June 9, 1931. E. M. CLAYTOR 1,809,293

ADJUSTABLE THERMAL ELEMENT

Filed July 27, 1927

Fig. 1.

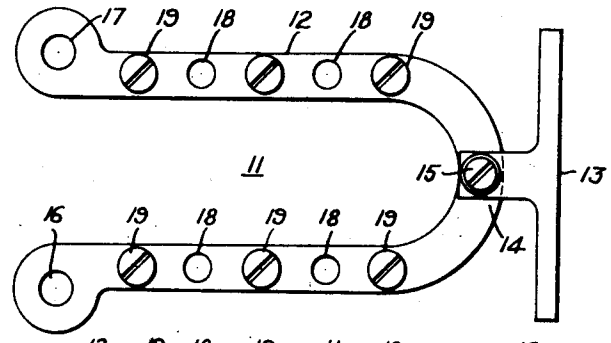


Fig. 2.

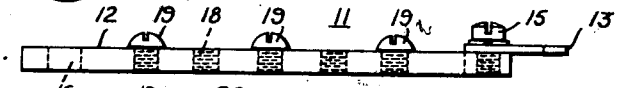


Fig. 3.

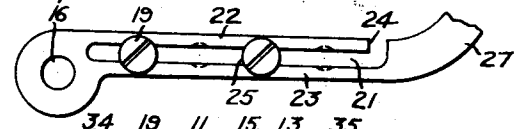


Fig. 4.

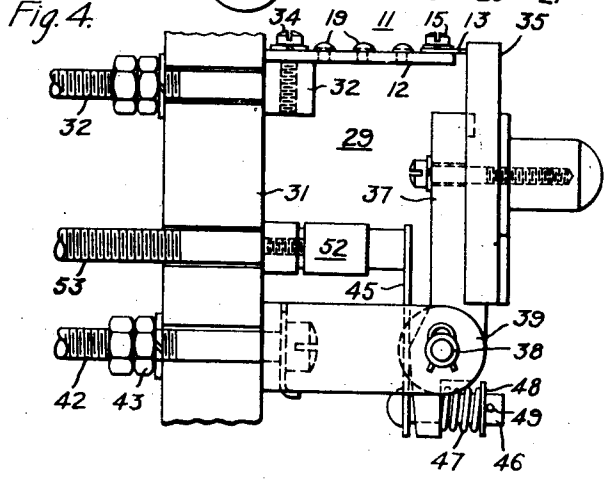


Fig. 5

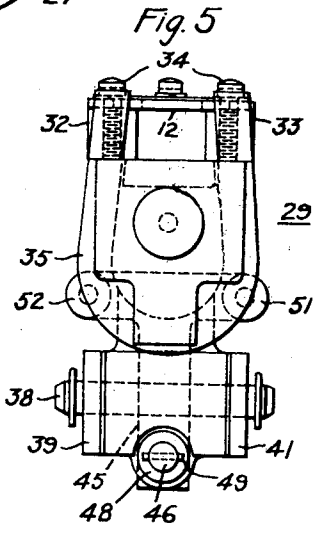


Fig. 6.

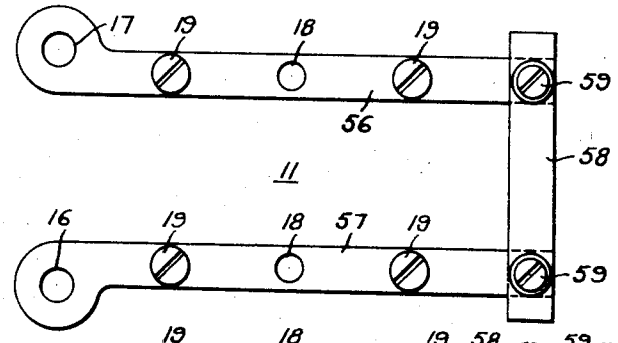
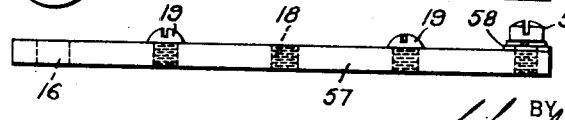


Fig. 7.



INVENTOR
Edward M. Claytor.
BY
Wesley G. Carr
ATTORNEY

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UNITED STATES PATENT OFFICE

EDWARD M. CLAYTOR, OF WILKINSBURG, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA

ADJUSTABLE THERMAL ELEMENT

Application filed July 27, 1927. Serial No. 208,812.

My invention relates to thermal control devices and particularly to thermal elements therefor.

An object of my invention is to provide an adjustable thermal element for a thermal relay that shall be simple in construction and easily manufactured.

Another object of my invention is to provide means for a thermal element of a thermal relay whereby the rate of heating a predetermined section of the element may be varied.

In practicing my invention, I provide a resistor element and means for so varying the current-conducting area of the element, at predetermined points along the length thereof, that the rate of heating a predetermined section of the resistor, per unit of current traversing the same, may be varied. The resistor is provided with an element that is responsive to the temperature of the section in which the rate of heating is to be controlled.

For a fuller understanding of my invention, reference may be had to the following description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a top plan view of an adjustable thermal element embodying my invention,

Fig. 2 is a view, in side elevation, thereof,

Fig. 3 is a partial top plan view of a modification of the thermal element illustrated in Figs. 1 and 2,

Fig. 4 is a view, in side elevation, of a thermal relay in which either of the thermal elements shown in Figs. 1 to 3 may be embodied,

Fig. 5 is a view, in front elevation, of the device illustrated in Fig. 4,

Fig. 6 is a still further modification of the thermal elements illustrated in Figs. 1 to 3, and

Fig. 7 is a view, in side elevation, of the thermal element illustrated in Fig. 6.

In the drawings, a thermal element 11 is illustrated that comprises a resistor 12 of substantially U-shape and a thermally-responsive magnetically reversible member 13 secured to the resistor at 14 by a screw 15 or other suitable securing means.

The element 13 may be made of an alloy of nickel and iron with minor portions of other metals, the percentages of nickel and iron being approximately 35% and 65%, respectively. Such an alloy has the characteristic that, when normally cool, it is magnetic, but when heated to a temperature of approximately 150° C., the alloy becomes non-magnetic, and, if cooled to a temperature slightly below this value, it again becomes magnetic. For this reason, the element 13 may be designated as a magnetically reversible member. Other materials, having similar thermal magnetic characteristics, may be utilized, but an alloy of iron and nickel, in the proportions set forth above, has been found to be suitable for my present purpose.

The resistor 12 is provided with terminals having openings 16 and 17 therein, and a plurality of internally screw-threaded openings 18 disposed along the length thereof. In order that the current-conducting area of the resistor 12 may be varied, the openings 18 may be selectively filled with screws 19 that are adapted to have screw-threaded engagement therewith, the purpose of the openings 18 and the screws 19 being to vary the rate of heating that portion of the resistor 12 to which the element 13 is secured.

It is to be understood that the resistor 12 may be made of the alloy herein described, if so desired, in which case the member 13 may be omitted.

If it is desired that the element 13 be heated at a relatively high rate per unit of current traversing the resistor 12, the screws 19 may be removed from the openings 18. When the screws are removed, it is evident that the current-conducting area of the resistor 12 is appreciably less than when they are in the positions shown in Figs. 1 and 2.

If, on the other hand, it is desirable to retard the rate of heating the element 13, per unit of current traversing the resistor element, the openings 18 may be substantially filled by the screws 19, in accordance with the rate of retardation. When the openings are filled by the screws, the current-conducting area of the resistor and the

thermal capacity of the resistor are increased in proportion to the mass of the screws. Since the current-conducting area is increased, the resistance of the resistor is decreased in proportion to the size of the openings. Thus, the screws affect not only the resistance of the resistor, but, its thermal capacity also in proportion to the mass of the screws.

In Fig. 3 of the drawings, a modification of the resistor 12 is illustrated. As there shown, the resistor is provided with an elongated opening 21 extending along each leg of the resistor (only one-half of which is shown). Thus, the legs of the member of substantially U-shape are divided into two parallel current-conducting members 22 and 23, the member 22 being disconnected from the resistor at 24.

In order to vary the resistance and the thermal capacity of the resistor illustrated in Fig. 3, the screws 19 may be placed at predetermined points between the end 24 and the terminal end of the slot 21. If only one screw is placed therein, as at 25, a part of the portion 22 is connected in parallel with a corresponding part of the portion 23, thus reducing the resistance of the resistor and causing the hottest portion obtaining therein to move in the direction of the portion 27.

In Figs. 4 and 5 of the drawings, an application of the thermal elements illustrated in Figs. 1 to 3, inclusive, to a thermal relay 29 is shown. The relay comprises a base 31 that is provided with terminals 32 and 33 to which the thermal element 11 may be secured by means of screws 34 that project through the openings 16 and 17 of the resistor 12. The magnetically reversible thermal element 13 normally engages a permanent magnet 35 of substantially U-shape, that is carried by a supporting arm 37 that is pivotally mounted at 38 between laterally extending arms 39 and 41 of a bracket of substantially U-shape. The bracket may be secured to the base 31 by means of a bolt 42, that extends through the bracket and the base, and a cooperating nut 43.

To the lower end of the arm 37, a contact-bridging member 45, of substantially T-shape, may be secured, the bridging member being yieldably mounted thereon and secured thereto by a bolt 46 and a spring 47. As shown, the spring is disposed between the arm 37 and a washer 48 that is prevented from moving outwardly to the end of the bolt by a pin 49.

The contact-bridging member 45 bridges a pair of stationary contact members 51 and 52 that are carried at the ends of a pair of terminals 53.

The terminals 32 and 33 of the relay may be connected in circuit with an electro-responsive device (not shown) to be controlled. The resistor 12 is then traversed by the current traversing the electro-responsive device and is heated in accordance with the rate of flow of said current. The terminal 42 may be connected in circuit with a relay or circuit-interrupting device for controlling the circuit in which the terminals 32 and 33 are included.

When the magnetically reversible member 13 has been heated to a temperature of substantially 150° C., in response to a current of a predetermined value traversing the resistor 12, the member 13 becomes non-magnetic and causes the permanent magnet 35 to be released, thereby effecting disengagement of the contact-bridging member 45 from the cooperating stationary contacts 51 and 52. When the thermal element 13 has been cooled to a predetermined value, the contact-bridging member 45 may be caused to re-engage the contacts 51 and 52 by placing the magnet 35 in engagement with the element 13, as illustrated in Figs. 4 and 5, and the circuit in which the resistor 12 is included, may be again energized.

The value of current at which the magnetically reversible element 13 may be rendered non-magnetic, may be adjusted by varying the number and positions of screws that are placed in the openings 18 of the resistor.

In Figs. 6 and 7 of the drawings, a modification of the thermal elements illustrated in Figs. 1 to 3 is shown, and comprises a pair of resistor elements 56 and 57. The elements 56 and 57 may be provided with internally screw-threaded openings 18 and cooperating screws 19. The adjacent ends of the resistors 56 and 57 may be bridged by a magnetically reversible member 58 having substantially the same thermal characteristics as the member 13 of Figs. 1 and 2.

The element 58 may be secured at the ends of the resistors 56 and 57 by screws 59 or other suitable securing means. The other ends of the resistors are provided with terminals having openings 16 and 17 therein, whereby the thermal element may be secured to the terminals 32 and 33 of the relay illustrated in Figs. 4 and 5.

While the thermally-responsive member 13 has been specifically described as being a member consisting of an alloy of nickel and iron, it is to be understood that other thermally responsive devices may be secured thereto.

By my invention, I have provided an adjustable thermal element for a thermal relay that comprises a current-traversed resistor having means for varying the rate of heating a predetermined section thereof, in accordance with the current traversing an electro-responsive device to be controlled.

Various modifications may be made in the device embodying my invention without

departing from the spirit and scope thereof. I desire, therefore, that only such limitations shall be placed thereon as are imposed by the prior art and the appended claims.

I claim as my invention:

1. An adjustable thermal element for a thermal relay comprising a resistor element and means including an opening in the resistor element and a plug insertable therein for varying the current-conducting cross-sectional area of said resistor at a predetermined section thereof.

2. An adjustable thermal element for a thermal relay comprising a resistor element and means for varying the current-conducting cross-sectional area of said resistor at a plurality of sections along the length thereof, the initial external dimensions of said resistor element remaining constant.

3. An adjustable thermal element for a thermal relay comprising a resistor element and means for varying the current-conducting cross-sectional area and the mass of said resistor at a predetermined section thereof, the initial external dimensions of said resistor element remaining constant.

4. An adjustable thermal element for a thermal relay comprising a resistor element and means for varying the current-conducting cross-sectional area and the mass of said resistor at a plurality of sections along the length thereof, the initial external dimensions of the resistor element remaining unchanged.

In testimony whereof, I have hereunto subscribed my name this 20th day of July 1927.

EDWARD M. CLAYTOR.