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C. L. PAULUS

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CIRCUIT BREAKER OR BLINKER

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FIG. 1.

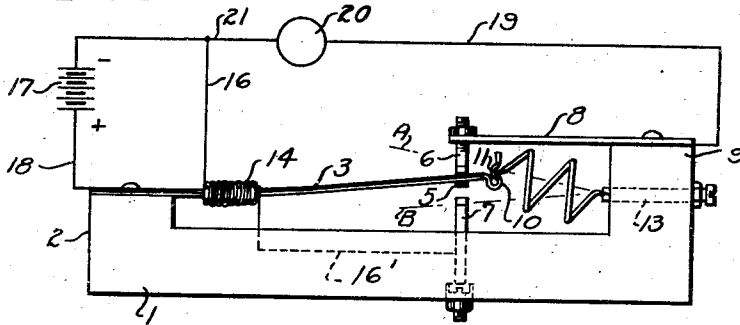


FIG. 2.

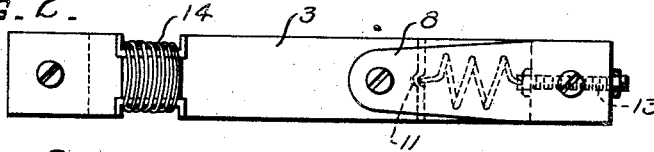


FIG. 3.

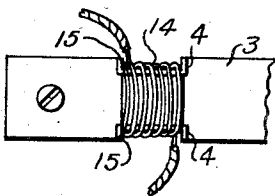
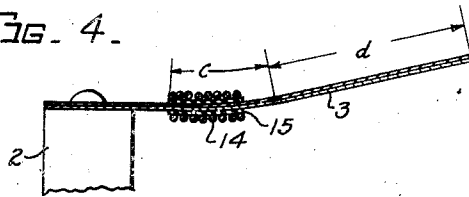


FIG. 4.



INVENTOR
CHARLES L. PAULUS
BY *Elmer H. Sanderson*
Charles K. Kuntz
ATTORNEYS

UNITED STATES PATENT OFFICE

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CIRCUIT BREAKER OR BLINKER

Charles L. Paulus, Dayton, Ohio

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3 Claims. (Cl. 200—122)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to a device for interrupting the flow of current through an electric circuit at regular intervals, and more particularly relates to a novel thermally actuated switch or blinker incorporating a snap-action device.

Thermal switches of the type employing a thermostatic metal strip electrically heated by the current in an electric circuit and operative through successive cycles of heating and cooling to continuously interrupt the current flow through the electric circuit, are per se old and well known in the art. When attempting to apply switches of the type known in the art to use in aircraft for causing timed making and breaking of electrical circuits for energizing electrical apparatus—for example, periodically caging gyroscopes and the like—it was found that the time intervals between successive makes and breaks did not remain constant and when such switches were operated for considerable periods of time, sticking of the contacts occurred. The above defect in the prior art switches was found to be due primarily to the fact that the contacts, when separated by the action of the thermostatic metal strip usually employed, cause an arcing which allows the current to flow for some time after the contacts are physically disengaged, resulting in an uneven time interval between successive makes and breaks, as well as burning and pitting of the contact points, with the resultant danger of sticking.

In accordance with the invention, however, it was found that if a snap-action device was incorporated with the thermal-responsive element such that the snap-action loading means held the contacts in positive engagement with sufficient force, until the stresses due to heating or cooling of the thermal-responsive device became sufficient to overcome the force of the snap-action loading means, the snap-action device then assisted in rapidly breaking the engagement between the contacts. The throw of the contact carried by the thermal-responsive element from one position to the other was so rapid that it was practically instantaneous, so that arcing and burning were reduced to a minimum, the time intervals between successive makes and breaks being regulated by adjustment of the loading of the spring of the snap-action device.

A further feature of the invention as distin-

guished from the prior art devices, is the placing of the heater winding on the strip of thermostatic metal at a zone adjacent the fixed end of the metal strip and having the thermostatic metal strip considerably wider beyond the heater resistance winding so that the thermostatic strip is deformed, due to the heating action of the resistance winding adjacent only the fixed end of the strip. The wide portion of the strip allows a maximum dissipation of heat as compared to the prior art devices, in which the heater resistance winding covers a substantial portion of the length of the strip, necessitating the radiation of the heat of the resistance winding before any substantial radiation of the heat within the strip can occur.

The principal object of the invention is the provision in a thermally actuated switch for continuously interrupting the flow of current in an electric circuit, of a thermostatic metal element operative upon successive heating and cooling thereof to successively engage and disengage circuit-controlling contacts, said element adapted to be heated in a confined zone having a reduced cross-sectional area so that a maximum amount of heat may be dissipated through the remaining portions of the element upon de-energizing of the heating means, and snap-action means operative to assist said thermostatic strip in moving from one contact-engaging position to the other.

A further object of the invention is the provision in a thermally actuated snap-action switch of the character described, of a thermostatic metal strip fixed at one end and having the free end thereof operative to deflect in either direction to thereby alternately make and break an electric circuit, the said thermostatic metal strip having a narrow portion adjacent the fixed end thereof and a heater element surrounding the narrow portion of said strip, the cross-sectional area of said narrow portion being less than the cross section at points beyond said portion.

Other objects of the invention will become apparent by reference to the specification and the appended drawing in which:

Fig. 1 illustrates an enlarged side elevation of a device constructed in accordance with the invention and connected in an electric circuit;

Fig. 2 is a plan view of the thermal switch illustrated in Fig. 1;

Fig. 3 is a view illustrating the arrangement of the heater winding on the thermal-responsive element;

Fig. 4 is a view, partly in section, showing the support of the resistance winding and the manner in which the thermostatic strip deflects.

Referring now to Fig. 1, the reference numeral 1 indicates a base of a heat-resistant insulating material such as Bakelite or the like, having a raised portion 2 at one end thereof, which serves as a support for one end of a thermostatic metal strip 3, which is rigidly secured to the raised portion 2 by means of screws or rivets. Adjacent its outer end the thermostatic metal strip 3 is provided with a double contact 5 which is adapted to engage either of a pair of contacts, 6 or 7, arranged on opposite sides of the double contact 5 in spaced adjustable relation thereto. The adjustable contact 6 is supported by means of a metal bracket 8 secured to a raised portion 9 on the outer end of the base 1. At its extreme end, the thermostatic metal strip 3 has a bent-up portion 10 which is provided with a shallow depression 11 which serves as a seat for the pointed end of a spring 12, the other end of the spring being similarly supported by a depression formed in the end of an adjustable screw 13, the pointed ends of the spring being coaxial with the center line of the spring. By adjustment of the screw 13 relative to the projection 9 of the base 1, varying degrees of compressive stress may be introduced into the spring 12. Adjacent its inner end the thermostatic metal strip 3 is provided with two cut-away portions 4, as best seen in Fig. 3, and a resistance winding 14 is wound around the thermostatic metal strip 3 within the cut-away portions 4, the coil of the winding being insulated from the metal strip 3 by means of asbestos or other heat-resistant insulating material placed around the edges of the cut-away portions 4 as illustrated in Figs. 3 and 4. The resistance winding 14, which serves as a heater element, is electrically connected by means of a conductor 16 to a conductor 21 which, in turn, is connected to the negative terminal of a battery 17, the other terminal 16' of the resistance winding 14 being connected to the contact 7. The positive terminal of the battery 17 is connected by means of a conductor 18 to the thermostatic metal strip 3. The electrical contact 6, through its support 8, is electrically connected by means of a conductor 19 to a load device, such as relay or other electrical apparatus to be controlled, which, in turn, is connected by means of the conductor 21 to the battery 17.

The operation of the device is as follows: Thermostatic metal strip 3 is initially formed so that when in the cooled condition, it urges the contact 5 into engagement with the electrical contact 7, thus causing an electrical current to flow from the battery 17 through the conductor 18 and metal strip 3, contacts 5 and 7, and through the resistance coil 14, heating the same and causing a consequent upward deflection of the thermostatic metal strip to the position illustrated in Fig. 1. In its extreme upper position, the electrical contact 5 engages the contact 6 and thus completes an electrical circuit from the battery 17 through the control device 20 to actuate the same. Upon the thermostatic strip 3 being deflected upward, the electrical circuit through the heater coil 14 is interrupted by the disengagement of contacts 5 and 7, causing the heater coil to cool; and, after a predetermined length of time, the thermostatic strip 3 will have cooled a sufficient amount to set up stresses therein tending to return the strip towards its initial position to again cause

an engagement between the contacts 5 and 7, repeating the above cycle indefinitely. When the resistance coil 14 is energized, the heat developed therein causes a deflection of the thermostatic strip through a circular arc indicated by the reference character C (Fig. 4) adjacent its inner fixed end, while the portion of the strip beyond the heater coil 14 indicated by the reference character D (Fig. 4) remains substantially straight. By thus confining the heating to a small zone adjacent the point of support of the thermostatic strip, it is possible to obtain a substantial deflection of the contact 5 at the free end of the strip without appreciably raising the temperature of the straight portion of the strip D (Fig. 4). The cool portion of the thermostatic strip 3, having a larger cross-sectional area than the section of the strip inclosed by the resistance winding 14, serves as a means to rapidly withdraw and dissipate the heat generated within the strip and the resistance winding upon the interruption of the flow of current through the resistance, resulting in a much improved action over the prior art devices.

As the current flowing through the heater 14 tends to cause an upward deflection of the free end of the thermostatic strip 3, this tendency to deflect is opposed by the loading spring 12, which forms a snap-action device. The line of action of the spring is along the line indicated by the reference character A in Fig. 1, tending to maintain the double contact 5 in engagement with the contact 7 during the heating period. As the stresses in the metal strip 3 increase due to the application of heat, the forces acting in opposition to the spring 12 become sufficient to permit the thermostatic strip to rapidly deflect in the upward direction due to the decrease of the moment arm of the spring force with increase of deflection of the free end of the thermostatic strip, and as soon as the line of action of the spring force passes the dead center position, the line of action of the spring force is changed and the spring assists in further deflecting the free end of the thermostatic strip until the contacts 5 and 6 are engaged. The thermostatic strip will then remain in its upward deflected position for a length of time such that the stresses induced therein by heating will be greatly reduced by radiation of the heat to the ambient atmosphere, and bending stresses of a contrary nature will then be present in the strip due to its initial deformation, which stresses will be sufficient to overcome the force exerted by spring 12 along the line B (Fig. 1) and the free end of the thermostatic strip will be snapped to its initial position, with contacts 5 and 7 being re-engaged and connecting the resistance unit 14 again in the electric circuit. The spacing between the contacts 6 and 7 relative to the contact 5 is such that the actual movement of the free end of the thermostatic strip 3 is a small amount and the action of the loading spring 12 in causing a movement of the contact 5 from one extreme position to the other is so rapid that the action may be considered to be instantaneous. This action results in a clean breaking of the contacts and a positive engagement thereof due to the loading of the spring 12. This feature has resulted in elimination of burning and arcing at the contact points and buzzing due to delayed contact breaks, materially contributing to the uniform time intervals between successive makes and breaks characteristic of a device constructed in accordance with the invention, as distinguished

from the operation of the known prior art devices. The time interval between successive makes and breaks is regulated by varying the compression loading of the snap-action spring 12, which may be accomplished by axial adjustment of the spring 13 relative to the supporting projection 9 of the base 1; and in devices actually constructed and tested it has been found that the time interruptions of the electrical circuit containing the device 20 to be controlled, may be adjusted from approximately three seconds on—three seconds off, to as high as ten to fifteen-second intervals, and it has been found that these time intervals remain substantially constant throughout this range. The effects of variations in the ambient temperature are minimized by maintaining the heater temperature sufficiently high.

While one form of snap-action device has been disclosed, it is obvious that other snap-action mechanisms capable of serving an equivalent function may be employed in conjunction with a thermostatic blinker switch to achieve the desired results in accordance with the teaching of the invention, and while only one principal form of the invention has been disclosed in the drawing, other modifications will become apparent to those skilled in the art, as falling within the scope of the invention as defined by the appended claims.

I claim:

1. A thermally actuated switch comprising a thermostatic strip fixed at one end and having its free end movable in opposite directions to either of two limiting positions in accordance with an increase or decrease in the temperature of said strip, heater means surrounding a portion of said strip adjacent the fixed end thereof, the cross-sectional area of said strip being a minimum in the said portion surrounded by the heater, said heater being adapted to be energized when said strip is deflected to one of said limiting positions to cause a deflection thereof in the opposite direction toward the other of said positions, snap-action means for positively maintaining said strip deflected into either of said limiting positions until the thermal stresses due to the heating or cooling thereof exceed a pre-

termined value, and electric-switching mechanism controlled by the movement of said strip between said limiting positions.

2. A thermal switch for periodically interrupting the flow of current in an electric circuit comprising a thermostatic metal strip movable between two limiting positions, said strip being formed so as to deflect to one of said positions when cooled to a predetermined temperature with respect to the ambient temperature, said strip having a portion adjacent one end thereof smaller in cross-sectional area than the other parts thereof, heater means surrounding only the said portion of said strip having a reduced cross-sectional area and adapted to be energized when said strip is in said one position to raise the temperature of said strip an amount sufficient to cause said strip to deflect to the other of said positions, means yieldingly opposing the movement of said strip in either direction from said limiting positions until said strip has deflected a predetermined amount and thereafter assisting said strip in its movement from one of said positions to the other, and electric-circuit-controlling-contact mechanism actuated by said thermostatic strip.

3. A thermally actuated interrupter for interrupting the flow of current in an electrical circuit at timed intervals comprising a thermostatic element movable between two limiting positions, said thermostatic element having a limited portion thereof reduced in cross-sectional area, a heater means associated with said element and adapted to apply heat to said element in said limited portion when said element is in one of said limiting positions to cause movement thereof to the other of said positions, a snap-action device for yieldingly opposing the movement of said strip from either of said positions until said element has moved a predetermined amount from either of said positions, said snap-action device then assisting the further motion of said strip towards one of said limiting positions, and an electric-control-circuit switch adapted to be actuated by said thermostatic element in at least one of said limiting positions.

CHARLES L. PAULUS.