March 26, 1957 R. T. CASEY 2,786,917

CIRCUIT BREAKER TRIP DEVICE

Filed June 4, 1954

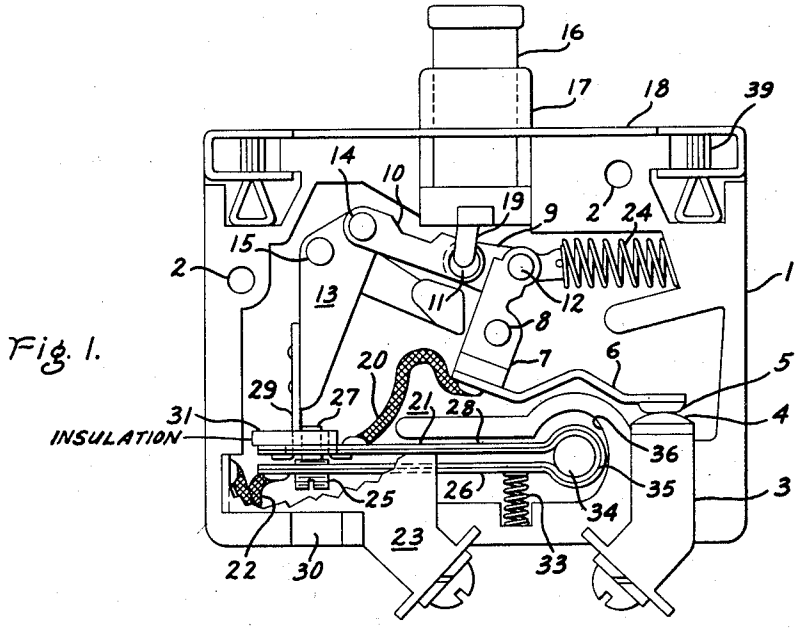


Fig. 1.

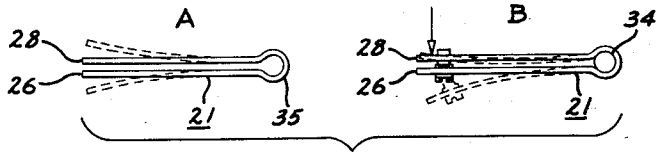


Fig. 2.

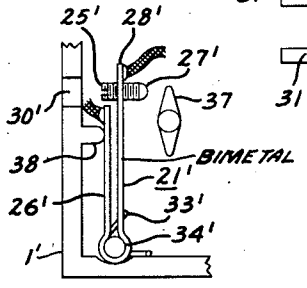


Fig. 3.

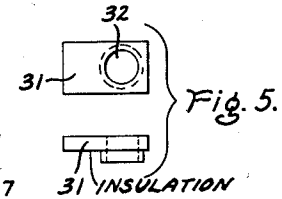


Fig. 5.

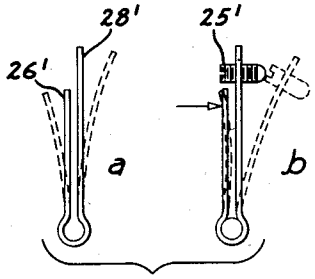


Fig. 4.

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# CIRCUIT BREAKER TRIP DEVICE

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Application June 4, 1954, Serial No. 434,529
8 Claims. (Cl. 200—116)

My invention relates to current responsive overload or trip devices for electric circuit breakers, and, more particularly, to trip devices of the bimetallic strip type.

One object of my invention is to provide a trip device for use in circuit breakers which is very sensitive, that is, which yields a large amount of movement in response to a comparatively small current.

Another object of my invention is to provide such a sensitive trip device which is also capable of withstanding large short-circuit currents.

It is another object of my invention to provide a trip device which can be "pre-calibrated" or set to cause tripping at a given temperature or current before it is assembled in the circuit breaker, and can also be readjusted after assembly in the breaker.

Another object of my invention is the provision of such a current responsive device which has a magnetic "instantaneous" tripping action on high overloads as well as a thermal or "delayed" tripping action on low and intermediate overloads.

In carrying out my invention in one form, I provide a trip device comprising two parallel, closely spaced, generally co-extensive, bimetallic arms, joined at one end to form a U. One of the bimetallic arms carries a latch projection adjacent its free end, which is adapted to cause release of a releasable member of the circuit breaker operating mechanism. The bimetal assembly is pivotally supported as a whole in the breaker casing at its connected end, and is biased for rotation about its pivotal support. The other bimetallic arm engages a stop at or adjacent its free end to limit such pivotal movement. The said free ends tend to move in opposite directions upon heating, whereby the usable movement of the said latch projection is proportional to the sum of the deflection of both of said arms.

Further objects and advantages of my invention will become apparent from the following description, reference being had to the accompanying drawing, and its scope will be pointed out in the appended claims.

Figure 1 is a side view of a circuit breaker incorporating my invention, the side cover being removed and the mechanism being shown in the "on" position.

Figure 2 is a view of the bimetal construction of the device of Figure 1 as it appears when heated in a free-standing condition, and also when heated in its assembled condition.

Figure 3 is a fragmentary side elevation view of a modified form of my invention.

Figure 4 is a view of the bimetal of Figure 3 as it appears when heated in a free condition and also when heated in its assembled condition.

Figure 5 is a top and side view of the insulating collar 31 of Figure 1.

For the purpose of illustrating my invention, I have shown embodiments thereof in a manually operable automatic circuit breaker adapted to operate in response to predetermined conditions of abnormal current flow through the circuit breaker. As far as my invention is concerned, many different types of circuit breaker mechanisms may be used but I have shown it applied to a manually operable, trip-free air circuit breaker such as that disclosed, for example, in Patent 2,673,267, R. N. Rowe, granted March 23, 1954, and assigned to the same assignee as the instant application.



Referring to the drawings more specifically, I have shown my invention incorporated in a circuit breaker comprising an open-sided insulating casing 1, having recesses therein for receiving and retaining the parts to be described, the said parts being held in place by an insulating cover (not shown) adapted to be secured by bolts or rivets passing through the holes 2.

The housing is provided with a metal top-plate 18 having return-bent end portions which seat in slots (not shown) in the housing. Within the return-bent end portions are disposed threaded stop-nuts 39, adapted to receive bolts (not shown) for mounting the circuit protector upon a panel or the like. The aforesaid mounting means including top-plate 18 and stop-nuts 39 forms a portion of the subject matter disclosed and claimed in Patent Number 2,761,937 issued September 4, 1956 to E. A. Ericson, and assigned to the same assignee as the instant application.

The circuit breaker further comprises a line terminal 3, having a stationary contact 4 mounted on its inner end, and a load terminal 23, electrically connected to a movable contact 5 in a manner to be described.

The circuit breaker operating mechanism is more fully described in Patent Number 2,673,267, issued March 23, 1954, to R. N. Rowe et al. and assigned to the same assignee as the present invention, and will be only briefly described herein. As described in the above patent, the operating mechanism comprises a movable contact-arm assembly including an arm 7 pivotally supported on pin 8 in the casing 1, and a resilient contact arm 6 fixedly attached thereto which carries the said movable contact 5 at its outer end.

To provide for movement of arm 7 about its pivot between open and closed circuit positions, there is provided a toggle linkage made up of links 9 and 10, one end of the said linkage being connected to arm 7 by pin 12, and the other end being connected by pin 14 to releasable member 13, pivotally supported in the casing by pin 15. The said toggle linkage is adapted to be moved between straightened and collapsed positions by a rectilinearly movable handle member 16 connected to the midpoint 11 of toggle linkage by means of a swinging bale 19.

A compression spring 24 anchored to an extension of link 9, constantly urges arm 7 counterclockwise or toward open-circuit position. Upon release of releasable member 13 from the latch screw 25 (to be described) the compression spring 24 moves the straightened toggle linkage endwise to the left as viewed in Figure 1, rotating both arm 7 and releasable member 13 in the counterclockwise direction to open position. If the handle 16 is not restrained, the spring 24 will thereafter cause automatic resetting or return of latch 13 to its original position by reason of the fact that as arm 7 moves to its open or counterclockwise position, spring 24 moves link 9 clockwise about its pivot 12, moving the toggle-linkage 9—10 to its upwardly collapsed position drawing pivot pin 14 to the right and returning releasable member 13 clockwise to its relatched condition.

In order to hold the latch arm 13 in its normal or latched position and release it upon the occurrence of predetermined electrical conditions, I provide a trip device comprising a generally U-shaped bimetal strip 21, having two closely-spaced, parallel, generally coextensive arms 26 and 28, connected by an arcuate bight 35, and pivotally supported in the housing 1, on a cylindrical boss 34 formed in the casing 1. The U-shaped bimetal strip 21 is constructed so that the high expansion side of each of the arms 26 and 28 is on the inside of the "U," facing the other. A portion 36 of the casing 1 is formed to provide a bearing surface against which the outer surface of the bight 35 is adapted to bear. An adjustable

latching screw 25 is threadedly engaged in one arm 26 of the bimetal and has an extension 27 which projects through an opening provided in the opposite arm 28 of the bimetal 21. The projecting portion of the latching screw 25 is adapted to engage and restrain a latching tip 29 carried by latch arm 13. An opening 30 is provided in the bottom wall of the casing, and permits access to the screw 25 after assembly of the retaining side cover.

A flexible conductive braid 22 is attached to the free end of the arm 26 by suitable means, as by welding or brazing. The other end of braid 22 is similarly joined to load terminal 23. A second flexible conductive braid 20 electrically connects the free end of arm 28 to the resilient contact arm 6. The bimetal arms 26 and 28 are therefore placed electrically in series with each other and with load terminal 23 and movable contact 5.

In order to insulate the extension 27 of calibrating screw 25, as well as the latching tip 29, from the arm 28 of the bimetal 21, I provide an insulating member 31 (see Figure 5) which is mounted in an opening in the outer end of the arm 28. The insulating member 31 also has an opening 32 through which the calibrating screw 25 projects. The entire U-shaped bimetal structure 21 is biased clockwise about the pivot 34 by means of compression spring 33, causing the insulating member 31 to bear against the end of latch tip 29.

The operation of my improved trip device will now be described. Upon the passage of current through the contacts 4 and 5, and thence through the bimetal 21, the bimetal is heated thereby and each of the arms 26 and 28 warps outwardly, away from the other. As will be readily seen, the deflection of arm 26 draws the calibrating screw 25 away from latch tip 29, thereby tending to cause release of the latch arm 13. In addition, the deflection of the arm 28 causes that arm to exert a force against the end of latch tip 29, and to transmit a reactive force to the remainder of the bimetal, causing the remaining portion of the bimetal to rotate slightly counterclockwise. This action causes a further withdrawal of the calibrating screw 25 away from latch tip 29 and also tends to cause release of the latch arm 13. Thus the deflection of each of the legs 26 and 28 is caused to be additive.

This action of the current responsive assembly will be more readily understood by reference to Figure 2. Figure 2A indicates the condition of such a bimetal when free to deflect without external restraint, the normal condition being indicated in solid lines and the heated position being shown in dotted lines. As will be seen from this figure, the amount of movement of the calibrating screw 25 with respect to the insulating collar 27 is equal to the total separation of the ends of the bimetal, or two times the deflection of either arm. Figure 2B indicates in exaggerated form the action of the bimetal when installed in a circuit breaker, the heated condition again being shown in dotted lines. As indicated in this figure, the bimetal will still tend to assume a condition, upon heating, similar to that shown in dotted lines in Figure 2(A). In this case, however, the end of arm 28 is restrained from deflecting upwardly and the bimetal as a whole is pivotally supported on boss 34. On heating, the bimetal therefore takes the position indicated in dotted lines.

In addition to the thermal action already described, my invention furnishes a tripping action due to magnetic forces generated by the current. This is made possible by the closely-spaced parallel arrangement of the arms 26 and 28 and the fact that the currents in the arms always travel in opposite directions. Upon occurrence of a short circuit, the two arms repel each other due to the interaction of the magnetic fields associated with the currents, causing calibrating screw 25 to be withdrawn instantaneously.

Because the amount of movement in a tripping direction provided by my improved current responsive device is twice the deflection of either arm, I may use a heavier bimetal strip for a given application, thereby providing larger thermal storage capacity and ability to withstand high short-circuit currents. Likewise, with a bimetal of given thickness I may provide tripping action at lower current values than otherwise obtainable.



Moreover, because of the fact that the two arm portions 26 and 28 are in closely-spaced, parallel arrangement, heat is not readily lost from the confronting surfaces, rendering the trip device more sensitive.

Another important feature of my invention as shown in Figure 1, is that it can be accurately "pre-calibrated" or set before assembly into the circuit breaker or other device. This is possible because with the arrangement shown, the collar 31 acts as a stop to limit the amount of latch engagement, which then is measured by the amount that the tip 27 of the latch screw 25 projects beyond the outer face of the collar 31. This can be accurately measured and set before the trip device is assembled in the circuit breaker housing. Due allowance can be made for the compressive effect of spring 33, or the actual spring to be used in the breaker can be used in a suitable fixture, to exert its force on the trip device as it is being pre-calibrated. The amount of projection is not thereafter affected by the mounting of the device in the casing, or by small variations in the dimensions of the casings or of the other parts mounted therein. In addition, the calibrating screw may be readjusted after complete assembly of the breaker if necessary by means of a screwdriver inserted through opening 30.

In the form shown in Figure 3, I have shown my invention applied to a circuit breaker in which the trip device must move a member (37), rather than hold a member, in order to cause automatic opening of the device.

In this form, the bimetal 21′ is similarly formed and supported for pivotal movement in a circuit-protector insulating casing 1′. The bimetal is biased counterclockwise by spring 33′ against a stop 38 provided in the casing which may be made adjustable. The calibrating screw 25′ is threadedly engaged in one arm 28′ of the bimetal, and the arm 26′ is made slightly shorter than arm 28′ in order to provide easier access to the calibrating screw 25′.

Deflection of the bimetal 21′ occurs in a manner similar to that of the bimetal 21, i. e., the ends of the bimetal strip deflect outwardly, away from each other the calibrating screw tip 27′ engaging the member 37 and moving it so as to cause tripping. The total movement of the calibrating screw tip 27′ is likewise equal to the sum of the deflections of either arm of the bimetal. This is because the deflection of arm 28′ moves the calibrating screw 25′, and in addition, the deflection of the arm 26′ causes a rotation of arm 28′ clockwise about the pivot 34′, causing further movement of the calibrating screw.

Figure 4(*a*) indicates the deflection of the bimetal of Figure 3 in the free-standing condition. Figure 4(*b*) indicates the deflection of the bimetal when assembled in a device as in Figure 3. As shown in Figure 4(*b*) the deflection of arm 28′ moves the calibrating screw 25′, and in addition, the deflection of arm 26′ rotates arm 28′ further in a clockwise direction, causing further movement of the calibrating screw.

On the occurrence of high short circuit currents magnetic forces cause or assist tripping in a manner similar to that described in connection with the form of Figure 1.

It will be seen that I have provided a current-responsive assembly that is simple and rugged in construction, and one which also furnishes a large amount of usable movement in response to small currents. At the same time, and without the addition of further parts, the device is also responsive to the magnetic effect of large

currents, and is presettable before assembly in a breaker as well as adjustable after assembly.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a thermally responsive electrical overload device, a bimetallic structure comprising a pair of actuating arms adapted to carry current therethrough extending in closely-spaced magnetically interacting relation in substantially parallel alignment with each other and connected together at one end thereof, means pivotally supporting said connected end of said structure, means biasing said structure for rotation about said pivotal support, and stop means engaging one of said actuating arms at a point remote from said connected ends for limiting said rotation to provide upon heating a cumulative movement of the other of said arms relative to said stop means derived from the movement of both said arms and trip actuating means carried by said other arm adjacent the free end thereof.

2. In a thermally responsive electrical overload device, a bimetallic structure comprising a pair of actuating arms adapted to carry current therethrough extending in closely-spaced magnetically interacting relation in substantially parallel flatwise alignment with each other, and connected together at one end thereof, means pivotally supporting said connected end of said structure, means biasing said structure for rotation about said pivotal support, adjustable stop means for limiting said rotation, and means for heating said bimetallic structure in response to current in a circuit to be controlled by said overload device, said adjustable stop means engaging one of said actuating arms at a point remote from said connected ends.

3. In a thermally responsive device for normally restraining a circuit-breaker trip member, a pair of bimetallic actuating arms extending in closely-spaced flatwise parallel alignment with each other, connecting means connecting said bimetallic actuating arms together at one end thereof so as to form a substantially rigid generally U-shaped structure, means pivotally supporting said U-shaped structure at said connecting means, a latch projection carried by the free end of one of said arms and extending to and beyond the other of said arms, the portion of said latch projection which extends beyond said other arm normally engaging and restraining said circuit breaker trip member, means biasing said U-shaped structure for rotation about said pivotal support and toward said trip member, said other arm engaging said trip member and limiting said rotation.

4. In a thermally responsive device for causing movement of a circuit breaker trip member, a pair of bimetallic actuating arms adapted to carry current therethrough extending in closely-spaced magnetically interacting relation in flatwise alignment with each other, said bimetallic actuating arms being connected together at one end thereof so as to form a substantially rigid generally U-shaped structure, means pivotally supporting said U-shaped structure at its bight, a trip-actuating portion adjacent the free end of one of said arms, means biasing said U-shaped structure for rotation about said pivotal support and away from said trip member, said other arm engaging a stationary stop adjacent its free end and limiting said rotation.

5. An electric circuit breaker comprising an insulating casing, relatively movable contacts, operating mechanism for said relatively movable contacts, said operating mechanism including a trip member releasable to cause automatic opening of said contacts, current responsive means normally restraining said releasable trip member, said current responsive means comprising a bimetallic structure having two elongated substantially parallel arms, means connecting said arms at one end thereof, means pivotally supporting said bimetallic structure in said casing at a point adjacent the said connecting means, latch means carried by the free end of one of said arms for normally engaging and restraining said trip member, said latch means extending through an opening in the free end of the other of said arms, biasing means biasing said bimetallic structure about said pivotal support and into engagement with said trip member, and means carried by the said other arm for limiting movement of said structure toward said trip member and for insulating said bimetallic arm from said trip member.



6. An electric circuit breaker comprising a casing, relatively movable contacts and releasable operating mechanism for said contacts, a generally U-shaped bimetallic element comprising a pair of actuating arms extending in closely spaced magnetically interacting relation in substantially parallel flatwise alignment with each other and connected together at one end thereof, means pivotally supporting said U-shaped bimetallic element in said casing adjacent its bight portion, means for passing an electric current through said closely-spaced arm portions in series relation trip actuating means for releasing said releasable operating mechanism carried by one end of said bimetallic element, means biasing said bimetallic element for rotation abouts its pivotal support, stop means normally stationary with respect to said casing for limiting said rotation, said stop means engaging said bimetallic element at an end opposite from the end carrying said trip actuating means.

7. An electric circuit breaker comprising an insulating casing, relatively movable contacts, operating mechanism for said relatively movable contacts, said operating mechanism including a trip member movable to cause automatic opening of said contacts, current responsive means for moving said movable member upon the occurrence of predetermined electrical conditions, said current responsive means comprising an elongated bimetallic strip returnbent substantially at its mid-point to form a U-shaped structure having two generally parallel closely-spaced arm portions and an intermediate bight portion, means carried by the end of one of said arm portions for causing movement of said movable member, said bimetallic strip being supported adjacent said bight portion for pivotal movement in said casing, means biasing said bimetallic strip for rotation about said pivotal support, stop means engaging the other of said arm portions for limiting said rotation, said bimetallic strip having a high thermal expansion side and a low thermal expansion side, the said high expansion side being on the inside of said "U" so that the said arm portions deflect outwardly upon heating, and means for passing an electric current through said closely-spaced arm portions in series relation whereby the magnetic field associated with said current tends to also deflect said arm portions outwardly.

8. The electric circuit breaker of claim 7, wherein the said means for pivotally supporting said bimetallic strip comprises a generally cylindrical boss carried by said casing extending within said bight portion parallel to the axis of pivotal movement of said bimetallic element.


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