Oct. 29, 1957 T. M. COLE ET AL 2,811,604

AUTOMATIC CIRCUIT BREAKERS

Filed Dec. 11, 1953

FIG. 1

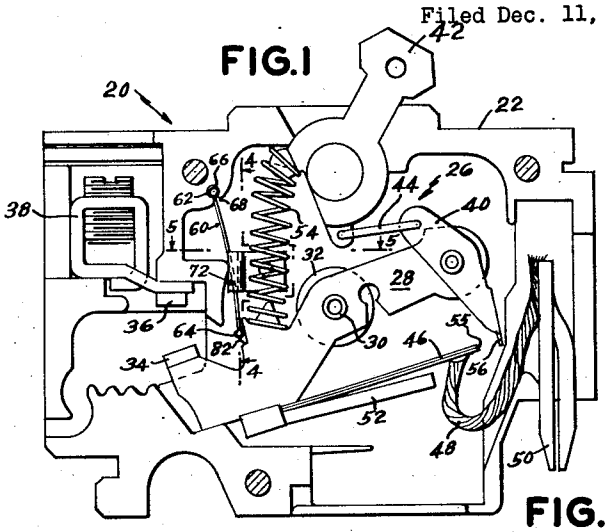


FIG. 2

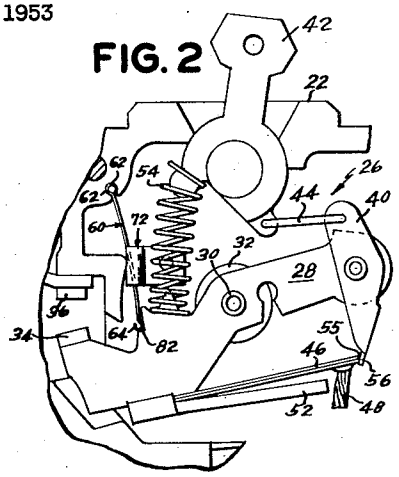


FIG. 6

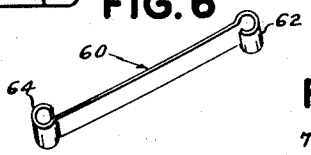


FIG. 3

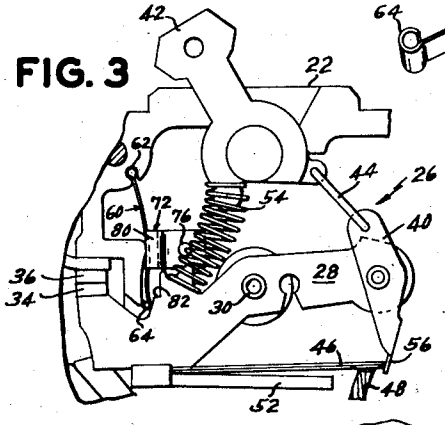


FIG. 5

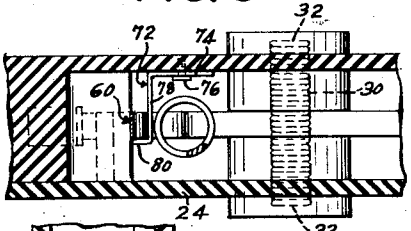


FIG. 10

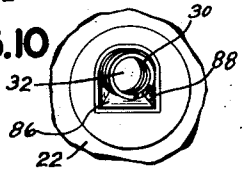


FIG. 7

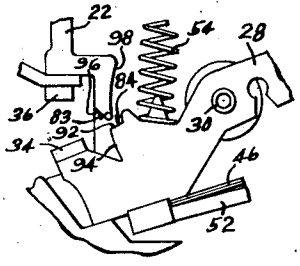


FIG. 8

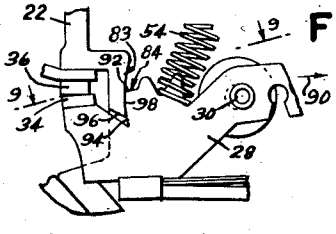


FIG. 9

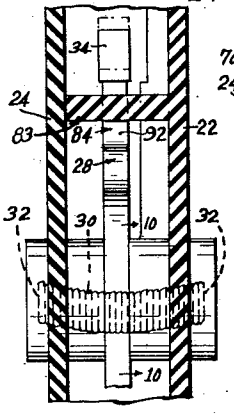
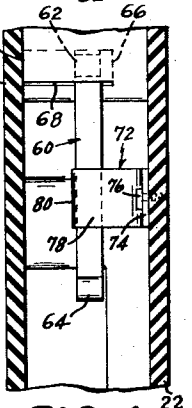


FIG. 4



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United States Patent Office 2,811,604 Patented Oct. 29, 1957

2,811,604

AUTOMATIC CIRCUIT BREAKERS

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Application December 11, 1953, Serial No. 397,551

13 Claims. (Cl. 200—116)

The present invention relates generally to switching mechanism and, in particular, to automatic circuit breakers.

In manually closing a circuit breaker or a switch, the closing operation to effect the engagement of the contacts should be smooth, even and positive. Persons who are inexperienced or timid in the operation of circuit making and breaking devices often have a tendency to close the device with hesitation and timidity when engaging the contacts for establishing or making the electric circuit. Hesitancy or pausing just before the contacts are closed, generally known in the art as "teasing," may permit the current to arc across the gap between the contacts. Current flow across the high resistance of the gap may produce sufficient heat at the contacts to weld or fuse them together upon the engagement thereof. In the case of automatically operated circuit breakers, the fusing or "sticking" of the contacts prevents the automatic opening thereof upon overload and, therefore, removes the desired safety control or tripping action from the circuit.

In view of the foregoing, an object of the present invention is the provision of means for assuring a consistent and quick closing action for effecting the engagement of the contacts of manually operated switches and circuit breakers, regardless of hesitancy or uneven manual operation by the operator.

Another object is the provision of means for depriving the operator of an electric circuit breaker or switch of control over the speed of movement of the manually operated element which effects the closing or engagement of the contacts.

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 drawing.

In the drawings which illustrate the best mode presently contemplated by us of carrying out our invention:

Fig. 1 is a side elevation of a circuit breaker pursuant to the present invention, with a portion of the circuit breaker housing removed for purposes of illustration, the circuit breaker being illustrated in the open or circuit interrupted condition thereof;

Figs. 2 and 3 are fragmentary views similar to Fig. 1, Fig. 2 illustrating an intermediate position during the closing operation of the circuit breaker, and Fig. 3 illustrating the circuit closed or circuit making condition of the circuit breaker;

Figs. 4 and 5 are fragmentary sectional views taken on the lines 4—4 and 5—5, respectively, of Fig. 1;

Fig. 6 illustrates a spring obstructing element for the circuit breaker;

Fig. 7 is a fragmentary view similar to Fig. 1 and illustrates another embodiment of the invention, the circuit breaker being in the open condition thereof;

Fig. 8 is a view similar to Fig. 7 with the circuit breaker in the circuit closed condition thereof;

Fig. 9 is a fragmentary sectional view, on an enlarged scale, taken on the line 9—9 of Fig. 8; and

Fig. 10 is a fragmentary sectional view taken on the line 10—10 of Fig. 9.

Referring now to the drawings in detail, there is shown a circuit breaker 20 of the type illustrated and described in our U. S. Patent No. 2,642,509, dated June 16, 1953, and in U. S. Patent No. 2,647,186, dated July 28, 1953, to T. M. Cole, one of the joint inventors hereof, both of which patents are assigned to the assignee hereof. The automatic circuit breaker 20 is provided with a body part 22 of a two part insulated casing or housing, the cover thereof being indicated at 24 in Figs. 4 and 5. The circuit breaker mechanism 26 provided in said body part, as here shown, comprises the contact arm 28, mounted for pivotal movement on a pivot member 30 which, as here shown, is constituted by a helical coil spring, as in our copending application Serial No. 367,324, filed July 10, 1953, now Patent No. 2,700,713 dated January 25, 1955, and assigned to the assignee hereof. It will be understood that in the embodiment of the invention illustrated in Figs. 1–6 herein, it is not essential that the pivot 30 be constituted by a spring element but on the contrary, said pivot may be a rigid pivot as illustrated in both of the previously identified patents. Suitable bearing apertures 32 are provided in the casing parts 22 and 24 for the pivot 30. The contact arm 28 is provided with the movable contact 34, at one end thereof, for engagement with and disengagement from a companion contact 36 provided on a solderless terminal connector 38. At its other end, the movable switch member 28 is provided with a pivotally mounted actuator 40 which is in operative engagement with the handle or manual operating member 42 by means of a link 44 which forms a toggle with the handle 42. The movable switch member 28 is also provided with a current responsive or overload device, here shown as a bimetallic element or latch 46, the free end of which is in latched engagement with the actuator 40 in the circuit making or closed condition of the mechanism. As here shown, the latch is connected through a flexible conductor 48 to a stab element 50, which constitutes the other terminal of the circuit breaker. Also as here shown, the circuit breaker mechanism 26 is provided with electro-magnetic means for effecting the disengagement thereof, said means comprising an electro-magnetic member 52 which constitutes a rigid armature which is secured at one end thereof to the latch 46 and to the movable switch member 28. A spring 54 is interposed between the handle 42 and the movable member 28, as illustrated in Figs. 1, 2 and 3.

The operation of the circuit breaker is described in detail in the above mentioned patents. However, it will be understood that the bimetallic element 46 operates to latch the manually operable actuator 40 and to unlatch said actuator from the movable contact member, the unlatching taking place upon deflection of the bimetallic element 46 causing the disengagement of the free end 55 thereof from the bottom part 56 of the actuator 40 upon the occurrence of an overload, or under other abnormal predetermined current conditions in the circuit controlled by the circuit breaker. When the bimetallic element 46 is deflected from engagement with the actuator 40, the spring 54 is effective to move the contact member 28 to its open position as illustrated in Fig. 1 wherein the contact 34 is disengaged from the companion stationary contact 36.

Pursuant to the present invention, provision is made to prevent sticking or fusing of the circuit breaker contacts which may result from the hesitant closing of the circuit breaker by an operator. As previously indicated, the hesitant or timed operation of the manual operating member 42 immediately before the engagement of the

contacts, may permit the current to arc across the gap between the contacts and result in the generation of relatively high heat at the contacts which may serve to weld or fuse the latter together upon engagement thereof. Such welding or fusing of the contacts will result in the sticking thereof to prevent the automatic opening of the circuit breaker upon overload or under other abnormal circuit conditions as previously described. Pursuant to the present invention, provision is made for a temporary obstruction to the movement of the movable contact member 28 to the closed position thereof. As here shown, said obstruction is constituted by the member 60, formed of a strip of spring metal, and provided at the ends thereof with the looped portions 62 and 64. The body part 22 of the casing is provided with a recessed portion 66 which has a slit 68 and which has an open end 70. The spring member 60 is mounted in the casing part 22 by inserting the looped end 62 thereof into the recessed portion 66 through the open end 70 of the latter so that the spring member extends through the slit 68. The open end of the recessed portion 66 is closed by the cover member 24. Provision is also made for a deflection member 72 for the spring 60, which member, as here shown, is provided with a portion 74 secured to the body part 22, as at 76, and with a portion 78 which extends transversely of the circuit breaker housing, as best illustrated in Fig. 5, to constitute a deflection surface for the spring member 60. The part 72 is also provided with the angular portion 80 which serves to retain the spring 60 in position in the recessed portion 66 and against movement transversely of the circuit breaker housing.

As illustrated in Fig. 1, the lower looped end 64 of the spring obstructing element 60 is disposed in the path of movement of the movable contact member 28 to the closed position thereof for engagement of the contacts 34 and 36. More specifically, provision is made in said movable contact member 28 for a step or abutment 82 which is defined in the marginal edge thereof. As previously indicated, the circuit breaker is closed by operation of the handle 42 from the position illustrated thereof in Fig. 1 to the position thereof illustrated in Fig. 3. This motion, which is transmitted through the link 44 and the actuator 40, results in the pivotal movement of the movable switch member 28 in a direction to effect the closing of the contacts which are locked in engagement by the overcentering of the toggle constituted by the link 44 and the handle 42, said toggle being conditioned for said overcentering by operation of handle 42. It will be apparent that during the course of said movement of the handle 42, the abutment 82 of the movable contact member 28 will be engaged by the looped spring end 64, as illustrated in Fig. 2. Said engagement of the spring with the movable contact member 28 obstructs the movement of the latter to its closed position and therefore serves to provide an obstruction to the engagement of the contacts. Continued movement of the handle 42 in the closing direction thereof, results in the bowing or bending of the spring 60, the spring body engaging the portion 78 of the deflection member 72 to facilitate said bowing of the spring. It will be apparent that the bowing of the spring results in the free end 64 thereof moving closer to the fixed end 62 thereof until said free end snaps off the step 82 to remove the temporary obstruction constituted by the spring. However, it will be understood that said bowing of the spring occurred as a result of the continued movement of the handle to the closed position thereof and that said movement has also caused operation of the toggle constituted by the handle and the link toward the overcentered condition thereof. This further operation of handle 42, link 44, actuator 40 and moving contact member 28 can occur even after arrest of abutment 84 by spring 60 because of spring pivot 30. This spring pivot is initially substantially unstressed, but after spring 60 engages abutment 82, operation of the handle and linkage 44, 40 and 28 progressively builds up stress in spring 30. During the period that the contacts were separated as a result of the obstruction constituted by the spring 60, as described, the gap between the contacts was too large to permit arcing between the contacts. However, it will be noted that substantially at the time that the spring 60 snaps out of engagement with the step 82, the toggle has been moved to overcentered condition thereof so that when the obstruction of the spring 60 is discontinued or relieved, the stressed spring 30 serves to snap-engage the contacts together with a smooth and positive action which is not under the control of the operator. Spring 30 acts on moving contact member 28 to swing that moving contact member clockwise about the right-hand end thereof as shown in Fig. 1. That right-hand end is restrained by the toggle formed by link 44 and the dependent portion of handle 42. The left-hand end of contact member 28 which bears moving contact 34 is unrestrained and therefore spring 30 snaps moving contact member 28 into contacts-closing direction when spring 60 disengages abutment 82. Therefore, it will be apparent that the actual engagement of the contacts during the last portion of the closing movement of the handle 42 is removed from the control of the operator. This occurs at the time of the overcentering of the toggle at which time the contacts 34 and 36 would be in engagement even if no spring 60 and abutment 82 were provided. This therefore prevents a hesitant or "teasing" closing engagement of the contacts such as may result in the heating thereof.

The type of circuit breaker in Figs. 1 to 5 inclusive, disregarding spring 60 and abutment 82 which constitute obstruction means that temporarily prevent advance of the moving contact toward the stationary contact, involves progressive movement of the operating handle from one extreme in which the contacts are open to the opposite extreme in which the contacts are closed, and a linkage interconnecting the handle and the moving contact provide progressive drive of the moving contact from open toward closed position as the handle is moved between its open and closed extreme positions, in the absence of the obstruction means. In the usual operation of this type of circuit breaker the contacts would meet when the handle is still spaced from its closed extreme position and further movement of the handle, or "overtravel," is made possible by yielding means in the operating mechanism, pivot spring 30 in the form of circuit breaker illustrated. This overtravel develops the necessary contact pressure and accommodates contact wear and other variations. Thus the drive linkage in the known type of circuit breaker includes yielding spring means that previously had its own purpose and is utilized for the additional function of being stressed because of the obstruction means 60—82 and thereafter of snap closing of the contacts.

Referring now to Figs. 7–10 in detail, there is illustrated another embodiment of the present invention pursuant to which the obstruction provided in the casing is not constituted by a spring member, such as 60, but is constituted by an integral lateral projection 83 which is provided on the inner surface of the casing part 22, as best illustrated in Fig. 9, and by a cooperating planar portion 84 provided on the movable member 28. As here shown, said latter portion is provided with the angularly related surfaces 92 and 94. It will be noted that the free edge 96 of the casing portion 83 extends transversely of the movable contact member 28.

Pursuant to the present embodiment of the invention, a spring pivot is required for the movable contact member 28, said pivot being constituted by the previously described helically wound spring member 30 mounted in the bearing portions 32 defined in the casing. Said bearings are beveled downwardly, as at 86 in Fig. 10 and also laterally in a direction toward the end of the movable

contact member which mounts the actuator **40**, as at **88** in said figure. Consequently, it will be apparent that the spring pivot **30** will be free to bow, as illustrated in Figs. 9 and 10. In the present embodiment, the operation of the handle **42** to close the contacts results in the pivotal movement of the movable contact member so that the surface **92** of portion **84** thereof engages the fixed edge **96** of the casing projection **83** which extends into the path of movement of the portion **84**. Consequently, the casing portion **83** constitutes an obstruction or fixed abutment to the movement of the contact member **28** toward closing of the contacts and the portion **84** of the latter constitutes a movable abutment which engages with said fixed abutment. However, continued operation of the movable handle **42**, after engagement of surface **92** with edge **96**, results in the bowing of the spring pivot **30** so that the movable contact member has a limited bodily movement in the direction of the arrow **90** (Fig. 8) away from the stationary contact **36** until the surface **92** clears the fixed projection **83**. At this point in the handle movement, the toggle constituted by the handle **42** and the link **44** has reached its overcentered position. Spring pivot **30** which was bowed and therefore stressed by operation of the handle after obstruction means **83—84** came into effect is suddenly freed to drive the moving contact member **28** clockwise about the restrained right-hand end thereof and therefore serves to snap engage the movable contact **34** against the stationary contact **36** which movement is independent of the operator's control. This then also prevents the hesitant or teasing engagement of the contacts and therefore prevents the heating and sticking thereof. It will be noted from Fig. 9 that the pivot spring **30** is downwardly bowed in the engaged condition of the contacts, and this provides for a desired contact pressure to compensate for wear of the contacts or for manufacturing inaccuracies, as described in our previously identified copending application. It will also be noted that when the surface portion **92** slides or moves past the free edge **96**, after its initial engagement therewith, to clear said free edge, the surface portion **94** is free to move up along the complementary shaped surface **98** of the casing portion **83**, to the position thereof illustrated in Fig. 8, to permit for the engagement of the contacts. Upon tripping or manual opening of the breaker, the expansion of compressed spring **54** causes the surface **94** to move down along surface **98** and when it clears the latter surface the pivot spring **30** is free to return from its bowed to its normal condition, whereby to bodily move the contact member **28** in a direction opposite the arrow **90** so that the surface **92** will be disposed relative the edge **96**, as in Fig. 7, in condition for the next closing operation of the breaker.

In both of the embodiments described above there is seen to be a drive mechanism which interconnects an operating handle and a moving contact where the drive mechanism is of a form that normally would produce progressive advance of the moving contact as the handle is progressively moved from its open to its closed extreme position. The mechanism includes yieldable spring means in this known type of circuit breaker; and that yieldable spring means is stressed as soon as the obstruction means (**64—82** in Fig. 1 and **83—84** in Fig. 7) arrests the advance of the moving contact. The toggle which includes the dependent portion of the handle and link **44** provides the drive that stresses the spring and, conversely, the spring produces a reaction force in the drive mechanism at a phase of operation of the handle when the contacts would normally be closed in the absence of the obstruction means. The reaction force causes release of the obstruction means. There is no distinct mechanical element that produces the release of the obstruction means but rather this occurs as a result of the building up of the stress in the yieldable spring means provided in the drive linkage. In the form of Fig. 1 release occurs when the stress is great enough to bow spring **60**. In the form of Fig. 7 release occurs when pivot spring **30** has been bowed to the right sufficiently to carry shoulder **84** clear of fixed abutment **83**.

The subject matter of the present application relating to the provision of means to prevent the sticking or fusing of the contacts is also the subject matter of the applications of Alexander R. Norden, Ser. No. 397,527 and Ser. No. 397,673 and the application of Paul M. Christensen and Dominick Wiktor, Ser. No. 397,662, all filed concomitantly herewith and all assigned to the assignee hereof.

While we have shown and described the preferred embodiments of our invention, it will be understood that various changes may be made in the idea or principles of the invention within the scope of the appended claims.

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

1. In a circuit breaker, a stationary contact, a movable contact member engageable and disengageable therewith, handle operated toggle means for closing and locking said member into engagement with said contact and means for preventing the engagement of said contact member with said contact until said toggle is substantially about to overset, whereby said toggle provides for a quick closing of said breaker, said preventing means being an obstruction mounted in the path of movement of said movable member to prevent the engagement of said movable member and said contact, and means operable to release said movable member from said obstruction substantially at the oversetting of said toggle, said movable member being pivotally mounted, and said releasing means comprising a resilient pivot which permits for limited bodily movement of said contact member.

2. An automatic circuit breaker having a stationary contact, a movable contact member for engagement and disengagement therewith, manually operable means for operating said movable contact member for engagement with and disengagement from said stationary contact, said means comprising an actuator mounted on said movable member, a manual operating element and a mechanical connection between said element and said actuator forming a toggle with said element, said toggle being operative when overset to snap-lock said contacts together, a current responsive control element carried by said member and operable to releasably latch said actuator thereto, and means operatively independent of said manual element to prevent the engagement of said member and said contact until said toggle is overset, whereby said toggle effects the closing of said breaker, said means comprising a rigid obstruction fixed in the path of movement of said movable member, and means to disengage said movable member from said obstruction substantially at the oversetting of said toggle, said latter means comprising means to effect limited bodily movement of said movable member for releasing the latter from said obstruction.

3. An automatic circuit breaker having a stationary contact, a movable contact member for engagement and disengagement therewith, manually operable means for operating said movable contact member for engagement with and disengagement from said stationary contact, said means comprising an actuator mounted on said movable member, a manual operating element and a mechanical connection between said element and said actuator forming a toggle with said element, said toggle being operative when overset to snap-lock said contacts together, a current responsive control element carried by said member and operable to releasably latch said actuator thereto, and means operatively independent of said manual element to prevent the engagement of said member and said contact until said toggle is overset, whereby said toggle effects the closing of said breaker, said means comprising a rigid obstruction fixed in the path of movement of said movable member, and means to disengage said movable

member from said obstruction substantially at the oversetting of said toggle, said latter means comprising a resilient mounting for said movable member whereby to provide for limited bodily movement of said movable member for releasing the latter from said obstruction.

4. An electric circuit breaker having relatively movable contacts including a movable contact, an operating handle movable between extreme positions in which said contacts are, respectively, open and closed, a drive mechanism interconnecting the handle and said movable contact for progressively operating said movable contact towards its closed position as the handle is moved toward its closed position, means automatically operable in response to the load condition of the circuit to open said contacts, and obstruction means coacting with said mechanism and effective to arrest the advance of said movable contact during said closing motion of said handle, said mechanism including yieldable spring means allowing said handle to be so moved despite arrest of said movable contact, said handle being effective during further operation thereof to release said obstruction means after said handle has reached a position at which said movable contact would, in the absence of said obstruction means, engage the other contact, said handle acting to progressively increase the stress in said yieldable spring means during said handle motion, and said spring thereby producing a reaction force in said drive mechanism, said drive mechanism coacting with said yieldable spring means when a sufficient stress has been built up to release the obstruction means.

5. An electric circuit breaker having relatively movable contacts including a movable contact, operating mechanism for said contacts including an operating handle movable between extreme positions in which said contacts are, respectively, open and closed, said operating mechanism also including a drive mechanism interconnecting the handle and said movable contact for progressively operating said movable contact toward its closed position as the handle is moved toward its closed position, means automatically operable in response to load condition of the circuit to open said contacts, and obstruction means coacting with said drive mechanism and effective to arrest the advance of said movable contact during said closing motion of said handle toward its closed position, said operating mechanism including yieldable spring means allowing said handle to be so moved despite arrest of said movable contact, said handle being effective during further operation thereof to effect release of said obstruction means after said handle has reached a position at which said movable contact would, in the absence of said obstruction means, engage the other contact, said handle acting to progressively increase the stress in said yieldable spring means during said handle motion, and said spring thereby producing a reaction force in said drive mechanism, said drive mechanism coacting with said yieldable spring means when a sufficient stress has been built up to release the obstruction means.

6. An electric circuit breaker having relatively movable contacts including a movable contact, an operating handle movable between extreme position in which said contacts are, respectively, open and closed, a drive mechanism interconnecting the handle and said movable contact for progressively operating said movable contact toward its closed position as the handle is moved toward its closed position, said drive mechanism including an actuator and current-responsive latch means for the actuator operable automatically in response to load condition of the circuit to release said actuator and thereby to cause opening of said contacts, and obstruction means coacting with said mechanism and effective to arrest the advance of said movable contact during said closing motion of said handle, said mechanism including yieldable spring means allowing said handle to be so moved despite arrest of said movable contact, said handle being effective during further operation thereof to effect release of said obstruction means after said handle has reached a position at which said movable contact would, in the absence of said obstruction means, engage the other contact, said handle acting to progressively increase the stress in said yieldable spring means during said handle motion, and said spring thereby producing a reaction force in said drive mechanism, said drive mechanism coacting with said yieldable spring means when a sufficient stress has been built up to release the obstruction means.

7. Apparatus in accordance with claim 4 wherein said drive mechanism includes an overcentering toggle connected to said handle for progressive operation therewith, and wherein said yieldable spring means is in the form of a spring pivot for an element of said drive mechanism.

8. An electric circuit breaker in accordance with claim 4, including a movable contact member for said movable contact, said circuit breaker being provided with a housing and said obstruction means including a movable element interposed between a portion of said housing and said movable contact member when the advance of the movable contact is to be arrested and said movable element being removed from said interposed position when said drive mechanism has been conditioned for engagement of said contacts in the absence of said obstruction means.

9. A circuit breaker in accordance with claim 8 wherein said movable element interposed between said housing portion and said movable contact member is a leaf spring, and wherein said leaf spring is arranged to snap out of obstructing relation with said movable contact member when said drive mechanism has been operated by said handle sufficiently for causing engagement of said contacts in the absence of said obstruction means.

10. A circuit breaker in accordance with claim 4 including a movable contact member for carrying said movable contact, and a spring pivot which permits limited bodily movement of said contact member, said circuit member having a housing providing a fixed obstruction cooperable with means carried by said movable contact member to constitute said obstruction means and wherein said movable contact member is bodily shifted by said drive mechanism to discontinue cooperation of said fixed obstruction and said portion of said movable contact member when said drive mechanism and said yieldable spring means are conditioned by the operating handle to cause engagement of said contacts in the absence of said obstruction means.

11. A circuit breaker in accordance with claim 10 wherein said means carried by said movable contact member is an integral portion thereof.

12. A circuit breaker including relatively movable contacts including a movable contact and a movable contact member for said movable contact, a spring pivot for supporting said movable contact member and an articulated drive linkage interconnecting said operating handle and said movable contact member, said linkage including overcentering self-locking toggle means and further including an actuator, current-responsive means carried by said movable contact member and arranged for latching engagement with said actuator during closing operation of the circuit breaker, an insulating housing, cooperating elements forming portions of said housing and of said movable contact member moved into cooperating relationship by actuation of said linkage and effective to arrest advance of the movable contact temporarily, said spring pivot being bowed during further operation of said linkage to a point where said contacts would be closed in the absence of said cooperating elements, bowing of said spring pivot acting to bodily shift said movable contact member and the obstruction element thereof out of cooperative relation with the obstruction element of the housing and the spring pivot being thereafter operative to cause snap closing of the contacts.

13. A circuit breaker having a stationary contact, a movable contact member engageable and disengageable

therewith, a manually operable mechanism including a handle and a toggle articulated thereto for closing and locking said member in engagement with said contact, and means for preventing the engagement of said contact member with said contact until said toggle is substantially about to overset, said preventing means being an obstruction in the path of movement of said movable member to prevent the engagement of the movable member and said contact, and means obperable to release said movable member from said obstruction substantially at the oversetting of said toggle, said movable member being pivotally mounted, and said releasing means comprising a resilient pivot which permits limited bodily movement of said contact member, said resilient pivot being increasingly stressed by continued operation of said handle when said preventing means is operative to prevent said engagement, and said contact member being shifted bodily during said increasing stress, and said resilient pivot effecting quick closing of said breaker upon release of said movable member as a result of said bodily movement of said movable contact member.

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