Jan. 1, 1957 W. A. THOMAS 2,776,349

MAGNETIC THERMAL TRIP

Filed Oct. 20, 1954

Fig. 1.

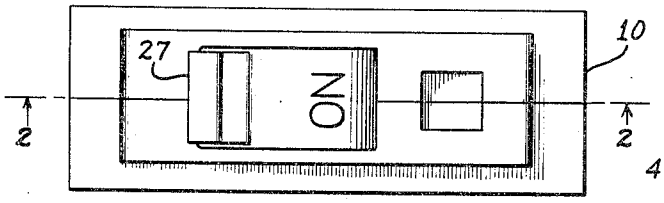


Fig. 2.

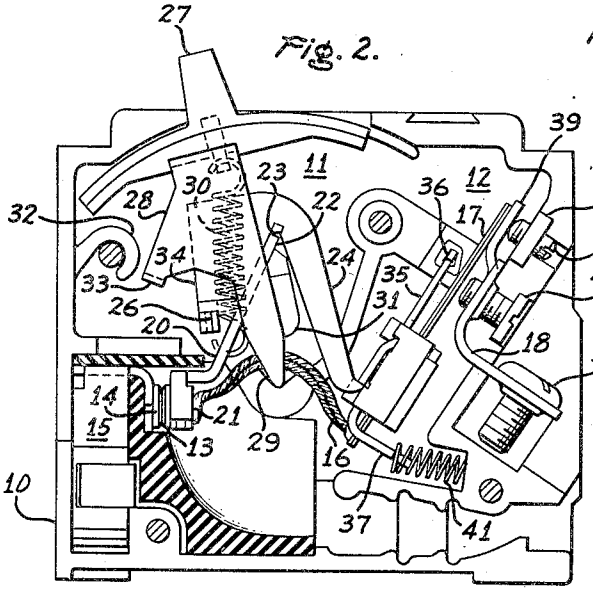


Fig. 5.

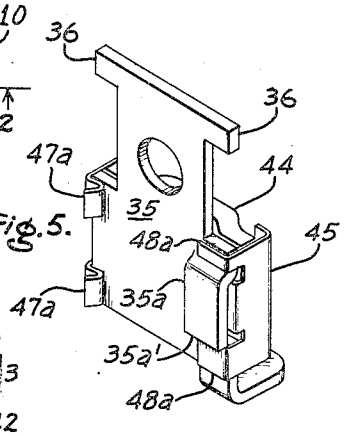


Fig. 6.

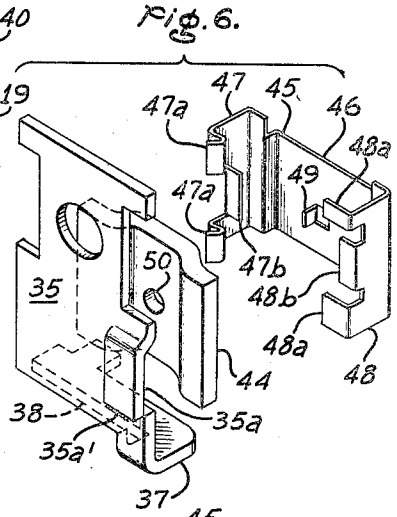


Fig. 3.

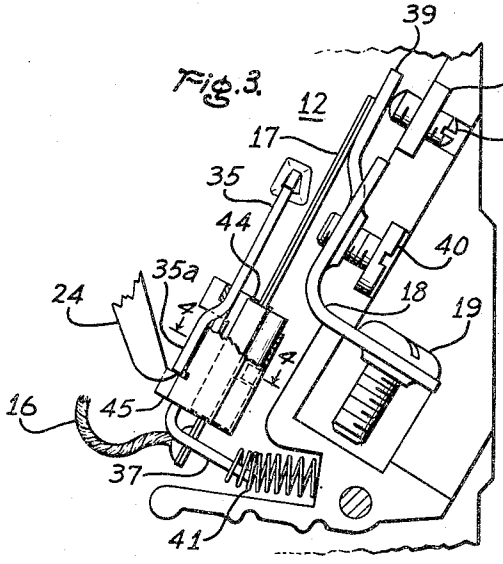
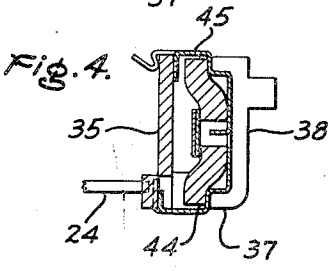


Fig. 4.



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2,776,349

MAGNETIC THERMAL TRIP

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Application October 20, 1954, Serial No. 463,454

8 Claims. (Cl. 200—88)

My invention relates to automatic circuit breakers of the type adapted for use in controlling power and lighting circuits of small or medium capacity such as used in residential electrical systems and, more particularly, to a combination thermal and magnetic tripping means for use in such circuit breakers.

Thermal-magnetic tripping means for such automatic circuit breakers have heretofore generally comprised a magnetic armature attached to a pivoted latch and adapted to be moved by bimetallic member to cause thermal or "delayed" tripping, and a magnetic field member either mounted in the casing or carried by the movable portion of the bimetallic strip member, which on occurrence of high overloads attracts the armature to cause instantaneous tripping. When the magnetic field member is directly welded or riveted to the bimetal, the supporting portion of the bimetallic strip is rendered relatively inactive in the function of deflecting to cause thermal tripping, seriously impairing the bimetal's deflecting characteristics. When the magnetic field member is supported in the casing, on the other hand, the air gap of the magnet is altered during deflection of the bimetallic member, since the armature is moved by the bimetal while the field member remains stationary. The rating or calibration at which the magnetic-trip mechanism functions is therefore altered by changes in the position or condition of the bimetallic member. In addition, when the armature has been moved by the bimetal into contact with the magnetic field member in this construction, further travel of the bimetal is opposed by the field member which is likely to cause the bimetal to become permanently distorted or to take a "set" so as to alter the calibration.

An object of the present invention is to provide a combination thermal and magnetic trip for an automatic circuit breaker wherein the magnetic field member is not attached to the bimetallic member or to the casing and in which the air gap is not affected or altered by deflection of the bimetal.

Another object of my invention is to provide a combination thermal and magnetic tripping mechanism wherein the field member is not attached to the bimetal and in which the travel of the bimetal is not limited by the magnetic field member.

It is a further object of my invention to provide a combination thermal and magnetic trip which is easy to manufacture and calibrate, and in which accuracy of calibration is not likely to be accidentally altered.

A still further object of my invention is to provide a combination thermal and magnetic trip for automatic circuit which may be assembled without the use of special tools.

In accordance with my invention, I provide a combined thermal and magnetic trip for a circuit breaker including a bimetallic strip, a magnetic armature member pivotally supported adjacent the bimetallic strip and a cooperating magnetic field member supported independently of the bimetal but arranged to maintain a relatively fixed position with relation to the movable portion of the bimetal and adapted to be moved thereby simultaneously with said armature member so as ordinarily to maintain a constant air gap between the magnetic field member and the armature member, and means whereby the pivotally-supported armature member itself provides the support for the magnetic field member, the said means comprising a simple "snap-on" non-magnetic bracket.

Referring to the drawings, Figure 1 is a top plan view of a circuit breaker incorporating my invention.

Figure 2 is a side elevation view of the circuit breaker of Figure 1, one side of the casing being removed.

Figure 3 is a side elevation view of the trip mechanism of the circuit breaker of Figures 1 and 2.

Figure 4 is a view in section of the portion of the trip mechanism taken on the line 4—4 of Figure 3.

Figure 5 is a view in perspective of the trip device of Figure 2, the bimetallic strip member being omitted for clarity.

Figure 6 is a view in perspective of the parts shown in Figure 5, the parts being shown in disassembled condition.

In the drawings I have shown my invention as embodied in an automatic electric circuit breaker comprising a casing 10 formed of two cooperating halves the parts being set into suitable formed recesses therein. The circuit breaker comprises an operating mechanism indicated generally at 11 and a trip mechanism indicated generally at 12. The operating mechanism 11 functions to operate a movable contact 13 between open and closed circuit positions with respect to a relatively stationary contact 14. The stationary contact 14 is supported in the casing 10 and adapted to be connected in an electric circuit by a connector 15 adapted to receive a blade-type connector (not shown). The movable contact 13 is connected by a flexible conductive braid 16 to one end of a bimetallic strip 17 which in turn is connected to and supported on a generally L-shaped terminal 18 carrying an external connecting screw 19. The operating mechanism for the movable contact 13 is described in detail in Patent 2,627,563 issued February 3, 1953, to the present inventor and assigned to the same assignee as the present application and will be described only briefly herein. The movable contact 13 is fixedly attached to a contact arm 20 by means of clip 21 to which it is welded and which is crimped or clamped on the end of contact arm 20. The contact arm 20 is bifurcated and has its diverging ends 22 pivoted in bearings 23 in the sides of trip member 24. The trip member 24 is generally U-shaped and is supported in bearings in the opposite side walls of the casing 1 by projecting lugs 26 and is normally restrained from rotating about these bearings by a latch means to be described. A manually operable handle 27 is supported on handle support member 28, pivotally supported in bearings 29 formed in the opposite side walls of the casing 10. A tension spring 30 is connected between the handle 27 and the contact arm 20. When the manually operable handle 27 is moved from its extreme counterclockwise position as shown in Figure 2 to the clockwise position the line of action of spring 30 passes through the axis of the pivot 23 and moves the contact arm 20 to the open circuit position in which it rests against the stop member 31, carried by handle support member 28.

When the parts are in the "on" or closed position as shown in Figure 2, the action of the spring 30 is to bias the contact arm 20 clockwise about its pivot and simultaneously to urge the contact arm upwardly into the V-shaped bearings 23 of the cradle or trip member 24 and thereby to exert a counterclockwise bias on the member 24 with respect to the pivot 20. As mentioned, the trip member 24 is restrained from movement in a counterclockwise direction by a latch means 12 to be described. Upon the release of the trip member 24 by the latch 12 in response

to abnormal current conditions, the trip member 24 rotates in a counterclockwise direction under the influence of spring 30 until the pivotally supported ends 22 of the contact arm 20 pass across the line of action of the spring 30 whereupon the contact arm 20 rotates in a counterclockwise direction to the open or tripped position. A stop 32 is provided in the casing to limit the counterclockwise rotation of the trip member 24. When the pivot point 23 moves to the left of the line of action of the spring 30 and the contact arm 20 moves to its open circuit position the line of action of the spring 30 is shifted so that it then biases the handle support member 28 clockwise about its pivotal support 29, causing the handle support member to move in this direction until the lugs 33 on the handle support member 38 engage the edge 34 of the trip member 24. This limits the clockwise movement of the handle support member 28 and retains the manually operable handle 27 in a central position midway between "off" and "on" position which indicates to the user that the circuit breaker has tripped automatically. In order to reset and reclose the circuit breaker the handle 27 is manually moved to its extreme clockwise position during which action the lugs 33 engage the edge 34 of the trip member 24 and rotate it in a clockwise direction until the tip of the latch arm of the trip member 24 reengages and is once again held by the trip mechanism 12. Thereupon the handle 27 may be once again moved to its extreme counterclockwise position moving the contact arm 20 back to the closed circuit position.

The trip mechanism 12 includes an elongated combination latch and armature member 35 which is pivotally supported in the casing 10 by lugs 36. The latch member 35 has a foot portion 37 extending generally at right angles to the main body portion and having a laterally extending hook 38. An elongated bimetallic strip 17 is rigidly attached by suitable means, such as by welding, to the upper end 39 of the terminal member 18 which in turn is fixedly retained in the casing by being set into conforming recesses therein and by being anchored thereto by means of screw 40. The lower end of the bimetallic strip 17 has attached thereto the flexible conductive braid 16 and extends through a cut-away portion of the latch member 35. The latch member 35 is biased clockwise against the end of the bimetallic strip by compression spring 41, the forward edge of hook portion 38 engaging the rear surface of the bimetallic strip. The bimetallic member 17 has its high expansion side adjacent the latch 35 so that when it becomes heated by current passing therethrough, the lower end of the bimetal 17 deflects to the right as viewed in Figure 2, pushing against the hook portion 38 of latch 35. For the purpose of adjustably positioning the movable end of the bimetallic strip 17 and therefore the latch member 35, a calibrating screw 42 is provided, threadedly engaged in a nut 43 retained by conforming recesses in the sides of the casing 10. The tip of the screw 42 bears against the upper end 39 of the terminal member 18 so that as the screw is turned inwardly the end 39 is bent to the left as viewed in Figure 2 thereby altering the angle which its surface, carrying the bimetal 17, makes with respect to the main portion of the terminal. This causes the lower end of the bimetallic strip 17 to move to the right as viewed in Figure 2, which in turn bears against the hook portion 38 of the latch member 35 causing the lower part of the latch member 35 to also move to the right as viewed in Figure 2. The latch member 35 has a lanced out latch portion 35*a*, the ledge 35*a'* of which normally engages and restrains the tip of the trip member 24. Upon the occurrence of a persisting overload in the circuit such as to heat the bimetallic member 17, the bimetal 17 deflects so as to cause the lower end to move to the right as viewed in Figure 2 carrying with it the latch member 35 and withdrawing the latch surface 35*a'* from the trip member 24 and causing tripping.

For the purpose of implementing the magnetic tripping action so as to accelerate tripping on the lower current values without the disadvantages attendant upon rigidly attaching a magnetic member to the bimetallic strip, I provide a magnetic field member 44 and novel supporting means therefor. The magnetic field member 44 comprises a shallow generally U-shaped member of ferromagnetic material adapted to extend partly around the bimetallic strip 17. The magnetic field member 44 is held in close proximity to the bimetallic strip 17 without being attached thereto by means of a non-magnetic bracket 45 which is supported on and carried by the latch member 35. The non-magnetic bracket 45 comprises a generally U-shaped member having a back wall 46, side walls 47 and 48 and in-turned retaining lugs extending from each of the side walls, and a lug 49 projecting inwardly from the back wall 46. The inwardly projecting lugs 47*a* and 48*a* extend partly across the front surface of the latch member 35 as best shown in Figure 5. These lugs limit the possible movement of the magnetic field member 44 in a direction away from the armature 35. The lug members 47*b* and 48*b* extend behind the surface of latch 35. These lugs limit the movement of the non-magnetic bracket 45 toward the latch member 35. Since the lanced-out portion 35*a* of the latch 35 projects between the two lug members 48*a*, vertical movement of the non-magnetic bracket member 45 is thereby prevented. The projecting lug 49 carried by the back wall 46 of the bracket 45 extends into an opening 50 provided in the central portion of the field member 44. By means of this engagement the magnetic member 44 is held from moving vertically with respect to the bracket 45. It will thus be seen that when the non-magnetic bracket member 45 is attached to a latch member 35, as described, it is mounted on and relatively immovably held by latch member 35. When the parts are assembled in the circuit breaker they are assembled around the bimetallic strip 17 so that the bimetallic strip 17 extends between the field member 44 and the latch member 35. Assembly of the bracket 45 on the latch 35 is a simple manual operation, the members 48*a* being first hooked over one edge of the latch member, and the members 47*a* then being snapped over the other edge.

It will now be seen that in the assembled condition, as shown in Figures 2, 3 and 4, the field member 44 is trapped in place between the bimetal 17 and the back wall 46 of the non-magnetic bracket 45. As described and as indicated particularly in Figures 4 and 5, the field member 44 is not supported by the bimetal 17, and would stay substantially in place even without the presence of the bimetal 17.

Upon the occurrence of a relatively high over-load in the circuit through the circuit breaker the magnetic field associated with the current passing through the bimetal 17 threads through and energizes the magnetic field member 44 so as to cause an attraction between field member 44 and the armature 35. Since the magnet 44 is restrained from moving toward the left as viewed in Figures 2 and 3 by the bimetal 17, the armature 35 is drawn thereto, releasing the latch 24. It will be understood that the compression spring 41 is compressed slightly when this occurs. It will also be appreciated that although during such instantaneous tripping the hook portion 38 of the latch member 35 may momentarily move out of engagement with the end portion of the bimetal 17, nevertheless the simultaneous tendency of the bimetal 17 to deflect toward the left as viewed in Figures 2 and 3 supplements the natural stiffness of the bimetal in resisting the tendency of the magnetic member 44 to move to the left, and therefore the bimetal 17 assists the magnetic tripping operation to a varying degree, depending on the rate of rise and the magnitude of the shortcircuit current.

It will be seen that I have provided a thermal and magnetic tripping means for a circuit breaker in which the magnetic field member is moved by the bimetallic

member along with the armature member so as to maintain a magnetic gap ordinarily at a fixed amount but which nevertheless does not require deforming or removing a portion of the bimetallic strip. It is of great importance to the satisfactory functioning of such circuit protective devices in protecting electrical wiring from overloads that the bimetallic member be capable of being accurately calibrated so that it is known with relatively great accuracy at what current the temperature levels tripping will occur. Such accuracy is most easily achieved and maintained when the bimetallic element is constructed of substantially flat material and is of simple configuration having no holes or other distortions therein. The cantilever-mounted, unmodified straight strip bimetal has proved to be the one of the most dependable and accurate of all current-responsive devices, and a great amount of data and experience is available relating to this structure. By means of my invention I have provided a construction in which all of the advantages are achieved of having the magnetic field member rigidly attached to and carried by such a straight bimetallic strip while yet retaining its desirable unmodified structure. In addition, I have provided a construction which is more readily assembled than previous devices and which lends itself to modification for altering the rating of the magnetic member to be associated with a given bimetallic member.

While I have shown and described but one embodiment of my invention by way of illustration, modifications will naturally occur to those skilled in the art and I, therefore, wish to have it understood that I intend by 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 combined thermal and magnetic trip mechanism for an automatic electric circuit breaker, a bimetallic strip, a latch member pivotally supported adjacent said bimetallic strip at one side thereof and comprising a magnetic armature member, a generally U-shaped non-magnetic bracket carried by said latch member and embracing said bimetallic strip and a magnetic field member carried by said non-magnetic bracket between said bracket and said bimetallic strip and adjacent the side of said bimetallic strip opposite from said one side.

2. In an automatic circuit breaker at least two relatively movable contacts, a releasable trip member movable to cause automatic opening of said contacts, a combined thermal and magnetic trip mechanism for moving said movable trip member upon the occurrence of predetermined electrical conditions comprising an elongated bimetallic strip, an armature member pivotally supported at one side of said bimetallic strip member, a magnetic field member positioned at the opposite side of said bimetallic strip and means supporting said magnetic field member on said armature member while permitting limited movement relative thereto.

3. A combined thermal and magnetic trip mechanism for an automatic circuit breaker comprising a trip member, means for latching said trip member, an elongated bimetallic strip, an armature member pivotally supported at one side of said bimetallic strip member, a magnetic field member positioned at the opposite side of said bimetallic strip member and means supporting said magnetic field member on said armature member while permitting limited movement relative thereto.

4. In an automatic circuit breaker, at least two relatively movable contacts, a trip member movable to cause opening of said contacts, means for latching said trip member, a magnetic armature member movable to cause tripping movement of said trip member, said armature member being pivotably mounted within said casing, an elongated bimetallic strip member fixedly mounted in said casing at one end thereof and in contact with said

armature member adjacent the other end thereof, a magnetic field member adjacent said bimetallic strip member on the side opposite from said armature member and a non-magnetic bracket carried by said armature member, said magnetic field member being loosely supported by said non-magnetic bracket between said bimetal and said bracket, said non-magnetic bracket embracing said field member and said bimetallic member.

5. In an automatic circuit breaker an insulating casing, at least two relatively movable contacts in said casing, a trip member operable to cause automatic opening of said contacts, means for latching said trip member, a combined thermal and magnetic trip mechanism for moving said latching means and causing tripping movement of said trip member upon the occurrence of predetermined current conditions, said trip mechanism comprising an elongated bimetallic strip member mounted in said casing at one end thereof and movable at the other end thereof, magnetic tripping means for said circuit breaker comprising two members of ferro-magnetic material mounted on opposite sides of said bimetallic strip and connected to each other by a non-magnetic bracket, one of said magnetic members being pivotally supported in said casing.

6. In an automatic circuit breaker having at least two relatively movable contacts, an insulating casing, a trip member movable to cause automatic opening of said contacts, means for latching said trip member combined thermal and magnetic mechanism for causing tripping movement of said trip member upon the occurrence of predetermined electrical conditions in said circuit breaker, said trip mechanism including an armature member movable to cause tripping movement of said trip member, an elongated bimetallic strip member fixedly attached in said casing at one end thereof and movable at the other end thereof to cause tripping movement of said armature, a magnetic field member cooperable with said armature member, said armature member and said field member being on opposite sides of said bimetallic member whereby current through said bimetallic member energizes said field member, and means supporting said field member comprising a non-magnetic generally U-shaped bracket carried by said armature member and embracing said field member and said bimetallic member.

7. An automatic circuit breaker comprising an insulating casing, at least two relatively movable contacts in said casing, operating mechanism for said contacts comprising means for manually moving said contacts between open and closed circuit positions, a member movable to cause automatic opening of said contacts, combined thermal and magnetic trip mechanism for causing movement of said movable member comprising an elongated bimetallic strip member fixedly attached in said insulating casing at one end and movable at the other end, a latch member of ferro-magnetic material pivotally supported in said casing and extending generally parallel to and closely spaced from said bimetallic strip member and adapted to be moved thereby, a generally U-shaped non-magnetic bracket having a back wall, side walls and in-turned lugs on said side walls, said bracket embracing said bimetallic strip and being supported by said lugs on said latch member, a generally U-shaped magnetic field member in loosely captured position between the back wall of said non-magnetic bracket and said bimetallic strip.

8. In an automatic circuit breaker comprising insulating casing, a relatively movable contact in said casing, operating mechanism for operating said relatively movable contact between open and closed circuit position, said operating mechanism including a member releasable to cause automatic opening of said contacts, means for normally restraining said releasable member from movement comprising an elongated latch member pivotally supported at one end in said insulating casing, an elongated bimetallic strip member extending in closely-spaced

generally parallel relation to said elongated latch member and electrically connected in circuit with said relatively movable contact, a lost motion connection between said latch member and said bimetallic strip member adjacent the movable ends thereof whereby movement of said bimetallic strip member in a tripping direction causes simultaneous movement of said latch member in said tripping direction but movement of said latch member in a tripping direction does not cause movement of the movable end of said bimetallic member in said tripping direction, a magnetic field member adjacent the side of said bimetallic strip member opposite from said latch member, means supporting said magnetic member in said position comprising a generally U-shaped non-magnetic bracket having a back wall and side walls terminating in in-turned lugs, said bracket embracing said magnetic field member and said bimetallic member, said in-turned lugs cooperating with formations on said latch member to prevent substantially all movement of said non-magnetic bracket with respect to said latch member, an in-turned lug struck

inwardly from the central portion of said back wall of said non-magnetic bracket and adapted to be received in a central opening of said magnetic member, the side walls of said non-magnetic bracket member being substantially greater than the thickness of said magnetic member whereby relative movement between said magnetic member and said armature member toward each other is made possible and means for adjustably positioning said bimetallic strip member in said casing.

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