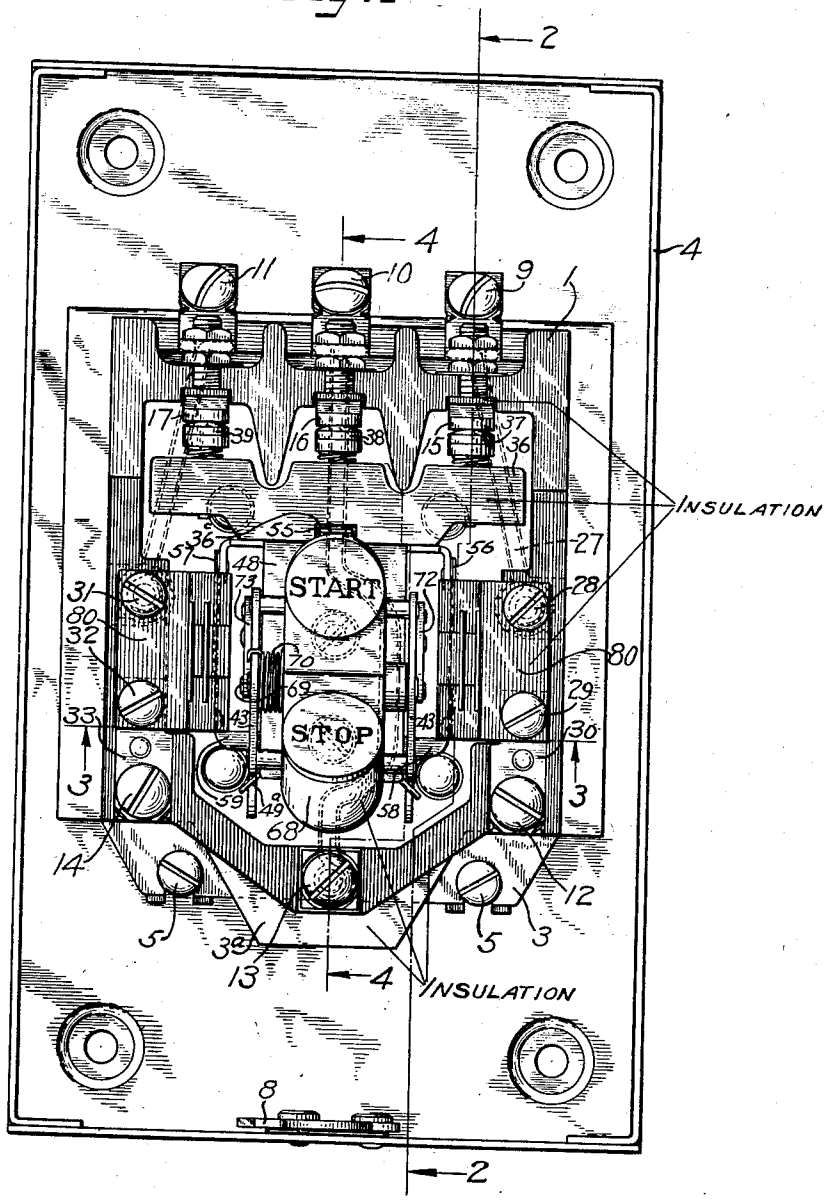
Jan. 2, 1940. J. SACHS 2,185,525

AUTOMATIC CIRCUIT BREAKER

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Fig. 1



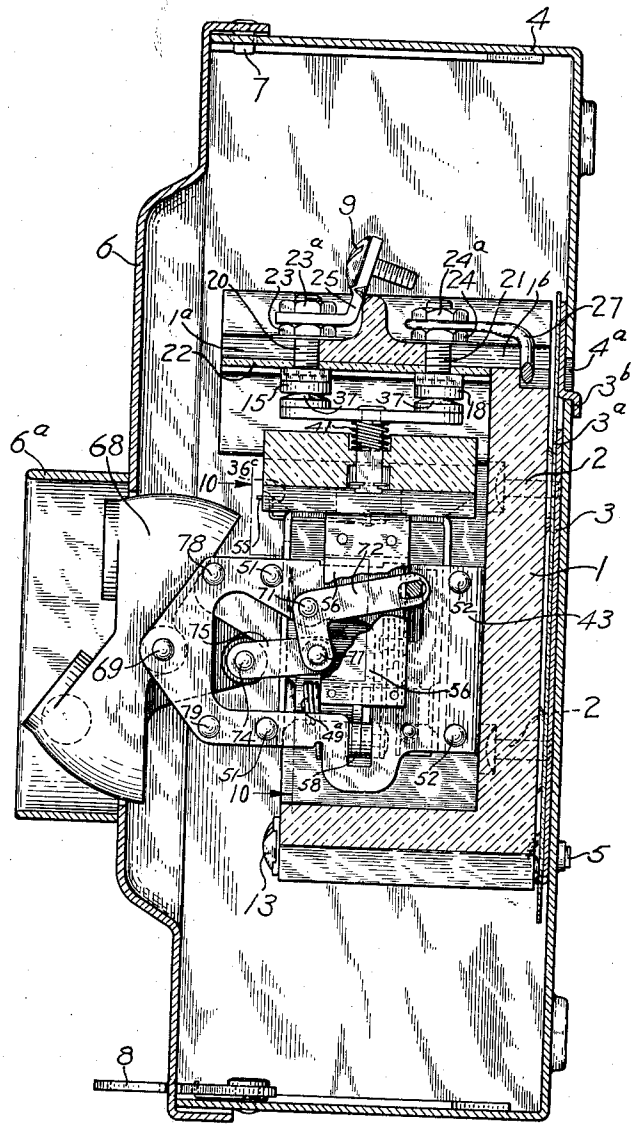
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Fig. 2



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Fig. 4

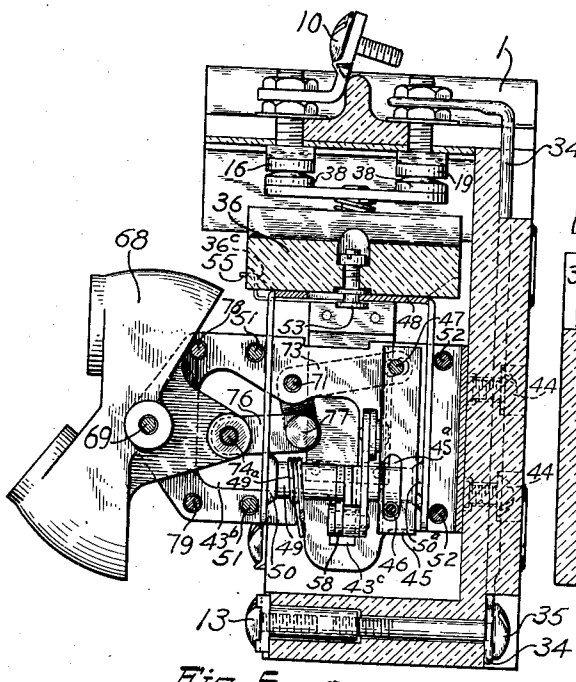


Fig. 3

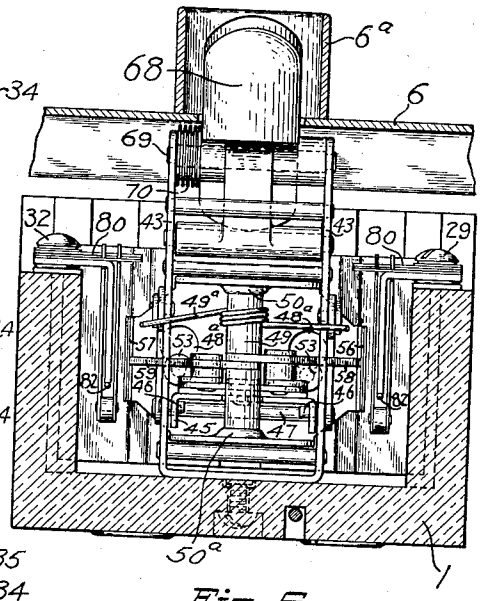


Fig. 5

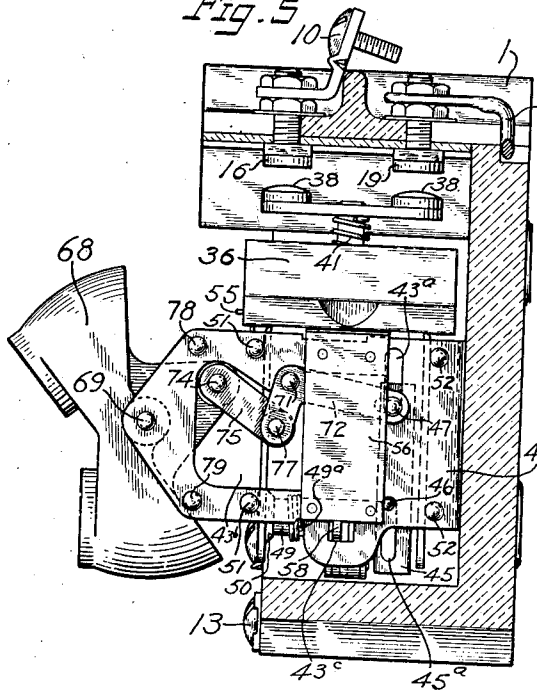
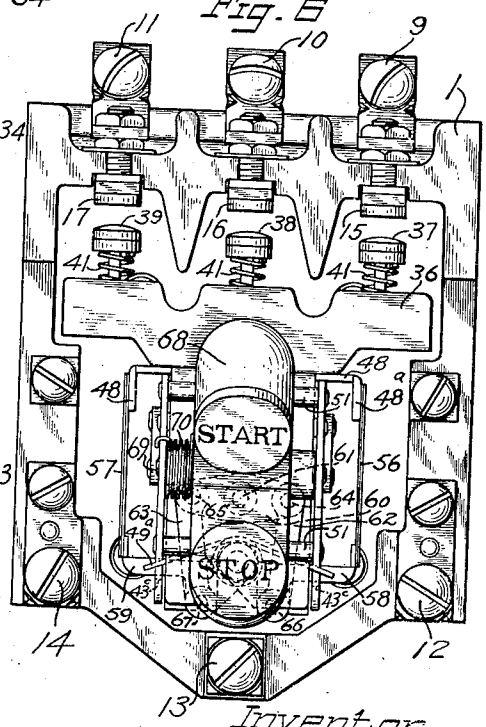


Fig. 6



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Fig. 9

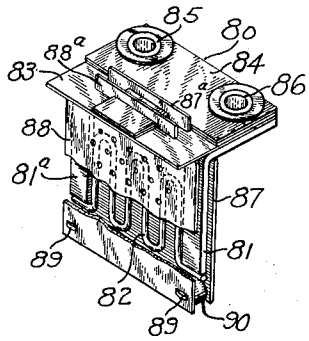


Fig. 8

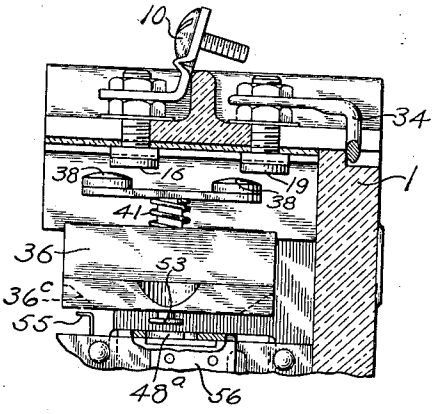
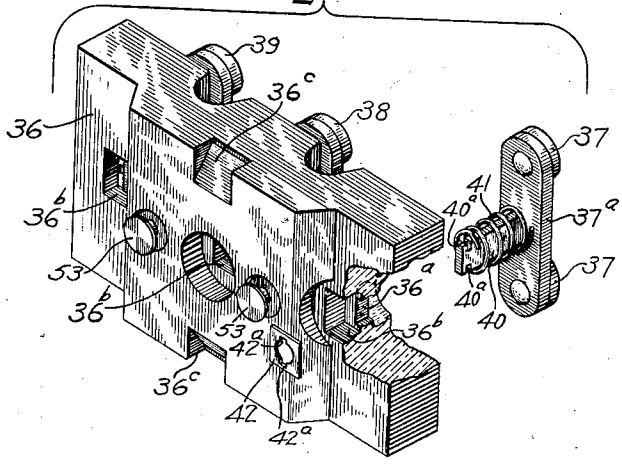


Fig. 7



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AUTOMATIC CIRCUIT BREAKER

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Fig. 10

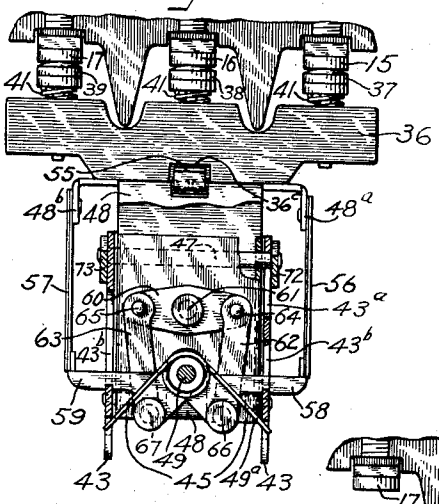


Fig. 11

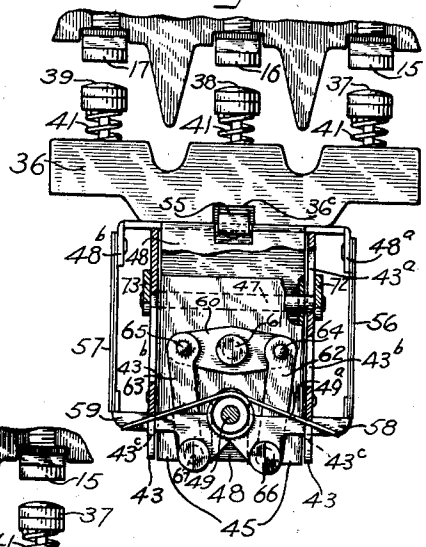


Fig. 12

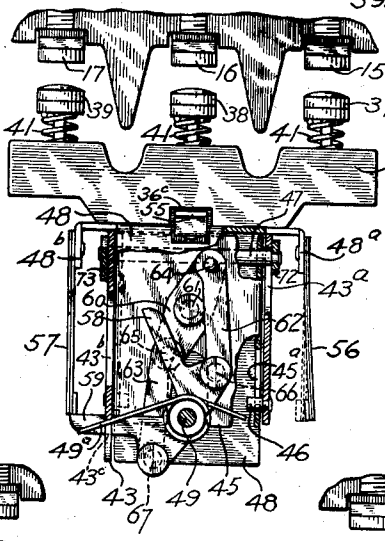


Fig. 13

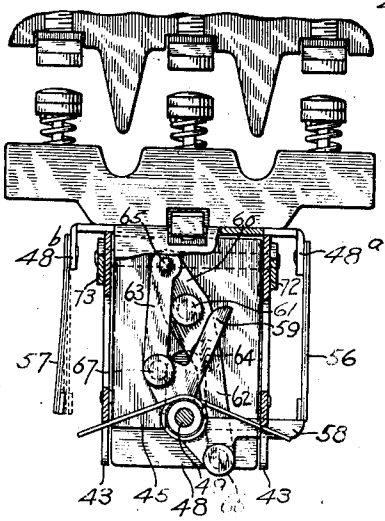
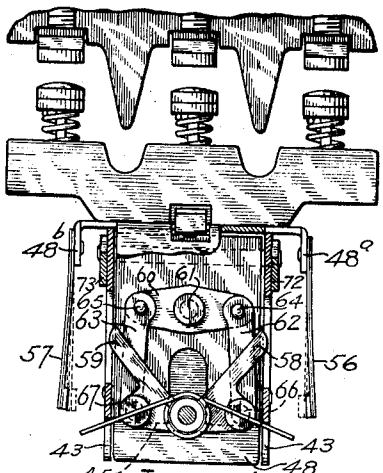


Fig. 14



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Patented Jan. 2, 1940 2,185,525

UNITED STATES PATENT OFFICE

2,185,525

AUTOMATIC CIRCUIT BREAKER

Joseph Sachs, West Hartford, Conn., assignor to Colt's Patent Fire Arms Manufacturing Company, Hartford, Conn., a corporation of Connecticut

Application October 4, 1938, Serial No. 233,266

17 Claims. (Cl. 200—116)

The present invention relates to an automatic circuit breaker and is particularly adapted for incorporation in an automatic circuit breaker of the general type disclosed in my prior patent for Automatic circuit breaker No. 2,094,964 dated October 5, 1937. The circuit breaker disclosed in the said patent is responsive to only one controlling condition, that is, an excess current condition in one leg of an electric circuit. The circuit breaker embodying the present invention is essentially different in that it is responsive to either one of two different controlling conditions, as for instance an excess current condition in either one of two legs of the circuit. A circuit breaker embodying the present invention is in many respects similar to that disclosed in my co-pending application for Automatic circuit breaker, Serial No. 233,265, filed on even date herewith.

While I do not necessarily so limit myself, a circuit breaker embodying the present invention is particularly adapted for use as a "motor starter." It is capable of carrying a moderate overload for a predetermined short interval of time, but the design is such that automatic opening of both legs of the circuit will occur if the overload continues in either one of the two legs of the circuit for a longer interval of time.

A motor starter embodying the present invention is manually operable to close and open the circuit for the ordinary starting and stopping of the motor. Two electro-responsive devices are provided connectible in two legs of the circuit and each serving upon the attainment of excess current conditions in the corresponding circuit leg to release the movable contacts from the control of the operating member or handle and thus permit the circuit to automatically open independently of the handle.

In accordance with the invention set forth in the said copending application, two movable devices each automatically responsive to a predetermined condition are included in the mechanical connection which normally holds the movable contact member with its contact or contacts in circuit-closing position. When there is an operating member or handle, the mechanical connection is interposed between the said operating member or handle and the said contact member so that the former can effect the movement of the latter for ordinary switching purposes. The two said condition-responsive devices normally serve to maintain the said mechanical connection and either of them upon automatic action serves to break the mechanical connection. Preferably these condition-responsive means are bi-metallic strips bodily movable with the movable contacts and constituting latches. One of the objects of the present invention is to provide a circuit breaker or motor starter of the type specified having an improved mechanism for engagement with the bi-metallic strips or latches. This mechanism greatly reduces the pressure on the strips or latches and has other important advantages as will presently appear.

In accordance with the invention I provide various advantageous details of construction and operation all of which will be fully apparent from the following specification.

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

Of the drawings:

Fig. 1 is a front view of a circuit breaker embodying the invention, the front cover of the enclosing box being omitted.

Fig. 2 is a vertical sectional view taken along the line 2—2 of Fig. 1 and showing the cover of the enclosing box.

Fig. 3 is a transverse sectional view taken along the line 3—3 of Fig. 1 and showing the cover of the enclosing box.

Fig. 4 is a vertical sectional view taken along the lines 4—4 of Fig. 1, the enclosing box being omitted.

Fig. 5 is a view similar to Fig. 4 but showing the various parts in open-circuit positions instead of closed-circuit positions.

Fig. 6 is a view similar to Fig. 1 but omitting the enclosing box and showing the parts in open-circuit positions. In this view the heaters are omitted.

Fig. 7 is a perspective view showing the supporting block for the movable contacts and the contacts and other parts thereon, one pair of contacts being shown removed from the block.

Fig. 8 is a fragmentary sectional view similar to Fig. 4 but showing the movable contacts and their insulating supporting block partly removed.

Fig. 9 is a perspective view of one of the heaters.

Fig. 10 is a fragmentary sectional view taken along the line 10—10 of Fig. 2 and showing certain of the parts in their closed-circuit positions.

Fig. 11 is a view similar to Fig. 10 but showing the parts in the positions which they assume when the operating member or handle is moved to open-circuit position.

Fig. 12 is a view similar to Fig. 10 but showing the parts in the positions which they assume when the operating member or handle is held in closed-circuit position and when automatic opening is effected by reason of excess current in the right hand leg of the circuit.

Fig. 13 is a view similar to Fig. 10 but showing the parts in the positions which they assume when the operating member or handle is held in closed-circuit position and when automatic opening is effected by reason of excess current in the left hand leg of the circuit.

Fig. 14 is a view similar to Fig. 10 but showing the parts in the positions which they assume when the operating member or handle is held in closed-circuit position and when automatic opening is effected by reason of excess current in both legs of the circuit at the same time.

Referring to the drawings, 1 represents an insulating block or base which serves as a support for all of the electrical parts of the circuit breaker and for all of the mechanically operative parts. The base 1 is secured by means of rivets 2, 2 to a metallic supporting plate 3 which is connected with the rear wall of an enclosing box 4. An insulating sheet 3^a is interposed between the base 1 and the plate 3. The plate 3 is preferably readily detachable, being held at the top by hook portions 3^b which enter holes 4^a in the box wall, and being held at the bottom by screws 5, 5. After loosening the screws, the plate 3 and all parts carried thereby can be raised and removed.

The box 4 has a removable front cover 6 normally held in place by a pin 7 at the top and a latch 8 at the bottom. The cover 6 has a front opening adapted to receive the operating member or handle of the circuit breaker as will presently appear. A flange 6^a surrounds the opening to protect the operating member.

A three pole circuit breaker is shown, there being three wire terminals 9, 10 and 11 carried by the base 1 near the top edge thereof and three other wire terminals 12, 13 and 14 carried by the base 1 near the bottom edge thereof. Electrically and mechanically connected with the respective wire terminals 9, 10 and 11 are stationary contacts 15, 16 and 17 having downward exposed contact faces. Each of the stationary contacts 15, 16 and 17 constitutes one of a pair of such contacts, the other contact of each pair being similarly constructed and positioned but located toward the rear. These latter contacts will be referred to as the rear stationary contacts, the rear contact 18 for the right leg of the circuit being shown in Fig. 2 and the rear contact 19 for the center leg of the circuit being shown in Figs. 4 and 5.

The stationary contacts of each pair, as for instance contacts 15 and 18 shown in Fig. 2, are carried by screws 20 and 21 which extend through slots 1^a and 1^b in the base 1. Preferably the screws also extend through a horizontal strip 22 formed of insulating material, this strip serving to close the slots 1^a and 1^b. The screws are held in place by nuts 23 and 24. A nut 23^a on the screw 20 serves to connect a conductor 25 which carries the beforementioned wire terminal 9. A nut 24^a on the screw 21 serves for the connection of a conductor 27 which is located in the main in a suitable groove in the rear of the base. By removing the nuts from the screws 20 and 21, the stationary contacts are released so that they can be readily removed.

The other end of the conductor 27 is connected with a screw 28 which extends through the base to the front thereof. A screw 29 similar to the screw 28 is mounted at the front of the base, this screw being associated with a conductor 30 which carries the before-mentioned wire terminal 12. A heating unit or heater to be presently described in detail is connected between the screws 28 and 29 and there is thus established a continuous electric circuit from the rear stationary contact 18 to the wire terminal 12. In similar manner the rear stationary contact at the left is electrically connected with the wire terminal 14, there being heater engaging screws 31 and 32 similar to the screws 28 and 29, and there being a conductor 33 and the front similar to the conductor 30.

The rear stationary contact 19 at the center is connected with a conductor 34 at the rear of the base which extends downward through a suitable groove to a position near the lower end of the base where it is engaged by a screw 35 extending forward to the front of the base and providing electrical connection with the wire terminal 13.

A contact carrying block 36 is movable vertically in a manner to be presently described. This block 36 carries three pairs of bridging contacts 37, 38 and 39 adapted when in their upper positions to engage and electrically connect the stationary contacts of the several pairs.

The several pairs of bridging contacts carried by the block 36 are similar and a detailed description of one of them will suffice for all. Referring particularly to Fig. 7, it will be observed that the contacts 37, 37 constituting one pair are mounted on a bridging conductor 37^a which is carried by the block 36. Preferably the bridging contacts and their connecting conductor are readily detachable from block 36 so that they can be replaced if worn or burned.

Projecting rearward from the bridging conductor 37^a is a flat stud 40 which normally projects trrough a slot 36^a in the block 36. A spring 41 surrounds this stud. The slot 36^a terminates in a substantially square recess 36^b in which is positioned a washer 42. This washer has a central hole therein with opposite notches 42^a, 42^a adapted to receive the stud 40. The stud 40 has notches 40^a, 40^a adapted to receive the unnotched portions of the washer 42. In assembling, the stud 40 is entered in the slot 36^a, the spring 41 being compressed. The washer 42 is placed on the stud 40 and turned through approximately 90° so that the unnotched portions of the washer are entered in the notches 40^a, 40^a of the stud. Then the stud with the bridging member and contacts thereon is permitted to move forward under the influence of the spring 41, the washer 42 entering the square recess 36^b. The walls of the recess prevent the washer from turning and thus the contact unit is securely held. When removal is desired, the contact unit is pressed downward so as to bring the washer 42 out of the recess and then the washer can be turned and removed. Thus the bridging connectors are detachably and yieldably connected to the contact carrying block. When the block is moved upward the movable contacts on the three bridging connectors can engage the corresponding stationary contacts, the springs 41 yielding as required and providing the necessary contact pressure.

Carried by the base 1 is a frame 43 which serves to carry all of the movable parts of the circuit breaker. This frame is approximately U-shaped in horizontal section, the legs of the U consisting of two parallel vertical side portions or plates which project forward. The rear yoke portion of the frame is secured directly to the base 1 as for instance by means of screws 44, 44.

Mounted between the side plates of the frame 43 for rectilinear movement is an actuating member 45. As shown, this member 45 is a U-shaped metallic plate having slots 45a in the side legs thereof which receive studs 46, 46 projecting inward from the frame side plates. Extending transversely between the side legs of the U-shaped plate 45 is a pin 47 having end portions which project through slots 43a in the frame side plates. It will be seen that the studs 46, 46 and the end portions of the pin 47 serve as means for guiding the actuating member 45 for rectilinear movement between the frame side plates.

The contact carrying block 36 is carried by a metallic member 48 which is U-shaped in vertical section, the legs of the U extending downward. The two legs are connected with each other near the bottom by means of a horizontal pin 49 having spacing washers 50 and 50a thereon. Transverse pins 51, 51 and 52, 52 serve to guide the member 48 for rectilinear movement between the side plates of the frame. It will be observed that the member 48 is supported and guided entirely independently of the actuating member 45.

The insulating contact carrying block 36 is shown as being so connected with the member 48 as to be readily detachable. The block is provided with two headed studs 53, 53 which normally enter keyhole slots 48a, 48a in the top or yoke portion of the member 48. The studs 53 are normally seated in the smaller rearward portions of the keyhole slots as shown in Fig. 3. The block is yieldably held in the position shown in Fig. 3 by means of a spring 55 which enters a notch 36c in the block 36. Preferably there are two notches 36c at opposite sides of the block so that the block can be held in either of two positions. When it is desired to remove the block 36 and the contacts thereon, the block is moved forward against the resistance of the spring 55 and is then moved upward so as to bring the studs 53 out of the slots 48a as shown in Fig. 8. The block with the contacts thereon can then be entirely removed from the circuit breaker and by reversing the procedure described the block and the contacts can be replaced and connected.

For convenience the member 48 together with the insulating block 36 and the contacts carried thereby will be referred to collectively as constituting the "contact member" of the circuit breaker. All of the parts of the contact member are movable in substantial unison with each other so as to make and break the circuit simultaneously at all of the contacts.

The contact member is biased for movement in the circuit-opening direction. As shown, this biasing is effected by means of a spring 49a which surrounds the spacing bushing 50 and has end portions which are seated in suitable notches in the bottom edge portions of the side plates of the frame.

There are two condition-responsive or electro-responsive means, each of which has at least a portion thereof normally bodily movable with the contact member and with the actuating member, the said means normally serving to provide at least a portion of a mechanical connection so that the actuating member can cause the movement of the contact member to open and close the circuit. Upon action of either one of the condition-responsive or electro-responsive means separately from the other, the before-mentioned mechanical connection is released and the contact member is permitted to automatically move to its open-circuit position entirely independently of the actuating member. The details of the mechanical construction and arrangement of the two said means may be widely varied within the scope of my invention. One particular construction which has been found satisfactory is shown and will be described in detail.

The before-mentioned means for operatively connecting the actuating and contact members preferably comprises two thermostatic bi-metallic strips fixedly connected with one of the said members. As shown, there are two such strips 56 and 57 positioned at the sides of the contact member and connected respectively with integral extensions 48a and 48b on the plate 48. The strips 56 and 57 are at the outer sides of the frame side plates as clearly shown in Fig. 6. The mechanical connecting means also comprises certain relatively movable interconnected mechanical elements which cooperate with the bi-metallic strips. These elements are connected with both members, that is, with the actuating member and with the contact member which are thus normally held in fixed relationship. The construction is such that the bi-metallic strips carry only a portion of the force required to move and hold the contact member, the remainder of the said force being carried by the before-mentioned connecting elements.

In the construction as shown there are two arms 58 and 59 pivoted to the same member which carries the strips 56 and 57, that is, the contact member. These arms 58 and 59 are pivotally mounted on the pin 49, being held against forward or rearward movement by the bushings 50 and 50a. The end portions of the arms 58 and 59 are normally engaged by the strips 56 and 57, the frame side plates having openings 43b, 43b with notches 43c, 43c which provide clearance for the arms. A lever 60 is pivoted between its ends at 61 to the actuating member 45. Links 62 and 63 are connected at 64 and 65 to the end portions of the lever 60, the links being also connected to the respective arms 58 and 59 at 66 and 67 between the ends thereof. With the parts in open-circuit position as shown in Figs. 5 and 6, movement of the arms 58 and 59 downward beyond the positions shown is prevented by their engagement with the frame at the edges of the notches 43c, 43c.

Positioned between the side plates of the frame 43 is an operating member or handle 68 this being pivotally supported on the side plates by means of a transverse pivot pin 69. A spring 70 serves to bias the operating member 68 for movement in the counter-clockwise direction. Pivotally connected with the frame side plates at 71 are two similar bell-crank levers 72 and 73. The rear arms of these levers are slotted near their rear ends to receive the end portions of the before-mentioned transverse pin 47 carried by the actuating member 45. Pivotally connected at 74 to the operating member 68 are two links 75 and 76, the other ends of the links being pivotally connected at 77 with the forward arms of the bell-cranks 72 and 73. The before-mentioned

openings 43b, 43b in the side plates of the frame provide clearance for the links 75 and 76 and for the pivotal connections at 77. Transverse pins 78 and 79 serve as stops to limit the pivotal movement of the operating member.

The bell-cranks 72 and 73 and the links 75 and 76 serve to enable the operating member 68 to move the actuating member 45 in either direction. With the parts in closed-circuit position as shown in Figs. 1, 2, 3 and 4, the parts may be moved to open-circuit position by applying rearward pressure on the button of the operating member which is marked "Stop." This moves the operating member in the counter-clockwise direction with resultant movement of the actuating member and of the connected contact member in the downward direction to the open-circuit positions shown in Figs. 5 and 6. To restore the parts to the closed-circuit positions shown in Figs. 1, 2, 3 and 4, rearward pressure is applied to the button of the operating member which is marked "Start."

By referring more particularly to Figs. 2 and 4, it will be observed that with the parts in closed-circuit positions the links 75 and 76 cooperate with the operating member itself to form an overset toggle which holds all of the parts in the positions shown. Pressure for maintaining the toggle in its overset or locked position, as shown, is provided by the spring 49a which tends to move the contact and actuating members downward and hence tends to move the bell-crank levers 72 and 73 in the clockwise direction. The spring 55 acting through the toggle serves to overcome the tendency of the spring 70 to move the operating member in the counter-clockwise direction.

The bimetallic strips 56 and 57 are deflectible by heat, and as concerns the broader aspects of the invention I do not limit myself as to the manner of heating the said strips. Preferably, however, there are two separate means associated respectively with two legs of the circuit and with the said two bimetallic strips, the said means serving upon the attainment of excess current conditions in either leg of the circuit to cause the independent heating and deflection of the corresponding strip. As shown, there are two similar separate heaters 80, 80 having normally fixed positions, these heaters being mounted on the insulating base 1 entirely independently of the frame which carries the contact member and the associated parts. The heater 80 at the right, serves as an electrical connection between the screws 28 and 29 and the heater 80 at the left, serves as an electrical connection between the screws 31 and 32. The heaters are thus readily detachable and it will be clear that by removing the corresponding screws either of the heaters can be removed for inspection, repair or replacement.

The mechanical construction of the heaters can be widely varied but one suitable construction is shown in Fig. 9. Essentially each heater comprises two L-shaped strips 81 and 81a which are apertured to receive the attachment screws before mentioned. Connected with the ends of the strips 81 and 81a is a section of high resistance heating wire 82 bent to a serpentine shape as shown. Preferably the L-shaped members 81 and 81a are covered by insulating plates 83 and 84 connected with the said members by means of hollow rivets 85 and 86 which receive the corresponding attachment screws. Other insulating plates 87 and 88 are provided at opposite sides of the resistance wire 82, these plates having extensions 87a and 88a which extend through slots in the insulating plate 83. The plates 87 and 88 are connected with each other by rivets 89 which extend through suitable spacing washers 90. If desired the inner plate 88 may be perforated as shown to permit heat from the wire 82 to be more readily transmitted.

By referring particularly to Fig. 3 it will be observed that the resistance wires 82, 82 of the two heaters 80, 80 are normally positioned in relatively close proximity to the bimetallic strips 56 and 57. The heaters are connected respectively in the right hand and left hand legs of the circuit and the resistance wires of the heaters are designed to carry normal current without excessive heating. However, upon attainment of excess current conditions in either of the said legs of the circuit the corresponding resistance wire is heated to a much higher temperature, and its heat is transmitted to the adjacent bi-metallic strip 56 or 57.

The operation of the circuit breaker under normal and abnormal current conditions will be more readily understood by reference to the fragmentary diagrammatic views which constitute Figs. 10, 11, 12, 13 and 14. Fig. 10 shows the parts in closed-circuit position, this view corresponding in this respect to Fig. 1. The actuating member 45 is held in its upper position by means of the operating member 68, the links 75 and 76, and the bell-cranks 72 and 73; and the contact member is correspondingly held in its upper position by reason of the engagement of the bimetallic strips or latches 56 and 57 with the pivoted arms 58 and 59. The contact member tends to move downward under the action of the spring 49a, and this tendency is resisted by the levers 58 and 59 which are held by the links 62 and 63, the links in turn being held by the lever 60 and the pivot pin 61 connected with the actuating member 45. The pressure required to hold the contact member is transmitted thereto partly through the latches 56 and 57 and partly through the pivot pin 49. Thus the force required to hold the contact member is transmitted only partly through the bi-metallic latches, and the pressure upon them is much less than it otherwise would be. In fact, with the links connected as shown only about one-third of the total force is transmitted through the latches 56 and 57, the remaining two-thirds being transmitted through the pivot pin 49.

When the operating member 68 is moved to break the toggle as shown in Fig. 5, the actuating member and the contact member move downward in unison to the positions shown in Fig. 11. This separates the movable contacts from the stationary contacts and breaks all three legs of the circuit simultaneously. It will be clear that by moving the operating member 68 in the starting or stopping directions, the actuating member and the contact member can normally be moved upward to close the circuit or downward to open the circuit.

As has already been explained, the heaters 80, 80 are connected in the two outer legs of the circuit and are so designed that under normal current conditions they remain at relatively low temperatures. However, upon the attainment of excess current conditions, the resistance wires of the heaters are heated to much higher temperatures and this heat is transmitted to the adjacent bi-metallic strips to cause outward deflection thereof. Obviously, a momentary excess current condition in either leg of the cir-

cuit will have no appreciable effect as time is required to heat the resistance wire and to transmit the heat from the wire to the adjacent bi-metallic strip or latch. However, if the excess current condition is continued in one leg of the circuit, as for instance in the right hand leg, the corresponding bi-metallic latch **56** is eventually heated so as to be deflected outward sufficiently to become disengaged from the corresponding pivoted arm **58** as shown in Fig. 12. This disengagement of the latch **56** from the arm **58** releases the before described mechanical connection through the arms **58** and **59**, the links **62** and **63** and the lever **60**. In this way the contact member is premitted to be moved downward by the spring **49a**, entirely independently of the actuating member, thus opening the circuit.

If it be assumed that the actuating member is held in closed-circuit position as shown in Fig. 10, the pivotal axis at **61** remains stationary and the several connecting elements move to the positions shown by reason of the movement of the axis at **49**. There is no actual disconnection of the elements **58, 59, 62, 63** and **60** from the actuating and contact members, but the relative positions of the members are changed to effect release of the contact member, this change of positions resulting from the action of one or the other of the bi-metallic latches. During independent movement of the contact member the arm **59** remains in engagement or substantially in engagement wtih the latch **57**. Even if the arm should tend to move away from the latch during movement from the position of Fig. 10 to the position of Fig. 12, it would be restored to normal relationship by engagement with the frame at **43c**. It will be observed that this automatic opening of the circuit as described occurs as the result of the deflection of only one of the bi-metallic latches, as for instance **56**, without any heating or deflection of the other bi-metallic latch, as for instance **57**.

As already stated, automatic opening as described and as illustrated in Fig. 12 will occur even though the operating member **68** be held in closed-circuit position so as to hold the actuating member **45** in its upper position as shown. However, if the handle is not held, or if it is first held and later released, the absence of the stress normally exerted by the spring **49a** permits the toggle to be broken and permits the operating member to be thrown to its open-circuit position by means of the before-mentioned spring **70**, thus causing the actuating member to also move to its lower open-circuit position as shown in Fig. 11. In this way the disengaged arm **58** is returned to position for re-engagement with the latch **56** as soon as the latch has sufficiently cooled. It will be understood that when the operating member is not held it starts to move to open-circuit position as soon as the toggle is broken. The operating member and also the actuating member therefore move while the contact member is moving, with the result that the actuating member is not at any time far behind the contact member. When the actuating and contact members both move, the disengaged arm **58** is not permitted to move relatively upward and inward to the extreme position shown in Fig. 12, and it may in fact move only slightly from its engaged relationship with the latch **56**.

The fact that the actuating and contact members move almost simultaneously to their open-circuit positions greatly facilitates relatching as the disengaged arm is restored to relatching position while the bi-metallic latch is still heated and deflected.

Fig. 13 is similar to Fig. 12, but shows the action which takes place when the excess current condition is in the right hand circuit instead of in the left hand circuit. Inasmuch as the manner of operation is similar, a repetition of the description is unnecessary.

Fig. 14 is somewhat similar to Fig. 13, but shows the action which takes place in the rather improbable event that excess current conditions should occur in both legs of the circuit so as to cause the release of both of the arms **58** and **59** exactly simultaneously. In this case the lever **60** does not move, but both of the arms **58** and **59** move relatively upward and inward so as to permit downward movement of the contact member.

While I have shown and described a circuit breaker responsive to excess current conditions in either one of two legs of a circuit, it is to be understood that as to some of the features of mechanical construction I do not necessarily so limit myself. The mechanical construction of the actuating and contact members and their associated parts has certain advantages which are not necessarily limited for use with two separate electro-responsive means.

What I claim is:

1. The combination in an automatic circuit breaker, of a stationary contact, a movable contact member having a contact adapted to engage and disengage the stationary contact, means biasing the contact member toward its open-circuit position, and a mechanical connection normally adapted to hold the contact member in closed-circuit position, the said mechanical connection comprising relatively movable elements normally serving to transmit a portion of the force required to hold the contact member and also comprising two bi-metallic strips deflectible by heat and normally movable bodily with the said contact member and normally cooperating with the said relatively movable elements to transmit another portion of the said force, each of the said strips upon deflection acting separately from the other to permit relative movement of the aforesaid elements and to thus permit the contact member to automatically move to its open-circuit position.

2. The combination in an automatic circuit breaker, of a stationary contact, a movable actuating member, a movable contact member having a contact adapted to engage and disengage the stationary contact, means biasing the contact member toward its open-circuit position independently of the actuating member, and a mechanical connection between the actuating and contact members normally enabling the former to effect movement of the latter to open and close the circuit, the said mechanical connection comprising relatively movable elements connected with both of the said members and normally serving to transmit a portion of the force required to move and hold the contact member and the said mechanical connection also comprising two bi-metallic strips deflectible by heat and normally movable bodily with the said contact and actuating members and normally cooperating with the said relatively movable elements to transmit another portion of the said force, each of the said strips upon deflection acting separately from the other to permit relative movement of the aforesaid elements and to thus permit the contact member to auto-

matically move to its open-circuit position independently of the actuating member.

3. The combination in an automatic circuit breaker, of a stationary contact, a movable contact member having a contact adapted to engage and disengage the stationary contact, means biasing the contact member toward its open-circuit position, a plurality of relatively movable mechanical elements permanently connected with one another, and two electro-responsive means each having at least a portion thereof normally movable bodily with the contact member, each of the said electro-responsive means releasably engaging one of the said mechanical elements and the two said means thus normally serving jointly to maintain all of the elements in fixed relationship with each other so as to normally hold the contact member in closed-circuit position and each of the said electro-responsive means being adapted to release its normally engaged element upon electro-responsive action so as to permit relative movement of the elements and automatic circuit-opening movement of the contact member.

4. The combination in an automatic circuit breaker, of a stationary contact, a movable contact member having a contact adapted to engage and disengage the stationary contact, means biasing the contact member toward its open-circuit position, a plurality of relatively movable mechanical elements permanently connected with one another, and two thermally responsive means each having at least a portion thereof normally movable bodily with the contact member, each of the said thermally responsive devices releasably engaging one of the said mechanical elements and the two said means thus normally serving jointly to maintain all of the elements in fixed relationship with each other so as to normally hold the contact member in closed-circuit position and each of the said thermally responsive devices being adapted to release its normally engaged element upon thermally responsive action so as to permit relative movement of the elements and automatic circuit-opening movement of the contact member.

5. The combination in an automatic circuit breaker, of a stationary contact, a movable actuating member, a movable contact member having a contact adapted to engage and disengage the stationary contact, means biasing the contact member toward its open-circuit position independently of the actuating member, a plurality of relatively movable mechanical elements permanently connected with one another and with the actuating and contact members, two devices normally movable bodily with the contact and actuating members and each releasably engaging one of the said mechanical elements, the two said devices thus normally serving jointly to maintain all of the elements in fixed relationship with each other and with the actuating and contact members so as to enable the actuating member to move the contact member and each of the said devices being adapted to release its normally engaged element upon action so as to permit relative movement of the elements and independent circuit-opening movement of the contact member, and two separate means associated with the said devices and respectively causing each of them to act in response to a predetermined condition.

6. The combination in an automatic circuit breaker, of a stationary contact, a movable actuating member, a movable contact member having a contact adapted to engage and disengage the stationary contact, means biasing the contact member toward its open-circuit position independently of the actuating member, a plurality of relatively movable mechanical elements permanently connected with one another and with the actuating and contact members, and two electro-responsive means each having at least a portion thereof normally movable bodily with the contact and actuating members, each of the said electro-responsive means releasably engaging one of the said mechanical elements and the two said means thus normally serving jointly to maintain all of the elements in fixed relationship with each other and with the actuating and contact members so as to enable the actuating member to move the contact member and each of the said electro-responsive means being adapted to release its normally engaged element upon electro-responsive action so as to permit relative movement of the elements and independent circuit opening movement of the contact member.

7. An automatic circuit breaker comprising in combination, a stationary contact, a movable contact member having a contact adapted to engage and disengage the stationary contact, means biasing the contact member toward its contact-disengaging open-circuit position, and a mechanical connection normally adapted to hold the contact member in closed-circuit position, the said mechanical connection comprising two interconnected independently movable arms normally having operative connection with the contact member and bodily movable therewith and also comprising two electro-responsive devices normally engaging the respective arms so as to jointly enable the mechanical connection to hold the contact member and each of the said devices upon being electro-responsively moved serving independently of any movement of the other device to release its corresponding arm so as to permit automatic circuit-opening movement of the contact member.

8. An automatic circuit breaker comprising in combination, a stationary contact, a movable actuating member, a movable contact member having a contact adapted to engage and disengage the stationary contact, means biasing the contact member toward its contact-disengaging open-circuit position independently of the actuating member, and a mechanical connection between the actuating and contact members normally enabling the former to effect movement of the latter to open and close the circuit, the said mechanical connection comprising two interconnected independently movable arms having operative connection with one of the last said members and also comprising two devices carried at least in part by the other of the last said members and electro-responsively movable out of their normal relationship therewith, the least said devices normally engaging the respective arms so as to jointly maintain the operative connection between the two members and each of the said devices upon being electro-responsively moved serving independently of any movement of the other device to release its corresponding arm so as to permit circuit-opening movement of the contact member independently of the actuating member.

9. An automatic circuit breaker comprising in combination, a stationary contact, a movable actuating member, a movable contact member having a contact adapted to engage and disengage

the stationary contact, means biasing the contact member toward its contact-disengaging open-circuit position independently of the actuating member, and a mechanical connection between the actuating and contact members normally enabling the former to effect movement of the latter to open and close the circuit, the said mechanical connection comprising two interconnected independently movable arms having operative connection with one of the last said members and also comprising two latches carried by the other of the last said members and electro-responsively movable out of their normal relationship therewith, the said latches normally engaging the respective arms so as to jointly maintain the operative connection between the two members and each of the said latches upon being electro-responsively moved serving independently of any movement of the other latch to disengage its corresponding arm so as to thus release the said mechanical connection and permit circuit-opening movement of the contact member independently of the actuating member.

10. An automatic circuit breaker comprising in combination, a stationary contact, a movable actuating member, a movable contact member having a contact adapted to engage and disengage the stationary contact, means biasing the contact member toward its contact-disengaging open-circuit position independently of the actuating member, and a mechanical connection between the actuating and contact members normally enabling the former to effect movement of the latter to open and close the circuit, the said mechanical connection comprising two interconnected independently movable arms having operative connection with one of the last said members and also comprising two bi-metallic latches carried by the other of the last said members and deflectible out of their normal relationship therewith when heated, the said latches normally engaging the respective arms so as to jointly maintain the operative connection between the two members and each of the said latches upon being electro-responsively moved serving independently of any movement of the other latch to disengage its corresponding arm so as to thus release the said mechanical connection and permit circuit-opening movement of the contact member independently of the actuating member.

11. An automatic circuit breaker comprising in combination, a stationary contact, a movable actuating member, a movable contact member having a contact adapted to engage and disengage the stationary contact, means biasing the contact member toward its contact-disengaging open-circuit position independently of the actuating member, and a mechanical connection between the actuating and contact members normally enabling the former to effect movement of the latter to open and close the circuit, the said mechanical connection comprising two interconnected independently movable arms having pivotal connection with one of the last said members and also comprising two latches carried by the other of the last said members and electro-responsively movable out of their normal relationship therewith, the said latches normally engaging the respective arms so as to jointly maintain the operative connection between the two members and each of the said latches upon being electro-responsively moved serving independently of any movement of the other latch to disengage its corresponding arm so as to permit independent pivotal movement thereof and thus permit circuit-opening movement of the contact member independently of the actuating member.

12. In an automatic circuit breaker, the combination of a stationary contact, a movable actuating member, a movable contact member having a contact adapted to engage and disengage the stationary contact, means biasing the contact member toward its contact-disengaging open-circuit position independently of the actuating member, two interconnected arms movably connected with one of the last said members, two devices carried by the same member with which the arms are connected and electro-responsively movable out of their normal relationship therewith, the last said devices normally engaging the respective arms and each of the said devices upon being electro-responsively moved serving independently of any movement of the other device to release its corresponding arm, and connecting means between the arms and the other of the members normally holding the two members in fixed relationship while both of the arms are in normal positions but permitting circuit-opening movement of the contact member independently of the actuating member when either arm is released by its corresponding electro-responsive device.

13. In an automatic circuit breaker, the combination of a stationary contact, a movable actuating member, a movable contact member having a contact adapted to engage and disengage the stationary contact, means biasing the contact member toward its contact-disengaging open-circuit position independently of the actuating member, two interconnected arms movably connected with one of the last said members, two bi-metallic latches carried by the same member with which the arms are connected and deflectible out of their normal relationship therewith when heated, the said latches normally engaging the respective arms and each of the said latches upon being deflected serving independently of any deflection of the other latch to release its corresponding arm, and connecting means between the arms and the other of the members normally holding the two members in fixed relationship while both of the arms are in normal positions but permitting circuit-opening movement of the contact member independently of the actuating member when either arm is released by its corresponding latch.

14. In an automatic circuit breaker, the combination of a stationary contact, a movable actuating member, a movable contact member having a contact adapted to engage and disengage the stationary contact, means biasing the contact member toward its contact-disengaging open-circuit position independently of the actuating member, two interconnected arms movably connected with one of the last said members, two devices carried by the same member with which the arms are connected and electro-responsively movable out of their normal relationship therewith, the last said devices normally engaging the respective arms and each of the said devices upon being electro-responsively moved serving independently of any movement of the other device to release its corresponding arm, connecting means between the arms and the other of the members normally holding the two members in fixed relationship while both of the arms are in normal positions but permitting circuit-opening movement of the contact member independently of the actuating member when either arm is released by its corresponding electro-responsive de-

vice, and means serving upon movement of the members to open-circuit positions to restore the arms to their normal relationship with respect to the electro-responsive devices.

15. In an automatic circuit breaker, the combination of a stationary contact, a movable actuating member, a movable contact member having a contact adapted to engage and disengage the stationary contact, means biasing the contact member toward its contact-disengaging open-circuit position independently of the actuating member, two interconnected arms pivotally connected with one of the last said members and each movable independently of the other, two devices carried by the same member with which the arms are connected and electro-responsively movable out of their normal relationship therewith, the last said devices normally engaging the respective arms and each of the said devices upon being electro-responsively moved serving independently of any movement of the other device to release its corresponding arm, and connecting means between the arms and the other of the members normally holding the two members in fixed relationship while both of the arms are in normal positions but permitting circuit-opening movement of the contact member independently of the actuating member when either arm is released by its corresponding electro-responsive device.

16. In an automatic circuit breaker, the combination of a stationary contact, a movable actuating member, a movable contact member having a contact adapted to engage and disengage the stationary contact, means biasing the contact member toward its contact-disengaging open-circuit position independently of the actuating member, two interconnected arms pivotally connected with one of the last said members and each movable independently of the other, two devices carried by the same member with which the arms are connected and electro-responsively movable out of their normal relationship therewith, the last said devices normally engaging the respective arms and each of the said devices upon being electro-responsively moved serving independently of any movement of the other device to release its corresponding arm, a lever pivotally connected between its ends with the other of the members, and two links connecting the respective arms with the end portions of the lever, the said links serving in cooperation with the lever to normally hold the actuating and contact members in fixed relationship while both of the arms are in normal positions but permitting circuit-opening movement of the contact member independently of the actuating member when either arm is released by its corresponding electro-responsive device.

17. In an automatic circuit breaker, the combination of a stationary contact, a movable actuating member, a movable contact member having a contact adapted to engage and disengage the stationary contact, means biasing the contact member toward its contact-disengaging open-circuit position independently of the actuating member, two interconnected arms pivotally connected with the contact member and each movable independently of the other, two devices carried by the contact member and electro-responsively movable out of their normal relationship therewith, the last said devices normally engaging the respective arms and each of the said devices upon being electro-responsively moved serving independently of any movement of the other device to release its corresponding arm, a lever pivotally connected between its ends with the actuating member, and two links connecting the respective arms with the end portions of the lever, the said links serving in cooperation with the lever to normally hold the actuating and contact members in fixed relationship while both of the arms are in normal positions but permitting circuit-opening movement of the contact member independently of the actuating member when either arm is released by its corresponding electro-responsive device.

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