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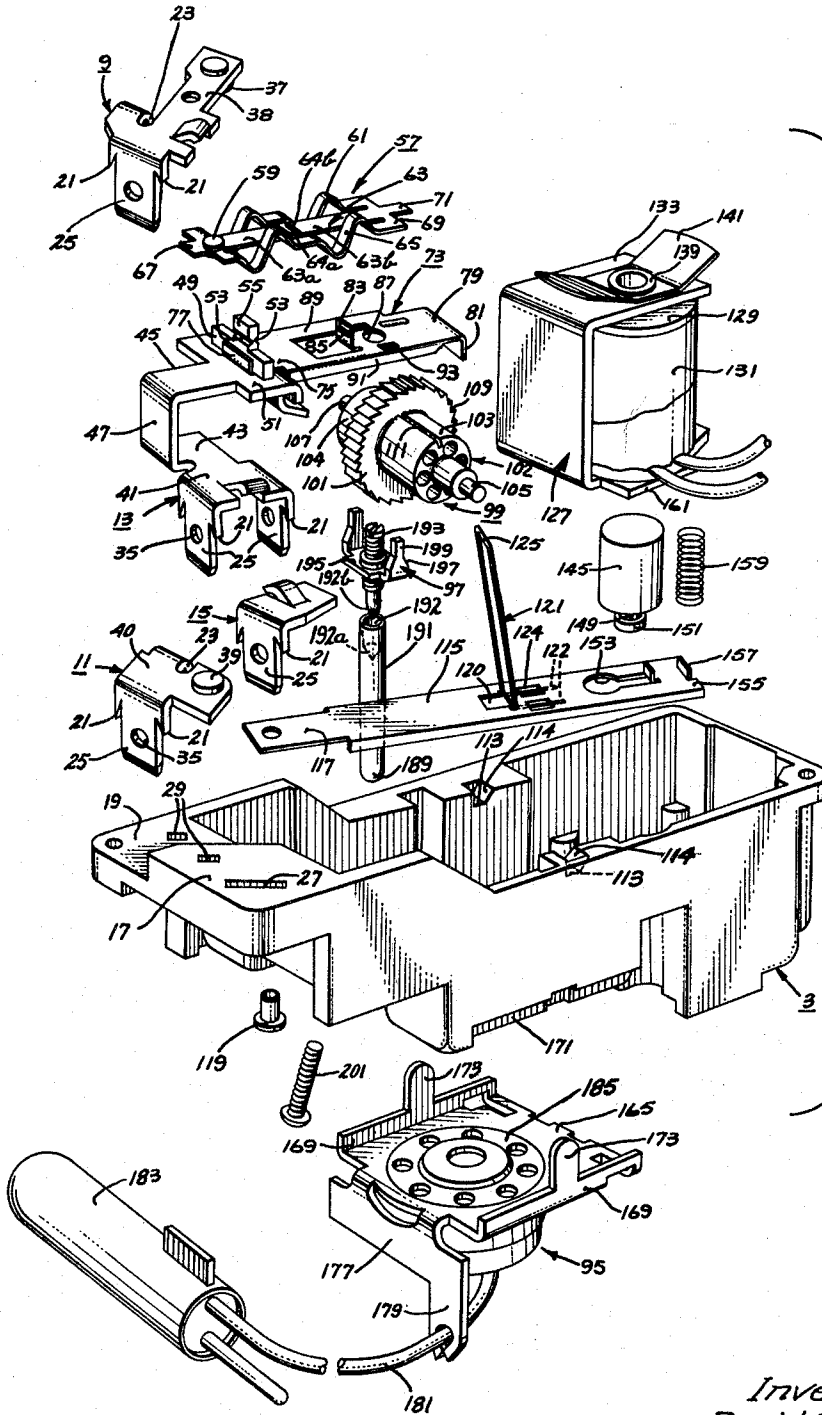
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3,169,179

REFRIGERATOR CONTROL DEVICE

Filed March 28, 1961

4 Sheets-Sheet 2



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Fig. 4.

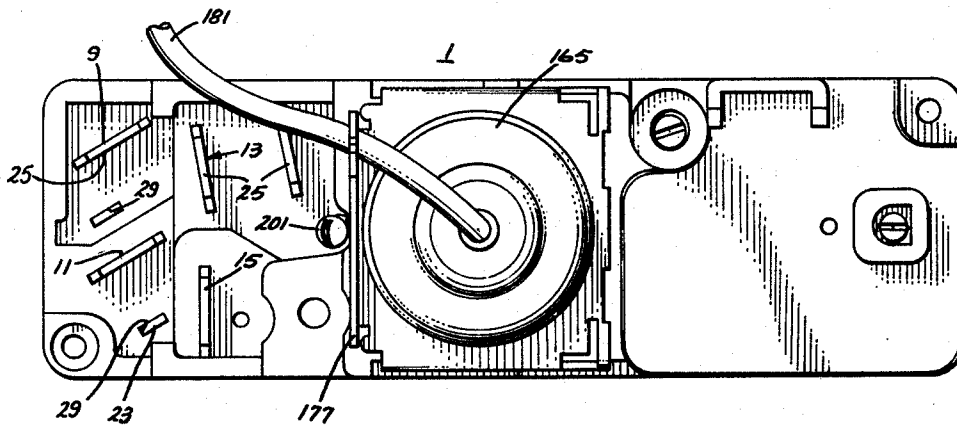
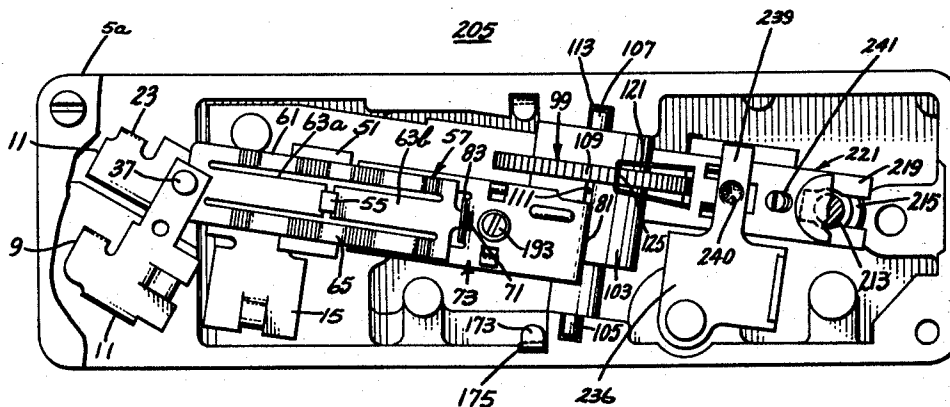


Fig. 5.



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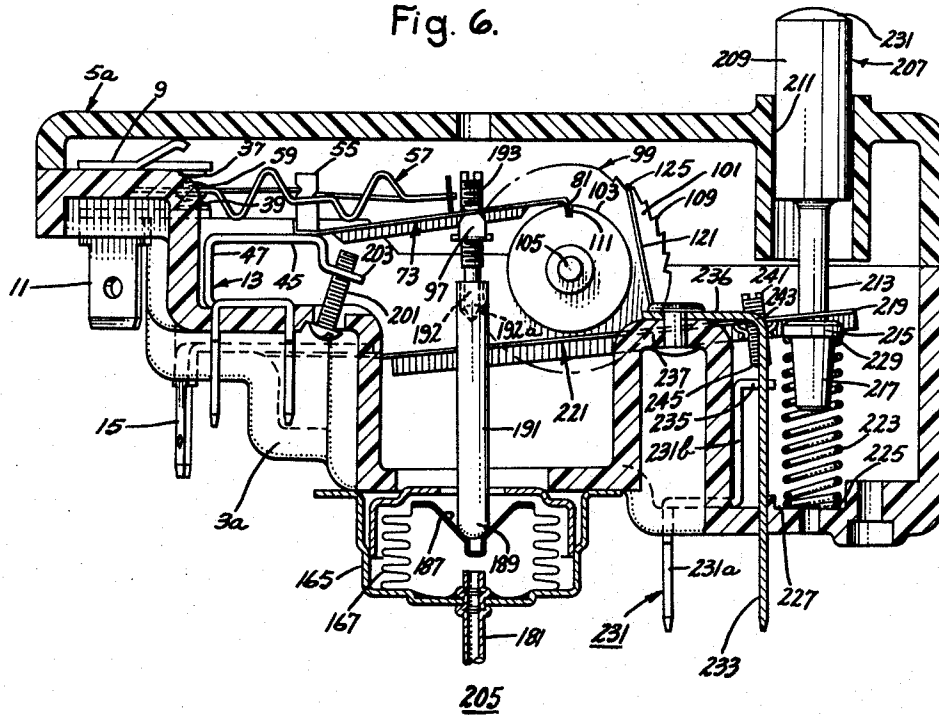
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Fig. 6.



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REFRIGERATOR CONTROL DEVICE

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14 Claims. (Cl. 200-61.69)

This invention relates to control devices for refrigerators, and more particularly to control devices for automatically defrosting household-type refrigerators and freezers.

It is well known that in household refrigerators and freezers there is a tendency for frost to form on the exterior surfaces of the evaporator. The accumulation of this frost progressively lowers the efficiency of the unit as the thickness increases, since the frost is essentially an insulating blanket surrounding the evaporator. Such frost is formed by the admission of moist air into the interior of the refrigerator or freezer when the door is open.

In the design of household refrigerators and freezers, it is desirable to provide a means for periodically and automatically removing the frost which is formed on the evaporator. This may be accomplished by providing an auxiliary heating means, such as for example a resistance heater, which will rapidly melt the frost formation from the evaporator when the compressor motor has been deenergized. This particular defrosting control must, therefore, deenergize the compressor motor and energize the auxiliary heater in response to some predetermined condition or combination of conditions and subsequently reenergize the compressor motor and deenergize the auxiliary heater.

A number of different types of automatic defrosting systems for domestic household refrigerators have been provided in the past. In one of these systems, the compressor motor is deenergized and the auxiliary heater is energized after a predetermined number of compressor cycles. In another system, provision is made for deenergizing the compressor motor and energizing the heater after a predetermined number of openings of the refrigerator door. One other system which has been used is a combination of the first two systems mentioned, wherein the compressor motor is deenergized and the auxiliary heater is energized after a predetermined aggregate number of compressor cycles and door openings. Prior art defrost controls used in these aforementioned systems have been found to be somewhat complicated in structure, thereby adding appreciably to the overall cost of the control mechanism. In addition, the configuration of the various complementary parts of the control mechanism usually eventuates in a mechanism which is inflexible in its application and has a relatively large configuration.

It has, therefore, become desirable to provide a defrost control which is simple in construction and readily manufacturable, thereby contributing to a substantially lower over-all cost. It is further desirable that such a control be very flexible in its application and relatively small in size. It is additionally desirable that such a control be sturdy and compact.

Accordingly, an important object of my invention is to provide an improved defrost control which due to its relative simplicity may be manufactured at a reduced cost.

Another object of my invention is to provide a defrost control which is simple in structure and has an improved flexibility of application.

A further object of my invention is to provide a defrost control with an improved means for actuating a switch after a predetermined number of cycles have elapsed.

A still further object of my invention is to provide an improved defrost control which is very efficient in operation, sturdily constructed, and relatively small in size.

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In carrying out my invention, in one form thereof, I have provided a defrost control including a switch that has two positions and includes two fixed contacts engageable by a movable contact. The supporting arm for the movable contact is a snap acting spring member and it has one of its ends in cooperation with a pivoted follower. This follower rides upon a rotatable switch actuating member. The actuating member includes a ratchet wheel portion, a hub portion with a peripheral interruption formed thereon, and a pair of axle sections. The ratchet wheel portion of the actuating member has a toothed periphery which is intermittently driven by a driving means to rotate the member. The axle sections furnish rotatable trunnions for the actuating member. The hub portion of the actuating member is in continuous engagement with the follower and arranged to actuate the follower by coaction between the follower and the interruption of the hub portion to operate the movable contact into one of its positions. The structure of the switch actuating member is therefore such that it performs three functions in the defrost control, serving as a combination ratchet wheel, switch actuating element, and axle means for the device. With this arrangement of the switch actuating member in the defrost control, a compact structure which is flexible in application and efficient in operation is thereby achieved.

Further aspects of my invention will become apparent hereinafter and the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which I regard as my invention. The invention, however, as to organization and method of operation, together with other objects and advantages thereof, may best be understood by reference to the following description when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a plan view of an improved solenoid operated defrost control embodying my invention, with the cover removed therefrom;

FIG. 2 is a side elevational view, partially in section and partially broken away to illustrate the various internal parts of the control of FIG. 1;

FIG. 3 is an exploded view showing the various parts of the control of FIG. 1, with the exception of the cover;

FIG. 4 is a bottom view of the control of FIG. 1;

FIG. 5 is a plan view of an improved manually operated defrost control embodying my invention in alternate form thereof; and

FIG. 6 is a side elevational view partially in section and partially broken away to illustrate the various internal parts of the control of FIG. 5.

Referring now to FIGS. 1 and 2, there is shown a defrost control for a domestic household refrigerator, which embodies one form of my invention. The control 1 includes an elongated insulating base 3 which, for example, is formed of molded phenolic thermosetting plastic, and cover 5 which may be constructed of similar material. Base 3 and cover 5 each have recesses formed therein and are suitably fastened together to provide cavity 7 wherein the various parts of my control are expeditiously contained and supported.

As best shown in FIGS. 2 and 3, insulating base 3 serves as a container for supporting upper and lower fixed contact terminals 9 and 11, respectively, movable contact terminal 13, and solenoid terminal 15. Terminals 9 and 11 are fastened to base 3 at vertically stepped upper horizontal walls 17 and 19 (FIGS. 1 and 3) by means of barbed outer edges 21 and downwardly turned ears 23. More particularly, blade portion 25 of each of the terminals 9 and 11 is extended through a molded slot formed perpendicularly through one of the walls 17 and 19, such as slot 27, which is illustrated representatively in FIG. 3

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for terminal 11. The terminals 9 and 11 are then staked to the base wall 17 and 19 by means of barbed outer edges 21 which are parted to overlap bottom ends of each of the slots and engage the walls to securely fasten terminals 9 and 11 to the base 3. Ears 23 are generally parallel to blade portions 25 and extend through molded slots 29, to rigidly laterally position the terminals 9 and 11 in the base.

Terminals 13 and 15 attached to stepped base walls 31 and 33, respectively (shown in FIG. 2) by means of barbed outer edges 21 formed upon blade portions 25 of these terminals, the blade portions being extended through the wall slots in the same manner as described for terminals 9 and 11. Detent holes 35 are formed in the various blade portions 25 of the terminals 9, 11, 13, and 15 for engagement with an associated "quick connecting" terminal. Movable contact terminal 13, as illustrated, has two blade portions 25 to facilitate its attachment to two associated "quick connecting" terminals.

Turning now to a discussion of the switching mechanism of my improved defrost control 1, as shown in FIGS. 1 and 2, the upper and lower fixed contact terminals 9 and 11 are generally L-shaped to include horizontal supporting sections 38 and 40 which are parallel to each other and seated on the top surfaces of horizontal walls 17 and 19. Sections 38 and 40 have fixed contact buttons 37 and 39 attached respectively thereto. To furnish a pivotal support for a snap acting switch mechanism is defrost control 1 and also to support in cantilever fashion a motion transmitting follower member which efficiently actuates this switch mechanism in response to predetermined conditions, movable contact terminal 13 is specially constructed, as shown in FIGS. 2 and 3. More particularly, terminal 13 includes an aforementioned pair of parallel blade portions 25 which are connected together by bight 41 to form a U-shaped terminal portion. Bight 41 has a lateral extension 43 (FIG. 3) formed thereon which serves as a base for a T-shaped platform section 45 connected thereto by upright section 47. Extension 43, platform section 45 and upright section 47 thus form a U-shaped switch supporting portion, as shown in FIG. 2. To attach the snap acting switch mechanism and follower member to terminal 13, a conductive metal post 49 is projected outwardly and upwardly in edgewise fashion from wing 51 of platform section 45. As shown in FIG. 3, post 49 has the configuration of an inverted T, the bottom of which is extended through a slot (not shown) of platform wing 51 and staked thereto. Transverse notches 53 are formed in vertically offset relationship on opposite lateral sides of the central upright portion 55 of post 49. These notches serve to pivotally support a snap-acting switch member, as shall become apparent hereinafter.

The snap-acting switch mechanism for my improved defrost control 1 includes a leaf-type-spring member 57 which serves as a resilient blade for supporting a two-sided movable contact button 59. Strip member 57 is preferably composed of a resilient or spring-type conductive metal, such as beryllium copper. For an understanding of the structure of member 57, attention is directed to FIGS. 1 and 3. Strip member 57 includes three generally parallel arms 61, 63, and 65, all joined together at both ends, and with the central arm 63 being split into two longitudinally extending sections 63a and 63b, respectively. One end 67 of the strip member 57 carries movable contact button 59 while the other end 69 has tongue 71 formed thereon. Tongue 71 of member 57 serves to actuate the switch in response to predetermined conditions, as shall be described in detail hereinafter. The other arms 61 and 65 are pressed into a corrugated or undulating configuration, as shown in FIGS. 2 and 3, in order to produce an end-to-end tension in the member 57. The inner ends 64a and 64b of the two sections 63a and 63b of the central arm 63 fit within vertically offset notches 53 on opposite sides of central upright portion

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55 of conductive post 49. As a result of the end-to-end tension imparted in member 57 by the corrugated configuration of outer arms 61 and 65 and the engagement of the inner ends of the sections 63a and 63b with notches 53, the strip member 57 stresses and pivots to provide snap action of the movable contact button 57 between its two switching positions in response to actuating forces exerted upon tongue 71.

Turning now to an important aspect of my invention, whereby I have provided a simplified and efficient means for actuating the contacts of my switch in response to predetermined conditions, as further shown in FIGS. 2 and 3, a channel-shaped follower 73 is also attached to and supported by the movable contact terminal 13. More specifically, the follower 73 has its supported end portion 75 extended underneath the base of post 49 between post 49 and platform section 45, with the extreme end 77 of follower 73 being turned upwardly to the left of post 49 (viewing FIG. 2). Follower 73 is thus mounted in cantilever fashion by sandwiching its supported end 75 between post 49 and platform section 45. As shown in FIGS. 1 and 2, the right half of spring member 57 then overlies a portion of follower 73. The other end 79 of follower 73 is turned downwardly, as shown in FIG. 3, to form depending actuating tooth 81. Between ends 75 and 79 of follower 73, an upright tab 83 is formed. Tab 83 extends perpendicularly upwardly from principal surface 89 of the follower 73 and includes a transverse elongated slot 85 through which tongue 71 of snap acting member 57 is extended. By means of the cooperation of tongue 71 with slot 85, condition responsive forces are transmitted to member 57, as shall become apparent hereinafter. Between tab 83 and the toothed end 79 of the follower 73, an aperture 87 is formed in the principal surface 89 midway between the flanged longitudinal sides 91. A pair of slots 93 are also disposed on opposite sides of aperture 87 between the aperture and the flanged sides 91. Aperture 87 receives an adjustable screw for a motion transmitting plunger of bellows assembly 95. The purpose of slots 93 is to fasten a U-shaped nut 97 to follower 73, for threaded engagement with the adjustable screw. Further aspects of the transmission of condition responsive force to follower 73 by bellows assembly 95 shall be described hereinafter. Follower 73 is supported in cantilever fashion upon terminal 13 so that slot 85 of tab 83 receives tongue 71 of movable contact member 57, and actuating tooth 81 is biased in a radial direction toward the axis of rotation of switch actuating member 99. This biasing effect is caused by stressing the end 79 of follower 73 upwardly (viewing FIG. 2) from a free position, to impart a spring action to the follower.

To enable switch actuating member 99 to efficiently perform three important functions in my improved defrost control 1, it is essentially of tripartite construction. More particularly, the switch actuating member 99 comprises a ratchet wheel portion 101, a hub portion 102 including sections 103 and 104, and an axle portion including sections 105 and 107. The ratchet wheel portion 101 of member 99 has an annular configuration with a series of teeth 109 formed on the outer periphery thereof. These teeth are intermittently driven by an electrically energized mechanism, as shall be described in detail hereinafter. Hub sections 103 and 104 are formed integral to ratchet portion 101 on each side thereof respectively, and are concentric and adjacent thereto. To actuate follower 73 in response to rotation of member 99, an elongated slot 111 is formed in the outer cylindrical surface of hub section 103, in parallel disposition to the axis of member 99. Axle sections 105 and 107 project outwardly from the outer ends of hub sections 103 and 104 respectively, and are concentrically arranged with relation to ratchet portion 101 and hub sections 103, 104. The axle section 105 is connected to hub section 103 by an intermediate hub section of lesser diameter. Axle

sections 105 and 107 are rotatably supported in opposed bearing recesses 113 formed on the inner walls of base 3. To accurately and efficiently seat the rotatable sections of the switch actuating member in recesses 113, rear surfaces 114 thereof are sloped downwardly and toward the terminal end of base 3, as shown in FIG. 3.

To explain the manner of actuation provided by my improved switch actuating member 99 and its coaction with follower 73 for operating the contacts of the defrost control switch, attention is directed to FIG. 2. The driving assembly for defrost control 1 comprises an elongated driving member 115, pawl 121 which is attached thereto, and an electrically energizable solenoid mechanism 123. Driving member 115 is mounted in cantilever fashion to a bottom wall of base 3 by fastening rivet 119 through end 117 of member 115 and to the base. U-shaped hairpin-type pawl 121 is extended through slot 120 of member 115 and has the bottom ends 122 of its sides turned over, as shown by dotted lines of FIG. 3. Pawl 121 is attached to driving member 115 intermediate the longitudinal ends thereof by extending bottom ends 122 of the pawl through lanced channels 124. Pawl 121 serves to intermittently drive actuator 99 in defrost control 1. More specifically, the pawl 121 brackets a segment of the cylindrical ratchet wheel portion 101 (as shown in FIG. 2) and the outermost bight portion 125 (FIG. 3) of the pawl intermittently engages consecutive ratchet teeth 109 to drive member 99 in a clockwise direction (viewing FIG. 2) in step-by-step fashion.

The actuating tooth 81 of follower 73 normally rides upon the smooth outer periphery of hub section 103. With tooth 81 of the follower 73 in such a position, the snap acting movable contact member 57 is normally biased so that its movable contact button 59 engages upper fixed contact button 37. With the switch of defrost control 1 in this position, a circuit may be closed through terminals 9 and 13 via conductive post 49 to maintain the compressor motor of a refrigeration system in an operative (i.e. energized) condition. Each time driving member 115 pivots downwardly through a small angle and in a clockwise direction of rotation from the position wherein it is shown in FIG. 2, bight section 125 of pawl 121 drives switch actuating member 99 about its axle sections 105 and 107 one tooth in a clockwise direction of rotation. After a predetermined angular rotation of member 99, tooth 81 of follower 73 reaches slot 111 of hub portion 103. Actuating tooth 81 thereupon enters slot 111. As the free end of follower 73 pivots downwardly to where it is shown in FIG. 2, slot 85 of the follower carries its cooperating tongue 71 of switch member 57 with it and thereby snaps tongue 71 of the movable contact member 57 in a clockwise direction about post 49. Movable contact button 59 is thereupon rapidly moved out of engagement with upper fixed contact button 37 and pivots itself in a counterclockwise direction of rotation about notch 53 and into engagement with lower fixed contact button 39. (See FIG. 2.) This is the defrosting position for control 1 and a control circuit to a suitable defrosting heater may be connected through lower fixed contact terminal 11 and movable contact terminal 13.

To control the rotative movement of switch actuating member 99, detent strip 126 is fastened to an internal wall of base 3 by screw 126b. The free end of strip 126 is disposed in continuous frictional engagement with the periphery of hub section 103 to thereby control the rotative movement of member 99.

To intermittently pivot driving member 115 upon its cantilevered supporting end 117 and thereby step switch actuating member 99, in the defrost control 1, I have provided the aforementioned solenoid mechanism 123. Solenoid mechanism 123 includes a substantially U-shaped supporting frame 127, bobbin 129 which fits within the frame, and coil 131 which is wound around bobbin 129 and properly insulated. An aperture is formed in

the top portion 133 of frame 127. Neck 135 of a suitably configured core 137 is extended through the aperture of top portion 133, as shown in FIG. 2, and an annular flange 139 of the core is turned over on the outer surface of top portion 133 to fasten the core in its proper position. To help position top portion 133 of frame 127 relative to the adjacent inner surface of cover 5, a shallow U-shaped retainer spring 141 is also attached to the frame by being sandwiched at its center between flange 139 and top portion 133. Spring 141 provides outstretched arms, the free ends of which resiliently engage the inner surface of cover 5. The cylindrical surface of core 137 is fitted within the axial bore of bobbin 129, as shown in FIG. 2. Core 137 has a suitable annular pole shaver 143 positioned in an annular groove on the bottom 144 thereof (viewing FIG. 2). Cylindrical plunger 145 is positioned to reciprocate within the bottom of the bore of bobbin 129 (viewing FIG. 2) and is extended through an aperture in the frame. Plunger 145 has a depending stud section which is shaped to provide a cylindrical surface 149 of reduced diameter which extends outwardly from the bottom 146 of plunger 145 and an outermost end 151 of increased diameter. To operatively link plunger 145 to pawl 121, the elongated driving member 115 has a key-shaped slot 153 (FIG. 3) formed therein for receiving reduced diameter surface 149 of plunger 145. More particularly, the depending stud section of plunger 145 is extended through an enlarged entrant portion of slot 153 and the reduced diameter surface 149 is then moved laterally toward the end 155 of member 115 until the parallel sides of slot 153 are disposed vertically between outermost end 151 and bottom 146 of the plunger. Tab 157 is turned upwardly from end 155 of member 115 and inserted through the bottom of compression spring 159. The upper end of compression spring 159 is seated within a suitable recess provided by bottom portion 161 of frame 127. Spring 159 biases end 155 of member 115 away from the solenoid coil, as shall be described in detail hereinafter.

Turning now to a discussion of the operation of driving member 115 in response to energization and deenergization of solenoid mechanism 123, attention is directed to FIG. 2. The solenoid coil 131 may have one of its ends connected to fixed contact terminal 9 and the other of its ends connected to solenoid terminal 15. Terminals 13 and 15 may then, for example, be connected in series with contacts of a suitable switch that is normally open and either closes when the refrigerator door is opened, or closes when the compressor motor is deenergized. It will be understood by those skilled in the art that the solenoid coil 131 may also be connected in a circuit so that it becomes energized and deenergized in response to the total number of times in which the compressor motor is deenergized and the refrigerator door opens.

When the solenoid coil 131 is energized, plunger 145 is attracted into the bore of solenoid bobbin 129 and is in the position wherein it is shown in FIG. 2. In this position, spring 159 is held in compression by shoulder 152 of plunger 145 bearing against the driving member 115 and member 115 has just moved pawl bight 125 into a driving position in straddling engagement with one of the ratchet teeth 109 of switch actuating member 99. When the solenoid coil 131 is then thereafter deenergized, the plunger 145 is released and spring 159 expands to pivot free end 155 of member 115 about its cantilevered support. Hairpin pawl 121 then drives the switch actuating member 99 one tooth in a clockwise direction (viewing FIG. 2). After a predetermined number of compressor cycles or door openings commensurate with the number of ratchet teeth 109 of member 99 have thus been counted, actuating tooth 81 then moves into slot 111 of the hub portion 103 and movable contact 59 toggles out of engagement with fixed contact 37 and into engagement with its fixed contact 39.

To provide a means for adjusting the pivotal stroke

of driving member 115, adjusting screw 163 is shown in threaded engagement with a bottom wall of base 3 and is engageable with the adjacent underside of driving member 115. (See FIG. 2.) Screw 163 may also be placed in threaded engagement with the aperture underlying end 151 of the plunger 145 to vary the stroke thereof.

To return the movable contact 59 into engagement with its upper fixed contact 37, after it has been in its defrost position (i.e., in engagement with contact 39) and thereby deenergize a defrosting heater, I have provided the aforementioned bellows assembly 95. Turning now to an explanation of bellows assembly 95, as shown in FIGS. 2 and 3, bellows cup or housing 165 serves to support and contain bellows 167. Bellows cup 165 includes upwardly extending flanged sides 169 for straddling oppositely disposed stepped walls 171 on the bottom of base 3. Sides 169 of cup 165 engage stepped walls 171 and are held rigidly in position against these walls by means of tabs 173 which are inserted into appropriate receiving slots 175 in the bottom wall of base 3 and then turned over against an inner surface as shown in FIG. 1.

Bellows cup 165 also includes a depending flange 177 (FIG. 3) with projecting arm 179 extending therefrom for supporting capillary 181. Capillary 181 is connected to a suitable bulb 183 and contains a thermally responsive fluid, such as methyl chloride or dichlorodifluoromethane.

For furnishing the temperature responsive actuating force to return the movable contact 59 of defrost control 1 to its normal or nondefrosting position (i.e., into engagement with contact 37), bellows 167 is mounted within and supported by the bellows cup 165. A restraining annulus 185 is attached to cup 165 to restrict upward movement of bellows 167. To provide a transmission area for the temperature responsive force, bellows 167 has a central cup-shaped recess 187. Recess 187 bears against the semi-spherical bottom 189 of pushrod 191. Pushrod 191 is constructed of a plastic material and its upper end has a cup shaped recess 192 with a conical seat 192a formed therein for engagement with adjustable screw 193. More particularly, screw 193 is in threaded engagement with bight section 195 (FIG. 3) of U-shaped nut 97. From each side of bight section 195 of nut 97, an arm 197 is extended upwardly toward cover 5 (as shown in FIG. 2). The arms 197 are parallel to each other and each arm has a finger 199. The fingers 199 are extended through slots 93 of follower 73 and lapped over (as shown in FIG. 1) to secure nut 97 to the follower. Screw 193 is extended through aperture 87 of follower 73 and its pointed bottom 192b engages seat 192a of pushrod 191 in swivel like fashion. With nut 97 in threaded engagement with screw 193 attached to the follower 73 (FIG. 2), engagement of the pointed bottom 192b of the screw with the pushrod forces bottom 189 of the pushrod 191 toward the bottom of cup-shaped recess 187 of the bellows 167. When the movable contact 59 is in engagement with upper fixed contact 37, the pointed bottom 192b of screw 193 is spaced slightly from the bottom of seat 192a and pushrod 191 therefore has no effect upon follower 73. After the movable contact 59 has been snapped downwardly into engagement with defrost contact 39, however, the compressor motor is deenergized, a defrosting heater is energized, and the temperature of the capillary or bulb (which would, of course, be properly positioned in the unit to sense temperature), then starts to increase. As a result of the increased temperature of the bulb, the vaporization of some of the fluid therein causes the bellows internal pressure to increase accordingly. After the temperature has risen to a predetermined value, the bellows moves pushrod 191 upward from the position wherein it is shown in FIG. 2 and screw 193 is accordingly engaged by pushrod seat 192a to pivot the follower in a counterclockwise direction of rotation. Slot 85 of follower 73 then acts upon tongue 71 and forces movable

contact 59 out of engagement with defrost contact 39 and into engagement with upper fixed contact 37.

To facilitate the adjustment of the bellows pressure exerted upon follower 73, a suitable aperture 194 is formed in cover 5 above the notched outer end of adjustable screw 193. Aperture 194 allows access to screw 193 for purposes of adjustment thereof after cover 5 has been assembled to base 3.

To calibrate the trip position for the switch with relation to the actuator 99 and assure that the tooth 81 of follower 73 will move out of slot 111 of actuator 99 before movable contact 59 moves out of engagement with defrost contact 39 and into engagement with contact 37, screw 201 has been provided. Screw 201 has its slotted head outside one of the walls of base 3, as shown in FIG. 2, and its inner end is in threaded engagement with L-shaped tongue 203 of terminal 13. For calibrating the trip position for the switch, with the movable contact 59 in its defrost position (i.e. in engagement with contact 39), a suitable shim (not shown) is inserted between the smooth periphery of hub section 103 and the bottom tip of tooth 81. Screw 201 is then tightened into engagement with terminal tongue 203 until movable contact 59 moves into engagement with fixed contact 37. By adjusting screw 201 in this manner, it has been found that if the switch is in the defrost position and bellows pushrod 191 acts upon follower 73, when tooth 81 moves out of slot 111, the solenoid coil still being deenergized, spring 159 moves the free end 155 of driving member 115 downwardly to step ratchet wheel portion 101 of the actuator before the movable contact 59 engages fixed contact 37. In my defrost control 1, screw 201 thus provides a simple and efficient means for calibrating the trip position of the switch with relation to the actuator 99.

It will now therefore be seen that I have provided a new and improved defrost control which is very simple in construction and has an improved flexibility of application. This control provides an efficient means for automatically controlling defrost in a household-type of refrigerator. By providing a switch actuating member which performs three important controlling functions, a very effective and low cost means for actuating the switch contacts and counting cycles has been thereby achieved. My defrost control 1 also incorporates a very effective means for snapping the switch contacts between their two positions in response to temperature and also in response to an electrical actuating device.

FIGS. 5 and 6 illustrate, as an alternate embodiment of my invention, a mechanically operated defrost control 205. This particular defrost controlling device is specially designed to initiate a defrosting heater after a predetermined number of door closures have been counted. Control 205 may therefore, be mounted so that it is mechanically operated by a refrigerator door. For defrost control 205, the same reference numbers have been employed to indicate switch parts which have heretofore been described for control 1. Parts which have a modified structure in comparison to the structure of their correlative parts in defrost control 1 but perform the same basic function in the control 205 are identified by the same reference numerals with the letter "a" suffixed thereto. The essential difference between defrost control 205 and defrost control 1 is, of course, that the defrost control 205 is operated by a plunger 207 instead of being operated by a solenoid. Plunger 207 may be constructed of molded plastic material and it includes a cylindrical guiding portion 209 which reciprocates in a projecting guiding aperture 211 formed in cover 5a. Plunger 207 also includes shank 213, an annular rim 215 which is formed near the bottom of shank 213 (viewing FIG. 6), and depending frusto-conical projection 217. Shank 213 of plunger 207 is extended through the bifurcated free end 219 of driving member 221. (See FIG. 5.) To normally bias plunger 207 to its outermost position spring 223 runs in compression between a bottom wall of base

3a and the annular bottom shoulder of rim 215 of the plunger. Bottom 225 of spring 223 is laterally positioned in recess 227 which is formed on the inner surface of the bottom wall of base 3a. Top 229 of compression spring 223 surrounds depending projection 217 of the plunger and is thereby laterally positioned with respect to and in engagement with the plunger 207.

To explain the operation of the plunger operated defrost control 205, attention is directed to FIG. 6. When the outermost end 231 of plunger 207 is depressed, the bifurcated free end 219 of driving member 221 is pivoted downwardly about its cantilevered support due to the biasing force imparted thereto and hairpin pawl 121 drives switch actuating member 99 in a clockwise direction in the same manner as previously described for defrost control 1. After a predetermined number of cycles such as for example refrigerator door closures have been counted, actuating tooth 81 enters slot 111 of the switch actuating member 99 to move movable contact 59 out of engagement with contact 37 and into engagement with defrost contact 39. The bellows assembly 95 thereafter acts upon follower 73 in the same manner as previously described for defrost control 1. It will therefore, be seen that notwithstanding the fact that defrost controls 1 and 205 incorporate different intermittent driving means, they operate in essentially the same manner and also incorporate a multiplicity of interchangeable parts.

To enable the mechanically operated defrost control 205 to be used for operating appliances, such as an electric fan, and an illumination means in response to each reciprocation of the plunger 207, additional terminals 231 and 233 are provided. Each of these additional terminals may control a circuit connected across it and terminal 15, through conductive driving member 221. Terminal 231 comprises two integral L-shaped sections 231a and 231b (see FIG. 6). Section 231a is suitably fastened to the bottom wall of base 3a and includes a vertically extending outer blade portion for receiving an external connection. Section 231b has an elongated vertical portion which terminates in a horizontally disposed fixed contact portion 235. Terminal 233 is L-shaped and includes an elongated vertical section with a blade portion formed thereon and a horizontal section 236 which is riveted to the top of raised portion 237 of base 3a. The horizontal section 236 of terminal 233 has an elongated transverse section 239 as shown in FIG. 9 which has a fixed contact indentation 240 for cooperation with driving member 221 when the driving member is in its uppermost position (FIG. 6). Stud 241 is threaded into engagement with a lanced aperture 243, and the bottom 245 of this stud engages fixed contact section 235 of terminal 231 when driving member 221 is in its down position (viewing FIG. 6). It will therefore be seen that terminals 231 and 233 provide an efficient means in control 205 for controlling at least two additional circuits in response to reciprocating movement of plunger 207.

The simplicity of structure, efficiency of operation, and flexibility of application of my improved defrost control will now therefore become apparent and as a result of this simplicity, the defrost controls which form the illustrative embodiments of my invention are relatively inexpensive to manufacture.

While in accordance with the patent statutes, I have described what at present are considered to be the preferred embodiments of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and I, therefore, aim in the following claims to cover all such equivalent variations as fall within the true spirit and scope of the invention.

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

1. A refrigerator control comprising a switch movable between two operating positions, follower means for moving said switch between its operating positions, a unitary

rotatable switch actuating member of tripartite construction, said member including a ratchet wheel portion, a hub portion with an axially extending peripheral interruption formed thereon, and an axle means, said portions being concentrically arranged for rotation upon said axle means, means for intermittently driving said switch actuating member, said ratchet wheel portion having a toothed periphery driven by said driving means thereby to rotate said actuating member, said hub portion being in continuous engagement with said follower means and arranged to actuate said follower means once during each revolution by coaction between said follower means and the interruption of said hub portion, whereby said unitary switch actuating member serves as a combination ratchet wheel, switch actuating element, and rotatable journal.

2. A refrigerator control comprising a switch movable between two operating positions, a follower for moving said switch between its operating positions, a molded insulating base for supporting and containing said switch, a unitary rotatable switch actuating member of tripartite construction, said unitary member including a ratchet wheel portion, a hub portion with a peripheral interruption formed thereon, and an axle means, said portions being concentrically arranged upon said axle means, said axle means being journaled for rotation upon stationary bearing surfaces formed in said molded insulating base, means for intermittently driving said switch actuating member, said ratchet wheel portion having a toothed periphery driven by said driving means thereby to rotate said member, said follower being supported in cantilever fashion at one of its ends and having its free end biased radially toward the axis of rotation of said actuating member, said hub portion being in continuous engagement with the free end of said follower and arranged to actuate said follower by coaction between the free end of said follower and the interruption of said hub portion, whereby said unitary switch actuating member serves as a combination ratchet wheel, switch actuating element, and rotatable journal.

3. A refrigerator control comprising a switch movable between two operating positions, follower means for moving said switch between its operating positions, a molded insulating base for supporting and containing said switch, a unitary rotatable switch actuating member of tripartite construction, said unitary actuating member including a ratchet wheel portion, a hub portion with a peripheral interruption formed thereon, and an axle means, said portions being concentrically arranged for rotation upon said axle means, stationary bearing means for rotatably supporting said axle means formed in said molded insulating base, said ratchet wheel portion having a toothed periphery thereon, a driving member supported in cantilever fashion, said driving member having a pawl means thereon, the pawl means of said driving member being arranged to intermittently engage the toothed periphery of said ratchet wheel portion, thereby to rotate said actuating member, said hub portion being in continuous engagement with said follower means and arranged to actuate said follower means by coaction between said follower means and the interruption of said hub portion, whereby said unitary switch actuating member serves as a combination ratchet wheel, switch actuating element, and rotatable journal.

4. A refrigerator control comprising a switch movable between two operating positions, follower means for moving said switch between said positions, a molded insulating base for supporting and containing said switch, a unitary switch actuating member supported for rotation within said base, said unitary switch actuating member including a ratchet wheel portion, a hub portion with a peripheral interruption formed thereon, and a pair of axle sections, said ratchet wheel and hub portions being concentrically arranged for rotation upon said axle sections, a pair of oppositely disposed recesses formed in said base, said recesses each having at least one sloping surface

thereon and arranged to receive and support said axle sections in bearing relationship therewith, means for intermittently driving said switch actuating member, said ratchet wheel portion having a toothed periphery driven by said driving means thereby to rotate said member, said hub portion being in continuous engagement with said follower means and arranged to actuate said follower means by coaction between said follower means and the interruption of said hub portion, whereby said unitary switch actuating member performs three operating functions in said control, serving as a ratchet wheel, a switch actuating member and a rotatable bearing axle.

5. A refrigerator control comprising a snap acting switch member movable between two operating positions, a follower cooperating with said switch member and acting thereupon for moving said switch member between its operating positions, a molded insulating base for supporting and containing said switch, a unitary rotatably switch actuating member of tripartite construction, said unitary actuating member including a ratchet wheel portion, a hub portion with a peripheral interruption formed thereon, and an axle means, said portions being concentrically arranged for rotation upon said axle means, stationary bearing means for rotatably supporting said axle means formed in said molded insulating base, means for intermittently driving said switch actuating member, said ratchet wheel portion having a toothed periphery driven by said driving means thereby to rotate said member, said follower being supported in cantilever fashion at one of its ends and having its free end biased radially toward the axis of rotation of said actuating member, said hub portion being in continuous engagement with the free end of said follower and arranged to actuate said follower by coaction between the free end of said follower and the interruption of said hub portion, whereby said unitary switch actuating member serves as a combination ratchet wheel, switch actuating element, and rotatable journal.

6. A refrigerator control comprising an elongated leaf spring member pivotally supported at the center thereof, said spring member having a movable contact at one of its ends and a tongue formed at the other end thereof, a follower disposed in partially overlying relationship to said spring member, said follower being supported in cantilever fashion at one of its ends and having an actuating tooth formed at the other end thereof, a raised tab formed in said follower intermediate its ends, said tab having a slot formed therein which receives the tongue of said leaf spring member thereby to impart pivotal motion from said follower to said spring member for moving said spring member between two operating positions, a rotatable switch actuating member of tripartite construction, said actuating member including a ratchet wheel portion, a hub portion with a peripheral interruption formed thereon, and an axle means, said portions being concentrically arranged for rotation upon said axle means, stationary bearing means for rotatably supporting said axle means, means for intermittently driving said switch actuating member, said ratchet wheel portion having a toothed periphery driven by said driving means thereby to rotate said member, the actuating tooth of said follower being biased radially toward the axis of rotation of said actuating member, said hub portion being in continuous engagement with the tooth of said follower and arranged to actuate said follower by coaction between the tooth of said follower and the interruption of said hub portion, whereby said switch actuating member serves as a combination ratchet wheel, switch actuating element, and rotatable journal.

7. A refrigerator control comprising an elongated leaf spring member pivotally supported at the center thereof, said spring member having a movable contact at one of its ends and a tongue formed at the other end thereof, fixed contact means engageable by said movable contact, a follower disposed in partially overlying relationship to said spring member, said follower being supported in cantilever fashion at one of its ends and having an ac-

tuating tooth formed at the other end thereof, an upright tab formed in said follower intermediate its ends, said tab having a slot formed therein which receives the tongue of said leaf spring member thereby to impart pivotal motion from said follower to said spring member for moving said movable contact between first and second operating positions, a rotatable switch actuating member, said actuating member including a ratchet wheel portion, a hub portion with a peripheral interruption formed thereon, and an axle means, said portions being concentrically arranged for rotation upon said axle means, stationary bearing means for rotatably supporting said axle means, means for intermittently driving said switch actuating member, said ratchet wheel portion having a toothed periphery driven by said driving means thereby to rotate said actuating member, the actuating tooth of said follower being biased radially toward the axis of rotation of said actuating member, said hub portion being in continuous engagement with the tooth of said follower and arranged to actuate said follower and move said movable contact to its first operating position upon coaction between the tooth of said follower and the interruption of said hub portion, and a condition responsive means engageable with said follower when said movable contact is in the first position and arranged to actuate said follower and move said movable contact to its second operating position in response to a predetermined condition.

8. A refrigerator control comprising a switch movable between two operating positions, follower means for moving said switch between its operating positions, a unitary rotatable switch actuating member for tripartite construction, said unitary member including a ratchet wheel portion, a hub portion with an axially extending peripheral interruption formed thereon, and an axle means, said portions being concentrically arranged for rotation upon said axle means, said ratchet wheel portion having a toothed periphery thereon, a driving member supported at one of its ends in cantilever fashion, said driving member having a pawl means thereon, said pawl means being arranged to intermittently engage the toothed periphery of said ratchet wheel portion as said driving member pivots upon its supported end, a solenoid means coacting with said driving member and arranged to step said driving member upon deenergization of said solenoid means thereby to rotate said switch actuating member, said hub portion being in continuous engagement with said follower means and arranged to actuate said follower means once during each revolution by coaction between said follower means and the interruption of said hub portion, whereby said unitary switch actuating member serves as a ratchet wheel driven by said solenoid means, a switch actuating element cooperating with said follower, and an axle for rotatably supporting said unitary switch actuating member.

9. A refrigerator control comprising a switch movable between two operating positions, follower means for moving said switch between its operating positions, a unitary rotatable switch actuating member of tripartite construction, said unitary member including a ratchet wheel portion, a hub portion with an axially extending peripheral interruption formed thereon, and an axle means, said portions being concentrically arranged for rotation upon said axle means, said ratchet wheel portion having a toothed periphery thereon, a driving member supported at one of its ends in cantilever fashion, said driving member having a pawl means thereon, said pawl means being arranged to intermittently engage the toothed periphery of said ratchet wheel portion as said driving member pivots upon its supported end, a plunger coacting with said driving member and arranged to step said driving member thereby to rotate said actuating member upon its axle means, said hub portion being in continuous engagement with said follower means and arranged to actuate said follower means once during each revolution by coaction between said follower means and the inter-

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ruption of said hub portion, whereby said unitary switch actuating member serves as a ratchet wheel driven by said plunger, a switch actuating element cooperating with said follower, and an axle for rotatably supporting said unitary switch actuating member.

10. A refrigerator control comprising a switch movable between two operating positions, follower means for moving said switch between its operating positions, a unitary rotatable switch actuating member of tripartite construction, said unitary member including a ratchet wheel portion, a hub portion with a peripheral interruption formed thereon, and an axle means, said portions being concentrically arranged for rotation upon said axle means, stationary bearing means for rotatably supporting said axle means, said ratchet wheel portion having a toothed periphery thereon, a driving member supported at one of its ends in cantilever fashion, said driving member having a pawl means thereon, the pawl means of said driving member being in the configuration of a U-shaped hairpin, a bight portion of said pawl means being arranged to intermittently engage the toothed periphery of said ratchet wheel portion as said driving member pivots upon its supported end, thereby to rotate said unitary actuating member, said hub portion being in continuous engagement with said follower means and arranged to actuate said follower means by coaction between said follower means and the interruption of said hub portion, whereby said unitary switch actuating member serves as a combination ratchet wheel, switch actuating element, and rotatable journal.

11. A refrigerator control comprising a snap acting switch member movable between first and second operating positions, a follower engaging said switch member for moving said switch member between its operating positions, said follower being supported in cantilever fashion at one of its ends, having a projection formed at the other end and including a threaded recess between its ends, a rotatable switch actuating member with an interruption formed thereon, said interruption being engaged by said follower for operating said switch member to its first position, means for intermittently driving said switch actuating member in response to the cyclic operation of an external device, and a condition responsive means disposed in threaded relationship with the recess of said follower and engaged therewith when said switch member is in its first position for operating said switch member to its second position.

12. A refrigerator control comprising a snap acting switch member movable between first and second operating positions, follower means engaging said switch member for moving said switch member between its operating positions, said follower means being supported in cantilever fashion at one of its ends, having a projection formed at the other end thereof and including a threaded recess disposed between the ends, a rotatable switch

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actuating member engaged by the projection of said follower means for operating said switch member to its first position, means for intermittently driving said switch actuating member in response to the cyclic operation of an external device, and a condition responsive means disposed in adjustable relationship with the recess of said follower means and engaged therewith when said switch member is in its first position for operating said switch member to its second position.

13. A refrigerator control comprising a switch member movable between first and second operating positions, a follower engaging said switch member for moving said switch member between its operating positions, said follower having a projection formed thereon, a support for said switch member and said follower, a rotatable switch actuating member having an interruption thereon which receives the projection of said follower for operating said switch member to its first position at a predetermined rotative position of said actuating member, means for intermittently driving said switch actuating member in response to the cyclic operation of an external device, condition responsive means disposed in manually adjustable relationship to said follower and engaged therewith when said switch member is in its first position for operating said switch member to its second position, and means for adjusting the position of the support for said switch member and said follower to assure that said switch member will not reach its second position until the projection of said follower has been disengaged from the interruption of said actuating member and said actuating member has been driven by said driving means from said predetermined rotative position.

14. The refrigerator control of claim 13 wherein the condition responsive means includes a manually adjustable screw disposed in threaded engagement with said follower, said screw having a pointed bottom, a bellows underlying the bottom of said screw, and a pushrod acted upon by said bellows and in swivelling engagement with the pointed bottom of said screw thereby to transmit condition responsive force from said bellows to said follower.

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