comprising a sensing element, means mounting said sensing element for pivotal movement with respect to said support for sweeping the surface of the collection tray, resilient means interconnecting said element with the ice tray to urge said element to pivot with the tray but operable to permit relative movement between said element and said tray when pivotal movement of said element is blocked by its engagement with ice blocks during a pivoting cycle of the ice tray, and switch means for controlling energization of the control means operable as a function of the relative position between said element and tray.

2. In combination with an ice making assembly including a support having an ice tray pivotally mounted thereon and disposed within a freezing compartment, control means for rotating the ice tray and ejecting ice blocks therefrom, a collection tray for collecting ice blocks ejected from the ice tray, the improvement of means for operating the control means as a function of the level of ice blocks within the collection tray comprising a sensing element, means mounting said sensing element for pivotal movement with respect to said support about the same axis as the ice tray for sweeping the surface of the collection tray, resilient means interconnecting said element with the ice tray to urge said element to pivot with the tray but operable to permit relative movement between said element and tray when pivotal movement of said element is blocked by its engagement with ice blocks during a pivoting cycle of the ice tray, and means for controlling the energization of the control means and operable to deenergize same upon relative movement between said element and tray.

3. In combination with an ice making assembly including a support having an ice tray pivotally mounted thereon and disposed within a freezing compartment, control means for rotating the ice tray and ejecting ice blocks therefrom, a collection tray for collecting ice blocks ejected from the ice tray, the improvement of means for operating the control means as a function of the level of ice blocks within the collection tray comprising a sensing element pivotally mounted on the ice tray at the pivotal axis of the ice tray for sweeping the surface of the collection tray, a resilient drive connection between the ice tray and said sensing element operable to resiliently maintain said element and the ice tray in a fixed position relative to one another but operable to prevent relative movement between said element and tray when pivotal movement of said element is blocked by its engagement with ice blocks during a pivoting cycle of the ice tray, and switch means for controlling energization of the control means actuatable to a deenergizing position upon relative movement between said element and tray.

4. In combination with an ice making assembly including a support having an ice tray pivotally mounted thereon and disposed within a freezing compartment, control means for rotating the ice tray and ejecting ice blocks therefrom, a collection tray for collecting ice blocks ejected from the ice tray, the improvement of means for operating the control means as a function of the level of ice blocks within the collection tray comprising a sensing element pivotally mounted on the ice tray for sweeping the surface of the collection tray, resilient means interconnecting said element with the ice tray to urge said element to pivot with the tray but operable to permit relative movement between said element and tray when pivotal movement of said element is blocked by its engagement with ice blocks during a pivoting cycle of the ice tray, switch means connected to the ice tray and corotatable therewith having a plunger extending therefrom which is reciprocably movable to actuate the switch means, and abutment means forming an extension from said sensing element engageable with said plunger and cooperable therewith to effect reciprocable movement thereof as a function of the relative position of said element and tray.

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