

April 16, 1957

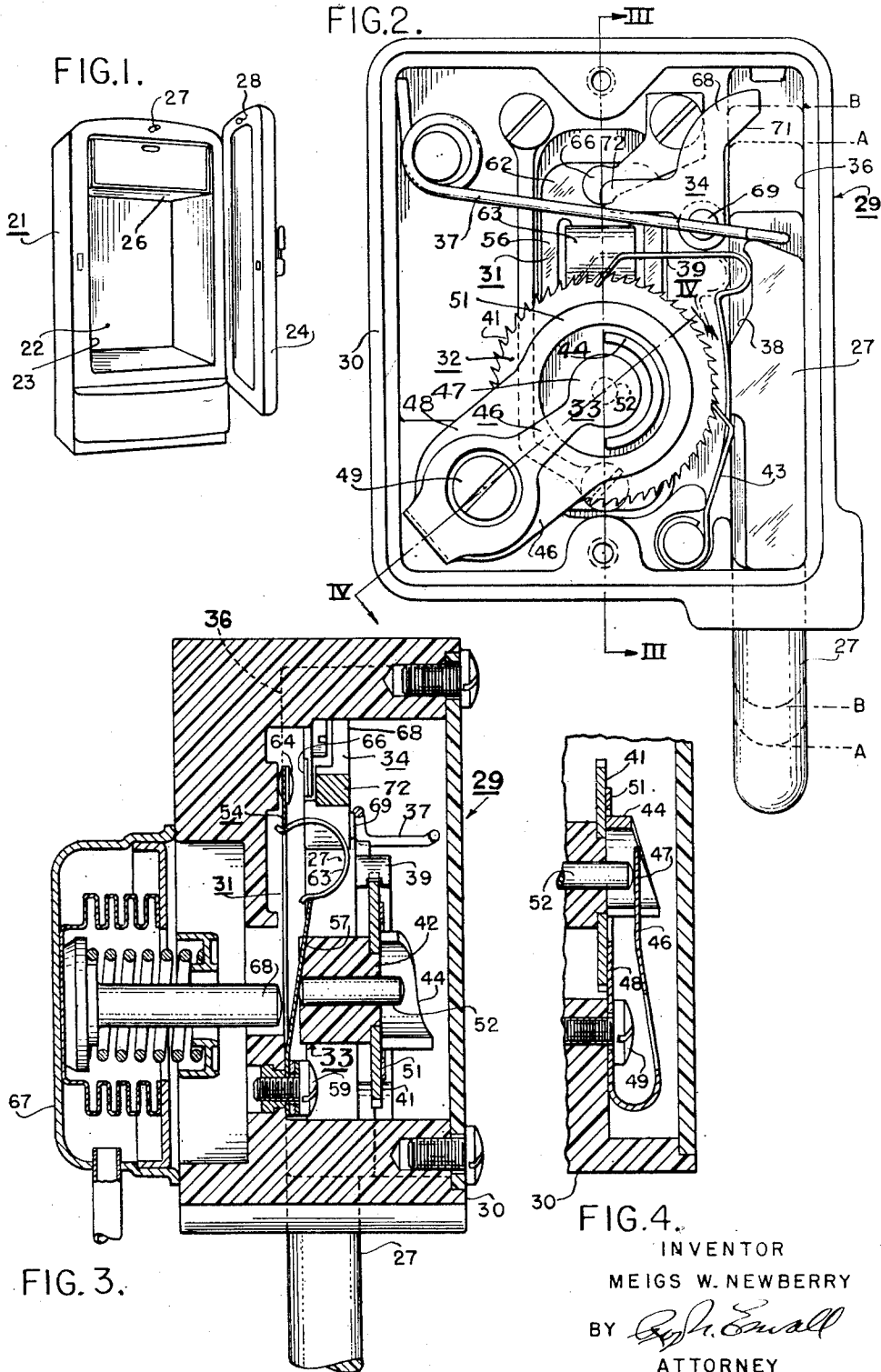
M. W. NEWBERRY

2,788,640

CONTROL FOR REFRIGERATION APPARATUS

Filed Dec. 23, 1954

3 Sheets-Sheet 1



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CONTROL FOR REFRIGERATION APPARATUS

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FIG. 7.

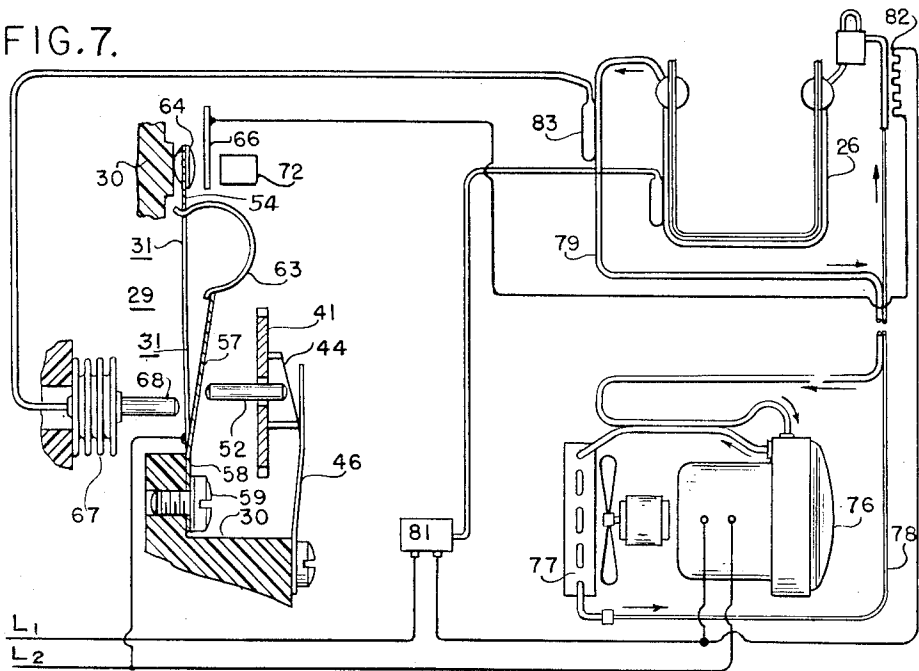


FIG. 5.

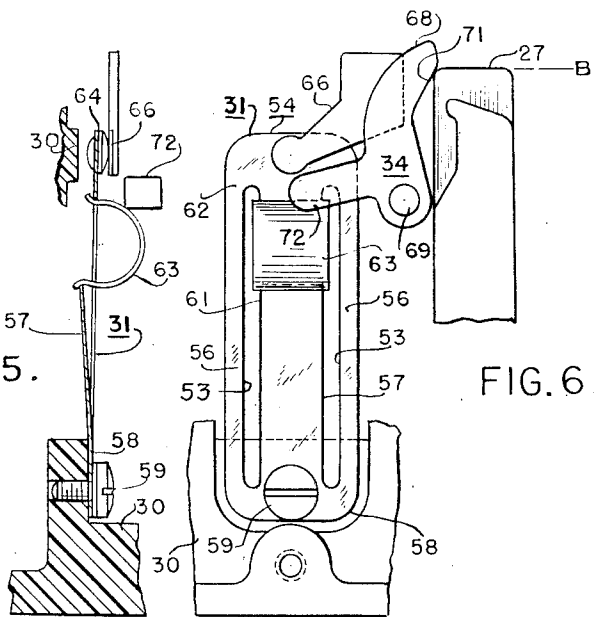


FIG. 6.

INVENTOR

MEIGS W. NEWBERRY

BY

R. H. Ewall

ATTORNEY

April 16, 1957

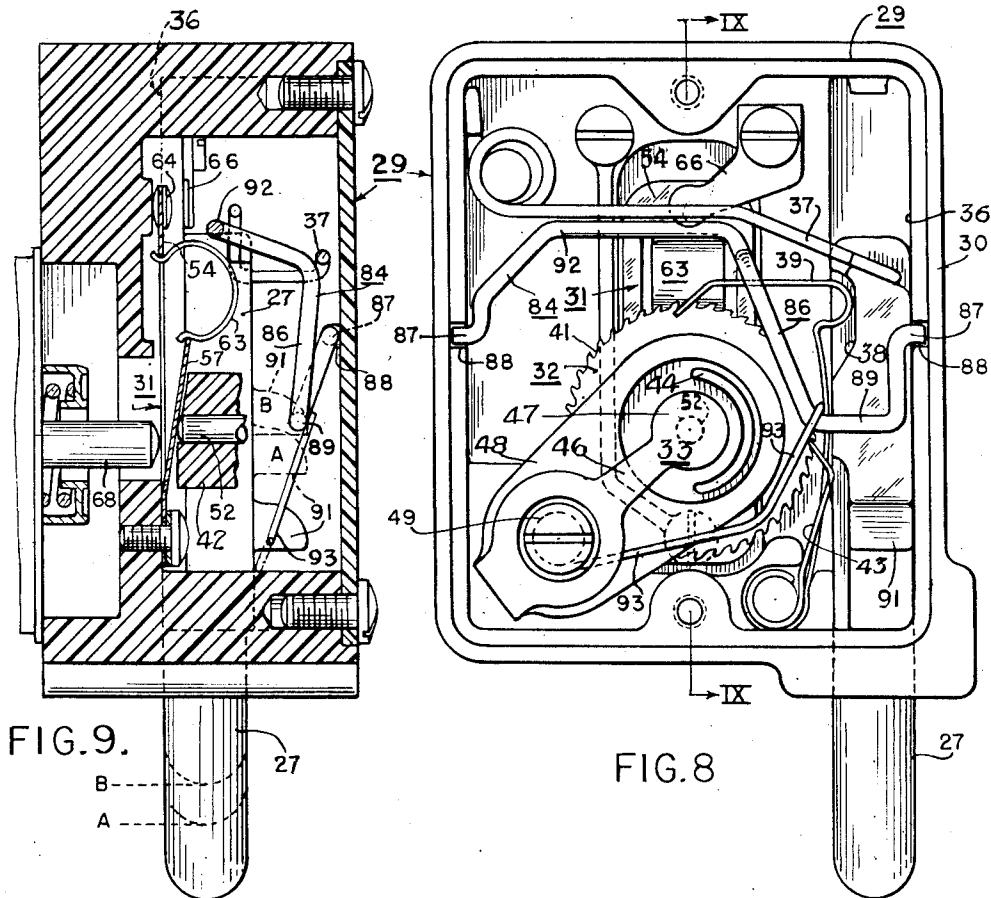
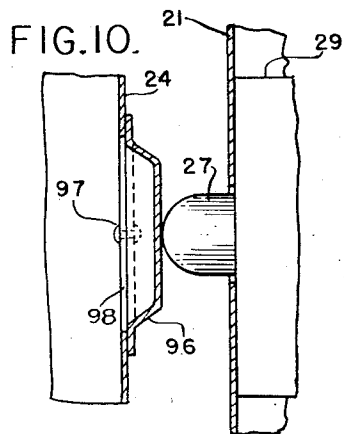
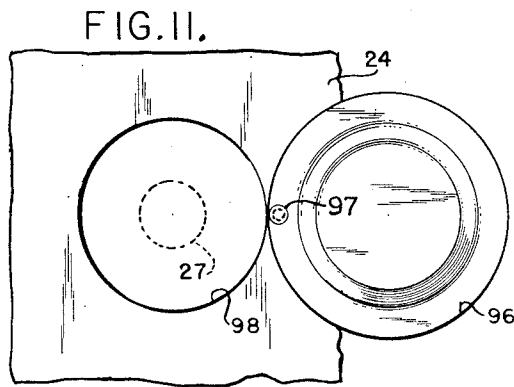
M. W. NEWBERRY

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CONTROL FOR REFRIGERATION APPARATUS

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3 Sheets-Sheet 3



INVENTOR
MEIGS W. NEWBERRY
BY *Robert E. Enall*
ATTORNEY

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2,788,640

CONTROL FOR REFRIGERATION APPARATUS

Meigs W. Newberry, South Windsor, Conn., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application December 23, 1954, Serial No. 477,187

5 Claims. (Cl. 62—4)

This invention relates to refrigeration apparatus and more particularly to means for initiating and controlling an operation whereby the cooling unit of a domestic refrigerator is defrosted.

Many present-day domestic refrigerators are equipped with automatic means for periodically raising the temperature of the cooling unit to melt frost which has collected thereon. These refrigerators are provided with controls which are responsive to certain operations of the refrigerator and which initiate the defrosting operation whenever it is needed. A control specifically designed for this application is described and claimed in Patent No. 2,595,967, granted May 6, 1952, to G. S. McCloy and assigned to the assignee of the present invention. This control is responsive to the opening and closing of the refrigerator cabinet door and is adapted to initiate a defrosting operation whenever the door has been opened and closed a predetermined number of times. Controls of this type effectively limit the frost accumulation on the refrigerator cooling unit, and do so automatically with no supervision by the housewife or other user of the refrigerator. It is desirable, however, in some instances to have a more flexible control for the defrosting operation; one which enables the housewife to initiate a defrosting operation at any time she desires to do so. For example, when the housewife cleans the interior of the refrigerator, she may wish to rapidly defrost the cooling unit in order that it might also be cleaned at that time. With a rigid automatic defrost control, she would be unable to utilize the rapid defrosting means available unless her cleaning period coincided with a defrosting operation as determined by the control.

It is therefore an object of this invention to permit the user of an automatic defrosting refrigerator to initiate a defrosting operation at any time, independently of the automatic defrosting control means.

It is another object of this invention to provide control means for automatically initiating a defrosting operation of the refrigerator which also includes a provision for manual initiation of the defrosting operation independently of the automatic control means.

More specifically, it is an object of this invention to provide a defrost control means capable of automatically counting certain operations of a domestic refrigerator and for thereafter initiating a defrosting operation, and in which there is also a provision for initiating a manual defrosting operation.

A further object of the invention is to provide a novel means for actuating an electrical switch by several means responsive to different movements of a reciprocating operating member.

A still further object of the invention is to provide novel means for actuating an electrical snap switch.

These and other objects are effected by the invention as will be apparent from the following description taken in connection with the accompanying drawings, forming a part of this application, in which:

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Fig. 1 is a perspective view of a refrigerator cabinet embodying this invention;

Fig. 2 is a view of the defrost control of this invention with the housing cover removed;

Fig. 3 is a sectional view of a defrost control of this invention taken along the line III—IH of Fig. 2;

Fig. 4 is a fragmentary sectional view of the defrost control taken along line IV—IV of Fig. 2, and illustrating a portion of the switch actuating means of the control;

Fig. 5 is an edge view of the snap switch utilized in this control and showing the switch in a state of being actuated;

Fig. 6 is a plan view of the switch shown in Fig. 5;

Fig. 7 is a schematic drawing of a refrigeration circuit with the control of this invention applied thereto;

Fig. 8 is a view of a modified version of the defrost control with the housing cover removed;

Fig. 9 is a sectional view of the modified control taken along line IX—IX of Fig. 8;

Fig. 10 is a fragmentary view of a portion of the refrigerator door and cabinet showing the relationship between the defrost control operating member and the door striker which actuates the member; and

Fig. 11 is a fragmentary view of the refrigerator door showing the striker member of Fig. 10 in an inactive position.

Referring to the drawings, especially to Fig. 1, the reference numeral 21 designates generally a refrigerator cabinet having a food storage compartment 22 provided with an access opening 23 in the front thereof which is closed by a door 24. The food storage compartment 22 is cooled by a cooling unit 26 positioned therein. Suitable refrigerating equipment, which will hereinafter be described, is provided for circulating refrigerant through the cooling unit 26 in a controlled manner to maintain the temperature of the cooling unit 26 below the freezing point of water.

During operation of the refrigerator, the cooling unit 26 accumulates frost which must be periodically removed to insure efficient operation of the refrigerator. Means are provided for periodically raising the temperature of the cooling unit to effect defrosting. This defrosting means is controlled both automatically and manually through the defrost control of this invention which has a reciprocating operating member, such as a plunger 27 protruding from the front of the refrigerator cabinet 21 in a position to be actuated by a door carried striker member 28 each time the cabinet door 24 is opened and closed.

The plunger 27 is the reciprocating operating member of the defrost control shown in Fig. 2 and indicated generally by the numeral 29. This defrost control 29 includes a housing 30 containing the principal components of the defrost control. These components are the reciprocating plunger 27, an electrical switch 31, a counting device 32 for counting the reciprocations of the plunger 27, switch actuating means 33 controlled by the counting means 32, and additional switch actuating means 34 for actuating the switch directly in response to movement of the plunger 27.

The plunger 27 rests in a channel 36 molded in one wall of the control housing 30 and is biased to the position shown in Fig. 2 by a spring 37, also carried by the housing 30. The channel 36 permits the plunger 27 to reciprocate with an axial movement. The plunger 27 is provided with a cam surface 38 for actuating a resilient L-shaped actuating dog 39. The free end of the dog 39 overlies and engages the toothed periphery of a ratchet wheel 41 journaled on a portion 42 of the control housing 30. It will be noticed that an inward movement of the plunger 27 (upward as viewed in Figs. 2 and 3), from the full line position shown in Fig. 2 to the dot

and dash line position A, cams the actuating dog 39 to the left rotating the ratchet wheel 41 in a counterclockwise direction. When released, the plunger 27 is returned to its full line position by the spring 37 permitting the actuating dog 39 to move to the right and pass over and pick up another tooth of the ratchet wheel 41. Reverse movement of the ratchet wheel 41 during the return motion of the plunger 27 is prevented by a resilient holding dog 43 preferably made integral with the actuating dog 39 and likewise carried by the control housing 30. It can thus be seen that each movement of the plunger 27 from its full line position in Fig. 2 to dot and dash line position A rotates the toothed ratchet wheel 41 an amount equal to the distance between two of its adjacent teeth, enabling the ratchet wheel 41 to record, by its movement, the number of reciprocations of the plunger 27.

The ratchet wheel 41 carries on the upper face thereof an arcuate, wedge-shaped cam 44 which rotates with the ratchet wheel 41 and is positioned to ride under and lift the free end of a spring member 46. The spring member 46 has a hairpin configuration in cross-section, as shown in Fig. 4, with the free leg 47 thereof spaced a short distance above the center of the ratchet wheel 41. The other leg 48 of the spring member 46 is secured to the control housing by means of a screw 49 and is provided with an enlarged, ring-shaped portion 51 which engages one face of the ratchet wheel 41 and retains the ratchet wheel on its mounting in the housing 30.

The ratchet wheel 41 together with the actuating dog 39 and the cam 44 comprise the counting means 32 of the control 29. As the ratchet wheel 41 rotates in response to reciprocating movements of the plunger 27, the cam 44 is progressively moved under the free leg 47 of the spring member 46 until the highest point of cam 44 is reached; after which the cam moves out from under spring element 46 permitting the spring element to snap to the left, as viewed in Fig. 4. This raising and releasing motion of the spring member 46 takes place once during each complete revolution of the ratchet wheel 41, and will occur after the plunger 26 has undergone a certain number of reciprocations as determined by the number of teeth on the ratchet wheel. The counting means 34 can, therefore, be said to count the reciprocations of the plunger 27 and condition the spring member 46 for operation after a predetermined number of reciprocations.

The spring member 46, when released by the cam 44, swings to the left as viewed in Fig. 4 and is carried beyond its neutral or relaxed position shown in Fig. 4 by its own inertia. In moving beyond its relaxed position, the spring member 46 strikes an actuating pin 52 slidably housed in the control housing 30 driving the pin to the left to actuate electrical switch 31.

The electrical switch 31 is of a snap-acting variety, and is shown more clearly in Figs. 5 and 6. The switch 31 is preferably formed from a single sheet of thin resilient material having a generally U-shaped slot 53 cut therein in such a manner that the remaining material forms an outer contact carrying member 54 having a pair of elongated legs 56, and a shorter inner cooperating member 57 which is joined to the legs 56 of the contact carrying member at the fixed end 58 of the switch 31. The switch 31 is attached to the control housing 30 by a screw 59 passing through the fixed end 58 of the switch. The inner cooperating member 57 has its free end 61 spaced from the free end 62 of the contact carrying member 54 to receive a compressible, resilient U-shaped spring 63 which is compressed between the free ends of the contact carrying member 54 and the cooperating member 57. The U-shaped spring 63 biases the free ends of members 54 and 57 away from one another in such a manner that, when one of the members is moved toward and through the plane of the other, the other member is snapped in the opposite direction to a

new position opposite that now assumed by the member which has been moved. In so doing, the U-shaped spring 63 undergoes a tilting motion apparent from a comparison of the positions of spring 63 in Figs. 3 and 5.

When the defrost control 29 is in a non-controlling state, i. e., the refrigerator is undergoing a refrigerating operation and the defrosting means is not energized, the electrical switch 31 assumes the position shown in Fig. 3. In this position, the cooperating member 57 of the switch 31 is deflected toward the actuating pin 52 and in a position to be struck by the pin 52 when the pin is driven by the spring member 46. A blow received by the cooperating member 57 in this position moves the member 57 to its opposite position (to the left as viewed in Fig. 3) causing the contact carrying member 54 to snap to a position opposite to that which it formerly assumed (to the right as viewed in Fig. 3). The switch members 54 and 57 are returned to the positions shown in Fig. 3 by a thermostatic control element 67 operating through a plunger 68 positioned to engage the cooperating member 57 of the switch 31.

The contact carrying member 54 carries a movable contact 64 which cooperates with a fixed contact 66 carried by the control housing 30. These contacts control an electrical circuit to the defrosting means.

From the foregoing, it can be seen that the switch 31 is actuated under control of the counting means 32 each time the plunger has undergone a number of reciprocations as are produced when the refrigerator door 24 is opened and closed. With the switch contacts 64 and 66 controlling an electrical circuit to a defrosting means, as will hereinafter be explained, the defrosting means will be periodically and automatically energized to remove frost from the refrigerator cooling unit.

The control of this invention also provides for initiation of a defrosting operation by the user of the refrigerator at any time, independently of the automatic feature of the control. The actuation of switch 31 for manual initiation of a defrosting operation is accomplished through the additional switch actuating means 34 which transmits motion of the plunger 27 directly to the switch. This additional switch actuating means 34 consists of a bell crank 68 pivotally mounted at 69 in the housing 30 in such a manner that one cam shaped arm 71 thereof lies in the path of travel of the plunger 27. Another arm 72 of the bell crank 68 acts as a switch actuating member and is positioned in such a manner that when the bell crank is rotated about its pivot 69, the arm 72 engages the U-shaped spring 63 of the switch 31.

The relationship between the actuating arm 72 of bell crank 68 and U-shaped switch spring 63 is illustrated most clearly in Figs. 3, 5 and 6. It will be noted that the plane of movement of the bell crank is substantially parallel to and spaced from the general plane of the switch 31. The bell crank actuating arm 72 is positioned to engage the U-shaped switch spring 63 in an area farther displaced from the contact carrying member 54 than the amount that the free end of cooperating member 57 is displaced from the contact carrying member 54. When the bell crank actuating arm 72 engages the U-shaped spring 63 in this area, it imparts to the U-shaped spring a tilting or rocking motion of the spring causing the members 54 and 57 of switch 31 to reverse their positions. It will be noted from the positions of the elements shown in Figs. 3, 5 and 6 that, in order to actuate the contact carrying member 54 from the position shown in Fig. 3 to the position shown in Fig. 5, the actuating arm 72 engages the convex surface of the U-shaped spring 63 between the middle thereof and its point of engagement with the free end 62 of the contact carrying member 54. Actuation of the switch 31 in this manner can take place when the contact carrying member 54 is in that one of its positions (the Fig. 3 position) which is farthest displaced from the actuating arm 72.

The defrost control 29 is mounted within cabinet 21

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in such a position that door 24 moves plunger 27 inwardly only to dot and dash line position A of Fig. 2, as mentioned previously. Reciprocation of plunger 27 within this range of movement does not bring the end of the plunger into engagement with bell crank 68. Hence, the additional switch actuating means 34 is not brought into operation when the control is actuated automatically by the opening and closing of the cabinet door. Plunger 27 may, however, be moved farther into housing 30, to dot and dash line position B of Fig. 2, by manually pushing on the plunger.

Figs. 5 and 6 illustrate the relative positions of the plunger 27, the actuating means 34 and the switch 31 as the plunger 27 is pushed to dot and dash line position B of Fig. 2 to actuate switch 31. The cam shaped arm 71 of bell crank 68 has been engaged by the end of plunger 27, forcing the bell crank 68 to move in a counterclockwise direction. The actuating arm 72 has engaged U-shaped spring 63 causing the spring to rock on its connections with the switch members 54 and 57 and contact carrying member 54 has snapped to its contact closed position.

Fig. 7 illustrates the application of the improved defrost control to an automatic defrosting refrigerating circuit. The circuit shown is a compression-expansion type comprising a motor compressor unit 76 which compresses gaseous refrigerant subsequently to be condensed in an air cooled condenser 77, a capillary tube expansion device 78 for conveying condensed refrigerant to the evaporator type cooling unit 26, and a suction conduit 79 for conveying gaseous refrigerant back to the motor compressor unit 76. The motor compressor unit 76 is intermittently energized from lines L¹ and L² under control of a temperature-responsive thermostat 81 to maintain the temperature of the cooling unit 26 substantially constant. The refrigerating system is equipped with an automatic defrosting arrangement which includes an electric heating element 82 arranged to heat refrigerant flowing into the cooling unit 26 to raise the temperature of cooling unit 26 to above the freezing point of water to melt frost therefrom. The particular arrangement for effecting a rise in temperature of the cooling unit forms no part of the present invention and no detailed description is deemed necessary here. A number of defrosting systems have been devised to which the present defrost control could be applied. One of these systems is described and claimed in Patent No. 2,459,173, granted January 18, 1949, to G. S. McCloy and assigned to the assignee of the present invention. The particular arrangement of the electric heater 82 illustrated in the drawings is intended to be only symbolic of the various arrangements which could be utilized in connection with this invention. In the arrangement shown, the heater 82 is under dominant control of the defrost control 29 of this invention and is energized from lines L¹ and L² through contacts 64 and 66 of the defrost control switch 31. Heater 82 is also energized through temperature control thermostat 81 to insure that the heater will be energized only when the motor compressor unit 76 is energized and refrigerant is circulating through the system. As shown in Fig. 7, defrost control switch 31 is in a non-controlling position in which contacts 64 and 66 are separated, heater 82 is deenergized, and the refrigeration circuit is undergoing a refrigerating operation. When the control 29 is permitted to operate automatically, switch 31 will be actuated to its closed position to energize heater 82 and initiate a defrosting operation after plunger 27 has been reciprocated a predetermined number of times by the opening and closing of the refrigerator door. The thermostatic control element 67 returns switch 31 to its open position (as shown in Fig. 7) to terminate the defrosting operation automatically when the temperature of the suction conduit 79 reaches a predetermined value indicating that the temperature of the cooling unit 26 has been raised sufficiently

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to melt the frost thereon. The thermostatic control 67 senses the temperature of the suction conduit 79 by means of a control bulb 83 attached to the suction conduit 79, all of which is well understood in the art and no detailed description thereof is deemed necessary.

Defrost control switch 31 may also be actuated to its closed position manually by pushing plunger 27 all the way in causing bell crank 68 to engage the U-shaped switch spring 63 to actuate the switch. The defrosting operation is terminated automatically by thermostatic control 67 as previously described for an automatic operation.

Figs. 8 and 9 illustrate a modified form of the defrost control 29. The switch 31, the counting means 32 and the actuating means 33 of this control are the same as those described in the first embodiment of the invention and like reference numerals have been used to indicate these assemblies and their components in the figures illustrating the modification.

The principal distinction between the two embodiments lies in the means for actuating the switch 31 in response to a manual movement of the plunger 27 beyond the range of reciprocating motion produced by the opening and closing of the refrigerator door. This modified switch actuating means is indicated generally by the reference numeral 84 and consists of a crank member 86 having trunnion-like end portions 87 journaled in recesses 88 in the control housing 30. The crank 86 is formed with a first throw arm 89 near one end thereof and positioned within the path of movement of a cam shaped projection 91 on the plunger 27. The intermediate portion of the crank member 86 is provided with another throw arm 92 positioned adjacent the U-shaped spring 37 of switch 31.

Fig. 9 illustrates in dot and dash lines the various positions that the cam 91 on plunger 27 will assume when the plunger is pushed into the control housing 30. During automatic operation of the defrost control 29, the plunger 27 is reciprocated between the full line position of Fig. 9 and dot and dash line position A by the opening and closing of the refrigerator door. During this range of movement, the cam 91 does not engage crank arm 89 and crank 86 is maintained in the full line position of Fig. 9 by a light spring 93. The plunger 27 is, however, as in the first embodiment, mounted in the control housing 30 in such a manner as to permit it to be moved inwardly to a further position in which cam 91 is positioned at B of Fig. 9. This movement of plunger 27 is effected manually by the user of the refrigerator by pushing on plunger 27. This additional movement of plunger 27 moves cam 91 under crank arm 89 of crank 86, moving arm 89 upwardly thereby effecting a counterclockwise motion of the crank 86, as viewed in Fig. 9. This motion of crank 86 moves arm 86 into engagement with the U-shaped switch spring 63 to actuate switch 31 and initiate a defrosting operation. The operation of the modified defrost control is otherwise the same as the embodiment previously described and is applied to a defrosting system as illustrated in Fig. 7.

Figs. 10 and 11 illustrate a further feature of the invention which enables the user of the refrigerator to disable or lock out the defrost control to prevent automatic operation thereof. This feature includes a door mounted striker 96 similar to that illustrated in Fig. 1 but mounted on the door 24 in such a manner as to permit the striker to be moved out of alignment with the defrost control plunger 27. As illustrated, the striker 96 is pivotally attached at 97 to the inner surface of door 24 to permit the striker 96 to be swung aside to uncover an opening 98 in the inner wall of door 24. With the striker moved to the position shown in Fig. 11, plunger 27 enters opening 98 when the door 24 is closed and no movement of the plunger 27 takes place. The automatic operation of the defrost control 29 is thereby halted but a defrosting operation may be initiated by manually pushing the plunger 27 all the way in.

It will be apparent from the above description that this invention provides an improved control system for defrosting a domestic refrigerator. The control herein described is capable of automatically initiating a defrosting operation in response to the amount of usage given the refrigerator. At the same time, the control permits the user of the refrigerator to initiate defrosting at any time it is desired and irrespective of the condition or stage of operation of the automatic control apparatus.

While I have shown my invention in several forms, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications without departing from the spirit thereof.

What is claimed is:

1. A control device comprising a switch movable between two positions, an operating member adapted for reciprocating movement between first and second positions and first and third positions, the movement of said member between its first and third positions being greater than the movement between its first and second positions, means for counting the reciprocations of said operating member between its first and second positions and for actuating said switch from one position to its other position after said member has undergone a predetermined number of reciprocations between said positions, and means for actuating said switch from said one position to its other position in response to movement of said operating member to its third position.

2. A control device comprising a switch movable between two positions, an operating member adapted for reciprocating movement between first and second positions and first and third positions, the movement of said member between its first and third positions being greater than the movement between its first and second positions, means for counting the reciprocations of said operating member between its first and second positions and for actuating said switch from one position to its other position after said member has undergone a predetermined number of reciprocations between said positions, and means for actuating said switch from said one position to its other position in response to movement of said operating member to its third position, said additional means comprising a pivotally mounted crank member having an arm positioned to be engaged by said operating member when the operating member is moved to its third position, said crank member having another arm adapted to engage a portion of said switch.

3. A refrigerator control device comprising a switch arranged for movement between two positions, an operating member adapted for reciprocating movement between first and second positions in response to opening and closing of the refrigerator door, said operating mem-

ber being further adapted for manual movement to a third position, means for counting the reciprocations of said operating member between its first and second positions, means controlled by said counting means for actuating said switch from one of its positions to its other position, and additional means for actuating said switch from its said one position to its other position in response to movement of said operating member to its third position.

4. A refrigerator control device comprising a switch arranged for movement between two positions, an operating member adapted for reciprocating movement between first and second positions in response to opening and closing of the refrigerator door, said operating member being further adapted for manual movement to a third position, means for counting the reciprocations of said operating member between its first and second positions, means controlled by said counting means for actuating said switch from one of its positions to its other position, and additional means for actuating said switch from its said one position to its other position in response to movement of said operating member to its third position, said additional means comprising a pivotally mounted crank member having an arm positioned to be engaged by said operating member when the operating member is moved to its third position, said crank member having another arm adapted to engage a portion of said switch.

5. A control mechanism comprising a snap switch including a circuit contacting member having a free end movable in a fixed path between two positions, a cooperating member having a free end movable in a fixed path between two positions, and a compressible resilient U-shaped spring disposed between and engaging the free ends of said members, the construction and arrangement being such that said spring undergoes maximum stress when the free ends of said members are substantially in alignment whereby said spring biases said members toward opposite positions, and means for actuating said snap switch, said means comprising an actuating member adapted to engage the convex surface of said U-shaped spring between the middle thereof and the point of engagement between the spring and the free end of one of the switch members when that switch member is in that one of its positions which is farthest from the actuating member.

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