

PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in Current Responsive Actuating Devices

We, GENERAL ELECTRIC COMPANY, a corporation organised and existing under the laws of the State of New York, United States of America, of 1 River Road, Schenectady 5, New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to electric current responsive actuating devices for use in electric circuit breakers.

In such devices including thermal current responsive means, it is common practice to support the current responsive means on the inner end of a terminal strip member, the outer end of which also serves to make connection to an external conductor or wire of a circuit to be protected. Calibration of the device is accomplished by adjusting the position of the bimetallic strip. This is done by adjusting a screw which acts on the inner end of the terminal strap and bends the end with respect to the fixed portion of the strap.

The labor involved in the calibration of such devices at the time they are manufactured constitutes a significant part of the cost of manufacturing such devices. Prior devices have exhibited certain disadvantageous characteristics as regards the calibration process. Thus, for example, after calibration it is sometimes found that the adjustment or calibration of the device changes after a few hours or days. Such "calibration drift" is believed to be due primarily to the mounting of the aforesaid terminal strap. For example, such terminal straps are ordinarily anchored to the insulating casing of the device by means of a clamping screw which stresses the insulating material, ordinarily in compression, as well as stressing the material of the screw itself. In particular, the insulating material

directly under the head of the screw is placed under extremely high compressive force such, for example, as 5,000 pounds per square inch. Although generally accepted standard grades of insulating material, such as a general purpose phenolic molding compound, are used for such casings, it is often found that because of the high pressures exerted by such a mounting screw, the material changes its dimensions with the lapse of time. Since the adjustment of the calibration of the device is accomplished by bending a portion of the terminal strap, the change in dimension of the casing material at the point of the mounting screw causes a change in the stresses in the terminal strap, with a corresponding slight change in the position of the adjusted end.

A second major problem presented by devices of the prior art in this connection has to do with changes of such calibration after the circuit breaker in which the device is used has been put into use. In the process of connecting an electrical conductor to the outer end of the terminal strap which supports the bimetallic strip or other current responsive member, it has been found that pressures exerted on the clamping screw and on the end of the terminal strap during the process of connecting the conductor may bodily move or bend the terminal strap, causing changes in the position of the inner end and therefore destroying the accuracy of calibration. A second source of difficulty is that after a conductor has been connected to the outer end of the terminal strap, forces exerted on the conductor, such as by bending it to force it into position in an enclosing box along with other wires, etc., substantial forces are also exerted on the terminal strap which may cause slight changes in its position and therefore destroy the accuracy of calibration.

It is an object of the present invention to provide an electric current responsive actuat-

[Price 4s. 6d.]

ing device for use in electric circuit breakers and so constructed as to mitigate the above disadvantages when incorporated into a circuit breaker.

According to the present invention there is provided an electric current responsive actuating device including an insulating casing, an actuating member mounted in said insulating casing, a supporting member mounted in said insulating casing, said supporting member comprising an elongated strip of metallic material, said metallic strip having an intermediate portion fixedly mounted on said insulating casing and a first end portion spaced from said intermediate portion, an elongated strip of bimetallic material having one end thereof fixedly mounted on said first end portion of said metallic strip and having its other end in engagement with said actuating member, wherein means is provided in said casing for adjustably positioning said bimetallic strip provided with means for exerting a force on said first end of said metallic strip to bend said metallic strip at a bend point between said first end portion and said intermediate portion, said strip having a reduced cross-section at said bend point, whereby said metallic strip bends substantially only at said bend point upon adjusting movement of said first end, and means for heating said bimetallic strip in accordance with the electrical current passing through said device.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:—

FIGURE 1 is a side elevation view of an electric circuit breaker incorporating a device according to the invention, one half of the insulating enclosing case being omitted to show the parts;

FIGURE 2 is an end elevation view of the circuit breaker of FIGURE 1, the enclosing casing being shown complete;

FIGURE 3 is an exploded perspective view of portions of the load terminal supporting strap and wire connecting means;

FIGURE 4 is a perspective view of the wire connecting member of the circuit breaker of FIGURE 1, the clamping screw being omitted;

FIGURE 5 is an end elevation view of the wire connecting means of the circuit breaker of FIGURE 1 shown with a stranded conductor in clamped condition therein; and

FIGURE 6 is a fragmentary side elevation view of a portion of a circuit breaker incorporating another embodiment of the invention.

In the drawing, the invention is shown in FIGURE 1 as incorporated in an electric circuit breaker including an insulating casing 10, comprising a generally tray-shaped body portion 10A and a generally planar cover

10B (see FIGURE 2).

As shown in FIGURE 1, the parts of the circuit breaker are retained in generally conforming recesses in the body portion 10A, and include a line terminal socket member 11 having an integral extension 11A supporting a relatively stationary contact 12. A movable contact 13 is mounted on a contact arm 14 which in turn is pivotally supported at 15 on an insulating handle member 16.

The handle member 16, which is pivotally supported in the insulating casing at 17, may be manually rotated about its pivotal support to move the pivot point 15 of the contact arm 14 back and forth across the line of action of a tension type spring 18. The spring 18 has one end connected to the contact arm 14 and the other end connected to an intermediate point of a releasable support member 19. This causes the contact arm 14 to move between open circuit position as shown in full lines in FIGURE 1 and closed circuit position as shown in dotted lines in FIGURE 1, with a snap action. The tension spring 18 exerts a force downwardly as viewed in FIGURE 1 on the intermediate portion of the releasable member 19, tending to rotate it clockwise about its pivotal support 20 in the insulating casing. The releasable member 19 is normally prevented from rotating clockwise, however, by engagement of a latchable portion 21 thereof with a latch projection 22 carried by a combined armature-latch member 23.

The armature-latch member 23 is rotated about its pivotal support 24 in the insulating casing by the movable end portion 25 of a current responsive member comprising an elongated bimetallic strip 26. The armature-latch member 23 is biased toward latching position at all times by means of a compression spring 27 acting between the end portion of the member 23 and the insulating casing, as shown in FIGURE 1. The contact arm 14 is connected to the movable end 25 of the bimetallic strip 26 by means of a flexible conductor or braid 28.

On the occurrence of extremely high overloads or short-circuit currents, the magnetic piece 29 carried by an intermediate portion of the bimetallic strip 26 is energized by the flux associated with current passing through the bimetallic strip and causes the pole portions thereof to attract the armature-latch member 23 to causing tripping. The strip 26 is supported in the casing 10 by having one end thereof rigidly attached by suitable means such as by welding to a first end 30 of an elongated terminal strap 31. The terminal strap 31 is anchored to a wall portion 10C of the casing body 10A by means of a screw 32. The outer end of the strap 31 carries a generally tubular wire connecting member 34 having a clamping screw 35 threadedly engaged therein.

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portion 37 which is turned up at right angles to the adjacent portion of the strap and which includes outwardly directed lug portions 38 which are received in correspondingly shaped pockets or recesses 39 (see FIGURE 3) in the body 10A and the cover 10B of the insulating casing 10 respectively.

The lower end of screw 35 bears on the outer end portion of strap 31. As the screw 35 is turned inwardly, the tubular member 34 rides upwardly with respect to the strap 31, guided in the recess 34A and clamps a conductor between the bottom wall of the tubular member and the under surface of the strap 31, as shown particularly in FIGURE 5. In addition to its function of more rigidly supporting the end of the strap 31, the bent-up end portion 37 serves to prevent the insertion of a conductor on the wrong side (i.e. at the top) of the strap 31.

The tubular member 34 is constructed as shown particularly at FIGURES 4 and 5 and comprises a single piece wrapped around to form a tubular body, with the end 34B extending through an opening 34C. The end 34B is generally T-shaped and the opening 34C has a reduced portion, so that portions 34B' of the end 34B overlap portions of the body adjacent the reduced portion as shown in FIGURE 4. This interlocking construction greatly strengthens the piece against pull-apart forces.

The inner end 30 of the terminal strap 31 is adjustably positioned by means of a calibrating screw 40 which is threadedly received in a nut 41 trapped in the casing 10.

Current Responsive Element Mounting and Operation

As previously noted, the bimetallic strip 26 is rigidly attached to the end 30 of the terminal strap 31 by suitable means such as by welding. Passage of current through the bimetallic strip 26 causes it to warp so as to move the movable end thereof to the right as viewed in FIGURE 1, which in turn engages the return bent portion 23A of the armature-latch member 23 and rotates the armature-latch member 23 about its pivotal support 24 and disengages the latch projection 22 from the end 21 of the releasable member 19. The "calibration" or adjustment of the circuit breaker which determines the amount of current required to cause release of the latch 22 or "tripping" is determined by the positioning of the bimetallic strip 26.

In accordance with the invention, the terminal strap 31 which supports the bimetallic strip 26 is constructed and mounted in such a way as to greatly reduce the likelihood of any changes of position of the bimetallic strip occurring such as to affect the calibration of the circuit breaker after initial adjustments. For this purpose, the strap 31 is provided with a rectangular hole or cut-out 45 adjacent

the end 30. See FIGURE 3. In addition, a second rectangular hole or cut-out 46 is provided between the intermediate portion 42 of the strap 31 and the end portion 43, as shown in FIGURE 3. In addition, the central portion 42 is strengthened by the provision of an embossed rib 47 therein extending through the portion thereof in which the tapped hole 48 is provided for the screw 32.

The cut-out portion 45, together with the reinforcing embossed rib 47 assures that the bending which occurs when the calibrating screw 40 is turned inwardly against the surface 30A of the end 30, takes place at a predetermined, localized and controllable area of the strap 31. In particular, this structure assures that such bending will not take place adjacent the hole 48 in the intermediate portion 42 of the terminal strap. Bending adjacent the hole 48 of the central portion 42 would be undesirable for two reasons: (1) the amount of such bending would be difficult to predict and control, and (2) any bending in this area would set up stresses which would be relieved to some extent should there be any loosening of the screw 32, or change in the dimensions of the portion of the casing clamped between the strap 31 and the head of the screw 32.

The cut-out portion 46 similarly assures that forces exerted on the outer end of the strap 31 will not be transmitted to the rest of the strap.

As previously mentioned, the likelihood that forces exerted on the screw 35 in clamping a conductor in place, or forces exerted by such a conductor itself when bending it, etc., is greatly reduced by the bent-up portion 37 having lugs 38 which are received in pockets 39. This firmly supports the outermost end of the strap 31 and supports it directly adjacent the part on which most force is likely to be exerted.

If desired, the strap 31 may be weakened for the purposes indicated by reducing its thickness at the bend area, such as by provision of a notch as shown at 131A in the embodiment of FIGURE 6. This has the advantage of reducing the stiffness of the strap at this point to a greater degree for a given reduction of cross-sectional area than the construction of FIGURE 1. This is because a reduction of thickness reduces the "moment of inertia" much more than a reduction in width. The structure shown in FIGURES 1-3 is preferred, however, in the application illustrated since it is easier to control to accurate dimensions.

WHAT WE CLAIM IS:—

1. An electric current responsive actuating device including an insulating casing, an actuating member mounted in said insulating casing, a supporting member mounted in said insulating casing, said supporting member

portion 37 which is turned up at right angles to the adjacent portion of the strap and which includes outwardly directed lug portions 38 which are received in correspondingly shaped pockets or recesses 39 (see FIGURE 3) in the body 10A and the cover 10B of the insulating casing 10 respectively.

The lower end of screw 35 bears on the outer end portion of strap 31. As the screw 35 is turned inwardly, the tubular member 34 rides upwardly with respect to the strap 31, guided in the recess 34A and clamps a conductor between the bottom wall of the tubular member and the under surface of the strap 31, as shown particularly in FIGURE 5. In addition to its function of more rigidly supporting the end of the strap 31, the bent-up end portion 37 serves to prevent the insertion of a conductor on the wrong side (i.e. at the top) of the strap 31.

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In accordance with the invention, the terminal strap 31 which supports the bimetallic strip 26 is constructed and mounted in such a way as to greatly reduce the likelihood of any changes of position of the bimetallic strip occurring such as to affect the calibration of the circuit breaker after initial adjustments. For this purpose, the strap 31 is provided with a rectangular hole or cut-out 45 adjacent

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WHAT WE CLAIM IS:—

1. An electric current responsive actuating device including an insulating casing, an actuating member mounted in said insulating casing, a supporting member mounted in said insulating casing, said supporting member



comprising an elongated strip of metallic material, said metallic strip having an intermediate portion fixedly mounted on said insulating casing and a first end portion spaced from said intermediate portion, an elongated strip of bimetallic material having one end thereof fixedly mounted on said first end portion of said metallic strip having its other end in engagement with said actuating member, wherein means is provided in said casing for adjustably positioning said bimetallic strip provided with means for exerting a force on said first end of said metallic strip to bend said metallic strip at a bend point between said first end portion and said intermediate portion, said strip having a reduced cross-section at said bend point, whereby said metallic strip bends substantially only at said bend point upon adjusting movement of said first end, and means for heating said bimetallic strip in accordance with electrical current passing through said device.

2. A device as claimed in claim 1 wherein said metallic strip includes a reinforcing means at said intermediate portion resisting bending movement of said intermediate portion.

3. A device as claimed in claims 1 or 2 wherein said metallic strip is weakened between said second end portion and said intermediate portion whereby forces exerted on

said second end of said metallic strip cause bending if said metallic strip substantially exclusively at said portion between said end portion and said intermediate portion.

4. An electric current responsive actuating device as set forth in claim 3 wherein said second end portion includes a terminal portion bent at right angles to the main portion of said end portion, said bent portion including a pair of outwardly directed lugs received in corresponding recesses in said insulating and supporting said metallic strip at its outer most end portion.

5. A device as claimed in any one of the above claims wherein said adjustable positioning means comprises a calibrating screw threadedly carried in said casing and bearing on said first end portion of said metallic strip.

6. An electric current responsive actuating device substantially as described with reference to the accompanying drawings.

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