April 4, 1961 R. H. DAWSON 2,977,772

ICE LEVEL SENSING MECHANISM

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Fig. 1

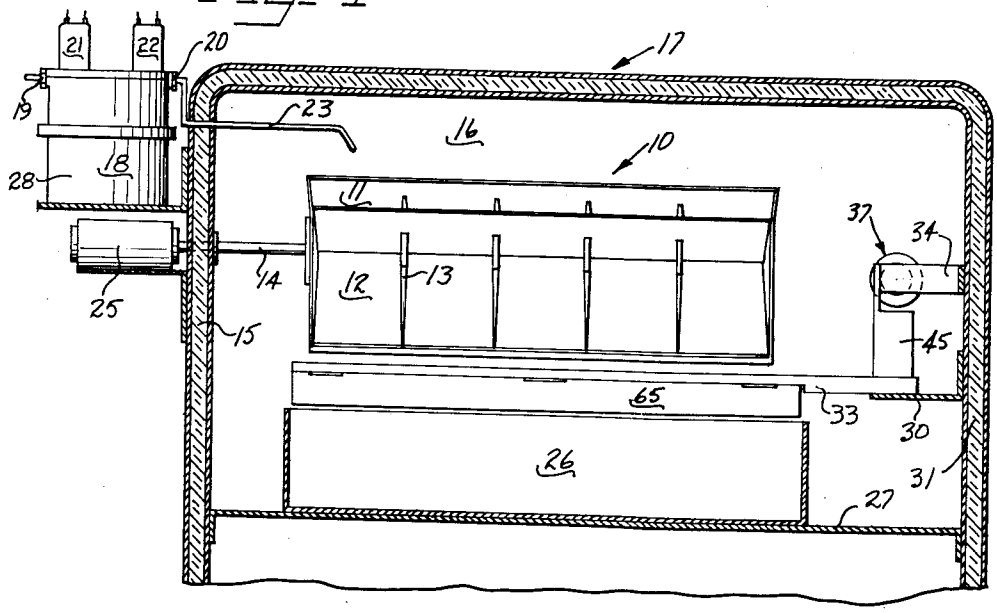
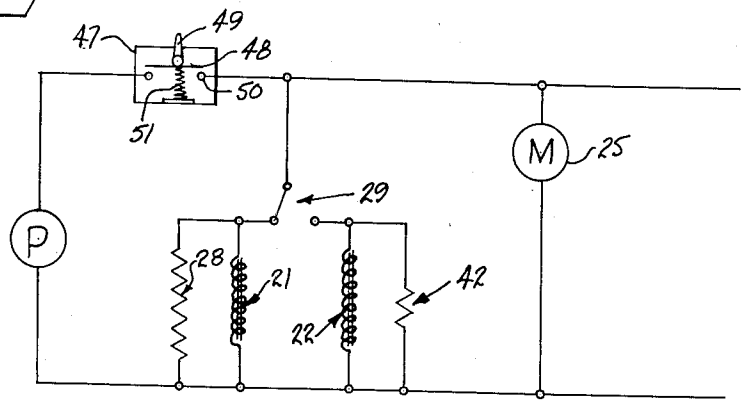


Fig. 2



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Fig. 4

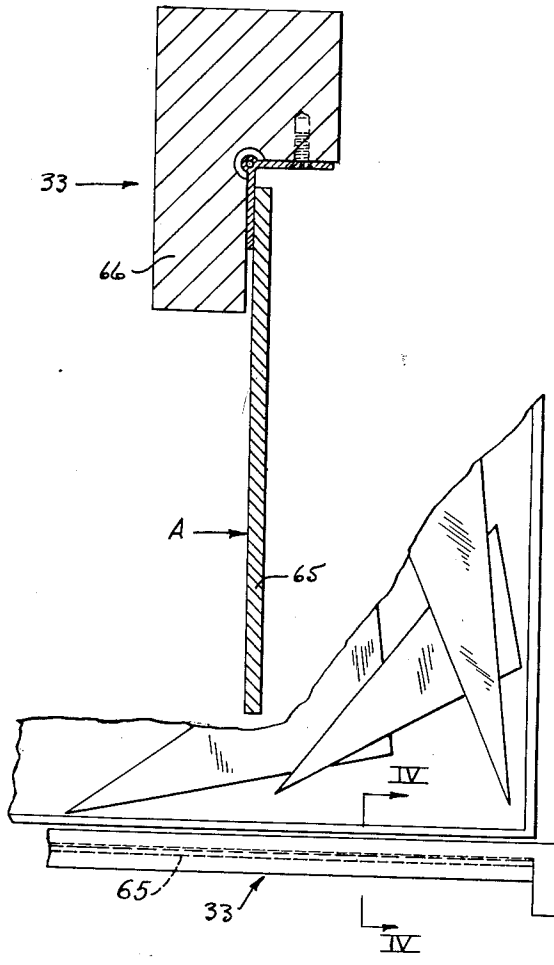
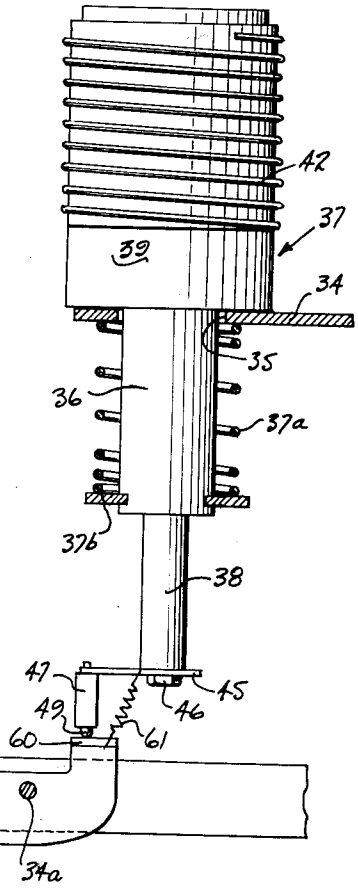


Fig. 3



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ICE LEVEL SENSING MECHANISM

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8 Claims. (Cl. 62—137)

This invention relates to automatic ice making devices and more particularly relates to a means for controlling the operation of such devices as a function of the level of ice blocks disposed within a collection tray.

In automatic ice making devices of the type which are adapted to be installed within the freezing compartments of the usual household refrigerators and in which a single cube or a plurality of cubes are continuously produced through the automatic operation of the ice making device, it is highly advantageous if not absolutely necessary to provide a means for discontinuing the operation of the ice making apparatus when the volume of ice cubes produced has reached a predetermined level within a collection tray.

Ice making devices which are adapted to be mounted within the freezing compartments of household refrigerators are of several different types but my invention will find equal utility in controlling the operation of any of these several types of ice making devices.

In general, however, it will be understood that some ice making devices comprise a rotatable ice tray having a plurality of molds formed therein (often in heat transfer relation with one another) so that water may be directed to an upwardly facing mold and so that subsequently upon solidification of the water within those molds the tray may be rotated and thereafter the walls of the downwardly facing molds may be heated to permit the gravitational ejection of the frozen ice blocks in those downwardly facing molds. Other ice making devices are formed with a plurality of invertible molds so that subsequent to silidification of water within the several molds, the molds can then be inverted by a mechanical hammer effect or by fluid pressure means to effect ejection of the frozen ice blocks from the molds. In each of these ice making devices the ejected ice cubes or blocks are directed to a collection tray where they are stored until they are utilized.

Specifically, this invention is directed to an electrical switch control means which is adapted to control actuation of the various components of the ice making apparatus and which is operable as a function of the level of ice blocks within a collection tray.

The ice level sensing mechanism which is illustrated in the drawings and which is hereafter described in detail, comprises generally a horizontally movable sensing arm which is mounted on a support adjacent a collection tray and which is pivotally horizontally movable over the tray. A thermal sensitive element is utilized to effect horizontal pivotal movement of the ice sensing arm, though any suitable power means having a reciprocably movable power element could be used as well. The reciprocably movable element is interconnected with the ice sensing arm by means of a switch, having an associated depressible plunger, and spring means serve to interconnect the power element with the sensing arm so that the depressible plunger on the switch is normally depressed. The switch is so arranged that depressional movement of the plunger will act to close the electrical circuit therethrough.

Upon extensible movement of the power member, the ice sensing arm is pivotally horizontally moved above the collection tray, and conversely, upon retractable movement of the power element the spring interconnecting the power element and the ice sensing arm acts to return the sensing arm to its original position. If such return pivotal movement of the sensing arm or lever is prevented, due to abutment of the ice sensing lever with ice blocks in the collection tray, the adjacent ends of the ice sensing lever and the power element will move relatively away from one another so that the depressible plunger within the electrical switch, which is normally biased to an extended position, will move extensibly from the switch to open the electrical energizing circuit through the switch and to thereby deactuate the various electrically controlled elements of the ice making apparatus to prevent further operation thereof.

A hinged element or flap depends from the ice sensing lever and is arranged to pivotally move only in one rotational direction about its pivotal axis so that when the ice sensing lever is pivoted horizontally across the surface of the tray in one direction pivotal movement of the lever will not be hindered by the level of cubes within the collection tray but so that when the sensing lever pivotally moves through its return stroke abutment of the hinged flap with frozen ice blocks within the collection tray will prevent further return pivotal movement of the sensing lever.

It will, of course, be understood that while the illustrated embodiment of the invention is directed to a means for operating an electrical switch, many different kinds of switches such as pneumatic switches and the like could similarly be operated if they were actuatable by reciprocable movement of a plunger.

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

Another object of the invention resides in the provision of a horizontally pivotally movable sensing element which is operable to sense the level of ice blocks within a collection tray and operate an electrical switch as a function of this ice level.

Yet another object of the invention resides in the provision of a hinged element which depends from the sensing lever and which is operable to permit pivotal movement of the ice sensing lever in one direction across the collection tray but which, conversely, acts to sense the level of ice blocks within the collection tray and thereby prevent return pivotal movement of the ice sensing arm when the ice blocks within a collection tray have reached a predetermined level.

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

Figure 1 is a side view of an ice making apparatus embodying the principles of the present invention which shows most of the parts in side elevation but which shows a few of the parts in vertical section;

Figure 2 is a schematic diagram of a wiring circuit which might be employed in an ice making apparatus such as is illustrated in Figure 1;

Figure 3 is a plan view of the switch control means including the pivotally horizontally movable ice sensing lever and its associated power means; and

Figure 4 is a vertical sectional view through the ice sensing lever illustrated in Figure 3 and taken along lines IV—IV of Figure 3.

In the embodiment of the invention illustrated in the drawings, an ice tray 10 formed of a heat conducting

material has a pair of mold banks 11 and 12 formed in heat transfer relation with one another which each are divided by a plurality of partition walls 13 into a plurality of individual ice molds. The ice tray 10 is mounted on a shaft 14 which is journalled within the side wall 15 of the freezing compartment 16 of a household refrigerator 17.

A solenoid actuated slug valve is mounted on the side wall 15 outside of the freezing compartment 16 and has an inlet 19 and an outlet 20 through which fluid flows upon actuation of the inlet or outlet solenoids 21 and 22, respectively. A filler spout 23 extends from the outlet 20 through the side wall 15 of the freezing compartment 16 and terminates adjacent and above the ice tray 10 to provide a means for filling the ice tray with water at preselected intervals.

The slug valve 18 might be one of ordinary design having fluid inlet and outlet ports therein with which the reciprocably movable armatures of the respective inlet and outlet solenoids 21 are associated. In this manner, upon actuation of the inlet solenoid 21 the inlet port will be opened to permit fluid to flow from the inlet 19 into the interior of the slug valve until the slug valve is filled with a predetermined volume of water. Subsequently, by deactuating the inlet solenoid thereby effecting closure of the inlet port and by actuating the outlet solenoid 22 the outlet port will be opened so that the fluid within the interior of the slug valve body can be forced through the outlet 22 and filler spout 23 to the ice tray 10. The particular means for effecting expulsion of the fluid from the interior of the slug valve 18 through the outlet 20 forms no part of the present invention and is consequently not illustrated in the appended drawings nor hereafter described.

A motor 25 is also mounted on the side wall 15 of the freezing compartment 16 which has its output power shaft connected to the shaft 14 for corotatable movement therewith to effect oscillatory movement of the ice tray 10.

A collection tray 26 is seated on the floor 27 of the freezing compartment 16 and is disposed below the ice tray 10 to receive the frozen ice blocks when they are ejected from the ice tray 10.

In operation the ice making apparatus functions substantially as follows: A predetermined volume of water is dispensed from the slug valve 18 through the filler spout 23 in the manner which has been briefly described above to the ice tray 10 to fill the upwardly facing molds therein. Subsequent to freezing of the water within the individual molds into ice blocks the ice tray is rotated by the motor 25 through the shaft 14 to dispose the bank of molds 12 in a liquid receiving position. Relatively warm water is then dispensed from the slug valve through the filler spout 23 into the upwardly facing bank of molds and the heat transferred through the heat conducting walls of the ice tray from the heated fluid filling the upwardly facing molds acts to disengage the ice blocks in the downwardly facing molds from their respective molds so that they fall into the collection tray 26.

The water which is directed to the ice tray from the slug valve may be heated by means of a resistor heater 28 wound about the main body portion of the slug valve and which is diagrammatically illustrated in Figure 2 as being simultaneously actuatable with actuation of the inlet solenoid 21.

As diagrammatically illustrated in Figure 2, the slug valve solenoid coils and the resistor heater 28 are energizable through a selector switch 29 which may comprise a thermal sensitive switch which is sensitive to the temperature of fluid within the slug valve and which is operable in a manner set forth and fully described in a copending application of Carl C. Bauerlein entitled "Internally Heated Slug Valve," Serial No. 814,047 which was filed on May 18, 1959 and which has been assigned to the assignee hereof.

An outwardly extending bracket 30 is secured to the side wall 31 of the freezing compartment 16 which is disposed opposite the side wall 15. The bracket 30 has an ice sensing arm 33 pivotally mounted thereon by means of a pin 34*a*.

A second bracket 34 is mounted on the side wall 31 about the bracket 30 which has an annular aperture 35 formed therein which is adapted to slidably receive the guide portion 36 of a thermal sensitive power unit 37.

The thermal sensitive power unit 37 is of a usual type and has a power member 38 slidably mounted within the guide 36 which is extensible from the guide portion 36 upon fusion and consequent expansion of a thermally expansible material disposed within a heat sensitive portion thereof. A compression spring (not shown) is disposed within the guide 36 which is seated on a collar on the power member 38 and which serves to bias the power member to a retracted position within the guide 36. A compression spring 37*a* encircles the guide 36 and has one end seated on the bracket 34 and its opposite end seated on a collar 37*b* which is secured to the guide 36 to permit "overtravel" of the power unit 37 when extensible movement of the power member 38 is prevented to thereby prevent damage to the power unit as is well known in the art.

A casing 39 is secured to and forms a part of the power unit 37 and serves to cover the heat sensitive portion of the power unit and to form in conjunction therewith, a chamber for containing water for reasons which will hereinafter become apparent.

In measuring temperature and instigating an operation in accordance with the freezing of a liquid, instead of measuring the temperature of the liquid directly through contact with the liquid, it is frequently desirable as in the present instance to estimate the temperature by measuring the temperature of another liquid having characteristics similar to the temperature of the liquid being measured and experiencing a similar variation of temperature with time.

Thus, by partially filling the chamber between the heat sensitive portion of the thermal sensing power unit 37 and the casing 39 with water and by heating the water within that chamber by means of a resistor heater 42 to approximately the temperature of the water used for filling the ice tray and by disposing the power unit within the same freezing compartment as the ice tray, the water within which the heat sensitive portion of the power unit is immersed will freeze at the same rate as the water within the ice tray 10. Thus, the thermal sensitive power unit may be made responsive to the temperature variances of the water within the ice tray 10.

As shown in the circuit diagram in Figure 2 the resistor heater 42 is always energized simultaneously with the outlet solenoid 22 so that the fluid within the chamber surrounding the heat sensitive portion of the power unit 37 will be heated simultaneously with filling of the upwardly facing molds in the ice tray 10. Thus, the power unit is actuated during each cycle of operation of the ice making apparatus.

As shown most clearly in Figure 3, a bracket 45 is affixed to the outer end portion of the power member 38 by a screw 46 which is threaded into the end of the power member and this bracket 45 has a switch box 47 mounted thereon which contains a normally open contact electrical switch. The switch box 47 has a movable contact 48 therein (as diagrammatically illustrated in Figure 2) which acts to control energization of each of the electrically energizable components of the ice making apparatus.

A plunger 49 extends from the switch box 47 and is operably connected with the movable contact 48 to actuate the same relative to a stationary contact 50 (as shown in Figure 2).

Referring particularly to Figure 2, a spring member 51 acts to normally bias the movable contact 48 to an

open circuit position so that closure of the movable contact 48 against the stationary contact 50 is only effected by means of depressible movement of the plunger 49.

Referring once again to Figure 3, the ice sensing arm 33 has an upturned flange 60 formed at the end thereof disposed adjacent the outer end of the power member 38 which is adapted to abut the outer end of the plunger 49 and effect depressible movement thereof to close the movable contact 48 against the stationary contact 50.

The flange 60 is resiliently urged against the plunger 49 to effect closure of the movable contact 48 by means of a tension spring 61 which interconnects the flange 60 with the laterally extending bracket 45.

In view of the foregoing the operation of the ice sensing mechanism may generally be described as follows: Assuming that the various parts of the ice making apparatus are in the positions illustrated in Figures 1 and 3, and that the switch 47 is closed, energization of the resistor heater 42 will act to heat the fluid within the chamber disposed intermediate the casing 39 and the heat sensing portion of the power unit 37 to cause fusion and consequent expansion of the thermally expansible material within the sensing unit 37 as is well known in the art. Upon expansion of this material the power member 38 will be extensibly moved relative to the guide portion 36 and such extensible movement of the power member 38 will be transmitted through the bracket 45, switch box 47, and plunger 49 to the flange 60 of the sensing arm 33 to thereby pivot the sensing arm 33 about the pivot pin 34*a* across the surface of the ice collection tray 26.

Subsequently, upon movement of the movable contact of the thermostatically actuatable switch 29 to the position illustrated in Figure 2, the outlet solenoid 22 and resistor heater 42 will be deenergized.

Upon energization of the outlet solenoid 22 fluid will be directed through the filler spout 23 to the upwardly facing bank of molds within the ice tray 10 to effect ejection of the ice blocks within the downwardly facing molds by heat transfer through the walls of the ice tray 10. The ice blocks falling from the downwardly facing molds will fall into the ice collection tray 26. Thereupon the temperature of the fluid within the analog thermostat 37 will have lowered to a sufficient degree to permit retractable movement of the power member 38 with respect to the guide 36 by means of the compression spring disposed within the guide 36 and acting to bias the power member 38 to a retracted position. Such retractable movement of the power member 38 will act through the tension spring 61 to pivotally return the power member 33 in a counterclockwise direction to the position illustrated in Figure 3.

If the returning sensing arm 33 should strike ice blocks within the collection tray and thereby be prevented from returning to the counterclockwise rotated position illustrated in Figure 3, the power member 38 will nonetheless retractably move within the guide 36 so that the flange 60 and bracket 45 will move relatively away from one another against the opposing biasing force of the tension spring 61. When the bracket 45 and flange 60 do thereby move relatively away from one another against the opposing biasing force of spring 61, the plunger 49 will be moved extensibly from the switch box 47 by the compression spring 51 to effect movement of the movable contact 48 out of engagement with the stationary contact 50 to thereby open the energizing circuit through the switch. As a result further operation of the ice making apparatus will be prevented since the motor means 25, solenoids 21 and 22, and resistor heaters 28 and 42 are all energized through the switch 47.

Since the ice level sensing arm 33 is operable to sense the level of ice cubes within the collection tray 26 and thereby prevent further cycling of the ice making apparatus only upon return counterclockwise pivotal movement of the sensing arm 33, the sensing arm is provided with a hinged flap 65 which is illustrated in Figure 4.

The hinged flap 65 is hinged to the main body portion of the sensing arm 33 and abuts a depending leg 66 thereof so that the flap (as shown in Figure 4) can rotatably move only in a counterclockwise direction from the position shown.

As a result, if the ice level is at a point such as the point A illustrated in Figure 4 prior to clockwise pivoted movement of the sensing arm 33 as shown in Figure 3, the flap will merely rotate about its hinge when the sensing arm is urged in a clockwise direction but will abut the ice blocks upon return movement of the sensing arm to prevent further counterclockwise rotated movement of the sensing arm to thereby act to open the switch 47 in the manner which has hereinbefore been described.

I have thus provided an extremely simple and economical method of controlling the operation of an electrically or pneumatically actuatable ice making apparatus as a function of the level of ice blocks within a collection tray.

It will 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. Switch control means sensitive to the level of solids within a tray comprising a support, a sensing element pivotally mounted on said support and positioned for pivotal sweeping movement across the tray, a reciprocably movable power element mounted on said support, a switch mounted on one of said elements having a depressible actuating plunger extending therefrom positioned to abut the other of said elements, means biasing said elements toward one another adjacent said switch to effect depression of said plunger, and means for reciprocating said power element to effect pivotal movement of said sensing element across said tray by motion translation through said switch and plunger.

2. Switch control means sensitive to the level of solids within a tray comprising a support, a sensing element pivotally mounted on said support and positioned for pivotal sweeping movement across the tray, a reciprocably movable power element mounted on said support, a switch mounted on one of said elements having a depressible actuating plunger extending therefrom positioned to abut the other of said elements, resilient means interconnecting said elements adjacent said switch to effect depression of said plunger, means for reciprocating said power element to effect pivotal movement of said sensing element across said tray by motion translation through said switch and plunger, and means on said sensing element to permit said sensing element to pivotally move across said tray in one direction but operable to abut the solids within the tray when they have reached a predetermined level to prevent return pivotal movement of said sensing element to effect actuation of said switch.

3. Switch control means sensitive to the level of solids within a tray comprising a support, a sensing element pivotally mounted on said support and positioned for pivotal sweeping movement across the tray, a reciprocably movable power element mounted on said support, a switch mounted on one of said elements having a depressible actuating plunger extending therefrom positioned to abut the other of said elements, resilient means interconnecting said elements adjacent said switch to effect depression of said plunger, means for reciprocating said power element to effect pivotal movement of said sensing element across said tray by motion translation through said switch and the plunger, and means comprising an extension from said sensing element and hinged to said sensing element operable to permit pivotal movement of said sensing element in one direction

across said tray but operable to abut the solids within the tray to prevent return pivotal movement of said sensing element when the solids within the tray have reached a predetermined level.

4. Switch control means sensitive to the level of solids within a tray comprising a support, a sensing element pivotally mounted on said support and positioned for pivotal sweeping movement across the tray, power means mounted on said support having a power element extensible therefrom upon energization of said power means, means biasing said power element to a retracted position with respect to said power means, a switch mounted on one of said elements having a depressible actuating plunger extending therefrom positioned to abut the other of said elements, resilient means interconnecting said elements adjacent said switch to effect depression of said plunger, means for reciprocating said power element to effect pivotal movement of said sensing element across said tray by motion translation through said switch and plunger, means comprising an extension from said sensing element operable to permit pivotal movement of said sensing element across said tray upon extensible movement of said power element but operable to abut the solids within the tray to prevent return pivotal movement of said sensing element upon retractable movement of said power element when the solids within the tray have reached a predetermined level.

5. Switch control means sensitive to the level of solids within a tray comprising a support, a sensing element pivotally mounted on said support and positioned for pivotal sweeping movement across the tray, a reciprocably movable power element mounted on said support, a switch mounted on said power element having a depressible actuating plunger extending therefrom positioned to abut said sensing element, resilient means interconnecting said elements adjacent said switch to effect depression of said plunger, and means for reciprocating said power element to effect pivotal movement of said sensing element across said tray by motion translation through said switch and plunger.

6. Switch control means sensitive to the level of solids within a tray comprising a support, a sensing element pivotally mounted on said support and positioned for pivotal sweeping movement across the tray, a reciprocably movable power element mounted on said support, a switch mounted on said power element having a depressible actuating plunger extending therefrom positioned to abut said sensing element, resilient means interconnecting said elements adjacent said switch to effect depression of said plunger, means for reciprocating said power element to effect pivotal movement of said sensing element across said tray by motion translation through said switch and the plunger, and means comprising an extension from said sensing element and hinged to said sensing element operable to permit pivotal movement of said sensing element in one direction across said tray but operable to abut the solids within the tray to prevent return pivotal movement of said sensing element when the solids within the tray have reached a predetermined level.

7. In combination with an ice making apparatus disposed within a freezing compartment and including an ice tray, electrically energizable means for filling the ice tray with water, electrically energizable means for ejecting frozen ice blocks from said tray, and a collection tray for receiving the ejected ice blocks, the improvement of means for controlling operation of said ice making apparatus as a function of the level of ice blocks within said collection tray comprising a support, a sensing element pivotally mounted on said support and positioned for pivotal sweeping movement across the collection tray, a reciprocably movable power element mounted on said support, a switch mounted on one of said elements for controlling electrical energization of each of said electrically energizable means and having a depressible actuating plunger extending therefrom positioned to abut the other of said elements and so arranged that when said plunger is extended from said switch the electrical circuit to said electrically energizable means will be open, resilient means interconnecting said elements adjacent said switch to effect depression of said plunger, and means for reciprocating said power element to effect pivotal movement of said sensing element across said tray by motion translation through said switch and plunger.

8. In combination with an ice making apparatus disposed within a freezing compartment and including an ice tray, electrically energizable means for filling the ice tray with water, electrically energizable means for ejecting frozen ice blocks from said tray, and a collection tray for receiving the ejected ice blocks, the improvement of means for controlling operation of said ice making apparatus as a function of the level of ice blocks within said collection tray comprising a support, a sensing element pivotally mounted on said support and positioned for pivotal sweeping movement across the collection tray, a reciprocably movable power element mounted on said support, a switch mounted on said power element for controlling electrical energization of each of said electrically energizable means and having a depressible actuating plunger extending therefrom positioned to abut said sensing element and so arranged that when said plunger is extended from said switch the electrical circuit to said electrically energizable means will be open, resilient means interconnecting said elements adjacent said switch to effect depression of said plunger, and means for reciprocating said power element to effect pivotal movement of said sensing element across said tray by motion translation through said switch and plunger.

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