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3,061,698

SPRING OPERATED MECHANISM FOR ELECTRIC CIRCUIT BREAKERS

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Filed Mar. 20, 1959, Ser. No. 800,839
1 Claim. (Cl. 200—88)

This invention relates generally to electric circuit breakers and more particularly to a spring-operated mechanism for automatically opening and for manually opening and closing the separable contacts of an electric circuit breaker.

Automatic electric circuit breakers often employ a spring-operated mechanism to facilitate the opening and closing of the separable contacts of the circuit breaker. The design of such spring operated mechanisms is based upon several known electrical and mechanical requirements. Contact pressure between the separable contacts of the circuit breaker must be sufficient to prevent excessive heating of the contacts. Also the force required to move a manual operator to initiate manual opening and closing of the contacts should be kept to a minimum. In addition, it is often required that a spring-operated mechanism should effect separation of the contacts of the circuit breaker as rapidly as possible upon the occurrence of a fault or overload in the branch circuit protected by the circuit breaker in order to limit the damaging effects of short circuit current on the separable contacts of the circuit breaker.

The requirements of adequate contact pressure, ease of manual operation, and rapid separation of the contacts are often met, in circuit breakers known to the art, by the use of relatively complex spring operated collapsible linkages that employ one or more toggle members pivotally connected to each other. Typically, the toggle members are connected to each other and to a movable contact carrier by a journaled bearing in the form of a rivet. However, every rivet employed as a pivotal connector between two parts requires both an assembly operation and an upsetting operation during fabrication of the mechanism. Further, close tolerances must be provided in such bearings which create further difficulty in the manufacture, assembly, and maintenance of the mechanisms.

Accordingly, a broad object of the present invention is to provide an improved and relatively uncomplicated spring-operated mechanism for a circuit breaker that satisfies the requirements of adequate contact pressure, ease of manual operation, and rapid separation of the contacts.

A further object of the present invention is to provide a spring-operated mechanism for a circuit breaker wherein no part is connected to another part by a riveted connection.

Another object of the present invention is to provide an improved spring-operated mechanism for a circuit breaker wherein an overcenter toggle biases a separately mounted contact carrier to the open and closed contact position.

A more specific object of the present invention is to provide a spring-operated mechanism for an electric circuit breaker comprising a manual operator that is supported for rotation by the enclosure and which has a fulcrum thereon. A releasable member is supported for rotation by the enclosure and is normally restrained in a latched position by a suitable trip device. A toggle link is supported for rotation by and upon the fulcrum on the manual operator and is biased into engagement therewith by an overcenter spring that extends between the releasable member and the toggle link. The manual operator is rotatable in opposite directions to carry the fulcrum thereon across the line of action of the overcenter spring to

reverse the rotative bias of the spring on the toggle link. The toggle link is slidably connected with a movable contact carrier that is supported for rotation by the enclosure. The trip device is operative in response to abnormal circuit conditions in a circuit associated with the circuit breaker to release the releasable member, which, upon release, carries one end of the spring, and therefore the line of action of the spring, to the opposite side of the fulcrum on the manual operator thereby to reverse the rotative bias of the overcenter spring on the toggle link. Rotation of the toggle link biases the contact carrier to the contact open position.

Other objects and advantages of this invention will become apparent from the following description wherein reference is made to the drawings in which:

FIG. 1 is a side elevation of a spring-operated mechanism in accordance with the present invention shown in the contacts closed position and supported by a molded insulating enclosure in operative relationship with a trip device.

FIG. 2 is a sectional view taken along the lines II—II of FIG. 1.

FIG. 3 is a perspective view of the handle, toggle link and contact carrier of the circuit breaker with the parts in disengaged position for clarity.

FIG. 4 is a side elevation of the spring-operated mechanism of FIG. 1 after manual operation to the contacts open position.

FIG. 5 is a side elevation of the spring-operated mechanism of FIG. 1 after automatic operation of the mechanism to the contacts open position.

Referring to FIG. 1, a spring-operated mechanism 10 in accordance with this invention is shown operatively mounted in a circuit breaker 11. As shown, the circuit breaker 11 comprises an insulating base 12 provided with suitable recesses 13 and barriers 14 for supporting the components thereof in operative position. A cover portion 15 (FIGS. 4 and 5) complementary to the base 12 substantially encloses the components of the circuit breaker to form an enclosure and is preferably held in position by a plurality of rivets 15'. For use in conjunction with a plug-in panelboard, the circuit breaker 11 may be electrically connected to one side of an external source of electrical energy by a spring jaw clip 16 that extends exteriorly of the circuit breaker 11 through an opening 17 in the base 12. The circuit breaker 11 is arranged to be mechanically supported and held within a panelboard by a spring jaw clip 18. The clip 16 is electrically connected to a source terminal 19 that has a fixed contact 20 mechanically and electrically secured thereto, as by welding. A movable contact 21 is supported on a movable contact carrier 22 in operative alignment with the fixed contact 20. The contacts 20 and 21 are shown in the circuit closed position in FIG. 1. A flexible conductor 24 is electrically and mechanically secured at one end to the movable contact carrier 22, as by welding, and at the other end to an insulated conductor 25 that extends from a trip device 26. The trip device 26 may be of any suitable construction but it is preferably one similar to the trip device disclosed in Serial No. 744,287, filed June 24, 1958, by Edward P. Dessert et al. and assigned to the assignee of the present application.

The trip device 26 is electrically and mechanically connected to a load terminal strip 28 that is maintained in position within the insulating base 12 as by a screw 29. To facilitate connection of the circuit breaker 11 to an external load, a solderless connector or load terminal 30 is electrically and mechanically connected to the load terminal strip 28 at the outer end thereof.

The trip device 26 comprises an elongated bimetallic strip 31 that is electrically and mechanically connected,

as by welding, at the upper end thereof as seen in the drawings, to the upper end of the terminal strip 28. A magnetic core 32 of generally U-shaped cross-section is attached to the lower end of the bimetallic strip 31, as by welding. The magnetic core 32 extends upwardly generally parallel to the bimetallic strip 31 with the leg portions thereof disposed on opposite sides of the strip 31 and extending toward the spring operated mechanism 10 of the circuit breaker 11. The insulated conductor 25 is wound about the magnetic core 32 and is mechanically and electrically secured to the strip 31, as by welding. The bimetallic strip 31 and insulated conductor 25 thus carry the current of the circuit associated with the circuit breaker and cause a flux to be created in the magnetic core 32 that is related in amount to the magnitude of current in the circuit.

The magnetic core 32 is provided, at its upper end portion, with a hook-like armature support 34 that pivotally supports a magnetic armature 36 in operative alignment with the magnetic core 32. A helical compression spring 41 normally biases the armature 36 clockwise with respect to the magnetic core 32 so as to provide an air gap between the armature 36 and the magnetic core 32. When the amount of flux in the core 32 exceeds a predetermined value, magnetic attraction of the armature 36 overcomes the bias of the spring 41 and causes the armature 36 to swing counterclockwise to release the spring-operated mechanism 10 of the circuit breaker 11, as will be discussed.

An ambient temperature compensating bimetallic strip 44 is attached, as by welding, to the lower end portion of the magnetic core 32 and extends downwardly therefrom substantially parallel to the core 32 from its point of attachment and upwardly inwardly of the circuit breaker to engage the lower end portion of the magnetic armature 36 on the opposite side thereof from the bimetallic strip 31. Counterclockwise flexure of the bimetallic strip 31 about its point of attachment to the terminal strip 28 upon heating thereof is transmitted through the magnetic core 32 to the magnetic armature 36 by the ambient temperature bimetallic strip 44. A latching surface 45 on the magnetic armature 36 serves to normally latch the spring-operated mechanism 10 in the reset position and is retracted from the latched or reset position upon movement of the armature 36 due to flexure of the bimetallic strip 31 or attraction of the armature 36 to the magnetic core 32 upon the occurrence of an overload or fault current, respectively, in the circuit associated with the circuit breaker 11.

The path of current through the circuit breaker 11 is from the solderless connector 30 on the terminal strip 28 through the bimetallic strip 31 and insulated conductor 25 to the flexible conductor 24 and movable contact carrier 22 to the movable contact 21, then to the fixed contact 20 and source terminal strip 19 and the spring jaw clip 16.

In accordance with the present invention, the spring-operated mechanism 10 comprises a manual operator 50 of insulating material having spaced integral trunnions 51 thereon which are pivotally supported in suitable bearing recesses (not shown) in the insulating base 12 and cover. The manual operator 50 has a handle portion 52 which projects through an opening 53 in the top of the base 12 to facilitate manual movement of the operator 50 to cause operation of the mechanism 10 to open and close the contacts 19 and 20.

An inner end portion 54 of the manual operator 50 is bifurcated to define two legs 55 and 56 provided with fulcrum recesses 57 and 58, respectively, for the support of an elongated U-shaped toggle link 59. The U-shaped configuration of the toggle link 59 is defined by a bight portion 60 and a pair of spaced upwardly extending leg portions 61 and 62. A pair of upper end faces 63 and 64 on the leg portions 61 and 62, respectively, are biased into the fulcrum recesses 57 and 58, respectively, of the

manual operator 50 by an operating spring 65 that extends between the toggle link 59 and a releasable member 66. One end portion of the spring 65 is secured in a hole 67 in the bight portion 60 of the toggle link 59 and the other end portion is similarly secured in a hole 68 in the releasable member 66. The releasable member 66 is supported for rotation by an upstanding pivotal support 69 formed on the base 12 and is releasably restrained from rotation by engagement of an end portion 70 thereof with the latching surface 45 on the magnetic armature 36.

A pin 71 extends transversely of the toggle link 59 and is secured to the leg portions 61 and 62 thereof adjacent and parallel to the bight portion 60, as by welding. The pin 71 is slidably engaged in a pair of spaced aligned slots 72 and 73 extending longitudinally of the contact carrier 22 and formed in a pair of spaced, parallel flanges 74 and 75, respectively, of the movable contact carrier 22. The contact carrier 22 is supported for rotation by a pin 77 that extends through aligned holes 78 and 79 in the flanges 74 and 75 of the contact carrier 22, respectively. The pin 77 is supported in suitable aligned recesses (not shown) in the insulating base 12 and cover. The pin 71 on the link 59 cooperates with the slots 72 and 73 in the contact carrier 22 to transmit movement of the toggle link to the contact carrier 22.

To limit heating of the operating mechanism 10 upon separation of the contacts 20 and 21, the toggle link 59 is provided with a hook-like end portion 80 that engages a suitably cutout portion 81 (FIG. 2) in a fiber slide member 82. The slide member 82 reciprocates in a suitable recess 13 in the base 12 upon movement of the toggle link 59.

As mentioned, the circuit breaker 10 may be manually operated to the open and closed position by movement of the manual operator 50. Movement of the manual operator 50 in the clockwise direction from the position shown in FIG. 1 to the open position, shown in FIG. 4, carries the upper ends 63 and 64 of the toggle link 59 to the left of the line of action of the spring 65 thereby causing the spring to bias the toggle link 59 counterclockwise with a snap action. Counterclockwise movement of the toggle link 59 is transmitted to the contact carrier 22 through the pin 71 which cooperates with the slots 72 and 73 in the contact carrier 22 to bias the contact carrier 22 counterclockwise to the open position. Movement of the manual operator 50 in the counterclockwise direction from the open position (FIG. 4) to the closed position (FIG. 1) moves the upper ends 63 and 64 of the toggle link 59 to the right of the line of action of the spring 65 which then biases the toggle link 59 clockwise with a snap action. Movement of the toggle link 59 is transmitted through the pin 71 to the contact carrier 22 which is biased clockwise to the contact closed position as shown in FIG. 1.

Upon the occurrence of an overload or fault in an electrical circuit associated with the circuit breaker 11, the latching surface 45 is retracted from under the end portion 70 of the releasable member 66. Upon release, the releasable member 66 rotates clockwise, as shown in FIG. 5, about the pivotal support 69 thereof carrying the spring 65 past the fulcrums 57 and 58 in the manual operator 50. Rotation of the releasable member 66 is arrested by a stop member 84.

The spring 65 then biases the toggle link 59 counterclockwise about the fulcrums 57 and 58 and the pin 71 thereon biases the contact carrier 22 to the contact open position. Also, the manual operator 50 is biased clockwise to a trip indicating position (FIG. 5) against a pin 85 on the releasable member 66. The mechanism 10 of the circuit breaker 11 may be reset after automatic operation thereof by moving the manual operator 50 in the clockwise direction beyond the off position, shown in FIG. 4, to rotate the lower end portion 54 thereof into contact with the reset pin 85 on the releasable member 66. The

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lower end portion 54 of the manual operator 50 upon further clockwise movement thereof biases the reset pin 85 and the releasable member 66 counterclockwise about the pivotal support 69 until the latching portion 70 of the releasable member 66 reengages the latching surface 45 on the armature 36. Subsequent counterclockwise rotation of the manual operator 50 to its closed position, shown in FIG. 1, closes the separable contacts 20 and 21 as described hereinbefore.

What is claimed is:

A circuit breaker comprising:

- (a) an insulating enclosure having a rotary support for a manual operator,
- (b) a manual operator rotatably supported in said rotary support of said enclosure,
- (c) a stationary contact supported by said enclosure,
- (d) a contact carrier rotatably supported by said enclosure,
 - (1) said contact carrier having a body generally U-shaped in cross section including a bight portion and a pair of spaced leg portions extending substantially perpendicularly therefrom,
 - (2) each of said leg portions having an elongated slot therein extending substantially parallelly to said bight portion and each leg portion also having a lateral extension pivotally connected at a free end portion thereof to said enclosure at a location closer to said stationary contact than is said rotary support for said manual operator.
 - (3) said bight portion having an integral angularly disposed extension forming an offsetting portion extending from an end of said bight portion remote from the pivotal connection of said lateral extensions of said leg portions to said enclosure and extending in substantially the same direction as the direction in which said leg portions extend from said bight portion, and
 - (4) said offsetting portion having an integral angularly disposed free end portion extending substantially parallelly to said bight portion and forming an offset extension thereof,
- (e) a movable contact secured to said offset extension of said bight portion of said contact carrier on the side thereof facing in the direction of extension of said leg portions from said bight portion, rotation of said contact carrier in opposite directions about the pivotal connections of said free end portions of said lateral extensions of said leg portions to said enclosure respectively engaging said movable contact with said stationary contact and disengaging said movable contact from said stationary contact,
- (f) a releasable member rotatably supported by said enclosure,
- (g) a trip device supported by said enclosure and normally retaining said releasable member in a

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latched position, said trip device being operative in response to abnormal circuit conditions to release said releasable member from said latched position,

- (h) a fulcrum on said manual operator rotatable therewith and located closer to said stationary contact than is said rotary support for said manual operator,
- (i) a toggle link rotatably supported by said fulcrum and interposed between said leg portions of said contact carrier,

- (1) said toggle link having a body generally U-shaped in cross section including a bight portion and a pair of spaced leg portions extending substantially perpendicularly therefrom toward said bight portion of said contact carrier,
- (2) said leg portions of said toggle link having lateral extensions respectively engaging said fulcrum and also having actuating portions thereon extending outwardly in opposite directions and respectively engaging said slots in said leg portions of said contact carrier, and
- (j) an overcenter spring connected at one end to said bight portion of said toggle link and at its other end to said releasable member at a location closer to said stationary contact than is said rotary support for said manual operator and biasing said lateral extensions of said toggle link into engagement with said fulcrum while also biasing said toggle link for rotation about said fulcrum, said manual operator being rotatable to rotate said fulcrum selectively in opposite directions across the line of action of said spring to thereby reverse the rotative bias of said spring on said toggle link and effect rotation of said contact carrier in a direction opposite to the direction of rotation of said manual operator, said releasable member being operative upon release from said latched position to carry the line of action of said spring to the opposite side of said fulcrum from its relative location in the latched position of said releasable member to thereby reverse the rotative bias of said spring on said toggle link, and said fulcrum in all positions of said manual operator being closer to the pivotal connection of said contact carrier to said enclosure than to the pivotal connection of said contact carrier at the slots thereof to the actuating portions of said toggle link.

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