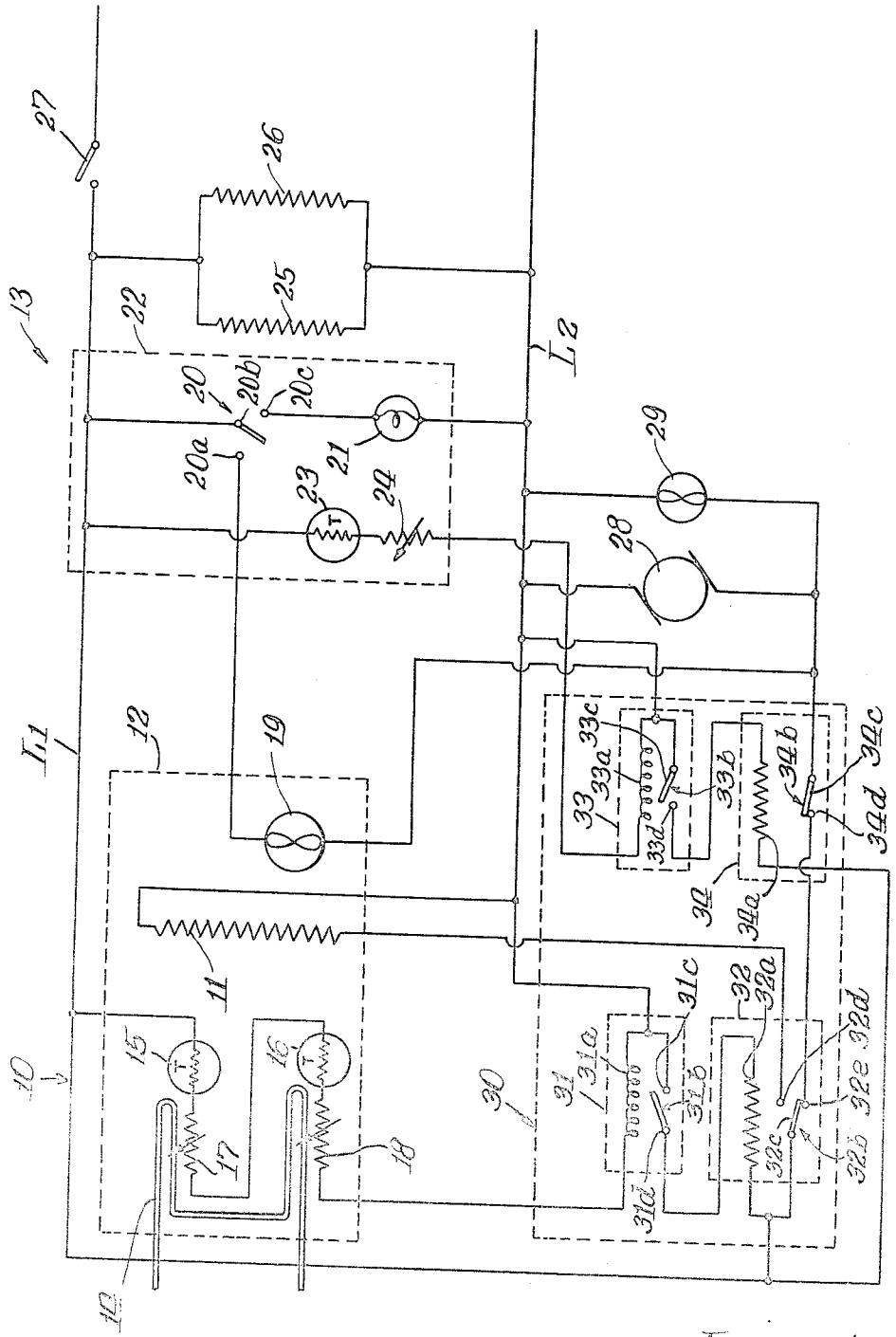
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DEFROST CONTROL FOR REFRIGERATION APPARATUS

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DEFROST CONTROL FOR REFRIGERATION APPARATUS

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ABSTRACT OF THE DISCLOSURE

A defroster control for use in refrigerators and the like utilizing a plurality of thermistor solid state controls including manually adjustable variable potentiometers for adjusting the defrosting cycle of the refrigerator apparatus. The controls are associated with the evaporator of the refrigerator apparatus to initiate a defrost cycle when the temperature sensed by one thermistor reaches a preselected low temperature and to discontinue the defrost operation when the temperature sensed by another thermistor reaches a preselected high temperature.

This invention relates to refrigeration apparatus and in particular to control systems for use in connection with defrosting of such refrigeration apparatus.

In conventional refrigeration apparatus such as refrigerators and freezers, it is desirable at times to effect a defrosting of the refrigerated means. Such defrosting has heretofore been effected by manual initiation by the user, or by automatic initiation as by time switch controls and the like. More recently, automatic defrost controls have been provided wherein a sensing of the need for initiating the defrosting operation is effected by means of a thermostat device disposed in thermal transfer association with the refrigerated means. None of the present control devices have proven completely satisfactory, and it is a principal object of the present invention to provide a new and improved control device for controlling the defrosting in such refrigeration apparatuses.

Thus, a principal feature of the present invention is the provision of a new and improved defrost control for use in refrigeration apparatus.

Another feature of the invention is the provision of such a defrost control having simple and economical construction while yet providing improved sensitivity and accuracy in the controlling of the defrost operation.

A further feature of the invention is the provision of such a defrost control for use in a refrigeration apparatus having refrigerated means and means for defrosting the refrigerated means, wherein the control comprises a first thermistor in thermal transfer association with the refrigerated means for sensing a requirement of defrosting thereof and having current control means to vary electrical current flow therethrough, a second thermistor in thermal transfer association with the refrigerated means for sensing a completion of a defrosting of the refrigerated means and current control means connected in series with the second thermistor to vary electrical current flow therethrough, and relay means having switch means electrically connected to the defrosting means, and coil means electrically connected to the current control means of the thermistors for operating the switch means as a function of the current flow through the current control means, the current control means being preselected to permit a sufficient current to flow to operate the relay means to energize the defrosting means when the first thermistor senses a defrost requirement and to maintain a sufficient current flow to hold the relay means energized until the second thermistor senses a completion of a defrosting of the refrigerated means.

Still another feature of the invention is the provision

of such a defrost control wherein the relay means comprises a pair of relays, a first one of which includes a coil connected in series with the current control means and switch means, and the second one of which includes a transducer connected in series with the switch means of the first relay and switch means connected in series with the defrosting means.

Other features and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawing which comprises a schematic diagram illustrating the electrical circuitry of the control apparatus embodying the invention.

In the exemplary embodiment of the invention as disclosed in the drawing, a defrost control generally designated **10** is shown to comprise a defrost heater **11** suitably disposed within an evaporator compartment **12** of a refrigeration apparatus **13** including a refrigerated means herein comprising an evaporator coil **14** of conventional construction.

For purposes of illustrating the invention, the mechanical structure of the refrigeration apparatus **13** is shown schematically only in the control circuit diagram. The invention herein resides in the control arrangement, and, thus, the mechanical structure of the refrigeration apparatus is shown only for environmental disclosure purposes.

The invention comprehends an improved control of the defrost operation in such a refrigeration apparatus **13**. More specifically, the invention comprehends the provision of a defrost-initiation thermistor means **15** and a defrost-termination thermistor **16** connected in series from one power supply lead L_1. As shown in the drawing, the thermistors **15** and **16** are closely associated with the evaporator coil **14** in the evaporator compartment **12**. As shown, a trimming potentiometer **17** is connected between thermistor **15** and thermistor **16** and a second trimming potentiometer **18** is connected in series with the second thermistor **16**. Also disposed within the evaporator compartment is a conventional evaporator fan **19** which is connected to one fixed terminal **20***a* of a single pole double throw door switch **20** having its movable contact **20***b* connected to power supply lead L_1. The door switch **20** further includes a second fixed contact **20***c* which is connected through a suitable illuminating light **21** to the other power supply lead L_2. As shown in the drawing, the door switch **20** is installed within the refrigerator compartment **22** of the refrigeration apparatus **13**, as is light **21**. Also disposed within the refrigerator compartment **22** is a third thermistor **23** and a trimming potentiometer **24** connected in series from power supply lead L_1.

A stile heater **25** and a mullion heater **26** for counteracting external cabinet sweating may be connected in parallel between power supply leads L_1 and L_2 in the conventional manner. An on-off switch **27** may be provided in power supply lead L_1.

Refrigeration apparatus **13** further includes a conventional compressor **28** and a conventional condenser fan **29** each of which is connected to power supply lead L_2.

The control **10** is completed by a control package generally designated **30** including a first relay **31**, a second relay **32**, a third relay **33**, and a fourth relay **34**. As shown, relay **31** comprises a conventional electromagnetic relay having a coil **31***a* and a normally open switch **31***b* having a fixed contact **31***c* and a moving contact **31***d*. Relay **32** comprises a thermal relay having a transducer, or electrical heater, **32***a* and a single pole, double throw switch **32***b*. Switch **32***b* includes a moving contact **32***c* and a pair of fixed contacts **32***d* and **32***e*. Relay **33** comprises a conventional electromagnetic relay having a coil **33***a* and a normally open switch **33***b* having a fixed contact **33***d* and a movable contact **33***c*. Relay **34** comprises a thermal relay having a transducer, or heater, **34***a* and a normally closed

switch 34*b* having a moving contact 34*c* and a fixed contact 34*d*.

Trimming potentiometer **18** is connected through relay coil 31*a* to power supply lead L_2. The fixed contact 31*c* of switch 31*b* of relay **31** is connected to power supply lead L_2, and the moving contact 31*d* of switch 31*b* is connected to the heater 32*a* of relay **32**. The heater in turn is connected to power supply lead L_1. The moving contact 32*c* of switch 32*b* of relay **32** is connected to power supply lead L_1. The fixed contact 32*d* of switch 32*b* is connected to the defrost heater **11** which in turn is connected to the power supply lead L_2. The other fixed contact 32*e* of switch 32*b* is connected to the fixed contact 34*d* of switch 34*b* of relay **34**, and the moving contact 34*c* of the switch 34*b* is connected to each of the evaporator fan **19**, compressor **28**, and condenser fan **29**. The coil 33*a* of relay **33** is connected from trimming potentiometer **24** to the power supply lead L_2. The moving contact 33*c* of switch 33*b* of relay **33** is connected to power supply lead L_2, and the fixed contact 33*d* of switch 33*b* is connected to the heater 34*a* of the relay **34**. Heater 34*a* in turn is connected to the power supply lead L_1 to complete the electrical circuit of the control **10**.

Thermistors **15**, **16** and **23** comprise conventional positive temperature coefficient thermistors of conventional construction. Thermal relays **32** and **34** comprise conventional time delay thermal relays wherein the movable contacts 32*c* and 34*c* are actuated by bimetallic elements having a snap action so as to provide a toggle effect in the operation thereof. The trimming potentiometers **17** and **18** comprise conventional manually adjustable potentiometers.

The operation of the refrigeration apparatus **13**, and in particular the operation of defrost control **10**, is as follows. The thermistor **23** functions to maintain a relatively high resistance until the temperature of the refrigerator compartment **22** drops to the preselected low temperature. The resistor **24** is adjusted so that at the preselected temperature the resistance of the thermistor **23** will drop rapidly and permit a current flow through the relay coil 33*a*, thereby to energize the relay **33** and close the switch 33*b*. As the heater 34*a* of relay **34** is in series with switch 33*b*, this will energize the heater 34*a* and after a period of time the heat from heater 34*a* will cause the switch 34*b* to open, thereby discontinuing further operation of the compressor **28**, fan motor **29**, and fan motor **19**. When the temperature within the compartment **22** rises to above a preselected temperature the resistance of thermistor **23** increases, thereby causing the relay **33** to be de-energized and allow the switch 33*b* to open whereupon the relay **34** is de-energized and the compressor **28**, fan motor **29**, and fan motor **19** are again energized for refrigerating the apparatus.

The defrost control **10** functions to control the defrosting of the evaporator coil **14** by suitably controlling the defrost heater **11**. More specifically, the thermistor **15** remains at a relatively high resistance until the evaporator coil **14** has a sufficient frost build-up thereon so as to cause a lowering of the temperature sensed by thermistor **15** to lower the resistance thereof to a preselected low value. The lowering of the temperature of the thermistor **15** may occur as a result of the continuous operation of the compressor resulting from the insulating effect of the frost build-up on the evaporator coil, or the thermistor may be in direct thermal contact with the frost on the evaporator coil as by a build-up thereof between the evaporator coil and the thermistor itself.

The thermistor **16** is associated with the evaporator coil **14** so as to sense the temperature of the evaporator coil at a point thereof which will indicate a thorough and complete defrosting of the coil. As shown herein, the thermistor **16** may be in direct thermal contact with the evaporator coil to obtain this functioning.

During normal operation of the evaporator coil **14**, that is, when an insufficient amount of frost has built up thereon to initiate the defrositng cycle, the current flow from the power supply lead L_1 through the series arrangement of thermistor **15**, trimming potentiometer **17**, thermistor **16**, trimming potentiometer **18**, and electromagnetic relay coil 31*a* to the power supply lead L_2, is insufficient to energize the relay **31** to close switch 31*b*. The trimming potentiometers **17** and **18** may be set to effect this desired condition. At this time, the resistance of the thermistor **16** will be relatively low, but insufficiently low to permit the coil 31*a* to have sufficient current therein to operate the relay **31**. However, when the thermistor **15** has the resistance thereof drop sufficiently as a result of the frost build-up on the evaporator coil **14**, an increase in the current through the series circuit results, which is sufficient to energize the relay **31** to close switch 31*b*. The closing of switch 31*b* effects an energization of heater 32*a* of relay **32** as the switch 31*b* is connected in series therewith between the lines L_1 and L_2. After a short time, the switch 32*b* is thrown so that the moving contact thereof engages fixed contact 32*d* thereby connecting the defrost heater **11** from power supply lead L_2 to the power supply lead L_1 and initiating the defrost cycle. As indicated above, the switch 32*b* is a snap action switch and the moving contact 32*c* thereof remains closed with the contact 32*d* during the defrost operation.

The temperature of the evaporator **14** rises as a result of the heat energy delivered thereto from the defrost heater **11**. However, the increase in the temperature sensed by the thermistor **15** is insufficient to increase the resistance thereof sufficiently to cause a drop-out of the relay **31**. This results from the fact that the ampere-turns necessary to energize the relay are substantially greater than the ampere-turns necessary to maintain the relay energized. However, as the temperature sensed by the thermistor **16** rises at the completion of the defrosting operation, the resistance thereof increases rapidly to decrease the current flowing to the relay coil 31*a* to below its hold-in requirement, whereby the relay **31** is de-energized with the switch 31*b* opening and thereby discontinuing energization of relay **32** which in turn discontinues further energization of the defrost heater **11**. The switch 32*b* at this time returns to the normal position wherein the moving contact 32*c* engages the fixed contact 32*e*, once again establishing the circuit to the compressor **28** and fan motors **29** and **19** through switch 34*b* to permit the normal refrigeration cycle to recommence.

The trimming potentiometers **17** and **18** are normally adjusted at the time of assembly of the defrost control **10** and remain as set during the life of the apparatus. Thus, suitable fixed resistors may be utilized in lieu of the adjustable resistors, if desired.

Thus, defrost control **10** provides an improved accurate control of the defrost cycle in a refrigeration apparatus. Trimming potentiometer **24** is provided with a manual adjustment to effect a variable resistance for the combination of thermistor **23** and trimming potentiometer **24**, thus providing a variable temperature at which relay **33** will function. The control **10** is extremely simple and economical of construction, while yet providing long trouble-free service.

While I have shown and described one embodiment of my invention, it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as defined in the appended claims.

The embodiment of the invention in which an exclusive property or privilege is claimed is defined as follows:

1. In a refrigeration apparatus having refrigerated means and means for defrosting said refrigerated means, a control for selectively actuating said defrosting means, comprising:

manually adjustable first thermostat means in thermal transfer association with said refrigerated means for

permitting a preselected electrical current flow in response to a preselected low temperature of said refrigerated means;

manually adjustable second thermostat means in thermal transfer association with said refrigerated means connected in series at all times with said first thermostat means for preventing said electrical current flow in response to a preselected high temperature of said refrigerated means; and

relay means having switch means electrically connected to said defrosting means, and coil means electrically connected in series with said first and second thermostat means for operating said switch means as a function of said current flow, said first and second thermostat means being constructed to permit said current flow to be sufficient to operate said relay means to energize said defrosting means when said first thermostat means senses a low temperature indicating a defrost requirement and to maintain said current flow sufficient to hold said relay means energized until said second thermostat means senses a high temperature indicating completion of a defrosting of said refrigerated means.

2. In a refrigeration apparatus having refrigerated means and means for defrosting said refrigerated means, a control for selectively actuating said defrosting means, comprising:

a first thermistor in thermal transfer association with said refrigerated means for sensing a requirement of defrosting thereof and having a first current control means connected in series therewith to vary electrical current flow therethrough;

a second thermistor in thermal transfer association with said refrigerated means for sensing a completion of a defrosting of said refrigerated means and a second current control means connected in series with the second thermistor to vary electrical current flow therethrough; and

relay means having switch means electrically connected to said defrosting means, and coil means electrically connected to said thermistors for operating said switch means as a function of the current flow through said current control means, said current control means being preselected to permit a sufficient current to flow to operate said relay means to energize said defrosting means when the first thermistor senses a defrost requirement and to maintain a sufficient current flow to hold said relay means energized until the second thermistor senses a completion of a defrosting of said refrigerated means.

3. The refrigeration apparatus of claim **2** wherein said current control means comprises manually adjustable resistor means in series with said thermistors for accurately calibrating the thermistor current control with the relay coil requirements.

4. The refrigeration apparatus of claim **2** wherein said current control means comprises a pair of manually adjustable resistors in series with said thermistors for accurately calibrating the thermistor current control with the relay coil requirements.

5. The refrigeration apparatus of claim **2** wherein said first thermistor is disposed to be directly contacted by frost on said refrigerated means for initiating the defrosting operation.

6. The refrigeration apparatus of claim **2** wherein said second thermistor is disposed to sense the temperature of the last portion of the refrigerated means to be defrosted.

7. In a refrigeration apparatus having refrigerated means and means for defrosting said refrigerated means, a control for selectively actuating said defrosting means, comprising:

a first thermistor in thermal transfer association with said refrigerated means for sensing a requirement of defrosting thereof and having current control means in series therewith to vary electrical current flow therethrough;

a second thermistor in thermal transfer association with said refrigerated means for sensing a completion of a defrosting of said refrigerated means and a second current control means connected in series with the second thermistor to vary electrical current flow therethrough; and

a pair of relays, a first one of said relays having (a) a coil connected in series with said current control means and (b) switch means, and the second of said relays having (c) a transducer connected in series with said switch means of the first relay and (d) switch means connected electrically in series with said defrosting means, said current control means being preselected to permit a sufficient current to flow to operate said first relay thereby to energize said second relay and, in turn, said defrosting means when the sensing element of the first thermistor senses a defrost requirement and to maintain a sufficient current flow to hold said first relay energized until the second thermistor senses a completion of a defrosing of said refrigerated means.

8. The refrigeration apparatus of claim **7** wherein said transducer comprises a heater and said switch means of the second relay comprises a thermally responsive switch.

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MEYER PERLIN, *Primary Examiner.*