# United States Patent

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[54] **REFRIGERATOR WITH SELF-REGULATING HEATERS**
**6 Claims, 4 Drawing Figs.**


[52] **U.S. Cl.** ..... **62/156,** 62/202, 62/275, 62/377, 219/505
[51] **Int. Cl.** ..... **F25d 21/06**
[50] **Field of Search** ..... 62/202, 275, 276, 377, 156; 165/30, 26, 27; 219/505, 504



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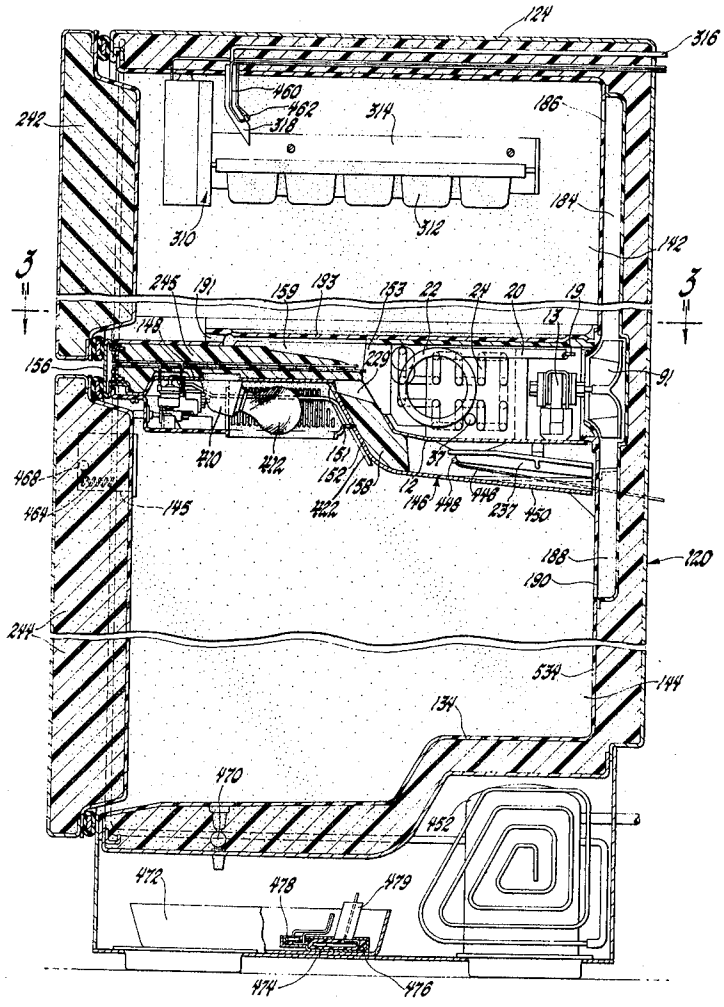
**ABSTRACT:** In the preferred form a refrigerator is provided with positive temperature coefficient thermistors acting either as heaters alone or in series with a small electric heater for preventing condensation of moisture adjacent the door openings and for evaporating melted frost and also to prevent freezing of the water delivery means of the icemaker provided in the refrigerator as well as preventing freezing of defrost water in the drainage means or the evaporator and to control the heating temperature of the butter compartment to maintain the butter at proper spreading consistency, and to heat the fluid motor of the control switch to assure control in accordance with the temperature of the thermosensitive element.

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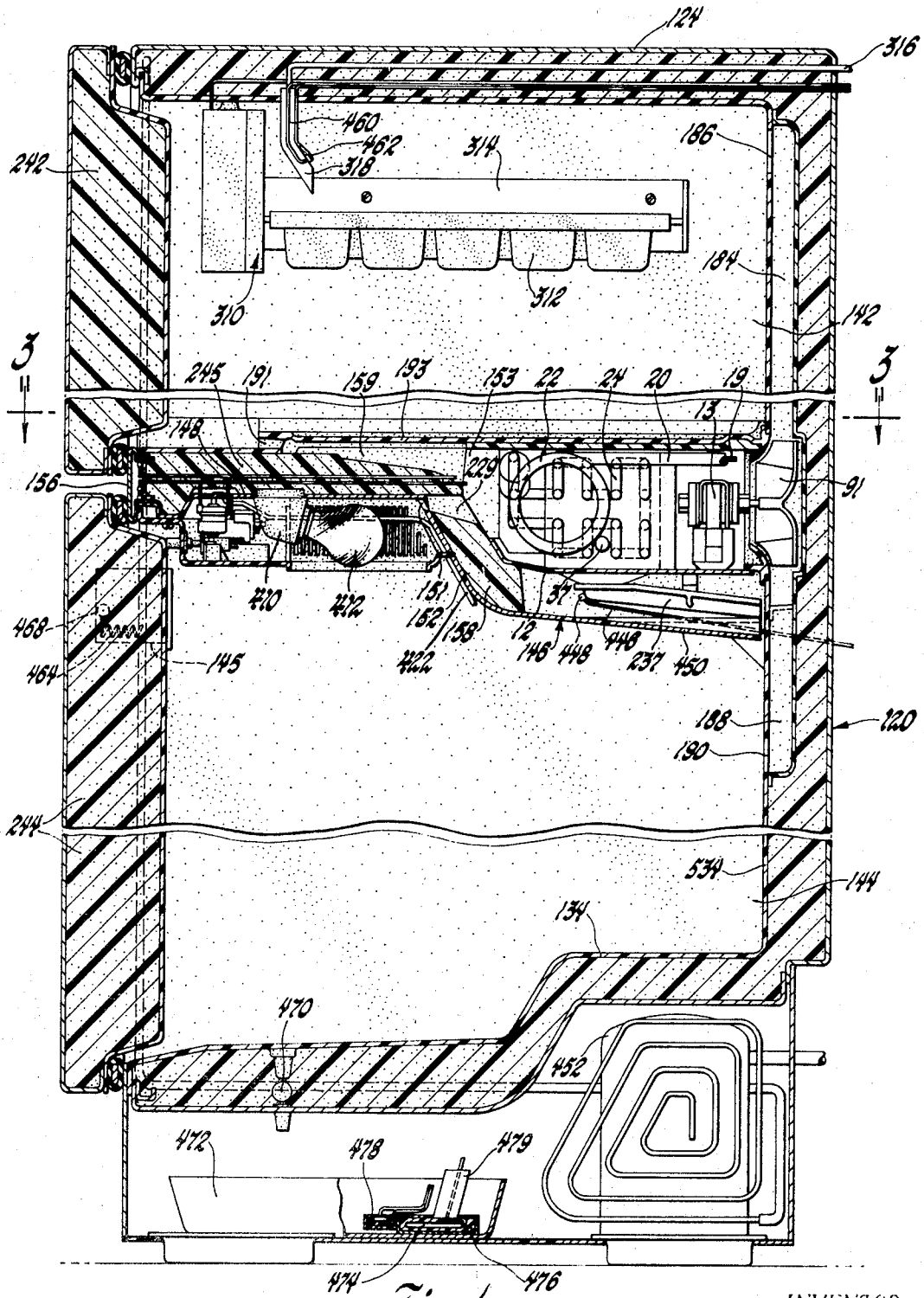


Fig. 1

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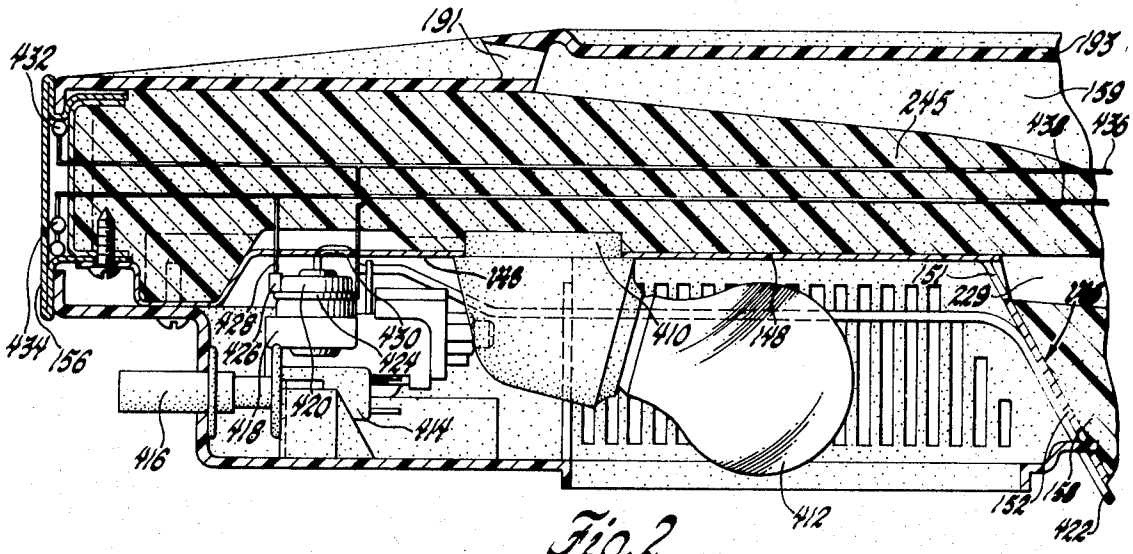


Fig. 2

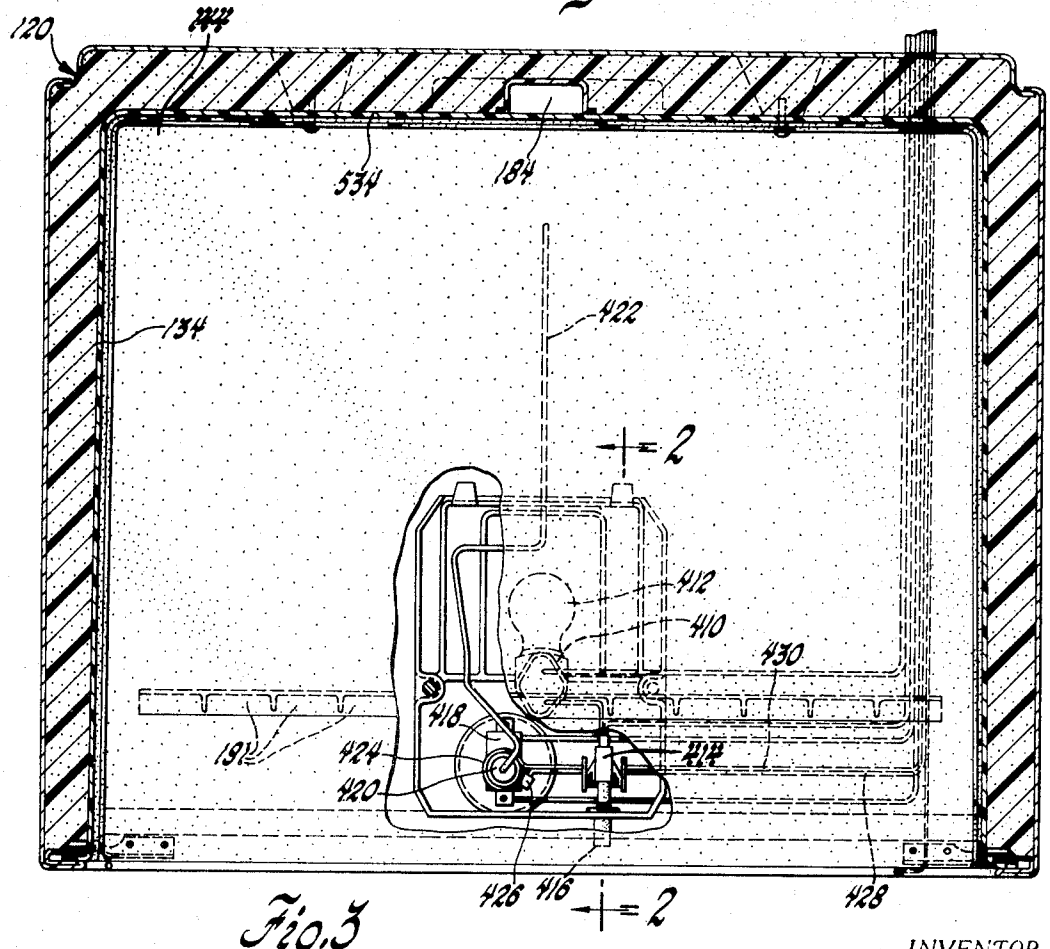


Fig. 3

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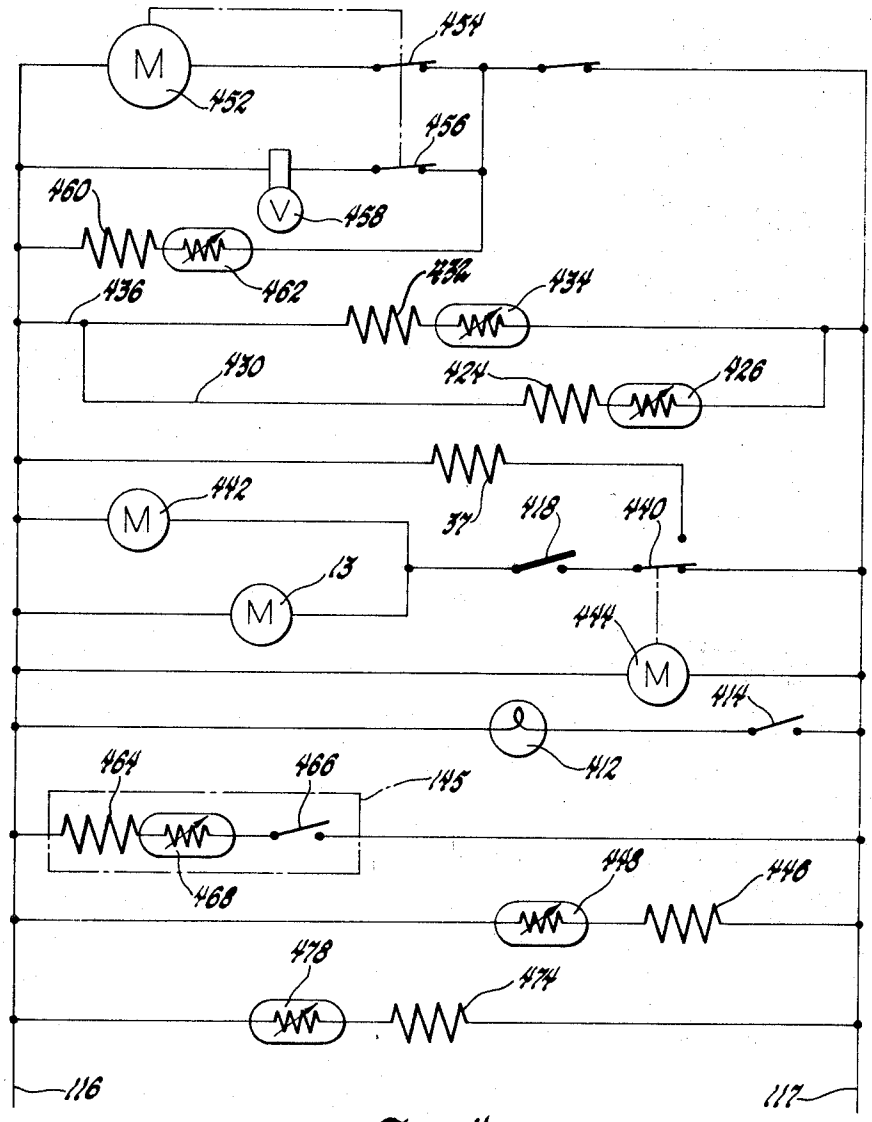


Fig. 4

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# REFRIGERATOR WITH SELF-REGULATING HEATERS

This invention relates to refrigerators normally provided with small electrical heaters in certain locations to prevent certain objectionable effects of excessive cooling and other conditions.

In household refrigerators it has been customary to provide small electric heaters adjacent the door openings to prevent condensation of moisture and also to provide small electric heaters adjacent the discharge spout of the water delivery means of the ice maker and a small electric heater in the drainage system of an evaporator and a small electric heater associated with the butter compartment to keep the butter at a desired temperature above the normal refrigerating temperature of the food compartment. In certain arrangements it is desirable to provide a small heater for the fluid motor of the control switch to assure control by the thermistor element. Also, heaters are provided to prevent refreezing and the accumulation of melted frost. This slight amount of heat is wasteful when it is not needed since it adds to the amount of heat which must be removed by the operation of the refrigerating apparatus and also adds to the electrical energy used by the refrigerator.

It is an object of this invention to provide a simple inexpensive reliable means which will reduce or eliminate such electrical heating when it is not needed, especially when the environment temperatures are sufficiently high to make such heating unnecessary, particularly when the demand for refrigeration is high and there may be difficulty in maintaining low refrigerating temperature in the refrigerated compartments.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein preferred embodiments of the present invention are clearly shown.

In the drawings:

FIG. 1 is a fragmentary side sectional view of a household refrigerator embodying one form of my invention;

FIG. 2 is an enlarged sectional view of the dividing wall shown in FIG. 1 taken along the line 2—2 of FIG. 3;

FIG. 3 is a horizontal sectional view taken along the lines 3—3 of FIG. 1; and

FIG. 4 is a wiring diagram of the refrigerator.

Referring now more particularly to FIG. 1, there is shown a refrigerator cabinet **120** provided with an upper below freezing compartment **142** and a lower above freezing compartment **144**. These compartments are separated by an insulated horizontal dividing means which includes a lower sheet metal wall **146** having a high front portion **148** and a low rear portion **450** with an inclined portion **152** in between. The top member **193** of the dividing means is provided with a series of air entrances **191** which connect with the air passages **159** in the front insulation piece **245** and with the evaporator chamber **153**. The evaporator compartment **153** is also surrounded by an insulation piece **158** having a passage **229** providing communication with the air entrances **151** from the above freezing compartment **144** to the evaporator chamber **153**.

The evaporator compartment **153** includes an evaporator **24** which is supported upon the drain pan **12**. It is supplied with liquid refrigerant from the compressor **452** and a condenser (not shown) through the capillary tube restrictor **19** extending within the suction conduit **20** provided with a loop **22** connecting with the combined entrance and exit of the evaporator **24**. A fan motor **13** is provided with a side inlet centrifugal fan **91** at the rear which draws air through the inlets **191** and **151** into the evaporator chamber **153** and through the evaporator **24** and discharges the air upwardly through the duct **184** and the discharge opening **186** into the below freezing compartment **142** while a reduced amount of air is discharged downwardly through the duct **188** and the discharge opening **190** into the above freezing compartment **144**.

The below freezing compartment **142** is provided with an ice maker **310** which may include a twistable rotatable flexible tray **312** rotatably supported on a frame **314**. The tray **312** is



filled once each cycle through a water delivery conduit **316** extending through the insulation in the top wall **124** to the discharge spout **318** which delivers the water to the front of the tray **312**. This icemaker for example may be similar to the icemaker shown in U.S. Pat. No. 3,308,631 issued Mar. 14, 1967. The refrigerator is also provided with an upper door **242** for closing the below freezing compartment **142** and a lower door **244** closing the above freezing compartment **144**. This door **244** is provided with a butter compartment **145** for keeping a small supply of butter for table purposes.

In FIGS. **2** and **3** there is shown a light socket **410** provided with a light bulb **412** which is controlled by a door switch **414** operated by a plunger **416** adapted to be engaged by the lower door **244** to open the door switch **414** to extinguish the lamp **412** when the door **244** is in the closed position. There is also provided a thermostatic switch **418** including an operating bellows **420** and a thermostat bulb **422** extending therefrom beneath the sheet metal wall **146** in order to make the switch responsive to the temperature in the compartment **144**. A small electric heater **424** is wrapped around the casing of the bellows **420** to provide a small amount of heat to ensure that the operating temperatures of the switch **418** are controlled by the temperature of the thermostat bulb **422** rather than being controlled by the temperature of the casing of the bellows or fluid motor **420**.

According to my invention, to limit the heating of the casing of the bellows **420**, I provide a positive temperature coefficient thermistor **426** in series circuit with the heater **424** and the conductors **428** and **430** connected across the conductors **436, 438**. This positive temperature coefficient thermistor **426** preferably sharply reduces the heating effect of the heater **424** and its own heating effect at temperatures between and above about 50° to 60° F. If desired, the electric heater **424** may be omitted and both the heating and controlling functions are embodied in the positive temperature coefficient thermistor **426**. The thermistor **426** thereby reduces the heating effect in either form when its temperature rises to 50°–60° F. This protects the refrigerator from excessive current flow in the event that the applied voltage is high or the environment temperature is high and thereby limits the heating effect and the current used. This also limits the amount of heat which is delivered to the above freezing compartment **144** so that a minimum of refrigeration is required to offset this introduction of heat.

The refrigeration of the compartments **142** and **144** also frequently causes the cooling of the exposed surfaces **156** of the cabinet around the doors **244** and **242** below the point at which water vapor will condense thereon. This causes objectionable sweating around the doors. For this reason, it has been customary to provide small electric heaters **432** around such door openings. According to my invention, I provide a positive temperature coefficient thermistor **434** in series with the heaters **432** and the conductors **436** and **438** connected across the supply conductors **116, 117** to limit the heating effect of the heaters **432**. Preferably this thermistor **434** will sharply reduce the current flow between and above the range of 90° to 100° F. This will prevent overheating of such surfaces and reduce the amount of refrigeration which is required to counteract such heating.

The evaporator **24** is provided with a radiant defrosting heater **37** for defrosting the evaporator. As shown in the wiring diagram FIG. **4** the heater **37** is connected to one of the alternate terminals of a double throw switch **440** which is normally closed to energize the compressor motor **442** and the fan motor **13** through the thermostat switch **418**. Periodically the timer motor **444** operates the double throw switch **440** to the alternate position energizing the defrost heater **37** and deenergizing the compressor motor **442** and the fan motor **13** to melt the frost from the evaporator **24**. The water resulting from the melted frost flows into the drain pan **12** and the drainage system **237** to the backwall **534** of the compartment **144** where it flows down the backwall to a drain **470** in the bottom wall of the inner liner **134**. Beneath the drain **470**, the

melted frost is collected in a pan 472. Under most circumstances the normal circulation of air is sufficient to evaporate the melted frost in the pan 472. However, under conditions of high atmospheric humidity the evaporation may be insufficient to prevent the accumulation of the melted frost. A nickel chromium electric wire heater 474 is embedded in epoxy material 476 and placed in the bottom of the pan 472 for heating and evaporating the melted frost water collected therein. The epoxy material includes an upwardly extending stem or pipe 479 which may enclose one or more of the lead-in wires for the heater 474. The drainage system 237 is also provided with a small heater 446 to prevent freezing of the defrost water in the drainage system 237 to prevent it from clogging.

According to another feature of my invention, a positive temperature coefficient thermistor 448 is connected in series with the heater 446 across the supply conductors 116, 117 to limit the current and the heat output in the heater 446. Preferably, the thermistor 448 provides a marked drop in current flow between and above the temperature range of 40° to 50° F. so as to limit the amount of heat provided when the temperature is high enough that freezing will not take place in the drainage system. If desired, the thermistor 448 may be of sufficient heat output to provide sufficient heat to the drainage system 237 without the use of the heater 446.

According to an additional feature of my invention, a positive temperature coefficient thermistor 478 is embedded in the epoxy 476 and connected in series with the heater 474 across the supply conductors 116, 117. This positive temperature coefficient thermistor 478 preferably has the characteristic of producing a sharp drop in current flow above the range of about 90° to 100° F. However, positive temperature coefficient thermistors with other temperature ranges such as 140° to 150° F. may be used if desired. The temperature range selected preferably should supply current to the heater 474 whenever the melted frost water is present in sufficient amounts to keep the heater 474 and the thermistor 478 cooled below the switching temperature of the thermistor 478. The thermistor 478 will prevent heating when there is no water present. The heater may have a rating of 2 watts for example. The heater 474 may be omitted if the thermistor 478 has a sufficient heat output to evaporate the water from the pan 472.

The icemaker 310 includes a motor 452 which turns and twists the tray 212 at the proper time and controls the switches 454, 456 which respectively control its operation and also the operation of the solenoid valve 458 which controls the flow of water through the supply conduit 316 to the discharge nozzle 318. The discharge nozzle 318 is provided with a small electric heater 460 of a rating of about 2 watts to prevent freezing of the water therein. According to another aspect of my invention, the positive temperature coefficient thermistor 462 is connected in series with this small electric heater in parallel circuit with the icemaker to limit its heat output. Preferably, this thermistor causes a sharply reduced lower current when the thermistor 462 rises to temperatures to and above a range of 40° to 50° F. This arrangement provides sufficient heat to prevent freezing of the water and yet minimizes the heat supplied and the current used sufficient to prevent the freezing. This likewise limits and reduces the amount of heat which must be removed by the refrigeration system and also reduces the amount of electrical energy consumed. If desired, the heater 460 may be omitted and sufficient heat output is then provided by the thermistor 462.

The butter compartment 145 in the door 244 is also provided with a small electric heater 464 of about 2 watts rating which may be connected in series with a switch 466 to provide a sufficient amount of heat to raise the temperature above the temperature of the above freezing compartment 144 so that butter is sufficiently soft to spread. According to another aspect of my invention, a positive temperature coefficient thermistor 468 is connected in series with the heater 464 and the switch 466 across the supply conductors 116, 117 to limit the heating so as to prevent overheating when the compartment 144 and the door 244 are warmer than normal and also during periods of high voltage. Preferably, the thermistor 468 provides a sharp drop in current flow as the temperature rises to and above the range of about 45° to 55° F. If desired the thermistor 468 may be provided a sufficiently high heat output so that heater 464 may be omitted.

The thermistors also prevent excessive heat output which may result from abnormally high supply voltages. Preferably, these positive temperature coefficient thermistors are of barium titanate made with rare earth doping materials and of such composition that they reduce the current flow within the temperature ranges suggested.

While the embodiments of the invention as herein disclosed constitute preferred forms, it is to be understood that other forms might be adopted.

I claim:

1. A refrigerator including a cabinet having below freezing and above freezing compartments to be kept cool, insulated partition means separating said compartments including a mullion exposed to the outside air, refrigerating means including an evaporator for cooling said compartments respectively to below and above freezing temperatures and incidentally accumulating frost upon said evaporator, means for periodically defrosting said evaporator, drainage means for disposing of the defrost water from said evaporator, an icemaker in said below freezing compartment provided with water delivery means for delivering water thereto, said cabinet being provided with a butter compartment for cooling butter preferably at a slightly higher temperature than the temperature in the above freezing compartment, wherein the invention comprises self-controlling positive temperature coefficient thermistor heaters associated with said butter compartment and said drainage means and said water delivery means and said icemaker and said mullion each of said thermistor heaters connected across the refrigerator power supply conductors so as to be continually energized, said thermistor heaters operative for supplying a small amount of heat in said locations at low temperatures to prevent freezing of the water in said drainage means and said water delivery means and to prevent the condensation of the water vapor upon said mullion and to maintain said butter compartment at temperatures the desired amount above the temperatures of said above freezing compartment.

2. A refrigerator including a cabinet having a below freezing compartment, refrigerating means for cooling said compartment to below freezing temperatures, an icemaker in said below freezing compartment provided with water delivery means for delivering water thereto, wherein the improvement comprises a positive temperature coefficient thermistor heater connected across the refrigerator power supply conductors so as to be continually energized, said thermistor heater in heat transfer with said water delivery means for said icemaker, said thermistor heater connected in parallel circuit with the icemaker thereby causing a sharply reduced lower current when said thermistor heater rises to temperatures to and above a range of 40° to 50° F., said thermistor heater operative for supplying a small amount of heat thereto at low temperatures to prevent the freezing of water in said water delivery means.

3. A refrigerator including a compartment to be kept cool, refrigerating means including an evaporator for cooling said compartment, means for periodically defrosting said evaporator, drainage means for disposing of the defrost water from said evaporator, wherein the improvement comprises a positive temperature coefficient thermistor heater connected across the refrigerator power supply conductors so as to be continually energized, said thermistor heater in heat transfer with said drainage means for supplying a small amount of heat in said location at low temperatures to prevent the freezing of the water in said drainage means.

4. A refrigerator including a cabinet having a compartment to be kept cool, refrigerating means for cooling said compartment to suitable refrigerating temperatures, said cabinet also being provided with a butter compartment for storage of

butter, wherein the improvement comprises a self-controlled positive temperature coefficient thermistor heater connected across the refrigerator power supply conductors so as to be continually energized, said thermistor heater in heat transfer with said butter compartment providing a sharp drop in current flow as the temperature rises to and above the range of about 45° to 55° F. to maintain said butter compartment at temperatures a desired amount above the temperature normally maintained in said refrigerating compartment.

5. A refrigerator including a cabinet having a compartment to be kept cool, refrigerating means for cooling said compartment and incidentally cooling surfaces of the cabinet around the door of the compartment exposed to the outside air, wherein the improvement comprises a positive temperature coefficient thermistor heater in heat transfer with said portion of said surfaces of said cabinet around the door exposed to outside air said thermistor heater connected across the refrigerator supply conductors so as to be continually energized, said thermistor heater operative for supplying a small amount of heat thereto at low temperatures to prevent the condensation of moisture upon said exposed surfaces while reducing the current flow in said thermistor heater at outside air temperatures above approximately 90° F. to prevent overheating of said cabinet surfaces.

6. A refrigerator including a cabinet having a compartment to be kept cool, refrigerating means for cooling said compartment, a thermostatic switch having an operating fluid motor in the form of a bellows and a thermosensitive bulb in the form of a long closed tube connected thereto containing a volatile liquid for controlling said refrigerating means, wherein the improvement comprises positive temperature coefficient thermistor heater connected across the refrigerator supply conductors so as to be continually energized, said thermistor heater in heat transfer with said fluid motor bellows to maintain said bellows at temperatures slightly higher than said thermosensitive tubing, said thermistor heater reducing its heating effect when its temperature rises to the range of 50° to 60° F. for ensuring that the thermostatic switch and the refrigerator means are continuously controlled in accordance with the temperature of the thermosensitive tubing.

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