July 23, 1957 E. V. SUNDT 2,800,555

LOW AMPERAGE CIRCUIT INTERRUPTER

Filed Aug. 18, 1954

Fig. 1.

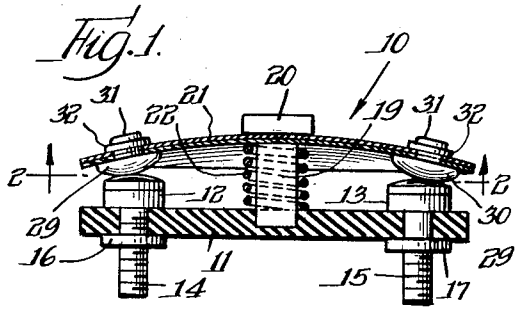


Fig. 2.

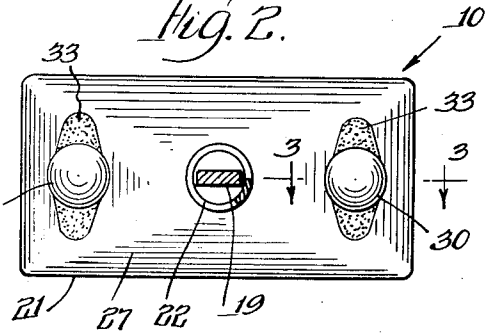


Fig. 4.

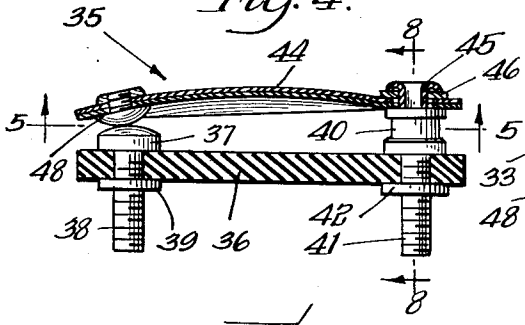


Fig. 5.

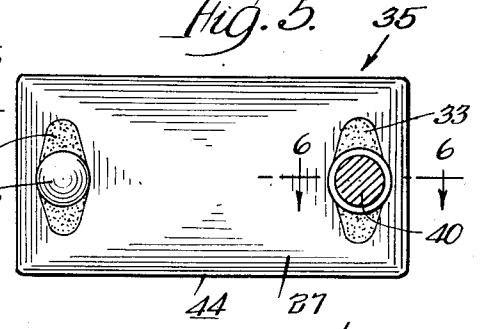


Fig. 7.

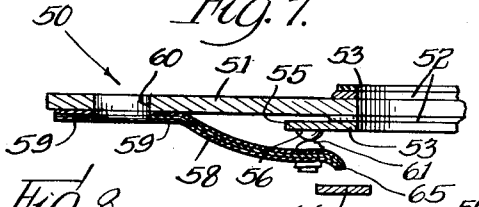


Fig. 3.

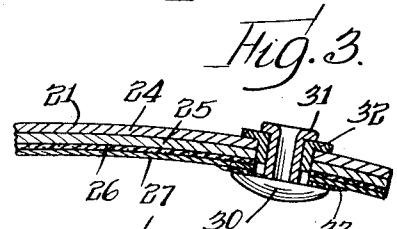


Fig. 8.

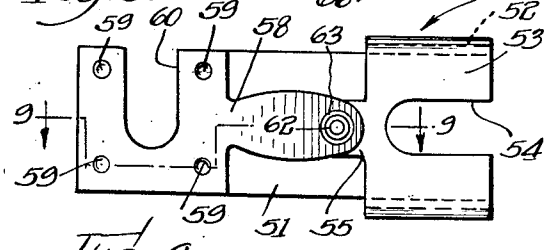


Fig. 6.

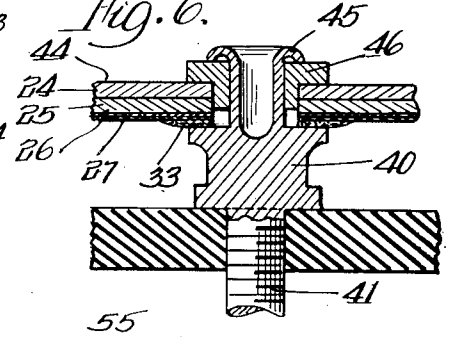
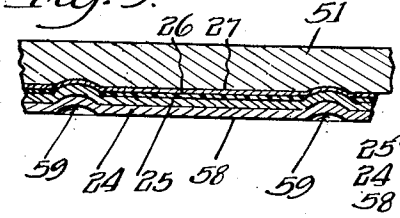
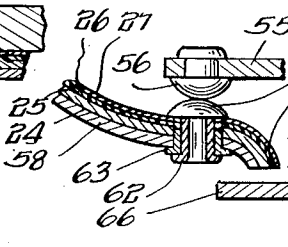


Fig. 9.





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LOW AMPERAGE CIRCUIT INTERRUPTER

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Application August 18, 1954, Serial No. 450,760

9 Claims. (Cl. 200—122)

This invention relates to circuit interrupters which utilize bimetallic elements as the actuating means therefor.

In circuit interrupters of this type the current being controlled usually passes through the bimetallic element in whole or in part, for heating and actuating the same, preferably with a snap action, to interrupt the circuit when the current reaches a predetermined high value. The lowest current to which these bimetallic elements will respond is a function of the watts it is possible to dissipate in the bimetal element itself in order to heat it to its circuit interrupting temperature. Even using bimetallic elements of the highest presently known specific resistances, it is still difficult to obtain positive circuit interrupting action below 5 amperes, and even in some cases 10 amperes. In such circuit interrupters a compromise must be made between the resistance and other electrical characteristics and the deflection and snap characteristics of the bimetallic elements with the result that most beneficial results cannot be obtained.

The principal object of this invention is to provide an improved circuit interrupter using a bimetallic element, wherein positive circuit interruption may be obtained at low current values, even as low as ¼ ampere, wherein maximum deflection and snap characteristics may be utilized in the bimetallic element without substantial regard to the electrical characteristics thereof, which is rugged in construction and foolproof in operation, and which may be inexpensively manufactured.

Briefly, the low amperage circuit interrupter of this invention includes a deflecting bimetallic element having optimum desired deflection and/or snapping characteristics. A thin electrical insulating film is bonded throughout its area to one side of the bimetallic element and a thin metallic film is bonded throughout its area to the electrical insulating film, the metallic film being electrically insulated from the bimetallic element by the electrical insulating film. The insulating film and the metallic film uniformly deflect with the bimetallic element. Electric current is passed through the metallic film and because of its thinness operates to generate heat therein, the amount of heat being determined by the composition and cross-sectional area of the film. This heat is conducted through the thin electrical insulating film to the bimetallic element for deflecting the latter in accordance with its deflecting and/or snapping characteristics. As a result the circuit interrupter acts as a compact unit with the mechanical characteristics being determined by the bimetallic element and the electrical characteristics by the metallic film, each of which may be independently selected for desired overall operations.

Further objects of this invention reside in the details of construction of the low amperage circuit interrupter and in the cooperative relationships between the component parts thereof.

Other objects and advantages of this invention will become apparent to those skilled in the art upon reference

to the accompanying specification, claims and drawing in which:

Fig. 1 is a vertical sectional view through one form of the low amperage circuit interrupter of this invention;

Fig. 2 is a horizontal sectional view taken substantially along the line 2—2 of Fig. 1;

Fig. 3 is an enlarged vertical sectional view taken substantially along the line 3—3 of Fig. 2;

Fig. 4 is a vertical sectional view through another form of the low amperage circuit interrupter of this invention;

Fig. 5 is a horizontal sectional view taken substantially along the line 5—5 of Fig. 4;

Fig. 6 is an enlarged vertical sectional view taken substantially along the line 6—6 of Fig. 5;

Fig. 7 is a vertical sectional view through another form of the low amperage circuit interrupter of this invention;

Fig. 8 is a bottom view of the circuit interrupter of Fig. 7;

Fig. 9 is an enlarged vertical sectional view taken substantially along the line 9—9 of Fig. 8.

One form of the low amperage circuit interrupter of this invention is generally designated at 10 in Figs. 1, 2 and 3. It includes a base 11 of suitable electrical insulating material. Stationary contacts 12 and 13 are secured in spaced apart relation on the base 11 by studs 14 and 15 and nuts 16 and 17. Secured on the base 11 is a support 19 having a head 20. A bimetallic element 21 is carried by the support 19 and is urged against the head 20 by a spring 22 interposed between the base 11 and the bimetallic element 21.

The bimetallic element 21 is formed of two metal strips suitably secured together as by welding. One of the metal strips 24 has a relatively low thermal coefficient of expansion and the other metal strip 25 has a relatively high thermal coefficient of expansion. For example, the metal portion 24 may be formed of Invar or the like and the other metallic portion 25 may be formed of brass, copper, or nickel, chromium or iron alloys and the like. To provide a snap acting action the bimetallic element 21 is mechanically stressed or deformed as illustrated in Figs. 1 and 2, this being the normal or on position of the bimetallic element. When, however, the bimetallic element 21 is heated, the mechanical stressing is overcome and the bimetallic element snaps to an off position wherein the ends of the bimetallic element are elevated or raised with a snap action. The metals in the bimetallic element and their thickness and configuration are selected and arranged to provide the desired deflection and snapping characteristics.

An electrical insulating film 26 is bonded throughout its area to one side of the bimetallic element 21, preferably the high expansion side 25. This electrical insulating film 26 may be formed of any suitable material which may be bonded to the bimetallic element. One material which provides excellent results is polytetrafluoroethylene (Teflon). The film 26 is preferably preformed and is bonded to the bimetallic element 21 by heat sealing or by using a high temperature flexible cement. This electrical insulating film is made quite thin, for example, having a thickness of about .001 or .002 inch. Bonded throughout its area to the electrical insulating film 26 is a thin metallic film 27. This metallic film may be formed of any suitable metal, chrome or nickel providing excellent results. Electric current is passed through this metallic film and the resistance of this film to the flow of current operates to generate heat in the film. In order to obtain a thin metallic film it is preferably coated on and bonded to the electrical insulating film by an evaporated metal process. For production reasons it is preferable to bond the metallic film 27 to the electrical

insulating film 26 before the latter is bonded to the bimetallic element 21. The thickness of the metallic film 27 is dependent upon the electrical characteristics and the amount of heat that it is desired to generate for a given current flow and by using the evaporated metal process this metallic film may be made extremely thin, as low as .0000020 inch thick. The electrical insulating film 26 operates to electrically insulate the metallic film 27 from the bimetallic element 21 and yet it operates to provide good heat transfer for conducting heat from the metallic film 27 to the bimetallic element 21.

The bimetallic element 21 carries a pair of contacts 29 and 30 which are adapted to normally engage the stationary contacts 12 and 13 when the bimetallic element 21 is in the normal or on position. The contacts 29 and 30 are riveted to the bimetallic element 21 as indicated at 31 in Fig. 3 and the contacts are electrically insulated from the bimetallic element 21 by electrical insulating washers 32. However, the contacts 29 and 30 are electrically connected to the metallic film 27. Thus, when the circuit interrupter is closed as illustrated in Fig. 1 electrical current passes from the contact 30 to the contact 29 through the metallic film 27 only and not through the bimetallic element 21. Because the metallic film 27 is very thin and in order to distribute the current flow through the metallic film 27, a layer of electrically conductive metal 33 is interposed between the contacts 29 and 30 and the metallic film 27. This layer of metal 33 may, for example, be formed from silver paints such as are used for printed circuit work. The metal layers 33 operate to prevent extreme concentration of the current in the metallic film 27 adjacent the contacts 29 and 30. While both contacts 29 and 30 are illustrated in Figs. 1, 2 and 3 as being electrically insulated from the bimetallic element 21, this is not necessary. So long as one of the contacts is so electrically insulated it is not necessary for the other one to be, since in either event, current can flow only through the metallic film 27.

In the operation of the low amperage circuit interrupter 10 as illustrated in Figs. 1, 2 and 3 the contacts 29 and 30 normally engage the contacts 12 and 13. Current flows only through the metallic film 27. If the current should become excessive, the metallic film 27 generates heat which is conducted through the electrical insulating film 26 to the bimetallic element 21. When the bimetallic element 21 is heated to a predetermined value by the conducted heat, it snaps to the off position for separating the contacts 29 and 30 from the contacts 12 and 13 and thereby interrupts the circuit. When the circuit is so interrupted the generation of the heat in the metallic film 27 is interrupted and the bimetallic element cools down. The bimetallic element 21 may be so constructed as to automatically reclose the contacts 29 and 30 against the contacts 12 and 13 or it may be so designed to maintain the contacts separated until such time as they are mechanically reset. The former arrangement is particularly useful as an automatic reclosing circuit breaker, as a flasher for advertising signs or the like, or as a flasher for automatic directional signals or the like. The latter arrangement is particularly useful as a circuit breaker which must be manually reset.

Another form of the low amperage circuit interrupter is generally designated at 35 in Figs. 4, 5 and 6. It includes a base 36 of electrical insulating material which carries a contact 37 by means of a stud 38 and a nut 39. A terminal 40 is secured to the base 36 in spaced relation from the contact 37 by a stud 41 and a nut 42. One end of a bimetallic element 44 is riveted to the stud 40 as indicated at 45 and here the terminal 40 is electrically insulated from the bimetallic element 44 by an insulating washer 46. The other end of the bimetallic element 44 carries a contact 48 which is adapted to engage the stationary contact 37. The bimetallic element 44 includes metals 24 and 25 of different thermal coefficients of expansion, an electrical insulating film 26 and a metallic film 27. If desired, the bimetallic element 44 may also be mechanically stressed to provide a snap action for engaging and separating the contacts 37 and 48 with a snap action. Here also, the metallic film 27 is electrically connected to the terminal 40 and the contact 48 by metallic layers 33. Instead of insulating the bimetallic element from the terminal 40 it may be insulated from the contact 48 in the manner described above in connection with Figs. 1 to 3. The circuit interrupter 35 of Figs. 4 to 6 operates in substantially the same manner as the circuit interrupter 10 of Figs. 1 to 3 and, therefore, a further description is not considered necessary.

The circuit interrupter generally designated at 50 in Figs. 7 to 9 is in the form of a telephone grasshopper fuse. It includes a base 51 which may be formed of nickel silver or the like. One end of the base 51 is cased with an electrical insulating sleeve 52. Over this sleeve 52 is mounted a terminal 53, the terminal 53 being electrically insulated from the base 51 by the electrical insulating sleeve 52. The base 51 and terminal 53 is provided with a slot 54 for mounting the same in a panel. The terminal 53 is provided with an extension 55 which in turn carries a stationary contact 56. A bimetallic element 58 is secured to the underside of the base 51 as by welding indicated at 59. The bimetallic element 58 includes metals 24 and 25 of different thermal coefficients of expansion, a layer 26 of electrical insulating material and a metallic film 27. When the bimetallic element 58 is welded to the base 51, the electrical insulating film 26 is destroyed at the weld points so that the bimetallic element 58 and the metallic film 27 are both electrically connected to the metallic base 51. The base 51 and bimetallic element 58 are provided with a slot 60 also for mounting the circuit interrupter in a panel.

The outer end of the bimetallic element 58 carries a contact 61 which is adapted normally to engage the contact 56. This contact 61 is secured to the bimetallic element 58 as by riveting indicated at 62 and is electrically insulated therefrom by an insulating washer 63. The manner of operation of the circuit interrupter 50 is very much like that described above in connection with the circuit interrupters 10 and 35. Here the circuit from the base 51 to the contact 56 extends only through the metallic film 27 and the contact 61 so as to generate heat in the metallic film 26 to the bimetallic element 58. When the bimetallic element 58 is sufficiently heated, it moves the contact 61 away from the contact 56 to interrupt that circuit. At the same time, the end 65 of the bimetallic element 58 may contact a bus bar 66 for completing an auxiliary circuit from the base 51 to the bus bar 66. This auxiliary circuit may form a portion of an alarm circuit for indicating opening or separating of the contacts 56 and 61.

In all forms of this invention the deflection and/or snapping characteristics of the bimetallic element may be determined independently from the electrical characteristics, the electrical characteristics being determined by the metallic film. These various characteristics may be independently selected so as to obtain any desired overall operation of the circuit interrupter. Thus it is possible to provide a circuit interrupter having desired mechanical characteristics and still be able to successfully interrupt low current circuits, even as low as ¼ ampere currents.

While for purposes of illustration several forms of this invention have been disclosed other forms thereof may become apparent to those skilled in the art upon reference to this disclosure and, therefore, this invention is to be limited only by the scope of the appended claims.

I claim as my invention:

1. A low amperage circuit interrupter comprising a deflecting bimetallic element, an electrical insulating film bonded throughout its area to one side of the bimetallic element, a metallic film bonded throughout its area to the electrical insulating film and electrically insulated thereby from the bimetallic element, said insulating film

and metallic film uniformly deflecting with said metallic elements, and means including contact means operated by the bimetallic element for passing an electric current through the metallic film for heating the same, the heat from the metallic film being conducted through the electrical insulating film to the bimetallic element for deflecting the same.

2. A low amperage circuit interrupter comprising a deflecting bimetallic element having high and low thermal expansion sides, an electrical insulating film bonded throughout its area to the high expansion side of the bimetallic element, a metallic film bonded throughout its area to the electrical insulating film and electrically insulated thereby from the bimetallic element, said insulating film and metallic film uniformly deflecting with said metallic elements, and means including contact means operated by the bimetallic element for passing an electric current through the metallic film for heating the same, the heat from the metallic film being conducted through the electrical insulating film to the bimetallic element for deflecting the same.

3. A low amperage circuit interrupter comprising a deflecting bimetallic element, an electrical insulating film bonded throughout its area to one side of the bimetallic element, a metallic film bonded throughout its area to the electrical insulating film and electrically insulated thereby from the bimetallic element, said insulating film and metallic film uniformly deflecting with said metallic elements, and means including a stationary contact and a contact carried by the bimetallic element normally engaging the stationary contact but electrically insulated from the bimetallic element and electrically connected to the metallic film for passing electrical current through the metallic film under the control of the contacts for heating the metallic film, the heat from the metallic film being conducted through the electrical insulating film to the bimetallic element for deflecting the same to separate the contacts upon the occurrence of excessive current conditions.

4. A low amperage circuit interrupter comprising a deflecting bimetallic element, an electrical insulating film bonded throughout its area to one side of the bimetallic element, a metallic film bonded throughout its area to the electrical insulating film and electrically insulated thereby from the bimetallic element, said insulating film and metallic film uniformly deflecting with said metallic elements, a contact member secured to the bimetallic element but electrically insulated therefrom, a metallic layer bonded to the metallic film about the contact member and engaging the contact member for electrically connecting the contact member to the metallic film, and means including the contact member and metallic layer for passing electrical current through the metallic film for heating the same, the heat from the metallic film being conducted through the electrical insulating film to the bimetallic element for deflecting the same.

5. A low amperage circuit interrupter comprising a deflecting bimetallic element, an electrical insulating film bonded throughout its area to one side of the bimetallic element, a metallic film bonded throughout its area to the electrical insulating film and electrically insulated thereby from the bimetallic element, said insulating film and metallic film uniformly deflecting with said metallic elements, and means including a contact member secured to the bimetallic element but electrically insulated from the bimetallic element and electrically connected to the metallic film for passing electric current through the metallic film for heating the same, the heat from the metallic film being conducted through the electrical insulating film to the bimetallic element for deflecting the same.

6. A low amperage circuit interrupter comprising a mechanically stressed deflecting bimetallic element having a normal on position and moved with a snap action to an off position when heated to a predetermined value, an electrical insulating film bonded throughout its area to one side of the bimetallic element, a metallic film bonded throughout its area to the electrical insulating film and electrically insulated thereby from the bimetallic element, said insulating film and metallic film uniformly deflecting with said metallic elements, a stationary contact, a contact carried by the bimetallic element and engaging the stationary contact when the bimetallic element is in the on position and disengaging the stationary contact when the bimetallic element is in the off position, and means including said contacts for passing an electric current through the metallic film for heating the same while the contacts engage each other, the heat from the metallic film being conducted through the electrical insulating film to the bimetallic element for heating the same to cause it to snap to the off position.

7. A low amperage circuit interrupter comprising a deflecting bimetallic element, an electrical insulating film bonded throughout its area to one side of the bimetallic element, a metallic film bonded throughout its area to the electrical insulating film and electrically insulated thereby from the bimetallic element, said insulating film and metallic film uniformly deflecting with said metallic elements, a stationary contact, a contact carried by the bimetallic element and normally engaging the stationary contact and disengaging the stationary contact when the bimetallic element is heated to a predetermined value, and means including said contacts for passing an electric current through the metallic film for heating the same while the contacts engage each other, the heat from the metallic film being conducted through the electrical insulating film to the bimetallic element for heating the same to cause it to move to a position for separating the contacts.

8. A low amperage circuit interrupter comprising a deflecting bimetallic element, an electrical insulating film bonded throughout its area to one side of the bimetallic element, a metallic film bonded throughout its area to the electrical insulating film and electrically insulated thereby from the bimetallic element, said insulating film and metallic film uniformly deflecting with said metallic elements, a stationary contact, a contact carried by the bimetallic element and normally engaging the stationary contact and disengaging the stationary contact when the bimetallic element is heated to a predetermined value, and means including said contacts for passing an electric current through the metallic film for heating the same while the contacts engage each other, the heat from the metallic film being conducted through the electrical insulating film to the bimetallic element for heating the same to cause it to move to a position for separating the contacts, a second stationary contact engaged by the bimetallic element when the bimetallic element is moved to separate said first mentioned contacts, and means including the bimetallic element and the second stationary contact for completing an auxiliary electric circuit when the bimetallic element engages the second stationary contact.

9. A low amperage circuit interrupter comprising an electrical insulating base, a deflecting bimetallic element, means mounting the bimetallic element at its center to the base, said bimetallic element being mechanically stressed and having a normal on position and movable with a snap action to an off position when heated to a predetermined value, an electrical insulating film bonded throughout its area to one side of the bimetallic element, a metallic film bonded throughout its area to the electrical insulating film and electrically insulated thereby from the bimetallic element, said insulating film and metallic film uniformly deflecting with said metallic elements, a pair of stationary contacts carried by the base, a pair of contacts carried by the bimetallic element and engaging the stationary contacts when the bimetallic element is in the on position and disengaging the stationary contacts when the bimetallic element is in the off position,

said contacts carried by the bimetallic element being electrically connected to the metallic film and at least one of said contacts being electrically insulated from the bimetallic element, and means including said contacts for passing an electric current through the metallic film for heating the same when the contacts engage each other, the heat from the metallic film being conducted through the electrical insulating film to the bimetallic element for heating the same to cause it to snap to the off position.

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