Sept. 20, 1938. P. M. CHRISTENSEN 2,130,369

AUTOMATIC CIRCUIT BREAKER

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Fig. 1

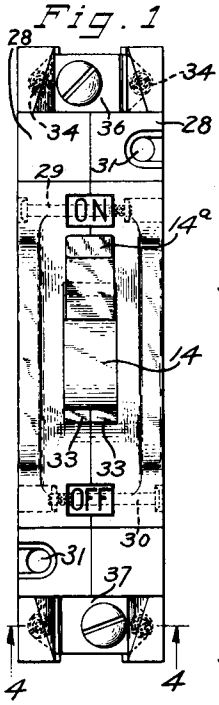


Fig. 2

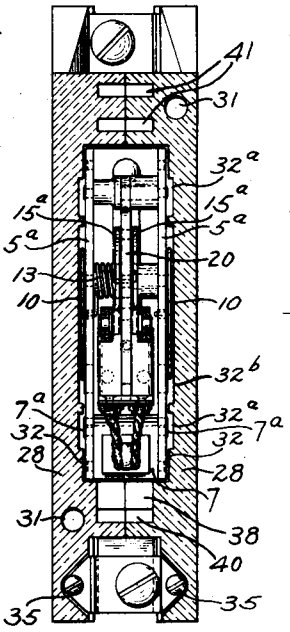


Fig. 3

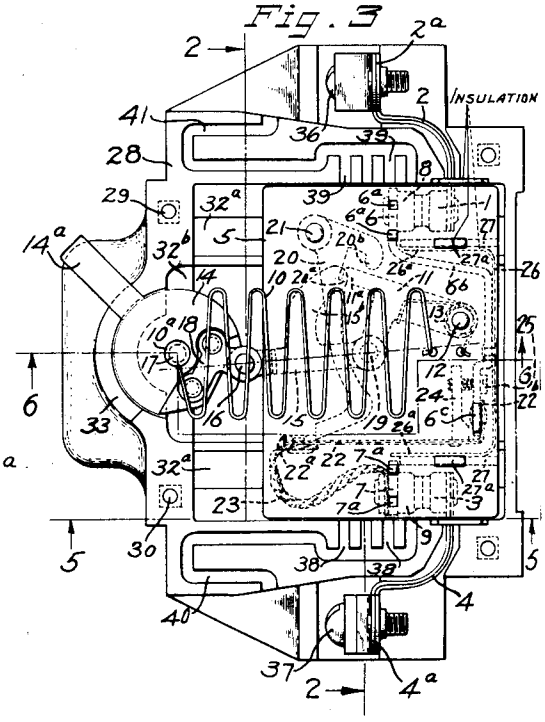


Fig. 4

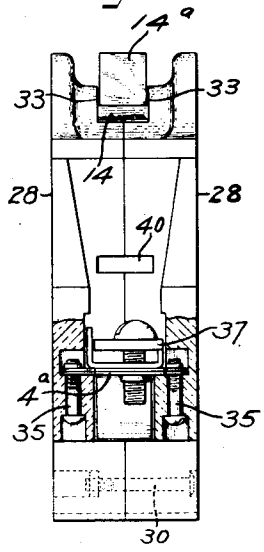


Fig. 5

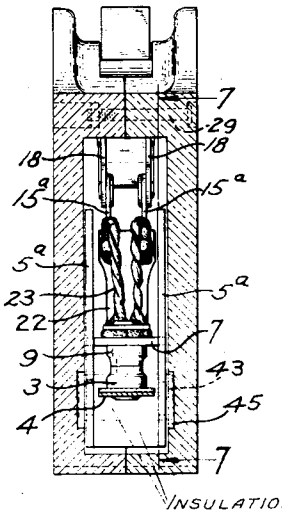
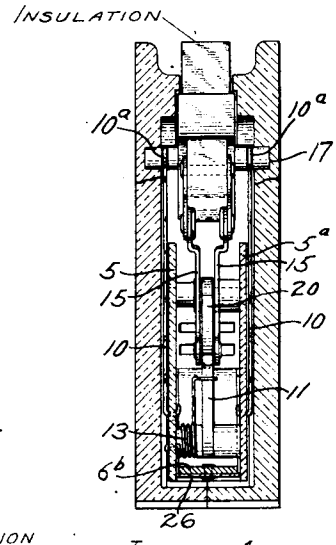


Fig. 6



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Fig. 7

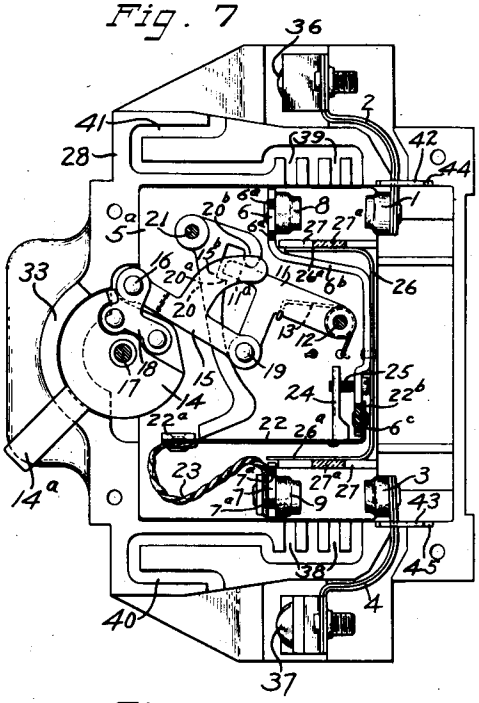


Fig. 8

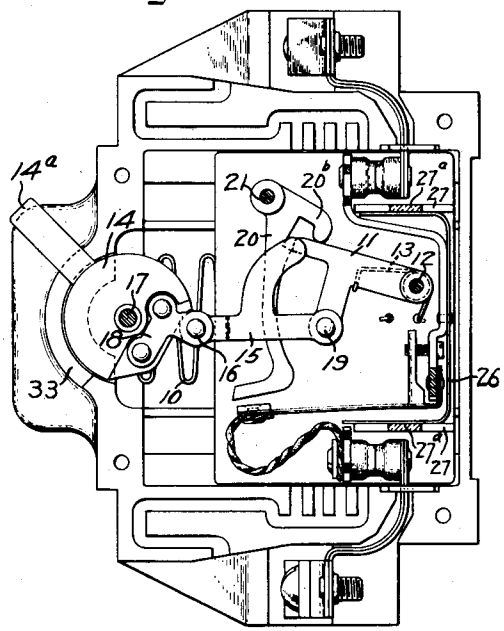


Fig. 9

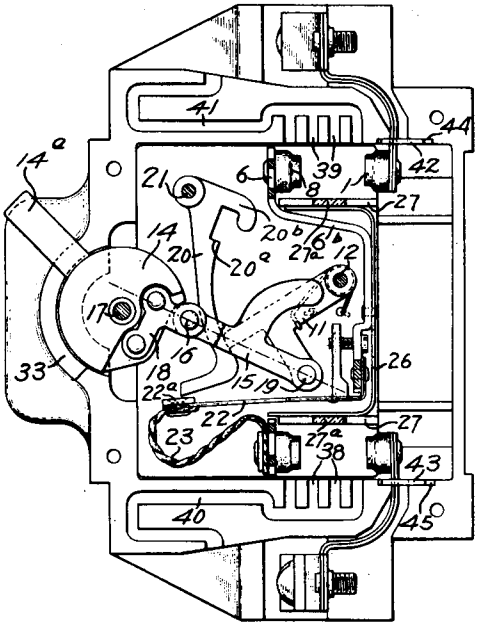
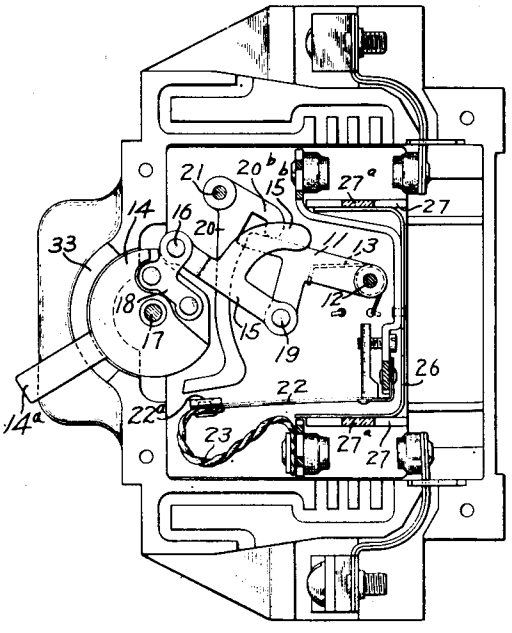


Fig. 10



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2,130,369

UNITED STATES PATENT OFFICE

2,130,369

AUTOMATIC CIRCUIT BREAKER

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Application September 9, 1937, Serial No. 163,114

20 Claims. (Cl. 200—116)

As concerns one of its phases, this invention relates particularly to a circuit breaker of the type disclosed in the patent to Joseph Sachs, No. 1,812,843, dated June 30, 1931. In a circuit breaker of this type there is provided at least one stationary or rupture contact, a movable contact member carrying at least one movable contact adapted to engage the rupture contact, an actuator movably connected with the contact member, an electro-responsive latch bodily movable wth the contact member and normally connecting it with the actuator for movement in unison therewith, and an operating means, as for instance toggle links, connected with the actuator for moving or holding it and for thus moving or holding the contact member.

As disclosed in the said patent the latch engages directly with the actuator, and it has been heretofore proposed, in the co-pending application of Joseph Sachs for Automatic circuit breaker, Serial No. 160,249, filed August 21, 1937, to provide a modified construction wherein the latch engages a movable trip member which is separate from the actuator but which is normally mechanically connected thereto for movement in unison therewith. This last mentioned construction makes it possible for the actuator and the latch to be each located in the most advantageous relationship to the contact member; and the said construction makes it possible for the major portion of the necessary force for moving or holding the contact member to be transmitted directly to the contact member independently of the trip member and latch.

In accordance with the present invention there is provided a separate trip member as above mentioned, but the parts are so related that the trip member upon being released by the latch moves only a small distance and then entirely releases the actuator which moves independently to permit circuit-opening movement of the contact member. By this arrangement I avoid excessive movement of the trip member and also very greatly reduce the force transmitted to the latch. Other advantages will appear from the detailed description hereinafter presented.

As concerns another phase of the invention, I do not necessarily limit myself to a circuit breaker of the type disclosed in the said Sachs patent. In accordance with this phase of the invention the mechanism of the circuit breaker is enclosed in a housing comprising two sections having the division plane between them parallel with the plane of movement of the contact member. The sections preferably constitute the sole guiding and supporting means for the movable parts of the circuit breaker, and the said sections are preferably duplicates of each other. Further advantages incident to the sectional housing will be pointed out in the detailed description.

In the accompanying drawings a suitable embodiment of the invention is shown, 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 handle being in the closed-circuit position.

Fig. 2 is a vertical sectional view taken along the line 2—2 of Fig. 3.

Fig. 3 is a side view of the circuit breaker with one section of the housing removed, the parts being in closed-circuit positions.

Fig. 4 is a bottom view of the circuit breaker partly in section along line 4—4 of Fig. 1.

Fig. 5 is a horizontal sectional view taken along the line 5—5 of Fig. 3 but showing both sections of the housing.

Fig. 6 is a horizontal sectional view taken along the line 6—6 of Fig. 3 but showing both sections of the housing.

Fig. 7 is a view similar to Fig. 3 but showing the parts in open-circuit positions. In this view the mechanism is shown partly in section along a line corresponding to the line 7—7 of Fig. 5.

Figs. 8, 9 and 10 are views similar to Fig. 7 but showing the parts in different relative positions.

In describing the circuit breaker as shown in the drawings, I will first describe the principal parts of the circuit breaker mechanism referring only briefly to the enclosing housing. Thereafter the housing will be described in greater detail. As shown, the housing is made in two sections and serves as the sole means for guiding and supporting the circuit breaker mechanism.

At least one stationary or rupture contact 1 is mounted within the housing near the rear thereof, this contact being carried by a resilient conductor 2. Preferably, and as shown, there is a second stationary or rupture contact 3 carried by a resilient conductor 4. The contacts 1 and 3 with their conducting supports are similar to each other and are spaced apart vertically. The contacts 1 and 3 are substantially stationary, that is, they are not movable to any substantial extent but only to the very limited extent permitted by the resiliency of the conductors 2 and 4. For

convenience the said contacts 1 and 3 will be herein designated as "rupture" contacts.

Mounted within the housing is a contact carrying member 5, which as illustrated comprises two insulating plates 5a, 5a spaced apart transversely. Although the invention is not necessarily so limited, the contact member 5 is shown as being rectilinearly movable forward and rearward.

Extending transversely between the insulating side plates 5a, 5a are two metallic strips or plates 6 and 7, these having lugs 6a, 6a and 7a, 7a at their ends which project through suitable holes in the plates 5a, 5a and are riveted over. Carried by the respective plates 6 and 7 between the side plates 5a, 5a are movable contacts 8 and 9 which are adapted to engage and disengage the respective stationary or rupture contacts 1 and 3.

The contact member 5 is biased for movement in the circuit-opening or contact disengaging direction, that is in the forward direction, and as shown such biasing is effected by means of springs 10, 10 connected with the side plates and positioned adjacent the outer sides thereof. The details of construction and mounting of these springs will be set forth in greater detail hereinafter.

An actuator 11 is provided which is connected with the contact member 5 so as to be movable relatively thereto and so as to be also bodily movable therewith. The actuator may be variously constructed, but it is shown as being of lever form and as being pivotally connected with the contact member by means of a transverse pivot pin 12 which extends through openings in the side plates 5a, 5a of the contact member. Shoulders of bushings serve to hold the actuator 11 in its normal central position. A coil spring 13 surrounds one of the shoulders or bushings on the pin 12, and this spring engages the actuator and one of the side plates and serves to bias the actuator for movement in the clockwise direction. As hereinafter explained in detail the actuator 11 is normally held against movement with respect to the contact member.

A suitable operating means is provided, this means preferably comprising two links or members 14 and 15 pivotally connected with each other at 16. The link or member 14 is formed to also constitute a handle and it is pivotally mounted on the housing for movement about a transverse axis at 17. A portion 14a of the handle member 14 projects forward and is exposed so as to be conveniently accessible for manual operation. The link 15 comprises two separate elements 15a, 15a spaced apart transversely, and separately connected with plates 18, 18 secured to the member 14.

The two elements 15a, 15a of the link 15 are pivotally connected at 19 with the actuator 11. With the parts in the position shown in Fig. 3 the two members or links 14 and 15 constitute an overset toggle which holds the contact member in its contact engaging or circuit-closing position. Movement of the links 14 and 15 beyond the position shown in Fig. 3 is prevented by the engagement of the handle portion 14a with a shoulder on the housing.

Movably connected with the contact member 5 is trip member 20, this being mounted upon a transverse pivot pin 21 extending between the side walls 5a, 5a of the contact member. The trip member is held in central position by suitable shoulders or bushings on the pin 21. Normally the trip member is held in fixed relationship with the contact member and to this end the trip member and the contact member are normally connected by means of an electro-responsive latch which is preferably carried by the contact member and which releasably engages the trip member.

As concerns the present invention I do not narrowly limit myself as to the exact character of the electro-responsive latch but I prefer and have shown a latch which consists of a bi-metallic thermally responsive strip 22. This strip carries a transverse latch bar 22a which normally engages with the trip member 20. The trip member is preferably normally positioned parallel with the side plates 5a, 5a and transversely to the direction of movement of the contact member. The latch 22 is between the side plates and is preferably approximately perpendicular to the trip member, extending approximately in the direction of movement of the contact member.

Preferably, but not necessarily, the latch 22 is electrically connected to form a part of the circuit and to be directly heated by the current. For supporting the latch 22 and for providing electrical connection therewith, the transverse plate 6 is formed with an integral extension 6b which is offset rearward and which extends downward between the side plates 5a, 5a. At its lower end the extension 6b has transverse lugs 6c which extend through holes in the side plates 5a, 5a to assist in holding the extension 6b in place. The bi-metallic latch 22 has an angularly bent portion 22b which is riveted to the extension 6b. This serves not only to mechanically support the latch but also to electrically connect it with the contact 8. The other end of the bi-metallic latch 22 is electrically connected with the transverse plate 7 and with the other movable contact 9 by means of a flexible conductor 23. As shown in Fig. 5 the conductor 23 is doubled to provide increased conducting capacity. Thus with the parts in closed-circuit positions an electrical connection is established from the contacts 1 and 8 through the conductor 6b, the latch 22 and the conductor 23 to the contacts 9 and 3.

In order that the bi-metallic latch 22 may be readily adjusted there may be provided an arm 24 rigidly secured to the latch near the rear thereof and projecting upward. A screw 25 extends forward through a suitable hole in the conductor 6b and has threaded engagement with a corresponding hole in the arm 24. It will be observed that by turning the screw 25 the latch 22 may be bent or deflected in the clockwise direction in order to change its operating characteristics.

Preferably there is provided a U-shaped insulating plate 26 which extends transversely between the main insulating plates 5a, 5a, the main body of the plate 26 being immediately behind the conductor 6b and secured thereto by rivets. The plate 26 has a suitable hole therein to permit access to the screw 25. The end portions 26a, 26a of the plate 26 extend forward, being positioned respectively below and above the contacts 1, 8 and 3, 9. Adjacent these said end portions are other insulating plates 27, 27, each provided with lugs 27a, 27a which project through openings in the main side plates 5a, 5a.

The actuator 11 is suitably connected with the trip member 20 so as to be held in fixed relationship with the contact member so long as the latch 22 holds the trip member in fixed relationship.

The connection is such that, when the latch releases the trip member, the actuator is then free to move relatively to the contact member entirely independently of the trip member. As shown the trip member is provided with a shoulder 20ª which is normally engaged by an extension arm 11ª forming a part of the actuator 11. The trip member is further provided with a rearward extending arm 20ᵇ which is adapted under certain circumstances, as will be presently explained, to be engaged by the arm 11ª.

Preferably, to prevent any possible transverse movement of the actuator so as to bring the arm 11ª thereof out of cooperative relationship with the portions 20ª and 20ᵇ of the trip member, the link elements 15ª, 15ª are provided with extensions 15ᵇ, 15ᵇ which are positioned at the sides of the arm 11ª to hold it in position.

With the parts in closed-circuit positions, as shown in Fig. 3, the movable contacts are firmly pressed against the rupture contacts, which have been moved rearward to a slight extent from their free positions. The overset toggle 14, 15 prevents circuit-opening movement as a result of the bias of the springs 10, 10. The pressure exerted by said springs 10, 10 and the pressure exerted on the contacts 8 and 9 by the contacts 1 and 3, are transmitted through the link 15 and the operating member 14 and serve to normally hold the operating member in its closed-circuit position. Inasmuch as the centerline of the link 15 extending through the pivotal axes 16 and 19 is below the actuator axis 12, the force transmitted through the link 15 reacts to tend to move the actuator 11 in the counter-clockwise direction against the bias of the spring 13 thus holding the arm 11ª of the actuator against the shoulder 20ª of the trip member.

The toggle operating means 14, 15 can be manually released by moving the operating member 14 in the counter-clockwise direction sufficiently to break the toggle. Thereupon the parts move to the open-circuit position as shown in Fig. 7 under the influence of the springs 10, 10.

As already stated, the latch 22 is responsive to current in the circuit, being preferably connected electrically to form a part of the circuit. Upon the attainment of excess current conditions in the circuit the bi-metallic latch is heated by reason of the current therein, and it is deflected downward so that the latch bar 22ª is disengaged from the trip member 20. If the operating member is manually held in closed-circuit position, as shown in Fig. 8, the trip member will move forward to the position shown in the said figure as soon as released by the latch. This forward movement of the trip member occurs as the result of the pressure exerted by the arm 11ª against the shoulder 20ª. As soon as the trip member has moved sufficiently to disengage the shoulder 20ª from the arm 11ª, the actuator moves in the counter-clockwise direction, and at the same time the contact member moves in the forward direction, these movements being caused by the springs 10, 10 which overcome the spring 13. As the result of this movement the parts reach the relative positions shown in Fig. 9, the movable contacts being separated from the stationary contacts and the circuit being broken at two places.

With the contact member in its extreme forward position as shown in Fig. 9, the springs 10, 10 are no longer effective and the spring 13 tends to move the actuator 11 in the clockwise direction. However, so long as the handle is held in closed-circuit position such movement of the actuator is prevented by the link 15. With the parts in closed-circuit positions as shown in Fig. 3, the centerline of the link 15 extending through the pivotal axes 16 and 19, is below the pivotal axis 17 of the operating member. However, when the parts shift to the relative positions shown in Fig. 9 the said centerline of the link 15 is above the pivotal axis at 17. Therefore upon release of the handle or operating member the actuator 11 is moved in the clockwise direction by the spring 13 and at the same time the link 15 moves the operating member in the counter-clockwise direction to the open-circuit position.

When the actuator nears the end of its movement in the clockwise direction, the arm 11ª thereof engages the arm 20ᵇ on the trip member, as shown in Fig. 10, and moves the trip member in the counter-clockwise direction to restore it to latching relationship with the latch 22. This brings the shoulder 20ª on the trip member into engaging relationship with the arm 11ª of the actuator, as shown in Fig. 7, and all of the parts are in the proper relationship for effecting reclosing of the circuit breaker, assuming of course that the latch has cooled sufficiently to engage the trip member.

The operation has been described upon the assumption that the handle is first held and then released. It will, of course, be understood that such holding does not ordinarily occur and that the parts move automatically and in succession to the positions shown in Figs. 8, 10 and 7, without assuming the relationship shown in Fig. 9.

From the drawings and from the foregoing description it will be apparent that by providing for movement of the actuator entirely independently of the trip member, I avoid any large or extensive or excessive movement of the trip member, while nevertheless permitting the necessarily extensive movement of the actuator. It will further be apparent that a very large portion of the pressure, stress or force necessary to move and hold the contact member is transmitted directly from the actuator to the contact member. The relationship of the parts is such that the force transmitted to the shoulder 20ª is only a small portion of the total force transmitted through the link 15; and the force transmitted from the trip member to the latch 22 is only a very small portion of the pressure exerted against the shoulder 20ª. By reason of this double reduction the force transmitted to the latch is very small, and it therefore follows that the latch is substantially free to deflect in accordance with temperature conditions without being unduly hampered or retarded by friction exerted upon it by the trip member.

In the foregoing description I have referred only briefly to the enclosing casing or housing, as this may be widely varied so far as the mechanism of the circuit breaker is concerned. However, in accordance with one phase of the invention I provide a housing which has important advantages, particularly when used with a circuit breaker of the type which has been described.

The housing which I prefer and which I have shown is of insulating material, and the said housing comprises two sections 28, 28 which enclose all of the essential circuit breaker parts and which serve as the sole supporting and guiding means for these parts. While I do not necessarily so limit myself, the two circuit breaker sections are preferably duplicates of each other thus reducing the cost of manufacture and providing other important advantages. These two

sections are assembled in relatively reversed positions but their construction is or may be identical in all respects. The housing sections are connected with each other by means of screws at 29, 29 and 30, 30; and they may be mounted on a rear supporting wall by means of screws inserted in the holes 31, 31. The housings are narrow and have flat side faces so that a plurality of them may be arranged in closely banked relationship.

Each of the housing sections 28 is provided with a main central recess 32 which is rectangular, the said recesses in the two sections registering with each other to form a chamber which is substantially closed at all sides and which receives and encloses most of the mechanism of the circuit breaker. The recesses 32, 32 are of such length that the ends thereof have direct guiding engagement with the ends of the side plates 5^a, 5^a of the contact member; and the recesses are of such width that the sides thereof have direct guiding engagement with the sides of the said plates 5^a, 5^a. The sides of the recess preferably have suitable clearance grooves 32^a, 32^a and 32^b therein as clearly shown in Fig. 2. The grooves 32^a, 32^a provide clearance for the ends of the pivot pin 21 and for the lugs 6^a, 7^a and 27^a; and the groove 32^b provides clearance for the ends of the pivot pin 12 and for the lugs 6^c, 6^c. The front walls of the recesses serve as stops to limit forward movement of the contact member.

The handle member 14 is provided with a pivot pin or trunnion at 17, the ends of the trunnion being seated directly in suitable holes formed in the side walls of the housing sections 28, 28. The housing sections are provided at the front with arcuate notches 33, 33 which register with each other to provide a slot through which the handle portion 14^a of the operating member 14 projects. As already stated, the housing sections constitute the sole guiding and supporting means for the movable parts of the circuit breaker. By this I mean that the said movable parts are supported and held in proper relationship by reason of their direct engagement with the housing parts, there being no additional or separate frame structure having this function. When the housing sections are separated the movable parts of the circuit breaker are freely separable therefrom and when so separated they are no longer held in their normal operative relationship; that is with the movable parts of the circuit breaker removed from the housing, the handle member 14 has no fixed relationship to the contact member 5 and can be freely moved in any direction within the limits permitted by the connecting link 15.

The springs 10, 10 which have already been referred to are preferably flat zigzag springs which are positioned in the shallow grooves 32^b, 32^b already referred to. These springs are provided at their upper ends with hooks 10^a, 10^a which engage annular grooves in the trunnion 17 for the operating member.

In addition to the screws 29, 29 and 30, 30 for connecting the housing sections, I preferably provide two metallic transverse connecting elements located respectively near the top and bottom of the housing. These two transverse connecting elements may be formed integrally with the before mentioned conductors 2 and 4 and they are so shown, being designated as 2^a and 4^a. The transverse member 2^a is connected with the housing sections by means of screws 34, 34 and the transverse member 4^a is connected with the housing sections by means of screws 35, 35. Carried by the transverse connecting elements 2^a and 4^a are suitable wire connectors or terminals 36 and 37.

Formed in the inner faces of the two housing sections are registering grooves forming at least one arcing vent adjacent each arcing zone. Preferably a plurality of such vents are provided adjacent each arcing zone, these being indicated at 38, 38 and 39, 39. These vents communicate with the exterior of the housing and preferably such communication is effected through other registering grooves 40 and 41 which form tortuous passageways. By referring particularly to Fig. 9 it will be observed that any gases formed from arcs resulting from separation of the contacts are entirely enclosed within the chamber 32 and can escape only through the vents 38, 38 and 39, 39 and through the passageways 40 and 41. In so escaping the gases are passed over the surface walls of the vents and passageways and are thus cooled so that no flame can pass to the exterior. It will also be observed that the insulating plates 26 and 27, 27 prevent the arc formed gases from passing inward to any considerable extent, thus protecting the latch and the movable parts of the mechanism from the action of such gases.

In order to prevent the gases from escaping through the openings which are necessarily provided for the resilient contact supports 2 and 4, movable insulating shields 42 and 43 are provided. These shields have holes therein through which the supports 2 and 4 extend and which they closely fit. The shields are seated in shallow grooves 44 and 45 in the top and bottom walls of the recesses 32. Preferably, as shown in Fig. 5, the grooves 44 and 45 are extended transversely into the side walls of the housing sections and the shields extend into these extensions. Thus the shields are accurately guided for forward and rearward movement in accordance with the forward and rearward movement of the contact supports.

What I claim is:

1. An automatic circuit breaker comprising in combination, a rupture contact, a movable contact member biased in the circuit-opening direction and including an electric contact engageable with the rupture contact, an actuator connected with the contact member for movement bodily therewith and also for movement relative thereto, operating means engaging the actuator to control it, a separate trip member movable relatively to the contact member, an electro-responsively controlled latch normally connecting the contact member and trip member to maintain them in fixed relationship, the said latch serving upon the attainment of abnormal current conditions in the circuit to release the trip member for independent movement, and means normally enabling the trip member to hold the actuator in fixed relationship with the contact member and serving upon release of the trip member to release the actuator and permit it to move independently of the trip member thus enabling the contact member to move automatically in the circuit-opening direction.

2. An automatic circuit breaker comprising in combination, a rupture contact, a movable contact member biased in the circuit-opening direction and including an electric contact engageable with the rupture contact, an actuator connected with the contact member for movement bodily

therewith and also for movement relative thereto, operating means engaging the actuator to control it, a separate trip member movable relatively to the contact member, an electro-responsively controlled latch normally connecting the contact member and trip member to maintain them in fixed relationship, the said latch serving upon the attainment of abnormal current conditions in the circuit to release the trip member for independent movement, means normally enabling the trip member to hold the actuator in fixed relationship with the contact member and serving upon release of the trip member to release the actuator and permit it to move independently of the trip member, and toggle links connected with the actuator to control it and adapted when in overset relationship to normally hold the actuator and contact member in closed-circuit positions, the said links being normally held in their said overset relationship by pressure transmitted from the contact member and being biased for movement to their open-circuit relationship when such pressure is reduced by reason of the relative movement of the actuator upon being released from the trip member.

3. An automatic circuit breaker comprising in combination, two rupture contacts spaced apart, a movable contact member biased in the circuit-opening direction and including two electric contacts engageable with the respective rupture contacts, an actuator connected with the contact member for movement bodily therewith and also for movement relative thereto, operating means engaging the actuator to control it, a separate trip member movable relatively to the contact member, a bodily movable bi-metallic latch electrically connected between the movable contacts and normally mechanically connecting the contact member and the trip member to maintain them in fixed relationship, the said latch serving upon the attainment of abnormal current conditions therein to automatically deflect so as to release the trip member for independent movement, and means normally enabling the trip member to hold the actuator in fixed relationship with the contact member and serving upon release of the trip member to release the actuator and permit it to move independently of the trip member thus enabling the contact member to move automatically in the circuit-opening direction.

4. An automatic circuit breaker comprising in combination, a rupture contact, a movable contact member biased in the circuit-opening direction and including an electric contact engageable with the rupture contact, an actuator connected with the contact member for movement bodily therewith and also for movement relative thereto, operating means engaging the actuator to control it, an electro-responsively controlled latch bodily movable with the contact member and movable relatively thereto upon the attainment of abnormal current conditions in the circuit, and a trip member movable relatively to the contact member and normally directly engaging the actuator to prevent relative movement thereof, the said trip member being normally engaged and held by the latch and being released upon electro-responsive movement thereof so as to disengage the actuator to permit movement thereof independently of the trip member and to thus enable the contact member to move automatically in the circuit-opening direction.

5. An automatic circuit breaker comprising in combination, a rupture contact, a movable contact member biased in the circuit-opening direction and including an electric contact engageable with the rupture contact, an actuator connected with the contact member for movement bodily therewith and also for movement relative thereto, operating means engaging the actuator to control it, an electro-responsively controlled latch bodily movable with the contact member and movable relatively thereto upon the attainment of abnormal current conditions in the circuit, and a trip member movable relatively to the contact member and having a shoulder with which the actuator normally directly engages to prevent relative movement of the latter, the said trip member being normally engaged and held by the latch and being released upon electro-responsive movement thereof so as to disengage its said shoulder from the actuator and permit the latter to move independently of the trip member and to thus enable the contact member to move automatically in the circuit-opening direction.

6. An automatic circuit breaker comprising in combination, a rupture contact, a rectilinearly movable contact member biased in the circuit-opening direction and including an electric contact engageable with the rupture contact, an actuator connected with the contact member for movement bodily therewith and also for relative pivotal movement about a transverse axis, operating means engaging the actuator to control it, a bi-metallic latch carried by the contact member and extending approximately in the direction of movement thereof, the said latch being adapted to automatically deflect upon the attainment of abnormal current conditions in the circuit, and a trip member connected with contact member for relative pivotal movement about a transverse axis and having a shoulder with which the actuator normally directly engages to prevent relative movement of the latter, the said trip member being normally approximately perpendicular to the latch and being normally engaged and held thereby and being released upon automatic deflection of the latch so as to disengage its said shoulder from the actuator and permit the latter to move independently of the trip member and to thus enable the contact member to move automatically in the circuit-opening direction.

7. The combination in an automatic circuit breaker, of a rupture contact, a movable contact member biased in the circuit-opening direction and including an electric contact engageable with the rupture contact, an actuator connected with the contact member for movement bodily therewith and also for movement relative thereto, operating means engaging the actuator to control it, an electro-responsively controlled latch bodily movable with the contact member and movable relatively thereto upon the attainment of abnormal current conditions in the circuit, a trip member movable relatively to the contact member and normally directly engaging the actuator to prevent relative movement thereof, the said trip member being normally engaged and held by the latch and being released upon electro-responsive movement thereof so as to release the actuator to permit movement thereof independently of the trip member and to thus enable the contact member to move automatically in the circuit-opening direction, and means engageable with the trip member to restore it to latching relationship with the latch when

the actuator and the contact member are moved to their open-circuit positions.

8. The combination in an automatic circuit breaker, of a rupture contact, a movable contact member biased in the circuit-opening direction and including an electric contact engageable with the rupture contact, an actuator connected with the contact member for movement bodily therewith and also for movement relative thereto, operating means engaging the actuator to control it, an electro-responsively controlled latch bodily movable with the contact member and movable relatively thereto upon the attainment of abnormal current conditions in the circuit, a trip member movable relatively to the contact member and normally directly engaging the actuator to prevent relative movement thereof, the said trip member being normally engaged and held by the latch and being released upon electro-responsive movement thereof so as to release the actuator to permit movement thereof independently of the trip member and to thus enable the contact member to move automatically in the circuit-opening direction, and interengageable means carried directly by the trip member and the actuator and serving to restore the trip member to latching relationship with the latch when the actuator and the contact member are moved to their open-circuit positions.

9. The combination in an automatic circuit breaker, of a rupture contact, a movable contact member biased in the circuit-opening direction and including an electric contact engageable with the rupture contact, an actuator connected with the contact member for movement bodily therewith and also for movement relative thereto, an electro-responsively controlled latch bodily movable with the contact member and movable relatively thereto upon the attainment of abnormal current conditions in the circuit, a trip member movable relatively to the contact member and having a shoulder with which the actuator normally directly engages to prevent relative movement of the latter, the said trip member being normally engaged and held by the latch and being released upon electro-responsive movement thereof so as to disengage its said shoulder from the actuator and permit the latter to move independently of the trip member and to thus enable the contact member to move automatically in the circuit-opening direction, toggle links connected with the actuator to control it and adapted when in overset relationship to normally hold the actuator and contact member in closed-circuit positions, the said links being normally held in their said overset relationship by pressure transmitted from the contact member and the said links and actuator being biased for movement to their open-circuit relationship when such pressure is reduced by reason of the relative movement of the actuator upon being released from the trip member, and means engageable with the trip member to restore it to latching relationship with the latch when the links and the actuator and the contact member are moved to their open-circuit positions.

10. In an automatic circuit breaker, the combination of two rupture contacts, a rectilinearly movable contact member including two transversely spaced insulating side plates and also including two separate electric contacts carried by the side plates and engageable with the respective rupture contacts, a manually movable operating member, mechanism operatively connecting the operating member with the contact member and including an element adapted to release the contact member from the control of the operating member upon the attainment of abnormal current conditions in the circuit, and two tension springs connected with the side plates at the outer sides thereof for biasing the contact member in the circuit-opening direction.

11. In an automatic circuit breaker, the combination of two rupture contacts, a rectilinearly movable contact member including two transversely spaced insulating side plates and also including two separate electric contacts carried by the side plates and engageable with the respective rupture contacts, a manually movable operating member, mechanism operatively connecting the operating member with the contact member and including an element adapted to release the contact member from the control of the operating member upon the attainment of abnormal current conditions in the circuit, and two substantially flat zigzag tension springs closely adjacent the outer surfaces of the side plates and connected with the said plates for biasing the contact member in the circuit-opening direction.

12. The combination in an automatic circuit breaker, of a rupture contact, a movable contact member provided with a contact engageable with the rupture contact, a manually movable operating member, mechanism operatively connecting the operating member with the contact member and including an element adapted to release the contact member from the control of the operating member upon the attainment of abnormal current conditions in the circuit, and a two-section insulating housing enclosing all of the aforesaid parts other than the manually engageable portion of the operating member and having the division plane between the two sections parallel with the direction of movement of the contact member, the said housing sections serving as the sole supporting and guiding means for the aforesaid parts and being free from positive connection with any substantially movable parts so that when the sections are assembled the said parts are guided and held between them and so that when the sections are separated the said parts are freely separable therefrom.

13. The combination in an automatic circuit breaker, of a rupture contact, a rectilinearly movable contact member provided with a contact engageable with the rupture contact, a manually movable pivoted operating member, mechanism operatively connecting the operating member with the contact member and including an element adapted to release the contact member from the control of the operating member upon the attainment of abnormal current conditions in the circuit, and a two-section insulating housing enclosing all of the aforesaid parts other than the manually engageable portion of the operating member and having the division plane between the two sections parallel with the direction of movement of the contact member, the said housing sections serving as the sole means for rectilinearly guiding the contact member and for pivotally supporting the operating member and the said housing sections being free from positive connection with any substantially movable parts so that when the sections are assembled the said parts are guided and held between them and so that when the sections are separated the said parts are freely separable therefrom.

14. In an automatic circuit breaker, the combination of two rupture contacts spaced apart

near the rear, a contact member rectilinearly movable forward and rearward and provided with two contacts engageable with the respective rupture contacts, a manually movable pivoted operating member at the front, mechanism operatively connecting the operating member with the contact member and including an element adapted to release the contact member from the control of the operating member upon the attainment of abnormal current conditions in the circuit, and an insulating housing enclosing all of the aforesaid parts other than the manually engageable portion of the operating member and comprising two duplicate sections having the division plane between them parallel with the direction of movement of the contact member, the said housing sections serving as the sole supporting and guiding means for the aforesaid parts and being free from positive connection with any substantially movable parts so that when the sections are assembled the said parts are held and guided between them and so that when the sections are separated the said parts are freely separable therefrom.

15. In an automatic circuit breaker, the combination of two rupture contacts spaced apart near the rear, a contact member rectilinearly movable forward and rearward and provided with two contacts engageable with the respective rupture contacts, a manually movable pivoted operating member at the front, mechanism operatively connecting the operating member with the contact member and including an element adapted to release the contact member from the control of the operating member upon the attainment of abnormal current conditions in the circuit, and an insulating housing enclosing all of the aforesaid parts other than the manually engageable portion of the operating member and comprising two duplicate sections having the division plane between them parallel with the direction of movement of the contact member, the said housing sections serving as the sole means for rectilinearly guiding the contact member and for pivotally supporting the operating member and the said sections being free from positive connection with any substantially movable parts so that when the sections are assembled the said parts are held and guided between them and so that when the sections are separated the said parts are freely separable therefrom.

16. In an automatic circuit breaker, the combination of two rupture contacts spaced apart near the rear, a contact member rectilinearly movable forward and rearward and comprising two flat insulating plates spaced apart transversely and carrying two contacts engageable with the respective rupture contacts, a manually movable pivoted operating member at the front, mechanism operatively connecting the operating member with the contact member and including an element adapted to release the contact member from the control of the operating member upon the attainment of abnormal current conditions in the circuit, and an insulating housing enclosing all of the aforesaid parts other than the manually engageable portion of the operating member and comprising two duplicate sections having the division plane between them parallel with the said plates of the contact member, the said housing sections serving as the sole means for rectilinearly guiding the contact member and for pivotally supporting the operating member and the said sections being free from positive connection with any substantially movable parts so that when the sections are assembled the said parts are held and guided between them and so that when the sections are separated the said parts are freely separable therefrom.

17. In an automatic circuit breaker, the combination of two rupture contacts spaced apart near the rear, a contact member rectilinearly movable forward and rearward and provided with two contacts engageable with the respective rupture contacts, a manually movable pivoted operating member at the front, mechanism operatively connecting the operating member with the contact member and including an element adapted to release the contact member from the control of the operating member upon the attainment of abnormal current conditions in the circuit, and an insulating housing enclosing all of the aforesaid parts other than the manually engageable portion of the operating member and comprising two duplicate sections having the division plane between them parallel with the direction of movement of the contact member, the two housing sections having registering grooves therein adjacent the rupture contacts and constituting arcing vents communicating with the exterior of the housing.

18. In an automatic circuit breaker, the combination of two rupture contacts spaced apart near the rear, a contact member rectilinearly movable forward and rearward and provided with two contacts engageable with the respective rupture contacts, a manually movable pivoted operating member at the front, mechanism operatively connecting the operating member with the contact member and including an element adapted to release the contact member from the control of the operating member upon the attainment of abnormal current conditions in the circuit, and an insulating housing enclosing all of the aforesaid parts other than the manually engageable portion of the operating member and comprising two duplicate sections having the division plane between them parallel with the direction of movement of the contact member, the two housing sections having therein at each end a plurality of registering grooves forming arcing vents adjacent the corresponding contacts and also having at each end other registering grooves communicating with the said vents and forming tortuous passageways communicating with the exterior of the housing.

19. The combination in an automatic circuit breaker, of two rupture contacts spaced apart, near the rear, a rectilinearly movable contact member provided with a contact engageable with the rupture contact, a manually movable operating member, mechanism operatively connecting the operating member with the contact member and including an element adapted to release the contact member from the control of the operating member upon the attainment of abnormal current conditions in the circuit, a two-section insulating housing enclosing all of the aforesaid parts other than the manually engageable portion of the operating member and having the division plane between the two sections parallel with the direction of movement of the contact member, and two metallic elements carrying the respective rupture contacts and each having its end portions connected to the respective housing sections.

20. The combination in an automatic circuit breaker, of two stationary rupture contacts spaced

apart near the rear, a rectilinearly movable contact member provided with a contact engageable with the rupture contact, a manually movable operating member, mechanism operatively connecting the operating member with the contact member and including an element adapted to release the contact member from the control of the operating member upon the attainment of abnormal current conditions in the circuit, a two-section insulating housing enclosing all of the aforesaid parts other than the manually engageable portion of the operating member and having the division plane between the two sections parallel with the direction of movement of the contact member, the said housing sections serving as the sole means for rectilinearly guiding the contact member and for pivotally supporting the operating member and the said sections being free from positive connection with any movable parts so that when the sections are assembled the said parts are guided and held between them and so that when the sections are separated the said parts are freely separable therefrom, and two metallic elements carrying the respective rupture contacts and each having its end portions connected to the respective housing sections.

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