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T. S. SAFFORD

2,335,967

REFRIGERATOR CONTROL

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Fig. 1.

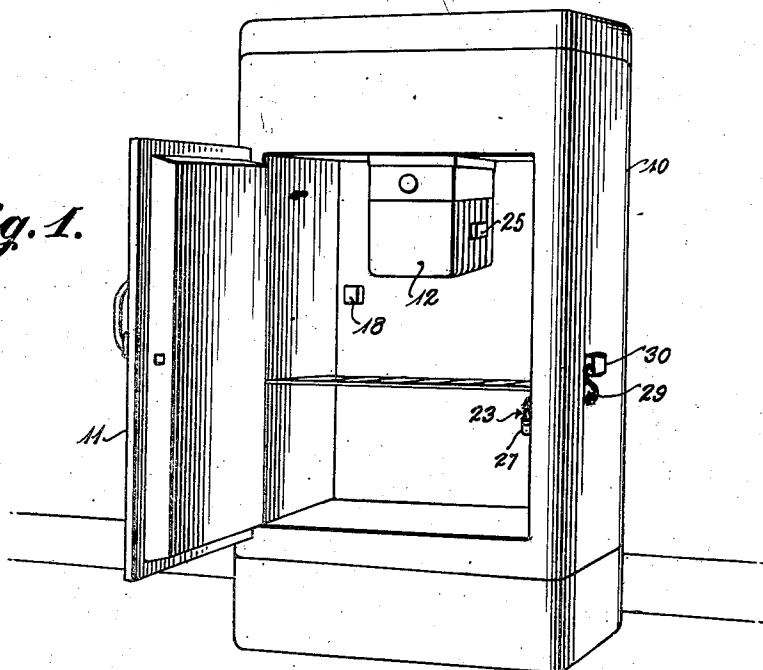


Fig. 2.

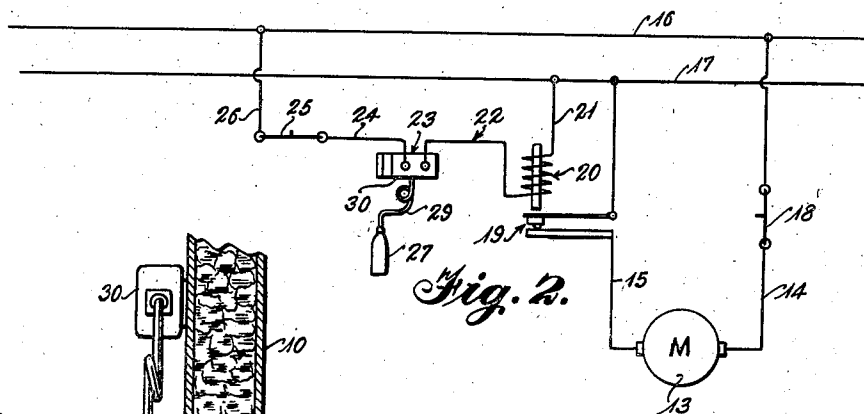
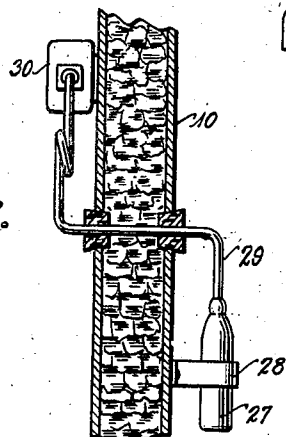


Fig. 3.



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REFRIGERATOR CONTROL

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3 Claims. (Cl. 62—115)

This invention relates to the defrosting of refrigerators of the mechanical type in which the heat required for the vaporization of a refrigerant is taken from the articles to be cooled and is more particularly concerned with the automatic control of defrosting operations.

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.

This application includes subject matter common to application Serial Number 104,840, filed October 9, 1936, which matured into Patent 2,319,349, granted May 18, 1943. In general, the apparatus of that invention involves means for automatically de-energizing the refrigerating machinery to permit defrosting and means responsive to an operation of the refrigerator door for delaying the operation of the de-energizing means until such time as defrosting may be convenient to the user of the refrigerator. This invention is concerned with an alternative method of solving the same problem in which the delay in the operation of the de-energizing means is responsive to use of the refrigerator so that defrosting does not take place during normal use when refrigeration is required but may, and does, take place if the refrigerator is not opened for a substantial period of time.

It is, therefore, an object of this invention to provide an automatic defrosting control which will require no attention on the part of the refrigerator user and which will insure the thorough and frequent elimination of frost while minimizing the likelihood of failure to provide adequate refrigeration at times when it is needed for any purpose.

Other objects and advantages of this invention will be apparent upon a consideration of the following detailed description of a preferred embodiment thereof in connection with the annexed drawing wherein:

Figure 1 is a perspective view of a domestic

refrigerator of the type in which the vaporization of a liquid medium is responsible for the cooling effect, showing various controls arranged according to this invention;

Figure 2 is a circuit diagram illustrating the operation of the several thermal switches responsible for deferred automatic defrosting of the evaporator coils of the refrigerator shown in Figure 1; and

Figure 3 is a view showing in detail the installation of one of the thermal switches included in the circuit diagram of Figure 2.

The refrigerator box shown in Figure 1 consists of the usual heat insulated walls 10, a close fitting door 11, and evaporator unit 12 disposed about a tier of drawers adapted to contain ice cubes or other material to be frozen within the refrigerator. In the preferred form of this invention, to be described in detail in this application, evaporator 12 will be considered as a part of a compressor-expander circuit in which the compressor is electrically operated by a motor. It will be evident, however, that the present invention is adaptable to various types of mechanical and heat-operated refrigerators and that the present description is exemplary rather than restrictive in nature.

Referring now to Figure 2, it can be seen that a motor 13 is connected by conductors 14 and 15 with main power lines 16 and 17, respectively. Motor 13 is intended for the operation of a compressor to supply refrigerant under pressure, the latent heat of vaporization of such refrigerant being withdrawn from the articles within insulated box 10 thereby cooling the same. As is customary, vaporization of the refrigerant occurs in evaporator 12. In conductor 14 leading to compressor motor 13 there is disposed a thermal or vapor pressure responsive switch 18 of conventional form. This switch is disposed in some position within the insulated box 10 which will control the average box temperature. Normally a switch of the type of switch 18 will be somewhat removed from the evaporator 12 but in a position to maintain an average temperature of any desired value on those shelves of the refrigerator on which objects are stored for refrigeration. It is contemplated that switch 18 be entirely conventional in form. Normally, such switches are capable of adjustment and it is understood that switch 18 may be of that type, if desired. The conductor 15 connecting the other pole of motor 13 with the power source is also conventional in form except for the disposition of a normally closed switch 19 therein. When switch 19 is

closed, the operation of the refrigerator illustrated is entirely conventional. Under these conditions, when the temperature falls below a predetermined value, switch 18 opens and allows the refrigerator to warm. An appreciable rise in temperature results in the closing of switch 18 and the initiation of operation of compressor motor 13 bringing about further refrigeration.

It has been stated that it is an object of this invention to provide a control of a type which will cause automatic defrosting at times when it will be convenient from a standpoint of the refrigerator user. To this end, the opening of normally closed switch 19 is effected automatically through a control circuit including a relay 20. One pole of relay 20 is connected by conductor 21 to main line conductor 17, while the other pole thereof is connected by a conductor 22 to a thermal switch 23 which is in turn connected through a conductor 24 to another thermal switch 25 connected by a conductor 26 to the other main power line 16. The disposition and function of thermal switches 23 and 25 forms an important part of the present invention.

Upon reference to Figure 1, it can be seen that thermal switch 25 is disposed on or close to the evaporator 12. This switch is normally closed when the evaporator temperature is substantially at or below the freezing point of water. In other words, the tendency of switch 25 is to close the circuit leading to relay 20 to thereby hold switch 19 open and de-energize motor 13. When, however, the temperature at the evaporator has risen to a value consistent with the melting of the frost thereon, for example about 34° or 35° F., thermal switch 25 will open thus de-energizing relay 20 and allowing switch 19 to close thereby causing operation of motor 13. Switch 25 is of the type commonly known as a "terminate defrost." Once open, it does not reclose until a low temperature is reached near the minimum of normal operation.

Thermal switch 23, which is also in the circuit controlling the operation of switch 19, is of the differential type. Such a switch is manufactured by the Minneapolis Honeywell Regulator Company and designated in their catalog as type L480 in section 4-G, form No. 95-1244. A thermal switch of this type may be normally disposed in circuit opening position when the temperature responsive portion thereof is exposed to a temperature above a certain value. Upon reduction in temperature to said value the switch will move to circuit closing position but will remain in that position for a differential which may be as great as a 12° rise in temperature before return to its first or circuit opening position. It is contemplated that thermal switch 23 include a capsule 27 held within the interior of the food storage chamber of the refrigerator by a clip 28. Capillary tubing 29 connects capsule 27 with the switch box 30 which may be disposed on the exterior of the refrigerator for convenient adjustment. The location of capsule 27 forms an important part of this invention. Upon reference to Figure 1 it may be seen that said capsule is disposed on the interior of a wall 10 adjacent the latch side of door 11. In this position, capsule 27 is most exposed to warm air upon the opening of door 11 and will be exposed also to the warmth of any foods, drinks, and dishes placed on the shelves in the box. It is also evident that because of the position of capsule 27 it will be much more affected by the opening of the door 11 and by the placement of warm objects in the refrigerator than will thermal switch 18 which controls the

average temperature. It is contemplated that capsule 27 be so arranged as to be cooled substantially solely by convection.

In the operation of the device described above let it be assumed that thermal switch 18 is adjusted to maintain an average temperature of 45° F. while thermal switch 25 opens at about 35° and recloses at a temperature about 20° F. Under such circumstances, thermal switch 23 can be adjusted to maintain the control circuit open at all temperatures above 45° F. but to move to circuit closing position upon reduction in temperature to substantially 45° F. The differential may be set for 5° or 6° so that switch 23 will stay in circuit closing position until a temperature in the neighborhood of 51° is reached.

With the above adjustments of the thermostats, normal use of a household refrigerator incidental to the preparation of 3 meals a day including frequent opening of the door and placement of warm objects within the refrigerator will keep thermal switch 23 for the entire day in circuit opening position. Under such conditions the relay 20 is de-energized, switch 19 is closed, and the refrigerator control is effected in the usual manner by operation of thermal switch 18. However, after preparation of the evening meal, it may be that the refrigerator will be no longer used until the next morning. Under such circumstances, the temperature within the insulated box will tend to equalize and eventually the temperature at capsule 27 will fall to about 45° F., this temperature being reached through operation of thermal switch 18. When this temperature value exists in the vicinity of capsule 27 switch 23 will move to circuit closing position. Since switch 25 is already closed, relay 20 will be energized and switch 19 will be opened causing motor 13 to stop. The temperature within the refrigerator will then gradually rise until melting at evaporator 12 raises the temperature at thermal switch 25 to 35°. At this time the control circuit will be opened, switch 19 will be closed, and motor 13 will resume operation. This will presently cause switch 25 to close again and the refrigerator will repeat a defrosting cycle. Eventually the temperature at capsule 27 may reach about 51° and that switch will return to circuit opening position. Of course, if the refrigerator is used before that time, switch 23 will be immediately restored to circuit opening position and normal refrigeration will commence.

From the foregoing it can be seen that before defrosting can occur there must be a time interval sufficient to permit capsule 27 to be cooled to a temperature determined by adjustment of switch 18. This time interval has been found to be sufficiently great so that it will not occur when a refrigerator is used every 3 or 4 hours as is common in the ordinary household. However, when no meals are prepared switch 23 may be sufficiently cooled to move to circuit closing position and so bring about defrosting. The apparatus described is entirely automatic and is fully adjustable. It is of course contemplated that temperature values other than those suggested above may be used if desired.

Although in the specification and the accompanying drawing there is shown and described a preferred embodiment of this invention and various modifications thereof, and although various alternatives are suggested, these are not intended to be exhaustive nor limiting of the invention, but, on the contrary, are given for the purpose of illustrating it and instructing others

in the principles thereof as well as the best practical manner of utilizing the invention in order that others may be enabled to modify it and apply it in numerous forms each as may be best suited as to conditions and requirements in any particular instance. In particular it is contemplated that my invention may be applied to gas and other heat-operated refrigerators, in which case the motor 13 may operate a fuel valve or relay to control the energy supply, instead of driving the usual mechanical refrigerator.

What is claimed is:

1. A refrigerator comprising a cabinet having an insulated chamber therein, refrigerating apparatus including a cooling unit disposed in said insulated chamber, an element at a point within the insulated chamber remote from the access opening thereof for controlling the apparatus for restricting variations in temperature within a narrow range from a fixed value, and control means for rendering the apparatus ineffective for cooling purposes so as to permit defrosting of the cooling unit, said control means including a temperature responsive element disposed in said chamber adjacent to the access opening thereof and at a point removed from the location of the first named element and in a position to be effected to an appreciable extent by heat from warm objects introduced through

said opening into said chamber, said temperature responsive element being of the differential type and initiating and then permitting operation of the control means after the temperature in the vicinity of the temperature responsive element reaches the low limit of a predetermined temperature range and suspending operation of the control means after the temperature in said vicinity reaches the upper limit of said range.

2. A refrigerator, according to claim 1, in which said control means includes a second temperature responsive element, said second temperature responsive element being located upon the cooling unit and being of the differential type and being operative at temperatures below the freezing point of water to cause the refrigerating apparatus to be inoperative, and at temperatures above the freezing point of water to permit the refrigerating apparatus to be operative.

3. A refrigerator, according to claim 1, in which the refrigerating apparatus includes a motor circuit having a normally closed switch therein, and said control means includes a second circuit comprising a solenoid which upon energization of said second circuit opens the switch in the motor circuit.

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