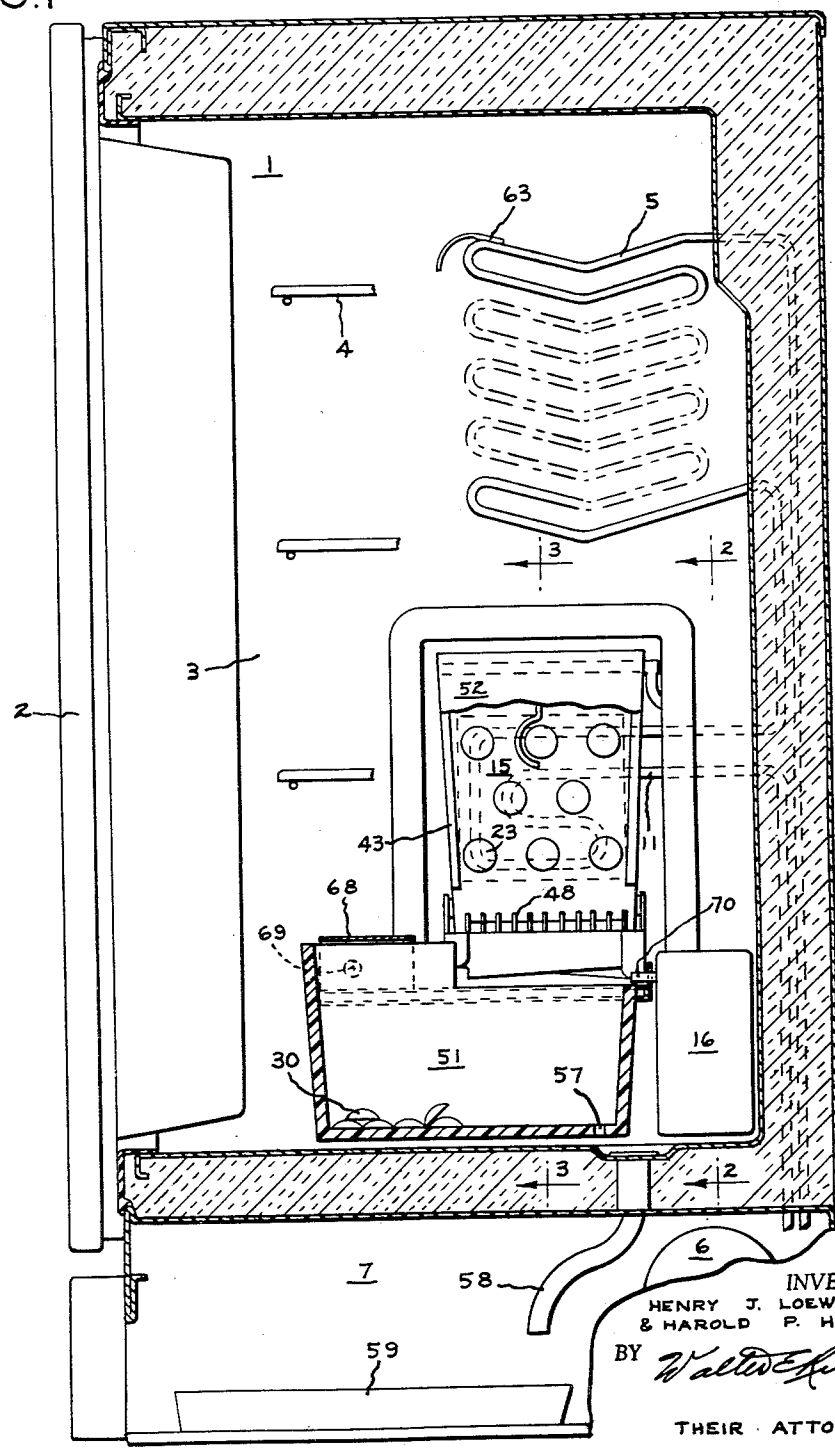
June 14, 1960 H. J. LOEWENTHAL ET AL 2,940,276

AUTOMATIC ICE MAKER

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FIG. 1



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FIG. 2

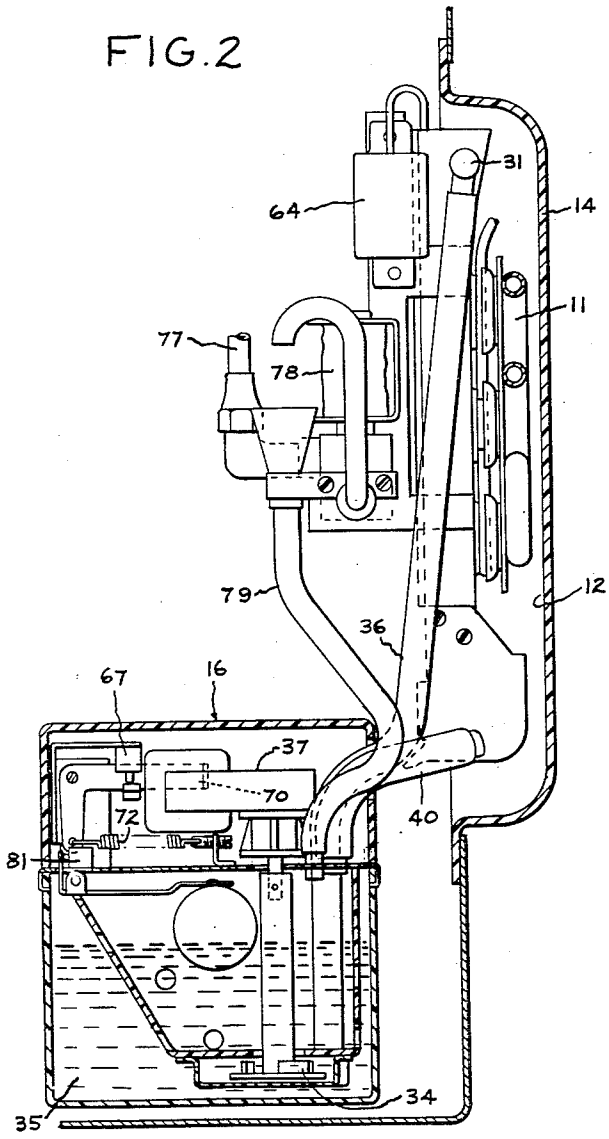
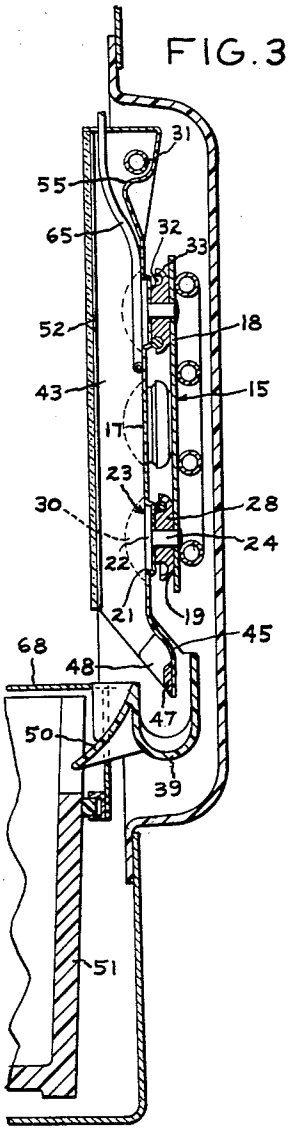


FIG. 3



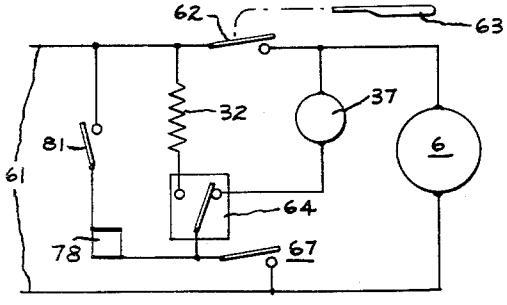


FIG. 4

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AUTOMATIC ICE MAKER

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3 Claims. (Cl. 62—138)

The present invention relates to an automatic ice maker and is particularly concerned with an automatic ice maker designed as an accessory for a household refrigerator.

It is a general object of the present invention to provide an improved automatic ice maker of simple and compact construction for use in a household refrigerator.

Another object of the present invention is to provide an ice maker particularly adapted to be incorporated in the fresh food compartment of a household refrigerator and so constructed and arranged that the space required for the ice maker is held to a minimum.

Further objects and advantages of the invention will become apparent as the following description proceeds and the features of novelty which characterize the invention will be pointed out with particularity in the claims annexed to and forming part of this specification.

In accordance with the present invention, there is provided an ice maker designed as an accessory for a household refrigerator having a cooperating evaporator element vertically arranged along an inner side wall of a refrigerated compartment. Preferably, the evaporator is disposed in a recessed portion of the side wall. The ice maker includes an ice making component or element which is arranged in the recess in heat exchange relationship with the evaporator and a water supply component suitably mounted within the fresh food compartment of the refrigerator. The ice making element comprises a substantially vertical face sheet providing an ice making surface, a rear sheet for mounting the element in heat exchange relationship with the evaporator and a heater support and heater sandwiched between the two sheets for periodically warming the face sheet to ice releasing temperatures. The face sheet is provided with a plurality of spaced indentations of depressions for receiving metal buttons, the shank portions of which extend through the sheets and the heater support and are headed or riveted over onto the rear sheet to fasten the sheets and heater support together. By providing a continuous flow of water over the front surface of the face sheet by means of a pump forming part of the reservoir component, refrigeration of the metallic buttons through contact of the rear sheet with the evaporator causes ice pieces to form on the buttons. Excess water collects in a trough arranged below the ice making element and is returned to the reservoir. For the purpose of obtaining an even distribution of water over the face sheet, the upper portion of this sheet is formed to provide a horizontal ledge onto which water is directed from a water distribution tube connected to the outlet end of the water pump. In order to separate the ice pieces periodically released from the ice making element by energization of the heater from the base sheet or plate, the lower end of the face sheet includes a downwardly and rearwardly extending portion and a grid positioned in this portion of the face sheet having a plurality of spaced teeth which bridge the gap between the trough and the sheet. These teeth break the adherence of the wet ice pieces for the sheet and

direct the ice pieces over the forward edge of the trough and into a suitable storage container.

For a better understanding of the invention reference may be had to the accompanying drawings in which:

Fig. 1 is a vertical sectional view of a household refrigerator including the automatic ice maker of the present invention;

Fig. 2 is a sectional view along line 2—2 of Fig. 1;

Fig. 3 is a sectional view along line 3—3 of Fig. 1; and

Fig. 4 illustrates a control circuit suitable for the automatic control of the ice maker of the present invention.

With reference to Fig. 1 of the drawing, the ice maker of the present invention is illustrated as an accessory for a household refrigerator comprising insulated walls defining a fresh food storage compartment 1 and an insulated door 2 for closing the access opening to that compartment. The ice maker is designed to be mounted within the storage compartment 1 along one side wall 3 thereof, it being understood that the remaining volume of the compartment 1 will be occupied by shelves 4 or the like for the storage of foodstuffs. For the purpose of cooling the contents of the compartment 1 there is provided an evaporator 5 arranged along the side wall 3 of the compartment through which refrigerant is circulated by means of a motor compressor unit 6 disposed in the machinery compartment 7 located below the fresh food compartment 3. Also, as part of the refrigerating system there is provided an ice maker evaporator 11 which in the illustrated embodiment of the invention is composed of a plurality of passes of refrigerant tubing arranged in a vertical plane within a recess 12 provided in the lower portion of the side wall 3, the walls 14 of the recess 12 preferably being made of a plastic or other heat insulating material.

The ice maker of the present invention broadly comprises an ice making element 15 adapted to be mounted in heat exchange relationship with the evaporator 11 and water supply means 16 adapted to be mounted in one of the rear corners of the compartment 1.

As is best seen from Figs. 2 and 3 of the drawing, the ice making element which is vertically arranged in contact with the evaporator 11 comprises a face sheet 17, a rear sheet 18 of metal or other good heat conducting material and a heater support 19 sandwiched between these sheets. The face sheet which may be formed of stainless steel or the like is provided with a plurality of spaced circular offset portions forming depressions or recesses 21 for receiving the circular heads 22 of a plurality of buttons 23 composed of aluminum or the like and including shanks or stems 24 extending through the face sheet, the heater support and the rear sheet 18. The shanks are headed over or riveted on the outer surface of the rear sheet to hold the sheets and heater support together. By this arrangement, the heads 22 of the buttons are refrigerated or cooled to freezing temperatures by the evaporator 11, the heat flow path from the heads 22 including not only the shanks or stems 24 but also the circular elements 28 forming part of the heater support 19.

When a film of water is directed over the face sheet 17 from a supply tube 31, localized refrigeration of the spaced areas of the face sheet 17 on and adjacent to the button heads 22 results in the formation of ice pieces shown in dotted lines and indicated by the numeral 30 on the face sheet 17. When these ice pieces have reached a suitable size, energization of the heating element 32 in the form of an electrical resistance heater looped about the various elements 28 and held in engagement with the rear surface of the face sheet 17 by means of the flanges 33 provided on the elements 32 is used to override the refrigerating effect of the evaporator 11 and melt the bond between the ice pieces 30 and the button heads

22 so that the ice pieces slide downwardly over the surface of the face plate 17.

The supply tube 31 positioned above the buttons is connected to pump 34 positioned in the lower part of the reservoir 35 through the tube 36. An electric motor 37 is provided in the upper portion of the water supply component 16 for driving the pump 34. In order to assure immediate and relatively uniform distribution of the water over the face sheet 17 this sheet has formed in the upper portion thereof and immediately below the discharge tube 31 a ledge 55 extending in a substantially horizontal direction or plane. By means of this ledge 55 and by providing a plurality of spaced outlets in the distribution tube 31, a thin continuous film of water flows downwardly over the entire front surface of the face sheet 17. For the purpose of containing the water discharged from the distribution tube 31 on the sheet 17, this sheet is preferably provided with flanges 43, only one of which is shown, along its side edges and preferably also as shown in Fig. 1 of the drawing these side edges taper toward the bottom of the face sheet 17 in order to assure a continuous film of water over all of the freezing areas of the face sheet 17. Excess water from the plate 17 is caught in a drain trough 39 disposed directly below the main or button containing portion of the face sheet 17 and is returned to the reservoir through the drain tube 40.

In order to assure separation of periodically released ice pieces from the sheet 17, the lower end of the face sheet is bent rearwardly and downwardly as indicated by the numeral 45 and a grid 47 is disposed in this area. The contour of the sheet at this point is such that the thin film of water flowing downwardly thereover will adhere to the surface of the sheet and be carried back-over the trough 39. The grid 47 is provided with a pluraltiy of downwardly and forwardly extending teeth 48 horizontally spaced along the length of the grid which is attached to the face sheet 17 in the area of the contoured portion 45 in such a manner that the teeth 48 will cause the sliding ice pieces to separate from the face sheet and be discharged forwardly over the front edge of the trough 39, an apron 50 on the forward edge of the trough 39 providing means for discharging the ice pieces into a receptacle 51 positioned within the compartment 1 below and in front of the ice making element 15. A cover plate 52 extending between the flanges 43 of the face sheet 17 prevents water from splashing off the face sheet 17 and into the storage compartment 1 and also helps to insulate the ice making element from the normally higher storage compartment temperature.

Upon operation of the refrigerating unit to cool the evaporator 11, the button heads 22 are maintained at sub-freezer temperatures so that during the time water flows over the sheet 17 there is gradually formed thereon the ice pieces 30. The excess water flowing downwardly off the lower edge portion of the face sheet 17 into the trough 39 returns to the reservoir through the drain tube 40. When the ice pieces 30 have reached their desired size, energization of the heater 32 provides sufficient heat to override the refrigerating effect of the evaporator 11 so that the bond between the ice pieces 30 and the face sheet, primarily the button heads 22, is broken whereupon the ice pieces, while still adhering to the face sheet 17 because of the wet surfaces thereof in contact with the sheet, slide downwardly into contact with the grid teeth 48. The forwardly sloping grid teeth 48 disengage the ice pieces from the face sheet so that they are discharged over the front edge of the trough onto the apron 50 and into the storage receptacle 51.

Since these ice pieces are wet and are stored in a chamber or compartment 1 operating at above freezing temperatures, there is provided a drain hole 57 in the bottom of the storage container 51 so that meltage water can drain from this receptacle onto the bottom wall of the compartment 1 and be discharged from that compartment through a drain tube 58, and into drain pan 59 positioned in the machinery compartment where it is evaporated by the warming action of the compressor unit 6.

The control circuit for automatically controlling the operation of the ice maker and the refrigerating system of the compartment 3 is illustrated in Fig. 4. In this figure like reference numerals are used to indicate like parts. With reference to Fig. 4, it will be seen that the compressor 6 is connected across the supply lines 61 through a temperature responsive cold control switch 62 which is designed to close when the sensing element 63 contacting the main evaporator 5 senses a temperature slightly above freezing and to open when the element 63 senses a temperature well below freezing as for example 0° F. Thus, the evaporator 5 for cooling the compartment 3 fluctuates the temperature between the defrosting temperature slightly above freezing and a temperature of about 0° F. in order to maintain the compartment 1 at refrigerating but above freezing temperatures. The heater 32 and the water pump 37 are connected across the line 61 through a double-pole switch 64 which is thermostatically controlled in response to the change in temperatures sensed by a sensing bulb 65 positioned adjacent one of the button heads 22, the switch 64 being designed to energize the water pump 37 whenever the sensing element 65 senses a temperature above freezing, i.e., the temperature of the water flowing over it from the reservoir, and to de-energize the water pump 37 and energize the heater 32 whenever the ice pieces 30 have grown to the point where one of them contacts the sensing element 65, and reduces the temperature thereof thus indicating that the pieces are ready to be harvested. After freezing of the ice pieces, switch 64 resets the unit for making another batch of ice by conditioning the pump circuit for energization whenever switch 62 is closed.

By the control circuitry, it will be seen that while the harvesting of the ice pieces 30 is partly independent of the compartment cold control switch 62, so that harvesting can take place when the switch 62 is closed, the controls are so arranged that the water pump 37 is controlled by switch 62 so that it is shut off whenever the refrigerating unit cycles off. This allows the ice forming areas on the face sheet 17 to quickly pull down to evaporator temperatures and trip the control switch 64 to energize the heater. By this arrangement harvesting of ice which has not grown to full size is obtained during the off cycles, which ice would otherwise completely melt if the water pump continued to circulate water over the face sheet 17 during the time the compressor 6 is not running.

In order to discontinue the ice melting operation when the desired amount of ice is collected in the container 51, switch means responsive to the weight of the ice in this container is provided for de-energizing the entire ice making element circuitry. For this purpose the container 51 is slidably arranged in a guide frame 68 which is pivotably supported as indicated at 69 adjacent the front of the frame. The rear end of the frame is supported solely by a switch control arm 70 for operating the switch 67 provided in the control circuit between the switch 64 and one of the lines 61. A spring 72 normally biases switch 67 to a closed position. When the weight of the ice in the container 51 overcomes the biasing action of the spring 72, the switch is opened to de-energize both the heater 32 and the waterpump 37.

As the water in the reservoir 35 is gradually consumed in the manufacture or formation of ice pieces 30, means are also provided for automatically replenishing the supply of water. For this purpose there is provided a supply line 77 connected to a source of fresh water and a solenoid operated valve 78 for controlling the flow of water from the supply line 77 into the inlet tube 79 on the reservoir 35. As it will be seen from Fig. 4 of the drawing, the solenoid valve 78 is connected across the

supply lines 61 through a float switch 81 and the bin control switch 67. The float switch 81 is designed to open valve 78 when the supply of water in the reservoir 35 reaches a predetermined low level and to close when it reaches a predetermined high level.

While there has been shown and described a particular embodiment of the present invention, it will be understood that modifications may be made by those skilled in the art without actually departing from the invention. It is intended therefore in the appended claims to cover all such variations come within the true spirit and scope of the invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. In combination, a refrigerator cabinet including inner side walls defining a storage compartment, one of said walls having a recess therein, a tubular evaporator comprising a plurality of passes disposed in a vertical plane in said recess, an ice making element vertically disposed in said recess in front of said evaporator, said element comprising spaced vertical face and rear sheets, said face sheet being formed to have a plurality of depressions therein, said rear sheet being in heat exchange relation with said evaporator, a heater support disposed between said sheets and including flanged elements in contact with the rear surfaces of said depressions, an electrical heater carried by said heater support and including loops supported on said flanged elements between the flanges thereof and the face sheet, metal buttons having head portions disposed in said depressions and shank portions extending through said sheets and said flanged elements for securing said sheets and said heater support together, means for flowing a film of water downwardly over said face sheet including a water distribution tube horizontally arranged adjacent the upper end of said face sheet, said face sheet having a horizontally extending ledge formed in the front side thereof above said buttons and below said tube for distributing water across the front surface of said face sheet, a trough arranged below said element, said face sheet including a downwardly and rearwardly extending lower portion below said buttons for directing water flowing over said sheet into said trough, means for periodically energizing said heater to release ice pieces formed on said buttons whereby said ice pieces slide down the front side of said face sheet, and a grid positioned on said lower portion of said face sheet and having teeth for disengaging said ice pieces from said face sheet.

2. In combination, a refrigerator cabinet including inner side walls defining a storage compartment, one of said walls having a recess therein, an evaporator in said recess, an ice making element in heat exchange relation with said evaporator, said element comprising spaced face and rear sheets, said face sheet being arranged in a substantially vertical plane and being formed to have a plurality of depressions therein, said rear sheet being in heat exchange contact with said evaporator, a heater support disposed between said sheets and including flanged elements in contact with the rear surfaces of said depressions, an electrical heater carried by said heater support and including loops supported on said flanged elements and clamped between the flanges thereof and the face sheet, metal buttons having head portions disposed in said depressions and shank portions extending through said sheets and said flanged elements for securing said sheets and said heater support together, a water supply and distribution tube horizontally arranged adjacent the upper end of said face sheet for flowing water over said face sheet and buttons, a trough arranged below said element for receiving water flowing from said face sheet, said face sheet including a downwardly and rearwardly extending lower portion below said buttons for directing water flowing over said sheet into said trough, and a grid positioned on said lower portion of said face sheet above said trough and having teeth for disengaging said ice pieces from said face sheet and directing said pieces over the front edge of said trough for discharge into an ice piece storage receptacle.

3. In combination, a refrigerator cabinet including inner side walls defining a storage compartment, one of said walls having a recess therein, a tubular evaporator comprising a plurality of passes disposed in a vertical plane in said recess, an ice making element vertically disposed in said recess in front of said evaporator, said element comprising spaced face and rear sheets, said face sheet being formed to have a plurality of depressions therein, said rear sheet being in heat exchange relation with said evaporator, a heater support disposed between said sheets and including flanged elements in contact with the rear surfaces of said depressions, an electrical heater carried by said heater support and including loops supported on said flanged elements between the flanges thereof and the face sheet, metal buttons having head portions disposed in said depressions and shank portions extending through said sheets and said flanged elements for securing said sheets and said heater support together, a water reservoir in said compartment, a water distribution tube horizontally arranged adjacent to the upper end of said face sheet, a pump for supplying water from said reservoir to said tube, said face sheet having a horizontally extending ledge formed in the front side thereof above said buttons and below said tube for distributing water across the front surface of said face sheet, a trough arranged below said element, said face sheet including a downwardly and rearwardly extending lower portion below said buttons for directing water flowing over said sheet into said trough, means for periodically energizing said heater to release ice pieces formed on said buttons whereby said ice pieces slide down the front side of said face sheet, said trough including an apron on the front side thereof below said face sheet, a grid positioned on said lower portion of said face sheet having teeth disengaging said ice pieces from said face sheet and directing said pieces onto said apron for discharge into an ice piece storage receptacle.

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