Feb. 25, 1969 L. L. BAIRD 3,430,018

CIRCUIT BREAKER CONTACT STRUCTURE WITH RELEASABLY LATCHED "STATIONARY" CONTACT FOR MAKING CIRCUIT

Filed June 22, 1966 Sheet 1 of 2

Fig. 1.

PRIOR ART

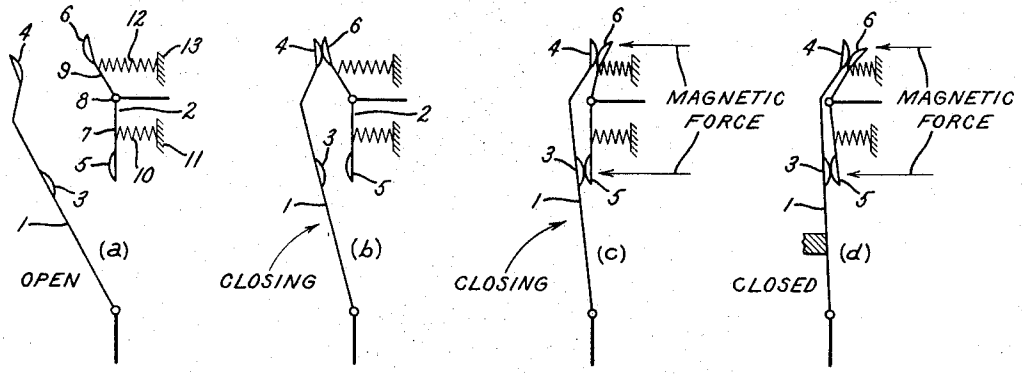
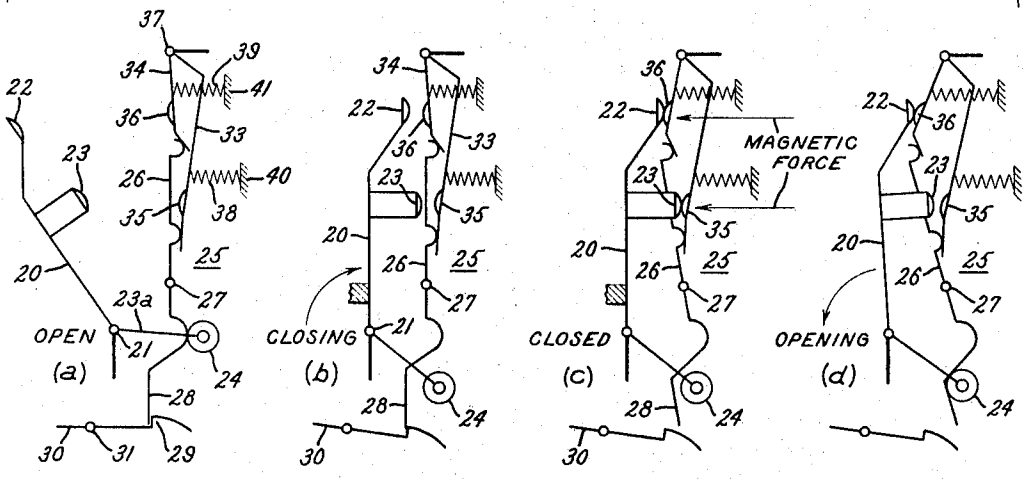


Fig. 2.



INVENTOR:
LESLIE L. BAIRD,
BY Albert S. Richardson Jr.
ATTORNEY

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Fig. 3.

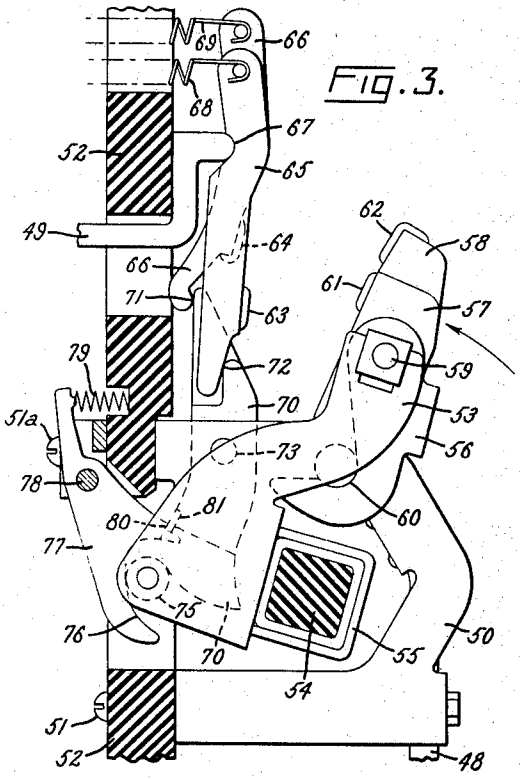


Fig. 4.

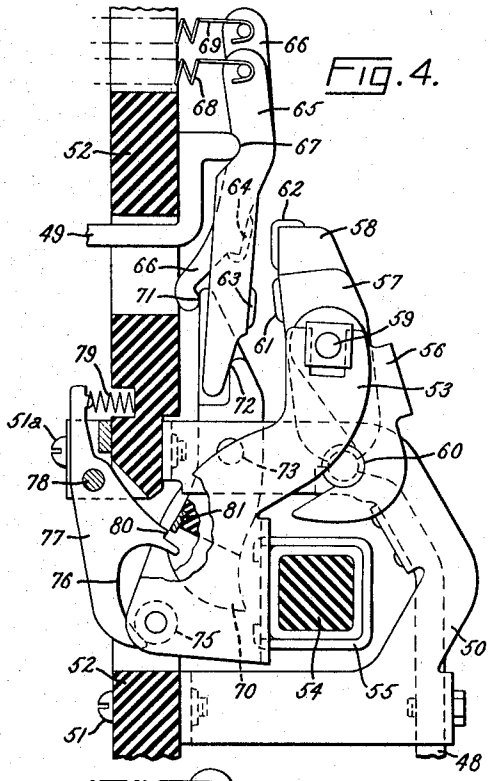


Fig. 5.

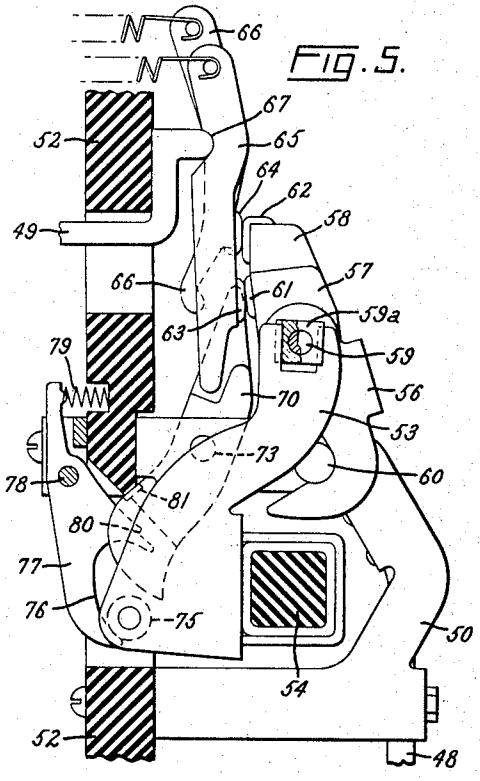
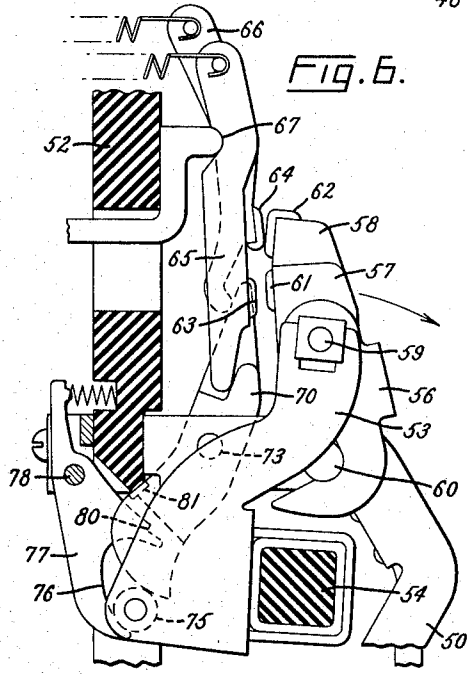


Fig. 6.



INVENTOR:
LESLIE L. BAIRD,
BY Albert S. Richardson Jr.
ATTORNEY

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CIRCUIT BREAKER CONTACT STRUCTURE WITH RELEASABLY LATCHED "STATIONARY" CONTACT FOR MAKING CIRCUIT

Leslie L. Baird, Swarthmore, Pa., assignor to General Electric Company, a corporation of New York

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U.S. Cl. 200—146 8 Claims
Int. Cl. H01h 9/38, 33/12

This invention relates to an electric circuit interrupter or breaker, and more particularly it relates to a circuit breaker including both main and arcing contacts and an operating mechanism therefor.

In order to prevent damage by electric arcs occurring during the opening operation of a circuit breaker, it is common practice to provide the circuit breaker with a pair of additional arcing contacts which are designed to withstand arcing. In such a circuit breaker the arcing contacts necessarily have a greater "wipe" than the main contacts so that they remain closed an instant longer than the main contacts during opening of the breaker. Thus, the arc is drawn on separation of the arcing contacts rather than the mains, and the life of the main contacts is preserved.

In such a circuit breaker a problem can arise during the closing operation. Specifically, breakers designed with arcing contacts which remain closed longer than the main contacts during the opening stroke of the breaker usually function such that during the closing stroke the arcing contacts touch first followed an instant later by the main contacts. In this set of circumstances current begins to flow through the arcing contacts of the circuit breaker thereby creating magnetic forces between various current conducting paths in the breaker. In high power breakers utilized to energize transformers, for instance, such initial currents may be substantial and, consequently, the magnetic forces experienced may be very high. The initial currents and their fields may interact in a manner creating forces tending to impede the closing stroke of the breaker. In order to overcome these expectable forces, the breaker may have to be equipped with a larger and more powerful closing mechanism than would otherwise be necessary. Additionally, these forces may reduce the speed of closing of the breaker undesirably. Finally, the currents already flowing through the contact arms because the arcing contacts are closed at the time the main contacts close may cause splashing and distortion of the main contacts. It would be desirable to eliminate these problems now often encountered in circuit breakers designed with both main and arcing contacts.

It is therefore an object of this invention to provide a novel circuit breaker including arcing contacts in which magnetic forces do not occur prior to closing of the main contacts.

It is a more specific object of this invention to provide a circuit breaker including arcing contacts in which both the arcing and main contacts close substantially simultaneously, but open sequentially.

These and further objects of my invention are achieved in one form by means of a circuit breaker including a means for moving a stationary contact arm out of its normal position during the opening stroke of the circuit breaker and latching it in this position by means of a latching mechanism. During the closing stroke the latching mechanism maintains the stationary contact out of its normal operating position until a movable contact arm has stopped in its closed position, at which time the latching means is tripped and the otherwise stationary contact arm is biased into contact with the movable contact arm.

My invention, distinctly pointed out in the appended claims, is described in the following specification in conjunction with the following figures in which:

FIG. 1 is a one line diagram showing the operation of conventional circuit breakers including arcing contacts,

FIG. 2 shows a one line diagram of a circuit breaker with arcing contacts according to the present invention,

FIG. 3 shows a schematic view of one embodiment of the present invention in the open position,

FIG. 4 shows this embodiment during its closing operation,

FIG. 5 shows the embodiment of FIGS. 3 and 4 after the contacts have closed, and

FIG. 6 shows the embodiment of FIGS. 3, 4 and 5 during the opening operation.

Referring to the one line diagram of FIG. 1, there is shown in (*a*) a movable contact arm **1** in its open position with respect to a stationary contact arm **2**. The movable contact arm **1** includes a main contact **3** and an arcing contact **4**. The stationary contact structure **2** includes a main contact **5** and an arcing contact **6**. The stationary contact structure **2** comprises a first member **7** extending from a pivot point **8** to the main contact **5** and a second extension member **9** extending from the pivot point **8** to the arcing contact **6**. The extension member **7** is biased outward by means of a spring **10** anchored to a support member **11** and the extension member **9** is biased outward by means of a spring **12** anchored to a support member **13**. The spring member **12** is shown longer than the spring member **10** to illustrate that its motion on the contact member **6** is longer than that of the contact member **5** so that when the contact arms **1** and **2** are separated the arcing contacts **4** and **6** tend to remain closed longer than the main contacts **3** and **5**. Referring to FIG. 1(*b*) the movable contact arm **1** is shown during its closing operation. In this position the arcing contacts **4** and **6** are already closed so that the current is flowing from the contact arm **1** through the arcing contacts **4** and **6** to the contact structure **2**. This current flow creates magnetic fields around each of the contact arms **1**, **6** and **7** which are in a direction to oppose the closing forces on the arm **1**. These forces are illustrated in FIG. 1(*c*) as going from right to left in a direction opposite to the direction of the mechanical force closing the movable contact arm **1**. In FIG. 1(*c*) the contact arm **1** has reached the point where the main contacts **3** and **5** have closed. Since the current through contacts **4** and **6** may have reached a high value just prior to the closing of the contacts **3** and **5**, undesirable distortion and splashing of these contacts may very well occur as current transfers into the parallel path formed by contacts **3** and **5**. FIG. 1(*d*) shows the contact arms **1** and **2** in their fully closed position.

In FIG. 2 is a similar one line drawing of a circuit breaker as that illustrated in FIG. 1 is shown; however, in this figure the principles of the present invention are employed. In FIG. 2(*a*) a movable contact arm **20** is shown in its open position pivoted about a point **21** and including an arcing contact **22** and an extended main contact **23**. The contact arm **20** includes an extension member **23**(*a*) which extends from the pivot point **21** in a direction opposite the main part of the contact arm **20** and which includes at its outer end a roller **24**. A stationary contact arm assembly **25** includes an upper member **26** and a lower member **28**, the two being separated by a pivot point **27**. The stationary arm **25** can rotate clockwise about the pivot point **27** away from its normal operating position, as shown in FIG. 2(*a*). When the contact arm assembly is in this position, it is held by means of a latch surface **29** on a latch member **30** contacting the lower member **28**. The latch member **30** pivots about a point **31** and is operated by some suitable means not shown in this line diagram.

The upper exension member **26** of the stationary contact arm assembly **25** abuts each of two contact carrying

arms 33 and 34. Contact carrying arm 33 carries a main contact 35 and contact carrying arm 34 carries an arcing contact 36. The contact carrying arms 33 and 34 are pivoted at a common point 37. Spring members 38 and 39 bias the contact carrying arms 33 and 34 respectively, outward, and are secured to anchor members 40 and 41 respectively. In the position shown in FIG. 2(*a*) the stationary contact arm assembly 25 is in a latched position, out of its normal, operating position, and against the biasing strength of the two spring members 38 and 39.

Referring to FIG. 2(*b*) the movable contact arm 20 is shown during the closing operation and with the arm 20 almost completely closed. Since the stationary contact arm assembly 25 has been held out from its normal operating position by means of the latch member 30, the contacts 22 and 23 of the movable arm 20 are not touching the contacts 35 and 36. Thus, no current flows through the arms and therefore no magnetic forces are acting on the assembly.

In FIG. 2(*c*) the movable contact arm 20 is fully closed and the latch member 30 has been tilted clockwise by its operating means so as to release the lower member 28 of the stationary contact arm 25. The stationary contacts 35 and 36 are then biased into their normal operating position by means of the spring members 38 and 39 and come in contact with the movable contact members 22 and 23 substantially simultaneously.

In FIG. 2(*d*) the movable contact member 20 is shown during its opening operation. It can be seen that the main contacts 23 and 35 have broken just prior to the arcing contacts 22 and 36. This is accomplished by the contact carrying arm 34 stopping against the upper member 26 after contact carrying arm 33 has stopped against 36. During the opening operation the roller 24 rides the surface of the lower member 28 of the stationary contact arm assembly 25 and, resets the stationary contacts to the position as is shown in FIG. 2(*a*), forcing the stationary member 25 to pivot clockwise about the point 27. When the member 28 reaches the position as shown in FIG. 2(*a*) it becomes latched by means of the latch 30. This latches the stationary contacts 35 and 36 out of their normal operating position.

While the principles of my invention has been completely described with respect to FIG. 2, its application in an actual circuit breaker mechanism may be made more plain with respect to FIGS. 3 through 6 wherein an actual schematic view of a circuit breaker mechanism is shown. In FIG. 3 there is illustrated a circuit breaker or interrupter comprising a supporting member 50 secured with bolts 51 and 51*a* to an insulating base member 52. A contact actuating arm 53 is secured to a cross bar member 54 by measn of metal straps 55. The arm 53 actuates a plurality of movable main and arcing contact members 57 and 58 which are pinned at 59 to the side pieces of a contact carrier 56. The contacts 57 and 58 and their carrier 56 are mounted for pivotal movement on a current conducting pin 60 which is attached to the supporting member 50. As is best seen in FIG. 4, a conductor 48, also attached to the supporting member 50, connects the pin 60 to an external electric power circuit (not shown).

The contact carrier 56 and the actuating arm 53 are joined by a sliding journal 59*a* located at the end of pin 59, as is best seen in FIG. 5. This joint accommodates the relative motion of these parts that results from the carrier 56 pivoting on the fixed axis of pin 60 and the arm 53 pivoting on the different fixed axis of the cross bar 54. The cross bar 54 is suitably mounted for reciprocal rotation about its axis, and such movement is imparted by an operating mechanism coupled thereto.

Whenever circuit breaker closing is desired, the operating mechanism drives the cross bar 54 counterclockwise from the angular position shown in FIG. 3, thereby rotating the contact actuating arm 53 in the same direction. This causes the journal 59*a* to travel in a counterclockwise arc thereby moving the respective contacts 57 and 58 from their open positions (FIG. 3) to their closed positions (FIGS. 4 or 5). Subsequently the breaker may be opened by reversing the operation of the mechanism to drive the cross bar 54 in a clockwise direction to its original position. The mechanism for driving the cross bar may be of any conventional design and does not form any part of the present invention. For this reason it is not shown or described in this specification. However, for a detailed description of such a mechanism which may be conveniently utilized in conjunction with the present invention, reference is made to United States Patent 2,961,510 issued on Nov. 22, 1960, and assigned to the assignee of the present application.

Referring back to FIG. 3, the movable contacts 57 and 58 are seen to have a main contact surface 61 and an arcing contact surface 62, respectively. Cooperating main contact surface 63 and arcing contact surface 64 are located respectively on relatively stationary contact members 65 and 66. All of the stationary contacts 65 and 66 are mounted for pivotal movement on a fulcrum 67 formed at the end of a conductor 49 which is fixedly secured to the insulating base member 52. A pair of spring members 68 and 69, suitably secured to the base 52 are attached to the stationary contacts 65 and 66 and function to bias these members counterclockwise about the fulcrum 67.

The lower portions of the stationary contact members 65 and 66 are shown in FIG. 3 in contact with a reset lever 70 at points 71 and 72, respectively. The lever 70 is adapted to pivot about a pivot pin 73 secured to the support means 50. The lower surface of the lever 70 is shown, in FIG. 3, in contact with a roller 75 which is rotatably secured to a lower portion of the contact actuating arm 53. The roller 75 is also shown in contact with a surface 76 of a latch means 77. The latch 77 is pivoted at point 78 rigidly secured to the insulating base 52. The latch 77 is biased to rotate counterclockwise by means of a spring 79.

The circuit breaker in FIG. 3 is shown with the actuating arm 53 in its open position and the stationary contacts 65 and 66 restrained by the reset lever 70 in their reset position, i.e., out of their normal operating position. This is accomplished by means of a notch 80 on the latch 77 engaging a latch plate 81 on the reset lever 70.

During the closing operation of the circuit breaker the contact actuating arm 53 swings counterclockwise about the axis of cross bar 54 thereby causing the roller 75 to ride downward along the surface 76 of the latch means 77. As it is shown in FIG. 4, the roller 75 is near the lower portion of the latch means 77 and has caused it to rotate against its bias in a clockwise direction. FIG. 4 shows the circuit breaker at a position when the actuating arm 53 has just reached its closed position. Approaching this position the roller 75 in contact with the surface 76 on the latch means 77 displaced the notch 80 downward from the latch plate 81 on the reset lever 70. The events that take place at this instant are illustrated in FIG. 5 wherein the reset lever 70 is now released and is free to rotate in a clockwise direction under the force of the spring bias on the stationary contacts 65 and 66. The reset lever parts at the points 71 and 72 so that the contacts 65 and 66 and their contact surfaces 63 and 64 are allowed to swing into their normal operating position, in contact with the movable contact surfaces 61 and 62, at substantially the same instant in time. FIG. 5 depicts the stationary contacts 65 and 66 in this normal operating position in which they respectively interengage the movable contacts 57 and 58 until the latter are subsequently moved away from their closed positions by an opening operation of the breaker.

Referring now to FIG. 6 the breaker is shown near the beginning of its opening phase, after the main contact surfaces 61 and 64 have parted but just prior to separation of the cooperating arcing contact surfaces 62 and 64. It can be seen that the roller 75 on the contact actuating arm 53 contacts the lower surface of the reset lever

70 as it rides up the surface of the latch means 77. This drives the reset lever 70 counterclockwise about its pivotal mounting point 73. As the reset lever 70 rotates in this direction it contacts the points 71 and 72 respectively on the stationary contact members 65 and 66 and begins to move them out of their normal operating position and into their reset position as shown in FIG. 3. It is apparent in FIG. 6 that the main contacts 61 and 63 break just prior to the arcing contacts 64 and 62. This means that the arc will be drawn to the arcing contacts and away from the main contacts, thereby increasing the life of the main contacts.

As the contact actuating arm 53 continues opening in the clockwise direction the roller 75 continues to ride up the surface 76 of the latch means 77 and also continues to contact the lower surface of the reset lever 70 thereby continuing its counterclockwise rotation. When this mechanism reaches the open position shown in FIG. 3 the notch 80 on the latch means 77 is caused to engage with the latch plate 81 on the reset lever 70 thereby latching it in place. The stationary contacts 65 and 66 are thereby cocked and latched out of their normal operating position.

While I have described my invention in terms of one embodiment as illustrated in FIGS. 3 through 6, the basic principle of the invention as described with respect to the one line diagram of FIG. 2 may be practiced in several other embodiments which will be apparent to those skilled in the art after reading the specification. Therefore I do not wish to be limited to the embodiment described but rather should be given the full protection as comes within the spirit and scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A circuit breaker including both arcing and main contacts, said circuit breaker comprising first and second cooperating contact members, each member having main and arcing contact surfaces, said circuit breaker operating such that when said first member is moved away from said second member said arcing contact surfaces remain in contact slightly longer than said main contact surfaces, said circuit breaker including in combination:
   (a) means for moving said first member between predetermined open and closed positions,
   (b) means cooperating with said first member for moving said second member from a normal operating position to a reset position during movement of said first member from its closed position to its open position,
   (c) means for latching said second member in said reset position when said first member is in its open position,
   (d) means for releasing said latching means when said first member approaches its closed position, and
   (e) means for biasing said second member into contact with said first member when said latching means is released.

2. A circuit breaker including at least two sets of separable contacts comprising in combination,
   (a) first means including a contact surface from each of said sets of contacts,
   (b) second means including another contact surface from each of said sets, said second means having a normal operating position,
   (c) third means for moving said first means to and from a normal operating position wherein said sets of contacts are closed if said second means is in its normal operating position,
   (d) fourth means cooperating with said third means for displacing said second means out of its normal operating position during movement of said first means away from its normal operating position,
   (e) latching means for holding said second means out of its normal operating position when so displaced by said fourth means,
   (f) tripping means for releasing said latching means in response to said third means moving said first means into its normal operating position, and
   (g) biasing means for moving said second means into its normal operating position when said tripping means releases said latching means, whereby said sets of contacts close substantially simultaneously.

3. A circuit breaker as defined in claim 2 wherein said sets of separable contacts comprise a set of main contacts and a set of arcing contacts, said first and second means being so constructed and arranged that said arcing contacts separate after said main contacts on movement of said first means from its normal operating position.

4. A circuit breaker as defined in claim 3 wherein said third means comprises a pivotally mounted actuating member coupled to said first means.

5. A circuit breaker as defined in claim 4 wherein said fourth means comprises a pivotally mounted lever adapted to contact both said actuating member and said second means, said lever urging said second means out of its normal operating position when driven by said actuating member on moving said first means from its normal operating position.

6. A circuit breaker as defined in claim 5 wherein said latching means comprises an engaging member adapted to engage and hold said lever when said lever has been driven to a predetermined position by said actuating member.

7. A circuit breaker as defined in claim 6 wherein said actuating member includes a roller that contacts said lever to drive the same.

8. A circuit breaker as defined in claim 7 wherein said tripping means is connected to said engaging member and is adapted to be contacted and moved by said roller during the time said actuating member is moving said first means into its normal operating position such that said engaging member disengages said lever, whereupon said lever is released and consequently said second means is allowed to move to its normal operating position under the influence of said biasing means.

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ROBERT S. MACON, *Primary Examiner.*

U.S. Cl. X.R.

200—169; 335—23