May 18, 1943 T. S. SAFFORD 2,319,349

REFRIGERATION APPARATUS

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Fig. 1.

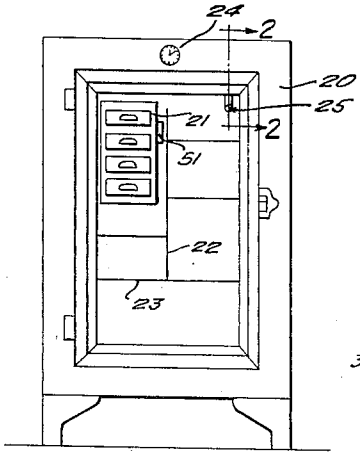


Fig. 2.

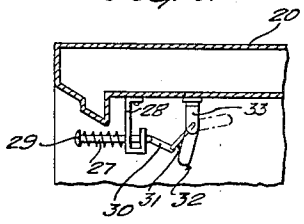


Fig. 3.

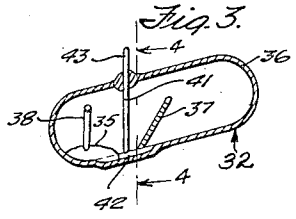


Fig. 4.

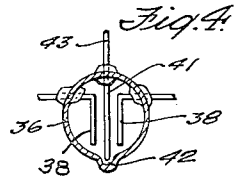


Fig. 5.

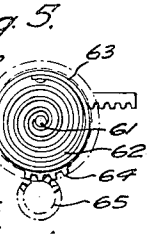
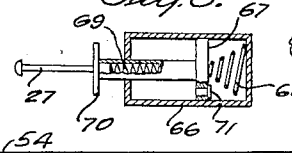


Fig. 6.



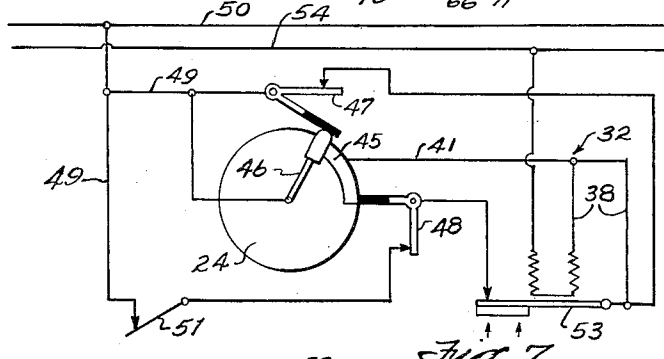
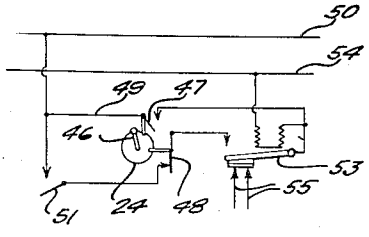


Fig. 7.

Fig. 8.



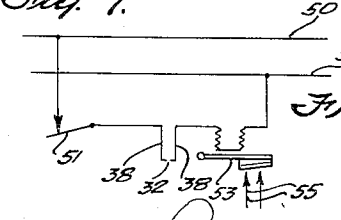


Fig. 9.

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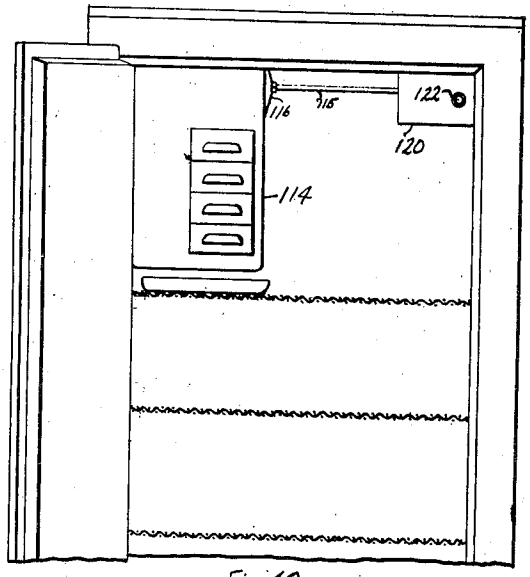


Fig. 10.

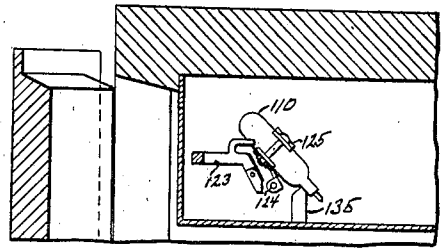


Fig. 12.

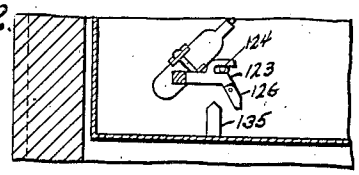


Fig. 13

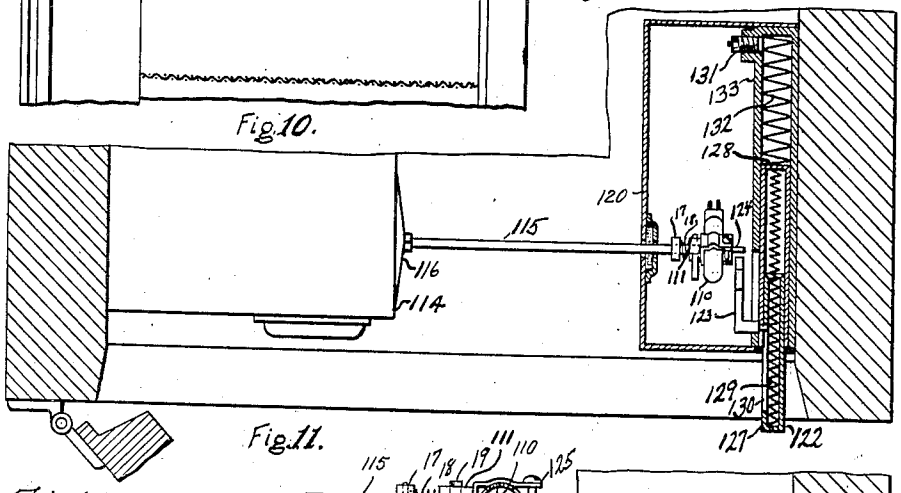


Fig. 11.

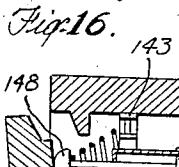


Fig. 16.

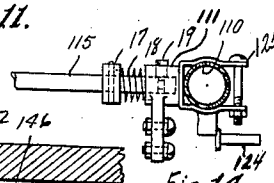


Fig. 14.

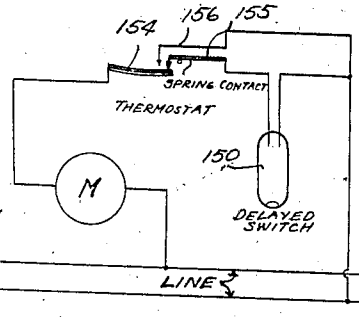


Fig. 17.

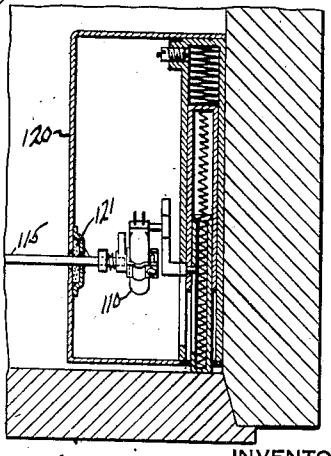


Fig. 15.

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Fig. 18.

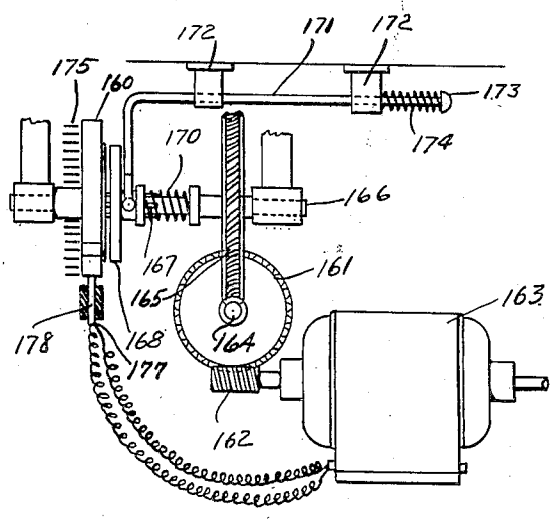


Fig. 19.

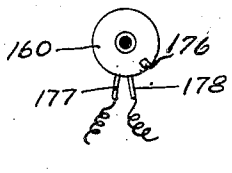
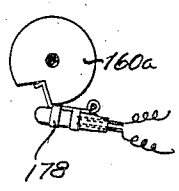


Fig. 20.



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Patented May 18, 1943

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UNITED STATES PATENT OFFICE

2,319,349

REFRIGERATION APPARATUS

Truman S. Safford, Riverside, Conn.

Application October 9, 1936, Serial No. 104,840

19 Claims. (Cl. 62—4)

This invention relates to a device for automatic defrosting of refrigerators, and more particularly to such a device which is adapted to control the refrigeration, e. g., by cutting off the supply of refrigerant, so that frost which may have accumulated upon the refrigerating surfaces may be allowed to melt away, but which will exercise such control only at times when rapid refrigeration is ordinarily not required.

Since the introduction many years ago of artificial refrigeration, the accumulation of frost upon the refrigerating surfaces has presented one of the most annoying and ever present problems. Numerous methods of defrosting by heating or dissolving the frost have been suggested and to some extent have been used, but such methods have been manually controlled and have been dependent therefore upon the care and watchfulness of the operator. In domestic refrigerators the cooling unit is often hidden behind an enameled iron screen, and the operator, often a domestic servant understanding little or nothing of the operation of the refrigerator, may allow the frost to collect for weeks or even months before the defrosting is carried out.

It has also been proposed to make defrosting automatic by widening the gap between the "on" and "off" temperatures of the thermostatic control. Thus the temperature at which the refrigeration is begun in each cycle or in one of a series of cycles may be sufficiently high to ensure that the frost will be melted before a new cycle or a new series thereof is initiated. While this suggestion may overcome the objection to manual control that the control will be operated too infrequently, it introduces a more serious objection from the point of view of the manufacturer and user of domestic refrigerators that it may at any time leave a hostess in the lurch with no ice cubes or with her ice cream and frozen desserts melted.

It is an object of the present invention to provide an automatic defrosting control, which will require no attention, and will ensure the thorough and frequent elimination of frost, with little or no likelihood of failing to provide adequate refrigeration at times when it is needed for any purpose.

In the accompanying drawings I have shown, for purpose of illustration, a number of embodiments of my invention by which this object and other objects may be accomplished.

Fig. 1 is a front elevation of a domestic refrigerator with the door removed to disclose the positioning of parts used in my invention;

Fig. 2 is a detailed cross sectional view taken on line 2—2 of Fig. 1 and shown on an enlarged scale;

Fig. 3 is a longitudinal vertical sectional view of a switch used in one embodiment of my invention;

Fig. 4 is a vertical cross sectional view taken on line 4—4 of Fig. 3;

Fig. 5 is a view in side elevation of a detail which may replace a portion of the device illustrated in Fig. 2;

Fig. 6 is a sectional view of a device which may be used in place of that illustrated in Fig. 5 or that of Fig. 2;

Figs. 7 to 9 inclusive are circuit diagrams illustrating various embodiments of my invention;

Fig. 10 is a fragmentary view of a refrigerator box showing another modified form of my invention in position;

Fig. 11 is a fragmentary view in horizontal section of the same embodiment as shown in Fig. 10;

Figs. 12 and 13 are detail views showing a part of the device of Figs. 10 and 11 in different positions of operation;

Fig. 14 is a detail view partly in section showing the device for holding the switch mechanism;

Fig. 15 is a fragmentary view similar to the right hand portion of Fig. 11 but showing the device after the predetermined delay and with the parts in position to permit defrosting;

Fig. 16 is a fragmentary view partly in vertical section of another embodiment of my invention;

Fig. 17 is a wiring diagram of the embodiment illustrated in Fig. 16;

Figure 18 is a diagrammatic illustration of another modification of my invention;

Figure 19 is a detail of the controlling means as used in Figure 18; and

Figure 20 is a detail of a control switch.

In Fig. 1, I have shown a domestic refrigerator of common form having an insulating box 20, the door of which has been removed to disclose the interior, a cooling unit 21, a central partition 22, and shelves 23. A clock 24, advantageously an electric clock operated from the same alternating current power line as the refrigerator motor, may be associated with the refrigerator, and as will be more fully disclosed hereinafter, this clock may serve as one control in the defrosting device. It is not necessary, however, that this clock, if used as a defrosting control should have a visible face, and it may be a mechanical spring or weight clock instead of an electrical clock.

A door operated device 25 is shown in the upper right hand corner of the interior of the refrig-

erator in Fig. 1, and the purpose of this as well as its detailed construction will be set forth below.

I have said above that one purpose of this invention is to protect the hostess against failure of adequate refrigeration at critical times. My invention therefore contemplates the provision of devices which are responsive to, or may be correlated with, the uses to which the refrigerator is put.

Fig. 2 illustrates the control element of a device which is directly responsive to the use of the refrigerator. In this device, an operating rod 27 is mounted in a hanger guide 28 secured to the box 20, and is preferably provided with a cushion buffer 29 on its outer end.

A link 30 is pivoted to the opposite end of the rod 27 and the opposite end of this link is pivotally connected to the crank 31, which engages a switch 32 of the type having a fluent conductive material adapted to flow onto and away from spaced electrodes. This switch is pivotally supported in hangers 33; and, as shown, the leads to the electrodes 38 may serve as the supporting pivots, thus making contact with the members 33, which, therefore, may serve as binding posts to connect these in-leads into the circuit. Thus when the door is open the operating rod 27 is released and the fluent conductive switch is allowed to hang vertically from its pivot. When the door is closed it pushes the rod 27 and through the linkage 30—31 the switch is pushed upwardly to the position shown in Fig. 3. It is desirable to provide a spring on the rod 27 between the support 28 and the buffer 29 to assist in restoring the parts to the position shown in Fig. 2 whenever the door is opened.

The switch which I use for this purpose is advantageously one of special design as shown in Figs. 3 and 4. A body of fluent conductive material 35 is carried in a vessel 36, commonly a sealed glass tube, and the vessel is provided with a baffle or dam 37 between the end having the electrodes 38 and the opposite end. Near the bottom of this dam is a narrow orifice, so related to the volume of the fluent conductive material as to require a predetermined time for it to flow therethrough, and at the top of the dam is an open space sufficiently large to allow the entire body of fluent material to flow back over the dam substantially instantaneously when the vessel is tipped down. Preferably the dam is slanted as shown in the drawings to facilitate the return flow over the dam. The fluent material may be an electrolyte, especially in the case of alternating current and especially where it controls a relay circuit rather than the main motor circuit, e. g., as shown in Figs. 7 and 9 of the drawings. The fluent material may also be a fine metallic sand or sprayed metal similar to shot but of very much finer grain.

The electrodes 38, in the preferred form of the invention are bent over so that they pass out through the walls of the vessel along the axis of tilting. The external parts of the electrode in-lead wires may therefore serve as trunnions to carry the fluent conductor switch, and in order to provide electrical contact, these electrode wire trunnions are preferably mounted in hangers 33 connected into the circuit so that they serve also as binding posts for the electrodes 38. These parts are insulated from the box 20 and should also be insulated from the rod 27 by an insulating link 30 or crank 31.

In the use of the device just described, the opening of the door allows the rod 27 to move outwardly and the fluent conductor switch to tilt downwardly to the position shown in Fig. 2. In this position, so much of the mass of fluent conductive material as has passed under the dam 37 falls down over it into the then lower end of the vessel 36. Upon the reclosing of the door the vessel 36 is again raised to the position shown in Fig. 3, whereupon the fluent conductive material is dammed behind the dam 37 and allowed to flow only very slowly through the orifice to the other end of the vessel, until it finally reaches the level of the electrodes 38 and closes the circuit between them. In this way a delay of any required duration may be interposed between the last opening of the refrigerator and the shutting down for defrosting, and thus sufficient time may be allowed for freezing ice cubes, etc., or the time interval may be adjusted so that it will be greater than will occur at any time during a normal working day, and thus defrosting will occur normally during the small hours of the morning when it cannot interfere with the various uses of the refrigerator.

When the device just described is combined with a clock or other chronometer device, e. g., as shown in Figs. 1 and 7, and the fluent conductive material is an electrolyte a third electrode 41 is advantageously provided. This electrode is arranged so that it just touches the stream of conductive material which flows under the dam 37 and along the trough 42, so that after the conductive material has made contact with the electrodes 38 and as the last of it flows along the trough 42, a contact will be established temporarily between the electrode 41 and the electrodes 38.

In Fig. 7, I have shown a wiring diagram of a circuit which may be used with the defrosting controls which have been thus far described. The clock 24 in this case is provided with a contact segment 45 and a rotating contact arm 46 which preferably makes one revolution each twenty four hours. Adjacent the beginning of the contact segment is a switch 47 normally held open but adapted to be temporarily closed by the action of the rotating arm 46 on the insulated portion of a bell crank lever which forms the switch 47. At or near the end of the segment 45 is another bell crank lever, also of insulating material, for operating a switch 48 normally held closed but opened temporarily by the arm 46. By "temporarily" I do not of course intend to imply that there is any short time limit upon the operation of these switches, but their work is quickly done and if they are held longer it is merely a convenient way of operating.

A lead 49 connects the arm 46 with the main line conductor 50, and each of the switches 47 and 48 is connected to this lead 49 through a parallel circuit portion. The parallel circuit portion which includes switch 48 also includes thermostat switch 51 associated with the refrigerating unit and adapted to open when the temperature at the outer surface thereof rises above a temperature limit at which defrosting is complete. Switch 51 is adapted to close when the said surface is cooled to a temperature at which frost occurs thereon. The switches 47 and 48 are also adapted to be connected to one of the electrodes 38, the former directly and the latter through the upper contact of the relay 53, and through the coil back to the main line conductor 54. The relay 53 controls the main refrigerator power circuit or the main refrigerator control circuit by means of the contacts 55.

The contact segment 45 is connected directly to the third electrode 41 of the switch 32.

In the operation of this device, the arm 46 is rotated by the clock until it strikes the arm of the bell crank switch 47 and thus closes the circuit through said switch 47 to the electrodes 38 of the fluent conductor switch 32. If the refrigerator door is closed and has been closed long enough to allow the fluent conductor to close the circuit between the electrodes 38, the relay 53 is energized at once and the main refrigerator circuit is broken at 55. Assuming that there is frost on the refrigerating unit, its temperature will be such that the thermostatic switch 51 will be closed, and immediately upon the operation of the relay 53, the parallel energizing circuit will be closed through the switch 48 and the switch 51. Thus the relay armature will be held up even after the switch 47 is dropped by the arm 46.

Defrosting is accomplished by preventing further refrigeration by reason of the opening of the main circuit at 55; and, once initiated, defrosting will continue until one of three things happens. In the first place someone may open the refrigerator. If this is done, it will very likely mean that the ice trays may have been freshly filled with water or that a considerable quantity of warm air has been admitted which will call for more rapid refrigeration to restore the desired temperature for preservation of the foods. Opening of the door will, as described above, break the relay circuit at 32, and will therefore allow normal operation of the refrigerator once more. When the specified period has elapsed after the closing of the door the conductive material will again contact with the electrodes 38. At this time, however, the circuit may be open at 47 by reason of the arm 46 having passed the arm of the bell crank switch 47, but if the arm 46 is still on the contact segment 45 the relay circuit will nevertheless be closed through the segment 45 and the electrode 41 and the stream of conductive liquid flowing in the trough 42 if the mass of conductive liquid collected in the end of the tube 36 has risen to the level of the electrodes 38. Once operated by this temporary circuit, the relay will be held by the closing of the circuit through the switches 48 and 51.

The second event which may cause the relay to drop its armature and restore normal operation of the refrigerator is the completion of the defrosting. When the temperature of the refrigerating surfaces rises above the freezing point the thermostatic switch 51 opens and the relay circuit is broken whereupon normal operation is restored and continues until the appointed hour is reached again.

The third event is the end of the time allowed for defrosting. It may sometimes happen that frozen desserts etc., or ice cubes may melt a little at the very end of the defrosting period, and since these may be needed early in the morning or at the end of any other period appointed for defrosting, it may be desirable to restore normal operation even before the completion of defrosting and before the door is opened. For this purpose the switch 48 is provided. This switch is opened by the passing of the arm 46, and when opened breaks the relay circuit and causes the dropping of the armature.

In Fig. 8 I have shown a similar wiring diagram of a circuit controlled by the clock alone. In this case the defrosting begins at the appointed time and continues until the end of the appointed time unless before then the defrosting is completed. The operation in this case by means of the switches 47, 48 and 51 will be readily apparent from what has already been said in connection with Fig. 7.

Fig. 9 shows a similar circuit diagram of the case where the circuit control is entirely by means of the door control, e. g., as illustrated in Figs. 2 to 6 inclusive. In this case the opening of the door breaks the relay circuit at 32, and it is only after the required delay that this circuit can be re-established. During the normal day the refrigerator will be frequently opened, and the delay may be chosen so that defrosting will occur only at night, or the delay may be sufficient so as to provide time to perform the refrigeration ordinarily required after the refrigerator is opened, such as the rapid cooling of the box and the freezing of water in ice trays.

In Figs. 5 and 6, I have shown two alternative types of door control which may be used instead of that illustrated in Figs. 2, 3 and 4, e. g. in the circuit shown in Figure 9. These are shown primarily to illustrate the widely varying mechanisms which may be used for this purpose without departing from the scope of my invention. In the device of Fig. 5 the push rod 27 is connected to a gear rack 60, which through a pinion and ratchet not shown rotates the shaft 61 to wind the spring 62 within the drum 63. Any known type of overwind protector may be provided as for example a friction clutch adapted to slip when the spring is fully wound. The gear 64 on the drum 63 drives pinion 65 forming part of a suitable clock work with escapement or governor to determine the required delay and at the end of such delay operates a switch or other defrosting control.

In Fig. 6, a dashpot 66 having a plunger 67 therein serves as the delaying means and at the end of the delay allows operation of the defrosting control. The spring 68 pushes the plunger 67 to the left when the door is opened and a spring 69 receives and stores up the force of the closing of the door. A flap valve 71 provides for rapid movement of the plunger to the left and delayed movement in the other direction. A flange 70 may serve to operate the defrosting control device.

When this form of door control replaces that shown in Figs. 2, 3 and 4, the closing of the door pushes the rod 27 so as to compress the spring 69. The piston 67 is then slowly driven down the cylinder under influence of the spring 69 until the point is reached at which the flange 70 closes or operates the control switch or other defrosting control device. As soon as the door is opened the pressure on spring 69 is relieved and the piston is promptly forced back under the influence of the spring 68. Since the flap valve 71 is opened during this return movement, the piston returns very quickly, and the delay begins anew when the door is again closed.

In Figs. 10 to 15 inclusive I have shown another embodiment of my invention. In this case I have provided a switch 110 connected directly into the motor circuit. This switch as best shown in Fig. 14 is rotatably mounted on a rod 115 connected to the snap disc thermostat 116 on the surface of the refrigerating member 114. The spring 18 on the shaft 115 engages at one end the holder 111 in which the switch 110 is mounted and at the other end engages the collar 17 secured to the shaft 115. This spring is under tension so that it tends to hold the switch 110

and its holder 111 in the position shown in Fig. 12, but permits it to be rotated to the position shown in Fig. 13.

From the bottom of one of the spring fingers 125 of the holder 111 a stud 124 projects laterally beyond the side of the switch 110 and into the path of the member 123 connected to the hollow piston member 128 which will be more particularly described below.

A casing 120 in this embodiment of my invention illustrated in the drawings encloses the switch and air cylinder mechanism and only the rod 115 and the plunger 122 project through this casing. A buffer block 135, preferably of soft rubber, is secured to the bottom of the casing, as shown in Figs. 12 and 13 to stop the rotation of the switch 110 and support it in the position shown in Fig. 12.

The air cylinder delay mechanism comprises a fixed cylinder 133 secured within the casing 120. At the inner end of this cylinder 133 is a vent opening controlled by an adjustable valve plug 131 which is constructed to allow an inrush of air but to permit a very slow leakage of air outwardly from the cylinder.

Within the cylinder 133 is accurately fitted the hollow piston member 128 and against this presses the spiral spring 132. Within the hollow cylinder 128 is fitted the hollow push rod 127 with its open end inward and the spring 129 is fitted within both hollow members pressing against opposite ends thereof respectively. The cam member 123 is secured in the piston member 128 and has a portion extending into the open slot 130 of the push rod member 127 so as to limit its movement out from the hollow piston member 128.

The spring 132 is chosen just strong enough to push the piston 128 back to the beginning of its stroke when it is released from the pressure of the spring 129. The spring 129 is sufficiently strong to drive the piston 128 against the pressure of the spring 132 to the inner end of its stroke.

In the operation of this device when the door of the refrigerator box is being opened the push rod 127 is released and under pressure of the spring 129 immediately moves out from the hollow piston 128 to the full extent permitted by the extension on the cam member 123 and its slot 130. At the same time the spring 132 pushes the piston 128 outwardly until the cam member 123 reaches the end of the slot in cylinder 133. This same movement draws air in through the valve 131 filling the space within the cylinder 133. The cam member thus is moved out from under the stud 124 and the switch 110 is allowed to drop into the position shown in Fig. 12 in which the fluent conductive material falls over the contact member and closes the circuit of the motor. Thus normal operation of the motor will continue under control of the usual pressure and/or temperature control. When the door is closed it contacts the push rod 127 and drives it into the hollow piston 128 compressing the spring 129. The force of the spring 129 causes the piston 128 to move a short distance but this movement is limited by the air within the cylinder 133 which under compression resists the force of the spring 129. Very slowly this air is allowed to escape through the valve plug 131 until after the required delay the cam member 123 passes under the stud 124 lifting it along its cam surface until it reaches the position shown in Figs. 13 and 14. In this position the switch is tilted so that the fluent conductive material falls away from the contacts and the motor circuit is broken beginning a defrosting period. This defrosting continues and the motor remains inoperative until one of two conditions occur. If the door is open the parts move again to the position shown in Fig. 11, and the switch is dropped to the position shown in Fig. 12. In this position, as already described, the motor becomes operative and refrigeration begins again. If, however, the door is not opened until defrosting is complete and the surface of the cooling unit 114 rises above freezing temperature then the snap thermostat 116 snaps to a flat position pulling the rod 115 toward the left, and pulling the stud 124 off of the cam member 123. When this occurs the switch 110 drops again to the position shown in Fig. 12, notwithstanding the fact that the cam 123 is still in the position shown in Fig. 13. Thus refrigeration can begin again. When this occurs, of course, the thermostat 116 is cooled and snapped back to the position shown in the Figs. 10 and 11. In order that the cam member 123 may pass over the stud 124 when it is thus restored to the position shown in Figs. 11 and 15 the end 126 of the cam member is pivoted so that it may swing up but not down. Thus when the cam member 123 is retracted to the position shown in Fig. 11 it passes readily over the stud 124 but when moved again to the position shown in Fig. 15 it will engage the stud 124 and shift the switch as already described.

In this case, as in the cases already discussed above, the delay interposed by the air cylinder mechanism is advantageously such as to permit freezing of ice cubes or desserts placed in the trays of the refrigerating unit 114.

In Figs. 16 and 17, I have shown another embodiment of my invention similar in operation to that illustrated in Figs. 10–14. In this case a cylinder 140 is supported in a bearing rail 141 on brackets 142 and 143. On the top of the cylinder is a gear rack 144 which meshes with a pinion 145 driving an escapement or governor, not shown, through a ratchet mechanism so that it can be quickly reversed but driven only at a constant slow speed in a forward direction.

Within the cylinder 140 is a spring 146 which bears against the end of the push rod 147 so that when the push rod is driven into the cylinder the spring 146 is compressed and energy stored therein. The outer end of the push rod 147 has a head 148 having one side positioned to engage the door when it is closed and its opposite side engages the spring 149 which, when the door is open moves the push rod 147 and through it the cylinder 140 to the left to the full extent of their permitted movement.

In line with the end of the cylinder 140 and at the end of its inward stroke is a switch mechanism 150. In the drawing this is shown enclosed in a casing, and of the working parts only the push rod 151 is shown extending from the casing. This push rod 151 is engaged by the end of the cylinder 140 as it approaches the end of its stroke and is pushed inwardly to open the switch and render the motor inoperative and thereby to initiate a defrosting period. As soon as the door is open, however, the cylinder 140 and the push rod 147 immediately move to the left to the full end of their permitted stroke. When the door is re-closed the push rod 147 is driven to the right to the end of its stroke, while the cylinder 140 is restrained by the escapement

mechanism 145 and, therefore, the spring 146 is compressed and a delay period begun. As the escapement operates under the drive of the spring 146 the cylinder 140 moves slowly towards the right until it again contacts the push rod 151, opens the switch and initiates another defrosting period.

As shown in Fig. 17, which shows a modification of the embodiment shown in Figures 10 to 15 inclusive a thermostat 154 is provided responsive to the temperature of a surface to be defrosted. This thermostat is shown as normally contacting with a spring contact 155 to close the circuit through the switch 150 to the motor. Thus when the switch is open the motor circuit is opened and a defrosting period begins. If, however, defrosting is completed before the door is reopened and the surface to which the thermostat is responsive rises above the temperature corresponding to complete defrosting, then the thermostat contacts with the second contact 156 and thereby closes a shunt across the switch 150 and begins the normal operation of the motor for renewed refrigeration. In this circuit the thermostat 154 is shown as controlling the normal operation of the motor M, i. e., when the temperature is sufficiently lowered by operation of the refrigerating mechanism the thermostat opens the circuit at the contact 155. It will be understood, however, that any of the usual controls may be included in the motor circuit and this thermostat 154 serves only for initiating a renewed refrigerating cycle after completion of the defrosting.

In Figures 18, 19 and 20 I have shown another embodiment of my invention. In this case the delay is determined by the operation of the refrigerating device. A rotary contact member 160 is driven through suitable reducing gears so that one rotation of the disc 160 represents a sufficient operation of the refrigerating device to freeze ice cubes or a dessert in the trays of the cooling unit. In the present instance I have shown a worm wheel 161 driven from a worm 162 on the shaft of the motor 163 which operates the refrigerating device, not shown. The worm wheel 161 is in turn connected to a second worm 164 which drives the worm wheel 165 on the shaft 166. At its opposite end the shaft 166 carries rotatably thereon the contact disc 160 and between the worm wheel 165 and the disc 160 is splined as shown at 167 for reception of a clutch 168 the hub of which engages the spline portion of the shaft and the face of which frictionally engages the disc 160. The clutch is pressed into engagement by the spring 170 and is connected for disengagement by the push rod 171 mounted in the brackets 172 and having a head 173 which engages some part on or connected to the door. Thus, whenever the door is open the clutch 168 is released by force of the spring 174 acting through the push rod 171 and the contact disc 160 is rotated to the beginning of its cycle by means of the spiral spring 175 which engages its hub.

As shown in Figure 19, the disc 160 is made of conducting material with an insert 176 of insulating material. The brushes 177 and 178 connected into the motor circuit contact with the rim of this disc 160. Thus the motor continues to operate from the beginning of its cycle until the insulating insert comes under one of the brushes. When this occurs the motor circuit is broken and a defrosting cycle begins. In this case no means is shown for automatically terminating the defrosting cycle and it will continue until the door is next opened. It will be understood, however, that in this case, as in the other cases illustrated, normal refrigeration can be again initiated thermostatically, e. g., by shunting through the switch 156 exactly as shown in Fig. 17.

Because of the danger of arcing when the insulating insert passes under one of the brushes, it is preferable that the disc 160, at least where the brushes 177 and 178 contact with it, should be immersed in oil or otherwise protected against arcing. Where this is not practicable a mercury switch can be used, for example, as illustrated in Fig. 20. In this case the mercury switch is mounted on a pivoted holder 178 which follows the contour of the edge of the cam disc 160*a*. Throughout the predetermined cycle the switch is held in closed circuit position, but when the follower portion of the holder reaches the indented portion of the disc 160*a* the switch drops to an open circuit position and the defrosting period begins. Of course, in this instance the conductors terminate near the left hand end of the switch shown in Figure 20 in extremities which may be bridged by the mercury, the conductors being otherwise suitably insulated from the mercury within the mercury containing tube.

Although in the above I have described a preferred form of my invention and several modifications thereof, it is to be understood that these are given only by way of illustration of the numerous ways in which the invention may be embodied.

Instead of shutting off refrigeration entirely for a period, the refrigerator may merely be set during that period to maintain a temperature slightly above freezing. Thus the closing of the refrigerator door may set the control for rapid freezing, and at the end of a delay sufficient to meet normal demands following upon the opening of the refrigerator, the control may be shifted so as to maintain the refrigerating surfaces at or slightly above the freezing point.

This application is a continuation in part of my prior copending application No. 618,220 filed June 20, 1932.

What I claim is:

1. A defrosting refrigerator comprising an insulating box having a door, a refrigerating unit therein of the type adapted automatically to maintain the temperature normally in the box within predetermined limits, supplementary electrical means for controlling the supply of refrigerant to said refrigerating unit so as to permit melting of frost therefrom, said means comprising a relay, a chronometer device, a switch operated by said chronometer device, at a predetermined time to close momentarily the relay circuit, a parallel circuit portion around said chronometer operated switch including in series a contact closed by the armature of the relay, a switch normally closed but opened by said chronometer device at a predetermined time after the closing and opening of the first-named chronometer operated switch, and a thermostatic switch responsive to the temperature of said surface to be defrosted and adapted to be opened when the temperature of said surface rises above the freezing point, and means for delaying the operation of said relay until a substantial time has elapsed after the opening of the refrigerator door.

2. A defrosting refrigerator as defined in claim 1 in which the means for delaying the operation

of the relay comprises a switch in the relay circuit, means for operating the switch having a substantial lost motion operation before it comes into effective operating relation to said switch, means for regulating the speed of said lost motion operation, and means responsive to opening of the refrigerator door for resetting said switch operating means to the beginning of its lost motion.

3. A defrosting device for a refrigerator having an insulated box with a door and a refrigerating unit, which comprises means for controlling the operation of the refrigerating unit temporarily to permit melting of frost, means for operating said controlling means having a substantial lost motion operation before it comes into effective operating relation to said controlling means, means for regulating the speed of said lost motion operation, and means responsive to opening of the refrigerator door for resetting said operating means to the beginning of its lost motion.

4. A defrosting refrigerator as defined in claim 1 in which the means for delaying operation of the relay comprises a body of fluent material, a barrier having a narrow orifice, means for controlling a circuit responsive to flow of a substantial volume of said fluent material through said orifice and means for restoring said fluent material to the opposite side of said barrier when the door is opened.

5. A device for automatic defrosting of refrigerators which comprises means for temporarily interrupting refrigeration, means responsive to the opening of the refrigerator door to prevent interruption of refrigeration by the interrupting means during a substantial delay after the opening of said door, a chronometer device, and means associated with said chronometer device for limiting the operation of the interrupting means to a predetermined time when rapid refrigeration is normally not required.

6. A device as defined in claim 5 which includes means responsive to said second-mentioned means for operating said interrupting means at the end of the delay if the means associated with the chronometer device is set to permit such operation, and means associated with the chronometer device for operating said interrupting means at the predetermined time if the delaying means is set to permit such operation, each of said operating means being adapted to operate said interrupting means only momentarily, and means associated with said interrupting means for holding the interrupting means in operated position after said momentary operation has ceased.

7. A device for automatic defrosting of refrigerators which comprises an electrical circuit adapted to control the refrigeration, a relay adapted to control said circuit so as temporarily to prevent further refrigeration, a chronometer device, a switch in the energizing circuit of said relay controlled by said chronometer device so as to operate the relay at a predetermined time when rapid refrigeration is not required, a parallel portion of the relay circuit adapted to be closed by the relay armature so as to keep it energized once the relay has been operated, and a switch in said parallel circuit portion adapted to be opened at a given time when rapid refrigeration is likely to be required whereby to release said relay and restore normal control of refrigeration.

8. A device as defined in claim 7 which further includes a thermostatically operated switch adapted to open said relay circuit when a temperature is reached at which defrosting is complete, and thereby to restore normal control of refrigeration.

9. A device for automatically defrosting refrigerators which comprises means for interrupting refrigeration, means for momentarily operating said interrupting means at a time when rapid refrigeration normally is not required, means for holding said interrupting means when thus operated, means responsive to completion of the desired defrosting for releasing said interrupting means so as to permit renewed refrigeration, and means for releasing the interrupting means at the end of an intended period of defrosting, whether or not the defrosting is complete.

10. A device for automatic defrosting of refrigerators which comprises an electrical circuit adapted to control the refrigeration, a relay adapted to open said control circuit temporarily to prevent further refrigeration, means in the energizing circuit of said relay adapted to close said relay circuit at times when rapid refrigeration is not required, and a thermostatic means responsive to the temperature of a refrigerating surface which is to be defrosted and adapted to open said circuit when the temperature of said surface rises above the freezing point.

11. The combination with an automatic refrigerator comprising a refrigerating device having a cold unit, a freezing container associated therewith, and an insulated box enclosing and cooled by the cold unit, of means for temporarily interrupting operation of the refrigerating device during a period adapted to permit melting of frost accumulated on the cold unit, and means responsive to an operation necessary to the placing of liquid in said container in such position as to be frozen by the cold unit, which means is adapted to delay the effect of said interrupting means during a normal freezing period following said operation.

12. A device for automatic defrosting of refrigerators which comprises means for temporarily interrupting refrigeration, means for operating the interrupting means and adapted to be set in operation by manipulation of the refrigerator otherwise required for a use thereof in which continued refrigeration is desired, and means adapted for delaying the operation of said operating means whereby a substantial period intervenes between said manipulation and the final effective interruption of the refrigeration.

13. A device for defrosting refrigerators which comprises means for storing energy, said means being associated with the refrigerator so that its energy charge is renewed by a manipulation which is involved in a normal use of the refrigerator, means operated by said stored energy for temporarily interrupting normal refrigeration, and means for so controlling the release of the stored energy that said interrupting means will not be operated to the point of interrupting refrigeration until after a predetermined delay following said renewal of the energy charge.

14. The combination with an automatic refrigerator comprising a refrigerating device, a freezing container associated therewith, a thermostatic control for the refrigeration device, and an insulating box having a door thereon, of means for automatically initiating a defrosting period, means responsive to movement of the door and adapted to prevent initiating of the defrosting

period by said first-named means during a period sufficient normally to freeze ice in said container.

15. The combination with an automatic refrigerator comprising a refrigerating device, a freezing container associated therewith, and an insulated box containing the cold unit of the refrigerating device and the freezing container, of means for temporarily interrupting operation of the refrigeration device during a period adapted to permit melting of frost accumulated on the refrigerating device and means responsive to use of the refrigerator involving the placing in said container of liquid to be frozen, adapted to delay the effect of said interrupting means during a period following said use while such liquid is freezing.

16. An automatic defrosting mechanism for mechanical refrigerators including means operable at a predetermined interval after the closing of the refrigerator door to cut out the refrigerating unit, and means to cut in the refrigerating unit when defrosting is completed.

17. A control device for a refrigerator including means operative to modify normal operation of the refrigerator to permit melting of frost thereon, and appreciably later than when said means is placed in its initial operative condition, and means for intermittently placing said first means in its initial operative condition, whereby modified operation of the refrigerator is effected only when a period between operation of said second means exceeds the time delay period of said first means.

18. In a refrigerator having a door, a control device including means operative to modify normal operation of the refrigerator to permit melting of frost thereon, and appreciably later than when said means is placed in its initial operative condition, and means for intermittently placing said first means in its initial operative condition each time said door is opened, whereby modified operation of the refrigerator is effected only when a period between door opening operations exceeds the time delay period of said first means.

19. The combination with an insulating box having an access opening, a closure therefor and refrigerating apparatus including an evaporator within the box, of means for suspending the operation of said apparatus to allow defrosting of said evaporator, and mechanism for delaying the operation of said suspending means for periods of time sufficient to permit a normally required amount of refrigeration to be effected by said apparatus, said mechanism including means for starting a period of delay, said last-named means being actuated in response to a use of the box including at least one operation of the closure.

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