Aug. 20, 1929. E. M. CLAYTOR 1,725,255

THERMAL ELEMENT

Filed May 14, 1927

Fig. 1.

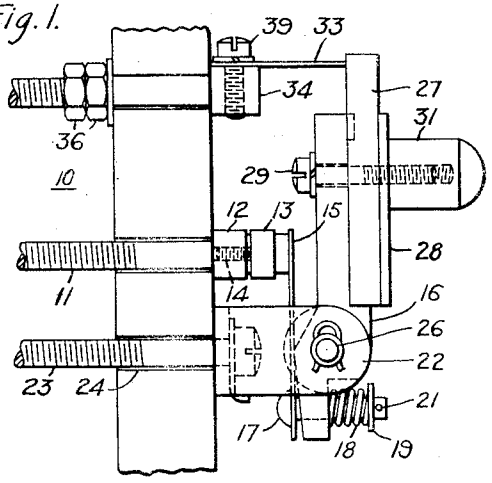


Fig. 2.

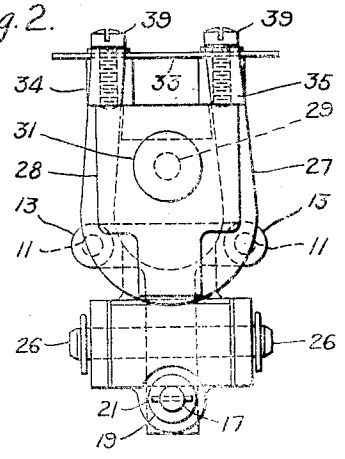


Fig. 3.

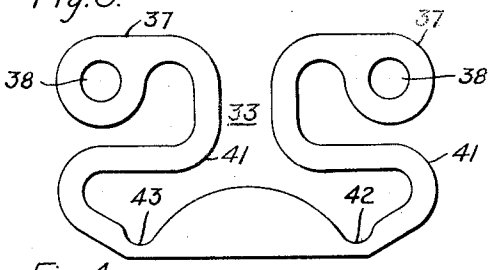


Fig. 5.

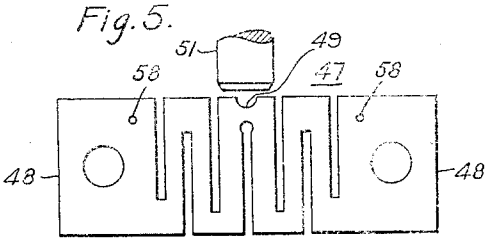


Fig. 4.

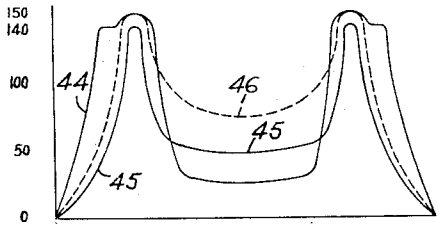


Fig. 6.

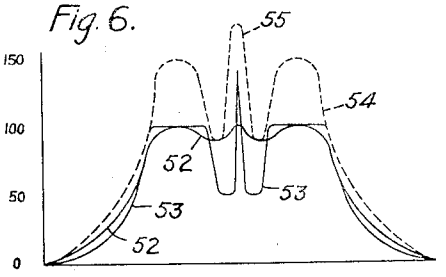
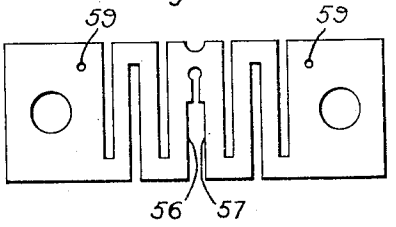


Fig. 7.



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Patented Aug. 20, 1929. 1,725,255

UNITED STATES PATENT OFFICE.

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THERMAL ELEMENT.

Application filed May 14, 1927. Serial No. 191,333.

My invention relates to thermal relays and particularly to thermal elements whose operation depends upon changes in magnetic permeability.

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

Another object of my invention is to provide a thermal element for a control device that comprises an armature for a magnetic relay that is adapted to lose its magnetic properties at predetermined portions thereof.

And a further object of my invention is to provide a magnetically reversible armature for a magnetic thermal relay that shall have means embodied therein for causing it to lose its magnetic properties at predetermined portions thereof when a current of a predetermined value has traversed the armature for a predetermined length of time.

In practicing my invention, I provide a magnetically reversible armature for completing the magnetic circuit of a magnetic field-producing means. The armature may be provided with terminals whereby an electric current may be passed therethrough for heating the armature to a temperature at which it becomes non-magnetic in order that the armature may be caused to lose its magnetism at predetermined portions.

For a fuller understanding of the device embodying my invention, reference should be had to the following description taken in conjunction with the accompanying drawings in which;

Figure 1 is a partial view in side elevation of a magnetic thermal relay in which the device embodying my invention may be utilized.

Fig. 2 is a front view, in elevation, of the device shown in Fig. 1.

Fig. 3 is a view illustrating one form of the armature comprising my invention.

Fig. 4 illustrates the current and heat distribution throughout the armature shown in Fig. 3.

Fig. 5 is a modification of the armature illustrated in Fig. 3.

Fig. 6 illustrates the current and heat distribution throughout the armature illustrated in Fig. 5 and;

Fig. 7 is a further modification of the armature illustrated in Fig. 5.

In the drawings a magnetic thermal relay is provided with a base 10 through which a pair of terminals or stationary contacts 11 extend. The right hand ends of the stationary contacts 11 may be provided with enlarged portions 12 to which contact tips 13 may be secured. The tips 13 may be equipped with studs 14 that have screw-threaded engagement with the portion 12 of the stationary contacts. The contact tips 13 may be made of such materials as carbon or a composition of graphite molded into a compact structure, such material being resistant to the burning effect of electric arcs which may take place at the surface thereof.

The stationary contacts 11 are associated with a resilient contact bridging member 15 of substantially T-shape that is secured to a pivotally mounted bracket 16. As shown, the bridging member 15 may be secured to the lower end of the bracket 16 by a bolt 17 that passes through an opening therein.

In order that the contact bridging member 15 may be yieldingly supported by the bracket 16, a spring 18 is provided. The spring may be located between the right hand surface of the bracket 16 and a washer 19, the spring being supported by and coaxial with the bolt. The washer 19 may be limited in its outward movement along the bolt 17 by means of a key 21 or its equivalent.

In order that the bracket 16 may be pivotally supported by the base 10, a bracket 22 of substantially U-shape is provided, the bracket being secured to the base 10 by means of a bolt 23 that extends through an opening 24 in the base. As shown in the drawings, the bracket 16 is pivotally mounted on the bracket 22 by a pin 26 extending through coaxial openings provided in each of the brackets.

To the upper portion and on the right hand face of the bracket 16 a magnet 27 of substantially horse-shoe-shape is disposed. The magnet may be secured to the bracket by means of a plate 28, a bolt 29 that passes through the bracket 16 and the plate 28, and a knob 31 with which the bolt has screw thread engagement. As shown, the horse-shoe magnet is located between the plate 28 and the bracket 16.

In order that the contact bridging member 15 may be maintained or held in the position shown in Fig. 1 of the drawings, an armature 33 is provided for engaging the magnet. The armature 33 is preferably made of magnetic material that is adapted to lose its magnetism when heated to temperature of a predetermined value and to regain its magnetism upon cooling to a temperature slightly lower than the said temperature. The armature 33 may be supported by terminals 34 and 35 that extend through openings in the base 10, the terminals being secured thereto by cooperating nuts 36.

The armature 33 may be an alloy of iron and nickel having the characteristic that when normally cool it will magnetically cooperate with the magnet 27 to retain it in substantially the position shown in Fig. 1 of the drawing, and when heated the alloy will cease to be magnetic at a predetermined temperature thereby causing the magnet to be released therefrom. A suitable material for my purpose comprises an alloy containing about one part of nickel to two parts of iron by weight. An alloy containing approximately 35% nickel and 65% of iron with traces of other materials is very suitable for my present purpose. Such an alloy ceases to be magnetic when heated to about 150° C. and becomes magnetic again when cooled to a slightly lower temperature, according to the characteristic of the alloy. Other nickel iron alloys having low transformation points are well-known and may be used for my purpose, but the one referred to above lends itself to consistent and reliable operation of the relay.

In Fig. 3 of the drawings the armature 33 is illustrated more particularly in detail, this particular illustration being one form in which the armature may be made. The armature 33 is provided with terminals 37 of relatively large section and mass, the terminals having openings 38 therein through which bolts 39 may extend in order to secure the armature 33 to the terminals 34 and 35. As shown, the bolts 39 are adapted to have screw thread engagement with the terminals. The middle portion of the armature 33 may be of relatively large section and mass and the portions 41 connecting the terminals to the middle portions may be of much smaller section.

At the ends of the middle portion, the armature is provided with narrow sections 42 and 43 at which sections the current density is caused to be high relatively to the density obtaining in the other portions thereof.

In Fig. 4 of the drawings, a curve 44 illustrates graphically the current distribution throughout the armature from one terminal to the other and a curve 45 illustrates the temperature variation therebetween. So long as the current traversing armature 33 conforms substantially to the distribution illustrated by the curve 44, the temperature obtaining at the reduced sections 42 and 43 will be below the temperature at which the armature becomes non-magnetic at these sections. However, if the current increases to a higher predetermined value, the temperature variation throughout the armature 33 may be substantially that illustrated by curve 46. With this distribution of heat, the reduced sections will be heated to 150° C. or higher, at which temperature they become non-magnetic.

Since the poles of the horse-shoe magnet normally engage the armature at the reduced sections 42 and 43, the armature will be released therefrom when the aforesaid temperature obtains.

If the armature is constructed as shown in Fig. 3, the heat generated at the reduced sections 42 and 43 will flow into the middle portion. Since the middle portion is of relatively large mass and the portions 41 are of much smaller section, the heat will flow more readily to the middle portion than to the terminals 37. Therefore, a saving of heat is accomplished because the energy required to heat the armature need not be so great, since a very small amount of heat escapes through the terminals 34 and 35.

In Fig. 5 of the drawings, an armature 47 is illustrated which is of a different shape than the armature 32. The armature 47 is provided with relatively large terminals 48, the portion intervening being oppositely and alternately slotted laterally so that a sinuous current conducting path is obtained. The central portion of the armature 47 is made small in section at 49, relatively to sections to the right and the left thereof. When normal values of current traverse the armature, the temperature at the portion 49 is caused to be higher than the surrounding portions, therefore, heat tends to flow towards the terminal 48. The armature 47 may be utilized in magnetic thermal relays in which a bar magnet is employed a portion of which is shown at 51.

The distribution of current and the resultant heating effect thereof obtaining in the armature 47 is illustrated in Fig. 6. As there shown, a curve 52 illustrates the current distribution throughout the length of the armature 47 and a curve 53 illustrates the resultant temperature at the various points between the terminals 48.

So long as the current traversing the armature is below a predetermined value, the temperature at the section 49 will remain below the temperature at which it becomes non-magnetic. However, if the current is increased above this value, the temperature distribution will follow substantially in accordance with a curve 54, the peak 55 thereof representing the temperature at the sec-

tion 49 which temperature is that required to render it non-magnetic. When this temperature is reached, the bar magnet 51 will be released to perform a useful function, such as controlling the contacts of a circuit maker or breaker.

The armature illustrated in Fig. 7 of the drawing is substantially similar to the one illustrated in Fig. 5, except that the two central portions 56 and 57 are of lesser width than the corresponding portions in member 48, and it may be generally stated that the current and heat distribution therein follow substantially in accordance with the current and heat distribution illustrated in Fig. 6. The armature illustrated in Figs. 5 and 7 may be provided with openings 58 and 59 for modifying the current and heat distribution therein.

It is evident from the foregoing description that the armatures illustrated in the drawings may be rendered non-magnetic at predetermined portions or points depending upon the particular shape or design of magnet to be used in cooperation therewith. Since these armatures may be so constructed that localized intensive heating takes place substantially at the points where it is desirable for the armature to become non-magnetic, the entire armature need not be heated to this temperature. It is evident, therefore, that the armature will cool quickly in order to be ready for operation in a short period of time. Therefore, armatures of this structure may be provided having relatively long life and which are efficient and reliable in their operation.

Various modifications may be made in the device embodying my invention without departing from the spirit and the 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 armature for an electromagnetic device comprising a current conducting member adapted to change its permeability when current of a predetermined value flows therethrough, said member being equipped with terminals and having slots located intermediate said terminals whereby heat flow towards the terminals is retarded and a hot spot generated at one point only between said slots.

2. An armature for an electromagnetic device comprising a magnetically-reversible current-conducting member, said member comprising portions of reduced section adjacent the terminals of said member, an enlarged section between said reduced sections and a second portion of smaller section than the first-named sections located between the enlarged portion and the adjacent sections to thereby effect a hot spot at the portions of reduced section when an electric current is passed therethrough.

3. An armature for an electro-magnetic device comprising a magnetically reversible current-conducting member and means for effecting a concentration of current at a predetermined point whereby said member becomes heated to a temperature to render the same non-magnetic at said point.

4. An armature for an electromagnetic device comprising a magnetically reversible current conducting member having terminals therefor, means for effecting a concentration of current at predetermined points between the terminals and means for retarding flow of heat from said points to said terminals.

In testimony whereof, I have hereunto subscribed my name this 7th day of May, 1927.

EDWARD M. CLAYTOR.