

June 30, 1931.

J. SACHS

1,812,843

AUTOMATIC CIRCUIT BREAKER

Filed Jan. 16, 1929

4 Sheets-Sheet 1

Fig. 1

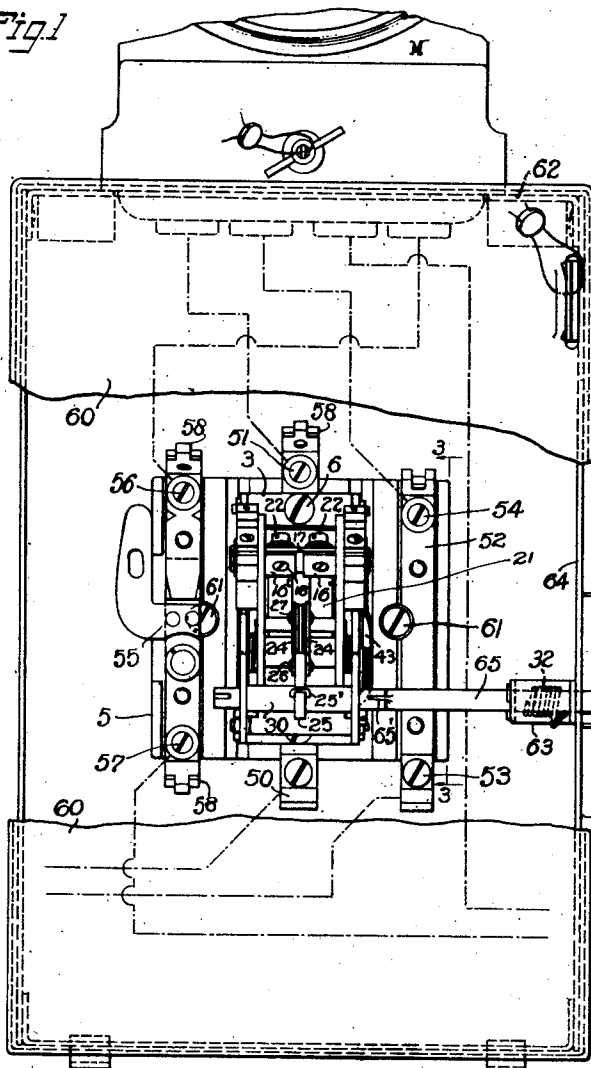


Fig. 3

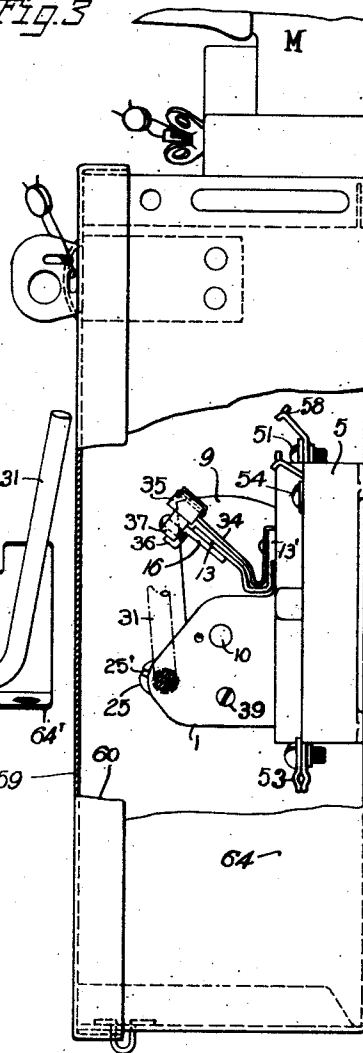
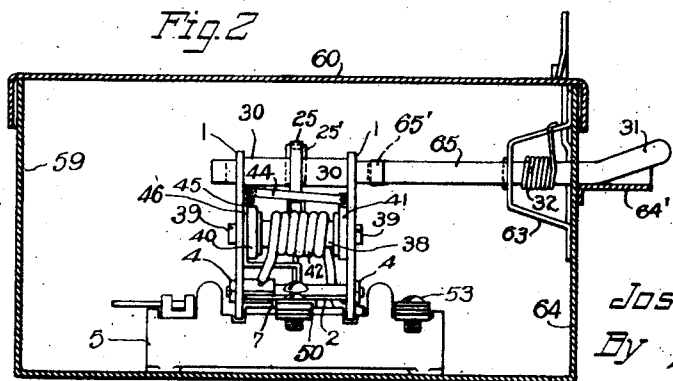


Fig. 2



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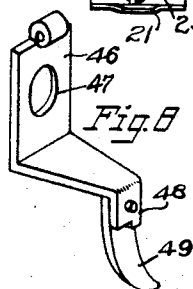
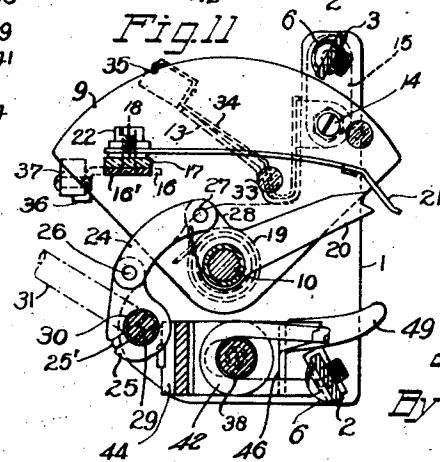
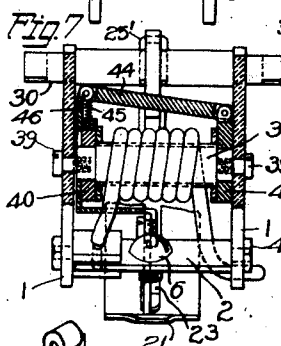
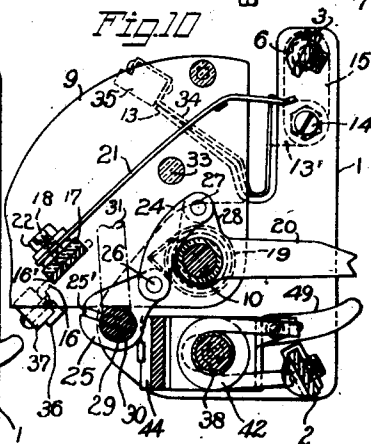
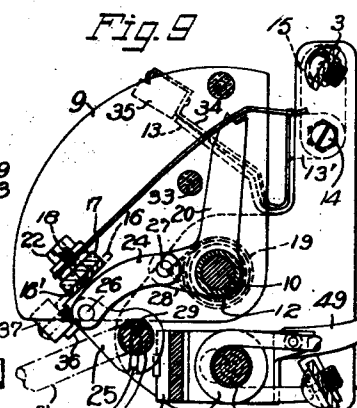
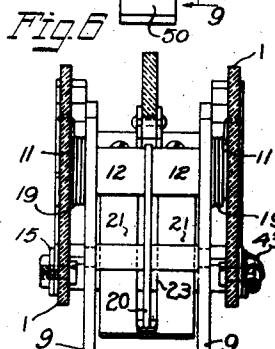
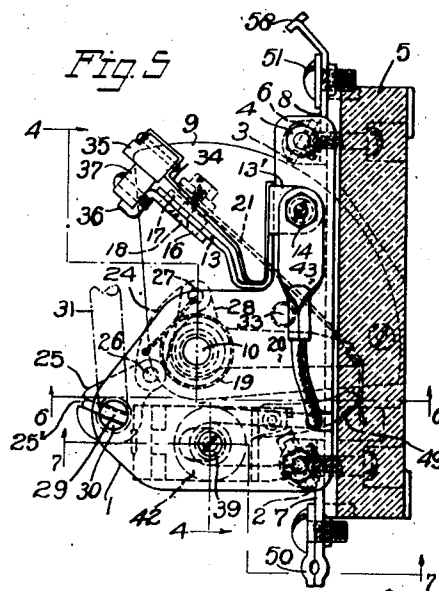
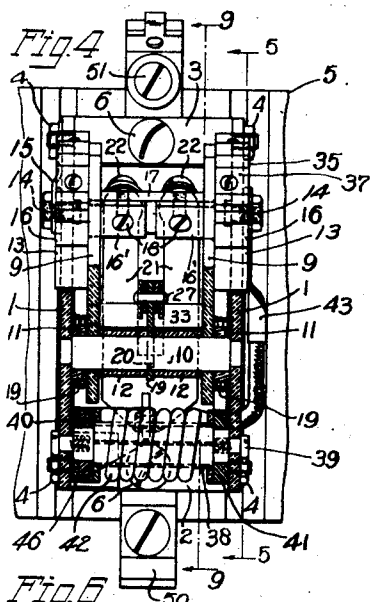
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AUTOMATIC CIRCUIT BREAKER

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4 Sheets-Sheet 2



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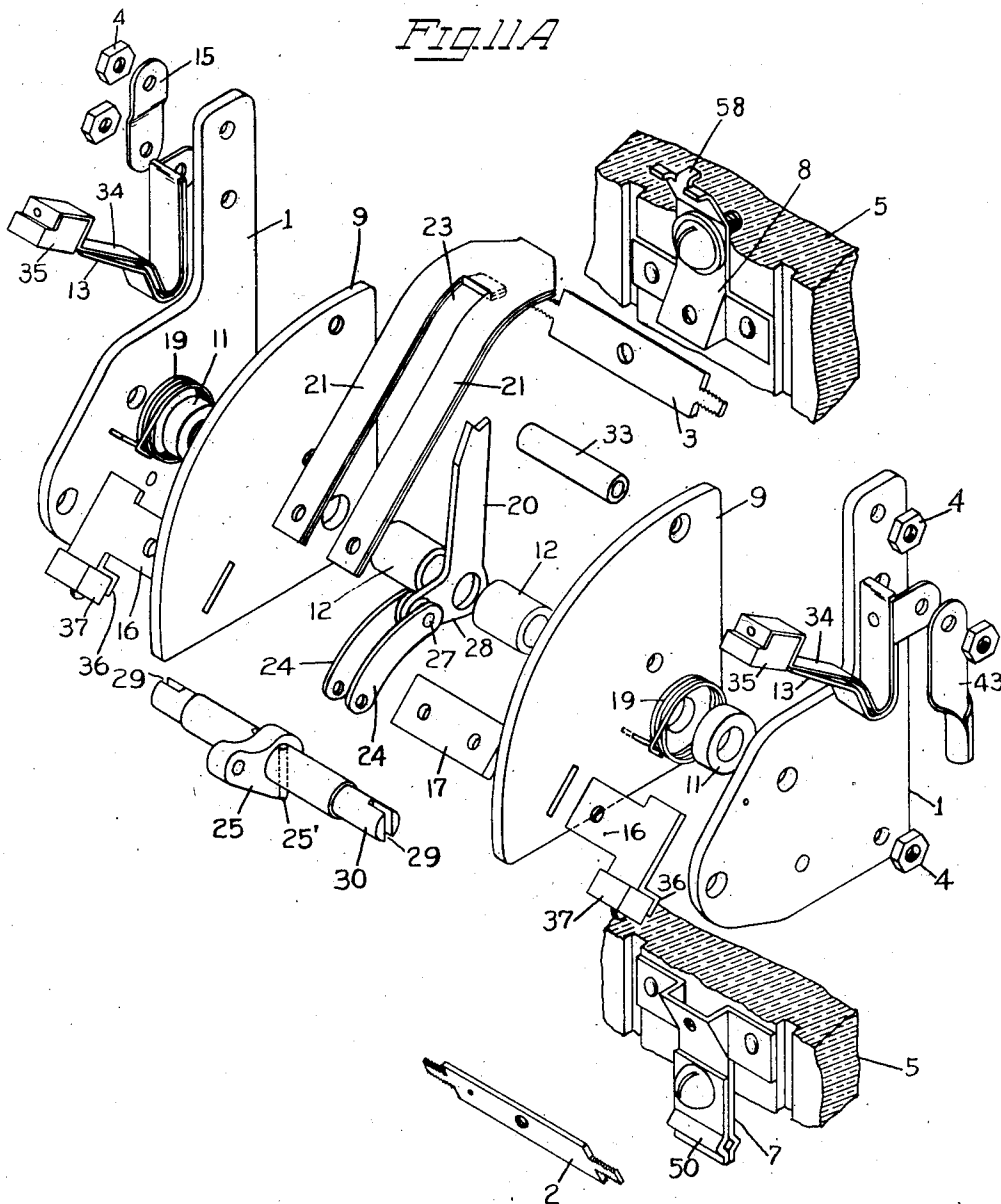
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Fig. 11A



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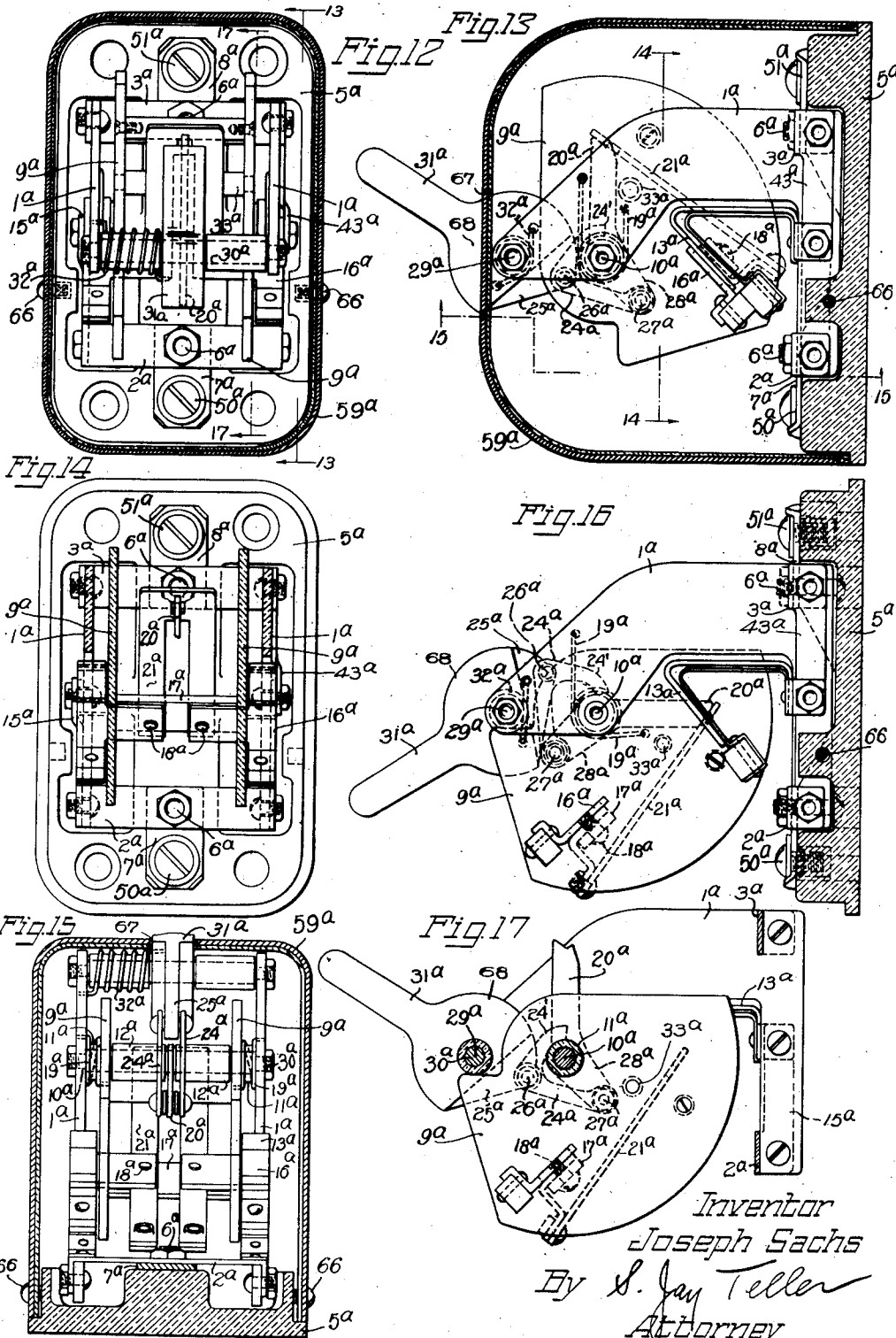
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AUTOMATIC CIRCUIT BREAKER

Filed Jan. 16, 1929

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UNITED STATES PATENT OFFICE

JOSEPH SACHS, OF WEST HARTFORD, CONNECTICUT

AUTOMATIC CIRCUIT BREAKER

Application filed January 16, 1929. Serial No. 332,924.

The general object of the invention is to provide an automatic circuit breaker wherein the automatic circuit breaking action takes place entirely independently of the operating handle and wherein the said handle is nevertheless automatically moved to its open-circuit position whenever the circuit breaker is automatically operated to break the circuit. Thus after an automatic breaking of the circuit it is only necessary to move the handle in the regular way from its open-circuit position to its closed-circuit position in order to re-establish the circuit.

In accordance with the invention there is provided an actuator which is adapted to be manually controlled either directly or indirectly and a normally operative mechanical connection is provided between the actuator and a movable contact member which mechanical connection is automatically rendered inoperative upon the attainment of abnormal current conditions in order to permit the contact member to move independently of the actuator to its open-circuit position. There is also provided a suitable locking or restraining means normally holding the actuator in closed-circuit position, this restraining means being additional to the mechanical connection between the actuator and the contact member. Upon the release of the contact member for automatic movement to open-circuit position the actuator is substantially simultaneously released from the restraining means and also permitted to automatically move to its open-circuit position, the mechanical connection between the two parts being thereupon automatically restored. It is then possible to re-establish the circuit simply by moving the actuator back to its closed-circuit position.

The invention is particularly applicable to circuit breakers of the general type disclosed in my copending applications for automatic circuit breakers, Serial No. 271,319, filed April 21, 1928, and Serial No. 283,060, filed June 5, 1928, but it is not necessarily so limited. In the accompanying drawings I have shown two embodiments of the invention, each similar in some respects to the disclosure in the last aforesaid appli-

cation, but it will be understood that the drawings are intended for illustrative purposes only and are not to be construed as defining or limiting the scope of the invention, the claims forming a part of this specification being relied upon for that purpose.

Of the drawings:

Fig. 1 is a front view of a circuit breaker embodying the invention, the said circuit breaker being shown as enclosed in a cabinet adapted to be protectively associated with an electric meter.

Fig. 2 is a bottom view of the circuit breaker shown in Fig. 1, the enclosing cabinet being shown in transverse section.

Fig. 3 is a side view partly in section along the line 3—3 of Fig. 1.

Fig. 4 is an enlarged vertical sectional view taken along the line 4—4 of Fig. 5 and showing the circuit breaker unit and a portion of the base.

Fig. 5 is a vertical sectional view taken along the line 5—5 of Fig. 4.

Fig. 6 is transverse horizontal sectional view taken along the line 6—6 of Fig. 5.

Fig. 7 is a transverse sectional view taken along the line 7—7 of Fig. 5.

Fig. 8 is a detail perspective view of a part of the magnet mechanism.

Fig. 9 is a vertical sectional view taken along the line 9—9 of Fig. 4 and showing the circuit breaker unit only, omitting the base.

Figs. 10 and 11 are views similar to Fig. 9 but showing the parts in different relative positions.

Fig. 11A is an isometric view showing the principal parts of the circuit breaker spaced from each other so that their details of construction may more clearly appear.

Fig. 12 is a front view of a different embodiment of the invention, the enclosing cover being shown in section.

Fig. 13 is a side view of the parts shown in Fig. 12, the enclosing cover being shown in section.

Fig. 14 is a vertical sectional view taken along the line 14—14 of Fig. 13.

Fig. 15 is a bottom view with the enclosing casing shown in transverse section.

Fig. 16 is a view similar to Fig. 13 but

showing the parts in different relative positions.

Fig. 17 is a fragmentary view similar to Figs. 13 and 16 but showing the parts in a still different position.

Referring to the drawings, particularly Figs. 1 to 11A thereof, it will be observed that the main body of the circuit breaker unit comprises two spaced side plates 1, 1 and metallic cross members 2 and 3 connected at their ends with the side plates by means of nuts 4, 4. The said body of the circuit breaker unit is connected with a base 5 by means of screws 6, 6 extending through the members 2 and 3 and engaging metal plates 7 and 8 carried by the base.

I provide a contact member which is movably mounted with respect to the body, preferably being mounted for pivotal movement. As illustrated the contact member includes two side plates 9, 9 which are pivotally mounted upon a transverse rod 10 supported at its ends by means of the side plates 1, 1 of the body, the ends of the rod being reduced in diameter and extending through holes in the plates. The side plates 9, 9 are spaced from the side plates 1, 1 by means of washers 11, 11 and are spaced from each other by means of bushings 12, 12 surrounding the rod 10.

Suitable electric contacts are provided, there preferably being two stationary contacts carried by the body of the circuit breaker and two movable contacts carried by the contact member and adapted to be engaged with and disengaged from the respective stationary contacts. The details of the contacts may be widely varied but as illustrated the two stationary contacts 13, 13 are carried respectively by the two side plates 1, 1. Each of the contacts 13 comprises a flat strip bent as shown in Figs. 3, 5 and 11A and having the contact face thereof located in a transverse plane.

Each contact strip is provided with an ear 13' in a vertical plane and held in engagement with the corresponding side plate 1 by means of a bolt 14. The left hand contact 13 is electrically connected with the upper transverse member 3 by means of a strip 15 held by the nuts at 4 and 14. The right hand contact 13 is connected directly or indirectly with the lower transverse member 2 and the details of the connection will be hereinafter described. The movable electrical contacts are shown at 16, 16, these contacts projecting laterally from the side plates 9, 9 of the contact member and being adapted to engage the stationary contacts 13, 13 as shown in Fig. 5. I do not herein claim the specific construction and relationship of the stationary and movable contacts, as these details are disclosed and claimed in my copending applications for automatic circuit breakers, Serial

No. 283,060 filed June 5, 1928 and Serial No. 365,419 filed May 25, 1929.

Extending transversely between the two side plates 9, 9 is an insulating bar 17 and the two contacts 16, 16 are extended inward as shown at 16' through suitable apertures in the side plates so as to engage the bar 17 at the lower face thereof as shown in Figs. 4 and 5. The said contacts are held in place by means of screws 18, 18. The entire contact member is biased toward its upper open-circuit position, and for this purpose I have provided coil springs 19, 19 surrounding the washers 11, 11 and having their ends connected respectively with the body and the contact member.

In accordance with the invention I provide a movable member which I will term an actuator, this member serving as the means for moving or actuating the contact member for normal switching purposes or to effect closing of the circuit after automatic opening thereof. This actuator is preferably movable in fixed relationship with the contact member during normal operation and when the contact member is pivotally mounted as shown and described the actuator is also pivotally movably mounted for movement about the same axis as the contact member. As shown the actuator is in the form of a plate 20 pivotally mounted on the bar 10 and between the bushings 12, 12 and thereby held against transverse movement. This actuator is adapted to be operated in the manner to be presently described. I provide an electro-responsive controlled mechanical connection between the actuator and the contact member which connection is normally operative to enable the actuator to effect the movement of the contact member to its closed-circuit or its open-circuit position for ordinary switching purposes. The said connection is automatically rendered inoperative in so far as its holding function is concerned upon the attainment of abnormal current conditions to permit the contact member to automatically move independently of the actuator to its open-circuit position. The abnormal current conditions referred to are ordinarily those resulting from an overload or a short circuit but the invention is not necessarily so limited.

The electro-responsive control of the aforesaid mechanical connection may be effected by an electro-responsive means bodily movable with the mechanical connection or by an electro-responsive means separate from the said connection and fixed against bodily movement therewith or by two such means acting in conjunction with each other. The invention is particularly applicable, however, to a construction wherein the electro-responsive means is mounted for bodily movement with the contact member, or with the actuator, or with both. I prefer and have shown 13'

for this purpose an electro-responsive bi-metallic thermal strip which is adapted to be deflected by reason of the heating action of excess current therein in accordance with the well known action of such bi-metallic strips. The bi-metallic strip is shown in the drawing at 21 this strip being substantially U-shaped and having the legs of the U connected respectively with the movable contacts 16, 16. As illustrated the end portions of the said legs are provided with holes through which extend the aforesaid screws 18, 18, nuts 22, 22 engaging the said screws and serving to clamp the strip 21 in place. It will be observed that the strip 21 provides an electrical connection between the two movable contacts 16, 16, thus, when the movable and fixed contacts are in engagement, completing the circuit through the entire unit.

The said strip 21 is so shaped and positioned that it serves in and of itself as a latch to hold the contact member and the actuator 20 in normally fixed relationship with each other. For this purpose the slot 23 in the strip 21 is made of such a length that it is adapted to receive a reduced end portion of the actuator 20. At normal temperatures the strip 21 serves to mechanically connect the contact member and the actuator 20, but when the bi-metallic strip is heated by reason of the passage of excess current therethrough it is deflected upward and rearward so as to disengage the actuator 20 and permit the contact member to move under the influence of the springs 19, 19 in the counter-clockwise direction so as to separate the contacts 16, 16 from the contacts 13, 13 and thus break the circuit.

By reason of its normal mechanical connection with the biased contact member the actuator 20 is also normally biased for automatic movement toward its open-circuit position, but there is provided a restraining means which serves when the actuator is in its closed-circuit position to prevent automatic movement thereof to open-circuit position, the said restraining means preferably acting independently of the contact member. Thus, when the restraining means is effective, the actuator and the contact member are both maintained in their closed-circuit positions notwithstanding their bias to their open-circuit positions.

The restraining means may be widely varied in construction so far as the broader aspects of the invention are concerned, but preferably and as shown the said restraining means comprises two links 24 and 25. These two links are pivotally connected together at 26 and the link 24 is pivotally connected at 27 with an arm 28 connected with or formed as a part of the actuator 20. The link 24 has two similar parts at opposite sides of the link 25 and of the actuator 20. These parts are separated from the actuator by means of

washers as shown. The other link 25 is mounted for movement about a fixed axis at 29. When the actuator is in its closed-circuit position as shown in Fig. 5 the two links 24 and 25 occupy the position shown with the pivotal axis at 26 below and at the right of a straight line connecting the pivotal axes at 27 and 29. Movement of the links toward the right is prevented by the engagement of the link 24 with the sleeves 12, 12, and thus the two links 24 and 25 have a toggle relationship wherein they positively resist the tendency of the actuator and contact member to automatically move in the clockwise or circuit opening direction.

Provision is made whereby the electro-responsive means serves upon the passage of excess current not only to release the contact member for movement independently of the actuator but also render the restraining means ineffective so as to permit the actuator to also move to its circuit-opening position. The action of the electro-responsive means upon the restraining means will depend upon the type of restraining means selected but when the restraining means comprises toggle links as shown I preferably provide means which bias the said links for movement out of their locking position, in this case upward and forward. It will be apparent that the links 24 and 25 are held in their toggle relationship by reason of the pressure or stress exerted thereon by the actuator which pressure or stress is the result of the circuit-opening bias of the contact member which is transmitted to the actuator through the mechanical connection, in this case the thermal strip 21. Obviously the pressure or stress thus transmitted to the actuator must be great enough to overcome the tendency of the links to automatically move to unlocking positions. As soon as the mechanical connection becomes inoperative, that is, as soon as the thermal strip disengages the actuator, pressure or stress is no longer applied to the toggle links and thereupon the links immediately move out of their locking position, thus permitting the actuator to move to its open-circuit position.

An operating member or handle is provided for operating the actuator and through the actuator operating the contact member. This handle may be variously mounted and connected but when there are provided toggle links such as 24 and 25 the handle is preferably connected directly with the lower or outer toggle link 25. As illustrated there is provided a transverse spindle 30 which is mounted in bearing apertures in the two side plates 1, 1. The link 25 is rigidly mounted upon the spindle 30 by means of a staple 25' and a handle 31 is operatively connected with the spindle 30 so as to be capable of moving it in either direction. As already stated the toggle links are biased for movement out of

their locking position, and this result is obtained by means of a spring 32 which tends to move the spindle 30 and the link 25 in the counter-clockwise direction. (See Figs. 1 and 2.)

As already stated Fig. 5 shows the circuit breaker with the parts in closed-circuit position, the toggle links 24 and 25 serving as restraining means to prevent the movement of any of the parts to their open circuit positions. By means of the handle 31 the actuator and the contact member can be moved, while remaining in fixed relationship to each other, to their open-circuit position as shown in Fig. 9. It will be understood that during such movement the strip 21 remains in engagement with the actuator 20. Thus the handle 31 can be used to operate the circuit breaker as a switch for ordinary switching purposes. The contact member is positively moved in the clockwise circuit-closing direction by reason of the engagement of the thermal strip 21 with the actuator 20, and the said contact member is moved in the counter-clockwise circuit-opening direction by the springs 19, 19 acting under the control of the actuator.

The counter-clockwise movement of the contact member is limited by the spindle 30 as shown in Figs. 9 and 10. The transverse rod 33 extending between the side plates 9, 9 of the contact member prevents excessive counter-clockwise movement of the actuator, if the said movement is not otherwise limited.

As already pointed out the thermal strip 21 is so constructed and adjusted that upon the passage of a current therethrough in excess of a predetermined amount it will be deflected upward and rearward. When the current in the strip exceeds the said predetermined amount the strip will disengage the actuator 20, thus breaking the mechanical connection between the actuator and the contact member. As soon as this mechanical connection is broken the contact member is immediately turned in the counter-clockwise direction under the action of the springs 19, 19 to the open-circuit position, the circuit being thus broken in two places as already described.

It will be understood that the automatic movement of the contact member to open-circuit position takes place entirely independently of the actuator and will so take place even though the actuator be positively held in its circuit-closing position as shown in Fig. 10. Thus it is impossible for anyone to prevent the operation of the circuit breaker by holding or fastening the handle in its closed-circuit position.

The parts can assume the relative positions shown in Fig. 10 only when the handle 31 is held by external means. If not externally held, the handle and the actuator will immediately move to their open-circuit positions

as soon as the stress on the actuator 20 is released by reason of the disengagement of the thermal strip 21 therefrom. As already stated the toggle links are biased for movement out of their locking position and the handle is also biased for movement to its open-circuit position. Therefore, as soon as the stress on the actuator 20 is removed, the toggle links move out of their locking position and the handle immediately starts to move toward its open-circuit position carrying the actuator with it. Thus, as the contact member moves toward its open-circuit position, the handle and the actuator move substantially simultaneously toward their open-circuit positions, the contact member being only slightly in advance of them as indicated in Fig. 11. The contact member will reach its open-circuit position first but the actuator and handle will reach their open-circuit positions immediately thereafter and the mechanical connection between the actuator and the contact member will be substantially immediately restored by reason of the re-engagement of the thermal strip 21 with the actuator 20. When the circuit is broken as the result of an ordinary overload the thermal strip is deflected only far enough to effect release and it very quickly cools sufficiently to effect reengagement; but when the circuit is broken as the result of a short circuit the heating of the strip may be such as to deflect it more than enough to effect release and in such a case an appreciable interval of time may elapse before the strip cools sufficiently to effect re-engagement. Thus the normal relationship between the parts is automatically restored and to close the circuit it is only necessary to move the handle to its closed-circuit position.

It will be clear that if the excess current condition still prevails upon attempted reclosure of the circuit the bi-metallic strip will act as set forth to cause the re-opening of the circuit.

Preferably auxiliary contacts are associated with the before mentioned main contacts 13 and 16. Connected with each of the main stationary contact strips is an auxiliary resilient strip 34 carrying a small block 35 of carbon or other suitable contact material. Each of the contacts 16 is provided with an extension 36 carrying a small block 37 of contact material similar to the block 35. When the main contacts are in engagement as shown in Fig. 5 the auxiliary contacts 35 and 37 are also in engagement the strip 34 being flexed as shown. When the contact member is moved to separate the main contacts 13 and 16 the resilient strip 34 maintains the contacts 35 and 37 in engagement for an instant after the separation of the main contacts thus causing any arcing that may occur to take place between the auxiliary

contacts rather than between the main contacts.

It may be desirable to include in the circuit breaker unit not only an electro-responsive thermal strip such as 21 but also a magnetically controlled means for mechanically effecting the disengagement of the strip independently of the thermal action thereof. The details of such a construction are presented in my said copending application Serial No. 283,060 and a brief description here will be sufficient.

Extending transversely between the main plates 1, 1 of the unit is a core 38 held in place by means of screws 39, 39. Carried by the reduced end portions of the core 38 are cheek pieces 40 and 41. Surrounding the core 38 is a coil 42 of relatively large wire, only a few windings such as shown being required. The wire constituting the coil 42 serves as the electrical connection between the right hand contact 13 and the cross member 2. One end of the wire is connected with the said contact 13 by means of a terminal member 43 as shown in Figs. 4 and 5, and the other end of the wire is connected directly with the connector 2.

Pivoted to the right hand cheek piece 41 is an armature 44 which is normally held in its forward position by means of a spring 45 engaging the cheek piece 40. Pivotaly connected with the armature 44 is a plate 46 which extends between the cheek piece 40 and the corresponding side plate 1. This plate 46 is shown in detail in Fig. 8. The plate 46 is slotted at 47 to receive the left hand portion of the core 38 and the lower portion 48 thereof is offset to be positioned near the center of the unit. The said offset portion 48 carries an insulating member 49. The member 49 is normally positioned in close proximity to the lower inner end of the thermal strip 21 as clearly shown in Fig. 5.

The magnetic device as described is so positioned as not to interfere in any way with the manual operation of the device as already described. Upon the passage of excess current the bi-metallic strip 21 tends to act in the way already described to effect the opening of the circuit. However, the magnet which has been described is in series with the thermal strip and is simultaneously energized tending to draw the armature 44 rearward, thus moving the plate 46 rearward and causing the member 49 to strike against the thermal strip 21. The parts are so constructed and adjusted in relation to each other that a moderate overload will cause the strip 21 to deflect and thus permit the opening of the circuit as described, the magnet not being sufficiently energized to be effective. However, in the case of an excessive overload such as might be caused by a short circuit the magnet will be instantly energized, thus instantly moving the strip 21

mechanically to cause it to be disengaged from the actuator 20 and thus permit the opening of the circuit. In the case of an excessive overload the magnet would act more quickly than the bi-metallic strip and thus the circuit would be interrupted more quickly than it would by means of the normal action of the said strip.

The circuit breaker unit which I have described may be used in association with any desired parts and I do not limit myself to any one use thereof. However, in order that one application of the invention may be clearly understood I have shown the said unit combined with other parts to form a house entrance installation adapted to be directly associated with an electric meter M.

The aforesaid plates 7 and 8 on the base 5 are provided with means such as the clamp 50 and the screw 51 for engagement with electric conductor wires. In order that complete provision may be made for the connection and use of an electric meter I provide on the base 5 in addition to the circuit breaker unit a neutral conductor or strap 52 provided with wire terminals 53 and 54, and I also provide a test switch 55 interposed between wire terminals 56 and 57. In order to further facilitate the testing of the meter suitable contacts adapted for the attachment of instrument leads and by-pass connections are provided at 58, 58.

One arrangement of electrical connection which may be used is shown by dot-and-dash lines in Fig. 1. It will be apparent that the circuit breaker unit is interposed between an incoming service wire and the meter and thus serves to protect not only the customer's load circuit but also the meter in case of any excess current conditions. The circuit from the meter extends through the test switch 55 and this switch may therefore be utilized to disconnect the meter from the load wires for testing in accordance with well understood practice. Prior to the opening of the switch 55 a suitable by-pass may be connected to the proper contacts 58, 58 in order that the customer's circuit may not be interrupted.

The base 5 and the parts carried thereby may be enclosed in a protecting cabinet such as the cabinet 59. This cabinet is or may be of substantially standard construction being rectangular in form and having an openable front cover 60 adapted to be sealed in closed position to protect the interior parts. The base 5 may be secured to the rear wall of the cabinet by means of screws 61, 61. Preferably the upper end wall 62 of the cabinet is provided with a suitable opening through which the terminal chamber portion of the meter M may project as shown so as to entirely enclose the connections between the meter and the service appliance within the cabinet.

When a cabinet such as 59 is provided, the

handle 31 may be mounted on the cabinet independently of the circuit breaker unit and may be detachably connected therewith. As shown a bearing bracket 63 is riveted or otherwise secured to the right hand side wall 64 of the cabinet and the said bracket and the said side wall are formed with aligned bearing apertures for the spindle portion 65 of the handle. The before mentioned spring 32 is located within the bracket 63. The inner end of the spindle portion 65 detachably engages the spindle 30 of the circuit breaker unit. As shown the portion 65 has a flattened extension 65' projecting into a slot in the spindle 30. I do not herein claim the detachable mounting of the circuit breaker unit in combination with the separable connection with an independently mounted handle, as these features are set forth and claimed in my copending application for automatic circuit breaker, Serial No. 279,391 filed May 21, 1928. Carried by the side wall 64 is a stop 64' for limiting the movement of the handle 31.

From the foregoing description it will be apparent that the handle 31 is accessible when the cover 60 is closed to render the parts inside of the cabinet entirely inaccessible. By turning the handle 31 the customer can operate the circuit breaker as before described to open or close the circuit any time as desired. However, the circuit breaker construction is such that the operator cannot interfere with the automatic opening thereof, the said automatic opening taking place independently of the handle 31. However, upon automatic opening of the circuit the handle 31 automatically moves to its open-circuit position as already described.

In Figs. 12 to 17 I have shown another embodiment of the invention similar in many respects to that shown in Figs. 1 to 11A. In this construction, however, the magnetic device is omitted and there is no particular adaptation of the circuit breaker for use with an electric meter.

The side plates 1^a, 1^a of the body are connected by means of cross members 2^a and 3^a, these cross members being connected by means of screws 6^a, 6^a with conducting plates 7^a, 8^a secured to the rear base 5^a. The said plates 7^a and 8^a are provided respectively with wire terminals 50^a and 51^a. The side plates of the pivoted contact member are shown at 9^a, 9^a, these being pivotally mounted on a transverse rod 10^a extending between the body side plates 1^a, 1^a. The plates 9^a, 9^a are spaced from the plates 1^a, 1^a by means of washers 11^a, 11^a and are spaced from each other by means of bushings 12^a, 12^a. The contact member is biased to its open-circuit position by means of springs 19^a, 19^a surrounding the washers 11^a, 11^a.

The stationary and movable contacts are similar to those already described in connection with Figs. 1 to 11A although the rela-

tive arrangement is somewhat different. As clearly shown in Fig. 13 the main contacts 13^a and 16^a at each side are so arranged that the contact member with the contacts thereon is moved in the clockwise direction to separate the contacts instead of being movable in the counter-clockwise direction. The left hand stationary contact is connected with the cross member 2^a and thus with the terminal 50^a by means of a strap 15^a formed integrally with the cross member, and the right hand stationary contact 13^a is connected with the cross member 3^a and thus with the terminal 51^a by means of a strap 43^a formed integrally with the cross member. The contacts 16^a, 16^a are connected with a transverse insulating member 17^a and with the ends of a U-shaped bi-metallic strip 21^a by means of screws 18^a, 18^a. An actuator 20^a is provided which is similar to the actuator 20 and which is similarly mounted upon the transverse rod 10^a. The bi-metallic strip 21^a normally engages the actuator 20^a and functions similarly to the bi-metallic strip 21 already described, except that a separate hole is provided therein for receiving the actuator.

Carried by the side plates 1^a, 1^a is a transverse bearing member 30^a on which is pivotally mounted a handle 31^a, this handle being spaced from the side plates by means of suitable bushings. A spring 32^a surrounds one of the said bushings and tends to move the handle to its lower open-circuit position as shown in Fig. 16. The action of the spring 32^a is augmented by the weight of the handle. The actuator 20^a has an arm 28^a and a link 24^a is interposed between the arm 28^a and an inward extension 25^a of the handle, the pivotal connections being indicated at 26^a and 27^a respectively.

When all of the parts are in their circuit-closing positions as shown in Fig. 13 the link 24^a and the extension 25^a of the handle serve as toggle links which prevent automatic movement of the handle and contact member from their circuit-closing to their circuit-opening positions, the action being similar to that described in connection with the other construction. By reference to Fig. 13 it will be observed that the pivotal axis at 26^a is below a line connecting the pivotal axes at 27^a and 29^a. The links therefore tend to move in a downward direction and this tendency is overcome by means of a tail piece 24' formed on the link 24^a and engaging the corresponding bushing 12^a.

The contact member may be moved by the handle 31^a in either direction for ordinary switching purposes, Fig. 13 showing the parts in circuit-closing position and Fig. 16 showing them in circuit-opening position. It will be observed that the contact member is positively moved in the counter-clockwise circuit-closing direction by reason of the engagement of the thermal strip 21^a with the actu-

ator 20^a, and that it is moved in the clockwise circuit-opening direction by the springs 19^a, 19^a acting under the control of the actuator. Clockwise movement of the contact member is limited by the bushings on the bearing member 30^a as shown in Figs. 16 and 17. The transverse rod 33^a extending between the side plates 9^a, 9^a prevents excessive clockwise movement of the actuator 20^a.

Upon the passage of excess current the bimetallic strip 21^a is automatically disengaged from the actuator 20^a and the contact member then automatically moves to its open-circuit position under the influence of the springs 19^a, 19^a. It will be understood that this automatic movement takes place independently of the actuator so that the holding of the handle and the actuator in closed-circuit position as shown in Fig. 17 will not interfere with the automatic opening. If the handle is not held in its closed-circuit position the handle and the actuator will immediately move to their open-circuit positions as soon as the pressure on the actuator 20^a is released by reason of the disengagement of the thermal strip 21^a therefrom. The toggle links, that is, the link 24^a and the handle extension 25^a, are biased for movement out of their locking positions by means of the spring 32^a and therefore as soon as the pressure on the actuator 20^a is removed the toggle links move out of their locking position and the handle immediately starts to move toward its open-circuit position carrying the actuator with it. Thus, as the contact member moves toward its open-circuit position, the handle and the actuator move substantially simultaneously toward their open-circuit positions. The contact member will reach its open position first but the actuator and handle follow closely thereafter, the mechanical connection between the actuator and the contact member being immediately restored by reason of the re-engagement of the thermal strip 21^a with the actuator 20^a.

As shown the circuit breaker is enclosed in a casing 59^a which is held in engagement with the base 5^a by means of screws 66, 66. The casing 59^a has an opening 67 in the front thereof through which the handle 31^a projects. As shown the handle 31^a is provided with an enlarged hub 68 cylindrical in outline and substantially closing the opening 67 in the casing.

It will be observed that one of the principal differences between the construction shown in Figs. 1 to 11A and that shown in Figs. 12 to 17 is that in the former the linkage is arranged so that the contact member and the handle turn in the same direction whereas in the latter the linkage is so arranged that the contact member and the handle turn in opposite directions.

What I claim is:

1. An automatic circuit breaker comprising in combination, a movable actuator, a movable contact member biased independently of the actuator toward its open-circuit position and releasably connectible with the actuator so as to be normally controlled thereby for movement to its closed-circuit or its open-circuit position, a restraining means acting independently of the contact member and normally serving to prevent movement of the actuator from its closed-circuit position as the result of the circuit-opening bias of the contact member, an electro-responsive means serving upon the attainment of abnormal current conditions to release the contact member from the actuator for independent automatic circuit-opening movement and also serving to substantially simultaneously cause the release of the actuator from the control of the said restraining means, and means acting automatically upon the said release of the actuator to move it to its open-circuit position corresponding to the open-circuit position of the contact member.
2. An automatic circuit breaker comprising in combination, a movable actuator, a movable contact member biased independently of the actuator toward its open-circuit position, an electro-responsive controlled mechanical connection between the actuator and the contact member normally enabling the former to effect the movement of the latter to its closed-circuit or its open-circuit position, the said mechanical connection being automatically rendered inoperative upon the attainment of abnormal current conditions so as to thereupon release the contact member for independent automatic circuit-opening movement, a restraining means separate from the aforesaid mechanical connection and normally effective to prevent automatic movement of the actuator from its closed-circuit position, the said restraining means being effective so long as the said mechanical connection is operative to maintain the contact member in closed-circuit position and becoming ineffective when the mechanical connection is rendered inoperative for the said purpose, and means acting automatically to move the actuator to its open-circuit position when the restraining means becomes ineffective.
3. An automatic circuit breaker as set forth in claim 2, wherein the restraining means is normally rendered effective as the result of the stress transmitted from the contact member to the actuator through the said mechanical connection and automatically becomes ineffective upon the diminution of absence of such stress resulting from the release of the contact member from the actuator.
4. An automatic circuit breaker comprising in combination, an operating member

movable to closed-circuit and open-circuit positions and biased toward the latter, an actuator movable relatively to the operating member, a movable contact member biased independently of the actuator toward its open-circuit position and releasably connectible with the actuator so as to be normally movable thereby, means associated with the operating member and the actuator normally enabling the former to effect the movement of both the actuator and the contact member to their closed-circuit or their open-circuit positions, the said means also normally serving as a restraining means to prevent movement of the operating member and actuator from their closed-circuit positions as the result of the circuit-opening bias of the operating member and the contact member, and an electro-responsive means serving upon the attainment of abnormal current conditions to cause the release of the contact member from the actuator for independent automatic circuit-opening movement and also serving to substantially simultaneously cause the release of the operating member and the actuator from the control of the said restraining means and to thus permit them to automatically move to their open-circuit positions.

5. An automatic circuit breaker as set forth in claim 4, wherein the means associated with the operating member and the actuator consists of toggle links which act as a restraining means when in their toggle relationship, and wherein the said toggle relationship is broken upon the electro-responsive release of the contact member from the actuator.

6. An automatic circuit breaker comprising in combination, a movable operating member, a movable actuator, a movable contact member biased independently of the actuator toward its open-circuit position, an electro-responsively controlled mechanical connection between the actuator and the contact member normally enabling the former to effect the movement of the latter to its closed-circuit or its open-circuit position, the said connection being automatically rendered inoperative upon the passage of excess current so as to thereupon release the contact member for independent automatic circuit-opening movement, toggle links operatively connecting the operating member and the actuator and serving when in their toggle relationship to prevent automatic movement thereof from their closed-circuit positions, the said links being normally held in their said toggle relationship as the result of stress transmitted from the contact member to the actuator through the said mechanical connection, and means for breaking the said toggle relationship and moving the operating member and actuator to their open-circuit positions upon the diminution or absence of

the aforesaid stress resulting from the release of the contact member from the actuator.

7. The combination in an automatic circuit breaker, of a movable actuator and a movable contact member normally releasably connected together for movement in fixed relationship with each other so that the former may control the latter for movement to its closed-circuit or its open-circuit position, the said contact member being biased independently of the actuator toward its open-circuit position, a restraining means normally serving to prevent movement of the actuator from its closed-circuit position as the result of the circuit-opening bias of the contact member, an electro-responsive means serving upon the attainment of abnormal current conditions to cause the release of the contact member from the actuator for independent automatic circuit-opening movement and also serving to substantially simultaneously cause the release of the actuator from the control of the said restraining means, and means acting automatically upon the said release of the actuator to move it to its open-circuit position corresponding to the open-circuit position of the contact member.

8. The combination as set forth in claim 7, wherein the actuator and the contact member are movable in unison about a common pivotal axis.

9. The combination as set forth in claim 7, wherein the restraining means is normally rendered effective as the result of the stress transmitted from the contact member to the actuator through the said mechanical connection and automatically becomes ineffective upon the diminution or absence of such stress resulting from the release of the contact member from the actuator.

10. The combination in an automatic circuit breaker, of a movable operating member biased toward its open-circuit position, an actuator and a contact member normally movable in fixed relationship with each other, an electro-responsively controlled mechanical connection normally maintaining the actuator and the contact member in the said relationship and enabling the former to effect the movement of the latter to its closed-circuit or its open-circuit position, the said connection being automatically rendered inoperative upon the attainment of abnormal current conditions so as to thereupon release the contact member for independent automatic circuit-opening movement, and a means enabling the operating member to effect the movement of the actuator and also normally serving to prevent automatic movement of the operating member and actuator from their closed-circuit positions, the said means being rendered effective to prevent such automatic movement as the result of stress transmitted from the contact member

to the actuator through the said mechanical connection and becoming ineffective for such purpose upon the diminution or absence of the aforesaid transmitted stress.

connection upon the passage of excess current.

14. In an automatic circuit breaker, the combination of a movable operating member, a movable actuator, a movable contact member biased independently of the actuator toward its open-circuit position and releasably connectible with the actuator so as to be normally controlled thereby for movement to its closed-circuit or its open-circuit position, an electro-responsive means bodily movable as an entirety when the actuator and contact member are moved, the said electro-responsive means serving upon the attainment of abnormal current conditions to cause the release of the contact member from the actuator for independent automatic circuit-opening movement, and a means enabling the operating member to effect the movement of the actuator and also normally serving to prevent automatic movement of the operating member and actuator from their closed-circuit position, the said means being rendered effective to prevent such automatic movement as the result of stress transmitted from the contact member to the actuator through the said mechanical connection and becoming ineffective for such purpose upon the diminution or absence of the aforesaid transmitted stress.

15. An automatic circuit breaker as set forth in claim 14, wherein there are toggle links constituting the means enabling the operating member to effect the movement of the actuator and wherein the electro-responsive means is an electro-thermal strip serving in and of itself as the mechanical connection between the actuator and the contact member and adapted to become inoperative as such connection upon the passage of excess current.

16. An automatic circuit breaker comprising in combination, a movable actuator, a movable contact member biased independently of the actuator toward its open-circuit position and releasably connectible with the actuator so as to be normally controlled thereby for movement to its closed-circuit or its open-circuit position, a restraining means acting independently of the contact member and normally serving to prevent movement of the actuator from its closed-circuit position as the result of the circuit-opening bias of the contact member, an electro-responsive means separate from and additional to the mechanical connection between the actuator and the contact member, the said electro-responsive means serving upon the attainment of abnormal current conditions to release the contact member from the actuator for independent automatic circuit-opening movement and also serving to substantially simultaneously cause the release of the actuator from the control of the said restraining means, and means acting automatically upon

11. The combination in an automatic circuit breaker, of a movable operating member, an actuator and a contact member normally movable in fixed relationship with each other, an electro-responsively controlled mechanical connection normally maintaining the actuator and the contact member in the said relationship and enabling the former to effect the movement of the latter to its closed-circuit or its open-circuit position, the said connection being automatically rendered inoperative upon the attainment of abnormal current conditions so as to thereupon release the contact member for independent automatic circuit-opening movement, toggle links enabling the operating member to effect the movement of the actuator, the said links serving when in their toggle relationship to prevent automatic movement of the operating member and actuator from their closed-circuit positions and being normally held in the said relationship as the result of stress transmitted to the actuator through the said mechanical connection, and means for breaking the said toggle relationship to permit automatic circuit-opening movement of the operating member and actuator upon the diminution or absence of the aforesaid transmitted stress.

12. In an automatic circuit breaker, the combination of a movable actuator, a movable contact member biased independently of the actuator toward its open-circuit position and releasably connectible with the actuator so as to be normally controlled thereby for movement to its closed-circuit or its open-circuit position, a restraining means normally serving to prevent movement of the actuator from its closed-circuit position as the result of the circuit-opening bias of the contact member, an electro-responsive means bodily movable as an entirety when the actuator and contact member are moved, the said electro-responsive means serving upon the attainment of abnormal current conditions to cause the release of the contact member from the actuator for independent automatic circuit-opening movement and also serving to substantially simultaneously cause the release of the actuator from the control of the said restraining means, and means acting automatically upon the said release of the actuator to move it to its open-circuit position corresponding to the open-circuit position of the contact member.

13. An automatic circuit breaker as set forth in claim 12, wherein the electro-responsive means is an electro-thermal strip serving in and of itself as the mechanical connection between the actuator and the contact member and adapted to become inoperative as such

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the said release of the actuator to move it to its open-circuit position corresponding to the open-circuit position of the contact member.

17. The combination in an automatic circuit breaker, of a movable actuator and a movable contact member normally releasably connected together for movement in fixed relationship with each other so that the former may control the latter for movement to its closed-circuit or its open-circuit position, the said contact member being biased independently of the actuator toward its open-circuit position, a restraining means normally serving to prevent movement of the actuator from its closed-circuit position as the result of the circuit-opening bias of the contact member, an electro-responsive means separate from and additional to the mechanical connection between the actuator and the contact member, the said electro-responsive means serving upon the attainment of abnormal current conditions to cause the release of the contact member from the actuator for independent automatic circuit-opening movement and also serving to substantially simultaneously cause the release of the actuator from the control of the said restraining means, and means acting automatically upon the said release of the actuator to move it to its open-circuit position corresponding to the open-circuit position of the contact member.

18. In an automatic circuit breaker, the combination of a movable actuator, a movable contact member biased independently of the actuator toward its open-circuit position and releasably connectible with the actuator so as to be normally controlled thereby for movement to its closed-circuit or its open-circuit position, a restraining means normally serving to prevent movement of the actuator from its closed-circuit position as the result of the circuit-opening bias of the contact member, two electro-responsive means one of which is movable as an entirety when the actuator and contact member are moved and the other of which is not so movable, each of the said electro-responsive means serving upon the attainment of abnormal current conditions to cause the release of the contact member from the actuator for independent automatic circuit-opening movement and also serving to substantially simultaneously cause the release of the actuator from the control of the said restraining means, and means acting automatically upon the said release of the actuator to move it to its open-circuit position corresponding to the open-circuit position of the contact member.

In testimony whereof I have hereunto set my hand this 11th day of January, 1929.

JOSEPH SACHS.