

March 22, 1955

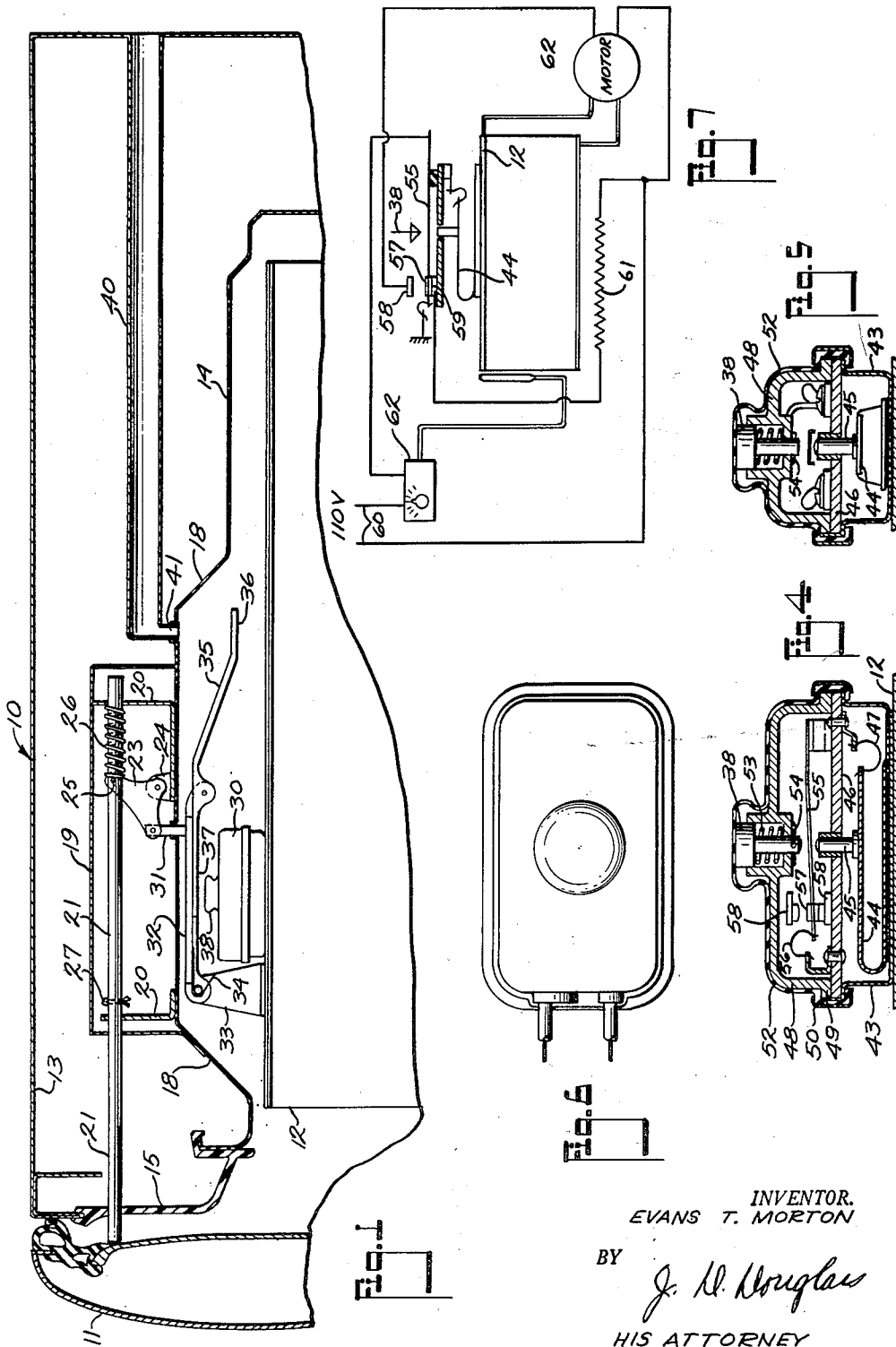
E. T. MORTON

2,704,441

AUTOMATIC DEFROSTING SYSTEM

Filed March 11, 1953

2 Sheets-Sheet 1



INVENTOR.
EVANS T. MORTON

BY

J. N. Douglas

HIS ATTORNEY

1

2,704,441

AUTOMATIC DEFROSTING SYSTEM

Evans T. Morton, Galesburg, Ill., assignor to Admiral Corporation, Chicago, Ill., a corporation of Delaware

Application March 11, 1953, Serial No. 341,751

13 Claims. (Cl. 62—4)

This invention relates to refrigerators and more particularly to a device for automatically defrosting a refrigerator in response to the building up of frost on the evaporator of the refrigerator.

In refrigerating devices, and particularly domestic household refrigerators, one large cause of a loss of efficiency is occasioned by the building up of a heavy layer of frost on the refrigerant coils. Such refrigerators require periodic defrosting in order to keep the coils clear of frost. At first, this defrosting was an operation performed by the housewife simply by turning off the compressor unit completely, or by setting the temperature control to a temperature sufficiently above the freezing point to allow the frost to melt and drop off the coils. Such defrosting took considerable time and was accompanied by the melting of ice cubes and frozen foods and the like. Therefore, unless it was quite obviously required, the housewife often neglected the task.

More recently, devices have been proposed which will defrost the unit automatically at a predetermined clock time or time interval or after a certain number of door openings and closings. Other devices have sensed the build-up of the frost on the unit and operated switches when the layer reached a predetermined thickness. My device may be characterized as of this latter type. However, as an important aspect of my invention the frost layer is built up somewhat artificially at a predetermined spot and at a faster rate than elsewhere on the unit. This allows a less sensitive and therefore stronger device to be used. It also assures that the frost everywhere else on the unit is of lesser thickness than at the control point. In prior devices, it was possible to have frost very thick everywhere but at the feeler point. My invention avoids this situation. The device also uses a novel switch of especial value and adapted particularly for use in such a device.

In defrosting devices of the type described, one of the advantages is that a heater may be used to raise the temperature of the coils quickly to melt off the frost and then they may be cooled again before frozen foods melt. A switch especially designed and constructed to turn off the compressor and turn on the heater and then reverse the controls is also a part of this invention.

A more complete understanding of the invention may be had by reference to the following description of an embodiment thereof together with the accompanying figures.

Fig. 1 is a vertical sectional view showing a portion of a refrigerator cabinet and illustrating my device in its preferred location, the door of the cabinet being closed;

Fig. 2 is a view similar to Fig. 1 showing the parts in the position they take with the door opened, no frost being present;

Fig. 3 is a view similar to Fig. 2 with frost present at the built-up spot;

Fig. 5 is a medial sectional view of the switch used in my invention;

Fig. 4 is a longitudinal sectional view of the switch;

Fig. 6 is a plan view thereof; and

Fig. 7 is a schematic view of a refrigerator system and associated wiring.

Briefly, my invention is embodied in a mechanism designed to be built into a household refrigerator, preferably on top of the freezing compartment, although use of the device on the side would also be satisfactory. The device comprises a switch of the single-pole double-throw type adapted to be switched from one pole to the

2

other in one direction by a push button device and in the other direction by action of a bi-metal strip. The switch is so arranged that the pressing of the push-button closes the contacts which energize a heating element in heat exchange relation with the evaporator thus causing a defrosting. The switch is held in this position by an "over-the-center" spring arrangement. A bi-metal strip or other heat responsive element is arranged to trip the switch to break the heater circuit when the temperature rises to a predetermined value. Opening the heater circuit causes the spring arrangement to go over the center in the opposite direction and close a motor control circuit which starts the compressor motor.

The push button is operated by a lever system under control of the opening of the main door of the refrigerator cabinet. Each time the door is opened, the lever system is moved toward the evaporator to sense the depth of the layer of frost thereon. When the depth is greater than a certain value, the push button of the switch is pressed and the defrosting heater is energized. Since the layer of frost must never be great for good efficiency of the cooling unit, and since the layer is seldom of even thickness, the problem of sensing the thickness in very small increments is apparent. This is avoided in my invention by providing an artificially large deposit of frost in a very localized area in the region sensed by the lever system.

More specifically and with reference to the drawings, my invention is designed for use in refrigerators having a cabinet 10 closed by a door 11 and having an evaporator shell 12 surrounding a freezing compartment. The cabinet is of the usual construction having an outer shell 13 and a food compartment liner 14 with a breaker strip 15 engaged between the parts to insulate one from the other. Between the liner and shell is packed an insulating material, not shown, in the customary manner.

In the construction according to my invention, the liner 14 is formed to provide a hollow 18 immediately above the evaporator shell in the top part of the food compartment. Above this hollow a small housing 19 is provided between the outer shell 13 and the liner 14. A pair of brackets 20 are mounted in this housing and a bar 21 is slidably journaled in these brackets. The bar 21 extends forward of the cabinet and out through the breaker strip 15 in position to be engaged by the door 11. A bell crank lever 23 is mounted on the liner by a bracket 24 and is pivotally connected to the bar 21 by a pin 25. A spring 26 engaged between the rear bracket 20 and the bell crank 23 at its pinned location on the bar 21 urges the bar outwardly toward the front of the cabinet. Movement in this direction is limited, however, by a stop which may be in the form of a split key 27 or the like on the bar 21 which is positioned to engage the forward bracket 20 at the desired forward limit of movement of the bar. The bar is of such length that the door will engage it when closed and move the bar rearwardly. Thus, between limits, the bar is movable by the door and spring.

Movement of the bar 21 moves the bell crank 23 because of the pinned connection therebetween. This movement is utilized to operate a switch 30 through a linkage described hereinafter. A sliding rod 31 pivotally connected to the second arm of the bell crank and slidably mounted in the liner transmits the motion of the bar and bell crank to this linkage.

The switch operating linkage includes a first lever 32 pivotally mounted at one end on a bracket 33 fixed to the top of the evaporator shell 12. A torsion spring 34 biases this lever and its associated parts away from the switch 30 and against the rod 31. A feeler lever 35 is pivotally mounted at the outer end of the lever 32. This lever is arranged so that the feeler end 36 is heavier than the switch operating end 37 so that it normally is in the position shown in Figs. 1 and 2 relative to the first lever 32. The operating end 37 abuts the underside of the first lever 32 as can be seen in those figures, and extends over the switch operating plunger 38.

When no frost is present as in Figs. 1 and 2, the movement of the bell crank 23 merely pivots the lever 32 up and down against the force of the spring 34, and the feeler lever 35 merely follows. This movement as noted

3

above is induced by opening and closing the door; opening the door being effective to depress the levers. It will be apparent, however, that many other devices which may be operated by clock motor, solenoids, or other means may be used to move the levers periodically toward and away from the evaporator shell. When there is a build up of frost as shown in Fig. 3, the feeler end 36 engages the frost and causes the feeler lever 35 to pivot relative to the first lever 32, and if the frost is sufficiently deep, the operating end 37 will press the plunger 38 down and cause the switch 30 to turn on the heating unit to defrost the evaporator shell.

In order to avoid having to sense a very minute thickness of a layer of frost, and to avoid the situation where frost may be thick on one part of the evaporator shell but not in the vicinity of the feeler, provision is made to build an artificially thick layer of frost in a very localized zone where it will be detected by the feeler lever. This is done simply by providing a tube 40 extending from without the cabinet through the insulation 16 and directed downward at 41 onto the surface of the evaporator shell 12 immediately beneath the feeler end 36 of the lever 35. This allows a small amount of warm moist air, which may be normal room air, to be bled into the refrigerator at all times, and to deposit its moisture as frost at the point where the feeler lever will sense the build-up of that frost. The build-up here will be substantially proportionate to that on the rest of the unit since the moisture of the air coming into the cabinet when the door is opened is the chief source of frost, and the air bleed tube 40 is open to the same source of air.

The switch 30 because of this particular application has unique features particularly adapted for its use. As best shown in Figs. 4 and 5 this switch has a metal base 43. This base is mounted directly on the evaporator shell 12 so that the interior thereof will be sensitive to changes in temperature of the shell. A bi-metal strip 44 or other temperature responsive element is mounted on the base and is arranged to operate a pin 45 slidably mounted in a partition wall 46. The strip 44 is engaged at one end by a compression spring 47 arranged so as to hold the strip in either an upward or a downward position. This type of spring arrangement is well known in the art as an "over-the-center" spring since it will hold the element in either position after an external force impels the unit past its center position.

An upper housing 48 encloses the switching elements. This housing is formed with a slight flange 49 as is the base 43. The wall 46 lies between these flanges and is clamped in place there by a sealing ring 50 extending around the switch and engaging the flanges. The switch is preferably sealed by a soft rubber cover 52 clamped by the ring 50 and completely enclosing the upper housing including the operating plunger 38. This plunger is slidably journaled in the housing 48 and is urged outwardly thereof by a compression spring 53. A stop pin 54 on the inside of the housing may be provided to limit the motion of the plunger.

The switch elements are very simple. The movable contact is a spring metal leaf 55 capable of carrying the required current. An over-the-center spring 56 is used on this leaf also, similar to the one on the bi-metal element. Contact members 57 are fixed to both the top and the bottom of the leaf in position to engage either of two fixed contacts 58 depending on which operating member last influenced the position of the leaf.

The lower of these fixed contacts is connected to the heater 61, Fig. 7, and the upper to the motor compressor 62, while the leaf is connected to a source of power 60. Thus when the leaf is in the lower position (as shown), the heaters 61 will be on. As the heaters warm the evaporator shell 12, the bi-metal element 44 begins to unfold and at about 40-degrees Fahrenheit this element will snap over center and cause the pin 45 to engage the leaf 55 and snap it over the center and engage the upper contact. This closes the circuit to the compressor, not shown, and returns the control thereof to the customary refrigerator temperature controls 62. This condition will remain until the feeler lever 35 engages more frost than is proper when upon the next opening of the door 11, the operating end 37 of that lever will press down the switch plunger 38 moving the leaf 55 over the center toward the lower position until the bi-metal strip again returns the control to the usual temperature controls. The forty-degree temperature for operation of the bi-metal element

4

is chosen so that complete melting of the frost is virtually assured. Since it is preferred that a heated evaporator be used, such temperatures on the surface are readily tolerated without too great a rise in the temperature of the cabinet or its contents.

It will be apparent thus that my device provides for a complete defrosting cycle automatically without the need for any interference whatsoever by the householder. It will also be apparent that this type of device might be readily adapted to refrigerator units of other than household types if desired.

Having thus described my invention, I am aware that numerous and extensive departures may be made therefor without departing from the spirit or scope of my invention.

I claim:

1. A refrigerator defrosting system for defrosting an evaporator in a refrigerator cabinet in response to a predetermined build-up of frost on the evaporator including a feeler for periodic engagement with the frost and means to artificially build-up said frost adjacent the feeler comprising a duct extending from a place closely adjacent the feeler and venting to the exterior of the cabinet.

2. A refrigerator defrosting system for a refrigerator having an outer cabinet and an inner liner in spaced relation with an insulating medium therebetween including an evaporator for absorbing heat from the interior of the refrigerator comprising a feeler mechanism periodically energized to engage said evaporator or the front layer thereon and arranged to control the defrosting of the evaporator upon a predetermined build-up of frost, means to accelerate the build-up of frost in a zone engaged by the feeler at a rate greater than the frost built up on the rest of the system comprising a duct extending through the inner and outer liner and open to the exterior of the refrigerator and arranged to conduct room temperature air and humidity to the zone contacted by the feeler.

3. A device of the class described for use with a refrigerator having a cabinet with an evaporator mounted therein, and a door; comprising door engaging means movably mounted in the cabinet adapted to be moved by the closing of the door, spring means biasing said door engaging means outwardly, frost sensing means adapted to sense the thickness of a layer of frost on said evaporator, a linkage engaged between said door engaging means and said frost sensing means adapted to cause said frost sensing means to sense the frost layer each time said door moves the door engaging means, air bleed means adapted to conduct outside air to a particular point on said evaporator sensed by said sensing means, and switch means operably engaged by said frost sensing means adapted to be operated thereby at a predetermined thickness of said frost layer, said switch being effective to energize heater means in connection with said evaporator.

4. For use with a refrigerator having a cabinet with an evaporator therein, a compressor connected to said evaporator and a door for said cabinet, apparatus of the class described comprising door engaging means movably mounted in said cabinet, spring means urging said door engaging means toward said door, said door engaging means being positioned to be moved by engagement with said door when said door is closed, linkage means movably mounted in said cabinet and engaged by said door engaging means, said linkage means including a feeler lever pivotally mounted thereon, said linkage being arranged to carry said lever toward and away from said evaporator as said door engaging means is moved, said lever having a feeler end adapted to engage frost at a particular point on said evaporator, tube means open from outside the cabinet and directed toward said particular point, a switch in position to be engaged by said lever, said lever being formed to engage said switch to operate it when said lever senses more than a predetermined thickness at frost at said point.

5. For use with a refrigerator having a cabinet with an evaporator therein, a compressor connected to said evaporator and a door for said cabinet, apparatus of the class described comprising door engaging means movably mounted in said cabinet, spring means urging said door engaging means toward said door, said door engaging means being positioned to be moved by engagement with said door when said door is closed, linkage

5

means movably mounted in said cabinet and engaged by said door engaging means, said linkage means including a feeler lever pivotally mounted thereon, said linkage being arranged to carry said lever toward and away from said evaporator as said door engaging means is moved, said lever having a feeler end adapted to engage frost at a particular point on said evaporator, tube means open from outside the cabinet and directed toward said particular point, a switch in position to be engaged by said lever, said lever being formed to engage said switch to operate it when said lever senses more than a predetermined thickness of frost at said point, said switch being arranged to close a first circuit when operated by said lever, and thermo-responsive means on said evaporator operably engaging said switch to operate said switch to open said first circuit and close a second circuit when said evaporator reaches a predetermined temperature.

6. In a refrigerator having a cabinet, a door for said cabinet, and an evaporator mounted within said cabinet, apparatus of the class described comprising a double-throw switch means mounted on said evaporator and including a thermo-responsive element adapted to operate the switch in one direction; lever means movably mounted in said cabinet; said lever means including a feeler lever having an operating end adapted to operate said switch in a direction opposite to said thermo-responsive element, and a feeler end; tube means in said cabinet adapted to conduct air from outside said cabinet to a point on said evaporator adjacent said feeler end to hasten the building up of a mound of frost beneath said feeler end; and means to move said lever means toward and away from said evaporator, whereby said feeler lever is carried into engagement with said frost and is tilted to operate said switch when said mound of frost reaches a predetermined height.

7. In a refrigerator having a cabinet, a door for said cabinet, and an evaporator mounted within said cabinet, apparatus of the class described comprising a double-throw switch means mounted on said evaporator and including a thermo-responsive element adapted to operate the switch in one direction; lever means movably mounted in said cabinet; said lever means including a feeler lever having an operating end adapted to operate said switch in a direction opposite to said thermo-responsive element, and a feeler end; tube means in said cabinet adapted to conduct air from outside said cabinet to a point on said evaporator adjacent said feeler end to hasten the building up of a mound of frost beneath said feeler end; linkage means mounted in said cabinet and operably engaging said lever means, said linkage means including a rod slidably journaled in said cabinet and extending outwardly therefrom in position to be engaged by said door, spring means engaging said rod urging it toward said door, closing of said door being effective to move said rod against said spring and thereby to move said lever means away from said evaporator, said spring being effective to move said lever means toward said evaporator whereby said feeler lever is carried into engagement with said frost and is tilted to operate said switch when said mound of frost reaches a predetermined height.

8. In a refrigerator having a cabinet and an evaporator mounted in said cabinet, apparatus of the class described comprising switch means having a base housing in heat transfer relationship to said evaporator, an upper housing sealed to said base housing, fixed contacts and double throw movable contact means mounted in said upper housing, a thermo-responsive element in said base housing operably engaging said movable contact means to move it into engagement with a first fixed contact upon reaching a predetermined temperature, an operating plunger movably mounted in said upper housing operably engaging said movable contact means to move it into engagement with a second fixed contact, and lever means engaging said plunger responsive to the thickness of a layer of frost on said evaporator, said lever means being arranged to operate said plunger when said layer of frost reaches a predetermined thickness.

9. In a refrigerator having an automatic defrosting system for an evaporator, switch means for control of said system comprising a base member of heat conductive material adapted to be mounted in heat conducting relation to said evaporator, an upper housing of insulating material, a dividing wall between said base and upper

6

housing, a thermo responsive member in said base member, an operating pin slidably mounted in said wall and operatively engaged with said thermo-responsive member, a movable contact member mounted in said upper housing having an upper and lower position, fixed contacts in said housing in position to be engaged at said upper and lower positions, said pin being arranged to engage said movable contact member to move it from its lower to its upper position when said thermo-responsive element reaches a predetermined temperature, and plunger means mounted in said housing engageable with said movable contact means to move said movable means from its upper to its lower position.

10. In a refrigerator having an automatic defrosting system for an evaporator, switch means for control of said system comprising a base member of heat conductive material adapted to be mounted in heat conducting relation to said evaporator, an upper housing of insulating materials, a dividing wall between said base and upper housing, a thermo responsive member in said base member, an operating pin slidably mounted in said wall and operatively engaged with said thermo-responsive member, a movable contact member mounted in said upper housing having an upper and lower position, fixed contacts in said housing in position to be engaged at said upper and lower positions, said pin being arranged to engage said movable contact member to move it from its lower to its upper position when said thermo-responsive element reaches a predetermined temperature, and plunger means mounted in said housing engageable with said movable contact means to move said movable means from its upper to its lower position, and cover means to seal the housings together to prevent influx of moisture and the like.

11. In a refrigerator having an automatic defrosting system for an evaporator, switch means for control of said system comprising a base member of heat conductive material adapted to be mounted in heat conducting relation to said evaporator, an upper housing of insulating material, a dividing wall between said base and upper housing, a thermo responsive member in said base member, compression spring means engaging said thermo-responsive member adapted to hold it in either of two positions on opposite sides of a center location, said thermo-responsive member being formed to snap from one position to the second position at a predetermined temperature, an operating pin slidably journaled in said wall in operative engagement with said thermo-responsive element, movable contact means mounted in said upper housing, compression spring means engaging said movable contact means adapted to hold said contact means releasably in either of two positions, fixed contacts in said upper housing to engage said movable contact means at both positions, said pin being positioned to engage said movable contact member to move it from its first position to the second position when moved by said thermo responsive element, and push button means slidably mounted in said upper housing positioned to engage said movable contact member to move it from its second to its first position under influence of external means.

12. In a refrigerator having a cabinet, a door for said cabinet and an evaporator mounted in said cabinet, apparatus of the class described comprising two position switch means mounted on said evaporator including thermo-responsive means adapted to cause the switching element to take a first position and an operating plunger, a bracket mounted on said evaporator, a carrier lever pivotally mounted on said bracket, spring means engaged between said bracket and said lever to bias said lever away from said evaporator, a feeler lever pivotally mounted on the free end of said carrier lever and having an operating end and a feeler end, said operating end being positioned to engage said operating plunger, said feeler end extending toward said evaporator, a pin slidably journaled in said cabinet engaging said carrier lever, bell crank means pivotally mounted in said cabinet operatively engaged with said pin, a bar slidably mounted in said cabinet extending toward said door in position to be engaged by said door when the door is closed, a spring engaging said bar to move it outwardly when said door is opened, opening of said door being effective to cause said bar to be moved by said spring and thereby to move said carrier lever toward said evaporator, said feeler end being positioned to engage frost on said evaporator, said feeler lever being tipped by the engagement of said feeler end with

7

frost to operate said plunger at a predetermined thickness of frost.

13. In a refrigerator having a cabinet, a door for said cabinet and an evaporator mounted in said cabinet, apparatus of the class described comprising two position switch means mounted on said evaporator including thermo responsive means adapted to cause the switching element to take a first position and an operating plunger, a bracket mounted on said evaporator, a carrier lever pivotally mounted on said bracket, spring means engaged between said bracket and said lever to bias said lever away from said evaporator, a feeler lever pivotally mounted on the free end of said carrier lever and having an operating end and a feeler end, said operating end being positioned to engage said operating plunger, said feeler end extending toward said evaporator, a pin slidably journaled in said cabinet engaging said carrier lever, bell crank means pivotally mounted in said cabinet operatively engaged with said pin, a bar slidably mounted in said cabinet extending toward said door in position to be engaged by said door when the door is closed, a spring engaging said bar to move it outwardly when said door is opened, opening of

8

said door being effective to cause said bar to be moved by said spring and thereby to move said carrier lever toward said evaporator, tube means in said cabinet formed to admit air from outside said cabinet and direct said air against said evaporator opposite said feeler end whereby the build-up of frost is accelerated locally to produce a mound of frost adjacent said feeler end, said feeler lever being tilted by engagement of said feeler end with said mound of frost as said carrier lever is moved toward said evaporator whereby said operating end engages and operates said plunger at a predetermined height of said mound of frost.

References Cited in the file of this patent

UNITED STATES PATENTS

2,007,409	Schweitzer	July 9, 1935
2,147,867	Volpin	Feb. 21, 1939
2,231,653	Baxter	Feb. 11, 1941
2,592,394	Cochran	Apr. 8, 1952
2,624,180	Grimshaw	Jan. 6, 1953