Sept. 25, 1962 T. I. SYFERT 3,055,188

REFRIGERATION DEFROST DEVICE

Filed Jan. 16, 1961

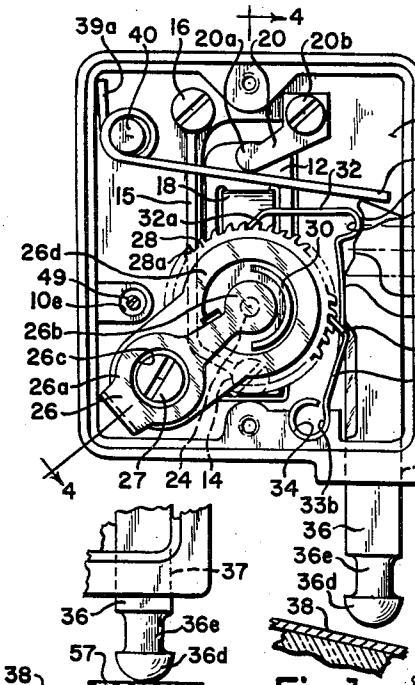


Fig. 1

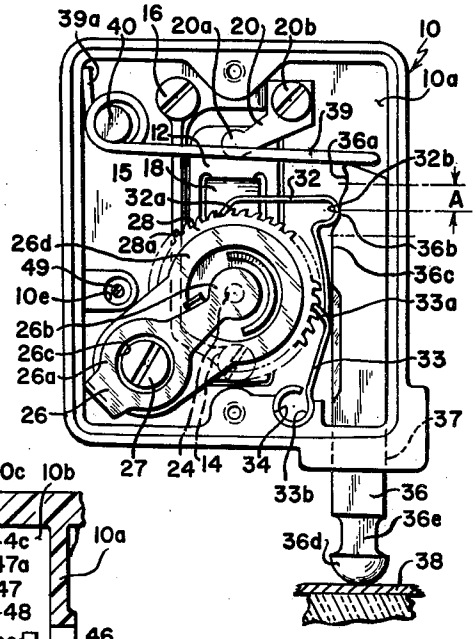


Fig. 2

Fig. 7

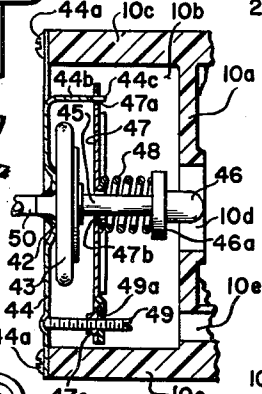


Fig. 5

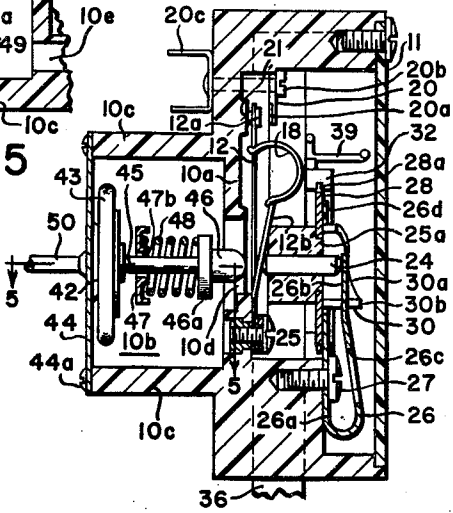


Fig. 4

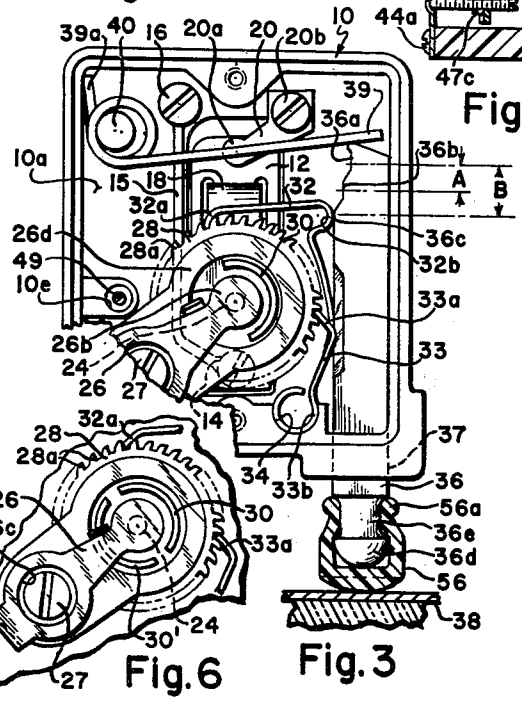


Fig. 6

Fig. 3

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United States Patent Office 3,055,188 Patented Sept. 25, 1962

3,055,188

REFRIGERATION DEFROST DEVICE

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Filed Jan. 16, 1961, Ser. No. 83,083
2 Claims. (Cl. 62—267)

This invention relates to refrigerator control apparatus for effecting periodic defrosting of mechanical refrigerators, and more particularly to an improved control apparatus of the type which initiates a defrosting operation whenever a door of the refrigerator has been opened and closed a predetermined number of times.

The rate of accumulation of frost on the freezing unit of a refrigerator is generally dependent upon the number of times the door is opened and also upon the degree of humidity in the air which enters the refrigerator cabinet when the door is opened. Controls have been devised which initiate the defrosting operation after a predetermined number of door openings or closings; however, due to the differences in humidity generally prevailing throughout the different parts of the country, the number of door openings and closings required to maintain relatively frost-free freezing units of refrigerators in different sections of the country will vary. Accordingly, it is a principal object of this invention to provide a refrigerator control apparatus for initiating a defrosting operation or cycle after a predetermined number of door openings, and which predetermined number may be readily varied in accordance with the prevailing requirements.

It is a more specific object of this invention to provide a control apparatus of the above mentioned character having an electric switch for controlling a defrosting cycle and which is operated after a predetermined number of door openings by counting means driven by the reciprocation of an actuating member which is engaged and moved through a drive stroke by the door upon each closing thereof, and wherein the predetermined number of openings can be changed by the provision of a removable extension means on the actuating member to change the length of the drive stroke thereof.

Other objects and advantages of this invention will be apparent from the following detailed description of a presently preferred embodiment thereof and from the accompanying sheet of drawings forming a part of this specification, and in which—

FIG. 1 shows a top elevational view of a control apparatus embodying this invention with the cover plate removed;

FIG. 2 is a view similar to FIG. 1 but showing the parts thereof in different positions;

FIG. 3 is a view similar to FIGS. 1 and 2 but showing the parts in still different position, and including an extension means on the actuating member thereof;

FIG. 4 is a sectional view of the apparatus of FIG. 1 taken substantially along line 4—4 thereof;

FIG. 5 is a fragmentary sectional view taken along line 5—5 of FIG. 4;

FIG. 6 is a fragmentary view of the device of FIG. 1 showing a modification thereof; and

FIG. 7 is a fragmentary view illustrating another modification.

In the form of the control apparatus illustrated, there is provided a housing **10** in the form of a generally rectangular box, preferably of a suitable molder insulating material and having an open side normally closed by a cover plate **11**. Electric switch means are mounted in the housing for initiating and terminating defrosting cycles in the freezing unit of a refrigerator by controlling the completion of a circuit for a defrosting system which may be of any well known type such as one in which a solenoid operated valve directs hot gas into the freezing unit.

Although the defrosting switch means may be of any suitable construction, it is preferably of the over center type of snap acting switch, and it is herein illustrated as comprising a flat spring switch arm **12** having an electrical contact **12***a* at one end thereof and being secured to the rear wall **10***a* of the housing **10** by a screw **14** at the other end thereof. The screw **14** also serves to secure one end of a conductor **15** which leads from arm **12** to a screw **16** which secures to wall **10***a* a terminal lug (not shown) for connection of the switch into the defrosting circuit. A stationary contact member **20**, having a contact **20***a* in registration with contact **12***a*, is secured to housing wall **10***a* by a screw **20***b* which may also secure a terminal lug **20***c* thereto. Switch arm **12** is movable to bring contact **12***a* into and out of engagement with contact **20***a* to make and break an electrical circuit therethrough in a manner which will be made apparent as the description proceeds.

A tongue member **12***b* is struck out of the central portion of arm **12** and has its free or movable end in engagement with one end of a C-shaped spring **18**, the other end of which engages the switch arm **12** adjacent the contact **12***a* thereof, as shown, and normally biases contact **12***a* against a stop **21** formed on the housing wall **10***a*.

A plunger **24**, having one end disposed adjacent tongue member **12***b*, is reciprocably carried in a bearing **25** which is preferably formed as a part of the housing **10**. Plunger **24** is adapted to be driven by means more fully described hereinafter, against the tongue member **12***b* to move the latter through its dead center position, in alignment with contact arm **12**, to a position on the other side thereof so that C-shaped spring **18** biases contact arm **12** in a direction away from housing wall **10***a* and brings contact **12***a* into maintained engagement with contact **20***a*.

The means for moving plunger **24** against the tongue **12***b* is in the nature of a ratchet type counting means responsive to a predetermined number of door openings and closings, and comprises as one part thereof a U-shaped spring member **26** which has one leg **26***a* thereof secured to housing **10** by a screw **27**, and has another leg **26***b* in overlying relation to an exposed end of plunger **24**. An opening **26***c* is conveniently provided in leg **26***b* of spring **26** to provide access to the securing screw **27**. A ratchet wheel **28**, forming another part of the counting means, is rotatably mounted on a reduced portion **25***a* of bearing **25** surrounding the exposed end of plunger **24**, and is conveniently retained thereon by a circular end portion **26***d* of spring **26**. A semi-circular cam member **30** is secured to the ratchet wheel **28** for rotation therewith and presents an inclined cam surface **30***a* which is adapted to engage the leg **26***b* of spring **26** and to move the latter away from the end of plunger **24** upon rotation of the ratchet wheel. Continued rotation of ratchet wheel **28** will permit the leg **26***b* to drop off the end **30***b* of cam **30**, allowing it to spring back toward the plunger **24**. The inertia of the leg **26***b* will carry it past its normal resting position, shown in FIG. 4, causing it to drive plunger **24** sharply against tongue **12***b*, moving the latter through its dead

center position and bringing contact 12*a* into engagement with contact 20*a* in the manner described previously, and thereby completing an electrical circuit for initiating the heating phase of the defrosting cycle.

Rotation of ratchet wheel 28 is effected in a step-by-step or incremental manner, upon repeated openings of a refrigerator door, by ratchet means including a flexible dog member 32 which is preferably formed of flat spring stock and includes a ratchet wheel engaging end 32*a* and a cam follower portion 32*b*. A ratchet pawl 33 having a ratchet wheel engaging end 33*a* is preferably formed integrally with dog member 32 and the two are secured to the housing 10 by a common eye 33*b* received in a cylindrical opening 34 formed in the housing.

An elongated actuating member 36, for moving dog member 32, extends through an opening 37 in one wall of housing 10 and is reciprocably disposed therein. The inner end of actuator 36 is provided with a cam surface having a plurality of steps 36*a*, 36*b* and 36*c* upon which the cam follower portion 32*b* of dog 32 is adapted to ride and the purposes of which will become apparent as the description proceeds. The outer end 36*d* of the actuator member is adapted to be engaged by a refrigerator door, a fragment of which is indicated at 38, for effecting inward movement thereof through a drive stroke. The actuating member 36 is normally biased outwardly to the position illustrated in FIG. 1 by a wire spring 39 which acts against the inner end of the actuating member and is coiled about a post 40 formed in the housing 10, and has a portion 39*a* bearing against a side wall of the housing.

It will be recognized that upon closing of the refrigerator door 38, the actuating member 36 will be engaged thereby and will be moved inwardly a distance A to the position shown in FIG. 2. It will also be recognized that upon such movement cam follower portion 32*b* of ratchet dog 32 will be moved to the left, coming to rest on the step or cam surface 36*b*, and that the tooth engaging portion 32*a* will effect rotation of ratchet wheel 28 in a counter-clockwise direction, as viewed in FIG. 2, a distance of one tooth. Upon a subsequent opening of door 38, actuator member 36 will be moved outwardly through a return stroke by spring 39 and ratchet dog 32 will move to the right with the end 32*a* thereof riding over one tooth, and with the cam follower portion 32*b* thereof coming to rest on the surface 36*a*. During the return movement of the ratchet dog 32, ratched wheel 28 is held against movement in a clockwise direction by the ratchet pawl 33. A number of door openings and closings corresponding to the number of teeth 28*a* of ratchet wheel 28 will result in one complete revolution of the ratchet wheel, and will cause the spring 26 to strike plunger 24 and actuate the defrosting switch means, closing contacts 12*a*, 20*a* thereof to initiate the defrosting cycle.

In some instances it is desirable to have a defrost cycle initiated upon one half a revolution of ratchet wheel 28, in which case a second semi-circular cam member 30' is provided on the ratchet wheel, as shown in FIG. 6. The second cam member 30' serves to operate the defrost switch in the same manner as cam member 30, thereby decreasing the number of door closings required to initiate a defrosting operation.

Means are provided to operate the defrosting switch means to open contacts 12*a*, 20*a* to terminate the defrosting cycle and return the refrigerator to normal operation when the freezing unit has been heated sufficiently to effect the defrosting. To this end a thermally responsive bellows means, generally indicated at 42, is mounted in a recess 10*b* defined by wall portions 10*c* extending from the housing rear wall 10*a*, and comprises a flexible metal bellows member 43 secured to a base plate 44 which is suitably fastened to wall portions 10*c* as by screws 44*a*. Bellows 43 is provided with a central post or plunger 45 which is threaded at its outer end and has an insulator member 46 threadedly engaged thereon. Insulator member 46 extends through an opening 10*d* in housing wall 10*a* and is adapted to engage tongue 12*b* when the latter has been moved by plunger 24. Base plate 44 includes an inwardly extending member 44*b* having a lug 44*c* thereon. A lever 47 has an opening 47*a* which received lug 44*c* and is thereby pivotally connected to member 44*b*. Lever 47 extends across the face of bellows 43 and has a central opening 47*d* through which plunger 45 extends. A compression spring 48 surrounds plunger 45 and is disposed between lever 47 and a flange 46*a* of insulator member 46. An adjusting screw 49 extends through a threaded opening in end 47*c* of lever 47 and bears against plate 44 with the end of the screw received in an indentation in the plate. Screw 49 can be advanced or retracted to move lever 47 and vary the tension of spring 48 which loads or biases the bellows in a direction tending to expand the same.

A tubular element 50, which is sealed at one end, is connected at its other end by brazing or soldering to plate 44, and is in communication with the interior of bellows 43. Both the tubular element 50 and the bellows 43 contain a fluid at a pressure less than atmospheric, which fluid expands and contracts with increases and decreases in temperature. The tubular element is preferably placed in a position adjacent the freezing unit of the refrigerator so that when the temperature of the unit rises to a predetermined degree, the bellows will be expanded by spring 48 forcing plunger insulator 46 against tongue 12*b* and moving the latter through its center position for actuating the defrosting switch means to return the refrigerator to normal operation. The predetermined temperature at which the defrosting operation is terminated may be adjusted or varied by means of load adjusting screw 49. The latter may be conveniently adjusted from the front of the device through an opening in cover 11 which is aligned with a tunnel 10*e* formed in housing 10 and leading to screw 49. Preferably, a nylon washer 49*a* surrounds screw 49 to hold the screw in its adjusted position.

After the refrigerator is returned to normal operation and as the freezing unit then cools, the fluid in tubular member 50 and bellows 43 contracts permitting the bellows to be compressed by atmospheric air pressure to withdraw plunger 45, thereby placing the apparatus in condition for initiating another defrosting cycle after the completion of the predetermined number of door openings required to turn ratchet wheel 28 through one revolution.

The construction of the bellows means 42 provides a fail-safe feature in that if a leak occurs in the tubular element or bellows, the sub-atmospheric condition therein will be destroyed and the plunger will move to the right as viewed in FIG. 4, under the influence of spring 48, thereby actuating the defrosting switch to return the refrigerator to normal operation or, to prevent a defrost cycle from being initiated. Thus, if such a leak occurs during a defrosting operation, there will be no danger of the defrosting means causing the temperature within the refrigerator to rise beyond the predetermined temperature and spoil the food or damage the refrigerator.

The invention provides means for readily changing the number of door closings required to initiate the defrost cycle so that when refrigerators equipped with the defrosting control of this invention are to be used in a section of the country having a high degree of humidity, where frost builds up on the freezing unit more rapidly, they can be simply and rapidly adjusted or modified to initiate the defrosting operation more frequently than those in less humid sections. To this end, and as illustrated in FIG. 3, an actuating member extension means in the form of a removable rubber or plastic cap 56 is provided on the end of the actuating member and serves to extend the length thereof. The cap or extension mem-

ber **56** is conveniently retained on the actuating member **36** by engagement of a reduced neck portion **56***a* with a groove **36***e* formed in the actuating member adjacent the end thereof. With the cap **56** in place, it will be seen that upon each closing of door **38**, actuating member **36** will be moved through a distance indicated at B in FIG. 3. The distance B, which is greater than distance A, represents a lengthened drive stroke of the member **36**. With each such lengthened drive stroke the dog **32** will be moved to the left by the cam surface on actuating member **36** until cam follower **32***b* rests on step **36***c*, thereby effecting rotation of the ratchet wheel **28** through an angular distance corresponding to two teeth rather than one tooth as in the previously described operation. It will be recognized that with such longer drive strokes as are effected with cap **56** in place, and with the resultant increased rotation of ratchet wheel **28**, contacts **12***a*, **20***a* will be closed and a defrosting operation will be initiated upon one-half the number of door closings required to initiate the operation when cap **56** is not used.

As an alternative to the use of a cap **56** to extend the drive stroke of member **36**, a striker plate or button **57** may be installed on the door **38** as shown in FIG. 7. It will be understood that the striker plate or button **57** will extend above the normal surface of the door **38** and is adapted to engage and move the actuating member **36** so as to provide an increased rotation of ratchet wheel **28** and a consequent decrease in the number of door openings and closings required to initiate defrosting of the refrigerator.

Although the apparatus has been described as moving the ratchet wheel one tooth for each normal drive stroke of actuator member **36**, and two teeth for each lengthened drive stroke thereof, it will be understood that different sizes of steps **36***b* and **36***c* can be used as well as different sizes of teeth **28***a* to vary the number of strokes required to operate the switch means. Also, although the device has been described as including only contacts **12***a* and **20***a*, which comprise a single pole, single throw switch means, it will be understood that additional contact means could be included in the place of stop member **21** to provide a single pole, double throw switch means.

From the foregoing detailed description of a refrigerator control apparatus embodying this invention, and from the accompanying sheet of drawings, it will be recognized that there has been provided by this invention an improved control apparatus whereby refrigerator defrosting operations can be initiated in accordance with different predetermined numbers of door openings as required by different frosting conditions and that the invention accomplishes this in a particularly simple, reliable and effective manner.

Although the invention has been described herein with reference to a specific embodiment of control apparatus, it is understood that the invention is not limited thereto but, rather, the invention includes all such adaptations, changes and modifications as are reasonably embraced by the scope of claims hereof.

Having described my invention, I claim:

1. A defrosting control apparatus for use in initiating a defrosting operation in a defrosting means of a refrigerator freezing unit in response to a predetermined number of openings and closings of the refrigerator door, said apparatus comprising:

(*a*) a housing,

(*b*) switch means mounted on said housing and having first and second operative positions for initiating and terminating defrosting cycles,

(*c*) a ratchet wheel rotatably mounted in said housing,

(*d*) means between said ratchet wheel and switch to effect operation of the latter to said first position upon predetermined rotation of said ratchet wheel,

(*e*) an actuator member reciprocable in said housing and presenting first and second cam surfaces,

(*f*) dog means movable by said first cam surface and operative to rotate said ratchet wheel through an increment of said predetermined rotation upon reciprocation of said actuator member through a stroke of a first length,

(*g*) said dog means being movable by said first and second cam surfaces and operative to rotate said ratchet wheel through a greater increment of said predetermined rotation upon reciprocation of said actuator through a stroke of a second and greater length,

and

(*h*) whereby said predetermined rotation of said ratchet wheel is effected by one number of strokes of said first length and by a lesser number of strokes of said second length.

2. Control apparatus as defined in claim 1 and wherein said actuator member is adapted to be reciprocated by engagement by a refrigerator door, and said actuator member comprises an extension means removably to vary the length of said strokes.

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