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QUICK-BREAK CIRCUIT BREAKER

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2 Sheets-Sheet 2

FIG. 3.

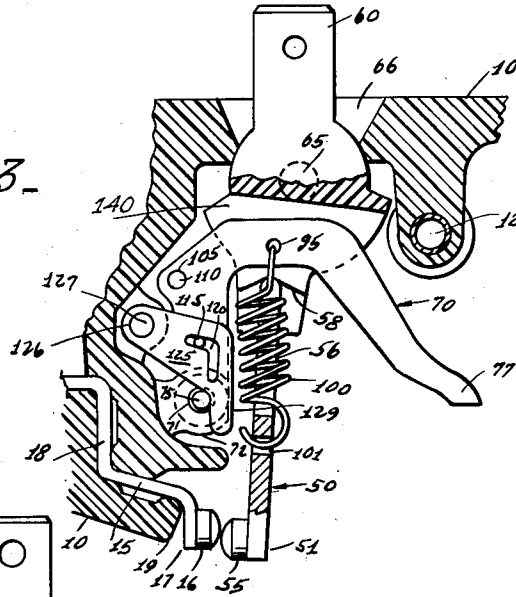
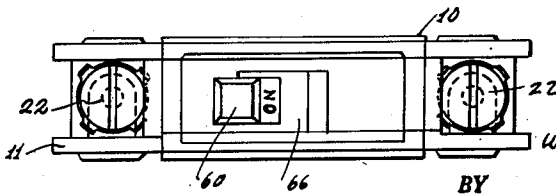
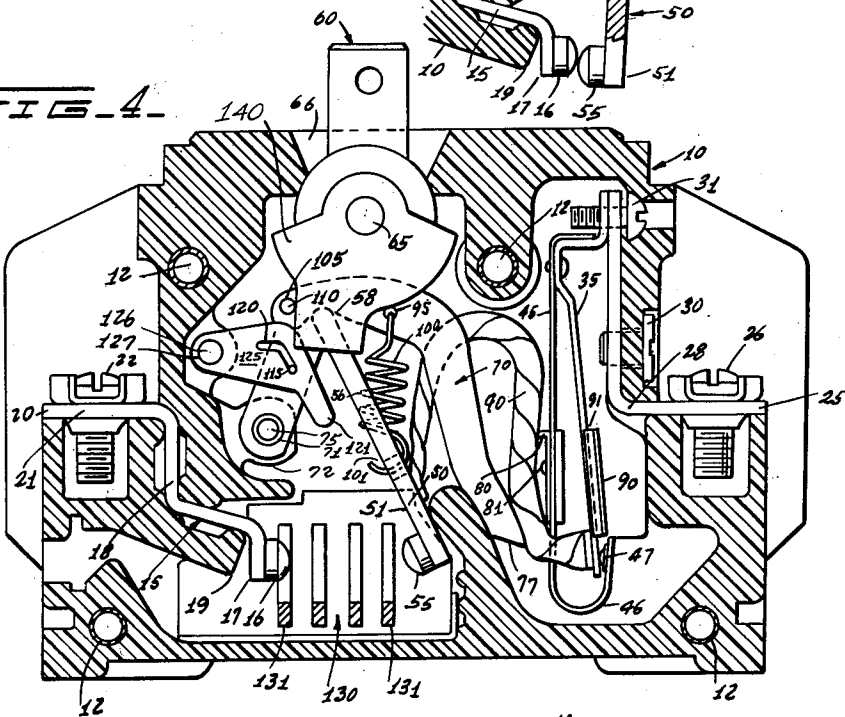


FIG. 4.



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QUICK-BREAK CIRCUIT BREAKER

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2 Claims. (Cl. 200—67)

My present invention relates to circuit breakers and more particularly it relates to circuit breakers of the quick-make and quick-break type for lighting circuits, that is, circuit breakers which close or open their contacts in very small intervals of time, preventing therefore an arc from being maintained between contacts for a period of time longer than desirable.

As is well-known in the art, a circuit breaker has both automatic opening means and manual opening means. The automatic opening means, which can be thermal or electro-magnetic, or a combination of thermal and electro-magnetic, open the circuit breaker contacts whenever a fault current is present in the electrical circuit protected by the circuit breaker.

Since fault currents are usually large, it is desirable that the contacts of a circuit breaker open very quickly so that the arc produced between the contacts during the opening movement be maintained for the shortest possible time.

The manual opening means instead open the circuit breaker whenever it is desired to interrupt the electrical circuit protected by the circuit breaker when only the usual load current flows through this electrical circuit. This means that the contacts of the circuit breaker when manually operated must interrupt the usual load current, much smaller than a fault current. But even this smaller current can produce considerable damage to the contact surfaces and the circuit breaker if the contacts move open very slowly in that an arc between contacts would be maintained for an undesirably long period of time.

It is thus seen that it is also necessary to have a quick-break action when the circuit breaker is opened manually.

In constructing circuit breakers for lighting use, it is essential that the circuit breaker be relatively compact and inexpensive. This has been achieved by mounting a movable contact for direct operation pivoted to and movable by a handle.

A cradle in a toggle mounting is latched so that a spring secured at one end to the cradle and at the other end to the movable contact arm is on one side of the movable contact arm biasing it open when the contact is open and biasing it closed when the contact is closed, this being achieved as noted above by a toggle operation.

In order to prevent the contacts from sticking to each other at automatic opening of the circuit breaker and then welding, a kicker is provided; this kicker consisting of a kicking member operated by a pin mounted on the cradle becomes operative and kicks the movable contact away from the complementary contact when the spring has been moved over center by the rotation of the cradle during the automatic opening operation.

In order to move the spring over center, the cradle had to be extended into the path of the spring and had to be pivoted away from the handle so that it acted as a fulcrum for the spring and the movable contact arm and tended to prevent quick trip during manual opening.

When, therefore, the movable contact assembly during the manual opening operation strikes the cradle, the two

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contacts are first pried apart by this fulcrum action before the over center spring is over center, that is, before the over center spring can come into operation and snap, in a small interval of time, the contacts open.

5 In other words, an arc will exist between contacts for the interval of time starting when the movable contact assembly strikes the cradle and ending when the spring is over center and, therefore, capable of assisting the initial opening operation.

10 My present invention overcomes this shortcoming by providing a cradle of such shape and so positioned with respect to the movable contact assembly that during the manual opening operation, the movable contact assembly never even touches the cradle, thus avoiding the fulcrum action previously described.

15 The main object of my present invention is, therefore, the provision of means whereby a circuit breaker has quick-break action not only during automatic opening of the contacts due to fault currents but also during manual opening of the circuit breaker contacts.

20 Furthermore, my invention can be easily applied to presently manufactured circuit breakers without having to change the assembly of said breakers.

25 Accordingly, another object of my present invention is the provision of means whereby presently manufactured circuit breakers can be made quick-break also during manual opening with a minimum amount of labor and without changing the assembly of said circuit breakers.

30 In previous types of circuit breakers, the position of the stationary contact was such that butt-type contact engagement existed between movable and stationary contact. This type of contact engagement does not permit the contacts to wipe themselves clean during the closing and opening movement. This shortcoming is overcome 35 by my present invention by placing the stationary contact in such a location that the two contacts slide with respect to each other and, therefore, wipe themselves clean during the closing and opening movements.

40 Accordingly, another object of my present invention is the provision of means whereby the contacts of a circuit breaker wipe themselves clean during the closing and opening movements.

45 The foregoing and many other objects of my invention will become apparent in the following description and drawings in which:

Figure 1 is a sectional view of a circuit breaker incorporating my invention showing the circuit breaker in the open position.

Figure 2 is a sectional view partly broken away of a circuit breaker incorporating my invention showing the circuit breaker in the closed position.

Figure 3 is a schematic view of the movable mechanism of the circuit breaker of my invention.

50 Figure 4 is a sectional view of the circuit breaker shown in Figures 1 and 2 in the open position after an opening caused by fault currents.

Figure 5 is a side view of the circuit breaker shown in Figures 1 and 2.

60 Referring now to Figures 1 and 5, the housing 10 is a shallow box, preferably a plastic insulating moulding, having a cover plate 11 which can be secured to housing 10 by any suitable means, for example, bolts and nuts placed in the appropriate aligned openings 12 of the housing 10 and cover plate 11.

65 The stationary contact assembly 15 consists of a contact button 16 welded to one bent end 17 of a conducting member 18. Member 18 is slidably mounted in housing 10; that is, it can be slid in and out of housing 10 when cover plate 11 is removed. The other end 20 of conducting member 18 has a center opening 21 threaded inside to be engaged by a terminal screw 22 which serves 70 to secure the wire (not shown) to one terminal 20 of

the circuit breaker. The other terminal 25 of the circuit breaker is similarly provided with a screw 26 engaging a contact member 28 and securing the other wire (not shown) to this second terminal 25.

Contact member 28 of rectangular cross-section is shaped like an angle and is secured to housing 10 by means of any appropriate means, for example, a screw 30. One end of angle 28 as above described has the terminal screw 26, while to the other end is secured by means of a screw 31 or other suitable means a thermally responsive member 35. The other end 36 of thermally responsive member 35 is connected by soldering or other appropriate means to a flexible conductor or pigtail 40.

A leaf spring 45 is riveted to the end of thermally responsive member 35 nearer to screw 31. Leaf spring 45 extends beyond end 36 of thermally responsive member 35 and forms a U at its farthest end 46. End 46 carries an insulating button 47 riveted to leaf spring 45 and capable of making contact with one side of thermally responsive member 35.

Pigtail 40 is connected on one side to end 36 of thermally responsive member 35 and on the other to the movable contact member 50 to which it is soldered. Contact member 50 has the shape of a U or that of a tuning fork and has an extension 51 at the bottom of the U which carries brazed to it a contact 55 engageable in the circuit breaker closed position with stationary contact 16.

Each extension 56 of U-shaped member 50 engages a groove or notch 58 of moulded plastic handle 60. Handle 60 is provided with two coaxial laterally extending trunnions 65, one of which engages an appropriate opening (not shown) in housing 10 and the other engages another appropriate opening (not shown) in cover plate 11, thus rendering the handle 60 movable in opposite directions in opening 66 of housing 10.

An overload responsive member 70 approximately hook-shaped has an opening at one end 71. Opening 71 is aligned with an opening (not shown) in boss 72 which is part of moulding 10. A pin 75 engages both openings 71 of overload responsive member 70 and the opening in boss 72 of housing 10.

The other end 77 of overload responsive member 70 engages normally a latch 80 rigidly secured to leaf spring 45 by means of a rivet 81. Rivet 81 also secures the armature 85 of an overload responsive magnet 90 to leaf spring 45 on the side opposite that in which latch 80 is located. Overload responsive magnet 90 consists of a rectangular piece of metal with a central recess 91 to receive thermally responsive member 35 to which it is secured also by a rivet or any other suitable means.

Between opening 71 and end 77 of hook-shaped member 70 is another opening 95. An over center tension spring 100 placed between legs 56 of U-shaped member 50 engages on one side an opening 101 at the apex of U-shaped member 50 and on the other side opening 95 of overload responsive member 70.

Between openings 71 and 95 is a third opening 105 which receives a reset rod 110. Overload responsive member 70 has also rigidly secured to it rod 115 engageable with slot 120 of a contact kicker member 125. Contact kicker member 125 pivoted at one end by means of pin 126 engaging an appropriate recess 127 in moulding 10 is provided in the center with the angularly shaped slot 120 and at the other end with an extension 129 whose function, as hereinafter described, is to assist the initial opening movement of the movable contact 50 during opening operation caused by a fault current.

In other words, the kicker 125 kicks the movable contact 55 away from stationary contact 16 after the over center spring 100 has been moved over center during automatic opening, thus preventing contacts 55 and 16 from sticking to each other.

An arc chute 130 consisting of conducting U-shaped plates 131 is placed in the path of operation of movable

contact 55 to extinguish the arc developed during the opening operation of the circuit breaker.

Referring now to Figure 2 showing the circuit breaker of my invention in the closed position, the over center spring 100 is on one side of contact member 50 and more precisely for this embodiment, the over center spring 100 is at the left of contact member 50, thus biasing contact 55 against stationary contact 16.

When a fault current flows in the circuit protected by the circuit breaker and its magnitude is below a certain predetermined maximum, the thermally responsive member 35 will become sufficiently heated and sufficiently bent in the direction of insulating button 47 to engage button 47 and pull leaf spring 45 in such a direction that extension 77 of hook-shaped member 70 is freed from engagement with latch 80 so that hook-shaped member 70 will rotate around pivot pin 75.

Rotation of hook-shaped member 70 will bring the over center spring 100 to the other side of contact member 50 passing through a position of unstable equilibrium on which the longitudinal axes of contact arm 50 and of spring 100 are substantially parallel and extend through the groove or notch 58, thus biasing contact member 50 away from stationary contact 16 and providing a snap opening of contacts 55 and 16. Rotation of hook-shaped member 70 during an opening caused by overload produces a movement of contact kicking member 125 around the pivot pin 126 through motion of rod 115 of member 70 in slot 120 of contact kicking member 125. This movement occurs just after spring 100 has been moved over center.

During its motion, contact kicking member 125 hits with its extension 129 one leg of U-shaped contact member 50, thus prying the contacts 55 and 16 open and providing an additional snap action during the opening movement of contacts 16 and 55 produced by a fault current.

When the fault current is larger than a certain maximum, instead magnet 90 due to the current flowing through thermally responsive member 35 will become sufficiently magnetized to pull its armature 85 and, therefore, also leaf spring 45 toward thermally responsive member 35, thus disengaging extension 77 of hook-shaped member 70 from latch 80. The movements following this disengagement are the same as those described above in connection with the thermally responsive member 35.

When open by fault current, the circuit breaker parts will be positioned as shown in Figure 4. Handle 60 will be positioned in the neutral position while spring 100 will bias contact member 56 toward hook-shaped member 70, but contact member 56 and extension 77 will remain separated by boss 140 of moulding 10.

The closing operation consists of two steps from the position shown in Figure 4. First handle 60 is rotated to the full open or "off" position. During this movement, the two extensions 140 carrying grooves 58 engage reset rod 110 and move rod 110 and, therefore, also member 70 in the direction opposite to that followed by member 70 during the opening operation. When handle 60 is in the full open or "off" position, extension 77 of member 70 will have engaged latch 80 and the position of the various parts of the circuit breaker will be that shown in Figure 1.

To close the circuit breaker, it is now only necessary to move handle 60 to the closed or "on" position. During this motion of handle 60, extensions 56 of contact member 50 rotate in grooves 58 of plastic handle 60, thus moving contact member 50 first against the bias of over center spring 100 which is now on the right side of contact 50 (see Figure 1).

If this motion is continued, a position for contact member 50 will be reached in which contact member 50 will be slightly to the left of over center spring 100. At this time spring 100 will bias contact member 50 toward

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stationary contact 16, thus providing a "quick make" action during the closing of contacts 55 and 16.

If the fault still persists while the operator is closing the circuit breaker and has his hand on the operating handle 60, the automatic opening mechanism made operable again by the above-described movement of handle 60 in the full open position will operate and will allow U-shaped member 70 to rotate around its pivot 75, thus causing, as above-described, the separation of contact 55 from contact 16.

When, on the other hand, the circuit breaker is to be opened manually since member 70 does not move during manual opening of the circuit breaker, no contact kicking action is provided in addition to the snap action of spring 100.

More specifically, as the operator moves the handle 60 from full closed to full open position, in Figure 3 from left to right, extensions 56 of U-shaped contact member 50 rotate in grooves 58 of handle 60, thus moving the contact member extensions 56 toward the left in the embodiment shown with respect to spring 100. The opening of contacts 55 and 16 occurs only when extensions 56 are actually at the left of spring 100, that is, when spring 100 is over center to the right of extensions 56 and, therefore, capable of imparting a snap action to contact member 50.

In Figure 3, my novel circuit breaker is shown at the time when spring 100 is still to the left of extensions 56 of contact member 50 but extensions 56 are moving toward the left of spring 100.

As is evident from Figure 3, as handle 60 is moved from closed to open position, in the figure from left to right, extensions 56 move toward spring 100 until they go beyond opening 100. At this point, spring 100 becomes operative and capable of producing a snap action opening of contacts 55 and 16.

Contrary to what happens in the older types of circuit breakers, when the circuit breaker mechanisms are in the position of Figure 4, contacts 55 and 16 are not pried apart because neither boss 72 nor section of member 70 around pin 75 act now as a fulcrum during the initial leftward movement of both contact member extensions 56 and spring 100.

As above-mentioned, no initial opening of contacts 55 and 16 will occur when my invention is used with the result that contacts 55 and 16 will not be damaged by a prolonged arc.

As previously mentioned in older types of circuit breakers butt type contact engagements were obtained between movable and stationary contacts. This type of contact is undesirable in that no contact sliding can occur between the contact surfaces of contacts 55 and 16 with the result that these contact surfaces never wipe each other clean.

This shortcoming is overcome in my invention by placing contact 16 at end 17 of member 18 away from moulding 10 as shown in Figure 4 so that when contacts 50 and 16 either come in contact or go out of contact they always wipe their contact surfaces one against the other, producing the necessary cleaning of the two contact surfaces.

In fact, when handle 60 is moved from the full closed to the full open position, that is, from the position shown in Figure 2 to the position shown in Figure 1, contact arm 50 slides initially in the longitudinal direction with respect to its axis or radial with respect to the center of rotation of contact arm 50 if contact 16 makes a certain angle with surface 19 of moulding 10 as shown more clearly in Figure 3.

This initial sliding movement of contact arm 50 permits wiping of movable contact 55 and stationary contact 16.

To summarize the above, since circuit breakers for lighting circuits must be very small and inexpensive, their movable contact arm 50 is pivoted to and movable by

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handle 60. A hook-shaped cradle 70 in a toggle mounting is latched by latch 80 so that a spring 100 secured at one end of cradle opening 95 and on the other end to opening 101 of movable contact arm 50 is on one side of the movable contact arm 50 biasing it open when contacts 55 and 16 are not in contact and biasing the contact arm 50 closed when the contacts 55 and 16 are in contact, this being achieved as above-described by a toggle operation.

In order to move spring 100 over center by movement of cradle 70, cradle 70 had to be extended into the path of spring 100 and had to be pivoted around pin 75 engaging opening 71 in boss 72 of housing 10 away from handle 60 or better away from fulcrum 58 of handle 50 so that it acted in older embodiment as a fulcrum for spring 100 and movable contact arm 50 and tended to prevent quick break action during manual opening.

In the circuit breaker of my invention, as previously described, quick break action is present not only when the circuit breaker is automatically opened but also when the circuit breaker is manually opened. This improvement is obtained by so shaping cradle 70 and boss 72 of moulding 10 that a clearance is always present between spring 100 on one side and cradle 70 and boss 72 on the other.

In the foregoing I have described my invention solely in connection with specific illustrative embodiments thereof. Since many variations and modifications of my invention will now be obvious to those skilled in the art, I prefer to be bound not by the specific disclosures herein contained but only by the appended claims.

I claim:

1. In a circuit breaker for opening with a snap action; a stationary contact, a movable contact arm carrying a movable contact, said arm having a circuit closed position in which its movable contact engages said stationary contact and a circuit open position in which said contacts are disengaged, a pivotally mounted operating handle having a manually operable end on one side of the pivot mounting and having a notch on the opposite end and other side of the pivot mounting, said movable contact arm being pivotally mounted in said notch and extending longitudinally substantially in the longitudinal direction of said handle with said movable contact on the end opposite the pivotal mounting of said arm, a substantially U-shaped cradle having one end latched and pivotally mounted at its opposite end, a spring, one end of said spring being secured to said movable arm adjacent its contact carrying end and the opposite end of said spring being secured to said cradle at the apex of the U-shaped cradle, said movable arm and spring extending between the legs of said cradle and into the loop formed by the substantially U-shaped cradle, the apex of said U being adjacent to the notch of said handle, said handle having a closed and an open position and being manually operable to an intermediate position in which said contacts are engaged in unstable equilibrium, said movable contact on said movable contact arm having relative motion to and remaining in electrical engagement with said stationary contact as said handle is moved from closed position toward circuit open position, to effect a wiping action between said stationary and movable contact until said notch and arm have been moved from said circuit closed position to the position of unstable equilibrium; said contact arm and spring being spaced from said boss when said contact arm and said spring are in the position of unstable equilibrium and said contacts are in engagement in unstable equilibrium so that full contact engagement is maintained at the unstable equilibrium position and any slight further movement of said handle moves this notch to the other side of the tension spring for applying a snap action opening force to said movable contacts.

2. In a circuit breaker for opening with a snap action; a plastic moulded housing and a cover plate, a stationary

contact, a movable contact arm carrying a movable contact, said arm having a circuit closed position in which its movable contact engages said stationary contact, a circuit open position in which said contacts are disengaged, a pivotally mounted operating handle having a manually operable end on one side of the pivot mounting and having a notch on the opposite end and other side of the pivot mounting, said movable contact arm being pivotally mounted in said notch and extending longitudinally substantially in the longitudinal direction of said handle with said movable contact on the end opposite the pivotal mounting of said arm, a substantially U-shaped cradle having one end latched, said plastic moulded housing having a boss extending therefrom to receive a pivot pin, said U-shaped cradle pivotally mounted at its opposite end on said pivot pin of said boss, a tension spring, one end of said tension spring being secured to said movable arm adjacent its contact carrying end and the opposite end of said tension spring being secured to said cradle at the apex of the U-shaped cradle, said movable arm and spring extending between the legs of said cradle and into the loop formed by the substantially U-shaped cradle, the apex of the said U being adjacent the notch of said handle, said handle having a closed and an open position and being manually operable to an intermediate position in which said contacts are engaged in unstable equilibrium, said movable contact on said movable contact arm initially having relative movement to and remaining in electrical engagement with said stationary contact as said handle is moved from closed position toward circuit open position, said stationary contact secured to said plastic moulded housing, the axis through the center of said stationary con-

tact having a first predetermined angle with respect to the axis through the center of said movable contact when said contacts are in engagement in said circuit closed position and having a second predetermined angle with respect to the axis through the center of said movable contact which is different than said first predetermined angle when said contacts are in engagement in said unstable equilibrium to effect a wiping action between said fixed and movable contact until such notch and arm have been moved from said circuit closed position to the position of unstable equilibrium on which the longitudinal axis of said arm and tension spring are substantially parallel and extend through the center of the notch, said boss having a substantially circular configuration; a cutaway portion on said substantially circular boss to prevent engagement of said tension spring and said contact arm with said boss at last mentioned parallel position; said tension spring and contact arm spaced from said boss and pivot pin so that full contact engagement continues at the unstable equilibrium position and any slight further movement of said handle moves it notch to the other side of the tension spring for applying a snap action opening force to said movable contact.

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