April 15, 1952 E. A. HAVASI 2,593,301

THERMAL CUTOUT SWITCH

Filed Feb. 1, 1949 2 SHEETS—SHEET 1

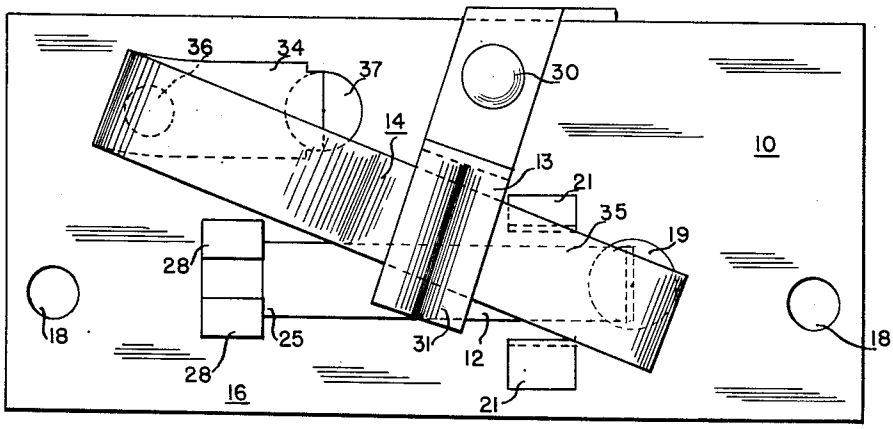
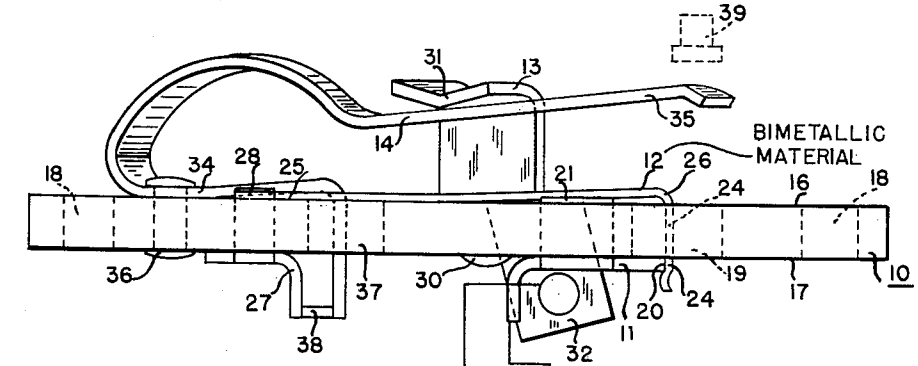


FIG. 2



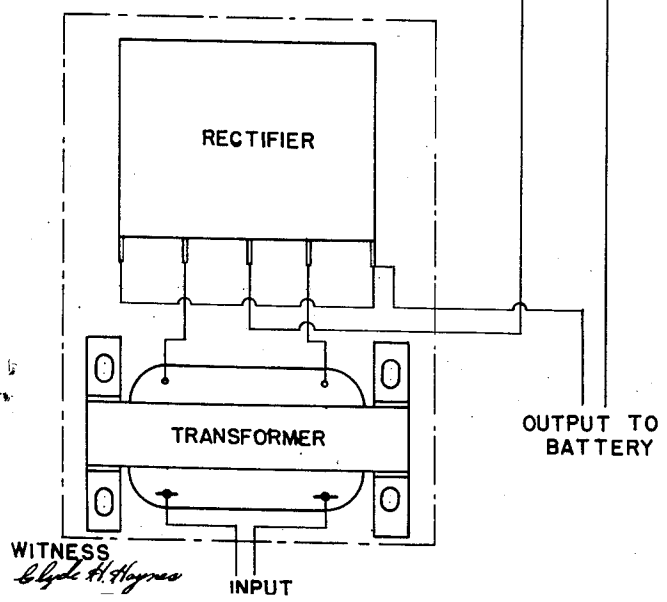


FIG. 1

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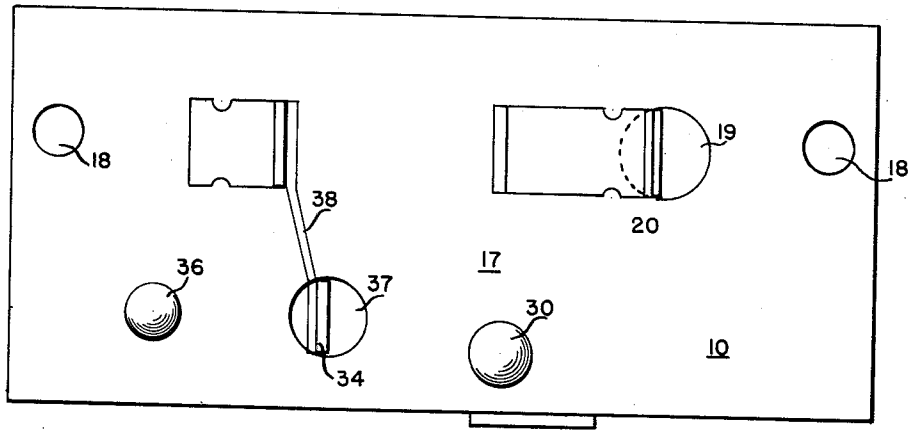

FIG. 3

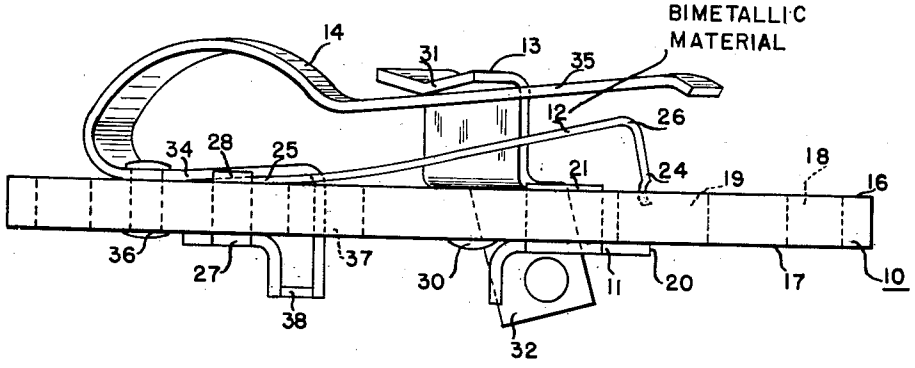

FIG. 4

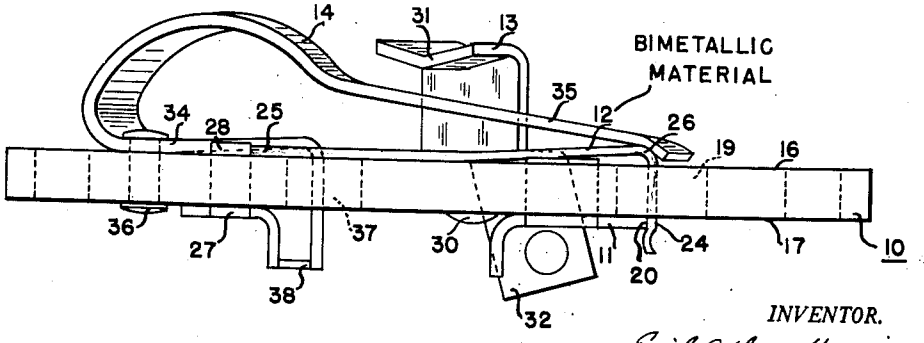

FIG. 5

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2,593,301

UNITED STATES PATENT OFFICE

2,593,301

THERMAL CUTOUT SWITCH

Emil Arthur Havasi, Cuba, N. Y., assignor to Acme Electric Corporation, a corporation of New York

Application February 1, 1949, Serial No. 73,990

2 Claims. (Cl. 200—116)

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My invention relates to a thermal cut-out switch which will automatically break the circuit upon occurrence of abnormal current conditions.

In describing my invention I will refer to the specific use of the thermal cut-out switch to disengage or cut-out the circuit of a battery charger, when the connections of the charger are reversed. The switch is connected in series with a low voltage rectifier, the secondary winding of the transformer and the battery. These thermal cut-out switches are primarily designed to cut out at a predetermined current and when the connections of the battery charger are reversed to prevent damage to the rectifier and the transformer.

Thermal cut-out switches have been used in battery chargers and other electrical equipment to break the circuit when an overload or excessive current is present. In these thermal cut-out switches, the contact is generally made by depressing a bi-metal arm against a stationary switch contact. Since the bi-metal arm is connected in series with the circuit, the current flows through the arm and heats it. Many times the operators burn the contact points between the arm and the stationary contact by not engaging the contacts properly. When the contacts are not engaged properly, an arc is drawn between the tip of the arm and the stationary contact. This arc either gradually burns the end of the bi-metal switch arm thus destroying the switch or tends to weld the arm to the contact. Very often the operators would place their fingers on the bi-metal arm to depress it and engage it with the stationary switch contact before the arm had cooled thus resulting in the burning of the operator's fingers.

I have developed a new thermal cut-out switch which overcomes these problems and which prevents damage to the bi-metal switch and burning of the operator's fingers. One of the objects in developing my new thermal cut-out switch is to provide a cut-out switch in which the contacts between the bi-metallic arm and the stationary contact can not draw an arc.

Another object of my invention is to provide a thermal cut-out switch which may be reset without possibility of the operator burning his fingers.

Another object of my invention is to provide a temperature responsive switch and a manually operable switch connected in series with the manually operable switch breaking circuit and engaging the bi-metal arm of the temperature responsive switch to move it into engagement with its respective contact or terminal.

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Another object of my invention is to provide a thermal cut-out switch which is safe to operate and which is economical to manufacture.

Another object of my invention is to provide a thermal cut-out switch comprising spaced thermals with a bi-metal arm and a spring arm electrically connected together and disposed between these terminals with the spring arm positioned in engageable alignment with the bi-metal arm to move the bi-metal arm into latching engagement with one of the terminals.

Another object of my invention is to provide a thermal cut-out switch in which the switch cannot be reset without opening the circuit in which the switch is connected.

Other objects and a fuller understanding of the invention may be had by referring to the following description and claims, taken in conjunction with the accompanying drawings, in which:

Figure 1 of my drawings illustrates a side view of my thermal cut-out switch with the switch diagrammatically electrically connected in the battery charger circuit.

Figure 2 illustrates a top view of the thermal cut-out switch;

Figure 3 illustrates a bottom view of the thermal cut-out switch;

Figure 4 is a side view of Figure 1 showing the position of the switch arm immediately after the switch has broken an overload circuit; and,

Figure 5 illustrates the side view of Figure 1 with the spring arm depressed and engaging the bi-metal arm to latch it over the latch terminal.

Referring to the drawings the reference character 10 represents an insulation support to which the component parts of my thermal cut-out switch are fastened. This insulation support 10 carries a latch terminal 11 and a latch arm 12 which is aligned for latching engagement with the latch terminal 11. The insulation support 10 also carries an abuttable terminal 13 and a spring contact arm 14 normally abutting this terminal. The abuttable terminal 13 is spaced from the latch terminal 11 and the spring contact arm 14 and the latch arm 12 are disposed therebetween with the spring arm 14 electrically connected to the latch arm 12 and positioned in engageable alignment therewith.

The insulation support 10 is described as having a top surface 16 and a bottom surface 17. The insulation support may be fastened in the housing of the battery charger by bolts or other suitable means which may extend through openings 18. The latch terminal 11 is disposed on the bottom surface 17 of the insulation support 10 and terminates in a latch edge 20. The insu-

lation support 10 has an opening 19 therein and across which this latch edge 20 of the latch terminal 11 extends. I have illustrated the latch terminal 11 as having ears 21 on the sides thereof with these ears 21 extending upwardly through the insulation support 10 and engaging the top surface 16 thereof to securely hold the latch terminal 11 onto the insulation support 10.

The latch arm 12 is preferably constructed from a bi-metal member having a free end portion 24 extendable through the opening 19 and also having a fastening end 25. The bi-metal latch arm 12 is fastened at the fastening end 25 thereof to the top surface 16 of the insulation support 10 and at a distance from the opening 19. The bi-metal arm has spring-like properties urging the free end 24 through the opening 19 away from the latch terminal 11. The free end portion 24 is disposed at an angle to the remainder of the latch arm and integrally connected thereto by a curved bi-metal portion 26.

The fastening end portion 25 of the latch arm 12 may be fastened to the top surface 16 of the insulation support 10 by rivets or other suitable means. However, I have found it advisable to use a fastening member 27 having fastening portions 28 extending through the insulation support 10 and engaging the fastening end portion 25. The fastening member 27 is disposed against the bottom surface 17 and these fastening portions 28 clamp the fastening end portion 25 of the latch arm 12 tightly against the top surface 16 of the insulation support.

When the bi-metal arm or latch arm 12 is maintained below a predetermined temperature, the free end portion 24 which extends below the opening 19 in the insulation support 10 may be latched over the latch edge 20 of the latch terminal 11. Should an overload condition exist, the contour of the bi-metal at the curved bi-metal portion 26 will tend to flatten this curved portion in response to the over heating of this arm by the current passing therethrough. The flattening of the curved bi-metal portion 26 results in disengagement of the free end portion 24 with the latch edge 20. The spring like properties of the latch arm 12 snap the free end portion 24 through the opening 19 away from the latch terminal 11.

The abuttable terminal 13 is preferably constructed from a stamping and is preferably fastened to the insulation support 10 by a rivet 30. This abuttable terminal 13 has an abutment contact portion 31 disposed at a distance from the top surface 16. The abuttable terminal 13 also has a wire connection portion 32 extending from the top surface 16 past the bottom surface 17 and outwardly away from the insulation support 10 to provide means for connecting a wire to the abuttable terminal.

The spring contact arm 14 comprises in general a fastening portion 34 and an extended arm portion 35. In my drawings I have illustrated the fastening portion 34 and the arm portion 35 as extending at an angle to each other with the fastening portion 34 riveted to the top surface of the insulation support by means of a rivet 36. The fastening portion 34 has a part thereof extending through an opening 37 in the insulation support 10 for electrical connection to the fastening member 27, which fastens the latch arm 12 to the insulation support. A wire 38 or any other suitable electrical connection means may be used to electrically connect the fastening portion 34 and the fastening member 27 thus electrically connecting the spring contact arm 14 and the latch arm 12 in series.

The extended arm portion 35 of the spring contact arm 14 is disposed in engageable alignment with the bi-metal or latch arm 12 and between the latch terminal 11 and the abuttable terminal 13. The spring like properties of the spring arm 14 urge the arm against the abutment contact portion 31 of the abuttable terminal 13. When the spring arm 14 is moved away from the abuttable terminal 13 and towards the latch terminal 11, the electrical contact is broken between the manually operable spring member 14 and the abuttable member 13. As the abuttable spring member is further moved towards the latch terminal 11 it engages the latch arm 12 and moves the free end portion 24 thereof against the latch edge 20 and into the latch engagement with the latch terminal 11.

In Figure 1 of my drawings I illustrate the latch terminal 11, the latch arm 12, the spring contact arm 14, and the abuttable terminal 13 as being electrically connected in series in the output side of a battery charger. The latch terminal 11 and the bi-metal latch arm 12 may be considered a temperature responsive switch and the abuttable terminal 13 and the spring arm 14 may be considered a manually operable switch connected in series therewith. As long as the charger is operating correctly the current flowing through the switches and through the bi-metal arm 12 will not be sufficient to heat the curved portion 26 of the bi-metal arm above a predetermined temperature. However, should the current flowing through the switches become excessive due to an overloading of the charger or to incorrectly connecting the output of the battery charger to a battery the curved portion 26 will flatten and the spring properties of the latch arm 12 will snap the free end portion 24 away from the latch edge 20 of the latch terminal 11.

In Figure 4 I best illustrate the position of the component parts of the switch immediately after an overload. In this figure the free end portion 24 is shown disconnected or disengaged from the latch terminal 11, thus breaking the circuit and preventing damage to the rectifier and transformer in the battery charger. Figure 4 also illustrates that the spring-like properties of the spring contact arm 14 hold the spring contact arm 14 against the abuttable terminal 13. When the temperature responsive switch is reset to again close the circuit the operator simply moves the spring contact arm 14 away from the abuttable terminal 13 and against the latch arm 12 to move the free end portion 24 into engagement with the latch terminal 11.

Many times the operators will attempt to close the switch before the overload condition has been corrected. Attempting to close this switch before the overload condition has been corrected causes an excessive sparking between the free end portion 24 and the edge 20. This excessive sparking either welds the free end portion 24 of the bi-metal arm to the terminal 11 or burns the end off so that it will not latch over the latch edge 20. I have discovered that on closing the circuit before the overload condition has been corrected often results in currents of 60 amperes flowing through the bi-metal latch arm 12 and the terminal 11. In normal operation the switch is constructed to carry approximately 8 amperes before it reaches the predetermined temperature which causes it to break the circuit. A switch constructed to withstand 8 amperes of current

normally will not last long when 60 amperes are put through the contact points.

I have also discovered that the interval of time required to reset the switch and latch the end portion 24 over the latch edge 20 is relatively long. During this time a continual expansion and contraction of the bi-metal arm occurs. There are a series of repeated makes and breaks in the electrical circuit between the free end portion 24 of the bi-metal arm 12 and the latch 11 during this resetting time. It is well known that the response of the bi-metal spring properties under these repeated make and break conditions decreases until substantially all the elasticity is finally destroyed by the excessive heat generated by the bi-metal arm. Thus, the bi-metal arm 12 will eventually alter into a piece of material which would be easily welded to the edge 20 of the latch terminal 11.

In my cut-out switch the electrical circuit is broken between the abuttable terminal 13 and the latch terminal 11 as is illustrated in Figure 5 while the latch arm 12 is engaged with the latch terminal 11. By breaking the circuit between the abuttable terminal 13 and the spring contact arm 11 excessive currents which would cause welding or burning of the delicate and sensitive temperature responsive switch are prevented. No current can flow again through the circuit until the pressure used to urge the spring contact arm 14 into the engagement with the latch arm 12 and away from the abuttable terminal 13 is released. As soon as this pressure is released the spring properties of the contact arm 14 will cause it to snap against and thereby abutt against the abuttable terminal 13 thus completing the circuit.

In Figure 1 of my drawings I have illustrated in phantom lines a reset button 39 which may be used when the thermal cut-out switch is mounted within the casing of the battery charger. This thermal reset button 39 is aligned with the extended arm portion 35 of the arm 14 so that the arm 14 may be operated manually from the outside of the battery charger.

Should a person automatically reverse the polarity of the connections of the battery charger output to the battery terminals and thereby cause an overload on the switch, the temperature responsive switch will automatically break the circuit. The bi-metal arm 12 will be heated beyond the predetermined temperature, thus breaking connection between the free end portion 24 and the latch terminal 11. The operator can immediately correct the connection of the terminals to the battery. Pushing the reset button and thus urges the spring contact arm 14 away from the abuttable terminal 13 and into engagement with the bi-metal arm 12. Continued pushing causes the spring arm 14 to move the latch arm 12 and thereby resets the bi-metal arm 12 in latching engagement with the latch terminal 11. The operator upon releasing the pressure on the reset button 39 and thus on the spring contact arm 14 will permit the spring properties on the arm to snap it into engagement with the abuttable terminal 13 thus completing the circuit.

No current can flow through the circuit and through the bi-metal arm 12 until the pressure against the spring arm 14 is released and the arm snaps back against the abuttable terminal 13. My new thermal cut-out switch thus eliminates any possibility of welding the bi-metal

latch arm 12 to the latch terminal 11 and also eliminates any possibility of excessive sparking therebetween which would burn the contact surface of the latch terminal and the latch arm. The operator cannot hold the bi-metal arm 12 in contact with the latch terminal 11 while the circuit is overloaded and burn his fingers. My thermal cut-out switch will latch and open indefinitely under overload conditions without any damage to the delicate bi-metal temperature responsive switch.

Although the invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

What is claimed is:

1. A thermal cut-out switch comprising, an insulation support member having first and second sides, a current conducting latch terminal provided with a latch edge and fastened on said second side, a current conducting bimetal latch arm fastened on said first side and having a transverse end portion thereof extendible to said second side for current conducting enlatchment over the edge of said latch terminal, a current conducting abutment terminal on said first side and spaced from said latch arm, and a current conducting spring arm fastened on said first side and electrically connected to said latch arm and manually abuttable against said bimetal latch arm and also abuttable against said abutment terminal, said spring arm having spring-like properties urging the same away from said latch arm and into current conducting contact against said abutment terminal thus establishing a series electrical circuit through said arms and said terminals.

2. A thermal cut-out switch comprising, an insulation support member having first and second sides and an opening therethrough, a current conducting latch terminal provided with a latch edge and fastened on said second side and extending at least partly across said opening, a current conducting bimetal latch arm fastened on said first side and having a transverse end portion thereof extendible through said opening for current conducting enlatchment over the edge of said latch terminal, a current conducting abutment terminal on said first side and spaced from said latch arm, and a current conducting spring arm fastened on said first side and electrically connected to said latch arm and manually abuttable against said bimetal latch arm and also abuttable against said abutment terminal, said spring arm having spring-like properties urging the same away from said latch arm and into current conducting contact against said abutment terminal thus establishing a series electrical circuit through said arms and said terminals.

EMIL ARTHUR HAVASI.

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The following references are of record in the file of this patent:

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