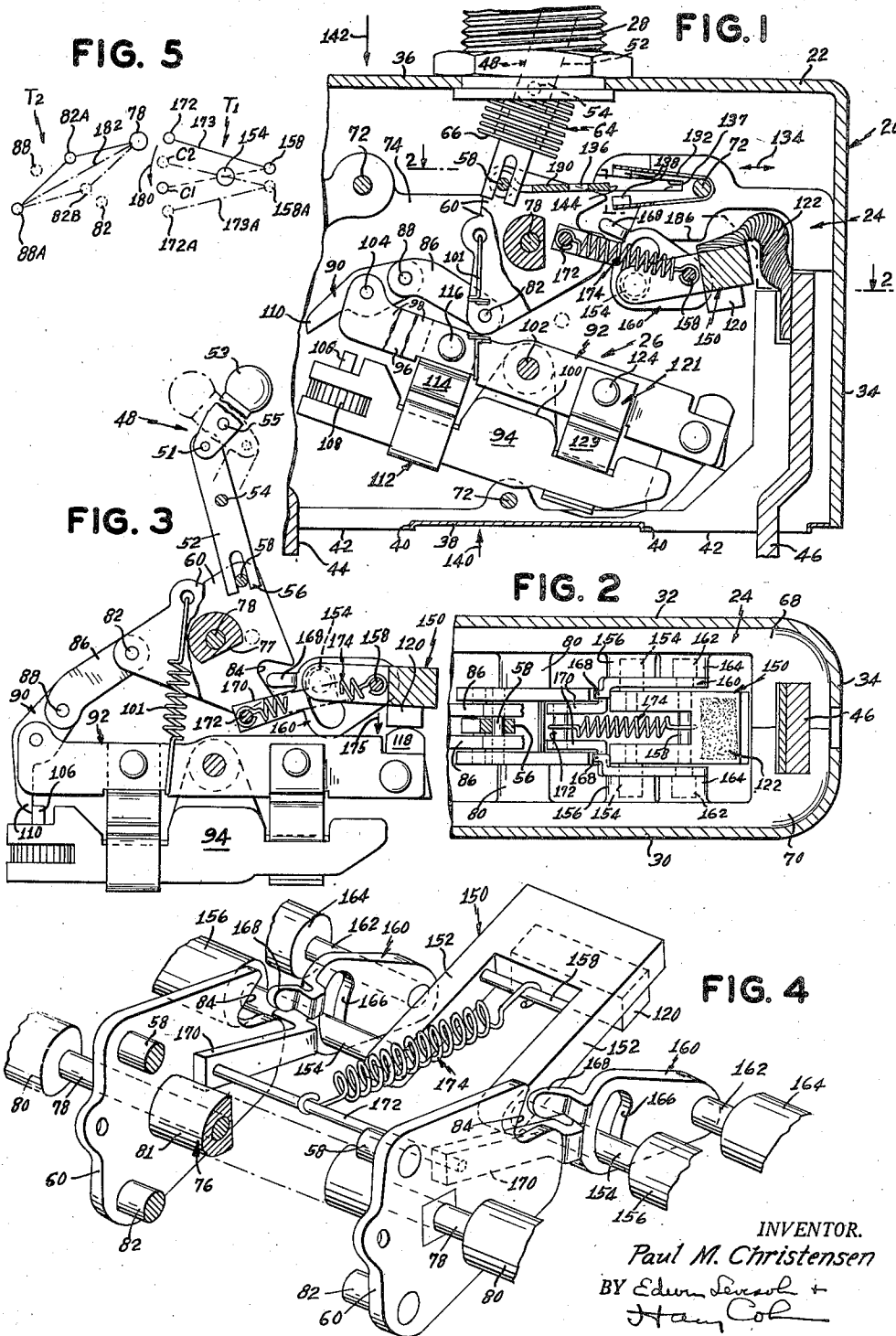


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QUICK MAKE AND QUICK BREAK CIRCUIT BREAKER
WITH AUTOMATIC RESET
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1

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QUICK MAKE AND QUICK BREAK CIRCUIT BREAKER WITH AUTOMATIC RESET

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The present invention relates generally to automatic circuit breakers.

The primary object of the present invention is the provision of a circuit breaker which has a high contact closing speed and a high contact opening speed, both of which speeds are independent of the operator so as to provide both a quick-make and a quick-break circuit breaker.

Another object is the provision of a quick-make, quick-break circuit breaker which is automatically reset upon the tripping thereof.

Another object is the provision in a circuit breaker having a movable contact and a cooperating normally stationary contact, of a highly novel mounting arrangement for the normally stationary contact, whereby the latter has provision for limited movement to provide for a quick-make and a quick-break of the circuit breaker contacts, and for an automatic resetting thereof upon the tripping of the circuit breaker.

The above and other objects, features and advantages of the present invention will be more fully understood from the following description considered in connection with the accompanying illustrative drawings.

In the drawings which illustrate the best mode now contemplated by me for carrying out my invention:

Fig. 1 is a side view of a circuit breaker, pursuant to the present invention, a part of the casing being removed and a portion thereof being broken away with the circuit breaker mechanism in the circuit-open or interrupted condition thereof, and parts being illustrated in section;

Fig. 2 is a fragmentary sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a fragmentary side view of the circuit breaker mechanism illustrating the condition thereof in the closed or circuit making condition of the circuit breaker;

Fig. 4 is a perspective view, on an enlarged scale, and illustrates the quick-make, quick-break mechanism of the present invention in the circuit interrupted condition of the circuit breaker; and

Fig. 5 is a diagrammatic illustration of the operation of the quick-make, quick-break mechanism.

In order to facilitate the explanation thereof, the present invention is illustrated and described in connection with a circuit breaker of the type which is illustrated and described in the copending application of Tracy B. Taylor and Gustave A. Duve, Serial No. 360,522 filed June 9, 1953, and assigned to the assignee hereof. However, it will be understood that the present invention is not limited to the specifically described breaker but may be utilized in other types of breakers.

Referring now to the drawings in detail, there is shown a circuit breaker 20 which is provided with a preferably metallic outer protective casing 22 in which there is disposed the insulated housing 24 which contains the circuit breaker operating mechanism, generally indicated by the reference numeral 26. The casing 22 hermetically seals the circuit breaker operating mechanism 26

2

therein, said casing being a rigid metallic member having a projecting neck 28, the side walls 30 and 32, respectively, the end walls 34 (of which only one is illustrated) a top wall 36 and a bottom closure plate 38. Said plate is apertured as at 40—40 for receiving the depending bottom wall portions 42—42 respectively of the housing 24. Terminal members 44 and 46 of the circuit breaker extend through the bottom wall portions 42 of the housing and through the apertures of the metallic casing, the projecting portion of said terminals being provided with suitable wiring securing elements, not illustrated herein. It will be understood that a suitable sealing compound is used at the portions of the casing and housing through which the terminals extend for hermetically sealing the casing at these points.

Manually operable mechanism 48 for operating the circuit breaker operating mechanism 26 to open and close the latter is provided in the previously mentioned throat portion 28 of the outer casing 22. Said manually operable mechanism may be of the type illustrated and described in the copending application of Tracy B. Taylor, Serial No. 270,297, filed February 7, 1952, issued as Patent No. 2,718,575 on September 20, 1955, and assigned to the assignee hereof. As illustrated therein, and as shown herein, said mechanism comprises a lever 52 pivotally mounted to an operating handle 53, as at 51, which handle is suitably pivoted at 55. Said lever is pivotally mounted intermediate the ends thereof by a suitable fixed pivot, such as is indicated at 54. At the lower end thereof, the lever 52 is forked, as at 56, and said forked end straddles a pin 58 carried by the companion yoke members 60. From the foregoing, it will be understood that the lever 52, when actuated by handle 53, is operative to move the pin or shaft 58 to and from the positions thereof illustrated in Figs. 1 and 3 for correspondingly moving the operating mechanism 26 of the circuit breaker, as hereinafter described in detail.

In order to hermetically seal the circuit breaker mechanism 26 within the casing, and as illustrated and described in both of the previously identified copending applications, there is provided sealing means comprising a flexible resilient tubular member 64 of bellows-like construction having one peripheral end portion thereof secured to the neck portion 28. The opposite peripheral end portion 66 of said tubular member is provided with a circular plate (not illustrated) which is centrally apertured and the lever 52 extends through the aperture in said plate and is secured thereto in sealing relation in any conventional manner. It will be understood that the first mentioned peripheral end of the member 64 is suitably sealed within the neck portion 28 so as to hermetically seal the circuit breaker mechanism 26 within the casing 22. As the flexible tubular member 64 does not per se constitute part of the present invention, further description thereof is deemed to be unnecessary herein, the same being fully described in detail in said copending applications.

As previously indicated, the circuit breaker operating mechanism 26 is contained within the previously mentioned housing 24, formed of the companion housing parts 68 and 70 which are preferably molded from a suitable insulation material, and which are mutually secured in housing defining relation, as by the securing elements 72. The housing is provided with an opening 74 in the upper end thereof between said housing parts so that the lever 52 may be operatively connected with the pin member 58, as previously described. As previously indicated, the pin member 58 extends between a pair of spaced substantially triangular shaped and insulated pivoted levers or yoke members 60. Said yoke members are mounted upon the shaft member 76 which is provided with the end pivot por-

3

tions 78 which have bearing support in the confronting bearing portions 80 provided in the housing parts 68 and 70, respectively. It will be noted that the shaft 76 is provided with a sleeve 81 which serves to space the yoke members 60. From the foregoing, it will be apparent that the previously described actuation of the lever 52 will result in the pivotal movement of the yoke members to and from the positions thereof illustrated in Figs. 1 and 3, due to the operative connection between the lever 52 and the pin 58 carried by said yoke members. It will be noted that the pin 58 interconnects the substantially triangular yoke members at one of the corners thereof, a second corner of said yoke members being interconnected by the pivot member 82 and the third corner being provided, pursuant to the present invention with a recess 84, the function of which will presently appear. Said member 82 pivotally mounts the spaced links 86—86. At the other end thereof, the links carry the pin member 88 which pivotally mounts the actuating lever 90 of the circuit breaker mechanism 26.

The actuating lever or actuator 90 is bodily carried by a movable switch assembly 92 of the circuit breaker operating mechanism. Said movable switch assembly comprises the movable switch member 94 which is preferably formed of insulating material, a conducting arm 96 and a companion arm 98 which is formed of insulating material. The movable switch member 94 is provided, intermediate the ends thereof, with the upwardly extending pivot portion 100 which is provided with a pivot member 102 which is suitably mounted in the companion housing members 68 and 70. It will be understood that the companion arms 96 and 98 straddle the pivot portion 100 and that the pivot member 102 extends through said arms. A pivot pin 104 pivotally mounts the actuating lever 90 between said arms 96 and 98.

In order to releasably latch the actuating lever 90 to the movable switch member assembly, the movable switch member 94 is provided with a latch element or catch 106. The member 94 is provided with an adjusting element 108 to effect the axial movement of the latch 106 for adjusting the extent of overlap of the latch with the free end 110 of the actuating lever 90 for calibrating the circuit breaker mechanism.

The current control device for the circuit breaker mechanism is constituted by a bimetallic element 112 which is interposed between the companion arms 96 and 98, on the one hand, and the movable switch member 94, on the other hand, between the pivot 102 and the latch element 106. In this connection, it will be understood that the bimetal 112 is provided with a looped portion 114 which forms parallel arms one of which bears against the movable switch member 94 and the other of which bears against the companion arms 96 and 98, as fully illustrated and described in the previously identified application of Taylor and Duve. Said bimetallic element 112 is connected in circuit through the circuit breaker, one end of the bimetal being electrically connected, as by the pin 116, to the conducting arm 96 and the other end being connected by a suitable flexible conductor (not illustrated) to the terminal 44. In the engaged condition of the circuit breaker, as in Fig. 3, the circuit is completed by the engagement of the companion contacts 118 and 120, movable contact 118 being carried by the conducting arm or movable contact support 96 and contact 120 being connected by means of the flexible conductor 122 to the terminal member 46. It will be understood that when the bimetal 112 is subjected to sufficient heat to cause it to flex, the arms provided in the looped portion 114 thereof move in opposite directions to effect relative movement of the movable switch member 94 and the companion arms 96 and 98, the latter moving as a unit, in a direction to disengage the actuating lever 90 from the latch 106.

From the foregoing, it will be apparent that the movement of the handle operated lever 52 from the "off" to the "on" position thereof will result in the pivotal move-

4

ment thereof from the position thereof illustrated in Fig. 1, to the full-line position thereof illustrated in Fig. 3, for movement of the shaft 58 as illustrated in said figures. Said movement of the shaft results in the clockwise rotation of the companion yokes to the position thereof illustrated in Fig. 3. During said movement of the yokes, the springs 101, which interconnect the yokes and the switch assembly 92, are tensioned, the companion links 86 move the free end 110 of the actuating lever 90 into engagement with the companion latch 106, and continued movement of the operating handle in the same direction, after said engagement of the latch 106, results in the pivotal movement of the movable switch member assembly 92 to the closed condition thereof, as illustrated in Fig. 3 wherein the companion contacts are in engagement. This completes the circuit between the terminals 44 and 46 and, upon an overload or other abnormal current condition, it will be understood that the bimetallic control element 112 will flex so that the arms thereof will move in opposite directions whereby to cause relative pivotal movement of the movable switch member 94 and the companion arms 96 and 98. This results in the disengagement of the latch 106 from the actuating lever 90 and the movement of the movable switch assembly to the open position thereof, by the contraction of the springs 101, interconnected between the yokes and the movable switch assembly 92, to open the breaker. In this connection, it will be understood that in the closed condition of the circuit breaker mechanism, there is a normally overset toggle constituted by the yokes 60, which form one arm of the toggle, and the links 86 which form the other arm of the toggle. It will be noted that in the closed condition of the breaker, the intermediate toggle axis, at 82, is to the left of or above a line extending between the outer toggle axes, as will be apparent from Fig. 3 and as shown in full line in Fig. 5 wherein 88A and 82A represents the movable toggle axes in their closed position. Furthermore, it will be noted that the companion springs 101 are stressed in said closed condition of the circuit breaker. Therefore, upon disengagement of the latch from the actuating lever, the springs 101 are effective to cause the collapse of the toggle and the pivotal movement of the movable switch assembly to the open position thereof, as in Fig. 1. The springs are also effective upon automatic tripping of the breaker, to rotate the companion yokes to the position thereof illustrated in Fig. 1, resulting in the movement of the shaft member 58 in a direction to move the lever 52 and thereby automatically move the handle 53 from the "on" position thereof, as shown in full line in Fig. 3, to the "off" position thereof, as shown in broken line, and as illustrated in said previously identified application of Taylor and Duve. Therefore, it will be apparent that the springs 101, operating upon the yokes 60, serve to automatically reset the handle upon the tripping of the breaker. The circuit breaker can be manually operated to the "off" position by movement of the handle to the "off" position whereby to rotate the yokes 60 to the position thereof illustrated in Fig. 1, to collapse the toggle and permit the springs 101 to rotate the movable switch assembly to "off" position thereof.

In order to provide for ambient temperature compensation provision is made for a second bimetallic element 121 which is similar in construction and in operation to the previously described bimetallic element 112, the latter constituting the current control device for the circuit breaker. The bimetallic element 121 is also provided with a looped portion 123 which has spaced parallel arms interposed between the movable switch member 94 and the companion arms 96 and 98 at the other side of the pivot 102 from the side at which the bimetal 112 is interposed. It will be understood that when the compensating bimetal 121 is subjected to sufficient heat to cause the latter to flex, the opposing arms thereof will flex in opposite directions, it being noted that said latter bimetal is connected by the pin member 124 to the insulated arm 98 and it

being understood that it is not electrically connected to the conductive arm 96, as illustrated and described in said copending application of Taylor and Duve.

It will be noted that the control bimetal 112 and the compensating bimetal 121 are disposed at the opposite sides of the pivot 102, substantially at the same distance therefrom. The ambient temperature will effect both of said metals in the same manner. Therefore, it will be readily apparent that when the ambient temperature tends to deflect the current control bimetal for the companion arms 96 and 98 so that the latter pivot as a unit relative to the switch member 94, in a direction to effect the separation of the latch 106 from the actuator 90, the compensating bimetal will be affected in the same manner and to the same extent by the ambient temperature so as to tend to deflect at the other side of the common pivot for effecting relative pivotal movement of said arms on said movable switch member in the opposite direction. Consequently, the forces or stresses existing between the switch member 94 and both switch arms, as a unit, on the opposite sides of the common pivot, which are due to ambient temperature, will tend to cancel out in view of the fact that they are in opposite directions and substantially of the same magnitude, whereby to prevent the disengagement of the latch and the actuating lever so as to retain the breaker in the closed condition thereof.

Pursuant to the present invention, provision is made to provide the circuit breaker with both a quick-make and a quick-break action so that it will have a high contact-closing speed, which is independent of the operator, as well as a high contact-opening speed which is independent of the operator. In accordance with the present invention, and as best illustrated in Fig. 4, the normally stationary contact 120 is carried by the contact member 150 which is connected by the previously identified flexible lead 122 to the terminal 46. The contact member 150 is provided with the spaced legs 152—152. Each of the legs is provided with a pivot member 154 which is mounted in a bearing portion 156 provided on the adjacent casing member. The member 150 is also provided with a tie pin 153 which extends between the legs 152, adjacent the contact 120. In addition to said member 150, provision is made for a lever member 160 at each side of the contact member 150. Each lever member 160 is provided with a pivot 162 which is mounted in a rotary bearing 164 formed in the adjacent casing wall. It will be noted that each lever 160 is provided with an arcuate slot 166 through which the pivot 154 of the adjacent leg 152 of the member 150 extends. In addition, each lever member 160 is provided with a tongue 168 and with an arm 170. It will be understood that the tongues 168 are complementary to the previously mentioned recesses 84 defined in the yokes 60 so as to be engageable therein, respectively. Tongue 168 may be crudely compared to a gear tooth of a driven gear movable on shaft 162, and recesses 84 in yokes 60 may be similarly compared to gear-tooth-receiving spaces of drive gears movable on shaft 78, with tongue 168 resembling a gear-tooth fitting loosely in the space 84. The loose fit of spaces 84 about tongues 168 enables yokes 60 to move through relatively wide angles in actuating the linkage including member 86, etc., without driving tongues 168 except at the appropriate times, as more fully explained hereinafter. The motion of yokes 60 is idle in respect to drive of tongues 168 for much of the operating strokes of manual operating element or lever 52; and this loose fit of tongues 168 in spaces 84 thus forms part of what may be termed a floating or a lost-motion connection. Consequently it will be apparent that there is a floating linkage or connection between the links 160 and the yokes 60. The arms 170 are off-set inwardly of the associated tongues so as to extend between the yokes. Said arms mount a tie pin 172 which cooperates with the previously mentioned tie pin 153 to secure a tension spring 174 between the member 150 and the levers 160, as best illustrated in Fig. 4.

From the foregoing, it will be understood that the contact member 150 and the levers 160 constitute cooperating toggle elements, the spring 174 being an overcentering spring for the toggle to provide a snap action therefor.

The pivots 154 constitute the intermediate or central fixed axis of the toggle and the tie pins 158 and 172 constitute the outer movable axes of said toggle. It will be noted that the spring 174 is a tension spring, and in the open condition of the circuit breaker, as illustrated in Fig. 1, said spring is under tension and serves to hold the contact member 150 in the open or disengaged position thereof.

Referring now to Figure 5, there is a diagrammatic illustration of the operation of the toggle constituted by the contact member 150 and the toggle levers 160, which is hereinafter referred to as the stationary contact toggle, and is designated as T1 in Fig. 5, the previously mentioned toggle constituted by the yokes 60 and the links 86, for operating the movable switch or contact assembly 92, being generally designated at T2 in said Figure 5. In the open condition of the circuit breaker, the axes or centers of toggle T1 are indicated in full line at 172, 154 and 158 which represent the axis of the spring tie pin 172, the axis of the pivot members 154, and the axis of the other spring tie pin 158, respectively, the axes 172 and 158 being above the axis 154, as indicated by the solid line 173. In the closed or circuit making condition of the breaker, the toggle axis 172 is indicated in broken line at 172A, and the toggle axis 158 is indicated in broken line at 158A, said axes being below the fixed axis 154, as indicated by the broken line 173A. When the lever 52 is operated from the position thereof illustrated in Fig. 1 to the full line position thereof illustrated in Fig. 3, in order to close the circuit breaker, the resultant clockwise movement of the yokes 60 results in the pivotal movement of the toggle levers 160, about their pivotal axes 162, due to the floating connection of the tongues 168 and the recesses 84. This results in movement of the toggle axis 172 in the direction of the arrow 180 in Fig. 5. C1 indicates the dead center position through which the pivotal axis 172 moves during the closing operation of the circuit breaker mechanism. It will be apparent that as the toggle axis 172 passes through its dead center position C1, the spring 174 overcenters to effect the movement of the toggle outer axes 172 and 158 to their positions indicated at 172A and 158A, respectively. This is accomplished with a snap action due to the overcentering of the spring and results in the snap action movement of the normally stationary contact 120, from the position thereof illustrated in Fig. 1 to the position thereof illustrated in Fig. 3, so as to provide a high contact closing speed for the contact 120 which speed is independent of the operator. Referring now to the concomitant action of toggle T2, the stationary toggle axis is indicated at 78 in Fig. 5, the intermediate toggle axis in the open position of the circuit breaker being indicated in broken line at 82 and the other outer toggle axis, in the open position of the circuit breaker, being indicated in broken line at 88. It will be apparent that, as the yokes 60 are moved from the circuit open to the circuit closed disposition thereof to overcenter the toggle T2, as described, the toggle axis 82 of toggle T2 is moving in an arcuate path toward the position thereof illustrated at 82A, and the toggle axis at 88 is moving in an arcuate direction toward the position thereof illustrated at 88A, and when the toggle axis 82 passes beyond its dead center position, the toggle is overcentered and the switch assembly 92 is moved to the circuit closed condition thereof wherein the movable contact 118 is disposed, as illustrated in Figure 3, for engagement by the normally stationary contact 120. In this closed and engaged condition of the contacts, the spring 174 of the toggle T1 is under tension and provides a resultant component of force, as indicated by the arrow 175 in Fig. 3, which tends to press the contact 120

against the contact 118 to provide for desired contact pressure in the closed condition of the circuit breaker. As a result of the opening movement of the circuit breaker mechanism, whether accomplished manually by operation of the handle 53, or automatically in response to overload or other abnormal circuit condition, the counter clockwise movement of the yokes 60, from the position thereof illustrated in Fig. 3, to the position thereof illustrated in Fig. 1, due to the floating engagement thereof with the toggle levers 160 as illustrated in Fig. 3, results in movement of the toggle axis 172 of the toggle T1 from the position thereof illustrated at 172A, in a direction opposite the arrow 130, toward the position thereof illustrated at 172 in Fig. 5. The broken line position C2 indicates the dead center position for the toggle axis 172 in the course of its movement from its closed to its open position, and it will be understood that when the toggle axis 172 passes through its dead center position C2 from its position at 172A, the spring 174 overcenters and effects a snap action movement of the toggle in the opposite direction. Consequently, the toggle axis 158 is moved from its closed position illustrated at 158A, to its open position illustrated at 158, to effect a quick-break movement of the normally stationary contact 120, from its position illustrated in Fig. 3, to its position illustrated in Fig. 1, the speed of which movement is relatively high and independent of the operator. It will be understood that during said opening operation of the toggle T1, the toggle T2 is also being operated to its open condition during which the toggle center 82 moves from its full line position illustrated at 82A to its broken line position illustrated at 82.

It will be noted that upon tripping, the circuit breaker is automatically reset at the end of the opening movement of the circuit breaker mechanism 92, the handle 53 being disposed in its full "off" position, and the contact 120 also being disposed in its full "off" position. The automatic resetting of the handle is accomplished by the movement of the yokes 60, under the control of springs 101, to the full "off" position thereof, due to the fact that the toggle levers 160 and the toggle spring 174 exert negligible force or pressure on the yokes 60. Therefore, they do not interfere with the action of the springs 101 in opening the circuit breaker and moving the yokes 60 to the full "off" position thereof, as in Fig. 1, for disposing the handle 53 in its full "off" position. This results from the fact that there is no direct connection between the yokes 60 and the toggle levers 160, said connection being a floating connection, as previously described. In this connection, it will also be noted that the length of the toggle spring 174 changes very little from its "off" position, as in Fig. 1, to its "on" position as in Fig. 3, due to the disposition of the axes of toggle T1. More specifically, the spring tie pin or axis 158 is aligned with and positioned quite close to the toggle pivots which constitute the axis 154, it being noted that the tie pins or axis 158 is positioned much closer to said axis 154 than is the companion spring tie pin or axis 172. Further, it will be noted that the arcuate path described by the tie pin or axis 172 in moving from its "off" to its "on" position causes only a very slight extension of the spring 174. Consequently, only very slight additional force is required of the springs 101 when resetting the handle 53 on tripping of the breaker, to operate the toggle T1 to its open condition to provide a quick-break of the contacts.

In view of the foregoing, it will be apparent that the actions of the toggles T1 and T2 are inter-related. More specifically, the toggle T1 begins to move from its position indicated by the centers 172A, 154 and 158A, in Fig. 5, and passes through its dead center position indicated by C2, 154 and 158A, before the movable contact 118 is moved from its closed position illustrated in Fig. 3. In this connection, it will be understood that, as the yokes 60 are moving in a counter clockwise direction from the

position thereof illustrated in Fig. 3, the contact pressure exerted by the contact 118 against the contact 120 increases as the toggle T2 is moving toward the straight line position 182 thereof, and more specifically, as the toggle center at 82A is moving toward said dead center line 182. Then, as the central toggle axis passes through the dead center line 182, the pressure exerted by the movable contact member 118 decreases and returns to the original pressure exerted by the toggle T2, and the action is such that the toggle T1 moves and passes beyond its dead center position C2, 154 and 158A, before the toggle T2 passes substantially through and beyond its dead center position as indicated by the line 182 during the opening movement thereof. More specifically, toggle T1 overcenters in contact separating direction substantially when toggle T2 is moving between the dead center line 182 and the axis position 82B, in Fig. 5, and before toggle T2 reaches its open position.

From the foregoing, it will be apparent that the present invention provides for both a quick-make and a quick break circuit breaker which is automatically reset, and in the combination of the quick break and the automatic reset operation the force which is required to move the elements of the toggle T1 to the "off" position thereof, is very small. Since provision is made for a toggle spring which is originally under tension, only a slight additional force beyond the original tension of the spring is required to operate the toggle T1 to its open condition. This is due to the fact that the toggle centers or toggle axes of the toggle T1 are so disposed that the length of the toggle spring 174 changes only very slightly since it moves along an arc which is comparatively quite slight.

It will be noted that a detent for the contact member 150, in the open condition thereof, is provided by an overlying casing portion 186. The stationary pivots 154, which extend through the arcuate slot 166 provided in the toggle levers 160, constitute a detent for said toggle levers in both the open and closed conditions thereof, as best illustrated in Figs. 4 and 3, respectively.

Provision is also made in the present construction, to compensate or neutralize mechanical shocks and vibrations. In this connection, provision is made for an inertia latch assembly as provided for in said previously identified application of Taylor and Duve. Said assembly is constituted by the inertia latch piece 130 and the inertia latch spring 132. The latch piece 130 is suitably connected to the pivot or shaft member 58 and is mounted in suitable guideways provided in the housing 24 for reciprocation in the direction of the arrows 134, the guideways being indicated at 137. The latch piece is also provided with a substantially square aperture 136. The inertia spring 132 is looped or bent between the ends thereof and is mounted on a securing element 72. It will be understood that the housing has suitable provision to retain the latch spring 132 in the operative disposition thereof illustrated in Fig. 1, the spring being provided at the free ends thereof with weights or catches 138 which are dimensioned to enter the aperture 136. In the closed condition of the breaker, it will be understood that the catches 138, are in registry with the aperture 136 and straddle the latter, as illustrated in the copending application of Taylor and Duve. In the open condition of the circuit breaker, the catches are disposed as illustrated as in Fig. 1.

If, with the mechanism 26 in the closed condition thereof, the circuit breaker 20 is subjected to a blow or a shock in the direction of the arrow 140, the upper catch 138 will engage in the aperture 136 to prevent the counter clockwise rotation of the yokes about their axis 78, due to the shock forces acting upon the manually operable actuating mechanism, and thereby prevent the collapse of the toggle and the consequent opening of the circuit breaker. In the same manner, in the event of a shock or a blow in the direction of the arrow 142, in the closed condition of the circuit breaker, the lower catch 138 will be engaged in the aperture 136 of the latch piece to pre-

vent the collapse of the toggle and the consequent opening of the circuit breaker.

With the circuit breaker mechanism in the open condition thereof, as illustrated in Fig. 1, the latch piece 130 is disposed outwardly of the opposing arms of the spring 132. Assuming a shock in the direction of the arrow 140, the tendency of the yokes will be to rotate in the clockwise direction so that the latch member will tend to move into position between the arms of the spring 132. However, in the event of such an occurrence, the upper spring catch 138 moves into position behind the free end 144 of the latch piece 130 to prevent the movement of the latch piece between the spring arms, to prevent the closing of the breaker.

Similarly, in the event of a shock or blow in the direction of the arrow 142, the lower catch 138 is momentarily disposed behind the free end 144 of the latch piece 130 to prevent the movement of the latch piece to its closed circuit condition and thereby to prevent the closing of the circuit breaker mechanism.

To facilitate the previously described operation of the toggle T1, it will be noted that the shaft 76, which mounts the yokes 60, is provided with a planar portion 77 to provide clearance for the described arcuate movement of the free end of the arms 170.

While I have shown and described the preferred embodiments of my invention, it will be understood that various changes may be made in the present invention without departing from the underlying idea or principles of the invention within the scope of the appended claims.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. In an automatic circuit breaker having companion relatively movable contacts, mechanism to effect engagement and disengagement thereof to close and to open the breaker, respectively, and means to automatically reset the breaker upon the tripping thereof, the combination with said reset means of means to provide a quick-make closing and a quick-break opening of said contacts, and manually operable means for operating said mechanism to close and to open the breaker, said reset means including spring means operable to move said manual means to a reset position thereof upon automatic tripping of the breaker, and said quick-make quick-break means operating under the control of said spring means to effect a quick-break opening of said contacts, said quick-make quick-break means including a pair of toggle links having respective fixed pivots and a stressed over-centering spring which is subjected to only slight change of length upon either manual operation or automatic tripping of the breaker, whereby to minimize the amount of force required of said first mentioned spring means to effect both said resetting of said manual means and said operation of said quick-make quick-break means upon automatic tripping of said breaker.

2. In an automatic circuit breaker having companion relatively movable contacts disposed for mutual engagement and disengagement to close and open the breaker, respectively, circuit breaker operating mechanism including control means operable to effect automatic tripping of the breaker upon the occurrence of predetermined current condition, and spring means operable to open the breaker upon said tripping thereof; that improvement which comprises the provision of means operable to provide a quick-make closing and a quick-break opening of said contacts, said latter means being operable under the control of said spring means to effect said quick-break opening of said contacts, said latter means comprising cooperating toggle elements mounted on fixed axes and carrying respective movable axes interconnected by a stressed over-centering spring, the movable axis of each element being closer to the fixed axes of the other element than the movable axis of each element is to its own fixed axis one of said elements being provided with one of said contacts, and the axes of said toggle elements

being so related as to require only slight change of length of said over-centering spring to effect a quick-break opening of said contacts, whereby to minimize the force required of said first mentioned spring means in the operation of said latter means to effect a quick-break opening of said contacts.

3. In an automatic circuit breaker having companion relatively movable contacts disposed for mutual engagement and disengagement to close and open the breaker, respectively, circuit breaker operating mechanism including control means operable to effect automatic tripping of the breaker upon the occurrence of predetermined current condition, and spring means operable to open the breaker upon said tripping thereof; that improvement which comprises the provision of means operable to provide a quick-make closing and a quick-break opening of said contacts, said latter means being operable under the control of said spring means to effect said quick-break opening of said contacts, said latter means comprising cooperating toggle elements mounted on fixed axes and carrying respective movable axes, a first one of said elements bearing one of said contacts and the other of said elements having a lost motion connection to said circuit breaker operating mechanism interconnected by a stressed over-centering spring, the movable axis of each element being closer to the fixed axis of the other element than the movable axis of each element is to its own fixed axis and said other element being arranged to shift the line of action of said over-centering spring from one side of the fixed axis of said contact-bearing element to the other side thereof and reversely in coordination with operation of said circuit breaker operating mechanism, one of said elements being provided with one of said contacts, and the axes of said toggle elements being so related as to require only slight change of length of said over-centering spring to effect a quick-break opening of said contacts, whereby to minimize the force required of said first mentioned spring means in the operation of said latter means to effect a quick-break opening of said contacts, and manually operable means for operating said circuit breaker mechanism and thereby operating said toggle elements for both opening and closing the circuit breaker in quick-make and quick-break fashion and said spring means being effective in response to automatic tripping to operate said linkage and said manually operable means when externally unrestrained into the circuit-opening condition thereof.

4. In an automatic circuit breaker having relatively movable contact members provided with companion contacts, respectively, actuating means for operatively effecting the engagement thereof, current-responsive control means for effecting the disengagement thereof, a handle for manually operating said actuating means and movable to and from circuit-open and circuit-closed positions, and spring means for opening the breaker and operable to move said handle to said circuit-open position thereof upon tripping of the breaker; means to provide a quick-make closing and a quick-break opening of said breaker, and link means operable between said handle and said spring means, said link means having an operative engagement with said quick-make quick-break means, whereby said quick-make closing is initiated by said handle and said said quick-break opening is initiated by said spring means under control of said current-responsive means, said quick-make quick-break means comprising cooperating toggle elements having fixed pivots and being interconnected by a stressed over-centering spring, one of said elements being provided with one of said contacts, and the axes of said toggle elements being so related as to require only slight change of length of said over-centering spring to effect a quick-break opening of said contacts, whereby to minimize the force required of said first mentioned spring means in the operation of said latter means to effect a quick-break opening of said contacts.

5. In an automatic circuit breaker having relatively

11

movable contact members provided with companion contacts, respectively, actuating means for operatively effecting the engagement thereof, current-responsive control means for effecting the disengagement thereof, a handle for manually operating said actuating means and movable to and from circuit-open and circuit-closed positions, and spring means for opening the breaker and operable to move said handle to said circuit-open position thereof upon tripping of the breaker; means to provide a quick-make closing and a quick-break opening of said breaker, and pivotally mounted yoke means operatively engaged with each of said actuating means, said handle and said spring means, said yoke means having a floating connection with said quick-make quick-break means, whereby said quick-make closing is initiated by said handle and said quick-break opening is initiated by said spring means.

6. In an automatic circuit breaker having relatively movable contact members provided with companion contacts, respectively, actuating means for operatively effecting the engagement thereof, current-responsive control means for effecting the disengagement thereof, a handle for manually operating said actuating means and movable to and from circuit-open and circuit-closed positions, and spring means for opening the breaker and operable to move said handle to said circuit-open position thereof upon tripping of the breaker; means to provide a quick-make closing and a quick-break opening of said breaker, and pivotally mounted yoke means operatively engaged with each of said actuating means, said handle and said spring means, said yoke means having a floating connection with said quick-make quick-break means, whereby said quick-make closing is initiated by said handle and said quick-break opening is initiated by said spring means, said quick-make quick-break means being provided with one of said contacts and including a stressed over-centering spring connected to require only negligible additional stressing to effect a quick-break opening of said contacts, whereby to minimize the force required of said first mentioned spring means in the operation of said latter means to effect a quick-break opening of said contacts.

7. In an automatic circuit breaker, companion relatively movable contacts, operating mechanism for said contacts including a movable contact support, an actuating member, spring means biasing said support in the direction to open the contacts and biasing said actuating member in the resetting direction, mechanism restraining said support and said member against said spring bias with the contacts closed and with the actuating member in closed-contact disposition, the foregoing being arranged to open said contacts and reset said actuating member upon release of the restraining means, and quick-make, quick-break operating means for one of said contacts operated conjointly with said actuating member.

8. In an automatic circuit breaker, companion relatively movable contacts, operating mechanism for said contacts including a movable contact support, an actuating member, spring means biasing said support in the direction to open the contacts and biasing said actuating member toward the reset position, mechanism restraining said support and said member against said spring bias and including a latch movable in one direction upon release of the restrained movable support and movable in the opposite direction after release and during movement of said actuating member toward reset position, and means coordinated with said actuating member for effecting quick-closing and quick-opening of said contacts.

9. An automatic circuit breaker having first and second separable movable contacts, a manual operating element, a linkage between said manual element and one of said contacts including a first movable contact-bearing arm, overload release means and means cooperable with said first arm and said overload release means and operable by said manual operating element for shifting said first contact from "open" to "closed" position, said linkage having a spring effective to bias said first contact-bearing

12

arm and said linkage and said manual operating element into their respective "open" positions, said second contact having a second movable contact-bearing arm and an over-center spring device for snap-operating the second contact between "open" and "closed" positions and reversely, said over-center spring device having a drive connection to said linkage for operation thereby.

10. An automatic circuit breaker, including a manual operating element movable in a stroke between "on" and "off" limits, a pair of separable contacts, mechanism operable to open and close said contacts, said mechanism including an over-centering spring device actuated by the manual operating element for causing snap-opening and snap-closing of the contacts when the manual operating element is operated through its said stroke, said mechanism also including overload release means and a spring-biased releaseable mechanism controlled thereby and effective in response to overload to cause trip-free snap-opening of the contacts and operation of the manual operating element from its "on" limit to its "off" limit when not externally restrained, said spring-biased mechanism having an operative connection to said over-centering spring device for returning said device to its "off" condition concurrently with the operation of the manual operating element to its "off" position.

11. An automatic circuit breaker, including a manual operating element movable in a stroke between circuit-open and circuit-closed limits, a pair of separable contacts, an over-center spring device having an operating connection to said manual operating element for operating said over-center spring device to effect snap-opening and snap-closing of the contacts in response to manual operation of the circuit-breaker, and further mechanism including an overload responsive element and a spring arranged to cause snap-opening of the contacts in response to an overload and said further mechanism including said spring being thereupon effective to bias said manual operating element toward circuit-open position and said further mechanism having a drive connection to said over-center spring device to operate said over-center spring device into its circuit-open position, when the manual operating element is returned to its circuit-open position.

12. An automatic circuit breaker including a manual operating element, a pair of separable contacts, and separate mechanisms operable by said manual operating element for operating said contacts between circuit-open and circuit-closed positions, one of said mechanisms including a trip-free overload release mechanism and a spring effective for snap-opening the contacts in response to an overload and, independently, for thereupon returning said element to its circuit-open position, the other of said mechanisms having a snap-acting over-center spring device movable between circuit-open and circuit-closed positions by said manual operating element and movable to said circuit-open position by said spring as an incident of return of the manual operating element to circuit-open position in response to an overload.

13. An automatic circuit breaker including a manual operating element, a pair of separable contacts, and separate mechanisms operable by said manual operating element for operating said contacts between circuit-open and circuit-closed positions, one of said mechanisms including a first contact-operating arm, a toggle linkage providing a drive connection between said manual operating element and said first arm, an overload release mechanism, and a spring biasing said first contact bearing arm in the circuit-open direction when the contacts are closed and said spring being effective upon release of the overload release mechanism for snap-opening the contacts and, when said manual operating element is unrestrained, for returning said element to its circuit-open position, the other said mechanisms having a snap-acting over-center spring device including a second contact-operating arm between circuit-open and circuit-closed positions, and having a lost-motion connection to said one mechanism for operation by said

13

manual operating element and movable to said circuit-open position by said spring as an incident of return motion of the manual operating elements to its circuit-open position in response to an overload.

14. An automatic circuit breaker including a pair of separable contacts, a manual operating element, a snap-acting mechanism operable by said element for both snap-opening and snap-closing said contacts, an automatic contact operating mechanism additional to said snap-acting mechanism and including overload release means for effecting trip-free release of the contacts in response to an overload, said automatic mechanism including a spring operative for snap-opening of the contacts and to return said manual operating element and said snap-acting mechanism to their respective circuit-open positions in response to an overload.

15. An automatic circuit breaker including a pair of separable contacts, a manual operating element, a first mechanism for operating one of said contacts including a contact-bearing arm, an overload release device movably carried with said contact-bearing arm, and a trip-free linkage between said manual operating element and said contact-bearing arm and including a spring for biasing said manual operating element toward circuit-open position, an overcenter spring device for snap-opening and snap-closing the second of said separable contacts and including a lost-motion connection to said manual operating element.

16. An automatic circuit breaker including a pair of separable contacts, a manual operating element, first and second mechanisms both operable by the manual operating element for moving said contacts into circuit-closed position, one of said mechanisms including a toggle linkage progressively operable by said manual operating element for moving one of said contacts to its circuit-closed position and for retaining said manual operating element in

14

its circuit-closed position and a spring arranged to bias said one contact toward circuit-open position and said one mechanism further including overload release means effective when released to enable said spring to cause snap-opening of the contacts and return of said manual operating element to its circuit-open position, the other of said mechanisms including a snap-acting over-centering spring mechanism operable for both snap-opening and snap-closing said contacts and said second mechanism including a pair of elements each having a fixed pivot and said elements being interconnected by an overcentering spring, said second mechanism being mechanically coordinated with said manual operating element for motion of both said second mechanism and said manual operating element for motion of both said second mechanism and said manual operating element between respective circuit-open and circuit-closed positions.

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