CIRCUIT BREAKER Resetting AND CLOSING MECHANISM

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ABSTRACT OF THE DISCLOSURE

A circuit breaker having "on," "off" and tripped positions whereby manual movement of the operating handle to the "off" position does not operate the tripping means and whereby operation of the tripping means moves the handle to the tripped position but does not reset the latching means. The single movement of the operating handle from its tripped position toward to its "on" position has the dual function of resetting the latching means and moving the movement trip to its operative position in contact with the fixed contact.

This invention relates to circuit breakers, and more particularly relates to mechanism for effecting automatic movement of the movable contact of a circuit breaker from its "tripped" to its "on" or closed circuit position in response to the operating handle of such circuit breaker being moved from its tripped to its "on" position.

In recent years there has been considerable effort expended in the electrical industry to reduce the size of circuit protective equipment. For example, in the area of small air circuit breakers of the type with which the instant invention is intended to cooperate, the industry has seen acceptance of one-half inch wide circuit breakers as a substitute for the long accepted one inch breaker. Further evidence of the present emphasis on reduction in size and simplicity in design is evidenced by United States patent application Ser. No. 632,045, filed Oct. 17, 1966, entitled, "Circuit Breaker Mechanism Mounting Plate Assembly," to Carl E. Gryciko, and assigned to the assignee of the instant invention, where there has been described in great detail a novel circuit breaker which has achieved utmost simplicity in design and maximum reduction in overall size.

Simultaneously with the development of smaller and more simplified circuit breakers, and related thereto, engineers have re-examined the operating characteristics of small circuit breakers and looked for ways in which the operation thereof might be simplified.

Thus circuit breakers of the prior art generally are manually operable between three positions. Specifically, assuming the circuit breaker to be in the "on" position, that is, with the contacts closed and with the latching mechanism, to be hereinafter described, in its latched position, the occurrence of a prolonged overload or instantaneous fault current causes the latching mechanism whereby an overcenter spring operated mechanism snaps the circuit breaker movable contact to its open circuit position. The breaker is now in its tripped position.

After the fault has been cleared and it is necessary to re-establish the circuit being protected, the following steps are normally required. First, the operating handle of the circuit breaker is moved from its tripped position (that is, the position the handle occupies with the circuit breaker contact open and the latching mechanism tripped) in a first direction to a reset position in which the latching mechanism is cocked for subsequent operation. In the reset position, the movable contact of the circuit breaker remains open, and hence the reset position is commonly called the "off" position. Finally, the operating handle is moved in the opposite direction from the reset position back to the "on" position. It is obvious that the two-step operation required to convert a circuit breaker from its tripped position to its "on" position is diametrically opposed to the basic concept of simplicity which today is of primary importance in the circuit breaker field.

The instant invention addresses itself to both problems outlined above. That is, with conscientious effort it has been specifically designed to cooperate with the circuit breaker operating mechanism of the aforementioned application Ser. No. 632,045, although in no way intended to be limited to such environment; while at the same time it simplifies circuit breaker operation, by providing that in a single movement of the operating handle thereof from the tripped to the "on" position, the movable contact of the circuit breaker will experience complete, automatic, and continuous movement from its tripped position through the "off" position and to the "on" position.

Specifically, and as explained in greater detail in said aforementioned patent application Ser. No. 632,045, a circuit breaker is provided with a common, relatively flat mounting plate upon which all parts of the circuit breaker mechanism are ultimately secured and about points on which various movable parts of the circuit breaker mechanism may rotate. The breaker includes a stationary contact and a movable contact rotatable about a pivot post provided on a cradle member pivotally secured to the aforementioned mounting plate. A handle is connected to the movable contact by means of an over-center operating spring, with the latch of the tripping mechanism of the breaker maintaining the cradle in its latched position whenever the breaker is in the "on" or "off" condition.

Upon the occurrence of a predetermined fault, the tripping mechanism permits the release of the cradle whereby the overcenter spring rotates both the cradle and the movable contact to open the circuit being protected.

To perform the automatic reclosing of the circuit breaker contact, upon the movement of the operating handle from its tripped to its "on" position, there is provided automatic relatching means in the form of a linkage assembly which cooperates with the operating handle, the cradle, and the common mounting plate of the circuit breaker to perform three primary functions. First, the automatic relatching means is so arranged as to define an intermediate or "off" position for the circuit breaker operating handle when such handle is manually rotated between its "on" and "off" position to close and open, respectively, the circuit breaker contacts while the cradle is latched. Second, upon the occurrence of a fault as detected by the circuit breaker tripping mechanism, the automatic relatching means is so arranged as to permit the circuit breaker operating handle to rotate past its "off" to its tripped position during which time, of course, the circuit breaker movable contact is experiencing further movement to its tripped position, beyond its "off" position, to assure current interruption. Third, in response to a single continuous movement of the circuit breaker operating handle from its tripped back to its "on" position, the automatic relatching means is so arranged as to (1) automatically relatch the cradle of the breaker and (2) return the circuit breaker movable contact to its engaged or "on" position.

It is to be understood that, although the instant invention has been and will be further described with respect to the particular operating mechanism of the novel circuit breaker shown and claimed in application Ser. No. 632,045, it is in no way limited to use in such circuit breaker but rather applicable to any type of circuit breaker mechanism which includes both an operating handle and a latchable cradle.
Accordingly, it is an object of the instant invention to provide automatic relatching means for use in a circuit breaker which achieves both the latching of the cradle thereof and an upstanding movement of the movable contact thereof by its tripped and "on" position in response to a single continuous movement of the operating handle thereof between its tripped and "on" position.

Another object of the instant invention is to provide such automatic relatching means which is particularly adapted to cooperate with circuit breakers especially designed from the viewpoint of reduction in size and utmost simplicity in operation.

Another object of the instant invention is to provide such automatic relatching means comprised of a linkage assembly of a minimal number of parts so arranged as to perform a multiplicity of functions.

Still another object of the instant invention is to provide such automatic relatching means which defines an "off" position for a circuit breaker operating handle; permits such operating handle to pass said "off" position and reach a tripped position in response to the detection of a fault by the tripping mechanism of such breaker; and causes the operating mechanism of such breaker to be automatically relatched and the movable contact of the breaker to experience movement from its tripped to its "on" position in response to a single continuous movement of the operating handle from its tripped to its "on" position.

Other objects and a fuller understanding of the instant invention may be had by referring to the following description and drawings, in which:

FIGURE 1 is an exploded perspective view of internal parts of a circuit breaker constructed in accordance with the teachings of said aforementioned patent application Ser. No. 632,045, and including the automatic relatching means of the instant invention;

FIGURE 2 is a plan view, with the cover removed, of the circuit breaker of FIGURE 1, with the operating mechanism thereof occupying the "on" position;

FIGURE 3 is a partial view of the circuit breaker of FIGURE 2, with the parts thereof occupying the "off" position; and

FIGURE 4 is a view similar to FIGURE 3, but showing the circuit breaker in the "trip" position.

Referring to FIGURE 1, there is shown the internal mechanism 10 of a circuit breaker constructed in accordance with the principles of the aforementioned patent application Ser. No. 632,045, which mechanism includes the automatic relatching apparatus 12 of the instant invention. It is re-emphasized that although the automatic relatching apparatus 12 will be specifically described with respect to the internal mechanism 10 of said aforementioned pending application, it is to be understood that such disclosure is intended in no way to limit the application of the instant invention, since the instant invention is equally applicable to any circuit breaker mechanism which includes both an operating handle and a rotating cradle as part of its operation.

Similarly, it is to be understood that although the instant invention will be described with respect to a circuit breaker for the protection of a single phase of current, the instant invention could be appropriately modified (for example, by tying together three linkage assemblies to operate simultaneously) to operate in a circuit breaker for the protection of more than one phase.

The circuit breaker mechanism 10 includes a common plate 14 integrally provided with the following parts: an upstanding cradle-pivoting tab 16; an upstanding relatching-pivoting tab 18; an upstanding tripping mechanism-pivoting tab 20; and an upstanding spring-retaining tab 22. In addition the plate 14 includes an elongated slot 24; a generally centrally located operating handle-pivoting aperture 26; and an arcuate slot 28 which receives an upstanding tab portion of the operating handle 30, as hereinafter described.
automatic relatching mechanism in a counterclockwise direction about the pivot point 18.

Referring to FIGURE 2, there is shown the manner in which the circuit breaker operating mechanism 10 cooperates within a circuit breaker casing generally indicated at 110. The casing 110 normally includes a cover not shown, whose withdrawal reveals the mechanism housing cavity 112. The casing walls include appropriately located passageways for stabs 78 and 90, a passageway 114 to permit the exit of gases generated during circuit interruption in the manner taught by United States patent application Ser. No. 568,500, filed July 28, 1966, entitled "Mounting Block for Circuit Breaker," in the name of Cas. E. Greitzko, assigned to the assignee of the instant invention, and now issued as U.S. Patent 3,326,553 on June 27, 1967; and a passageway 115 provided through the outer casing wall to house an adjusting screw 117 which is screw-threaded through an upstanding tab 119 provided on the mounting plate 14 to vary the position of the bimetallic element 82 and hence the entire tripping mechanism 80 relative to the latch tip 54 of cradle 44. (Note that the tripping assembly 80 is constantly biased in a counterclockwise direction in FIGURE 2 by the biasing spring 103 secured between the hook-like projection 105 on the tripping mechanism and the actuating surface 102 provided on the first member 92 of the automatic relatching mechanism.) The external casing wall is also removed at 116 through which an operating knob 118 may be secured to the operating handle 30 of the internal mechanism in a manner to be further described. The upper arcuate opening 116 is defined at opposite ends thereof by casing wall projections 120 and 122.

In the interior cavity 112 and upstanding from the rear wall 124 of the casing 110 there is provided an internally generally U-shaped projection 126 which houses the bifurcated end 46 of the cradle 44 which in turn is pivoted upon the tab 16 of the mounting plate 14.

The operating knob 118 is actually an integral portion of a one-piece arc-like member 124a which is guided for movement within the interior 112 of the casing 110 by the internal surfaces of the casing walls as well as the upstanding projection 126. The arc-like member 124a has a cutout notch 127 which receives the upstanding tab 32 of the operating handle 30 whereby rotation of the knob 118 between limits defined by wall projections 120 and 122 will similarly rotate the operating handle 30.

In FIGURE 2 the circuit breaker is in the "on" position, that is, with the contact pads 70 and 72 completing a circuit path through the stab 78, contact pads 70, 72, the conductive braid 86, the bimetallic element 82, the conductive braid 88 and through the stab 90. In the "on" condition, the latch 56 of the tripping mechanism 80 is in a locking relationship with respect to the latch tip 54 of cradle 44, with the operating spring 72 biasing the movable contact arm 62 in a counterclockwise direction about point 64 on cradle 44 to maintain the movable contact pad 70 in firm electrical contact with the stationary pad 76.

It will further be observed that in the "on" position, biasing spring 103 attempts to establish as short a distance as possible between the projection 105 on the tripping mechanism 10 and the actuating surface 102 on the first member 92 of the automatic relatching assembly whereby the planar actuating surface 100 of member 92 is necessarily so positioned as to be in the path of movement of an upstanding tab 128 (which cannot be seen in FIGURE 1) provided on the operating handle 30.

The function of this last mentioned upstanding tab 128 on the operating handle 30 may best be understood by referring to FIGURE 3 wherein the operating handle 30 has been manually moved from its "on" position to an "off" position intermediate the projections 120 and 122, and during which time the operating spring 72 has passed over point 64 on the cradle 44 to rotate the movable contact arm 62 from its "on" position to its "off" position. Note that since the opening of the circuit breaker was by manual operation and not in response to the occurrence of a fault, the circuit breaker is in its "off" position rather than the tripped position, with the latch 44 still being latched by the cooperation of latch 56 and latch tip 54.

As can be most clearly seen in FIGURE 3, the operating handle 30 is maintained in the "off" position by the cooperation of actuating surfaces 100 and 102 on member 92 with the upstanding tab 128 and the cradle 44, respectively. Specifically, as the operating handle 30 is rotated by means of the knob 118 counterclockwise in FIGURE 3, the tab 128 on the operating handle 30 engages the actuating surface 100 of member 92. However, with the cradle 44 latched, further counterclockwise rotation of the member 92 of the automatic relatching assembly 12 is prevented by the engagement of the upstanding actuating surface 102 thereon with the cradle 44.

Turning now to FIGURE 4, it will be assumed that a time-delayed or instantaneous fault current has been detected by the tripping mechanism 80 so as to rotate latch 56 from its blocking position with respect to the latch tip 54 of cradle 44. At this time the operating spring 72 rotates movable contact arm 62 and necessarily the cradle 44 in a clockwise direction to the tripped position shown in FIGURE 4, whereby there is even a greater separation between contact pads 70 and 76 thereby assuring extinguishment of any arc drawn therebetween. Simultaneously with the aid of biasing spring 42, the operating handle 30 is urged through its "off" position in FIGURE 3 to its tripped position in FIGURE 4; it being noted that the upstanding tab 128 thereon is now free to rotate member 92 counterclockwise since the actuating surface 102 thereof is no longer restrained by the cradle 44 as it was in FIGURE 3. It is to be noted that while member 92 is being rotated counter-clockwise, biasing spring 103 is put under tension whereby once the operating handle 30 has reached its tripped position and the upstanding tab 128 thereof is no longer in engagement with the actuating surface under it (this instant in time being shown in phantom at 100' in FIGURE 4), the member 92 will be rotated clockwise back to the initial position it occupied in FIGURE 2.

To convert the breaker from the tripped condition shown in FIGURE 4 back to the "on" position shown in FIGURE 2, the operator merely grasps the knob 118 and rotates it (and the operating handle 30) from its position in abutment with the wall projection 120 to its other extreme position defined by the wall projection 122. In so doing, the upstanding projection 128 on the operating handle 30 engages the actuating surface 100 of member 92 once again such that the member 92 rotates clockwise in FIGURE 4 and the second member 94 with the actuating surface 104 are moved toward the left in FIGURE 4, the movement of the actuating surface 104 being guided by the elongated slot 24 into contact with the cradle 44.

As this motion continues, the upstanding actuating surface 104 causes the cradle 44 to be rotated counterclockwise in FIGURE 4 until the latch tip 54 passes beneath the latch 56 (which has been urged counterclockwise in FIGURE 4 by the biasing spring 103) at which time the cradle 44 will occupy the latched position shown in FIGURE 3.

Finally, when the operating handle 30 passes over center point 64, the operating spring 72 will snap the movable contact arm 62 counterclockwise in FIGURE 4 until it reaches the "on" position shown in FIGURE 2. Thus the circuit breaker has been converted from trip to "on" position with one continuous motion of the operating handle 30.
It should be noted that once the upstanding tab 128 of operating handle 30 is free of the actuating surface designated at 100° in FIGURE 4, the biasing spring 103 will again return the member 92 to the position shown in solid in FIGURE 4 (corresponding to FIGURE 2), whereby the automatic relatching mechanism will be in condition to function properly for either the next tripping operation or manual movement from the "on" to "off" positions.

Thus there has been described automatic relatching mechanism specifically adapted for cooperation with the novel operating mechanism of a circuit breaker designed to reduce size and simplify operation which makes possible the conversion of a circuit breaker from its tripped to its "on" condition with one single continuous movement of the operating handle of such breaker from its tripped to its "on" position.

Although there has been described a preferred embodiment of this novel invention, many variations and modifications will now be apparent to those skilled in the art. Therefore, this invention is to be limited, not by the specific disclosure herein, but only by the appending claims.

We claim:
1. A circuit breaker comprising:
a first contact;
a second contact movable between a first position engaging said first contact and a second position disengaged from said first contact;
an arm upon which said second contact is mounted; operating means connected to said arm movable between a latched and tripped position for moving said second contact from its first to its second position in response to predetermined conditions;
an operating handle movable between trip and "on" positions for moving said second contact from its second position back to its first position after said second contact has been moved to its second position in response to movement of said operating means from its latched to tripped position;
with said operating means in said latched position said operating handle also being operable to an "off" position wherein said contacts are disengaged;
said "off" position for said operating handle located intermediate said "on" and said trip positions; and automatic relatching means engageable by said operating handle and said operating means for automatically moving said operating means to its latched position in response to movement of said operating handle from its tripped position toward its "on" position whereby movement of said operating handle will automatically move said operating means to its latched position and thereafter automatically move said second contact from its second position to its first position.
2. The circuit breaker of claim 1, wherein said operating means includes a cradle member rotatable about one end thereof between its latched and tripper positions; and said automatic relatching means includes linkage means having first and second actuating surfaces, said first actuating surface being movable between a first and second position in response to movement of said operating handle from its trip toward its "on" position, said second actuating surface coating with said cradle to rotate said cradle from its tripped to its latched position in response to movement of said first actuating surface of said linkage means to its second position by said operating handle as it moves toward its "on" position,
3. The circuit breaker of claim 2, wherein said operating handle is automatically moved from its "on" to its trip position in response to movement of said second contact to its second position; and said first actuating surface of said linkage means is obstructively positioned in the path of movement of said operating handle as it moves from its "on" to its trip position in response to movement of said second contact to its second position; and wherein said first actuating surface of said linkage means is momentarily moved to a third position by said operating handle as said operating handle moves from its "on" to its trip position; and further including biasing means for returning said first actuating surface of said linkage means from its third to its first position after said operating handle passes said first actuating surface of said linkage means.
4. The circuit breaker of claim 3, wherein movement of said operating handle from its "on" to its "off" position causes said second contact to be moved from its first position to a third position which is intermediate said first and second positions of said second contact.
5. The circuit breaker of claim 4, wherein said linkage means includes a third actuating surface which coats with said cradle to maintain said first actuating surface obstructively positioned in the path of movement of said operating handle to prevent said operating handle from being moved to its trip position whenever said cradle is in its latch position.
6. The circuit breaker of claim 5, and further including a plate member, said linkage means comprising first and second members pivotally linked to one another, said first member being pivotally mounted on said plate and having said first and third actuating surfaces thereon, said second member having said second actuating surface thereon.
7. The circuit breaker of claim 6, and further including tripping mechanism for detecting predetermined fault conditions, said biasing means being secured at one end to said tripping mechanism and at its other end to said third actuating surface.
8. The circuit breaker of claim 6, wherein said plate member has an elongated slot which intersects the path of movement of said cradle, and said second actuating surface comprises an upstanding surface which is guided for movement in said elongated slot to rotate said cradle about its said one end from its tripped to its latched position in response to movement of said first actuating surface of said first member from its first to its second position by said operating handle.
9. The circuit breaker of claim 3 further including a second biasing means connected with said operating handle for continuously biasing the same towards said trip position.

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