

May 25, 1954

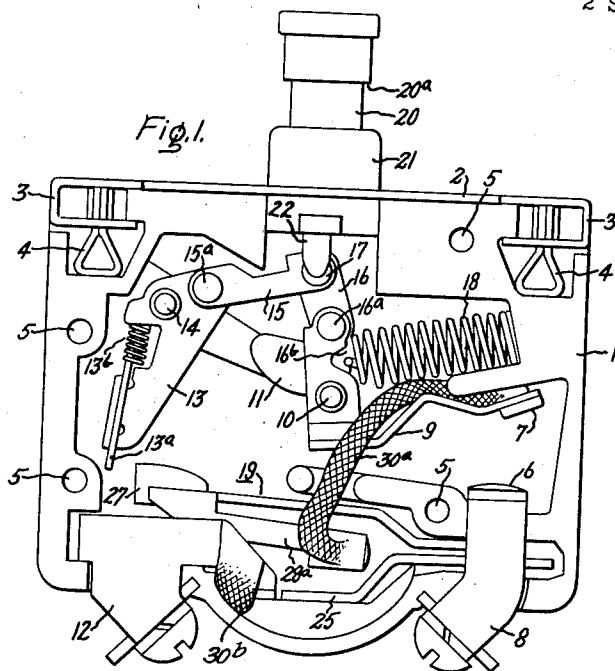
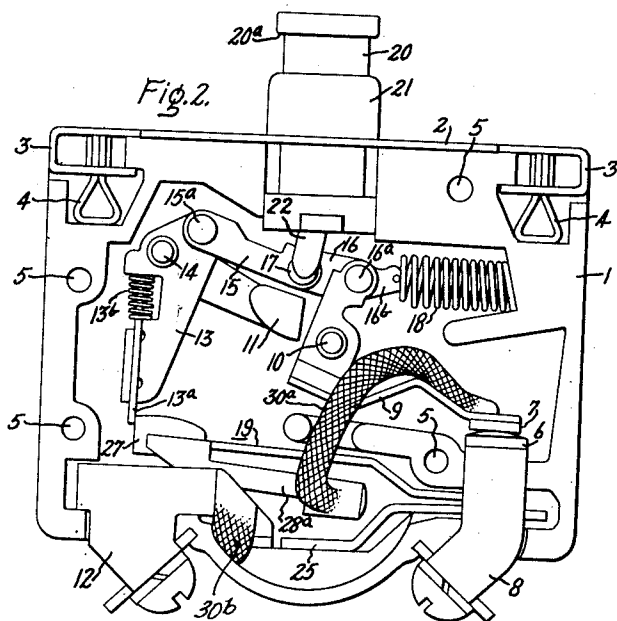
E. A. ERICSON

2,679,565

SELF-PROTECTING BIMETAL MEMBER

Filed Feb. 2, 1953

2 Sheets-Sheet 1



Inventor:
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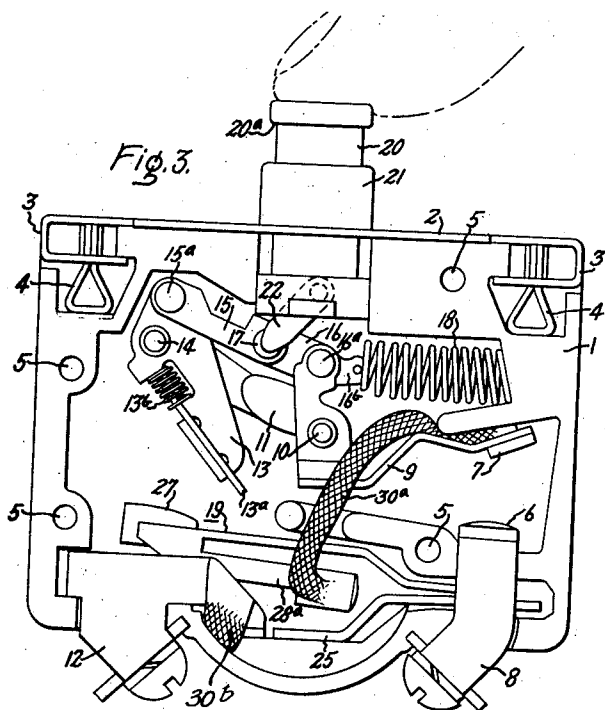
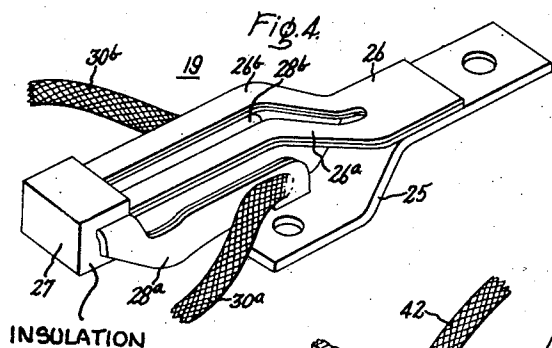
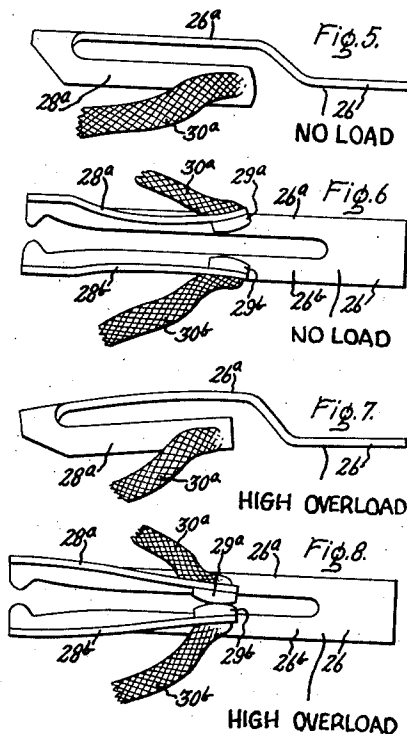
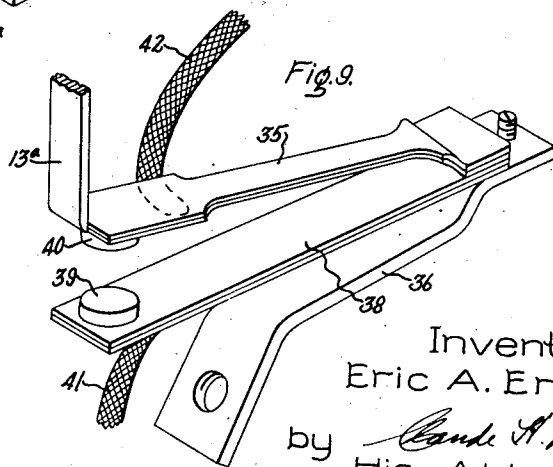
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SELF-PROTECTING BIMETAL MEMBER

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2 Sheets-Sheet 2



Inventor:
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UNITED STATES PATENT OFFICE

2,679,565

SELF-PROTECTING BIMETAL MEMBER

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New York

Application February 2, 1953, Serial No. 334,581

10 Claims. (Cl. 200-116)

1

My invention relates to bimetallic thermal responsive devices, and more particularly to self-protecting directly heated bimetallic members used to control the tripping mechanism of small air circuit breakers and the like.

In certain applications, manually operable current responsively tripped air circuit breakers of low current rating, i. e., of the order of 10 amperes, are required to be sensitive to comparatively small amounts of overload current, for example less than twice rated current, while at the same time they are required to successfully interrupt and withstand short circuit currents of the order of several hundred or several thousand times the rated current. These requirements cannot ordinarily be met by either the directly or indirectly heated bimetallic latch detents ordinarily used in circuit breakers. The indirectly heated bimetals (i. e., having juxtaposed heating coils) are not sufficiently sensitive, and the directly heated bimetals (i. e., current carrying), while more sensitive, are subject to permanent damage upon the passage of short circuit currents of the magnitude contemplated. For example, if a directly heated bimetallic member is so proportioned that it will deflect to trip the breaker at an overload current of for example 1.3 times rated current, such a bimetal will be permanently damaged by large overloads of the order of one thousand times the rated current.

Accordingly, therefore, it is a principal object of my invention to provide a directly current responsively heated bimetallic device which is sensitive to small amounts of overload currents and which includes additional current responsive means for shunting the bimetal element upon the occurrence of a predetermined high overload current.

It is another object of my invention to provide a directly current responsively heated bimetallic overload device which includes integral thermally deformable means for shunting the thermal sensitive element upon the occurrence of a predetermined high overload current.

A still further object of my invention is the provision of a manually operable current responsively tripped circuit breaker including a directly heated bimetallic latching detent for automatic tripping operation, which detent is sensitive to small overload currents and includes additional thermal current responsive means for protecting the bimetal against large short circuit currents.

In carrying out my invention in one form I

2

construct the thermally deformable latching detent for a manually operable current responsively tripped circuit breaker as a directly heated cantilever mounted bimetallic actuating arm connected in series circuit relation with at least one bimetallic protective arm, and so arranged that the protective arm is engaged by a thermally deformable member only upon the occurrence of a predetermined excessive overload current, and in such a manner as to shunt or short circuit the thermo-sensitive actuating arm. In a preferred form of the invention this is accomplished by mounting a bifurcated bimetallic actuating arm at its bight, and forming upon its spaced apart movable ends a pair of bimetallic protective arms disposed in parallel spaced relation and arranged to deform into engagement with each other only upon the occurrence of a predetermined excessive overload current. The protective arms and the bifurcated actuating arm are connected in series circuit relation and directly heated by current conducted therethrough, so that engagement of the ends of the protective arms short circuits the entire bimetallic conducting path.

My invention itself will be more fully understood and its various objects and advantages further appreciated by referring now to the following detailed specification taken in conjunction with the accompanying drawing, in which Fig. 1 is a side elevational view, with the cover removed, of a manually operable current responsively tripped electric circuit breaker embodying my invention and shown in the "open" or "off" position; Fig. 2 is a similar view of the same circuit breaker shown in the "closed" or "on" position; Fig. 3 is a similar view of the same circuit breaker shown in the "trip free" position; Fig. 4 is a perspective view of the bimetallic latching detent included in the circuit breaker of Figs. 1, 2 and 3; Figs. 5 and 6 are side elevational and plan views, respectively, of the bimetallic member of Fig. 4 showing the member in its no load condition; Figs. 7 and 8 are similar side elevational and plan views, respectively, of the bimetallic member of Fig. 4 shown in its short circuit condition; and Fig. 9 is a perspective view of a bimetallic latching detent embodying my invention in different form and suitable for use in the circuit breaker of Figs. 1, 2 and 3.

Referring now to the drawings, and particularly to Figs. 1, 2 and 3, I have shown my invention embodied in an air circuit breaker comprising an open-sided housing 1 formed of suit-

3
able molded plastic insulating material and having recesses therein for the reception and retention of an operating mechanism. The housing is provided with a metal top plate 2 having return bent end portions 3 which seat in slots (not shown) in the housing. Within the return bent end portions 3 are disposed threaded nuts 4 adapted to receive bolts (not shown) for mounting the circuit breaker upon a panel or the like. The operating mechanism is adapted to be held in place in the housing 1 by a side cover plate (not shown), which is adapted to be connected to the housing by means of rivets passing through holes 5 in the housing 1. The mounting nuts 4 are disclosed and claimed in my copending application Serial No. 342,633, filed on March 16, 1953, and assigned to the same assignee as the instant application.

Within the molded casing 1 is disposed a manual and automatic operating mechanism for a pair of cooperating switch contacts 6 and 7. The contact 6 is stationary and is mounted upon a terminal member 8 projecting from the bottom of the casing 1. The movable contact member 7 is mounted upon a movable switch member shown as an L-shaped contact arm 9 pivotally mounted at a point intermediate its ends upon a fixed pivot pin 10 carried by the casing 1. The contact arm 9 is movable between an open circuit position, shown at Fig. 1, where it engages a fixed stop 11 formed on the casing, and a closed circuit position, shown at Fig. 2, where the contacts 6 and 7 are in engagement. A second terminal member 12 is seated in suitable positioning recesses in the housing 1 and projects from the bottom of the housing opposite the terminal member 8.

The L-shaped movable contact arm 9 is manually and automatically movable between open and closed circuit positions by means of an automatically releasable toggle mechanism shown in the drawings in open, closed and tripped positions. The actuating mechanism, shown at Fig. 1 in its manual open position, comprises a releasable carrier member 13 pivotally mounted upon a fixed pivot 14 fixed in the casing 1, and a pair of toggle links 15 and 16 pivotally connected, respectively, to the upper ends of the carrier member 13 and the contact arm 9 by means of movable pivot pins 15a and 16a, respectively. The adjacent ends of the toggle links are pivoted together at their knee by means of a movable pivot pin 17. The toggle link 16 is connected intermediate its ends to the pivot pin 16a, and thus includes a portion 16b extending beyond the pin 16a and engaging a compression spring 18, the other end of which is fixedly seated in a suitable recess in the casing 1.

The releasable carrier member 13 has mounted thereon at its lower end a slidable latch member 13a, biased to latching position by a spring 13b disposed between the latch member 13a and a portion of the carrier member 13. The latch member 13a normally engages a thermo-responsive latching detent shown as a thermo-deformable bimetallic member 19 mounted in a recess in the lower part of casing 1. As shown at Fig. 1 the latch 13a is withdrawn from the bimetallic member 19 in the manual open position of the breaker by reason of a resetting bias exerted upon the toggle mechanism by the spring 18 as will be more fully explained hereinafter. At Fig. 2, however, it will be observed that when the mechanism is in its manual on or closed position, the latch 13a is in engagement with the bimetallic

member 19, thereby normally to retain the carrier member 13 in fixed position. As will be more fully explained hereinafter, the bimetallic latching detent 19 is connected in series circuit relation between the circuit breaker terminals 8 and 12 and carries the current passing through the breaker contacts 6 and 7. When sufficiently heated by the current the detent 19 deforms downwardly thereby to disengage the latch 13a and release the carrier member 13 for movement to its tripped position shown at Fig. 3.

For manual opening and closing operation the circuit breaker is provided with a reciprocable actuating rod 20 supported for rectilinear movement in a collar 21 carried by the top plate 2 and having a stop shoulder 20a which acts also as a dust seal when engaging the collar 21. At its lower end the rod 20 carries a swingable connecting link 22, which is connected to the knee pivot pin 17 of the toggle mechanism.

The operation of the foregoing circuit breaker mechanism may now be observed in detail before proceeding with a further description of my new and improved bimetallic latching detent. In the manual open position of the breaker, as shown at Fig. 1, the toggle formed by the links 15 and 16 is broken by movement of the actuating rod 20 to its upper or withdrawn position. The toggle being broken, the compression spring 18 holds the contact arm 9 against the stop 11 and, because of the toggle link extension 16b, biases the link 16 clockwise about the pivot pin 16a, as shown in the drawing. With the contact arm 9 engaging the fixed stop the pivot pin 16a is held in position, so that clockwise rotation of the link 16 about the pin 16a (within the limit of movement permitted by the swinging link 22), draws the toggle links 15 slightly to the right as shown in the drawing and rotates the carrier member 13 to a slightly withdrawn or "reset" position, as shown at Fig. 1.

When the actuating rod 20 is depressed, as shown at Fig. 2, until its stop shoulder 20a engages the collar 21, the knee pivot pin 17 is moved downwardly, thereby to extend the toggle links 15 and 16 and move the knee pivot pin 17 across the line of action of the spring 18 to a slightly overset position as shown at Fig. 2. Further movement of the knee pivot pin 17 is prevented by engagement of the actuating rod shoulder 20a with the collar 21. In this position the shoulder 20a acts as a dust seal for the casing 1. In this straightening movement the toggle links 15 and 16 force the pivot pins 15a and 16a apart. Movement of the pivot pin 15a is limited by engagement of the latch member 13a with the bimetallic latching detent 19, so that the pivot pin 15a in the normal unreleased position of the carrier member 13 acts substantially as a fixed pivot. Thus the straightening of the toggle links 15 and 16 serves principally to move the pivot pin 16a to the right, thereby to rotate the contact arm 9 clockwise about its fixed pivot pin 10 and bring the contacts 6 and 7 into engagement. In this position of the mechanism, the knee pivot pin 17 is slightly below the line of action of the spring 18, so that the pressure of the spring 18 retains the toggle in its overset position. In this position the spring 18 also tends to move the entire toggle mechanism to the left, as shown in the drawing and longitudinally of the extended toggle links. Rectilinear movement of the entire toggle mechanism to the left is restrained, however, by latching of the carrier member 13, and thus retention of the pivot pin 15a in a normal fixed position.

It will now be understood that reverse manual movement of the actuating rod 20, by withdrawing it from the position of Fig. 2 to the position of Fig. 1, moves the knee pivot pin 17 above the line of action of the spring 18 so that the spring collapses the toggle links 15 and 16 and restores the mechanism to the open position of Fig. 1.

If, with the circuit breaker in the "on" position shown at Fig. 2, an overload current passes through the breaker sufficient to deform the bimetallic strip 19 downwardly and release the latch 13a, the pressure of the spring 18 upon the extended toggle links 15 and 16 moves the links longitudinally to the left as viewed in the drawing and rotates the carrier member 13 counterclockwise to the tripped position shown in Fig. 3. Such rectilinear movement of the entire toggle mechanism moves the pivot pin 16a to the left and rotates the contact arm 9 counterclockwise, thereby to separate the contacts 6 and 7 even though the toggle links 15 and 16 are maintained in their extended position by holding actuating rod 20 depressed as shown at Fig. 3. This renders the breaker "trip free" in operation, in that the contacts are automatically separated by release of the carrier member 13, even though the actuating rod is manually held in its "on" position.

It may now be observed, however, that in moving to the tripped position shown at Fig. 3 the knee pivot pin 17, being carried by the swinging link 22, has swung upward and to the left. By this action the knee pivot is raised above the line of action of the spring 18. At the same time the link extension 16b, being rotated slightly clockwise by the foregoing movement, has lowered the line of action of the spring slightly. The spring 18 therefore now tends to collapse the toggle links 15 and 16. In addition, the contact arm 9 now being against the stop 11 to hold the pivot pin 16a against movement, the links extension 16b converts the pressure of spring 18 to a torque tending to rotate the link 16 clockwise about the pin 16a. Thus, if the actuating button 20 is released from the position shown at Fig. 3, the compression spring 18 will break the toggle and move the actuating rod 20 upwardly to its open position by rotating the link 16 clockwise about the pivot pin 16a. In so rotating the link 16 draws the link 15 to the right and by this action rotates the carrier 13 clockwise about its pivot pin 14 to reset the mechanism. If the bimetal 19 has cooled before resetting movement of carrier 13, the slidable latch 13a permits the resetting movement.

The foregoing single spring toggle mechanism, having the combined functions of manual opening and closing as well as tripping and automatic resetting is described and claimed in a copending application Serial No. 331,558, filed on January 16, 1953, jointly by me and Raymond N. Rowe and assigned to the same assignee as the instant application.

Referring now more particularly to the bimetallic latching detent 19, I have shown at Fig. 4, a perspective view of this detent mounted upon an offset metal base member 25 fixed in the casing 1.

The bimetallic member 19 comprises a bifurcated bimetallic actuating arm 25 including two spaced apart coplanar actuating fingers 26a and 26b and mounted at its right upon the supporting member 25, as by welding. The free ends of the actuating fingers 26a and 26b are connected together by a detent tip 27 of insulating

material, the tip 27 being engaged in operation by the latch member 13a as shown at Fig. 2. The tip 27 is of insulating material to prevent short-circuiting of the bimetal strip 19 through the metal actuated linkage. The actuating fingers 26a and 26b are each laterally and reversely bent at their ends to form a pair of bimetallic protective arms 28a and 28b. While these protective arms may be separate pieces fixed to the actuating fingers they are preferably formed as shown as integral reversely directed extensions of the actuating fingers 26a and 26b, and are turned over laterally so that they lie in planes perpendicular to the plane of the actuating arm and in parallel spaced relation with each other.

The protective bimetallic arms 28a and 28b are arranged to be deformed toward engagement with each other when heated. In the form of the invention shown at Figs. 1 to 8 this is accomplished by providing the relatively high expansion metal on the tops of the arms 26a and 26b, and thus on the outsides of the protective arms 28a, 28b. The movable ends of the protective arms 28a and 28b are provided with contact tips 29a and 29b respectively, which tips are sufficiently spaced apart under no-load conditions that they do not come into engagement with each other except upon the occurrence of predetermined excessive overload currents.

To connect the bimetallic device 19 in series circuit relation between the circuit breaker terminals 8 and 12, the contact carrying ends of the protective arms 28a and 28b are provided with flexible electric conductors or pigtails 30a and 30b respectively, between which the actuating fingers 26a and 26b and the protective arms 28a and 28b are connected in series circuit relation. As shown in Fig. 1 the pigtail 30a is connected to the movable contact arm 9, while the pigtail 30b (not shown) is connected to the terminal member 12. The normal current path through the device 19 is thus from the pigtail 30a, through the arm 28a, the finger 26a, the finger 26b, the arm 28b to the pigtail 30b, or the reverse.

The bimetallic member of Fig. 4 is shown in plan and elevation view in its no load condition at Figs. 5 and 6, the detent tip 27 and the mounting base 25 being omitted.

Referring now again to Figs. 1, 2 and 3, it will be observed that the bimetallic member 19 is so mounted in the casing 1 that when heated the actuating arm, consisting of the fingers 26a and 26b and the detent tip 27, moves downwardly as viewed in the drawing, to release the carrier member 13. For normal overloads of the order of several times up to ten or twenty times normal current, deformation of the protective arms 28a and 28b is insufficient to bring the contacts 29a and 29b into engagement. The normal spacing adjustment of the contacts 29a and 29b however is such that upon occurrence of a predetermined excessive overload current traversing the protective bimetallic arms 28a and 28b and the actuating fingers 26a and 26b in series circuit relation, the protective arms are sufficiently deflected toward each other so that the contacts 29a and 29b come into engagement, thus providing a short circuit path between the pigtails 30a and 30b and shunting the entire bimetallic member 19 out of the circuit. The device 19 is shown in this condition at Figs. 7 and 8. Moreover, the actuating fingers 26a and 26b are sufficiently deformed to release the latched carrier member 13 before the protective arms come into engagement. In practice it has been found that the

7
carrier member 13 is released and the protective arms engaged before the short circuit current (which may be an arcing current) through the circuit breaker contacts 6 and 7 attains its maximum value. In this way the bimetallic member is protected against the carrying of excessive short circuit currents.

At Fig. 9 I have shown another form of self-protecting bimetallic detent comprising a bimetallic actuating arm 35, mounted at one end upon a supporting base 36 and engaging at its other end a latch indicated as the latch 13a of Figs. 1, 2 and 3. Mounted also upon the base member 36 between the bimetallic arm 35 and the member 36, and in substantially parallel spaced relation with the arm 35, there is provided a bimetallic protective arm 38 carrying at its end a contact tip 39 engageable with a cooperating contact 40 on the end of the bimetallic actuating arm 35. The contacts 39 and 40 are normally spaced apart. Both the bimetallic actuating arm 35 and the bimetallic protecting arm 38 are arranged to deform downwardly, as shown in the drawing, when heated. The actuating arm 35, however, is of reduced cross section and is therefore heated to a greater extent by a current of any given value, so that the arm 35 moves downwardly at a greater rate than the arm 38. Current is conducted through the arms 35 and 38 in series circuit relation between a pair of flexible electrical conductors or pigtails 41 and 42 connected respectively to the free ends of the arms 38 and 35.

In operation the bimetallic overload device of Fig. 9 operates to release the latch 13a upon small overload currents without engaging the contacts 39 and 40, the contact 39 moving in the same direction as the contact 40 but at a lesser rate. Upon the occurrence of a predetermined excessive overload current, however, the rate of movement of the contact 40 becomes so great that it overtakes the contact 39 and brings the contact into engagement, thereby to shunt the arms 35 and 38 out of the circuit.

It may now be noted that the thermally responsive protective arms characterizing my invention normally carry current. These arms, being near the actuating arm, act to supplement the heating of the actuating arm. This is of considerable advantage in a bimetal of low current response where it is difficult to obtain sufficient heating without unduly reducing the cross section of the bimetal.

While I have described only certain preferred embodiments of my invention by way of illustration, many modifications will occur to those skilled in the art, and I therefore wish to have it understood that I intend in the appended claims to cover all such modifications as fall within the true spirit and scope of my invention.

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

1. In a directly current responsively heated electric overload device, a thermally deformable bimetallic actuating arm adapted to be heated by current conducted therethrough, and additional thermally deformable means, movable in response to current traversing said actuating arm and establish a short circuit around said actuating arm upon the passage of a predetermined excessive current through said actuating arm.

2. In a directly current responsively heated electric overload device, a thermally deformable bimetallic actuating arm adapted to be heated by current conducted therethrough, and a sec-

ond thermally deformable bimetallic arm connected in series circuit relation with said actuating arm and carrying at its end a contact movable therewith to establish a short circuit around said actuating arm upon the passage of a predetermined excessive current therethrough.

3. In a directly current responsively heated electric overload device, a thermally deformable bimetallic actuating arm adapted to be heated by current conducted therethrough, and a bimetallic protective arm mounted upon said actuating arm and connected in series circuit relation therewith, a contact carried by said actuating arm and disposed for engagement with said protective arm, said protective arm being deformable into engagement with said contact thereby to short circuit said actuating arm only in response to the passage of a predetermined excessive current through said bimetallic arm.

4. In a directly current responsively heated electric overload device, a pair of bimetallic actuating fingers mounted at one end in parallel coplanar relation and adapted to be heated by current conducted therethrough, and a pair of bimetallic protective arms mounted upon the free ends of said actuating fingers and disposed for thermal deformation into engagement with each other, said protective arms being connected in series circuit relation with said actuating fingers and engaging each other only upon the passage of a predetermined excessive current through said fingers thereby to short circuit said fingers.

5. In a directly current responsively heated electric overload device, a bifurcated bimetallic actuating arm mounted at its right and having its movable ends disposed in spaced apart coplanar relation, said movable ends being thermally deformable in a direction perpendicular to the plane thereof in response to electric current conducted therethrough, and a pair of bimetallic protective arms mounted upon the free ends of said actuating arm and disposed in parallel spaced relation with each other, said protective arms being connected in series circuit relation with said bifurcated actuating arm and being thermally deformable in opposite directions perpendicular to the direction of movement of said actuating arm and into engagement with each other, said protective arms remaining spaced apart in normal overload operation and engaging at their ends to short circuit said actuating arm only upon the passage of a predetermined excessive current through said arm.

6. In a directly current responsively heated electric overload device, a bifurcated bimetallic actuating arm mounted at one end with its other end movable perpendicular to the plane thereof, a pair of bimetallic protective arms mounted upon the spaced apart ends of said bifurcated actuating arm and disposed in parallel spaced relation for movement toward and away from each other along a line perpendicular to the direction of movement of said actuating arm, said protective arms being connected in series circuit relation with said bifurcated actuating arm and all said arms being adapted to be heated by current conducted therethrough, the ends of said protective arms being deformable into engagement with each other thereby to short circuit said actuating arm only upon the occurrence of a predetermined excessive current through said arms.

7. In a directly current responsively heated electric overload device, a bimetallic actuating arm mounted at one end and having its free en-

movable in response to current conducted there-through, a resilient protective arm mounted in substantially parallel spaced relation with said actuating arm and having at its free end a contact engageable with the free end of said actuating arm, said actuating arm deforming sufficiently to engage said protective arm only upon the passage of a predetermined excessive current therethrough, thereby to short circuit said actuating arm.

8. In a directly current responsively heated electric overload device, a bimetallic actuating arm mounted at one end and having its free end movable in response to current conducted there-through, a bimetallic protective arm mounted in substantially parallel spaced relation with said actuating arm and having at its free end a contact engageable with the free end of said actuating arm, said arms being connected in series circuit relation and being thermally deformable in the same direction and at different rates, said protective arm being movable at a lesser rate than said actuating arm whereby the free end of said actuating arm engages the free end of said protective arm only upon the passage of a predetermined excessive current thereby to short circuit said actuating arm.

9. In a current responsively tripped electric circuit breaker, a pair of relatively movable cooperating switch contacts, manually operable member releasable to automatically separate said contacts, a latching detent having a thermally deformable bimetallic actuating arm normally engaging said latch member to restrain its movement, said actuating arm being connected in

series circuit relation with said contacts for direct heating by current conducted through said arm, and thermally deformable means movable in response to current through said actuating arm and establishing a circuit around said actuating arm upon the passage of a predetermined excessive current therethrough.

10. In a current responsively tripped electric circuit breaker, a pair of relatively movable cooperating switch contacts, manually operable mechanism for opening and closing said contacts, said mechanism including a movable latch member releasable to automatically separate said contacts, a latching detent having a bifurcated bimetallic actuating arm mounted at one end and normally engaging at its free end said latch member to restrain movement of said latch member, and a pair of bimetallic protective arms mounted upon the spaced apart ends of said bifurcated actuating arm and disposed for thermal deformation into engagement with each other, said protective arms and said bifurcated actuating arm being connected in series circuit relation with said contacts for direct heating in response to current conducted therethrough and said protective arms being so spaced apart that they engage each other to shunt said actuating arm only upon the passage of a predetermined excessive current through said arm.

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