Jan. 31, 1967 A. URANI 3,301,981

PROTECTORS FOR ELECTRIC CIRCUITS

Filed Jan. 28, 1966

FIG. 1.

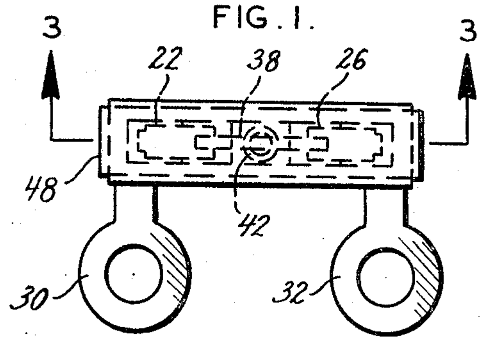



FIG. 2.

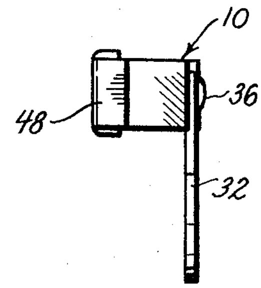



FIG. 3.

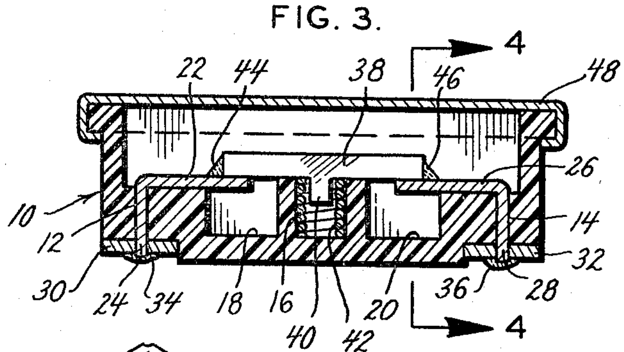
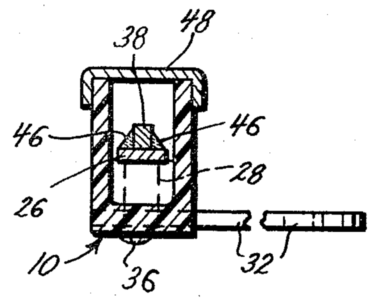



FIG. 4.



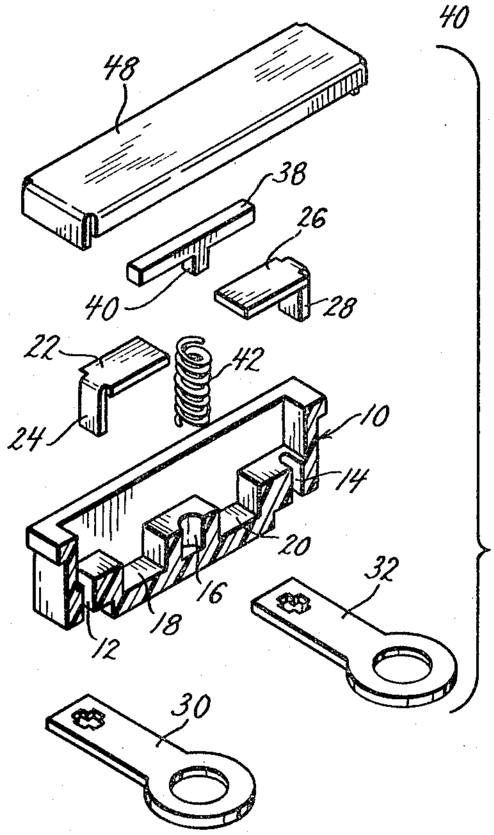




FIG. 5.

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PROTECTORS FOR ELECTRIC CIRCUITS
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4 Claims. (Cl. 200—142)

This invention relates to improvements in thermally-responsive circuit-breaking devices. It is, therefore, an object of the present invention to provide an improved thermally-responsive circuit-breaking device.

It would be desirable to provide a thermally-responsive circuit-breaking device which was small in size but which could break circuits that were carrying substantial values of current. Further, it would be desirable to provide a thermally-responsive circuit-breaking device which could respond almost wholly to externally-generated heat rather than to heat generated within it as current flowed through it. The present invention provides such a thermally-responsive circuit-breaking device; and it does so by providing spaced contacts with generally-flat surfaces, by providing a bridging contact which can have substantial portions of the area thereof disposed immediately adjacent the generally-flat surfaces of those spaced contacts, and by providing only small amounts of heat-softenable material to hold that bridging contact in electrically-conducting relation with those generally-flat surfaces of those spaced contacts. The bridging contact will be made of a highly conductive metal such as copper, and the spaced contacts also will be made of a highly conductive metal such as copper; and the cross sectional areas of that bridging contact and of those spaced contacts will be large enough to conduct the rated current of the thermally-responsive circuit-breaking device without generating any appreciable amount of heat. The bridging contact will be immediately adjacent the generally-flat surfaces on the spaced contacts, and hence only very small amounts of heat-softenable material can become interposed between that bridging contact and those generally-flat surfaces; and hence the current path through the thermally-responsive circuit-breaking device provided by the present invention will essentially be through a high conductive metal such as copper and only, in small measure, through the heat-softenable material. Further, because the bridging contact is generally flat, the overall dimensions of the thermally-responsive circuit-breaking device can be small. As a result, the thermally-responsive circuit-breaking device provided by the present invention can be compact and can respond almost wholly to externally-generated heat. It is, therefore, an object of the present invention to provide a thermally-responsive circuit-breaking device which has highly-conductive spaced contacts with generally-flat surfaces, a highly-conductive bridging contact which is generally flat and which is coextensive with substantial areas on those generally-flat surfaces, and which has only very small amounts of heat-softenable material to bond that bridging contact to those generally-flat surfaces.

Other and further objects and advantages of the present invention should become apparent from an examination of the drawing and accompanying description.

In the drawing and accompanying description a preferred embodiment of the present invention is shown and described but it is to be understood that the drawing and accompanying description are for the purpose of illustration only and do not limit the invention and that the invention will be defined by the appended claims.

In the drawing, FIG. 1 is a plan view of one embodiment of thermally-responsive circuit-breaking device that is made in accordance with the principles and teachings of the present invention.

FIG. 2 is an elevational view of the right-hand end



of the thermally-responsive circuit-breaking device of FIG. 1,

FIG. 3 is a sectional view, on a larger scale, through the thermally responsive circuit-breaking device of FIG. 1, and it is taken along the plane indicated by the line 3—3 in FIG. 1,

FIG. 4 is a sectional view, on the scale of FIG. 3, through the thermally-responsive circuit-breaking device of FIG. 1, and it is taken along the plane indicated by the line 4—4 in FIG. 3, and

FIG. 5 is an exploded view of the thermally-responsive circuit-breaking device.

Referring to the drawing in detail, the numeral **10** generally denotes the housing for the thermally-responsive circuit-breaking device provided by the present invention. That housing is made of insulating material; and it has a vertically-directed passage **12** through it adjacent the left-hand end thereof, as that housing is viewed in FIG. 3. The housing **10** has a second vertically-directed passage **14** through it; and that passage is located adjacent the right-hand end of that housing, as that housing is viewed in FIG. 3. A cylindrical recess **16** is formed in the housing **10**, and that recess extends upwardly from the bottom of that housing. A recess **18** is formed in the housing **10** intermediate the recess **16** and the passage **12**; and a recess **20** is formed in that housing intermediate the recess **16** and the passage **14**.

A contact **22** has a large, generally-flat upper surface, and also has a downwardly-extending leg **24**. That downwardly-extending leg is disposed within the passage **12**; and the bottom of that leg extends downwardly into an opening in a terminal **30**. The bottom of that leg will be suitably secured to that terminal, as by solder **34**. The generally-flat upper surface of the contact **22** extends to the right from the downwardly-extending leg **24**, and it partially overlies the recess **18** in the housing **10**. That contact is made from a highly-conductive metal such as copper.

The numeral **26** denotes a second contact which has a generally-flat upper surface, and also has a downwardly-extending leg **28**. That downwardly-extending leg is disposed within the passage **14**; and the bottom of that leg extends downwardly into an opening in a terminal **32**. The bottom of that leg will be suitably secured to that terminal, as by solder **36**. The generally-flat upper surface of the contact **26** extends to the left from the downwardly-extending leg **28**, and it partially overlies the recess **20** in the housing **10**. That contact is made from a highly-conductive metal such as copper. As indicated by the drawing, the generally-flat upper surfaces of the contacts **22** and **26** are substantially coplanar.

The numeral **38** denotes a bridging contact which is generally flat and which is longer than the distance between the confronting edges of the generally-flat upper surfaces on the contacts **22** and **26**. As a result, the ends of that bridging contact overlie, and can abut, the generally-flat upper surfaces of the contacts **22** and **26**. The areas of contact between the bridging contact **38** and the generally-flat upper surfaces of the contacts **22** and **26** are large enough to enable substantial amounts of current to flow through that bridging contact and through those stationary contacts without generating appreciable amounts of heat. A small projection **40** is provided intermediate the ends of the bridging contact **38**; and that projection extends downwardly into a helical compression spring **42** which is disposed within the recess **16** in the housing **10**. The unstressed length of the helical compression spring **42** is considerably longer than the vertical dimension of the recess **16**, but that helical compression spring can be compressed to fit wholly within that recess. The projection **40** coacts with the turns of the helical compression spring 42 to help position the bridging contact 38 lengthwise of the housing 10.

A small quantity 44 of heat-softenable material is used to bond the left-hand end of the bridging contact 38 to the generally-flat upper surface of the contact 22; and a small quantity 46 of heat-softenable material is used to bond the right-hand end of that bridging contact to the generally-flat upper surface of the contact 26. The contacts 22 and 26 and the bridging contact 38 will preferably be held within a jig or fixture while the temperatures of those contacts are raised to the level at which the heat-softenable material will bond to those contacts. Portions of the underface of the bridging contact 38 will directly abut portions of the generally-flat upper surfaces of the contacts 22 and 26; and hence the heat-softenable material which flows into position between that underface and those generally-flat upper surfaces will be in the form of very thin films. Such films will add very little resistance to the electrical path from terminal 30 through contact 22, contact 38, and contact 26 to terminal 32; and hence that path will essentially be a highly-conductive path. Such a path will generate substantially no heat, even when the thermally-responsive circuit-breaking device shown in the drawing is carrying its rated current. This is important; because it will enable that thermally-responsive circuit-breaking device to respond substantially wholly to externally applied heat and to be substantially insensitive to the heat which is generated by the current flowing through it.

A cover 48 is provided for the top of the housing 10, and that cover is preferably made of metal. Such a cover will fully protect the internal parts of the thermally-responsive circuit-breaking device from injury. Also, that cover can be disposed in heat-transferring relation with the device or mechanism which is to be protected by the thermally-responsive circuit-breaking device, and that cover can transmit heat from that device or mechanism to the air within the housing 10. As that air becomes heated, the small quantities 44 and 46 of heat-softenable material will become heated. In the event the temperatures of the small amounts 44 and 46 of heat-softenable material rise to the softening temperature of that material, the spring 42 will be able to force the bridging contact 38 upwardly and away from the generally-flat upper surfaces of the contacts 22 and 26. The resulting breaking of the circuit through the thermally-responsive circuit-breaking device will interrupt the circuit to the device or mechanism with which that thermally-responsive circuit-breaking device is associated, and will thereby prevent injury to that device or mechanism.

The generally-flat upper surfaces on the contacts 22 and 26 are important because they make it possible for the underface of the bridging contact 38 to directly abut those contacts. Those generally-flat upper surfaces also are important because they are wider and longer than the ends of the bridging contact 38, and thus enable the quantities 44 and 46 of heat softenable material to flow away from, rather than pile up at, the junctions between the bridging contact 38 and the contacts 22 and 26, as those quantities are being heated during the fabricating of the thermally-responsive circuit-breaking device. If those quantities of heat-softenable material were permitted to pile up at the junctions between the bridging contact 38 and the contacts 22 and 26, those quantities of heat-softenable material might subsequently tend to form string-like portions as the movable contact 38 was moved upwardly by the helical compression spring 42 when those quantities of heat-softenable material became softened. However, because the generally-flat upper surfaces of the contacts 22 and 26 enable the quantities 44 and 46 of heat-softenable material to flow away from, rather than pile up at, the junctions between the bridging contact 38 and the contacts 22 and 26, as those quantities are being heated during the fabricating of the thermally-responsive circuit-breaking device, the tendency of those quantities of heat-softenable material to form string-like portions will be reduced. Further, the maximum lengths which those string-like portions could attain would be too short to interfere with the opening of the circuit as the bridging contact 38 was moved upwardly.

The thermally-responsive circuit-breaking device provided by the present invention can carry a surprisingly-large value of current and still be substantially insensitive to the heat generated by the current flowing through it. Thus, a preferred embodiment of the thermally-responsive circuit-breaking device shown in FIG. 1 can carry as much as fifty amperes on a steady-state basis and can still be substantially insensitive to the heat generated by the current flowing through it, although the cross sectional area of the bridging contact of that embodiment is only two thousandths of a square inch. In that embodiment, that bridging contact is forty thousandths of an inch wide and fifty thousandths of an inch thick; and each of the fixed contacts 22 and 26 is forty thousandths of an inch thick and is eighty-two thousandths of an inch wide—more than twice as wide as the bridging contact 38. The housing for that embodiment is quite small—being only three-eighths of an inch deep, one-quarter of an inch wide, and one and five thirty-seconds of an inch long; and hence that embodiment is compact. Yet, that embodiment of thermally-responsive circuit-breaking device safely opens the circuit when that circuit is carrying fifty and more amperes; and it responds substantially wholly to externally-generated heat even when it is carrying as much as fifty amperes on a steady-state basis.

As shown particularly by FIG. 5, the terminals 30 and 32 have cruciform openings therein; and the arms of those openings can receive the downwardly-extending legs 24 and 28 of the contacts 22 and 26 and can prevent rotation of those terminals relative to those downwardly-extending legs. Also, those cruciform openings will prevent rotation of those terminals relative to those downwardly-extending legs even if the terminals 30 and 32 are initially displaced ninety degrees or one hundred and eighty degrees from the positions shown by FIG. 1.

After the bridging contact 38 has been bonded to the stationary contacts 22 and 26, and the ends of the downwardly-extending legs 24 and 28 have been set within the cruciform openings in the terminals 30 and 32, the lower ends of those legs will be staked, riveted over, or otherwise forced into direct and intimate engagement with those terminals. As a result, the solder 36 which is subsequently applied to the terminals 30 and 32 cannot materially increase the resistance of the path through the thermally-responsive circuit-breaking device.

Whereas the drawing and accompanying description have shown and described a preferred embodiment of the present invention, it should be apparent to those skilled in the art that various changes may be made in the form of the invention without affecting the scope thereof.

What I claim is:

1. A thermally-responsive circuit-breaking device that comprises:

(a) a housing of insulating material,
(b) a contact of highly-conductive material disposed within said housing,
(c) said contact having a generally-flat upper surface,
(d) a second contact of highly-conductive material disposed within said housing,
(e) said second contact having a generally-flat upper surface,
(f) said second contact being spaced from the first said contact,
(g) said contacts being fixedly secured to said housing,
(h) a bridging contact that is generally flat and that has the ends thereof overlying and being coextensive with portions of said generally-flat upper surfaces of said fixed contacts,

(i) said ends of said bridging contact directly engaging said portions of said generally-flat upper surfaces of said fixed contacts to provide two spaced-apart surface-to-surface areas of direct engagement between said bridging contact and said generally-flat upper surfaces of said fixed contacts,
(j) means biasing said ends of said bridging contact away from said portions of said generally-flat upper surfaces of said fixed contacts, and
(k) small quantities of electrically-conductive heat-softenable material that directly engage said ends of said bridging contact and said portions of said generally-flat upper surfaces of said fixed contacts to normally hold said ends of said bridging contact and said portions of said generally-flat upper surfaces of said fixed contacts in said direct engagement and against relative movement and that electrically bond said ends of said bridging contact to said portions of said generally-flat upper surfaces of said fixed contacts,
(l) said fixed contacts and said bridging contact normally being held in assembled relation to define a highly-conductive path which has only two film-like portions of heat-softenable material,
(m) whereby said thermally-responsive circuit-breaking device can respond almost wholly to externally-applied heat and is substantially insensitive to the heat generated by the current passing through it,
(n) said bridging contact being stiff and remaining substantially unbent despite the forces applied thereto by said biasing means while said small quantities of heat-softenable material hold said ends of said bridging contact in engagement with said portions of said generally-flat upper surfaces of said fixed contacts,
(o) said bridging contact experiencing substantially no change in the shape or configuration thereof as said bridging contact responds to said biasing means to move away from said portions of said generally-flat upper surfaces of said fixed contacts as said small quantities of heat-softenable material soften.

2. An electrical device that comprises:
(a) a housing of insulating material,
(b) a contact fixedly secured within said housing,
(c) said contact having a generally-flat upper surface disposed within said housing,
(d) a second contact fixedly secured within said housing,
(e) said second contact having a generally flat upper surface disposed within said housing,
(f) said generally-flat upper surfaces of the first said and said second fixed contacts being spaced apart,
(g) at least one of said contacts having a portion of generally rectangular cross section extending from said housing,
(h) a terminal secured to the first said fixed contact, and
(i) a second terminal secured to said second fixed contact,
(j) at least one of said terminals having a cruciform opening therein,
(k) the arms of said cruciform opening being adapted to receive said portion of said one contact and to prevent relative rotation between said one terminal and said one contact,
(l) said cruciform opening permitting said contact to be initially disposed, relative to said one terminal, in any one of several positions that are displaced ninety degrees or one hundred and eighty degrees from each other,
(m) a bridging contact that is generally flat and that has the ends thereof overlying and being coextensive with portions of said generally-flat upper surfaces of said fixed contacts,
(n) said ends of said bridging contact directly engaging said portions of said generally-flat upper surfaces of said fixed contacts,



(o) means biasing said ends of said bridging contact away from said portions of said generally-flat upper surfaces of said fixed contacts, and
(p) small quantities of electrically-conductive heat-softenable material that directly engage said ends of said bridging contact and said portions of said generally-flat upper surfaces of said fixed contacts to normally hold said ends of said bridging contact and said portions of said generally-flat upper surfaces of said fixed contacts in said direct engagement and against relative movement.

3. A thermally-responsive circuit-breaking device that comprises:
(a) a housing of insulating material,
(b) a contact of highly-conductive material disposed within said housing,
(c) said contact having a generally-flat upper surface,
(d) a second contact of highly-conductive material disposed within said housing,
(e) said second contact having a generally-flat upper surface,
(f) said second contact being spaced from the first said contact,
(g) said contacts being fixedly secured to said housing,
(h) a bridging contact that is generally flat and that has the ends thereof overlying and being coextensive with portions of said generally-flat upper surfaces of said fixed contacts,
(i) said ends of said bridging contact directly engaging said portions of said generally-flat upper surfaces of said fixed contacts to provide two spaced-apart surface-to-surface areas of direct engagement between said bridging contact and said generally-flat upper surfaces of said fixed contacts,
(j) means biasing said ends of said bridging contact away from said portions of said generally-flat upper surfaces of said fixed contacts,
(k) small quantities of electrically-conductive heat-softenable material that directly engage said ends of said bridging contact and said portions of said generally-flat upper surfaces of said fixed contacts to normally hold said ends of said bridging contact and said portions of said generally-flat upper surfaces of said fixed contacts in said direct engagement and against relative movement, and that electrically bond said ends of said bridging contact to said portions of said generally-flat upper surfaces of said fixed contacts,
(l) said fixed contacts and said bridging contact normally being held in assembled relation to define a highly-conductive path which has only two film-like portions of heat-softenable material,
(m) whereby said thermally-responsive circuit-breaking device can respond almost wholly to externally-applied heat and is substantially insensitive to the heat generated by the current passing through it,
(n) said housing having one side thereof open, and said fixed contacts and said bridging contact confronting and being adjacent to said open side of said housing, and
(o) a cover for said housing that overlies and closes said open side of said housing,
(p) said cover being made of metal and being disposable in direct engagement with the mechanism to be protected by said thermally-responsive circuit-breaking device,
(q) said cover protecting said bridging contact and said fixed contacts of said thermally-responsive circuit-breaking devices but transmitting heat from said mechanism to the air within said housing and thus to said fixed contacts and said bridging contact to enable the heat transmitted from said mechanism by said cover to be promptly and directly transmitted to said fixed contacts and to said bridging contact.

4. A thermally-responsive circuit-breaking device that comprises:

(a) a housing of insulating material,
(b) a contact of highly-conductive material disposed within said housing,
(c) said contact having a generally-flat upper surface,
(d) a second contact of highly-conductive material disposed within said housing,
(e) said second contact having a generally-flat upper surface,
(f) said second contact being spaced from the first said contact,
(g) said contacts being fixedly secured to said housing,
(h) a bridging contact that is generally flat and that has the ends thereof overlying and being coextensive with portions of said generally-flat upper surfaces of said fixed contacts,
(i) said ends of said bridging contact directly engaging said portions of said generally-flat upper surfaces of said fixed contacts,
(j) means biasing said ends of said bridging contact away from said portions of said generally-flat upper surfaces of said fixed contacts, and
(k) small quantities of heat-softenable material that normally hold said ends of said bridging contact and said portions of said generally-flat upper surfaces of said fixed contacts against relative movement,
(l) said fixed contacts and said bridging contact normally being held in assembled relation to define a highly-conductive path which has only two film-like portions of heat-softenable material,
(m) whereby said thermally-responsive circuit-breaking device can respond almost wholly to externally-applied heat and is substantially insensitive to the heat generated by the current passing through it.



(n) said generally-flat upper surfaces of said fixed contacts being wider and longer than said ends of said bridging contact to enable said quantities of heat-softenable material to flow away from, rather than pile up adjacent to, said bridging contact when said fixed contacts and said bridging contact become heated to the point where said heat-softenable material softens,
(o) said generally-flat upper surfaces of said fixed contacts being substantially co-planar,
(p) said ends of said bridging contact being substantially coplanar with said generally-flat upper surfaces of said fixed contacts whereby said ends of said bridging contact will coact with said portions of said generally-flat upper surfaces of said fixed contacts to provide two co-planar spaced-apart surface-to-surface areas of direct engagement between said bridging contact and said fixed contacts.

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