

[54] **DEFROSTING SYSTEM FOR REFRIGERATOR DOORS**

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[51] Int. Cl. .... **H05b 1/00**

[58] Field of Search ..... 219/218; 62/150, 176, 248, 62/275; 165/21, 30; 52/173; 73/336.5

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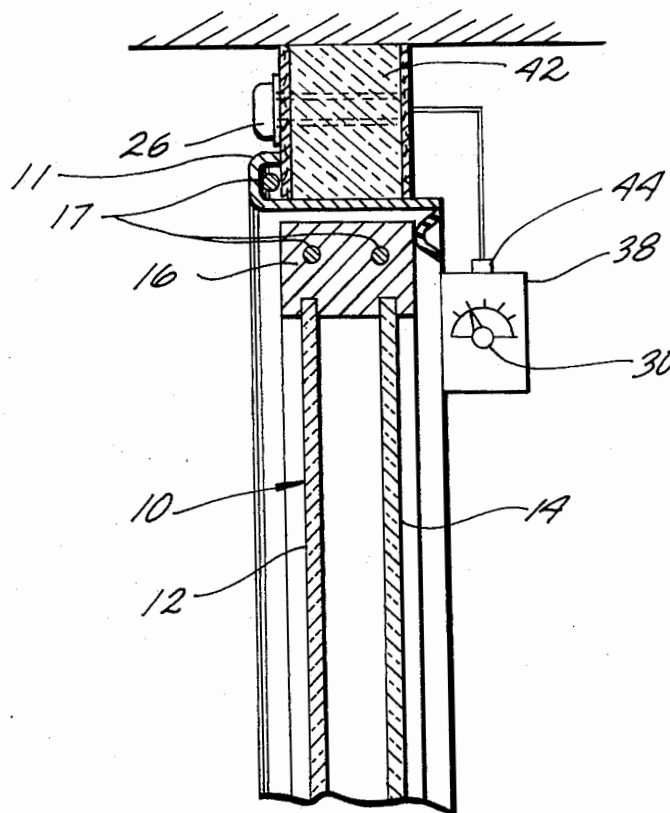
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[57] **ABSTRACT**

A system for defrosting large commercial refrigerator doors in which electrical heating means for heating the metal frames and/or the surface of the glass is turned off or on, depending upon whether the relative humidity is below or above a selected level.

**10 Claims, 2 Drawing Figures**





## DEFROSTING SYSTEM FOR REFRIGERATOR DOORS

### FIELD OF THE INVENTION

This invention relates to defrosting systems for refrigerator doors, and more particularly, is concerned with a humidity sensitive heat control.

### BACKGROUND OF THE INVENTION

The self-service supermarkets which sell refrigerated foods frequently use refrigerated storage areas having metal framed glass doors for displaying the refrigerated products to the customer. Because the surface temperature of the metal frame, support structure and the glass door is reduced below ambient temperature by the refrigerated interior, moisture tends to condense out on the surface of these structural parts and the glass when the relative humidity reaches the dew point at the lower temperature of the doors. One method of preventing the formation of undesired fog or frost on the refrigerator doors and pools of water from collecting on the floor has been to provide electrically resistive heaters, such as resistive wires mounted in the metal structural parts, and transparent resistive coatings placed on the glass to raise the surface temperatures of the glass and metal above the dew point of the ambient air. However, continuous heating by this means is wasteful of electrical power and also increases the cooling load on the refrigerator or freezer unit.

### SUMMARY OF THE INVENTION

The present invention is directed to a defrosting system for refrigerator and freezer doors which provides considerable saving in electrical power and reduces the load on the refrigeration equipment. Specifically, it has been found that it is not necessary to heat the door frame and/or glass continuously but only when the relative humidity of the ambient air reaches the dew point at the surface of the unheated doors. The present invention provides an arrangement which includes a humidity-sensitive element for sensing the relative humidity of the ambient air. A control circuit, responsive to the output of the humidity-sensitive element, operates to connect or disconnect the resistance heater elements of the door frame and/or glass from an electrical power source with changes in the relative humidity. Thus under low humidity conditions the power to some or all of the resistive heater elements is shut off and is only turned on when the ambient relative humidity rises to a level where the surface of the door frame and/or glass is at the dew point and condensation begins to form on the doors.

### BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the invention, reference should be had to the accompanying drawings, wherein:

FIG. 1 is an electrical circuit diagram illustrating the preferred embodiment of the present invention; and

FIG. 2 is a sectional view showing the manner in which the invention is installed.

### DETAILED DESCRIPTION

Referring to the drawings in detail, the numeral 10 indicates generally the door of a refrigerator of the type used in supermarkets for displaying and storing food

products which must be kept under refrigeration. The refrigerator door 10, supported in a metal door jamb 11, is provided with a glass area which typically is constructed of two or three panes of glass with a dead air space between to reduce heat transfer. The two or more panes of glass 12 and 14 are mounted in a metal door frame 16. The door frame and door jamb are provided with a plurality of resistance wires 17. One of the panes of glass is coated with a very thin transparent electrically conductive layer for heating the surface of the glass in response to the flow of electrical current therethrough. Heated glass panels of this type are well known in the art.

Electrical power is supplied to the resistive heating elements of the door 10 and the door jamb from a standard 115 or 220 volt A.C. power source through a relay control switch 18 which is switched to its closed position by energizing of the associated relay coil 20. The relay coil 20 is energized from a control circuit which includes a power supply 22 connected across the 115 or 220 volt A.C. source. The power supply preferably includes a step-down transformer to supply a low voltage output that is isolated from the power source. The output of the power supply provides a voltage across one diagonal of a conventional resistance bridge 24. One leg of the resistance bridge is provided by a humidity sensor element 26, which preferably is a humidity sensitive resistor made of sulfonated polystyrene, known as a Pope cell, such as described in the article "Linearizing Relative Humidity Measurements" by George Whitehaus, *Instruments and Control Systems*, September 1972, pages 72 and 73. A second leg of the bridge circuit 24 is a variable resistor 28 controlled by a rotatable knob 30. The other diagonal of the bridge circuit 24 is connected as the input to a switching circuit 32, for example. The switching circuit 32 switches from one stable state to another with changes in polarity of the input. The output of the switching circuit 32 in turn actuates a control relay 34 having a switch 36 for connecting the power relay coil 20 across the 115/220 volt A.C. source. The relay 34 is shown by way of example, but could be replaced by a semiconductor type switch or other sensitive switching means.

A typical installation of the invention is shown in FIG. 2 in which the control circuit is mounted in a box 38, preferably mounted inside the refrigerator or freezer. Box 38 may be attached to the refrigerator door jamb 11 where the heater power wires emerge for connection to the power source. The humidity sensor 26 is mounted outside and preferably above the refrigerator door 10, the pair of leads from the sensor 26 passing through a small opening in the insulated wall 42 of the refrigerator above the door. The leads from the sensor 26 connect into the control circuit in the box 38 through a suitable plug connector 44.

The control knob 30 extends outside the box 38 and preferably is provided with a scale of index markings calibrated in percent relative humidity. Typically the control knob 30 might be set to a relative humidity of 55 percent. Normally it should be adjusted to the highest relative humidity setting which maintains the refrigerator door free of undesirable moisture. Suitable electrical connections are provided selectively between the box 38 and the wires which supply power to the heated glass pane 12 and/or the heater wires in the door frame 16 and jamb 11. Connections are also provided from

the control box 38 to a suitable standard voltage source.

In operation, depending upon the setting of the variable resistor 28 by the control knob 30, variations in humidity above and below the selected level causes the switching circuit to actuate the relay 34. When the humidity at the sensor is below the indicated level, the relay 34 opens the switch 36 thereby allowing the relay 20 to become de-energized, opening the switch 18. This breaks the circuit to the heated wiring and window panel of the door. Any rise in the humidity above the preset level causes the polarity across the output of the bridge to reverse, actuating the switching circuit 32 and causing the relay 34 to close the switch 36, thereby operating the power relay to complete the heating circuit through the switch 18 to the refrigerator door heater elements. Thus it will be seen that the present invention provides a means of reducing the average power required by the defrosting system, since heat is applied to the door pane and glass mounting members and/or glass in the refrigerator door only when the humidity increases above a preset level at which precipitation of moisture occurs.

While the preferred embodiment includes the jamb, frame, and glass heating elements as part of the controlled load, it may be desirable in some installations to control only the heating elements in the metal frame and/or jamb, while continuously heating the glass. It will be apparent that other combinations of humidity controlled heating and continuous heating of the respective heating elements are also possible utilizing the concepts of the invention. Additionally, although a preferred embodiment of a humidity-sensitive element has been described, the principles of the present invention can readily be practiced with other types and styles of such elements.

What is claimed is:

1. Defrosting apparatus for display type refrigerator and freezer equipment having a door with a glass viewing area, comprising: electrical heating means associated with the door for heating portions of the door, a relative humidity-sensing element mounted outside the door for sensing ambient relative humidity, and control means responsive to the humidity-sensing means for connecting the heating means to an electrical power

source only when the relative humidity exceeds a predetermined level.

2. Apparatus of claim 1 wherein the electrical heating means includes an electrically resistive coating on the glass viewing area, the control means connecting the coating to the power source.

3. Apparatus of claim 1 wherein the door includes a metal frame mounted in a metal jamb, and the electrical heating means includes a resistance element embedded in the frame, the control means connecting the resistance elements to the power source.

4. Apparatus of claim 1 wherein the door includes a metal frame mounted in a metal jamb, and the electrical heating means includes a resistance element embedded in the jamb, the control means connecting the resistance elements to the power source.

5. Apparatus of claim 1 wherein the door includes a metal frame mounted in a metal jamb, and the electrical heating means includes a resistance element embedded in the frame and jamb, the control means connecting the resistance elements to the power source.

6. Apparatus of claim 5 wherein the electrical heating means includes an electrically resistive coating on the glass viewing area, the control means connecting the coating to the power source.

7. Apparatus of claim 1 wherein the relative humidity-sensing element includes resistance means that varies in resistance in response to changes in relative humidity.

8. Apparatus of claim 7 wherein the control means includes a resistance bridge circuit with the sensing element resistance means connected as one leg of the bridge, and means for adjusting the resistance of a second leg of the bridge to vary the humidity level at which the bridge is balanced.

9. Apparatus of claim 8 wherein the control means further includes switching means responsive to the bridge circuit for making and breaking an electrical path to the heating means with unbalancing of the bridge by changes in resistance of the sensing element.

10. Apparatus of claim 9 wherein the control means further includes a power supply having a lower voltage isolating transformer connecting the power supply to the power source.

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