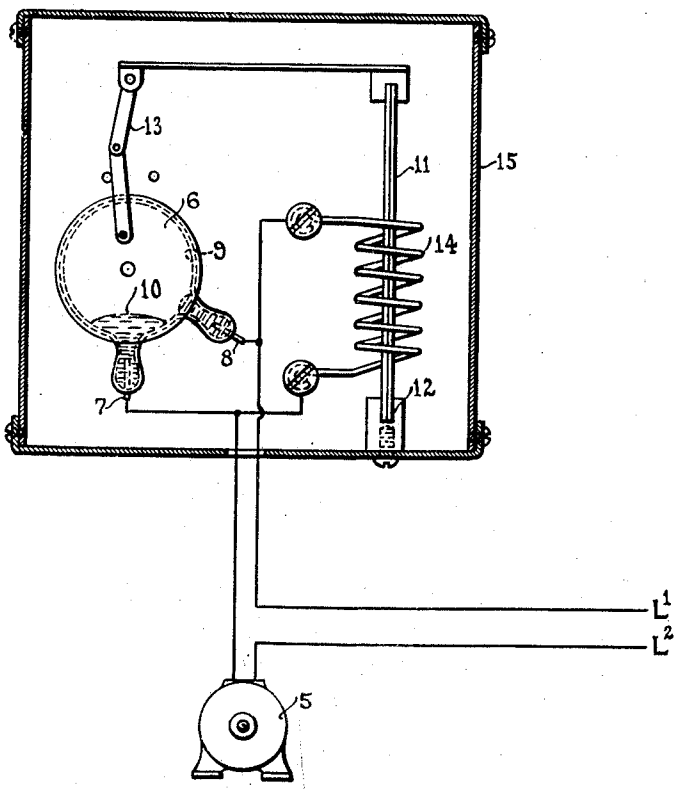
Aug. 11, 1931. C. T. EVANS 1,818,546

THERMORESPONSIVE DEVICE AND METHOD OF IMPROVING THE ACTION THEREOF

Filed Sept. 11, 1922



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Patented Aug. 11, 1931

1,818,546

UNITED STATES PATENT OFFICE

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THERMORESPONSIVE DEVICE AND METHOD OF IMPROVING THE ACTION THEREOF

Application filed September 11, 1922. Serial No. 587,633.

This invention relates to thermo-responsive devices and method of improving the action thereof.

An object of the invention is that of providing for accentuating the responsiveness of such devices to thermic influence and also for increasing the available working forces developed thereby in response to given values of such influence.

As a variant of the foregoing, another object is that of reducing the value of thermal influence required to produce a given value of operative effect of such devices.

Another object is that of providing for control of the time element incident to response of such devices to given values of thermic influence.

Other objects and advantages will hereinafter appear.

While the invention is applicable broadly the same may conveniently be described with reference to the application thereof to control of temperature changing apparatus such as refrigerating machines and the accompanying drawing, comprising a single figure, illustrates such an adaptation.

In the drawing the temperature changing device is represented by an electric motor 5 which may be assumed to be the driving motor of a refrigerating pump. Said motor is adapted to be supplied from line L', L2 subject to control by means of a switch 6 which in practice may be advantageously of the so-called fluid contact type, since this type of switch is operable at a relatively low expenditure of mechanical power and is moreover capable of direct control of load currents.

The switch 6 illustrated comprises a pair of contacts 7 and 8 projecting within an insulating container 9 which is in general cylindrical in contour and is preferably mounted to oscillate substantially within its own dimensions and about its own major axis to thereby effect movement of the contacts 7 and 8 such that in one angular position of the container said contacts are bridged by a quantity 10 of contained mercury or other conductive fluid and in a different angular position are disconnected electrically between separated surfaces of the conductive fluid.

A bimetallic or other thermostatic element 11 having one end anchored as at 12 is so located as to be subjected to influence by the temperature changes effected by motor 5 and is adapted upon given temperature changes to act by means of the mechanical connections indicated generally at 13 for effecting partial rotation of the container in opposite directions selectively depending upon the character of the temperature change for interrupting or establishing the circuit of said motor.

An electrical heating element 14 is arranged in heat transferring relation to the termostatic element 11 and adapted to be supplied with electrical energy from line L', L2 subject to control by the switch 6. Said switch and thermostatic element and the mechanical connections therebetween are in practice preferably enclosed within a suitable housing or casing 15 which is penetrated by the lead-in wires for the switch, although in practice provision of such housing is not absolutely essential.

In the drawing the thermostatic element 11 and the switch 6 are shown in a relation such that the motor circuit is interrupted, the arrangement and design of said thermostatic element being assumed to be such that upon subjection of said elements to influence of a predetermined rise in temperature said element is adapted to effect closure of the switch thereby completing the motor circuit and short circuiting the heating element, whereupon, the motor is adapted to act in a well known manner for reducing the temperature within the cold space to the temperature conditions of which the thermostatic element is subjected. Following operation of the motor for a period of time sufficient to effect given reduction in temperature in the cold space the thermostatic element is adapted to act in the opposite sense for causing the switch to interrupt the motor circuit and open the short circuit around the heating element.

Thus assume that it is desired to provide for starting the motor when the temperature

of the cold space rises to 40 degrees and that the design of the switch and thermostat is such as to require a variation of, for example, 10 degrees in the temperature to which the sensitive element of the thermostat is subjected to effect opening and closure of the switch respectively, it being also assumed that the type of switch selected is adapted to make and break circuit at substantially the same angular position, which assumption is sufficiently accurate for present purposes.

Obviously under such conditions and in the absence of the heating element the cold space will be subjected to temperature fluctuations covering a range of ten degrees and the mean temperature maintained will be approximately 5 degrees lower than the maximum permissible temperature.

On the other hand assume that the thermostat is provided as illustrated with a heating element and further that such heating element is so designated as, when energized, to maintain the temperature of the thermostatic element constant at, for example, 48 degrees, while the temperature of the cold space remains at 39 degrees. That is to say the rates of heat input to and output from the thermostatic element are in equilibrium under such conditions of relative temperature.

The mechanical connection between the thermostatic element and the switch should be so adjusted that upon a further rise of for example 1 degree in temperature of the thermostatic element the switch will be closed.

Assume now that the temperature of the cold space rises and approaches its maximum permissible value of 40 degrees, the rate of heat dissipation from the the thermostatic element thereupon decreases whereby the temperature of said element increases to the assumed tripping point of 49 degrees, whereupon the switch is actuated for starting the motor to reduce the temperature of the cold space, the heating element being also short-circuited.

Under such conditions the temperature of the thermostatic element falls rapidly to the temperature of the cold space which may be assumed to be now approximately 40 degrees, whereas as the temperature of the cold space falls due to the action of the motor the temperature of the thermostatic element, being now uninfluenced by the heating element, also falls and when such common temperature recedes to 39 degrees, or ten degrees below that at which the switch was closed by the thermostat, the switch is opened thereby stopping the motor and opening the short-circuit around the heating element whereby the latter again becomes effective. As soon as the heater has brought the temperature of the thermostatic element to 48 degrees the temperatures are again in equilibrium and will so remain as long as the temperature of the cold space remains at 39 degrees and upon rise of such temperature the foregoing cycle is repeated.

It is thus apparent that while the thermostatic element has been subjected to the necessary 10 degrees variation in temperature, the temperature variation of the cold space has been restricted to one degree and by such material curtailment of the fluctuation of such latter temperature it is obvious that not only a more accurate temperature control is effected but losses due to periodic lowering of the temperature far below that required are also eliminated.

While the aforedescribed construction relates primarily to the use of the heater in the control of apparatus functioning to reduce temperatures it is of course apparent that the heater may be quite similarly employed in the control of devices operating to increase temperature.

Thus if the motor 5 be replaced by a similarly controllable electric or the other device adapted to impart heat to the surrounding medium and the thermostatic element be again subjected to the temperature condition of such surrounding medium the heating element 14 would then be so arranged in circuit as to be energized while such primary heating element is active and to be unenergized when such primary heater is inactive and the thermostatic control will be influenced and improved in ways entirely analogus to that just described.

The casing 15 is to be employed primarily for varying the rate of heat transfer between the thermostatic element and the cold space to thereby provide for control of the time element incident to response of the device.

What I claim as new and desire to secure by Letters Patent is:

1. The combination with a circuit controlling device having a thermo-responsive operating element movable through a given range and adapted during final movement into an extreme position to effect operation of said device, said element having a relatively large temperature differential between the limits of said range of means subjecting said element to a given thermal influence to effect movement thereof through a predetermined part of its range without effecting operation of said device, whereby said element when subjected to the thermal influence of another controlling medium is movable into said extreme position upon a given slight variation in the temperature of such medium.

2. The combination with a switch having a thermo-responsive operating element movable through a given range and adapted in one extreme position to effect closure of said switch and in an opposite extreme position to effect opening of said switch, said element being returnable from either extreme position through a major part of its range without

affecting the conditions of said switch and said element having a relatively large temperature differential between its switch operating temperature values, of means subjecting said element to a given thermal influence to effect movement thereof through a major part of its range, whereby said element when subjected to the thermal influence of another controlling medium for movement into said extreme positions alternately is so movable upon relatively slight variations in the temperature of such medium.

3. The combination with a switch having a thermo-responsive operating element movable through a given range without affecting the condition of said switch and further movable into one extreme position to effect closure of said switch and into an opposite extreme position to effect opening of said switch, said element having a relatively large temperature differential between its switch operating temperature values, of means subjecting said element to a given thermal influence to effect movement thereof substantially throughout the first mentioned range, whereby said element when subjected to the thermal influence of another controlling medium for movement into said extreme positions alternately is so movable upon relatively slight variations in the temperature of such medium.

4. A thermally-actuable refrigerator controlling switch comprising a casing, a temperature-controlled actuating element within the casing having a relatively large temperature differential between its operating temperature values, co-operating contact members, certain of which are actuated by the actuating element, and means controlled by the temperature-controlled actuating element for reducing the temperature differential.

5. The combination of a controlling switch, a thermo-responsive operating element inherently requiring a relatively large temperature variation in an ambient medium to move the switch from circuit opening position to circuit closing position and vice versa, thermal means acting upon said thermo-responsive element to cause it to operate said switch upon a smaller variation of temperature in said medium.

6. The combination of a switch, a bimetallic operating member inherently requiring a relatively large temperature variation in an ambient medium to move said switch to open or closed position, an electric heating means in heat transferring relation to said bimetallic operating member to cause it to operate on a smaller variation of temperature in said medium.

In witness whereof, I have hereunto subscribed my name.

CLARENCE T. EVANS.