

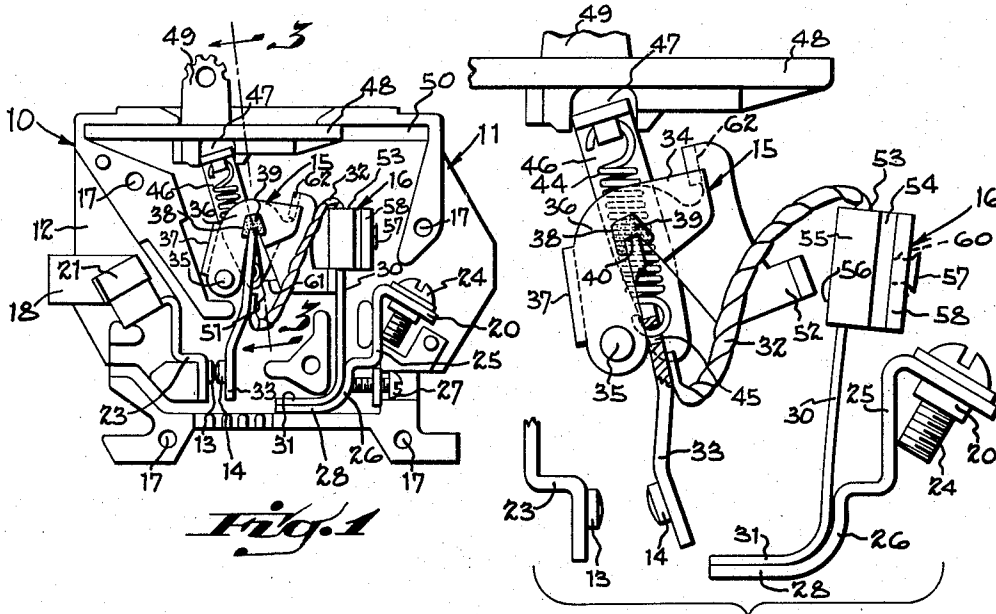
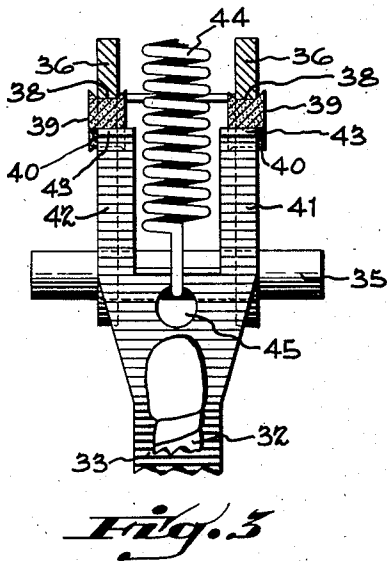
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CIRCUIT BREAKER

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CIRCUIT BREAKER

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This invention relates to circuit breakers and is more particularly directed to a circuit breaker embodying a spring actuated operating mechanism including a contact carrying member pivotally mounted in electrically insulated relation upon a carrier which is releasably latched by an overload current responsive element.

Circuit breakers of the type with which the present invention is concerned are employed for protecting residential and industrial power circuits against overload or short circuit conditions. In general, such a circuit breaker comprises a stationary and a movable contact, an operating mechanism for separating the contacts and a tripping device for actuating the operating mechanism in response to an overload condition. Many different forms of operating and tripping mechanism have been proposed.

A substantial number of these mechanisms include a switch arm carrying the movable contact at one end and pivotally nesting in the crotch of a rotatable carrier member at the other end. The carrier member is releasably engaged by a latching surface provided on a current responsive element such as bi-metallic strip or a magnetic armature. A manually operated handle is provided for shifting the carrier member and the switch arm to close the contacts and completed a circuit through the breaker. The switch arm is biased by an over center spring in such a manner that when the carrier is released due to an overload condition, the over center spring forces the carrier and switch arm to rotate, opening the contacts.

A flexible conductor usually in the form of a braided copper wire, interconnects the current responsive element and the switch arm for conducting current through the circuit breaker. It has been observed that the current flow actually divides, a portion flowing through the carrier member and a portion flowing through the flexible conductor. Consequently, under certain conditions a very substantial current flows from the latching element through the carrier member to the switch arm and movable contact. When the circuit breaker is tripped in response to an overload, arcing occurs between the carrier and latching member as they are separated, causing the adjacent surfaces of these elements to become pitted. Since these two surfaces must slide relative to one another to effect tripping of the breaker, any pitting or other roughening impairs the release of the breaker and forces the circuit to withstand a greater overload than that for which the breaker was originally calibrated. Furthermore, under some overload conditions the current flowing between the carrier and latching element is so high that the members are actually welded together, preventing the breaker from opening altogether. This, of course, is an extremely dangerous situation since the equipment in circuit with the breaker is then completely unprotected and fire or substantial damage to the equipment is likely to result. Also the current flowing through the latching element does not contribute to the magnetomotive force of the magnetic circuit, thereby reducing the effectiveness of the magnetic tripping means.

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The principal object of the present invention is to provide a circuit breaker in which any pitting or welding of the carrier member or latching element is eliminated. Consequently, the present breaker can be accurately calibrated and even after long periods of use remains effective to open a circuit at the same predetermined overload conditions for which the breaker was originally calibrated.

More specifically, the present invention is predicated upon the concept of providing a circuit breaker in which the carrier member is electrically insulated from one side of the power line so that no current can flow through the carrier from the latching member and no arcing can occur between these members when they are separated. In accordance with this invention, the carrier member is insulated by mounting insulator bearing members in the crotches or at the pivot bearings of the carrier member in which one end of the switch arm is cradled. Since this arm provides the only connection to one side of the circuit, the carrier is completely insulated from this side and no current flows between the carrier and the latching element. In the preferred embodiment these insulating members are preferably formed of nylon, Teflon or the like so that they not only provide effective electrical insulation, but in addition are advantageous since they also provide improved bearing surfaces, facilitating pivotal movement of the switch arm and further assuring smooth working of the breaker.

Another advantage of the present construction is that it can be incorporated in breakers of various designs without requiring any appreciable modification of the breaker. For example, one preferred form of circuit breaker is identical with the breaker shown in my earlier Patent No. 2,716,679 except that the crotches formed in the carrier member are slightly enlarged and insulating bearing members are press fitted in the crotches for pivotally supporting the switch arm.

These and other objects and advantages of the present invention will be more readily apparent from a further consideration of the following detailed description of the drawings illustrating a preferred embodiment of the invention.

In the drawings:

Figure 1 is a longitudinal view of a circuit breaker embodying the principles of the present invention, the front housing plate being removed to show the mechanism in detail.

Figure 2 is an enlarged elevational view showing the trip mechanism in the unlatched position.

Figure 3 is a cross-sectional view taken along line 3—3 of Figure 1.

As shown in Figure 1, a circuit breaker 10 constructed in accordance with the principles of the present invention comprises a housing 11 formed of two mating sections, fabricated from a suitable molded insulating material such as Bakelite or the like. For purposes of clarity, only section 12 is shown in the drawings.

The circuit breaker is provided with an electrical conducting circuit including a stationary contact 13 and a cooperating movable contact 14 mounted within the housing, together with a contact operating mechanism designated generally at 15 and a tripping mechanism indicated generally at 16. It will be understood that the exact details of the contact operating and tripping, or latching, mechanism constitute no part of the present invention. From the above discussion of the general principles of the present invention and the following detailed description of one embodiment, those skilled in the art will readily comprehend various circuit breaker mechanism in which the present invention may be advantageously incorporated.

The two sections of housing 11 preferably function not only to protect the various components of the breaker mechanism but also to support these elements in their proper operative relationship. The housing sections are configured to form various recesses and projections for receiving and retaining various breaker elements. The breaker parts such as contacts and operating mechanism components are set in their proper places in one section of the breaker housing before the two housing sections are brought together; the parts are thereafter retained in their proper position by the configuration of the two housing members which are joined together in any suitable manner, such as by means of bolts or rivets (not shown) passing through aligned openings 17 formed in each of the two sections.

Electrical connection to the breaker is made through contact jaws 18 and a threaded terminal connector 20. Contact jaws 18 extend outwardly from the housing in parallel spaced relationship with one another and are urged toward one another by a generally U shaped spring clip 21. The jaws and clip are sufficiently resilient to permit the insertion of a contact plate or other conductive member between the jaws, the member inserted being firmly gripped by the jaws to provide good electrical contact. The inner ends of the jaws are joined to connector strip 23 which fits within suitably configured slots formed in the housing members and carries stationary contact 13. This contact is welded or otherwise secured to the lower end of the strip.

Terminal 20 includes a screw 24 threadably engaging a terminal strip 25 which extends through an opening into the interior of the breaker housing. Terminal strip 25 is bent in an irregular shape and includes a segment 26 adapted for abutment with a calibrating screw 27 threadably mounted within an opening in the housing for movement toward and away from the terminal strip. Terminal strip 25 also includes a foot segment 28 adapted to support the tripping mechanism. Within the circuit breaker, the electrical circuit is completed through an elongated bi-metallic strip 30 having a mounting foot 31 welded to segment 28 of terminal strip 25, a flexible conductor or pigtail 32 secured to the free end of the bi-metallic strip and extending to a switch arm 33 which carries movable contact 14. The circuit also includes stationary contact 13, connector strip 23, and contact jaws 18.

The operating mechanism 15, by means of which the movable contact is shifted between its open and closed positions, includes in addition to switch arm 33, a carrier member 34 pivotally mounted within the housing by means of a pin 35 engaging aligned journal openings formed in the housing sections. Carrier member 34 includes two spaced parallel arms 36 joined by a cross strip 37.

Each of the carrier arms 36 is provided with a downwardly facing recess, or crotch 38. In accordance with the present invention an insulating bearing member 39 is mounted in each of these recesses. The bearing member is preferably formed of a material such as nylon, Teflon, Kel-F or the like which possesses both good electrical insulating properties and desirable mechanical properties such as resistance to breaking, cracking and deformation under pressure. The insulating bearing members 39 are preferably of generally U shaped configuration including a transverse groove 40 adapted to receive the upper end of switch arm 33. The insulating members are held within the crotches of arms 36 in any suitable manner such as by being press fitted in place or by means of a suitable adhesive.

As best shown in Figure 3, the upper end of switch arm 33, remote from contact 15 is bifurcated, forming arms 41 and 42. The upper ends of these arms are slightly rounded as at 43 to facilitate smooth pivotal movement of the arm within notches 40 formed in the bearing members. The switch arm is held in position by means of an over center spring 44 having one end

in engagement with an opening 45 provided in the switch arm and having a second end secured to an operating lever 46. The end of operating lever 46 to which this spring is attached resides in a recess 47 provided in plate 48 which is formed integral with operating handle 49 and is slidably mounted in a guideway 50 provided adjacent to the front wall of the housing sections. The opposite end of operating lever 46 is inserted between one wall of the housing and carrier member 34; this end of the operating lever abuts a projecting wall 51 of the housing.

One arm 36 of carrier member 34 constitutes a release arm and includes an extending portion 52 adapted for cooperative engagement with the core of the tripping mechanism to latch the operating mechanism with the contacts in a closed position and to release the operating mechanism so that the over center spring can rotate the carrier and switch arm to open the contacts.

The tripping device comprises a bi-metallic element 30 mounted upon segment 28 of terminal strip 25 and having a flexible conductor 32 welded adjacent to its free end. The free end of the bi-metallic element carries a generally U shaped ferromagnetic core 53 which is welded or otherwise secured in place and includes a support arm 54, a second arm 55 shorter than the first, and a connecting segment 56. Support arm 54 terminates in a tang 57 which loosely carries armature 58. The armature is preferably in the form of a substantially rectangular plate of ferromagnetic material and is provided with an elongated slot 60 for receiving tang 57. The tang passes through the slot and is peened over its end to hold the armature in place.

The ends of armature 58 reside in recesses formed in the opposite housing sections. When arm 33 is latched and the contacts are in the closed position, the free end of the armature is spaced from arm 55 of the core and prevented from moving to the core by its abutment with a shoulder of the housing. The end of armature 53 secured to core arm 30 is held in abutment with a second shoulder of the housing by the spring action of the bi-metallic strip. An air gap or spacing between arm 55 and the armature is thus established, the size of the gap being determined by the difference in length of the two core arms. This air gap preferably is of a minimum length which is not appreciably greater than the distance the core must move to release arm 52. Both the armature and core are free to move within the recesses of the housing in the direction of the movement of the hot bi-metallic strip, to the right in Figures 1 and 2. The depth of the recesses in the housing is preferably sufficient to permit substantial movement of the core and armature beyond the distance required to effect release of arm 52.

In operation, the contacts are manually shifted from an open to a closed position by operating handle 49. In order to close the contacts following a tripping of the breaker, the operating handle is shifted from its left hand position shown in Figure 1 to the right hand end of the slot. During its movement, handle 49 causes operating lever 46 and in turn spring 44 to pivot clockwise, the lower end of the operating lever pivoting within arcuate shoulder 61 of the breaker housing. The operating lever during its pivotal movement engages a projecting lug 62 formed on the carrier member and thereby forces the carrier member to rotate clockwise about pin 35. Near the end of its clockwise movement, the release arm 52 of the carrier member engages segment 56 of the core slightly flexing the bi-metallic strip to permit passage of the release arm under the core. At its extreme position, the release arm passes beneath the lower edge of the core and the bi-metallic strip returns to its original position in which segment 56 of the core locks the release arm in place.

The operating handle 49 is then returned to its left hand position as shown in Figure 1 to effect manual closing of movable contact 14 and stationary contact 13. Move-

ment of the handle in this direction causes counterclockwise pivotal movement of operating lever 46 and spring 44 carried by the operating lever. As the operating handle approaches its extreme left hand position, the spring is moved beyond its over center position, whereby the spring urges contact arm 33 in a clockwise direction to bring movable contact 14 into firm contact with stationary contact 13. An electrical circuit is now completed from terminal 20 through conductor strip 26, bi-metallic strip 30, pigtail 32, arm 33, movable contact 14, stationary contact 13, connector strip 23, and contact jaws 21. It will be noted, however, that carrier member 34 does not conduct any current since that member is insulated from switch arm 33 at insulated bearing members 39.

Upon the occurrence of a short circuit, or similar heavy overload condition causing a current flow of a predetermined magnitude through the breaker, the current through flexible conductor 32 and bi-metallic strip 30 energizes core 53 causing the establishment of a magnetic field around this core. The effect of this magnetic field is to cause the attraction of the free end of the armature and arm 52 of the core. The armature is restrained from movement toward the core by the shoulder of the housing, so that the core is forced to move toward the armature. In the strong magnetic field the core moves rapidly toward the armature and becomes disengaged from the release arm of the carrier member. Upon tripping of the release arm, carrier member 34 is urged in a counterclockwise movement about pin 35 by the main operating spring 44. Movement of the carrier member in this direction causes counterclockwise rotation of switch arm 33 about bearing members 39 thereby effecting rapid opening of the contacts. It will be appreciated that throughout the entire operation of the device, pigtail 32 conducts all of the current from bi-metallic strip 30 to switch arm 33, while carrier member 34 is completely insulated from the switch arm. Consequently, no arcing occurs between the carrier member and magnetic latch; and there is no tendency for these members to weld together or to become pitted.

When an overload current of moderate magnitude flows through the carrier member, it causes the bi-metallic strip 30 to become heated and since the high expansion side of the element is disposed toward the releasable arm, the bi-metallic strip deflects away from the arm, toward the right in Figure 1. If the moderate overload continues for an appreciable period, the free end of the bi-metallic strip is shifted sufficiently far to the right to disengage the core from the release arm, tripping the operating mechanism to open the contacts as explained above. Again all of the current flowing through the circuit breaker is carried by flexible conductor 32 and none passes through the carrier member, so that when the contacts are opened, there is no possibility of welding or pitting.

Having described my invention, I claim:

1. In a circuit breaker having a housing, a stationary contact, a movable contact adapted for engagement with the stationary contact, the combination of a switch arm supporting said movable contact, a carrier member, said carrier member being formed of a conductive metal, current responsive tripping means for releasably latching the carrier member, said tripping means including a current carrying bi-metallic strip, and core carried by said bi-metallic strip and disposed for engagement with said carrier member, a flexible conductor electrically inter-

connecting said bi-metallic strip and said switch arm, said carrier member being configured to form a crotch, a bearing member formed of non-conducting material disposed in said crotch, the end of said switch arm remote from said movable contact being pivotally supported by said bearing member, and means including an over center spring for actuating the switch arm to open the contacts upon release of said carrier.

2. A circuit breaker comprising a housing, a stationary contact, a movable contact adapted for engagement with said stationary contact, a switch arm supporting said movable contact, a carrier member, said carrier member being formed of a conductive metal, means for releasably latching the carrier member, said carrier member including two spaced arms, each of said arms being configured to form a crotch, an insulating bearing member disposed in each of said crotches, said switch arm being pivotally supported by said insulating members, and means including an over center spring for actuating the switch arm to open the contacts upon release of said carrier.

3. In a circuit breaker having a housing, a stationary contact, a movable contact adapted for engagement with the stationary contact, the combination of a switch arm supporting said movable contact, a carrier member, said carrier member being formed of a conductive metal, current responsive tripping means for releasably latching the carrier member, said tripping means including a current carrying bi-metallic strip, a magnetic core mounted upon said strip and disposed for engagement with said carrier member, a flexible conductor electrically interconnecting said bi-metallic strip and said switch arm, said carrier member being configured to form two arms each having a crotch formed therein, a hard plastic, non conductive bearing disposed in each of said crotches, the end of said switch arms remote from said movable contact being pivotally supported by said bearing members, and means including an over center spring for actuating the switch arm upon release of said carrier.

4. In a circuit breaker having a housing, a stationary contact, and a movable contact adapted for engagement with the stationary contact, the combination of a switch arm supporting said movable contact, a carrier member, said carrier member being formed of a conductive metal, current responsive tripping means for releasably latching the carrier member, said tripping means including a current carrying bi-metallic strip, a magnetic core mounted upon said strip and disposed for engagement with said carrier member, a flexible conductor electrically interconnecting said bi-metallic strip and said switch arm, said carrier member being configured to form two arms each having a crotch formed therein, a hard plastic non-electrically conductive bearing disposed in each of said crotches, each of said bearings having an arcuate recess formed therein, the end of said switch arm remote from the movable contact being in engagement with the recesses in said bearing members and being pivotally supported therein in spaced relationship with the carrier member, and means including an over center spring for actuating the switch arm upon release of the carrier.

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