Oct. 5, 1943. A. O. GROOMS 2,331,025

TEMPERATURE CONTROL SYSTEM

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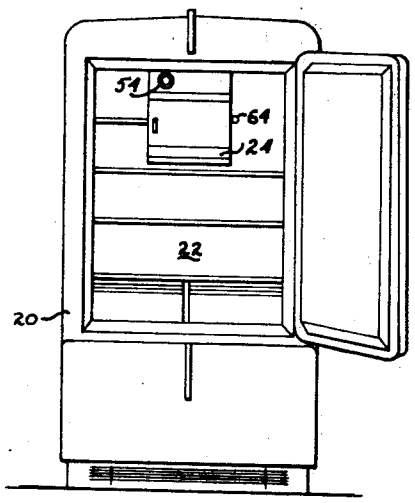


Fig. 1

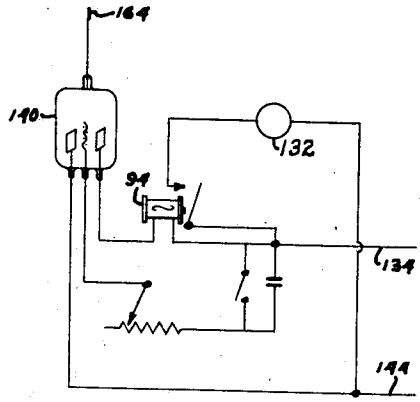


Fig. 2

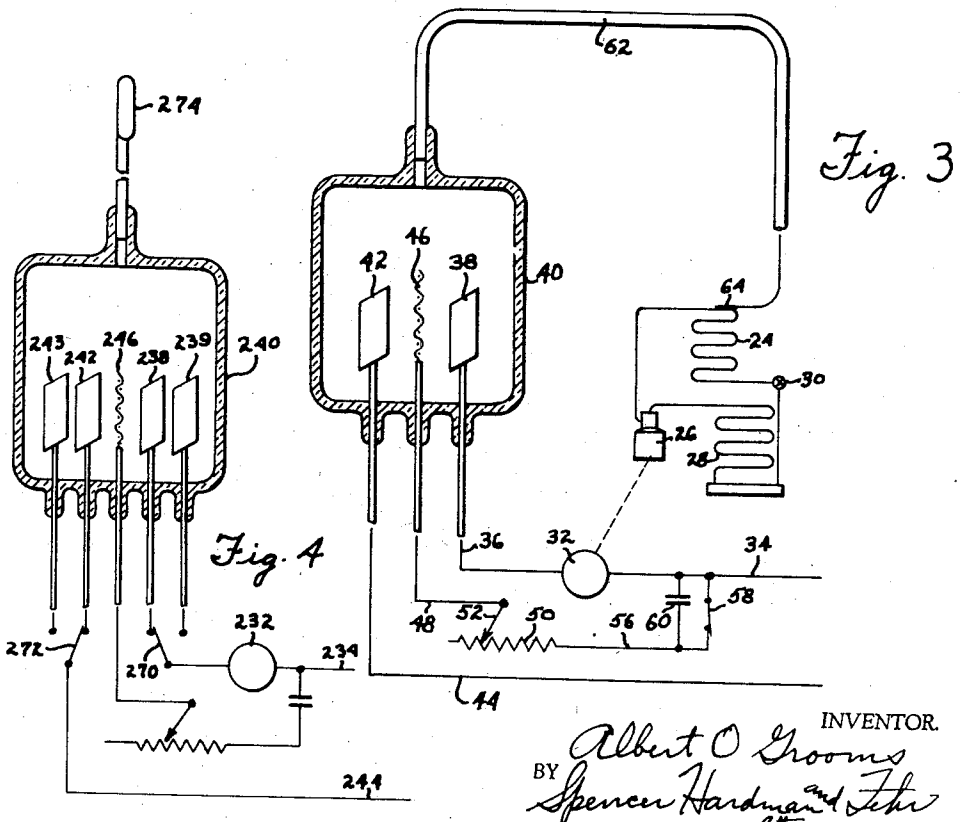


Fig. 4

Fig. 3

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TEMPERATURE CONTROL SYSTEM

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3 Claims. (Cl. 250—27)

This invention relates to temperature controls for refrigerating apparatus and other systems.

It is an object of my invention to provide a temperature control requiring no bellows or diaphragms.

It is another object of my invention to provide an electron tube with means for varying the pressures therein according to temperatures so that it will operate as a temperature control.

It is another object of my invention to provide a temperature control requiring no bellows or diaphragm but having a range and/or differential adjustment.

To attain these objects I have provided an electron tube of the cold cathode type and provided it with a grid. The interior of the tube is connected to a thermostat bulb which controls the vapor pressure within the tube according to the temperature so as to control the flow of electrons in the tube. In one form several sets of electrodes may be provided in the tube with selective connections outside the tube so that the temperature at which the electron flow starts and stops may be readily controlled by this means. Also, a rheostat is connected to the grid so as to independently control the temperature at which the electron-flow stops. The tube may be used to control an electrical device such as a relay which may be used to control the other devices or a motor or similar device may be connected directly in the tube circuit.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing, wherein a preferred form of the present invention is clearly shown.

In the drawing:

Fig. 1 is a view of a refrigerator embodying one form of my invention;

Fig. 2 shows a wiring diagram illustrating the control operating through the medium of a relay;

Fig. 3 is a view showing the tube connected directly in series with the motor driving the refrigerating system; and

Fig. 4 shows a modified form in which the tube contains a plurality of electrodes provided with selective external connections.

Referring now to the drawing and more particularly to Fig. 1, there is shown a refrigerator **20** containing a food compartment **22** cooled by a refrigerator evaporator **24** under the control of a suitable temperature control. One form of such a control is shown in Fig. 3 in which the refrigerating system is illustrated diagrammatically and includes a compressor **26** for withdrawing evaporated refrigerant from the evaporator **24** for forwarding the compressed refrigerant to the condenser **28** where it is liquefied and is returned to the evaporator under the control of a suitable liquid control device **30**. The compressor **26** is driven by an electric motor **32** which may be either of the single phase induction type or a commutator type.

This motor **32** is connected in series with the supply conductor **34** and in turn is connected by the conductor **36** to the plate electrode **38** within the electron tube **40** which is provided with a sealed envelope of glass or metal, or some other suitable material. The tube **40** is provided with a second plate electrode **42** which is connected directly to the other supply conductor **44**. The tube **40** is also provided with a grid **46** located between the plates and connected by the conductor **48** to the variable resistance **50** provided with a variable contact device **52** operated by an adjustment knob **54**. Connected to the variable resistance **50** is a conductor **56** which is connected either through the switch **58** directly to the supply conductor **34** or through a suitable capacitor **60**. The interior of the sealed tube **40** is connected by the tube **62** to a thermostat bulb **64** which is clamped in heat exchange relation to the evaporator **24**. The tube **40**, the tubing **62** and the thermostat bulb **64** are charged with some suitable vapor such as a mercury vapor or bromine vapor.

I find that with these vapors there is a range of pressures at which the electrons will flow from one of the plates to the other and allow the electric motor **32** to drive the refrigerating system. When the temperature and vapor pressure is increased above this range the flow will cease and likewise when the temperature and vapor pressure is reduced below this range the flow will cease. I propose to operate at the lower end of the range and to make the distance between the plates **38** and **42** such that when the evaporator temperature rises to a point showing the need for operation of the system, electrons will flow from between the plates **42** and **38** and cause operation of the motor **32** to drive the refrigerating system. When the evaporator **24** is cooled sufficiently the flow of electrons will stop due to the lowering of the vapor pressure within the tube **40** under control of the thermostat bulb **64**.

In order to provide a manual means for varying the temperature and pressure at which the electron-flow stops the variable resistance **50** is used. Since the motor **32** has considerable induction, the current flowing by means of the

electrons between the plates lags out of phase with the current flowing in the grid circuit which when the switch 58 is closed will be substantially in phase with the voltage and out of phase with the current passing through the motor 32. The current in the grid circuit may be made still further out of phase with the current in the plate circuit by opening the switch 58 causing the capacitor 60 to supply the leading current to the grid. This provides two different methods for controlling the stoppage of electron-flow through the grid circuit.

Fig. 2 shows a diagrammatic circuit in which a relay 94 is connected in series with the supply conductors 134 and 144 instead of the motor 32. The relay 94 controls the operation of an electric motor 132 for controlling the operation of the refrigerating system or other device. The tube 140 is illustrated diagrammatically and is provided with a thermostat bulb 164. The remainder of the circuit is similar to that shown in Fig. 3.

In Fig. 4 the tube 240 is provided with a grid 246 and plate electrodes 238, 239, 242 and 243. A selector switch 270 connects either of the electrodes 238 or 239 to the electrical device 232 which in turn is connected to the supply conductor 234. A selector switch 272 connects either of the electrodes 242 or 243 to the supply conductor 244. By suitably operating the selector switches 270 and 272 four different electrode arrangements may be used. Naturally when the electrodes used are closer together the starting and stopping bulb temperatures and the corresponding vapor pressures will be lower and when the electrodes used are further apart the starting and stopping bulb temperatures will be higher. The tube 240 may likewise be connected to a thermostat bulb 274. However, the bulb is merely a convenient means for causing the vapor within the tube to respond to the temperature of the element, such as the evaporator, to be measured. If desired the tube may be placed directly in heat exchange relation with the temperature to be measured or which serves as the source of control. It will be seen that this control is comparatively simple and avoids the use of bellows and diaphragms.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. A temperature control for controlling an electric device comprising an electron discharge device including an envelope containing a temperature responsive ionizable material and three electrodes located at various distances from each other, each of said electrodes being insulated from the other, an electric device to be controlled, and selective means for connecting the electric device selectively in series with any two of said electrodes and disconnecting the other electrodes from the electric device.

2. A temperature control for controlling an electric device comprising an electron discharge device including an envelope containing a temperature responsive ionizable material and three electrodes located at various distances from each other, each of said electrodes being insulated from the other, an electric device to be controlled, and selective means for connecting the electric device selectively in series with any two of said electrodes and disconnecting the other electrodes from said device, a grid within said envelope, and means for varying the flow of current to the grid.

3. A temperature control for controlling an electric device comprising an electron discharge device including an envelope containing a temperature responsive ionizable material, a first set of electrodes located a certain distance apart, a second set of electrodes located a greater distance apart, said electrodes all being insulated from each other, an electric device to be controlled, and selective means for disconnecting either set of electrodes from said electric device and for connecting the other set to said device.

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