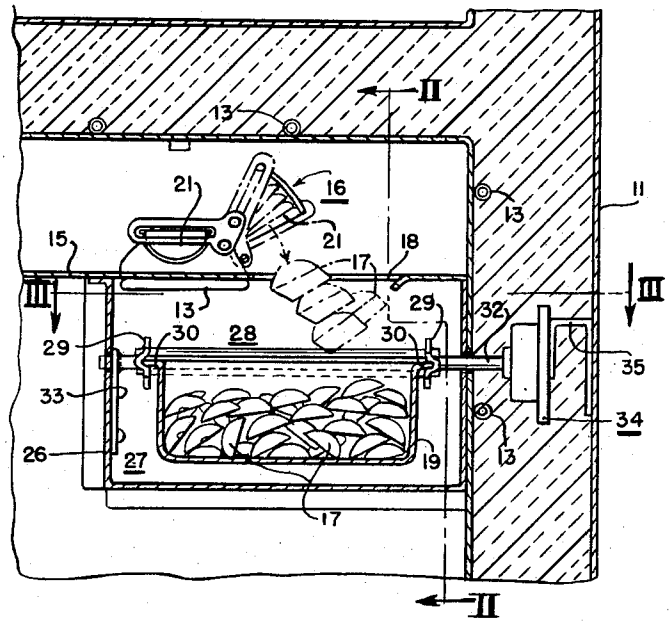
June 23, 1959 J. K. NELSON 2,891,385

ICE MAKER

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FIG. 1.



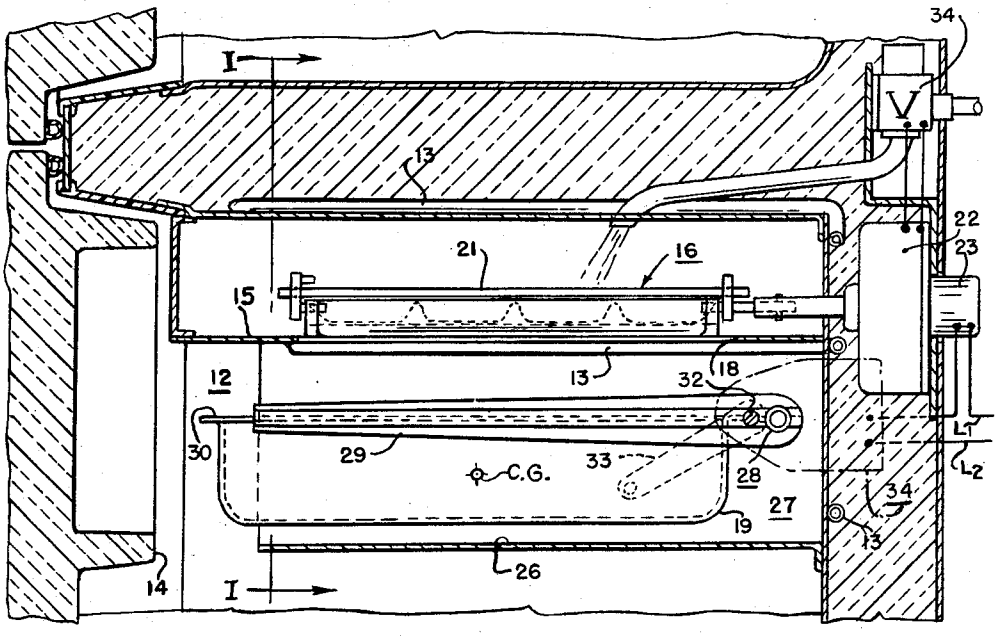


FIG. 2.

INVENTOR
JAMES K. NELSON

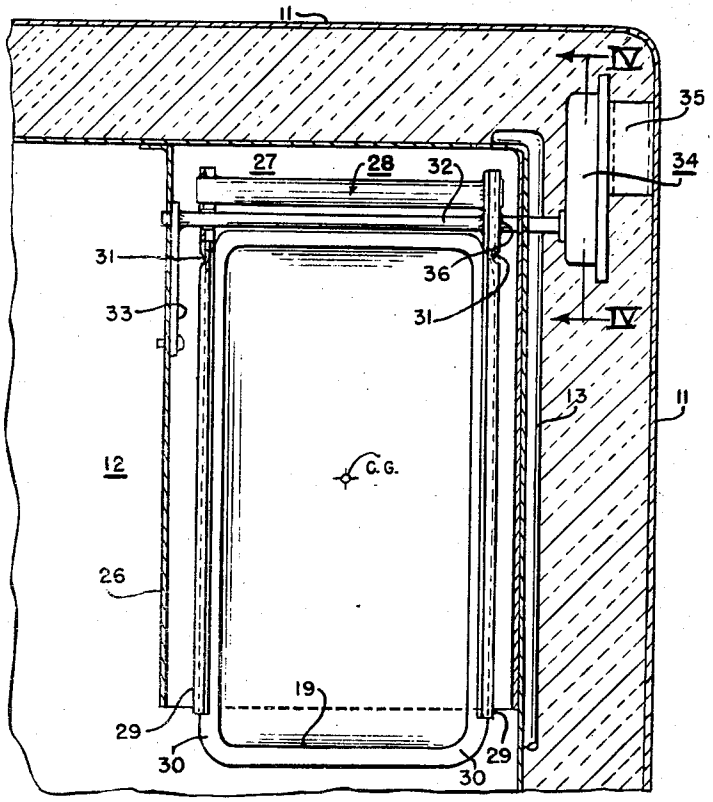
BY William J. Doley
ATTORNEY

June 23, 1959 J. K. NELSON 2,891,385

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FIG. 3.



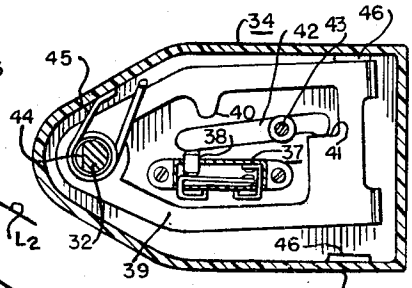


FIG. 4.

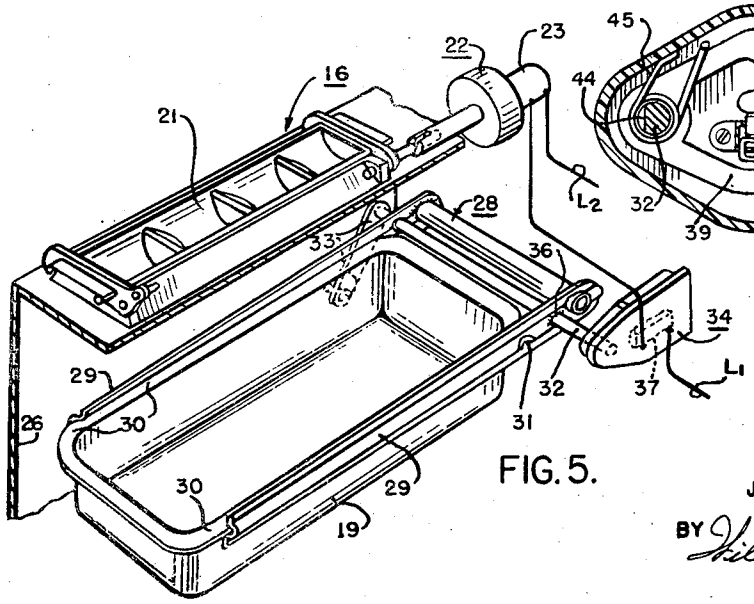


FIG. 5.

INVENTOR
JAMES K. NELSON

BY William Doley

ATTORNEY

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2,891,385

ICE MAKER

James K. Nelson, Grove City, Ohio, assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application February 28, 1958, Serial No. 718,260

6 Claims. (Cl. 62—137)

This invention relates to ice making apparatus and more particularly to means for controlling the production of ice by an automatic ice maker.

A number of different types of ice making equipment are currently commercially available that are capable of operating continuously to produce ice pieces, generally in batches at regular intervals. Customarily, a storage container or bin is provided for receiving and storing the ice pieces produced by the ice maker. The storage facilities for most ice makers, and particularly those associated with domestic refrigerators, are of limited capacity and can be overfilled if the ice maker is permitted to run continuously without ice being removed from the storage container.

This invention deals with controlling the production of ice by the ice maker in accordance with the quantity of ice pieces in the storage facility so as to prevent the discharge of ice pieces into the storage facility when it is filled or not in condition to receive additional ice pieces, as when the ice container has been removed for cleaning or use. The control permits the discharge of ice pieces into the storage facility when less than a desired maximum quantity of ice pieces is present therein.

In accordance with this invention, the output of the ice maker is controlled in accordance with the combined weight of a movable storage container and its contents, which container is adapted to receive ice pieces discharged by the ice maker. While the broad concept of controlling an ice maker in accordance with the weight of an ice storage container and its contents is not new, this invention enables a weight-responsive control to be constructed that has a number of features and advantages not present in prior controls. For example, the supporting means for the movable ice storage container embodies novel structural features that render the supporting system less susceptible than prior systems to becoming inoperative as a result of an accumulation of frost, and ice. This is achieved by employing a torsionally resilient rod member as the supporting means for the ice storage container, the deflections of which rod member are sensed as an indication of the weight of the ice container and its contents. As will later appear in greater detail, this rod member is particularly insensitive to frost and ice accumulation and, consequently, reliable and accurate sensing of the weight of the ice contained is assured throughout the life of the ice making apparatus.

The control system of this invention is, moreover, capable of preventing the discharge of ice from the ice maker when the ice storage container has been removed from the position in which it receives ice pieces. In accordance with this invention, a movable carrier is provided which is adapted to receive and support the ice storage container in a particular position thereon in which the container is properly located relative the ice maker to receive ice pieces discharged from the ice maker. The carrier is attached to the aforementioned resilient rod member and maintains a predetermined position relationship between the container and the rod member when

the container is properly positioned on the carrier so that the weight of the container and its contents is applied to the rod member through a predetermined moment arm to cause deflection of the rod member within predetermined limits. Removal of the container from the carrier, for cleaning or for removing ice pieces therefrom, permits the rod member to deflect beyond the said predetermined limits and the position sensing mechanism functions to prevent the discharge of ice pieces from the ice maker until such time as the container is returned to the carrier. Sliding the container forward on its carrier to gain access to ice pieces therein results in the weight of the container and its contents being applied to the rod member through a longer moment arm and causes the rod member to be deflected beyond said predetermined limits and, likewise, results in the ice maker being prevented from discharging ice pieces.

Other features, objects and advantages of the invention will become apparent from the following detailed description which includes reference to the accompanying drawings wherein:

Fig. 1 is a fragmentary front sectional view of a refrigerator incorporating ice making apparatus constructed in accordance with this invention;

Fig. 2 is a fragmentary sectional view of the refrigerator taken from one side, as indicated generally by the line II—II in Fig. 1, and showing in phantom certain elements of the apparatus not actually in view;

Fig. 3 is a fragmentary horizontal sectional view through the refrigerator, taken as indicated by the line III—III in Fig. 1 and showing in plan the ice storage container and associated supporting structure constructed in accordance with this invention;

Fig. 4 is an enlarged sectional view of a position-sensing switch mechanism employed in the preferred embodiment of this invention; and

Fig. 5 is a fragmentary perspective view of the ice making apparatus shown in Figs. 1 through 4.

In the drawings, the numeral **11** designates the insulated wall structure of a domestic refrigerator, or the like, having a compartment **12** therein which is cooled to below 32° F. by refrigerant coils **13** surrounding the compartment. As is well understood in the art of refrigeration, suitable means, not shown, are provided in the refrigerator for circulating refrigerant through the coils **13**. The compartment **12** is accessible to the user of the refrigerator through a front opening which is closed by a movable door **14** shown in Fig. 2.

The compartment **12** has a horizontal shelf, or partition, **15** therein on which rests the ice mold portion of an automatic ice maker **16**. The ice maker **16** is adapted to manufacture and discharge pieces of ice **17** which, upon leaving the ice maker **16**, fall through an opening **18** in the partition **15** into an ice storage facility which includes an open top pan, or container, **19**. In accordance with this invention, operation of the automatic ice maker **16** is controlled by apparatus that senses the presence of and the weight of the storage container **19** so as to cause the ice maker **16** to function to produce ice pieces **17** whenever the container **19** is properly located within the storage facility and less than a predetermined quantity of ice is present in the storage container.

The automatic ice maker **16** chosen for the purpose of illustrating this invention is of the twist-tray type described and claimed in my copending application Serial No. 566,582, filed February 20, 1956, under the title of Ice Maker, and assigned to the same assignee as the present invention. Briefly, this ice maker includes a flexible and movable mold **21** in which the ice pieces **17** are formed. The mold **21** is arranged in heat transfer relationship with the horizontal partition **15** which

has a loop of the refrigerant coil 13 secured to the underside thereof in the vicinity of the ice mold 21 for speeding the rate at which ice is frozen in the mold 21. At controlled intervals, the mold 21 is swung upwardly to a partially inverted position (illustrated in Fig. 1) and is twisted to cause the ice pieces 17 to be discharged therefrom. This swinging and twisting of the ice mold 21 is performed by a drive mechanism 22 which includes an electrically energized motor 23. The drive mechanism 22 also includes means for controlling the energization of a water filling valve 24 to which it is electrically connected and which is adapted to admit water to the ice mold 21 to refill the mold after a batch of ice pieces 17 has been discharged therefrom.

The automatic ice maker 16 is capable of repeatedly producing and discharging batches of ice pieces 17 and its operation must be controlled in order to prevent overfilling of the limited capacity storage facility provided for the completed ice pieces. As mentioned previously, this invention is particularly concerned with a weight responsive control for ice makers and, consequently, the storage container 19 is resiliently supported within the refrigerator compartment 12 so that changes in the weight of ice pieces stored therein cause the container 19 to move from one position to another. Support for the container 19 is partially provided by a sheet metal shield 26 which partially surrounds the container 19 and defines, together with the refrigerator wall structure 11 and the partition 15, an open front storage compartment 27 which houses the container 19. The shield 26 prevents food packages or other items that are stored within the refrigerator compartment 12 from being inadvertently placed in contact with the ice container 19 and insures that the container 19 is free to move as the weight of its contents changes. Generous spacing is preferably provided between the shield 26 and the container 19, as well as between the container 19 and other nearby wall structure, so that the container 19 will not be rendered immovable by the formation of ice or frost bridges between the container 19 and these wall areas.

The container 19 is carried by a U-shaped yoke 28 having forwardly extending arms 29, each of which has a groove therein for receiving a peripheral flange 30 formed about the top of the container 19. The grooved arms 29 frictionally engage the container flange 30 and permit the container 19 to be removed therefrom and replaced therein by horizontal sliding movements of the container. Thus the container 19 can be easily removed from the refrigerator compartment 12 to permit access to the ice pieces stored therein, or the ice pieces can be removed by simply sliding the container 19 forward a short distance on the yoke arms 29. The yoke arms 29 are provided with indentations 31 near the rear ends thereof for limiting the rearward movement of the container 19; in other words, to provide stops for locating the container 19 in proper relationship to the ice maker 16 and the partition opening 18 so that the container 19 is within the path of movement of all of the ice pieces discharged from the ice maker 16.

The yoke 28 is mounted on a torsionally resilient rod member 32 which extends horizontally across the storage compartment 27. One end of the rod member 32 is rigidly secured, by means of an arm 33, to the shield 26. The arm 33 is welded, or otherwise fixedly secured, to the rod 32 and is in turn bolted, or otherwise fastened, to the shield 26 to support and prevent rotation of that one end of the rod 32. The rod 32 extends through openings provided therefor in the refrigerator wall structure 11 and terminates in another end that is supported for rotational movement within a position sensing mechanism, identified generally by the reference numeral 34, which is mounted on a bracket 35 within the refrigerator wall structure 11. The rod 32 extends through both arms 29 of the yoke but only one arm is affixed, as indicated at 36, to the rod (see Fig. 3). The yoke arm 29

that is farthest displaced along the rod 32 from the fixed end of the rod, i.e. the end attached to the arm 33, is brazed or welded to the rod 32 and the other yoke arm 29 is free to turn on the rod 32. It will be noted from Fig. 3, that the yoke 28 carries the container 19 in a position in which the center of gravity of the container 19 and its contents (indicated by mark C.G.) is laterally displaced from the rod 32 so that the weight of the container 19 and the ice pieces therein apply a turning, or twisting, force to the rod 32 at the connection 36 between the yoke 28 and the rod 32. The length of the rod 32 between the arm 33 and the yoke connection 36 is free to twist and torsionally oppose the weight of the container 19 and its contents. The size and material for the rod 32 are selected so that the rod 32 is capable of balancing the weight of the container 19 and its contents and of maintaining the container 19 within predetermined position limits whenever the container 19 has less than a maximum quantity of ice pieces therein. Whenever the container 19 is completely filled with ice pieces, its weight becomes great enough to cause the container 19 to move downwardly beyond the above mentioned position limits. Whenever the container 19 is completely removed from the yoke 28, the absence of the container weight permits the rod 32 to move the yoke arms 29 upwardly beyond these position limits. The movements of the yoke 28 are reflected by angular movement of the end of the rod member 32 that is carried by the positioning sensing mechanism 34. The position sensing mechanism responds to these movements of the rod 32, which, it will be understood, are an indication of weight changes of the ice container 19 and its contents, and permits or prevents the discharge of ice pieces by the ice maker 16 in accordance therewith.

The construction of the position sensing mechanism 34 is illustrated in detail in Fig. 4. This mechanism comprises a housing 36 constructed of an electrical insulating material such as molded plastic, which houses an off-on switch 37. The switch 37 is adapted to open an electrical circuit when its plunger 38 is depressed, and to close an electrical circuit when the plunger 38 is released. The switch 37 is actuated by a frame 39 carried by the rotatable end of the rod 32 and a lever 42 pivotally mounted in the housing 36. The frame 39 has a pair of contact pads 40 and 41, adapted to engage the lever 42 at points spaced in opposite directions from a pivot pin 43 which is secured to the housing 36 and supports the lever 42. The frame 39 closely fits over the end of rod 32, which has a flat 44 thereon which insures that the frame 39 will follow rotational movements of the rod 32. The rod member 32 also carries a torsion spring 45 which acts between the housing 36 and the frame 39 to take up any looseness, or lost motion, between the frame 39 and the rod 32.

It will be noted from Fig. 4 that the lever 42 is engaged by pressure pad 41 and caused to depress the switch plunger 38 when the frame 39 is moved upwardly (counter-clockwise with respect to the axis of rod 32) to a predetermined upper position. The lever 42 is engaged by pressure pad 40, also to depress the switch plunger 38, when the frame 39 is moved downwardly (clockwise with respect to the axis of rod 32) to a predetermined lower position. It will also be noted that the frame 39 can be moved by the rod 32 within a limited range and not cause the switch plunger 38 to be depressed by the lever 42; in other words, the switch 37 will remain closed so long as the frame 39 is not moved in either direction beyond certain limits. When the container 19 is filled with ice pieces, the weight of the container and the ice stresses the rod 32 and turns the rotatable end thereof to cause the frame 39 to move upwardly and open switch 37. When the container 19 is removed from the storage compartment 27, the residual stress within rod 32 lifts the yoke arms 29, and the frame 39 is moved downwardly within housing 36 to open

switch 37. The housing 36 is equipped with stop projections 46 which are adapted to limit the overall movement of the frame 39 and prevent damage to the switch 37, such as might be occasioned by unusual loads being imposed on the container 19 or the yoke 28 which would tend to abnormally twist rod 32 and cause excessive movement of the frame 39.

The position-sensing mechanism 34 prevents or permits the discharge of ice by the ice maker 16 by virtue of having the electrical switch 37 thereof in the electrical supply circuit for the motor 23 in the drive mechanism 22 of the ice maker. This electrical circuit is illustrated diagrammatically in Figs. 2 and 5, wherein the characters L_1 and L_2 denote conductors for a supply line of electrical current, such as a normal household electrical supply system. It will be noted that conductor L_1 is connected to switch 37 and the circuit from the switch 37 to the motor 23 is completed by another conductor 46. Thus, whenever switch 37 is open, the ice maker drive motor 23 is deenergized so as to prevent the discharge of ice from the ice maker 16, and when switch 37 is closed, the electrical supply circuit to the motor 23 is complete, so that the motor 23 can be energized to discharge ice from the ice maker 16. It is to be understood that the ice maker 16 includes other electrical control circuits for energizing and deenergizing the drive motor 23 in accordance with the condition of the contents of the ice mold 21. Since these circuits form no part of the present invention, reference thereto has been omitted for the sake of brevity. It is intended that the switch 37 in the preferred embodiment of the invention here described be employed as a line switch, so as to completely deenergize the ice maker drive and prevent ice from being discharged regardless of the condition of the ice maker 16.

So long as switch 37 is closed, the ice maker 16 is permitted to operate to manufacture and discharge ice pieces at its maximum operating capacity. Should the ice storage container 19 become full, the position-sensing mechanism 34 functions to deenergize the ice maker by virtue of its switch 37 being opened.

The control arrangement of this invention is also capable of preventing the discharge of ice from the ice maker 16 when the ice storage container 19 is pulled forward on the yoke 28 to remove ice pieces therefrom, so that the container is outside the path of some of the ice pieces discharged by the ice maker 16. Assume, for example, that the partially filled ice container 19 is moved partially out of compartment 27 (moved to the left as viewed in Fig. 2), by a user who is removing ice pieces from the container but does not remove the container completely from the refrigerator. The container 19 is, therefore, in a forward position in which ice pieces discharged from the rear portion of the ice mold 21 would fall outside the container 19. Under such circumstances, the switch 37 in the position-sensing mechanism 34 is maintained in open position to prevent the discharge of ice from the ice maker 16. This is due to the fact that when the container 19 is thus placed, the center of gravity of the container and its contents is forward of the position which it normally occupies, and the moment arm between the center of gravity and the axis of rod 32 is increased to the point where the weight of the container 19 and its contents, even though it be but partially filled, is effective to twist the rod 32 to cause the switch 37 to be opened. Operation of the ice maker 16 under these circumstances is, therefore, prevented.

The above described supporting arrangement for the movable ice container 19 is particularly insensitive to frost and ice accumulations that can normally be expected in the freezing compartment of a household refrigerator. As mentioned previously, generous clearances are provided between the container 19 and surrounding structure so as to prevent frost and ice from fouling movements of the container. These generous clearances are likewise provided with respect to the yoke 28 which carries the container 19. The yoke 28 is, in turn, supported on the horizontal rod 32 which is torsionally twisted by the weight of the ice container 19 and its contents. The movements of the rod 32 are quite small and the stresses are high, so that ice or frost that builds up on the rod 32 is easily sheared free as the weight of the ice container 19 is changed by the addition or removal of ice pieces. The movable end of the rod 32 projects into the insulated wall structure 11 of the refrigerator cabinet and is connected to the position-sensing mechanism 34 in a region that is protected against frost and ice accumulation by the insulation in that wall structure. There is, therefore, minimum opportunity for ice or frost to interfere with operation of the weight sensing control system.

From the foregoing, it will be apparent this invention makes it possible to reliably control the operation of an automatic ice maker in accordance with the weight of the ice pieces contained in the storage facility for that ice maker. The improved results obtainable as a result of the invention are particularly noticeable in the insensitivity of the weight sensing system and mechanism to frost and ice accumulations.

The invention has been described in connection with one particular type of automatic ice maker, but it is to be understood that the control system and apparatus here described and claimed are equally applicable to the various other types of automatic ice makers that are known or will become known in this art. Moreover, the invention itself has been described in but one form, but it will be obvious to those persons skilled in the art that various changes and modifications can be made in the disclosed apparatus without departing from the spirit or scope of the invention.

What is claimed is:

1. The combination with an automatic ice maker adapted to manufacture and discharge ice pieces, and a container for storing ice pieces produced by said ice maker, of a movable carrier adapted to support said container in a position within the path of movement of the ice pieces discharged by said ice maker, said carrier being movable in one direction under the weight of said container, resilient means biasing said carrier in the opposite direction, said biasing means being adapted to maintain a condition of balance for holding said carrier within predetermined position limits when the combined weight of said container and its contents is within predetermined limits, and means for sensing the position of said carrier and adapted to prevent the discharge of ice by said ice maker, (*a*) when said carrier is moved in said one direction to a predetermined position beyond said limits by the accumulation of ice pieces in said container, and (*b*) when said carrier is moved in said opposite direction to another predetermined position beyond said limits upon removal of the container from said carrier, and being adapted to permit the discharge of ice from said ice maker when said carrier is positioned within said limits.

2. The combination with an automatic ice maker adapted to manufacture and discharge ice pieces, and a container for storing ice pieces produced by said ice maker, of a movable carrier adapted to support said container in a position within the path of movement of the ice pieces discharged by said ice maker, biasing means acting on said carrier and adapted to oppose movement of said carrier under the weight of said container, said biasing means being adapted to maintain a condition of balance for holding said carrier within predetermined position limits when said container is located on the carrier in the said position within the path of movement of ice discharged by said ice maker, the construction of said biasing means being such that a condition of unbalance exists when the said container is located on said carrier in other positions in which the container is outside the path of movement of at least part of the ice pieces discharged by said ice maker whereby said carrier moves to a position beyond said predetermined limits, and means

for sensing the position of said carrier and adapted to prevent the discharge of ice from said ice maker when said carrier is in a position beyond said predetermined limits.

3. The combination with an automatic ice maker for manufacturing and discharging ice pieces, and a container for receiving and storing ice pieces discharged from said ice maker, of means for controlling the production of ice by said ice maker and comprising, a carrier adapted to support said container within the path of ice pieces discharged by said ice maker, means for pivotally supporting said carrier for movement about a substantially horizontal axis that is displaced from the center of gravity of said container whereby the weight of said container biases said carrier in one direction about said axis, resilient means biasing said carrier in the opposite direction and for maintaining said carrier within predetermined position limits when the combined weight of said container and its contents is within predetermined limits, and means for sensing the position of said carrier and adapted to prevent the discharge of ice by said ice maker, (*a*) when said carrier is moved in said one direction to a predetermined position beyond said limits by the accumulation of ice pieces in said container, and (*b*) when said carrier is moved in said opposite direction to another predetermined position beyond said limits upon removal of the container from said carrier, and being adapted to permit the discharge of ice from said ice maker when said carrier is positioned within said limits.

4. The combination with an electrically energized, automatic ice maker for manufacturing and discharging ice pieces, and a container for receiving ice pieces discharged from said ice maker, of means for controlling the production of ice by said ice maker and comprising, a carrier adapted to support said container within the path of ice pieces discharged by said ice maker, means for pivotally supporting said carrier for movement about an axis that is displaced from the center of gravity of said container whereby the weight of said container biases said carrier in one direction about said axis, resilient means biasing said carrier in the opposite direction and for maintaining said carrier within predetermined position limits when the combined weight of said container and its contents is within predetermined limits, a switch movable between open and closed positions, means electrically connecting said switch to said ice maker whereby said switch, when in its open position prevents the discharge of ice by said ice maker, and when in its closed position permits the discharge of ice by said ice maker, and means moved by said carrier and adapted to open said switch, (*a*) when said carrier is moved in said one direction to a predetermined position beyond said limits by the accumulation of ice pieces in said container, and (*b*) when said carrier is moved in said opposite direction to another predetermined position beyond said limits when said container is removed from said carrier, and being adapted to close said switch when said carrier is positioned within said limits.

5. The combination with an automatic ice maker adapted to manufacture and discharge ice pieces, and a container for receiving and storing ice pieces discharged from said ice maker, of a movable carrier adapted to support said container in a predetermined position thereon, a torsionally resilient rod member, means for supporting one end of said rod member and for preventing rotation of said one end, means for supporting the other end of said rod member, said means permitting rotation of said other end of the rod member, means securing said carrier to said rod member intermediate the ends of said rod member, the construction and arrangement being such that such carrier maintains said container in a position in which the center of gravity of said container is laterally displaced from the axis of said rod member whereby the weight of said container applies a turning force to said rod member, and means for sensing angular movement of said other end of the rod member and for alternatively permitting or preventing the discharge of ice from said ice maker in accordance with the angular position of said other end of the rod member.

6. The combination of a cabinet structure having insulated walls defining a compartment adapted to be maintained at temperatures below 32 degrees F., an ice maker adapted to manufacture and discharge ice pieces, a container disposed within said compartment for receiving and storing ice pieces discharged by said ice maker, a torsionally resilient rod member having one end thereof disposed within said compartment and the other end thereof disposed exteriorly of said compartment, means for resisting turning movement of said one end of said rod member, means for sensing the angular position of the other end of said rod member, carrier means secured to said rod member intermediate the ends of the rod member, said carrier means being adapted to support said container with the center of gravity of the container laterally displaced from the axis of said rod member whereby the weight of said container applies a turning force to said rod member, and means controlled by said sensing means for alternatively preventing or permitting the discharge of ice from said ice maker in accordance with the angular position of said other end of the rod member.

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