

Oct. 5, 1937.

J. SACHS

2,094,965

AUTOMATIC CIRCUIT BREAKER

Original Filed Jan. 3, 1936

2 Sheets-Sheet 1

Fig. 1

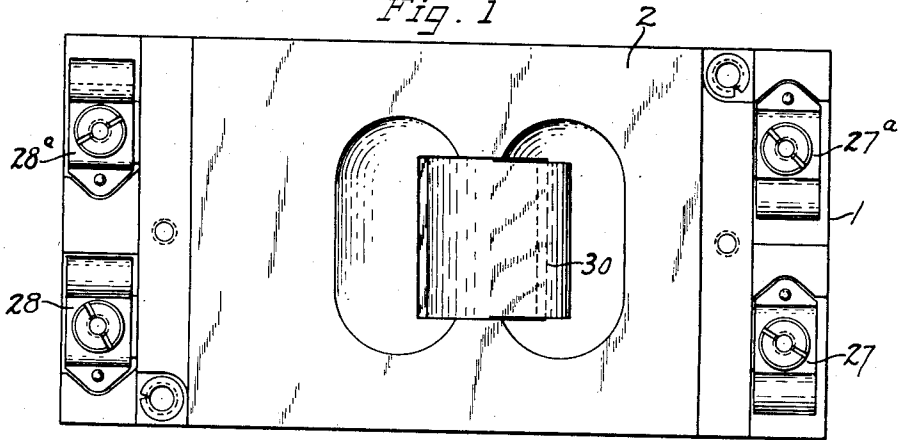


Fig. 2

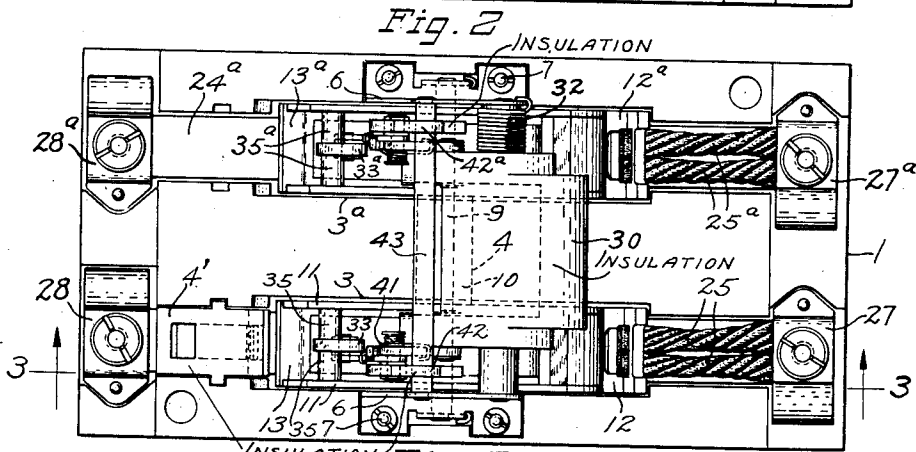
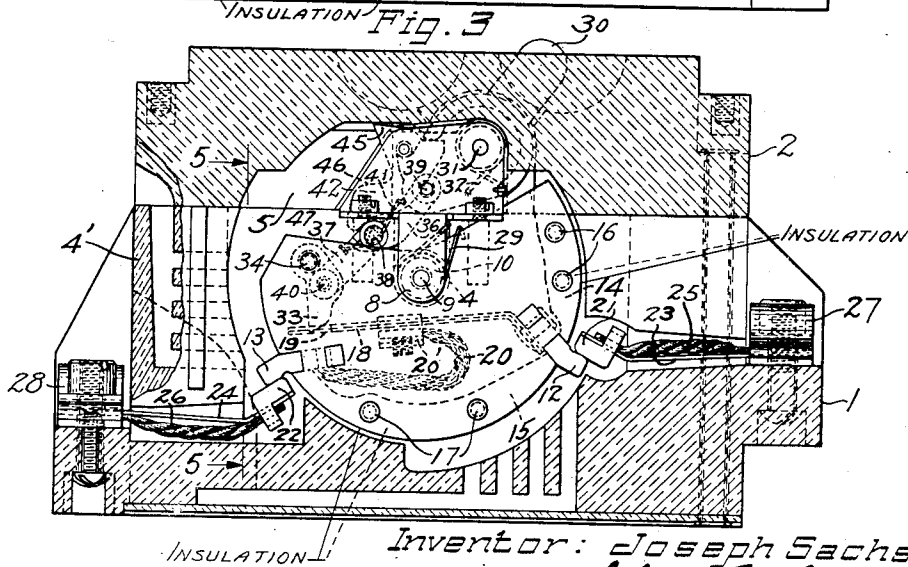


Fig. 3



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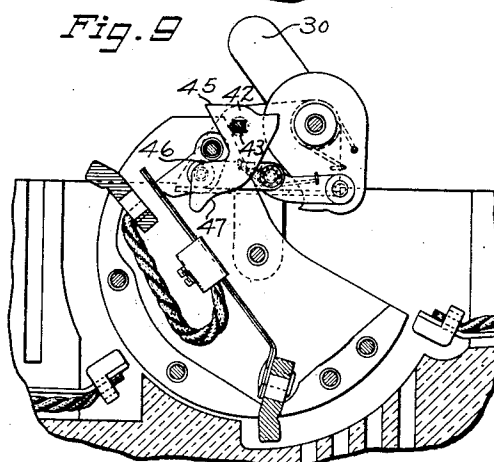
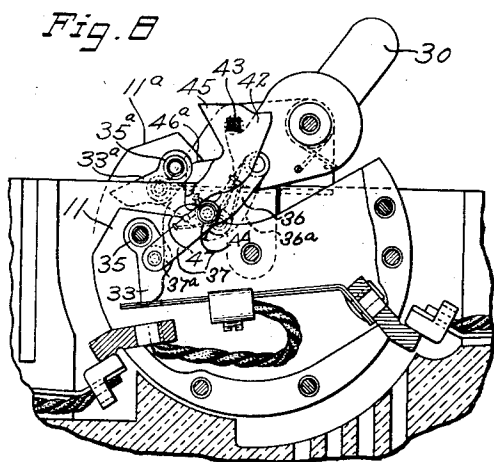
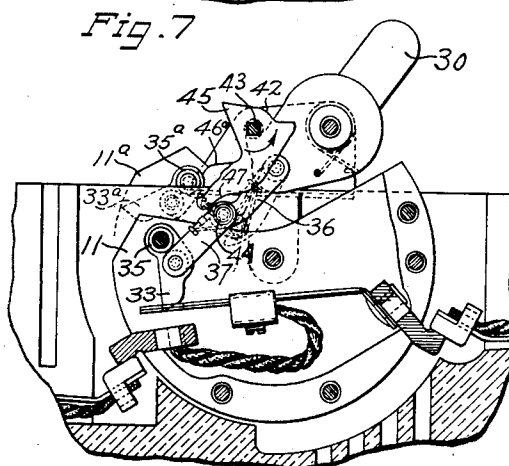
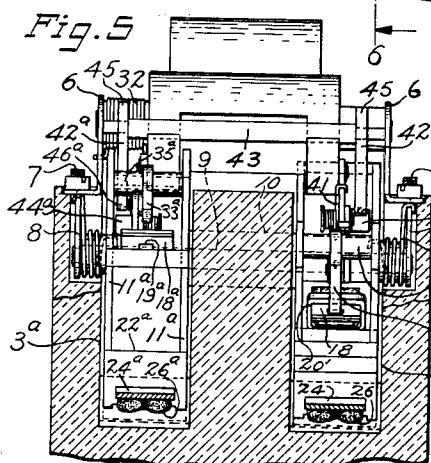
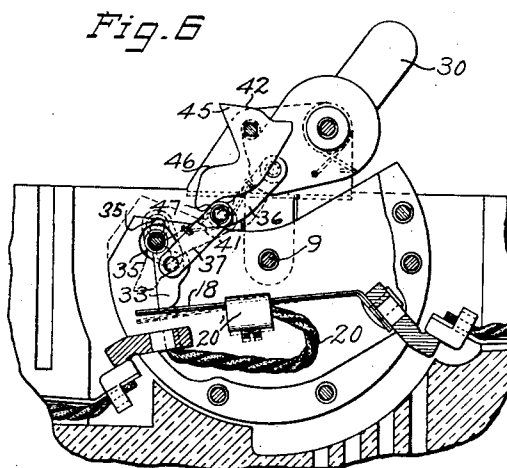
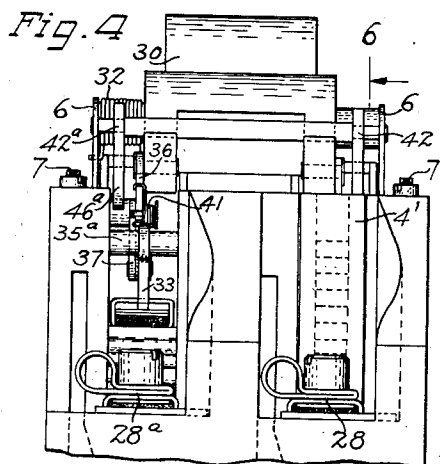
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AUTOMATIC CIRCUIT BREAKER

Original Filed Jan. 3, 1936

2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,094,965

AUTOMATIC CIRCUIT BREAKER

Joseph Sachs, West Hartford, Conn.

Application January 3, 1936, Serial No. 57,388

Renewed April 20, 1937

32 Claims. (Cl. 200—116)

The invention relates particularly to a circuit breaker which can be operated to open the circuit in any one of three ways; and one of the objects of the invention is to provide a circuit breaker wherein the circuit may be opened by the manipulation of a handle or other operating member, or may be opened automatically independently of the operating member upon the attainment of excess or other abnormal current conditions, or may be opened mechanically independently of the operating member and independently of the current conditions in the circuit.

While the invention is applicable in a number of ways it is particularly applicable to an automatic circuit breaker of the multi-polar type wherein there are independently acting circuit breaker mechanisms in two or more legs of the circuit; and it is a further object of the invention to provide in a circuit breaker of this type improved means whereby the mechanism in one leg of the circuit serves upon automatic opening to effect the opening of the mechanism in each other leg of the circuit.

A more specific object of the invention is to provide a circuit breaker of the character described wherein there is a single handle or operating member connected to operate the circuit breaker mechanisms in the several legs of the circuit, and wherein the automatic operation of one mechanism effects the operation of each other mechanism entirely independently of the operating member thus enabling the circuit to be broken in all of the legs thereof even though the operating member be retained in closed circuit position.

A further object of the invention is to provide a circuit breaker of the character described wherein the contact carrying member of the mechanism which first automatically moves to open-circuit position directly actuates a suitable means which, upon such actuation, serves to effect the circuit-opening movement of the other circuit breaker mechanisms.

Further objects of the invention will be apparent from the following specification and claims:

A multi-polar circuit breaker has been shown in the drawings as illustrating the invention, but it will be understood that the invention in its broader aspects is not so limited. The particular form of multi-polar circuit breaker shown is only one of several possible embodiments of the more specific phases of the invention and is to be regarded as merely representative or typical. The drawings are not to be relied upon 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 an automatic circuit breaker embodying the invention.

Fig. 2 is a view similar to Fig. 1 but showing the front insulating cover removed, and also showing one of the vented insulating blocks removed.

Fig. 3 is a longitudinal sectional view taken along the line 3—3 of Fig. 2 but showing the cover in place, and showing the movable parts in their closed-circuit positions.

Fig. 4 is a fragmentary end view of the parts shown in Fig. 2.

Fig. 5 is a transverse sectional view taken along the line 5—5 of Fig. 3 but omitting the front cover and showing one of the mechanisms in its open-circuit position.

Fig. 6 is a longitudinal sectional view taken along the line 6—6 of Fig. 4 and showing the movable parts in the same positions as in Fig. 3, that is in their closed-circuit positions.

Fig. 7 is a view similar to Fig. 6 but showing the contact member of one circuit breaker mechanism in an intermediate position, it being assumed that the said member has been automatically released and is moving toward its open-circuit position.

Fig. 8 is a view similar to Fig. 7 but showing the contact member in its full open-circuit position and also showing the connecting means for the contact member of the other mechanism about to be released.

Fig. 9 is a view similar to Fig. 8 but showing the connecting means for the contact member of the second mechanism fully released, the said contact member having moved automatically to its full open-circuit position and the operating member or handle also having moved to its open-circuit position.

The circuit breaker as shown in the drawings comprises two circuit opening and closing mechanisms connectible in two legs of a circuit. It will be understood, however, that I do not limit myself to only two such mechanisms and that three or more may be provided when required. The two mechanisms shown are similar in construction and each may be regarded as embodying the invention in its broader aspects. Each of the said mechanisms is in many respects similar to that shown and described in my patent for Automatic circuit breaker No. 2,020,333 dated November 12, 1935. While a mechanism of the

particular type shown in the said patent is well suited for use in a circuit breaker embodying the present invention, I do not necessarily so limit myself.

Referring to the drawings, 1 represents the main insulating base or support which carries all of the other parts of the circuit breaker. Fitting the support 1 at the front thereof is an insulating cover 2. The rear support 1 has two mechanism containing recesses 3 and 3' therein, each of these recesses being substantially closed at all four sides and at the rear, but there is provided a small transverse groove 4 which connects them. The left end walls of the recesses are in the form of removable insulating blocks 4' which are vented to permit the escape of arc formed gases as explained in my said patent. One of the blocks is omitted in Figs. 2 and 4. The front cover has recesses 5 open at the rear into which certain parts of the mechanism project. When the two parts 1 and 2 are assembled as shown, the recesses register and provide two interior chambers which contain all of the operative parts of the two circuit breaker mechanisms other than the handle.

Positioned in the two described chambers are two circuit breaker mechanisms, which have certain parts in common, but which in the main are duplicates of each other. A description of one of these mechanisms will suffice for both, and the following description will relate chiefly to the mechanism at the lower side as viewed in Fig. 2. In the drawings the letter *a* is added to the reference numbers to designate corresponding parts in the upper mechanism.

Carried by the rear support 1 near the front thereof and adjacent the respective recesses 3, 3' are two forward projecting parallel metallic plates 6, 6 which are held in place by means of screws 7, 7 embedded in the walls of the support. The plates 6, 6 are provided with integral rearward extending portions 8, 8. Carried by the said rearward extensions 8, 8 and extending transversely between them through the groove 4 is a pivot pin 9. Surrounding the pin 9 and fitting the groove 4 is a bearing bushing 10.

Each circuit breaker mechanism has a contact carrying member which is mounted on the pivot pin 9 and includes two parallel plates 11, 11 spaced apart transversely and suitably connected together to move as a unit. These plates have aligned bearing apertures through which the pivot pin extends, the said bushing 10 assisting in holding the plates in proper spaced relationship. Suitable spacing washers, not shown, hold the plates in proper spaced relationship to the supporting plate extensions 8, 8.

The two plates 11, 11 serve to carry the main movable circuit breaker contacts 12 and 13 of the circuit breaker which are arranged in tandem, being spaced apart in the direction of movement, that is, circumferentially. Preferably and as will be clearly apparent from an examination of Fig. 2, each movable contact 12 and 13 extends from one to the other of the two plates 11, 11 and is in direct engagement with both of them. Each of the said plates 11 is provided with a hole and a notch adapted to receive similarly shaped lateral projections on the corresponding contact. When the said projections on the contacts are entered in the said holes and notches of the two plates, the contacts are firmly held in proper pre-determined relationship. It will be observed that, by reason of the tandem arrangement of the contacts, the two plates 11,

11 are much closer together than would otherwise be possible.

The two plates 11, 11 are additionally connected and held in spaced relation by means of transverse insulating members 14 and 15, structurally separate from the plates and held in proper relationship by means of tie rods or rivets 16 and 17 extending through suitable holes. It will be apparent that the insulating members 14 and 15 extend transversely from plate to plate and that the movable contact 12 extends through the space between the two members. The member 15 engages with both movable contacts and extends circumferentially from one to the other. The two plates 11 together with the parts which mechanically connect them and together with the contacts which they carry, will for the sake of convenience be herein referred to collectively as a "contact member".

The two movable contacts 12 and 13 are electrically connected with each other, this electrical connection preferably being through an electro-responsive device which is carried by and is bodily movable with the contact member. By preference and as shown, this electro-responsive means is a bi-metallic thermostatic strip 18 mechanically and electrically connected directly with one of the contacts, as for instance the contact 12. The strip 18 is provided at its projecting end with an aperture 19 which enables the strip to serve as a latch as will be presently explained.

In order to complete the electrical connection between the two contacts 12 and 13 there is provided a suitable flexing or flexible connection 20 between the strip 18 and the contact 13. This flexing connection is connected to the strip by means of a yoke 20' and is sufficiently flexible to permit the bi-metallic strip 18 to freely deflect or bend under the influence of heat.

Carried by the insulating support 1 are two substantially stationary main contacts 21 and 22 which are connected with the said support by means of more or less resilient conducting straps 23 and 24, which may be supplemented by flexible conductors 25 and 26. These stationary contacts 21 and 22 are so positioned and arranged that they can be firmly engaged respectively by the two movable contacts 12 and 13 as clearly shown in Figs. 3 and 6. The resilient strap 23 and the conductors 25 are carried by the base 1 and are connected with a wire terminal 27. The resilient strap 24 and the conductors 26 are carried by the base and are connected with a wire terminal 28.

From the foregoing description it will be apparent that pivotal movement of the contact member serves to bring the movable contacts 12 and 13 into or out of engagement with the respective stationary contacts 21 and 22 to make or break the circuit. When the parts are in the contact engaging position, as shown in Figs. 3 and 6, electrical connection is established between the terminal 27 and the terminal 28. A suitable spring 29 is provided for biasing the contact member in the contact disengaging or circuit-opening direction.

For operating the two circuit breaker mechanisms I provide a single handle or operating member 30 which is mounted on a pin 31 extending transversely between the supporting plates 6, 6. The operating member projects through an opening in the front wall of the front cover 2, the opening being of sufficient length to permit the necessary movements. A spring 32 is provided which serves to bias the operating member

toward its open-circuit position, that is, in the counter-clockwise direction from the position shown in Fig. 3.

Interposed in the operative connection between the operating member 30 and the contact members of the respective mechanisms are intermediate members 33 and 33^a which I shall term actuating members or actuators. Each of these actuators is normally engaged by the corresponding thermostatic strip or latch 18, and is so positioned and connected that a portion of the stress of actuation is transmitted directly from the actuator to the contact member independently of the thermostatic latch. The actuator 33 is pivotally mounted on a pin 34 extending transversely between the two side plates 11, 11 and is held by two spacing bushings 35, 35. The actuator is provided with a pointed end which, at normal temperatures, is entered in the aperture 19 in the thermostatic latch 18. With the parts in the relative positions shown in Figs. 3 and 6, the actuator and the contact member are positively connected to move in unison.

The operating member 30 is connected with the actuator 33 by means of toggle links 36 and 37, the links being pivoted to each other at 38, the link 36 being pivoted to the operating member at 39 and the link 37 being pivoted to the actuator at 40. Similar links connect the operating member 30 with the other actuator 33^a. The two links 36 and 37 are normally held in their locking or toggle relationship by means of a spring 41.

The two links 36 and 37 co-operate with the operating member itself to form a triple toggle linkage or connection, and when the parts are in the relative positions shown in Figs. 3 and 6 the toggle links lock the parts in position with the movable contacts 12 and 13 pressed into firm engagement with the stationary contacts 21 and 22. The pivotal axis at 39 is above a straight line connecting the pivotal axes at 31 and 40, and thus the operating member 30 and the links 36 and 37 serve to resist the tendency of the contact member to move in the clockwise direction under the influence of the spring 29 and of the resilient contact supporting strips 23 and 24. At the same time the said toggle action holds the operating member 30 in its right hand or closed-circuit position, resisting the tendency of the spring 32 to move the operating member in the counter-clockwise direction.

The above-described toggle action can be released by pressing the operating member toward the left, the parts then moving under the action of the springs 29 and 32 to the open-circuit positions shown in Fig. 9. The movable contacts 12 and 13 are thus disengaged from the stationary contacts 21 and 22 and the circuit is broken in two separate places. By moving the handle toward the right the several parts can be restored to their respective positions, as shown in Figs. 3 and 6, and the circuit can be thus re-established.

As already explained, the bi-metallic strip 18 is electrically connected between the movable contacts 12 and 13. It is adapted to be deflected downward or outward upon the passage of excess current therethrough, with the result that the apertured portion 19 is disengaged from the end of the actuator 33, such disengagement being shown by dotted lines in Fig. 6. This disengagement permits the actuator 33 to turn relatively to the contact member and in the clockwise direction, the contact member also moving in the clockwise direction under the influence of the

spring 29. The clockwise movement of the actuator reduces the pressure which had theretofore helped to hold the links 36 and 37 in their effective toggle relationship; and the said clockwise movements of the actuator and contact member bring the parts into the relationship shown by dotted lines in Fig. 6. In the relative positions shown, one of the bushings 35 on the pivot pin of the actuator comes into contact with the link 37 so as to move it in opposition to the spring 41 and so as to thus break the toggle 36, 37. The breaking of the toggle permits the contact member to continue to move in the clockwise direction under the influence of the spring 29, this movement taking place even though the operating member be held in its closed-circuit position. Fig. 8 shows one contact member in its fully open position, the corresponding positions of the links 36 and 37 being shown in dotted lines. The said movement of the links also leaves the operating member 30 free to move in the counter-clockwise direction under the influence of the spring 32, and it will automatically so move if not held. Thus all of the parts normally move automatically to their open-circuit positions where the actuator 33 again engages the latch 18 as shown in Fig. 9, and wherein the toggle relationship of the links 36 and 37 is re-established. By moving the operating member in the clockwise direction the parts can be returned to their closed-circuit positions as shown in Fig. 6.

For each one of the mechanisms there are three separately operable devices for causing the movement of the contact member to its open-circuit position. These three devices are connected in tandem with each other and with the contact member. One of these devices is electro-responsively actuated latch 18 and the other two devices are mechanically actuated. The operating member 30 constitutes one of the mechanically actuated devices, and the second mechanically actuated device is a movable element, such as 42, adapted to break the toggle relationship between the links 36 and 37. It will be observed that when such toggle relationship is broken the contact member will move to open-circuit position, this occurring even though there be no abnormal conditions to affect the strip 18 and even though the operating member be held in its closed-circuit position. Thus each of the said three devices is adapted to operate independently of any operative movement of any other device.

When there is a common operating member, the toggle links and the releasable latch may be regarded as cooperatively constituting a connecting means between the corresponding contact member and the operating member. This connecting means may be rendered ineffective either by breaking the toggle or disengaging the latch.

It will be understood that upon the attainment of abnormal or excess current conditions in any one leg of the circuit, the corresponding circuit breaker mechanism will operate independently of any other mechanism to break the circuit through that particular leg. In accordance with the present invention, I provide a means adapted to be energized or actuated by the automatic operation of one mechanism so as to cause the automatic operation of each other mechanism. The means for accomplishing this result may be either electrical or mechanical and it may be widely varied in construction. As shown I utilize for the said purpose a mechanically actuated circuit

opening means which will now be described in detail.

Rotatably mounted in suitable bearing apertures in the plates 6, 6 is a transverse shaft or rod 43. Rigidly secured to the shaft or rod 43 for turning movement therewith are elements 42 and 42^a which are designated as cam members, these being in register with enlarged heads 44 and 44^a formed on the pivot pins connecting the links 36 and 37. The cam members are provided with projections 45 which co-operate with the front cover 2 as shown in Fig. 3 to hold the cam members against movement in the clockwise direction. Each cam member is provided with a portion 46 or 46^a adapted to be engaged by one of the bushings 35 or 35^a as the corresponding contact member moves toward its open circuit position. Each cam member is also formed with a portion 47 adapted to engage the corresponding enlarged head 44 or 44^a on the linkage to break the toggle relationship between the links 36 and 37.

In order that the action of the transverse rod 43 and the cam members 42 and 42^a thereof may be more clearly understood, let it be assumed that an abnormal or excess current condition has been attained in the leg of the circuit in which the wire terminals 27^a and 28^a are connected. The corresponding bi-metallic latch will have been deflected and the contact member will have been released in the manner already fully described. Fig. 7 shows the plates 11^a of the contact member in an intermediate position and shows one of the bushings 35^a on the contact member in engagement with the portion 46^a of the corresponding cam member 42^a. After being released the contact member with the parts thereof moves with considerable force in the clockwise direction and the bushing 35^a strikes the portion 46^a of the cam member 42^a, causing the said cam member to turn in the counterclockwise direction as indicated by the arrow in Fig. 7. The contact member continues to move to the fully open position as shown in Figs. 5 and 8.

The cam member 42^a carries with it the shaft or rod 43 and also the other cam member 42. The turning of the cam member 42 brings the portion 47 thereof into engagement with the head 44 on the toggle links, as shown in Figs. 5 and 7, thus overcoming the action of the spring 41. As shown in Fig. 8, the links 36 and 37 are thus moved out of their locking relationship and this leaves the remaining contact member free to turn in the clockwise direction to open the circuit, it moving to the position shown in Fig. 9. The breaking of the toggle relationship between the links 36 and 37 also releases the handle or operating member 30 and leaves it free to turn in the counterclockwise direction to its open-circuit position as shown in Fig. 9.

After the parts have reached their normal open-circuit position as shown in Fig. 9, the circuit can again be closed in both legs thereof by merely moving the handle or operating member in clockwise direction to restore the parts to the positions shown in Fig. 6.

It will be observed that the construction is such that each automatically movable contact member is released from the control of the operating member so that the opening of all of the legs of the circuit takes place even though the handle or operating member be held or retained in its closed circuit position. The toggle links constitute releasable means normally serving to hold

the operating member in its closed circuit position. The operation of the transverse rod or bar serves independently of the operating member and independently of the circuit conditions to open each leg of the circuit that would otherwise have remained closed.

What I claim is:

1. In a circuit breaker, the combination of a movable contact member, and three separately operable devices for causing movement of the contact member to open-circuit position which devices are mechanically connected in tandem with each other and with the contact member, each of the said three devices being effective for moving the contact member independently of any operative movement of either of the other two said devices.

2. In a circuit breaker, the combination of a movable operating member, a movable contact member, and a mechanical connection between the operating member and the contact member normally enabling the former to move the latter to open and close the circuit, the said mechanical connection comprising two devices mechanically connected in tandem and each operable independently of the other and independently of the operating member to cause movement of the contact member to its open-circuit position.

3. In an automatic circuit breaker, the combination of a movable contact member, and three separately operable means for causing the movement of the contact member to its open-circuit position, two of the said means being mechanically operable independently of each other and the third means being electro-responsively operable independently of the said mechanical means upon the attainment of abnormal current conditions in the circuit.

4. In an automatic circuit breaker, the combination of a movable operating member, a movable contact member biased independently of the operating member toward its open-circuit position, and a mechanical connection between the operating member and the contact member normally enabling the former to move the latter to open and close the circuit, the said mechanical connection comprising two devices each operable independently of the other to render the said connection ineffective so that the contact member may automatically move to its open-circuit position independently of the operating member, one of the said devices being electro-responsively operable independently of the operating member upon the attainment of excess current conditions in the circuit and the other of the said devices being mechanically operable independently of the operating member.

5. In an automatic circuit breaker, the combination of a movable operating member, a movable contact member, and a mechanical connection between the operating member and the contact member normally enabling the former to move the latter to open and close the circuit, the said mechanical connection comprising two devices each operable independently of the other to render the said connection ineffective so that the contact member may move to its open-circuit position independently of the operating member, one of the said devices being electro-responsively operable independently of the operating member upon the attainment of excess current conditions in the circuit and the other of the said devices being a pair of toggle links connecting the operating member with the corresponding electro-responsively operable device and adapted to be

mechanically moved out of their toggle relationship independently of the operating member.

6. In an automatic circuit breaker, the combination of a movable operating member, a movable contact member, and a mechanical connection between the operating member and the contact member normally enabling the former to move the latter to open and close the circuit, the said mechanical connection comprising two devices each operable independently of the other to render the said connection ineffective so that the contact member may move to its open-circuit position independently of the operating member, one of the said devices being a bodily movable bi-metallic strip connectible in the circuit and serving in and of itself as a latch which is automatically disengaged independently of the operating member upon the attainment of excess current conditions in the circuit and the other of the said devices being a pair of toggle links connecting the operating member with the said latch and adapted to be mechanically moved out of their toggle relationship independently of the operating member.

7. In an automatic circuit breaker, the combination of a movable operating member, a movable intermediate actuating member, a movable contact member biased toward its open-circuit position, a mechanical connection normally operative to enable the actuating member to move the contact member to open or close the circuit which mechanical connection includes an electro-responsive device automatically releasable upon the attainment of abnormal current conditions in the circuit to permit independent circuit-opening movement of the contact member, and a normally operative mechanical connection between the operating member and the actuating member and adapted to be rendered ineffective so as to permit the actuating member and the contact member to move to their open-circuit positions independently of the operating member and with the contact member remaining in operative connection with the actuating member.

8. In an automatic circuit breaker, the combination of a movable operating member, a movable intermediate actuating member, a movable contact member, a mechanical connection normally operative to enable the actuating member to move the contact member to open or close the circuit and adapted to be rendered ineffective so as to permit the contact member to move to its open-circuit position independently of the actuating member, a second mechanical connection normally operative to enable the operating member to move the actuating member and adapted to be rendered ineffective so as to permit the actuating member to move to its open-circuit position independently of the operating member, one of the said mechanical connections including an electro-responsive device which automatically renders it ineffective upon the attainment of abnormal current conditions in the circuit, and means dependent upon the operation of the said electro-responsive device in one mechanical connection for rendering the other mechanical connection ineffective.

9. In an automatic circuit breaker, the combination of a movable operating member biased toward its open-circuit position, a movable intermediate actuating member, a movable contact member biased toward its open-circuit position, a mechanical connection normally operative to enable the actuating member to move the contact member to open or close the circuit which me-

chanical connection includes an electro-responsive controlled device automatically releasable upon the attainment of abnormal current conditions in the circuit to permit independent circuit-opening movement of the contact member, and two toggle links normally in toggle relationship and mechanically connecting the operating member with the actuating member to enable the former to move the latter, the said two links being also normally in toggle relationship with the operating member so that the latter is normally held in its closed-circuit position and the said two links being movable out of toggle relation with each other to enable the actuating member and the contact member to move in unison to their open-circuit positions independently of the operating member and also to enable the operating member to automatically move to its open-circuit position.

10. In an automatic circuit breaker, the combination of two independently movable contact members having contacts electrically connectible respectively in two legs of a circuit, two pairs of devices connected with the respective contact members and having each device of each pair adapted to move independently of any operative movement of any other of the said devices of either pair and thereby cause movement of the corresponding contact member to its open-circuit position, one of the said devices of each pair being automatically operable electro-responsive upon the attainment of excess current conditions in the corresponding leg of the circuit and the other of the said devices of each pair being mechanically operable independently of the said electro-responsive operable means, and means mechanically dependent upon the automatic operation of the said electro-responsive device of either pair for operating the said mechanically operable device of the other pair.

11. In an automatic circuit breaker, the combination of two movable contacts electrically connectible respectively in two legs of a circuit, a movable operating member, two separate mechanical connecting means between the operating member and the contacts for moving the latter to open and close the circuit, each of the said connecting means being releasable independently of the other so as to be ineffective and each including an electro-responsive controlled device automatically operable to effect such release upon the attainment of excess current conditions in the corresponding leg of the circuit, and means dependent upon the operation of the said electro-responsive controlled device in either mechanical connecting means for effecting the release of the other mechanical connecting means whereby upon excess current conditions in either leg of the circuit both contacts are permitted to move to their open-circuit positions independently of the operating member.

12. In an automatic circuit breaker, the combination of two movable contacts electrically connectible respectively in two legs of a circuit, a movable operating member, two separate bodily movable mechanical connecting means between the operating member and the contacts for moving the latter to open and close the circuit, each of the said connecting means being releasable independently of the other so as to be ineffective and each including a bi-metallic thermostatic strip automatically deflectible to effect such release upon the attainment of excess current conditions in the corresponding leg of the circuit, and means dependent upon the deflection of the said

thermostatic strip in either mechanical connecting means for effecting the release of the other mechanical connecting means whereby upon excess current conditions in either leg of the circuit both contacts are permitted to move to their open-circuit positions independently of the operating member.

13. In an automatic circuit breaker, the combination of two movable contacts electrically connectible respectively in two legs of a circuit, a movable operating member, two separate bodily movable mechanical connecting means between the operating member and the contacts for moving the latter to open and close the circuit, each of the said connecting means being releasable independently of the other so as to be ineffective and each including a bi-metallic thermostatic strip automatically deflectible to effect such release upon the attainment of excess current conditions in the corresponding leg of the circuit and each also including links normally in toggle relationship, and means dependent upon the deflection of the said thermostatic strip in either mechanical connecting means for moving the links in the other mechanical connecting means out of their toggle relationship whereby upon excess current conditions in either leg of the circuit both contacts are permitted to move to their open-circuit positions independently of the operating member.

14. In an automatic circuit breaker, the combination of two independently movable contact members having contacts electrically connectible respectively in two legs of a circuit, a single operating member, and two pairs of devices mechanically interposed between the operating member and the respective contact members and normally enabling the operating member to move the contact members in unison to open and close the circuit, the said devices of each pair being connected in tandem and the said devices being operable each independently of the other to cause movement of the corresponding contact member to its open-circuit positions independently of the operating member.

15. In an automatic circuit breaker, the combination of two independently movable contact members having contacts electrically connectible respectively in two legs of a circuit, a single operating member normally serving to move the contact members in unison to open and close the circuit, and two pairs of devices mechanically connected in tandem between the operating member and the respective contact members and having the devices of each pair operable each independently of the other to cause movement of the corresponding contact member to its open-circuit positions independently of the operating member, one of the said devices of each pair being automatically operable electro-responsively upon the attainment of excess current conditions in the corresponding leg of the circuit and the other of the said devices of each pair being mechanically operable independently of the said electro-responsively operable device.

16. In an automatic circuit breaker, the combination of two independently movable contact members having contacts electrically connectible respectively in two legs of a circuit, a movable operating member, two separate bodily movable mechanical connecting means between the operating member and the contact members for moving the latter to open and close the circuit, each of the said connecting means being releasable independently of the other so as to be ineffective

and each including an electro-responsively controlled device automatically operable to effect such release upon the attainment of excess current conditions in the corresponding leg of the circuit, and means dependent upon the operation of the said electro-responsively controlled device in either mechanical connecting means for effecting the release of the other mechanical connecting means whereby upon excess current in either leg both contact members are permitted to move to their open-circuit positions independently of the operating member.

17. In an automatic circuit breaker, the combination of two independently movable contact members having contacts electrically connectible respectively in two legs of a circuit, a single operating member normally serving to move the contact members in unison to open and close the circuit, two pairs of devices mechanically connected in tandem between the operating member and the respective contact members and having the devices of each pair operable each independently of the other to cause movement of the corresponding contact member to its open-circuit positions independently of the operating member, one of the said devices of each pair being automatically operable electro-responsively upon the attainment of excess current conditions in the corresponding leg of the circuit and the other of the said devices of each pair being mechanically operable independently of the said electro-responsively operable device, and means mechanically dependent upon the operation of the said electro-responsive device of either pair for operating the said mechanically operable means of the other pair independently of the operating member.

18. In an automatic circuit breaker, the combination of a movable operating member, a plurality of independently movable contact members having contacts respectively connectible in different legs of the circuit and normally mechanically connected with the operating member for movement in unison to open or close the circuit, each of the said movable contact members being automatically releasable from the operating member upon the attainment of abnormal current conditions in the corresponding leg of the circuit and thereupon moving automatically to its open-circuit position independently of the operating member and independently of any other contact member, and means adapted to be actuated by any one of the contact members upon independent circuit-opening movement thereof and serving upon being so actuated to release each remaining contact member from the operating member to permit automatic circuit-opening movement thereof.

19. In an automatic circuit breaker, the combination of a movable operating member, a plurality of independently movable contact members having contacts respectively connectible in different legs of the circuit and normally mechanically connected with the operating member for movement in unison to open or close the circuit, each of the said movable contact members being automatically releasable from the operating member upon the attainment of abnormal current conditions in the corresponding leg of the circuit and thereupon moving automatically to its open-circuit position independently of the operating member and independently of any other contact member, releasable means of the triple toggle link type serving as the means for releas-

ably connecting the contact members with the operating member, and means adapted to be actuated by any one of the contact members upon independent circuit-opening movement thereof and serving upon being so actuated to move two of the toggle links out of locking relationship and thereby permit each remaining contact member to move to open-circuit position independently of the operating member.

20. In an automatic circuit breaker, the combination of a movable operating member biased in the circuit-opening direction, a plurality of independently movable contact members having contacts respectively connectible in different legs of the circuit and normally mechanically connected with the operating member for movement in unison to open or close the circuit, each of the said movable contact members being automatically releasable from the operating member upon the attainment of abnormal current conditions in the corresponding leg of the circuit and thereupon moving automatically to its open-circuit position independently of the operating member and independently of any other contact member, and a bar extending transversely of the contact members and movable by any one of such members upon independent circuit-opening movement thereof, the said bar upon being so moved serving to release each remaining contact member from the operating member to permit automatic circuit-opening movement thereof.

21. In an automatic circuit breaker, the combination of two movable contacts electrically connectible respectively in two legs of a circuit, a movable operating member, two separate mechanical connecting means between the operating member and the contacts for moving the latter to open and close the circuit, each of the said connecting means being releasable independently of the other so as to be ineffective and each including an electro-responsively controlled device automatically operable to effect such release upon the attainment of excess current conditions in the corresponding leg of the circuit, means dependent upon the operation of the said electro-responsively controlled device in either mechanical connecting means for effecting the release of the other mechanical connecting means whereby upon excess current conditions in either leg of the circuit both contacts are permitted to move to their open-circuit positions independently of the operating member, and means dependent upon the release of both of the said connecting means for automatically moving the operating member from its closed circuit position to its open circuit position.

22. In an automatic circuit breaker, the combination of two movable contacts electrically connectible respectively in two legs of a circuit, a movable operating member, two separate bodily movable mechanical connecting means between the operating member and the contacts for moving the latter to open and close the circuit, each of the said connecting means being releasable independently of the other so as to be ineffective and each including an electro-responsively controlled device automatically operable to effect such release upon the attainment of excess current conditions in the corresponding leg of the circuit, a transverse bar separate from the operating member and automatically movable upon the operation of the said electro-responsively controlled device in either mechanical connecting means, the said bar serving upon movement to effect the release of the other mechanical con-

necting means whereby upon excess current conditions in either leg of the circuit both contacts are permitted to move to their open-circuit positions independently of the operating member, and means dependent upon the release of both of the said connecting means for automatically moving the operating member from its closed circuit position to its open-circuit position.

23. In an automatic circuit breaker, the combination of a movable operating member biased in the circuit-opening direction, a plurality of independently movable contact members having contacts respectively connectible in different legs of the circuit and normally mechanically connected with the operating member for movement in unison to open or close the circuit, each of the said movable contact members being automatically releasable from the operating member upon the attainment of abnormal current conditions in the corresponding leg of the circuit and thereupon moving automatically to its open-circuit position independently of the operating member and independently of any other contact member, releasable means normally serving to hold the operating member in its closed-circuit position, and a transverse bar separate from the operating member and adapted to be moved by any one of the contact members upon independent circuit-opening movement thereof, the said bar serving upon being so moved to release the holding means and permit the operating member and each remaining contact member to move to their open circuit positions.

24. In an automatic circuit breaker, the combination of a movable operating member biased in the circuit-opening direction, a plurality of independently movable contact members having contacts respectively connectible in different legs of the circuit and normally mechanically connected with the operating member for movement in unison to open or close the circuit, each of the said movable contact members being automatically releasable from the operating member upon the attainment of abnormal current conditions in the corresponding leg of the circuit and thereupon moving automatically to its open-circuit position independently of the operating member and independently of any other contact member, releasable means of the toggle link type normally serving to hold the operating member in its closed-circuit position, and a transverse bar separate from the operating member and adapted to be moved by any one of the contact members upon independent circuit-opening movement thereof, the said bar upon being so moved acting upon the knee of the toggle to thereby break the toggle and permit the operating member and each remaining contact member to move to their open-circuit positions.

25. In an automatic circuit breaker, the combination of a movable operating member biased in the circuit-opening direction and normally releasably held in its closed-circuit position, a plurality of independently movable contact members having contacts respectively connectible in different legs of the circuit, a plurality of mechanical connections normally operative to enable the operating member to move all of the contact members in unison to open or close the circuit, each mechanical connection including an electro-responsive means bodily movable with the corresponding contact member and automatically releasable upon the attainment of abnormal current conditions in the corresponding leg to permit automatic circuit-opening move-

ment of the corresponding contact member independently of the operating member and independently of any other contact member, and means adapted to be actuated by any one of the contact members upon independent circuit-opening movement thereof and serving upon being so actuated to release the operating member and to thereby permit the said member and each remaining contact member to automatically move to their open-circuit positions.

26. In an automatic circuit breaker, the combination of a movable operating member, a plurality of movable actuating members, a plurality of independently movable contact members, a plurality of mechanical connections normally operative to enable the several actuating members to move the corresponding contact members to open or close the circuit, each mechanical connection including an electro-responsive device automatically releasable upon the attainment of abnormal current conditions to permit automatic circuit-opening movement of the corresponding contact member independently of any other contact member, a plurality of releasable means operatively connecting the operating member with the respective actuating members, and means dependent upon the automatic release of the mechanical connection for any one of the contact members and thereupon serving to release the releasable connecting means for the actuating member corresponding to each remaining contact member.

27. In an automatic circuit breaker, the combination of a movable operating member, a plurality of movable actuating members, a plurality of independently movable contact members, a plurality of mechanical connections normally operative to enable the several actuating members to move the corresponding contact members to open or close the circuit, each mechanical connection including an electro-responsive device automatically releasable upon the attainment of abnormal current conditions to permit automatic circuit-opening movement of the corresponding contact member independently of any other contact member, a plurality of releasable means operatively connecting the operating member with the respective actuating members, and means adapted to be actuated by any one of the contact members upon independent circuit-opening movement thereof and serving upon being so actuated to release the releasable connecting means for the actuating member corresponding to each remaining contact member.

28. In an automatic circuit breaker, the combination of a movable operating member, a plurality of movable actuating members, a plurality of independently movable contact members, a plurality of mechanical connections normally operative to enable the several actuating members to move the corresponding contact members to open or close the circuit, each mechanical connection including an electro-responsive device automatically releasable upon the attainment of abnormal current conditions to permit automatic circuit-opening movement of the corresponding contact member independently of any other contact member, a plurality of releasable means operatively connecting the operating member with the respective actuating members, and a transverse bar separate from the operating member and adapted to be moved by any one of the contact members upon independent circuit-opening movement thereof, the said bar serving upon being so moved to release the releasable connecting

means for the actuating member corresponding to each remaining contact member.

29. In an automatic circuit breaker, the combination of a movable operating member, a plurality of movable actuating members, a plurality of independently movable contact members, a plurality of mechanical connections normally operative to enable the several actuating members to move the corresponding contact members to open or close the circuit, each mechanical connection including an electro-responsive device automatically releasable upon the attainment of abnormal current conditions to permit automatic circuit-opening movement of the corresponding contact member independently of any other contact member, toggle links operatively connecting the operating member with the actuating members, the said toggle links being in their locking relationship when the corresponding actuating members and contact members are in their closed-circuit positions and thus serving to hold the operating member in its closed-circuit position, and means adapted to be actuated by any one of the contact members upon independent circuit-opening movement thereof and serving upon being so actuated to move out of their locking relationship those toggle links which hold the operating member in its closed-circuit position.

30. In an automatic circuit breaker, the combination of a movable operating member, a plurality of independently movable actuating members, a plurality of independently movable contact members, a plurality of mechanical connections normally operative to enable the several actuating members to move the corresponding contact members to open or close the circuit, each mechanical connection including an electro-responsive device automatically releasable upon the attainment of abnormal current conditions to permit automatic circuit-opening movement of the corresponding contact member independently of any other contact member, a plurality of pairs of toggle links operatively connecting the operating member with the respective actuating members, the said toggle links of each pair being in their locking relationship when the corresponding actuating member and contact member are in their closed-circuit positions and thus serving to hold the operating member in its closed-circuit position, and means adapted to be actuated by any one of the contact members upon independent circuit-opening movement thereof and serving upon being so actuated to move out of their locking relationship those toggle links which hold the operating member in its closed-circuit position.

31. In an automatic circuit breaker, the combination of a movable operating member, a plurality of independently movable actuating members, a plurality of independently movable contact members, a plurality of mechanical connections normally operative to enable the several actuating members to move the corresponding contact members to open or close the circuit, each mechanical connection including an electro-responsive device automatically releasable upon the attainment of abnormal current conditions to permit automatic circuit-opening movement of the corresponding contact member independently of any other contact member, a plurality of pairs of toggle links operatively connecting the operating member with the respective actuating members, the said toggle links of each pair being in their locking relationship when the corresponding actuating member and contact member are in their closed-circuit position and thus serving to

hold the operating member in its closed-circuit position, and a transverse bar separate from the operating member and adapted to be moved by any one of the contact members upon independent circuit-opening movement thereof, the said bar serving upon being so moved to move out of their locking relationship those toggle links which hold the operating member in its closed-circuit position.

32. In an automatic circuit breaker, the combination of a movable operating member, a plurality of independently movable actuating members, a plurality of independently movable contact members, a plurality of mechanical connections normally operative to enable the several actuating members to move the corresponding contact members to open or close the circuit, each mechanical connection including an electro-responsive device automatically releasable upon the attainment of abnormal current conditions to permit automatic circuit-opening movement of

the corresponding contact member independently of any other contact member, a plurality of pairs of toggle links operatively connecting the operating member with the respective actuating members, the said toggle links of each pair being in their locking relationship when the corresponding actuating member and contact member are in their closed-circuit position and thus serving to hold the operating member in its closed-circuit position, a transverse rotatable rod, and a plurality of cam members rigidly secured to the rod for rotating it, each cam member having a portion positioned to be engaged and moved by a corresponding contact member upon independent circuit-opening movement thereof and each cam member also having a portion positioned to engage the corresponding toggle links to move them out of locking relationship when the rod is moved by reason of the circuit-opening movement of any contact member.

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