July 30, 1940. P. M. CHRISTENSEN 2,209,319

AUTOMATIC CIRCUIT BREAKER

Filed Nov. 28, 1938

Fig. 1

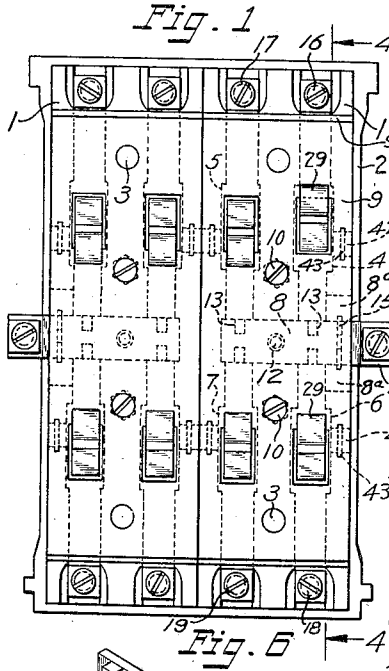


Fig. 2

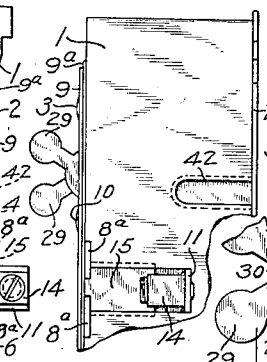


Fig. 4

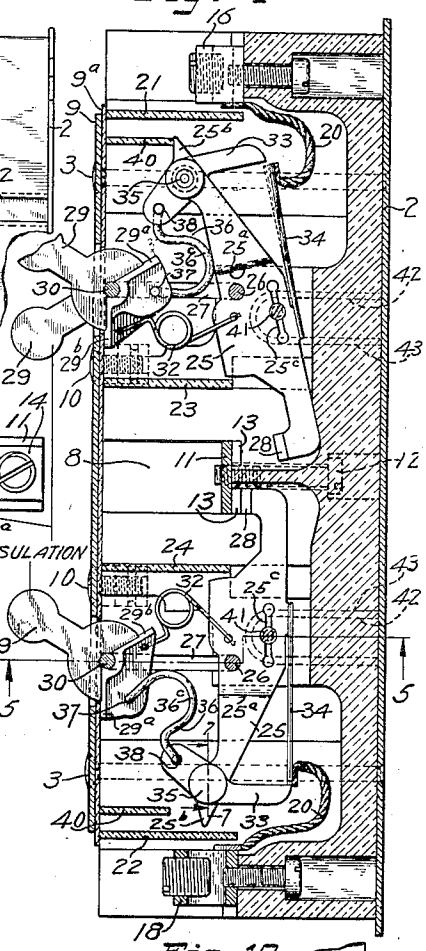


Fig. 3

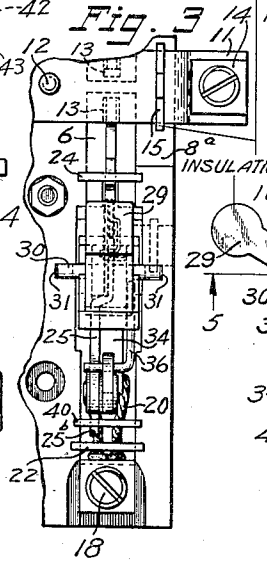


Fig. 6

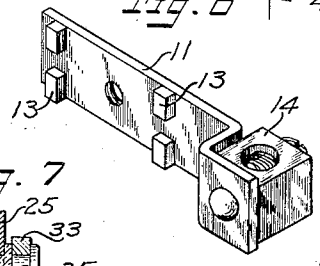


Fig. 7

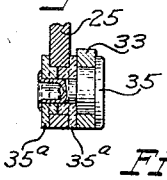


Fig. 8

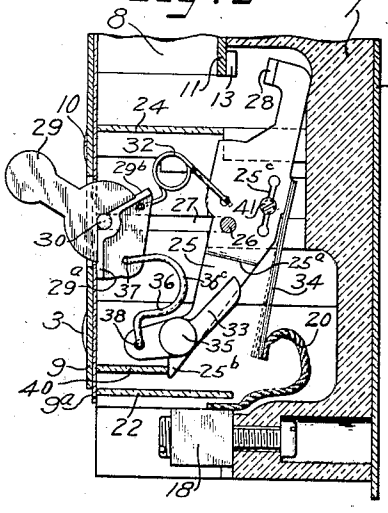


Fig. 5

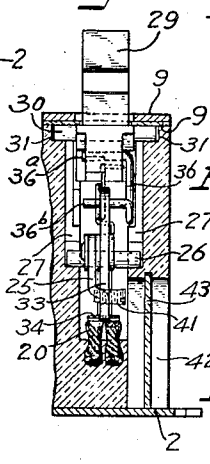


Fig. 9

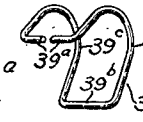
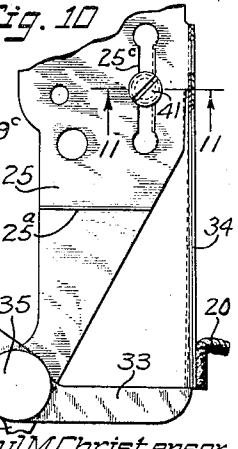


Fig. 11



Fig. 10



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2,209,319

AUTOMATIC CIRCUIT BREAKER.

Paul M. Christensen, Newington, Conn., assignor to Colt's Patent Fire Arms Manufacturing Company, Hartford, Conn., a corporation of Connecticut

Application November 28, 1938, Serial No. 242,763

16 Claims. (Cl. 200—116)

The present invention relates particularly to a circuit breaker having some of the characteristics of that disclosed in the co-pending application of Joseph Sachs for Automatic circuit breakers, Serial No. 152,020, filed July 6, 1937, and having some of the characteristics of that disclosed in the co-pending application of Joseph Sachs and Paul M. Christensen for Automatic circuit breakers, Serial No. 202,295, filed April 15, 1938.

The general object of the invention is to provide an automatic circuit breaker of the general character above set forth, but having certain improvements in arrangement of parts and in structural details which make it possible for it to be manufactured at lower cost while retaining high efficiency and reliability of operation.

In accordance with one phase of the present invention, the contact member is pivotally mounted between its ends and the pivot pins for the contact member and for the operating member are mounted directly in the main insulating housing, thus avoiding the necessity for separate frame members and at the same time obtaining other advantages as will more fully appear from the specification.

In accordance with another phase of the invention, the resilient link forming a part of the toggle linkage is provided with integral pivot portions, the link being preferably formed of a single piece of wire.

In accordance with another phase of the invention a single spring is provided which serves to properly bias both the pivoted contact member and the pivoted operating member.

In accordance with still another phase of the invention there is provided a greatly simplified means for adjusting the electro-responsive bimetallic element or latch for purposes of calibration.

In the accompanying drawing I have shown one principal embodiment of the invention and also a variation as to one of the details. It will be understood that the drawing is intended for illustrative purposes only and is 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 drawing:

Fig. 1 is a front view of a circuit breaker assembly embodying the invention.

Fig. 2 is a fragmentary side view of the assembly shown in Fig. 1.

Fig. 3 is an enlarged fragmentary front view of the lower right hand unit and associated parts as shown in Fig. 1, the front cover plate being omitted.

Fig. 4 is an enlarged vertical sectional view taken along the line 4—4 of Fig. 1.

Fig. 5 is an enlarged bottom view of the mechanism of the lower right hand unit, the housing being shown in section along the line 5—5 of Fig. 4.

Fig. 6 is an enlarged perspective view of a conductor with stationary contacts carried thereby.

Fig. 7 is an enlarged fragmentary sectional view taken along the line 7—7 of Fig. 4.

Fig. 8 is a view similar to the lower portion of Fig. 4, but showing the parts in the positions which they assume upon automatic opening while the handle is held in closed-circuit position.

Fig. 9 is a perspective view showing an alternative resilient link adapted to be substituted for the link shown in Figs. 3, 4 and 5.

Fig. 10 is an enlarged fragmentary view of some of the parts shown in the lower portion of Fig. 4.

Fig. 11 is a fragmentary sectional view taken along the line 11—11 of Fig. 10.

As to some of the features of the invention, I do not narrowly limit myself as concerns the character of the housing in which the circuit breaker mechanism is mounted. As to other features, however, the housing is important and I will describe one suitable housing which cooperates with the mechanism to provide certain novel characteristics.

Referring first to Figs. 1 and 2, the main insulating housing is represented at 1. The housing, as shown, is adapted for holding or containing four separate circuit breaker mechanisms but I do not necessarily limit myself as to the exact number. Fig. 1 shows two similar housings 1, 1 secured to a common supporting plate 2, by means of screws or rivets 3, 3. However, so far as the invention is concerned, the number of housings is immaterial.

It will be understood that the housings with the mechanisms contained therein are ordinarily enclosed in a suitable casing, but the casing is omitted from the drawing as it forms no part of the present invention. The co-pending application of Joseph Sachs for Automatic circuit breaker assembly, Serial No. 202,297, filed April 15, 1938, shows a suitable casing, and also shows suitable means whereby a supporting plate such as 2 can be detachably mounted in the casing.

As shown, the housing 1 is an integral structure molded from a suitable insulating material. It has four mechanism containing chambers 4,

5, 6 and 7 therein, all initially open at the front. The upper chambers 4 and 5 are initially open at the top and the lower chambers 6 and 7 are initially open at the bottom and all of the chambers are initially in communication with a main central chamber 8.

Each housing 1 has a front cover 9 which may be of metal, an insulating sheet 9a being interposed between the cover and the housing. The cover 9 and the sheet 9a will be referred to collectively as constituting the front cover plate. The front cover plate is held in place by screws 10, 10 extending into suitable inserts molded in the housing, and the cover plate has suitable openings therein through which the operating members of the circuit breaker mechanisms can extend.

Mounted within the central chamber 8 is a conductor 11 held in place by a screw 12 extending forward from the rear housing. The conductor 11 carries on its rear face four rearward facing stationary contacts 13, 13 positioned respectively at the lower ends of the chambers 4 and 5 and at the upper ends of the chambers 6 and 7. The conductor 11 extends to the exterior of the housing at the right and is there provided with a suitable wire terminal 14. A partition plate 15 of insulating material is fitted within grooves near the open right end of the chamber 8 so as to partly close the said open end after the conductor 11 has been put in place.

In addition to the stationary contact 13 which is provided for each mechanism, there is also provided a stationary conductor which is at the opposite end of the chamber. Each of these conductors is provided with a suitable wire terminal. The wire terminals for the mechanisms in the chambers 4 and 5 are at the top, being marked 16 and 17 and the wire terminals for the chambers 6 and 7 are at the bottom, being marked 18 and 19. The several conductors and wire terminals are held in place by screws extending forward through the main body of the housing as clearly illustrated in Fig. 4. Directly connected with each of the last mentioned conductors and wire terminals is a flexible conductor 20.

Transverse partition plates are provided at the tops and bottoms of the several chambers 4, 5, 6 and 7, these being insulating plates fitted in suitable rearward extending grooves in the side walls of the chambers. These partition plates are held in place by the front cover plate. As shown in Figs. 3 and 4, the upper chamber 4 has a partition plate 21 which substantially closes the chamber at the top, and the lower chamber 6 has a similar partition plate 22 which substantially closes the chamber at the bottom. The chambers 4 and 6 are respectively separated from the central chamber 8 by partition plates 23 and 24.

In the detailed description which follows, reference will be had chiefly to the circuit breaker mechanism contained in the lower right hand chamber 6 but reference will also be had to the mechanism contained in the upper right hand chamber 4. All of the mechanisms are identical in construction or substantially so, but the upper and lower mechanisms are reversed as to positions.

A movable contact member 25 is provided which is pivotally mounted between its ends. The contact member has a transverse pivot pin 26 which extends into grooves 27, 27 formed in the side walls of the mechanism containing chamber. These grooves are closed at their rear ends and their closed end portions therefore serve as bearings for the pivot pin. The contact member 25 is preferably a single piece of sheet metal offset transversely near the pivot pin 26 as indicated at 25a. Carried by the contact member near one end thereof is a forward facing movable contact 28 which is adapted to engage and disengage the corresponding rearward facing stationary contact 13.

A handle or operating member 29 is provided, this being formed of insulating material and having a transverse pivot pin 30 which is entered in registering bearing notches 31, 31 formed in the front face of the housing. The front cover plate cooperates with the pivot pin 30 to hold it in place in the bearing notches. A portion of the operating member 29 projects forward through the corresponding opening in the front cover plate so as to be accessible for convenient manual operation. At the rear of the front cover plate the operating member is provided with integral portions 29a and 29b which are adapted to contact with the front cover plate to limit the movement of the operating member in both directions.

The contact member 25 and the operating member 29 are both biased for movement toward their open-circuit positions, and preferably and in accordance with one phase of the present invention, the biasing of both of these members is effected by means of a single spring 32. The spring 32 is shown as being a coil spring having extending end portions which are entered respectively in holes formed in the contact member and in the operating member. The spring tends to open or separate, thus tending to move the contact member 25 in the clockwise direction and tending to move the operating member 29 in the counter-clockwise direction.

In order that the operating member 29 may operate the contact member 25, there is provided a connecting mechanism which includes an actuator 33. The actuator is pivotally connected with the contact member near the end thereof which is opposite the end carrying the movable contact 28. The actuator is controlled by means of a bi-metallic element 34 which is bodily movable with the contact member and which serves in and of itself as a latch cooperating directly with the actuator 33. The pivotal connection of the actuator 33 with the contact member 25 is effected by means of a pivot pin 35. The actuator is insulated from the contact member by means of insulating bushings 35a, 35a which surround the pivot pin 35 as shown in Fig. 7.

A link 36 is pivotally connected with the operating member 29 at 37 and with the actuator 33 at 38. With the parts in the normal closed-circuit position as shown in the lower portion of Fig. 4, the pivotal axis at 37 is below a straight line connecting the pivotal axes at 30 and 38, the operating member itself thus cooperating with the link 36 to form a normally locked or overset toggle. The before-mentioned stop 29a on the operating member engages the front cover to limit movement thereof in the clockwise direction.

The before-mentioned bi-metallic latch 34 normally engages at its lower end with the actuator 33 and it holds the actuator in its normal relationship with the other parts as shown in the lower portion of Fig. 4. The upper end of the latch is rigidly secured by brazing or otherwise to the edge of the sheet metal element 25

which constitutes the contact member, the connection being near the center. The before-mentioned flexible conductor 20 is electrically connected directly with the bi-metallic latch 34 near the lower latching end thereof. This connection may be effected by brazing.

With the circuit breaker mechanism in closed-circuit position as shown in the lower portion of Fig. 4, it will be apparent that electrical connection is established from the conductor 11 and the stationary contact 13 to the movable contact 28, thence through the contact member 25 and the bi-metallic latch 34, and thence through the flexible conductor 20 to the stationary conductor and wire terminal 18 at the bottom. As already stated, the contact member is biased in the clockwise or circuit-opening direction by means of the spring 32, and the operating member is biased in the counter-clockwise or circuit-opening direction by means of the same spring. However, actual movement in the circuit-opening direction is normally prevented by reason of the described overset toggle relationship between the operating member itself and the link 36, it being understood that the latch 34 normally holds the actuator 33 from relative movement in the counter-clockwise direction. Normally the operating member 29 may be moved to move the contact member in either direction and thus open or close the circuit. During such normal movements the latch 34 remains engaged with the actuator 33.

If the handle or operating member be held in its closed-circuit position as shown in the lower portion of Fig. 4, and if an abnormal current condition such as an overload is attained, the bi-metallic latch 34 is automatically deflected rearward, this deflection occurring as the result of the heating of the bi-metallic latch by the current flowing therein. This rearward deflection causes the latch to disengage and release the actuator 33. When the actuator is no longer held by the latch, the entire contact member is moved by the spring 32 to its open-circuit position as shown in Fig. 8, the actuator 33 and the link 36 assuming the relative positions shown in that figure. If the operating member be released after the parts have moved to the relative positions shown in Fig. 8, the spring 32 moves the operating member to the position shown in the upper portion of Fig. 4, this in turn moving the link 36 and the actuator 33 to the positions there shown. The actuator 33 is thus restored to engaged or engageable relationship with the bi-metallic latch 34.

The operation has been described as it occurs when the handle is first held and then released. Ordinarily, however, the operating member is not held and it starts to move to its open-circuit position as soon as the actuator has moved far enough to break the locking relationship between the operating member 29 and the link 36. All of the parts thus move practically instantaneously to the position shown in the upper portion of Fig. 4, the actuator being immediately restored to engaging relationship with the latch. As soon as the latch has cooled sufficiently the operating member can be moved to again close the circuit. It will be observed that in the open-circuit position as shown in the upper portion of Fig. 4, the stop 29^b engages the front cover plate to limit movement of the operating member.

When any one of the movable contacts 28 is separated from the corresponding stationary contact 13, either manually or by automatic action, any gases that may be formed by the resultant arc pass into the central chamber 8 which has been referred to. In order that these gases may escape to the exterior of the housing, the chamber 8 is preferably provided at one side with notches 8^a 8^a as shown in Figs. 1 and 2. It will be observed that the partition plates 23 and 24 prevent any considerable portion of these arc-formed gases from passing upward or downward into contact with the circuit breaker mechanism.

In accordance with one phase of the present invention, I provide a novel and advantageous construction for the link 36. As shown, particularly in Figs. 3, 4 and 5, the link 36 is formed from a single piece of metallic wire, the link having two integral pivot portions 36^a and 36^b and having a connecting portion 36^c between the two pivot portions. The two pivot portions 36^a and 36^b are entered directly in holes formed respectively in the operating member and the actuating member at 37 and 38. The adjacent housing wall holds the link in place and prevents any undue lateral movement thereof. The construction of the links 36 from a single piece of wire greatly reduces costs, as it eliminates the cost of machining or otherwise forming a link with bearing apertures therein, and it eliminates the necessity for separate pivot pins.

In a circuit breaker of the general character herein shown and described, it is necessary to provide resiliently acting means for insuring the required pressure between the contacts. As disclosed in the before-mentioned Sachs and Christensen application, Serial No. 202,295 the stationary contact is rigidly or fixedly secured in place so that no appreciable movement is possible, and the movable contact is rigidly secured to the contact member so that it cannot move relatively thereto. The necessary resiliency in or in association with the train of mechanism for moving and holding the contact member is provided by means of a resilient link between the operating member and the actuator. In the present construction the principle of the resilient link is retained, and the connecting portion 36^c of the link 36 is resilient, being of loop form as shown. The resiliency of the link 36 permits it to yield as the toggle approaches its overset relationship. In moving the mechanism from the open-circuit position as shown in the upper portion of Fig. 4 to the closed-circuit position as shown in the lower portion of the same figure, the contacts are brought into engagement just before the toggle reaches its dead center position. Continued pressure on the handle or operating member serves to compress the link 36 until the dead center position is reached, the link serving to apply the required contact pressure. When the handle or operating member is moved beyond the dead center position to the closed-circuit position, the force resiliently applied by the link 36 serves not only to maintain the contact pressure but also to hold the toggle in the overset position as shown.

In lieu of the spring 36 shown in Figs. 3, 4 and 5, I may use an alternative form of spring 39 as shown in Fig. 9. This spring 39 is of the same general character as the spring 36, but it is provided not only with two integral pivot portions 39^a and 39^b but also with two transversely spaced resilient connecting or loop portions 39^c, 39^c. The resiliency of the link permits the two parts of the pivot portion 39^a to be sprung apart so that the link can be threaded through the hole 38 in the actuator 33. The resiliency also permits the two

said parts of the pivot portion 39a to be sprung apart and then permitted to snap into the hole 37 in the operating member 29. With the spring 39 as constructed as shown in Fig. 9, I avoid any tendency for the two pivot portions to be forced out of parallelism with each other, and I thus provide a more direct and reliable resilient connection between the operating member and the actuator.

Referring particularly to Fig. 8, it will be observed that with the parts positioned as there shown, the pivot pin 26 is held at the rear ends of the slots 27 partly by the expansive action of the spring 32. If no other means were provided for so holding the pivot pin, there would be some tendency for it to move forward when the operating member is moved to closed-circuit position for re-engaging the actuator with the latch. This would be particularly true if the latch had in the meantime cooled and returned to its normal position so that a substantial amount of force would be required to move the actuator into its normal latch engaging position. In order to make it impossible for the pivot pin 26 to move forward as stated, it may be desirable to provide a suitable stop for engaging the contact member 25. As shown, the contact member 25 is provided with an extension 25b which engages a transverse insulating plate 40 fitted in suitable slots in the side walls of the housing chamber and held in place by the front cover plate.

It is ordinarily preferable to provide a means for effecting fine adjustments of the bi-metallic element or latch for calibration purposes. In accordance with one phase of the invention a simple and inexpensive means is provided for this purpose. This adjusting means is illustrated in conjunction with a bodily movable bi-metallic latch carried by a movable contact member, but it will be understood that I do not necessarily so limit myself.

Referring particularly to Figs. 10 and 11, it will be seen that the contact member has a longitudinal slot 25c therein, this slot being near the rear edge and adjacent the point of attachment of the bi-metallic element 34. The slot 25c is preferably closed at both ends although this is not absolutely essential. The slot 25c provides an edge portion of the contact member which is readily distortable in a direction parallel with the faces of the plate and which when distorted serves to move the bi-metallic element 34 so as to change its relationship with respect to the main body of the contact member and with respect to the actuator. In order to effect distortion of the beforementioned distortable edge portion of the contact member, I preferably provide a threaded hole which is so positioned as to be intercepted by the slot 25c. A tapered screw 41 is threaded into this hole, and it will be clear that when the screw is turned and forced into the hole, it will distort the edge portion of the contact member adjacent the slot. For instance, the said distortable edge portion may be distorted from the position shown by dotted lines in Fig. 10 to the position shown by full lines. This distortion of the edge portion of the contact member will move the bi-metallic latch from the position shown by dotted lines in Fig. 10 to the position shown in full lines.

It will be understood that the final adjustment of the screw 41 to effect calibration should be made after the operating parts have been completely assembled and made ready for testing. In practice the front cover plate is first secured by means of the screws 10, 10, but the rivets 3, 3 are omitted, the housing 1 being not yet mounted on the supporting plate 2. The housing 1 is provided with openings 42, 42 adjacent the respective screws 41, 41, so that the said screws remain accessible for final calibration. After the completion of calibration, partition plates 43, 43 are inserted in suitable slots in the edges of the openings 42. Then the housings are mounted on the supporting plate 2 and are secured in place by means of the rivets 3. Thus the partition plates 43 are locked in place and it becomes impossible for the user of the circuit breaker to tamper with the adjusting screws 41.

What I claim is:

1. The combination in an automatic circuit breaker, of a stationary contact, a stationary conductor separate from the said contact, a flexible conductor electrically connected at one end with the stationary conductor, a movable contact member pivotally mounted between its ends and including near one end a contact adapted to engage and disengage the stationary contact, the said member being biased in the contact disengaging direction, a bodily movable bi-metallic latch on the contact member electrically connected between the movable contact and the other end of the flexible conductor, the said latch being automatically deflected from its normal relationship with the contact member upon the attainment of abnormal current conditions in the circuit, an actuator bodily movable with the contact member and pivotally connected therewith near the end thereof opposite the movable contact, the said actuator being normally engaged by the latch to prevent relative pivotal movement and being released upon automatic deflection of the latch to permit automatic circuit-opening movement of the contact member, and means for operating the actuator to enable it in cooperation with the latch to normally effect the movement of the contact member or to normally hold it in contact engaging position.

2. The combination in an automatic circuit breaker, of an insulating housing comprising two spaced side walls having opposite similar closed-end grooves extending rearward from the front of the housing and also having two transverse registering bearing notches additional to the said rearward extending grooves, a rearward facing stationary contact in the housing, a contact member including a forward facing contact near one end adapted to engage and disengage the stationary contact, the said contact member having between its ends a pivot pin entered in the rear closed ends of the aforesaid grooves, an operating member having a pivot pin entered in the aforesaid bearing notches, and an electro-responsively releasable mechanical connection between the operating member and the other end of the contact member normally enabling the operating member to move the contact member.

3. The combination in an automatic circuit breaker, of an insulating housing comprising two spaced side walls having opposite similar closed-end grooves extending rearward from the front of the housing and also having two transverse registering bearing notches additional to the said rearward extending grooves, a rearward facing stationary contact in the housing, a contact member including a forward facing contact near one end adapted to engage and disengage the stationary contact, the said contact member having between its ends a pivot pin entered in the rear closed ends of the aforesaid grooves, an

operating member having a pivot pin entered in the aforesaid bearing notches, the said operating member having movement limiting stops thereon, a front cover for the housing having an opening through which a portion of the operating member extends, the said cover engaging the pivot pin for the operating member to hold it in place and the said cover also engaging the stops on the operating member to limit movement thereof in both directions, and an electro-responsively releasable mechanical connection between the operating member and the other end of the contact member normally enabling the operating member to move the contact member.

4. The combination in an automatic circuit breaker, of an insulating housing comprising two spaced side walls having opposite similar closed-end grooves extending rearward from the front of the housing and also having two transverse registering bearing notches additional to the said rearward extending grooves, a rearward facing stationary contact in the housing, a contact member including a forward facing contact near one end adapted to engage and disengage the stationary contact, the said contact member having between its ends a pivot pin entered in the rear closed ends of the aforesaid grooves, a spring applying rearward force to the contact member between the pivot pin and the contact and thus biasing the contact member for movement in the contact disengaging direction and also tending to hold the pivot pin at the rear of the grooves, an operating member having a pivot pin entered in the aforesaid bearing notches, and an electro-responsively releasable mechanical connection between the operating member and the other end of the contact member normally enabling the operating member to move the contact member.

5. The combination in an automatic circuit breaker, of an insulating housing comprising two spaced side walls having opposite similar closed-end grooves extending rearward from the front of the housing and also having two transverse registering bearing notches additional to the said rearward extending grooves, a rearward facing stationary contact in the housing, a contact member including a forward facing contact near one end adapted to engage and disengage the stationary contact, the said contact member having between its ends a pivot pin entered in the rear closed ends of the aforesaid grooves, a spring applying rearward force to the contact member between the pivot pin and the contact and thus biasing the contact member for movement in the contact disengaging direction and also tending to hold the pivot pin at the rear of the grooves, an operating member having a pivot pin entered in the aforesaid bearing notches, an electro-responsively releasable mechanical connection between the operating member and the other end of the contact member normally enabling the operating member to move the contact member, and a stop engaging the contact member near the end opposite the contact for positively preventing forward movement of the contact member when in open-circuit position.

6. An automatic circuit breaker comprising in combination, a stationary contact, a contact member guided for movement in a fixed path and including a movable contact adapted to engage and disengage the stationary contact which member is biased toward its open-circuit position, a movable actuator, an electro-responsively controlled mechanical connection movable with the contact member and engaging the actuator so as to enable the latter to effect movement of the former to its closed-circuit or its open-circuit position, the said mechanical connection being adapted to be automatically rendered inoperative upon the attainment of excess current conditions in the circuit so as to permit automatic movement of the contact member to its open-circuit position free from restraint by the actuator, an operating member pivotally movable about a stationary axis, and a link consisting of a single piece of metal bent to form two parallel pivot portions with a connecting portion between the pivot portions, the said pivot portions of the link entering holes in the actuator and the operating member respectively and the link cooperating with the operating member to form a toggle which serves when in overset relationship to normally hold the actuator and the contact member in their closed-circuit positions.

7. An automatic circuit breaker comprising in combination, a stationary contact, a contact member guided for movement in a fixed path and including a movable contact adapted to engage and disengage the stationary contact which member is biased toward its open-circuit position, a movable actuator, an electro-responsively controlled mechanical connection movable with the contact member and engaging the actuator so as to enable the latter to effect movement of the former to its closed-circuit or its open-circuit position, the said mechanical connection being adapted to be automatically rendered inoperative upon the attainment of excess current conditions in the circuit so as to permit automatic movement of the contact member to its open-circuit position free from restraint by the actuator, an operating member pivotally movable about a stationary axis, and a link consisting of a single piece of metal bent to form two parallel pivot portions with two similar transversely spaced connecting portions between the respective ends of the pivot portions, the said pivot portions of the link entering holes in the actuator and the operating member respectively and the link cooperating with the operating member to form a toggle which serves when in overset relationship to normally hold the actuator and the contact member in their closed-circuit positions.

8. An automatic circuit breaker comprising in combination, a rigidly supported stationary contact, a contact member guided for movement in a fixed path and including a movable contact rigidly carried thereby and adapted to engage and disengage the stationary contact which member is biased toward its open-circuit position, a movable actuator, an electro-responsively controlled mechanical connection movable with the contact member and engaging the actuator so as to enable the latter to effect movement of the former to its closed-circuit or its open-circuit position, the said mechanical connection being adapted to be automatically rendered inoperative upon the attainment of excess current conditions in the circuit so as to permit automatic movement of the contact member to its open-circuit position free from restraint by the actuator, an operating member pivotally movable about a stationary axis, and a link consisting of a single piece of metal bent to form two parallel pivot portions with a resilient loop portion between the pivot portions, the said pivot portions of the link entering holes in the actuator and the operating member respectively and the link cooperating

with the operating member to form a toggle which serves when in overset relationship to normally hold the actuator and the contact member in their closed-circuit positions and to apply to the contact member the force necessary to provide the required pressure between the contacts.

9. An automatic circuit breaker comprising in combination, a rigidly supported stationary contact, a contact member guided for movement in a fixed path and including a movable contact rigidly carried thereby and adapted to engage and disengage the stationary contact which member is biased toward its open-circuit position, a movable actuator, an electro-responsively controlled mechanical connection movable with the contact member and engaging the actuator so as to enable the latter to effect movement of the former to its closed-circuit or its open-circuit position, the said mechanical connection being adapted to be automatically rendered inoperative upon the attainment of excess current conditions in the circuit so as to permit automatic movement of the contact member to its open-circuit position free from restraint by the actuator, an operating member pivotally movable about a stationary axis, and a link consisting of a single piece of metal bent to form two parallel pivot portions with two similar transversely spaced resilient loop portions between the respective ends of the pivot portions, the said pivot portions of the link entering holes in the actuator and the operating member respectively and the link cooperating with the operating member to form a toggle which serves when in overset relationship to normally hold the actuator and the contact member in their closed-circuit positions and to apply to the contact member the force necessary to provide the required pressure between the contacts.

10. In an automatic circuit breaker, the combination of a stationary contact, a pivoted contact member including a movable contact adapted to engage and disengage the stationary contact, a movable actuator, an electro-responsively controlled mechanical connection movable with the contact member and engaging the actuator so as to enable the latter to effect movement of the former to its closed-circuit or its open-circuit position, the said mechanical connection being adapted to be automatically rendered inoperative upon the attainment of excess current conditions in the circuit so as to permit automatic movement of the contact member to its open-circuit position free from restraint by the actuator, a pivotally movable operating member, a link pivotally connected between the actuator and the operating member and cooperating with the operating member to form a toggle which serves when in overset relationship to normally hold the actuator and the contact member in their closed-circuit positions, and a single spring connected with the contact member and with the operating member and serving to bias both of them for movement toward their open-circuit positions.

11. In combination in an automatic circuit breaker, a contact biased for movement to break the circuit, releasable mechanism normally holding the contact in closed-circuit position and including a bi-metallic element held at one end and capable of deflection to cause the other end to relatively move and thereby effect the release of the mechanism, the said element being deflectible by heat resulting from the attainment of excess current conditions in the circuit, a metallic plate having a longitudinal slot near one edge which provides a readily distortable edge portion to which the first said end of the bi-metallic element is rigidly secured, and means associated with the metallic plate for distorting the said distortable edge portion thereof in a direction parallel with the faces of the plate so as to change the relationship of the said bi-metallic element with respect to the main body of the plate and thereby change the effectiveness of the deflection for causing the release of the mechanism.

12. In combination in an automatic circuit breaker, a contact biased for movement to break the circuit, releasable mechanism normally holding the contact in closed-circuit position and including a bi-metallic element held at one end and capable of deflection to cause the other end to relatively move and thereby effect the release of the mechanism, the said element being deflectible by heat resulting from the attainment of excess current conditions in the circuit, a metallic plate having a longitudinal slot near one edge which is closed at its ends and which provides a readily distortable edge portion to which the first said end of the bi-metallic element is rigidly secured, and means associated with the metallic plate for distorting the said distortable edge portion thereof so as to change the relationship of the said bi-metallic element with respect to the main body of the plate and thereby change the effectiveness of the deflection for causing the release of the mechanism.

13. In combination in an automatic circuit breaker, a contact biased for movement to break the circuit, releasable mechanism normally holding the contact in closed-circuit position and including a bi-metallic element held at one end and capable of deflection to cause the other end to relatively move and thereby effect the release of the mechanism, the said element being deflectible by heat resulting from the attainment of excess current conditions in the circuit, a metallic plate having a threaded hole therein near one edge and also having therein a longitudinal slot which intersects the hole and which provides a readily distortable edge portion to which the first said end of the bi-metallic element is rigidly secured, and a tapered screw extending into the threaded hole for distorting the said distortable edge portion of the metallic plate so as to change the relationship of the said bi-metallic element with respect to the main body of the plate and thereby change the effectiveness of the deflection for causing the release of the mechanism.

14. In an automatic circuit breaker, the combination of a stationary contact, a movable contact member having a contact adapted to engage and disengage the stationary contact, the said contact member comprising a metallic plate having a longitudinal slot near one edge which provides a readily distortable edge portion, a bi-metallic element adapted to be heated and deflected upon the attainment of excess current conditions in the circuit, the said element having one end free and having the other end rigidly secured to the said distortable edge portion of the contact member, an actuator movable with the contact member and normally engaged by the free end of the bi-metallic element but disengaged thereby upon deflection, means for moving the actuator to thereby normally effect movement of the bi-metallic element and the contact member, and means associated with the metallic plate of the contact member for distorting the said distortable edge portion thereof so as to

thereby change the relationship of the bi-metallic element with respect to the main body of the contact member and with respect to the actuator.

15. In an automatic circuit breaker, the combination of a stationary contact, a movable contact member having a contact adapted to engage and disengage the stationary contact, the said contact member comprising a metallic plate having a longitudinal slot near one edge which is closed at its ends and which provides a readily distortable edge portion, a bi-metallic element adapted to be heated and deflected upon the attainment of excess current conditions in the circuit, the said element having one end free and having the other end rigidly secured to the said distortable edge portion of the contact member, an actuator movable with the contact member and normally engaged by the free end of the bi-metallic element but disengaged thereby upon deflection, means for moving the actuator to thereby normally effect movement of the bi-metallic element and the contact member, and means associated with the metallic plate of the contact member for distorting the said distortable edge portion thereof so as to thereby change the relationship of the bi-metallic element with respect to the main body of the contact member and with respect to the actuator.

16. In an automatic circuit breaker, the combination of a stationary contact, a movable contact member having a contact adapted to engage and disengage the stationary contact, the said contact member comprising a metallic plate having a threaded hole therein near one edge and also having therein a longitudinal slot which intersects the hole and which provides a readily distortable edge portion, a bi-metallic element adapted to be heated and deflected upon the attainment of excess current conditions in the circuit, the said element having one end free and having the other end rigidly secured to the said distortable edge portion of the contact member, an actuator movable with the contact member and normally engaged by the free end of the bi-metallic strip but disengaged therefrom upon deflection, means for moving the actuator to thereby normally effect movement of the bi-metallic element and the contact member, and a tapered screw extending into the threaded hole in the metallic plate of the contact member for distorting the said distortable edge portion thereof so as to thereby change the relationship of the bi-metallic element with respect to the main body of the contact member and with respect to the actuator.

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