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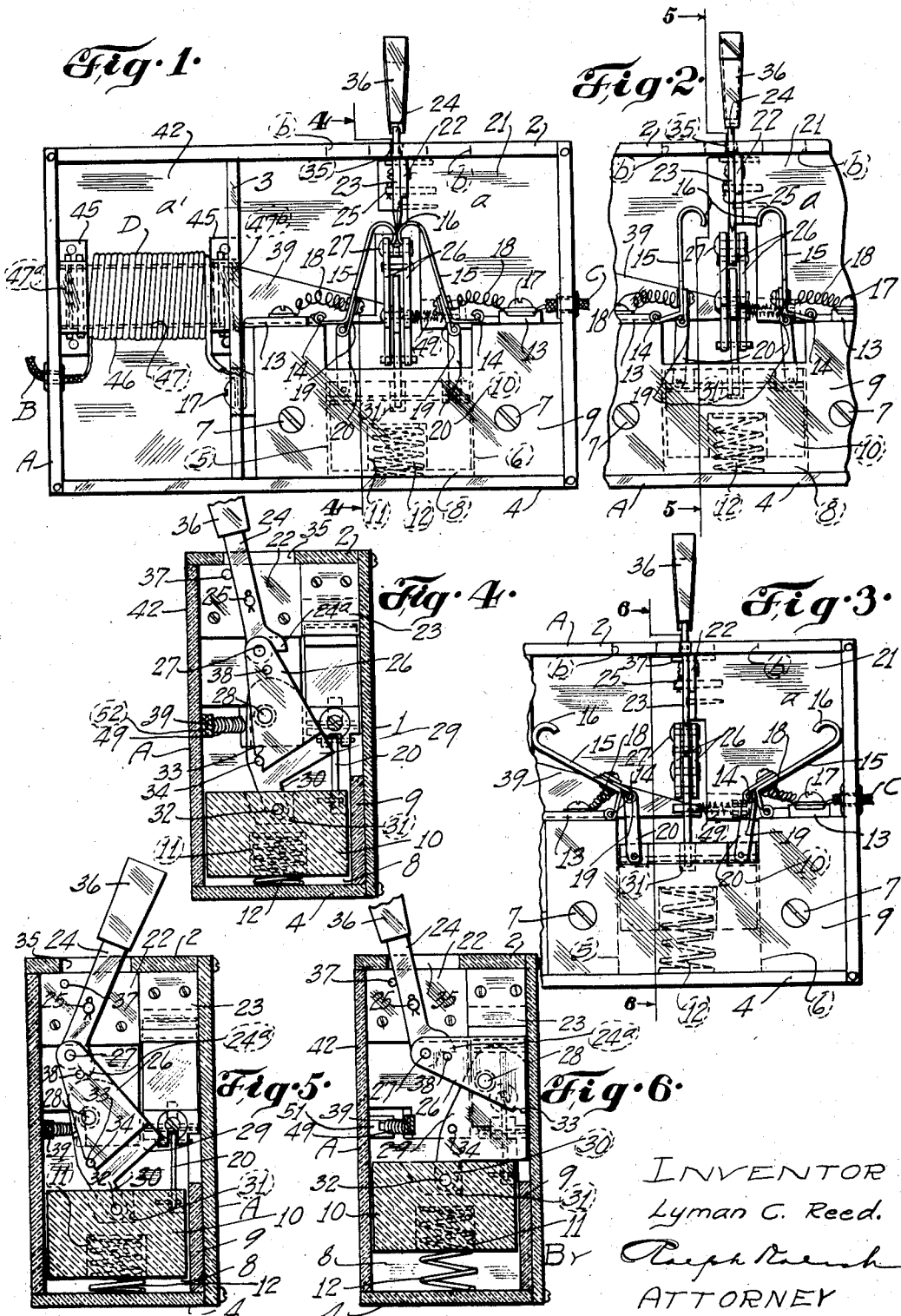
L. C. REED

1,834,550

CIRCUIT BREAKER

Filed Nov. 15, 1928

4 Sheets-Sheet 1



INVENTOR

Lyman C. Reed.

By *Reaper Reed*
ATTORNEY

Dec. 1, 1931.

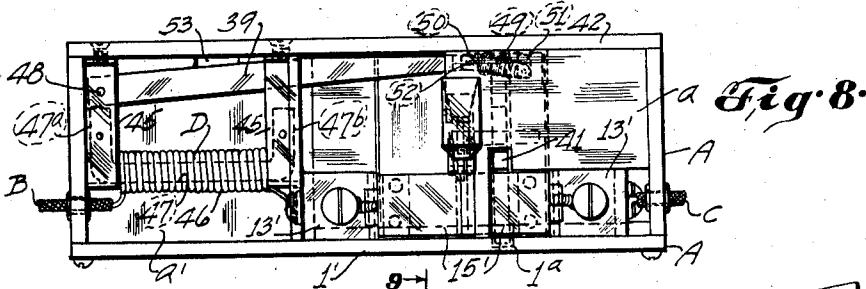
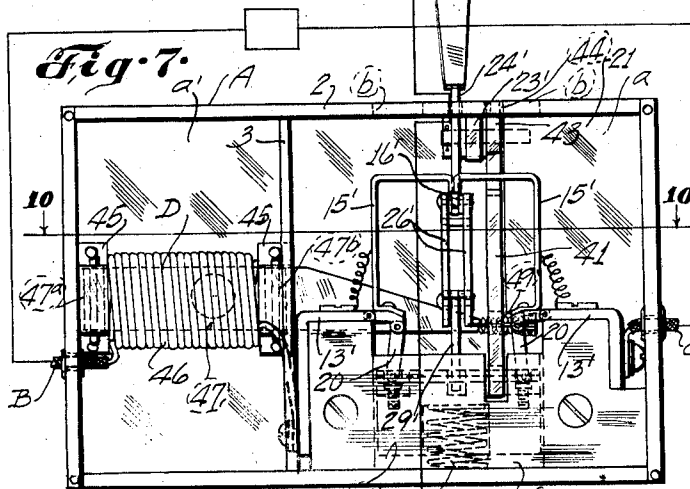
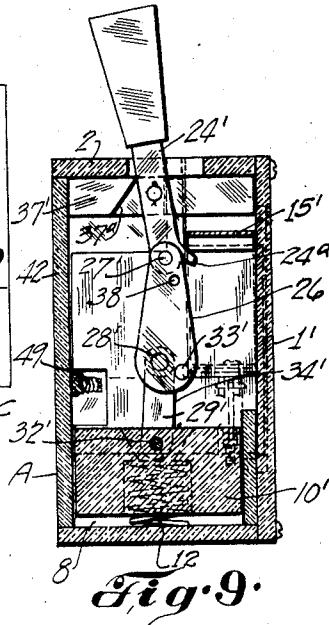
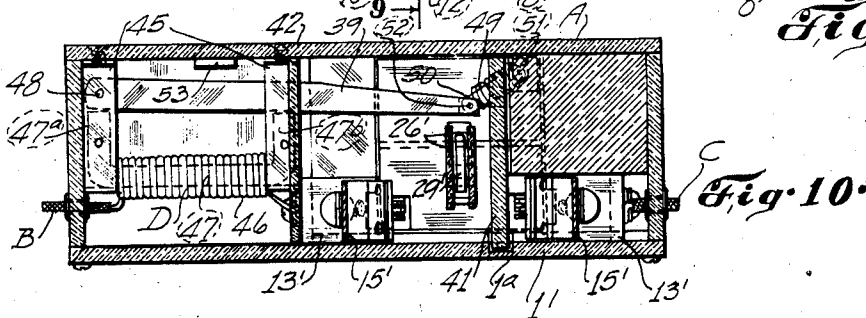
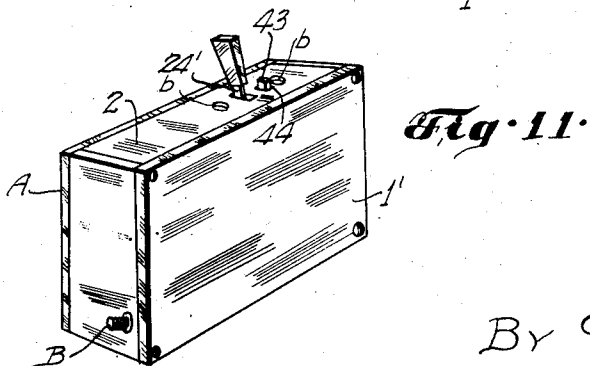
L. C. REED

1,834,550

CIRCUIT BREAKER

Filed Nov. 15, 1928

4 Sheets-Sheet 2



INVENTOR
Lyman C. Reed.

By *Ralph Reisch*
ATTORNEY

Dec. 1, 1931.

L. C. REED

1,834,550

CIRCUIT BREAKER

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4 Sheets-Sheet 3

Fig. 13.

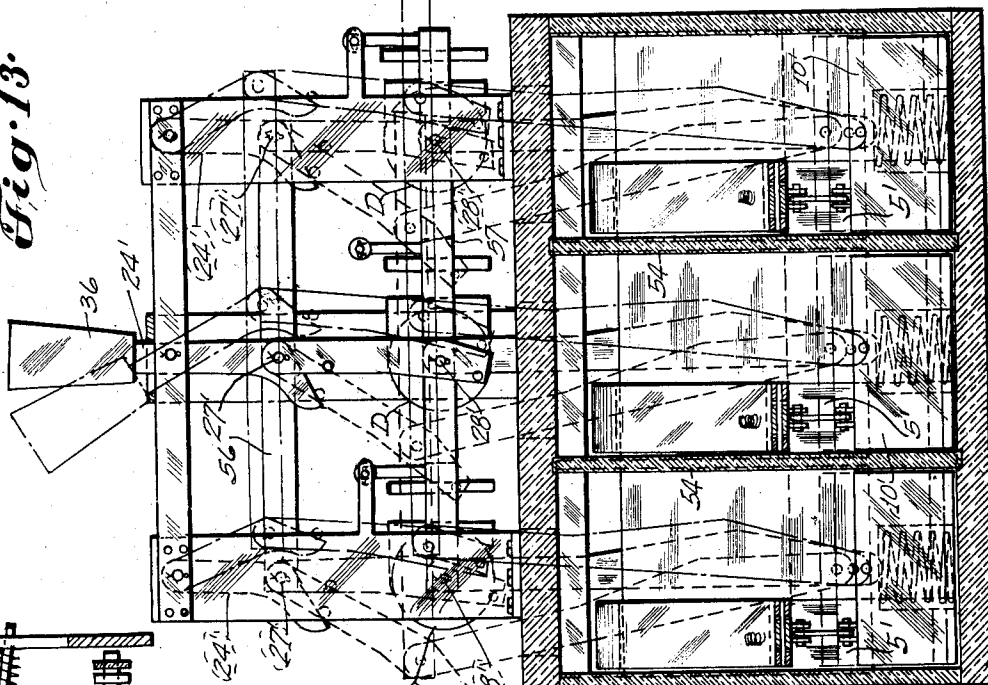


Fig. 14.

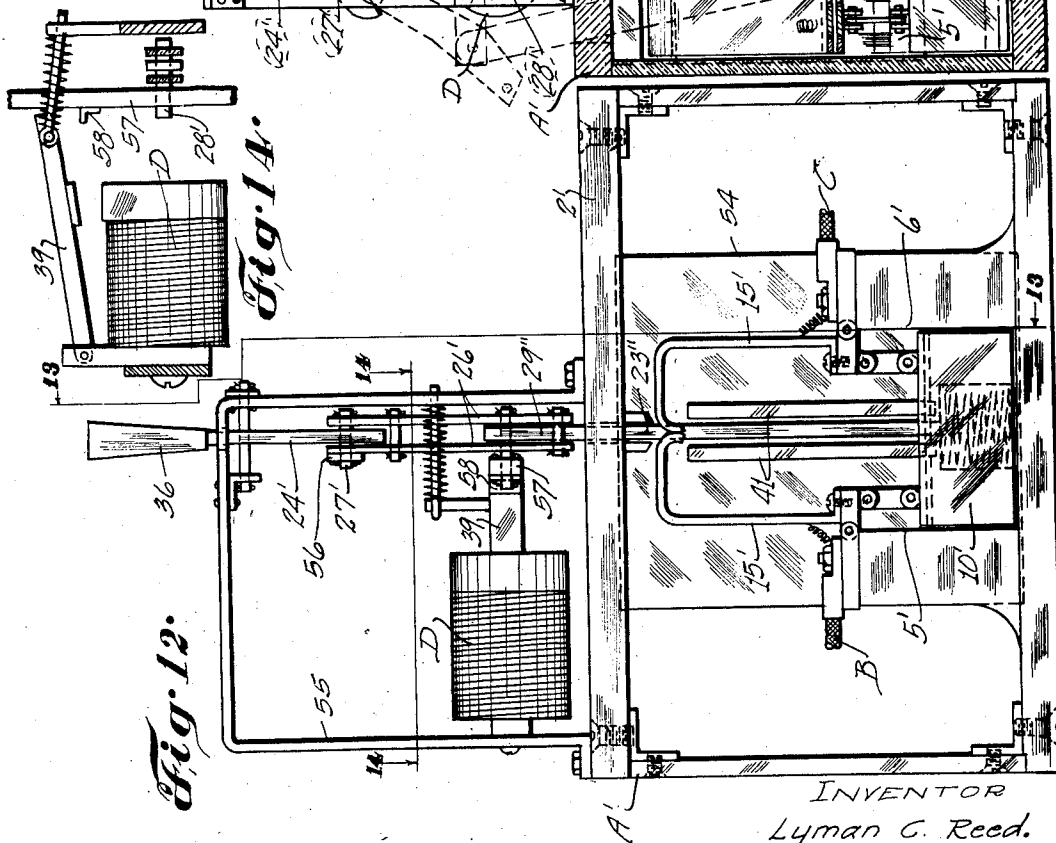
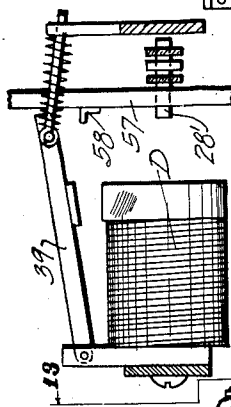


Fig. 12.



INVENTOR
Lyman C. Reed.
By *Ralph Reed*
ATTORNEY

Dec. 1, 1931.

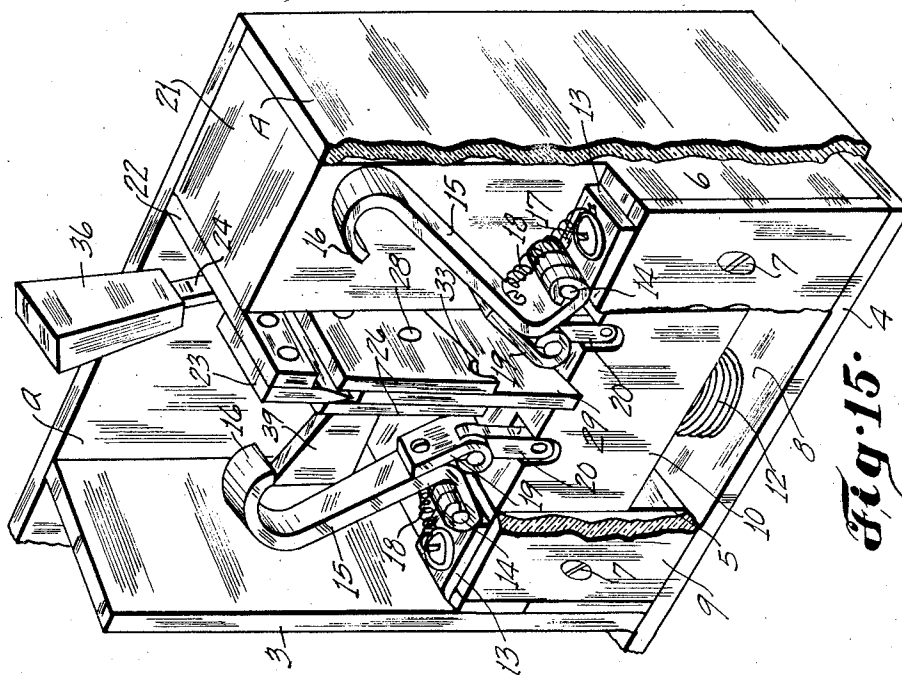
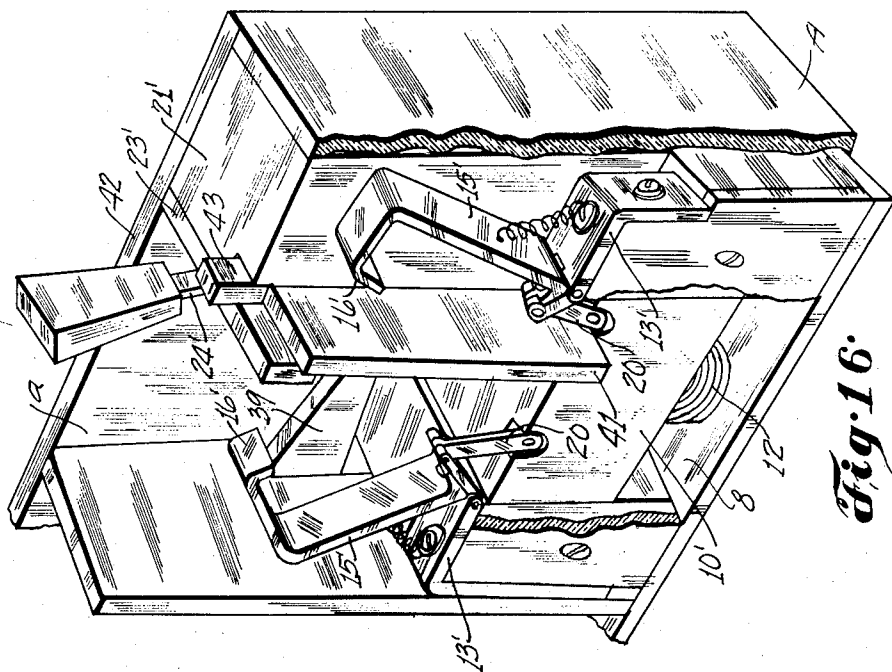
L. C. REED

1,834,550

CIRCUIT BREAKER

Filed Nov. 15, 1928

4 Sheets-Sheet 4



INVENTOR

Lyman C. Reed.

By

Ralph K. Kish
ATTORNEY

UNITED STATES PATENT OFFICE

LYMAN C. REED, OF NEW ORLEANS, LOUISIANA

CIRCUIT-BREAKER

Application filed November 15, 1928. Serial No. 319,480.

This invention relates generally to electrical devices and, more particularly, to certain new and useful improvements in electrical devices of the type commonly known as circuit-breakers.

My invention has for an object the provision in a circuit-breaker of co-operable contact-members which are simultaneously movable in opposite directions the one with respect to the other for effecting rapid separation thereof to open or break the circuit.

My invention has for another object the provision in a circuit-breaker of means for mechanically suppressing or breaking an arc that may occur between the contact-members on separation thereof.

My invention has for still another object the provision in a circuit-breaker of means for effecting dispersion or dissipation of, and thereby preventing the growing of a short circuit by, the hot gases of an arc occurring on separation of the contact-members.

My invention has for a further object the provision in a circuit-breaker of co-operable contact-members and means for isolating the same the one from the other on separation thereof on opening the circuit on an abnormal condition occurring therein.

My invention has for a still further object the provision in a circuit-breaker of co-operable contact-members and means for automatically effecting separation of the contact-members for opening the circuit on an abnormal condition occurring therein.

My invention has for a still further object the provision in a circuit-breaker of co-operable contact-members that may be manually manipulated to close and open the circuit under normal conditions and which are automatically actuatable to open the circuit under an abnormal condition.

My invention has for an additional object the improvement generally of electrical devices of the type stated.

And with the above and other objects in view, my invention resides in the novel features of form, construction, arrangement, and combination of parts hereinafter described and pointed out in the claims.

In the accompanying drawings (4 sheets)—

Figure 1 is a front elevational view of a circuit-breaker embodying my invention, the front wall of the housing being removed and the engageable-ends of the contact-members being in circuit-closing engagement;

Figure 2 is a fragmentary view of the circuit-breaker of Figure 1, the engageable-ends of the contact-members being in spaced circuit-opening position as when the circuit-breaker is manually actuated;

Figure 3 is also a fragmentary view of the circuit-breaker of Figure 1, the engageable-ends of the contact-members being in more widely spaced circuit-opening position as when the circuit-breaker is automatically actuated or tripped on an overload;

Figure 4 is a vertical sectional view taken approximately on the line 4—4, Figure 1, showing the toggle-means for actuating the contact-members in set or fully extended position as when the circuit is closed as in Figure 1;

Figure 5 is a similar view taken approximately on the line 5—5, Figure 2, showing the contact-members actuating toggle-means in flexed or partly extended position as when the circuit is manually opened as in Figure 2;

Figure 6 is also a similar view taken approximately on the line 6—6, Figure 3, showing the contact-members actuating toggle-means in fully folded position as when the circuit is automatically opened on an overload as in Figure 3;

Figure 7 is a front elevational view of a slightly modified form of circuit-breaker embodying my invention, the front wall of the housing being removed and the engageable-ends of the contact-members being in circuit-closing position;

Figure 8 is a plan view of the circuit-breaker of Figure 7, showing details of the trigger mechanism for automatically effecting actuation of the contact-members to open the circuit as on an overload;

Figure 9 is a vertical sectional view taken approximately on the line 9—9, Figure 7, showing the toggle-means for actuating the

contact-members in set or fully extended position as when the circuit is closed;

Figure 10 is a transverse sectional view taken approximately on the line 10—10, Figure 7, showing the trigger-mechanism as when moved to impinge or engage the contact-members actuating toggle-means to automatically open the circuit;

Figure 11 is a perspective view of the circuit-breaker of Figure 7, equipped with an indicator for visually signalling the position of the enclosed or housed contact-members;

Figure 12 is a plan view of another slightly modified form of circuit-breaker embodying my invention, adapted especially for protecting a three-phase high voltage circuit, the top wall of the housing being removed;

Figure 13 is a sectional view taken approximately on the line 13—13, Figure 12, showing a plurality of contact-member chambers in a single housing, each chamber enclosing a modified form of circuit-breaker of my invention and the several mechanisms being ganged or co-operatively associated and connected for simultaneous actuation, respective positions of the parts being indicated by full, dotted, and dot-and-dash lines;

Figure 14 is a detail sectional view taken approximately on the line 14—14, Figure 13, showing details of the trigger-mechanism for effecting automatically actuation of the contact-members to open the circuit as on an overload;

Figure 15 is an enlarged fragmentary perspective view of the circuit-breaker of Figures 1 to 6, inclusive, portions of the housing being broken away; and

Figure 16 is a similar view of the modified form of circuit-breaker of Figures 7 to 11, inclusive.

Referring now more in detail and by reference characters to the accompanying drawings, and first to the preferred form of my new circuit-breaker shown in Figures 1 to 6, inclusive, and Figure 15, the circuit-breaker includes a housing A of suitable contour and constructed preferably of any suitable insulation material, the front and top walls 1 and 2, respectively, thereof being preferably removable or detachable for facilitating assembly of parts.

Preferably, for purposes shortly appearing, the housing A is divided interiorly by a vertically disposed partition 3 to include adjoining chambers *a* and *a'*, and fixed within and upon the base 4 of chamber *a*, is a pair of spaced insulation blocks 5, 6, which are of suitable height and which preferably extend from front to rear of chamber *a*. Suitably, as by screws 7, fixed upon the front face of, and spanning the space between, the blocks 5, 6, for co-operation therewith in the formation of a plunger-well 8 in chamber *a*, is an insulation plate 9.

Disposed for reciprocatory movement in,

and guided in its reciprocations by the walls of, the well 8, is an insulation block or plunger 10, recessed upon its under face, as at 11, to seat an end portion of a suitable expansion-spring 12, whose other end portion is disposed upon the base wall 4, which spring functions to yieldingly urge the block 10 upwardly or outwardly in the well 8.

Disposed upon the blocks 5, 6, preferably adjacent the front wall 1 of the housing A, are conducting pieces or terminals 13, and suitably hinged or pivoted, as at 14—14, to the respective terminals 13, are preferably L- or hook-shaped contact-members 15, 15, presented upwardly in the chamber *a* and comprising flat strips of conducting material bent laterally at their respective upper or free ends to provide opposed engageable-ends 16. It may be here stated that the contact-members 15, 15, are simultaneously swingable in opposite directions to separate and space their ends 16 to open the circuit, as in Figures 2, 3, and 15, or to bring them together into engaging relation to close the circuit being protected, as in Figure 1, the circuit being indicated by the line and load wires B and C attached directly or indirectly to the respective terminals 13 by suitable binding-screws 17, which latter may also serve to secure the terminals 13 upon the respective blocks 5, 6. To obviate arcing at the hinge-joints 14 and insure line-connection with the contact-members 15, pigtails 18, 18, suitably also electrically connect the contact-members 15 with the respective terminals 13.

Fixed upon the inner face, and adjacent the hinge-joints 14, of the respective contact-members 15, are arms 19, and pivoted at their opposite ends to the arms 19 and to the block 10, are links 20, whereby the contact-members 15 are adapted for swingable actuation toward and away from each other as the plunger-block 10 is caused to respectively move downwardly and upwardly in its accommodating well 8, and it may be here stated that, when the engageable-ends 16 are in electrical circuit-closing engagement, the contact-members 15 incline towards each other, as shown in Figure 1; that, when the breaker is normally manually actuated to open the circuit, the contact-members 15 are disposed in approximately parallel relation, as shown in Figure 2; and that, when the breaker is automatically tripped to effect opening of the circuit as on an overload, the contact-members 15 fly apart and are then inclined away from each other, as shown in Figure 3.

Disposed in chamber *a* and upon the insulation block 6 to the rear of the one contact-member 15, is an insulation block 21, suitably fixed to and upon the inner face of which is an insulation bracket or arm 22, and depending from the forward end of the arm 22,

22 is an extension or wing 23, whose lower edge is preferably of acuminate formation and disposed adjacent the line of contact of the contact-ends 16 and whose forward and upper edges are adapted for engagement with the walls 1 and 2, respectively, of the housing A, all for purposes soon to appear.

I will now describe the means for actuating the plunger-block 10 to swingably shift the contact-members 15 to close or open the circuit. This mechanism is in the form of a toggle which includes a lever 24 pivoted intermediate its ends, as at 25, to and upon the inner face of the bracket 22, and a link-connection which, in turn, comprises a pair of insulation-members of arms 26 disposed in parallelism upon opposite sides, and conjointly pivoted at an end, as at 27, to the lower end, of lever 24, and having a portion disposed between and pivotally connected, as at 28, to the arms 26, is a second arm 29 provided with an extension 30, which fits in a recess 31 formed in the upper-face of, and which is pivotally connected, as at 32, to the block 10. Upon their rear edge and adjacent their lower end, the arms 26 are provided with a shoulder, recess, or the like, as at 33, whereby the arms 26 are adapted for engagement with a co-operating abutment or cross-pin 34 provided in the arm 29. Thus the co-operating abutments 33, 34, of the arms 26, 29, form what may be described as a rule-joint therebetween, limiting the rearward pivoted movement of said arms at the pivot 28, with the result that the arms 26, 29, are adapted to fold forwardly to effect opening or breaking of the circuit. I may here state that the lever 24 for convenient manual engagement projects at its upper end outwardly of the housing A through a slot, as at 35, provided for the purpose in the housing top wall 2, and is preferably equipped, as shown, with a gripping-handle or knob 36, the lever being limited in its swingable movement in one direction by engagement with a stop-pin 37 suitably provided upon the bracket 22; and formed on lever 24 is a laterally extending finger 24a adapted for co-operating engagement, for purposes soon to appear, with a stop-pin 38 fixed upon and extending between the toggle-arms 26.

When the toggle-mechanism is fully extended as in Figure 4, the lever 24 inclines rearwardly and engages the stop-pin 37, the block or plunger 10 is in its lowermost position closely adjacent the housing base-wall 4, the spring 12 compressed to its fullest extent, the engageable ends 16 of the contact-members 15 are firmly engaged with each other, as in Figure 1, and the protected circuit is closed. The spring 12 now yieldingly urges the block 10 upwardly against the toggle to cause the toggle-mechanism to fold or flex either rearwardly or forwardly. When so extended, it will be noted, particu-

larly by reference to Figure 4, that the hinge-joint 28 is slightly offset towards the rear of the linear direction of the pivot-points 27 and 32, and hence rearward folding or flexing of the toggle-mechanism at the hinge-joint 28 is prevented by the relative engagement of the abutments 33, 34, while forward folding or flexing thereof about the pivot 27 is prevented by the engagement of lever 24 with the stop-pin 37.

The circuit-breaker may now be manually actuated to open the circuit by swingably manipulating the lever 24 at its handle 36 forwardly, movement of the lever in such direction being limited as by engagement of its finger 24a with the second stop-pin 38. On such forward pivoted movement of lever 24, the pivot-point 27 thereof is shifted rearwardly and the linear distance between the pivot-points 25 and 32 thereby shortened, permitting the plunger 10 to move upwardly under the tension of its power-spring 12, whereby the contact-members 15 are swingably actuated away from each other to separate and space their ends 16 a sufficient distance to open the circuit, as shown in Figures 2 and 5.

On reverse pivoted actuation of lever 24, the toggle-mechanism is again fully extended, plunger 10 fully depressed, and the contact-members 15 swingably actuated toward each other, and their ends 16 thereby again brought into engaging electrical relation to close the circuit. Thus the circuit-breaker may as a switch be manually actuated with ease and convenience under normal load conditions, when any occurring arcing is not excessive and a relatively slight gap between the ends 16 will suffice to efficiently interrupt the flow of current, to open and close the circuit.

Further, however, to automatically open and thereby protect the circuit as on an overload, or other abnormal condition, I provide a mechanism, more fully later described, which, it may be here merely said, includes a swingable trigger-armature 39 that is adapted with sufficient impact, the toggle-mechanism being fully extended as in circuit-closing position, to engage or impinge the toggle-mechanism at the rule or pivot-joint 28 and throw the same forwardly of the linear direction of the pivot-points 27, 32. Under the tension or power of the spring 12, the toggle-mechanism is thereby caused to fold forwardly, permitting the plunger 10 to snap upwardly, and thereby simultaneously swing the contact-members 15 widely apart, or into the position thereof shown in Figure 3, and commensurately space the ends 16 to open the circuit.

By reference to Figure 6, it will be observed that, in such automatic separation of the ends 16, the normal circuit-closing position of lever 24 is not affected. Thus the

breaker is trip-free, that is to say, the toggle-connection may be automatically tripped and the contact-members 15 swingably actuated to open the circuit even though the lever 24 be manually or otherwise held or retained in its normal circuit-closing position. In such separation of the contact-ends 16, however, the stop-pin 38 is carried forwardly into engaging relation with the lever-finger 24a, as seen in Figure 6. To now again close the circuit, the lever 24 is first pivotally shifted forwardly into the position thereof illustrated in Figure 5, in which movement, under the engagement of finger 24a with the pin 38, the lever 24 and arms 26 function, so to speak, as a bell-crank and effect, in connection with the arm 29, partial extension of the toggle mechanism and thereby partial depression of plunger 10, with the result that the contact-members 15 are brought again into normal circuit-opening position, the parts then being in the position thereof illustrated in Figures 2 and 5. As will later appear, the armature-bar 39 is yieldingly returned to normal position on opening of the circuit; however, on such extension of the toggle mechanism, it may be here stated, the toggle would otherwise mechanically engage the bar 39 and pivotally actuate the same out of its tripping position. The lever 24 is now again pivotally shifted rearwardly, which effects full extension of the toggle mechanism and thereby full depression of plunger 10, with, likewise, the result that the contact-members 15 are further swingably actuated toward each other and their ends 16 brought into normal circuit-closing engagement, as in Figure 1.

Now, when the circuit-breaker is tripped or actuated on an overload or other abnormal condition, at which time the current is large, arcing is severe, and hot gases are created in the housing A, the sudden snap movement of the plunger 10 generates a pressure wave which causes a circulation of the air in chamber *a* and thereby the hot gases of the arc are carried away from the contact-members 15 and their ends 16 and dissipated or dispersed into atmosphere through the lever-slot 35 or through additional exhaust-openings *b* provided for the purpose in the housing top-wall 2, as shown.

The toggle-arms 26 and 29 are constructed of suitable insulation material and are preferably in the form of vanes having the contour best seen in Figures 4, 5, 6, and 15. When the toggle-mechanism is extended, the vanes or arms 26, 29, interleave, as shown in Figures 4 and 5, but when the toggle-link is folded forwardly on a breaking of the circuit on an overload or other abnormal condition, the vanes 26, 29, are expanded into overlapping relation, or into the formation best seen in Figure 15, and are located intermediate the contact-members 15 and their

ends 16. When so thrown forwardly, the toggle-vanes 26, 29, thus form a wall or partition between the contact-members 15 and divide the chamber *a* into compartments, as shown in Fig. 15, in which the contact-members 15 are respectively isolated. I might add that the contour of the vanes 26, 29, is such that on the formation of such partition, the conjoined, spaced arms 26 receive therebetween at their upper edge, the acuminate lower edge of the wing 23, the vanes 26 at the same time approximately contacting at their forward edge with the front wall 1 of housing A and at their lower margin overlapping the vane 29. Likewise, the vane 29 at its front edge approximately contacts with the front wall 1 of the housing A and at its bottom edge contacts with the upper face of the plunger block 10.

The vanes 26 and 29 are disposed closely adjacent the inner face of block 21, as seen in Figure 15, with the result that said partition thus substantially interposes an insulating body into the path of and thereby suppresses or breaks any arc that may occur on an automatic breaking of the circuit as on an overload or other abnormal condition.

Inasmuch as the trigger-mechanism for effecting automatic actuation or tripping of the toggle-mechanism to break the circuit on an overload or other abnormal condition is common to the preferred form of my new circuit-breaker as herein described as well as also to the modified form of the circuit-breaker illustrated in Figures 7-11, inclusive, and Figure 16, of the drawings, I will first briefly describe such modified form of the circuit-breaker. Accordingly, referring now more specifically to Figures 7-11, inclusive, and Figure 16 of the drawings, A designates the housing, 1' the front wall of the housing 8, the plunger well, 10' the plunger reciprocable in the well 8, 13' the line terminals, 15' the opposed contact-members pivoted for swingable movement on the terminals 13', and 16' the engageable ends of the contact-members, the contact-members 15' being pivotally connected to the plunger-block 10' by the links 20. Comprising the toggle-mechanism, is a lever 24', parallel spaced arms 26' conjointly pivoted at an end, as at 27', to the lower end of lever 24', and an arm 29' pivotally connected at an end, as at 28', to the arms 26' and at its opposite end, as at 32', to the block 10'. Provided in the arm 26', is a cross-pin or abutment 33' adapted for engagement with a shoulder or face 34' of the arm 29' in the formation similarly of a rule-joint to limit the relative rearward folding movement of the arms 26', 29'; and formed on the lever 24' is the finger-extension 24a adapted for co-operative engagement with the stop-pin 38 similarly provided upon and between the arms 26'.

In function and operation, such parts are

similar to like parts of the preferred form of my circuit-breaker, the plunger block 10' being fully depressed against the tension of the spring 12 and the engageable ends 16' of the contact-members 15' being in electrical-engagement, circuit-closing position when the toggle mechanism is fully extended, as in Figures 7 and 9, the contact-members 15' and their ends 16' being widely spaced, as shown in Figure 16, and the circuit broken when the toggle mechanism is automatically tripped by the magnet-bar 39, and the contact-members 15' and their ends 16' being less widely spaced to open the circuit when the lever 24' is manually actuated, all as fully herein described in connection with the preferred form of the circuit-breaker, the stop 37' for limiting the rearward pivotal movement of the lever 24' being preferably in the form of an insulation block suitably fixed to and upon the rear wall of the housing A and provided at its front end with a beveled face 37a, as best seen in Figure 9.

However, in the modified form of the circuit-breaker, the arms 26' and 29' do not have the vane formation or contour of the corresponding arms 26, 29, but mounted upon and upstanding from the plunger 10 and slidably engaging at a side margin in a guide-slot 1a, extending longitudinally in the front wall 1' of the housing A, is an insulation partition 41, which extends from front to rear of chamber a and approximately contacts at one side face with the adjacent undercut inner face of the insulation block 21', as best seen in Figure 16.

An insulation wing or bracket 23' is suitably fixed to and upon the inner upper margin of the block 21, which wing is of such dimension as to engage at its upper margin with the top housing-wall 2, at its front and rear margins with the front and rear housing-wall 1' and 42, respectively, and at its lower margin to overlap the partition 41 when the latter is in elevated position, as when the circuit is opened as on an overload or other abnormal condition, as best seen in Figure 16, the partition 41 being spaced downwardly from the wing 23' when the plunger-block 10' is in depressed or lowered position, as illustrated in Figure 9. The contact-members 15' in this form of the circuit-breaker are preferably of approximately inverted L-shape, as best seen in Figures 7 and 16, and when the engageable-ends 16' thereof are in circuit-closing engagement, the contact-members 15' are disposed in approximately parallel relation, as best seen in Figure 7, with the end 16' of one of the contact-members 15' disposed over and across the top edge of the partition 41 and under across the lower edge of the wing 23', all as best seen in Figure 7. In the normal manual or switch manipulations of the breaker, the movements of the plunger 10' are not

sufficient to elevate the partition 41 into overlapping relation at its upper margin with the wing 23', but when the breaker is tripped as on an overload, the plunger block 10' suddenly rises to its uppermost position, the ends 16' are caused to fly widely apart, and the partition 41 correspondingly moves upwardly with the plunger 10' into overlapping relation with the wing 23' and thus in co-operation with the wing 23' interposes an insulation wall between the contact-members 15' and their ends 16', thereby similarly isolating or separating the contact-members 15' and their ends 16' the one from the other and suppressing or breaking any occurring arc, while the sudden movement of the plunger 10' generates or creates an air-blowout effecting dissipation or dispersion of the hot gases, all as hereinbefore more fully described.

Integral with or otherwise fixed to and upon the upper margin of the partition 41 is an upwardly presented extension 43, which, while normally, as when the circuit is closed, concealed within the housing A, is adapted, when the partition 41 is elevated on upward movement of the plunger 10' on abnormal opening of the circuit, to project outwardly through an opening 44 provided for the purpose in the housing top wall 2 to indicate or signal that the circuit is open.

I will now describe the trigger-mechanism for effecting automatic actuation of the toggle-mechanism to break the circuit as on an overload or other abnormal condition.

Disposed in chamber a' and supported by spaced pairs of suitable brackets 45 fixed to and projecting forwardly from the housing rear-wall 42, is an electromagnet D, which includes a coil 46 and a core 47, the latter having pole-pieces 47a and 47b. As here shown, the coil 46 is in series with the line B, although it will be understood that the magnet D may be suitably electrically connected in an associated shunt circuit and that a suitable relay or time delay device, not shown, may be incorporated therewith.

The magnet D is suitably spaced by the brackets 45 from the rear housing-wall 42, and adapted for co-operation with the magnet D, is the armature-bar 39. This bar 39 is disposed for oscillation in the space intermediate the magnet D and the rear housing wall 42 and, to such end, has one end pivoted, as at 48, opposite the one pole-piece 47a, upon one set of the brackets 45, and then projects laterally of the housing past the other pole piece 47b, the free end of the armature-bar 39 being disposed in the plane of, and in adjacent engageable relation with, the hinge-joint 28 or 28', as the case may be, of the toggle-mechanism. At its free end, the armature-bar 39 is engaged by one end of a compression spring 49, mounted on a link 50 pivoted at one end to a bracket 51 mounted on the rear housing wall 42 and pivotally cou-

pled, as by a pin 52, to the free end of the bar 39, the spring 49 being primarily adapted to yieldingly retain the armature-bar or trigger 39 away from and out of engagement with the magnet pole-piece 47b.

The armature-bar or trigger 39 may be set at any suitable air gap to vary the tripping point of the circuit-breaker and hence, being so set, will normally be unaffected by the current flowing through the coil 46 and the circuit-breaker. On overload or other abnormal condition in the circuit, however, sufficient current passes through the magnet D to effect attraction of the bar 39, the bar 39 being thereby pulled forwardly into electrical engagement with the pole piece 47b and in such movement impinges or engages the hinge-joint 28 or 28', as the case may be, of the toggle mechanism, thereby tripping the same and effecting forward opening of the toggle and a breaking of the circuit, as hereinbefore more fully described, it being again observed that, on such tripping of the toggle mechanism, the contact-members, being both swingable, are thrown widely and rapidly apart with a consequent rapid break in the circuit.

My new circuit-breaker may be built in all commercial voltages and sizes for switch-board service, power distribution centers, and other classes of service, and I might mention that in panel-board service, the breaker may take the place of the usual toggle switch and plug fuse. This application would have many advantages over present usage in that blown fuses with their consequent fire hazard and inconvenience would be entirely eliminated and the much faster and more certain action of the circuit-breaker would afford much greater protection to all wiring and devices which they service. When employed with a meter service entrance box, the breaker would eliminate many service calls upon the public utilities due to blown fuses, which the circuit-breaker would replace; and when mounted in combination with service outlet for every kind of application, instead of the present practice where a fuse may be blown at some distant centre of distribution, the circuit-breaker would be instant protection and service and could be immediately restored with great saving in convenience to user.

It may be now stated that the partition 3 functions to protect the magnet D and its associate parts from the gases or arc arising on a separation of the contact-members.

When the magnet D is energized by alternating current flowing through the coil 46, such current tends to set up a vibration in the trigger armature 39 when the critical point of its calibration is reached. This causes a more or less objectionable hum, and to overcome this objection, a suitable sound deadener 53, such as a pad of rubber or the

like, is provided to absorb such vibrations, as best seen in Figures 8 to 10; and I may add that the spring 49 may also be employed in the calibration of the device, calibration being accomplished by employing springs of varied strength to provide suitable resistance to the pull of the electric magnet as may be desired, and means may also be provided for adjusting the pressure or pull of the spring in any suitable manner, as for example, moving the bracket 51 towards or away from the trigger armature.

While in Figures 1 to 11, both inclusive, I show a single pole or unit circuit-breaker of my invention, it will be understood that any number of units may be ganged or associated together and two, three, or four pole breakers obtained; and in Figures 12, 14, inclusive, I show my new circuit-breaking adapted for use with a three-phase high voltage alternating current.

In this form of the circuit-breaker, several unit circuit-breakers are preferably ganged together for simultaneous actuation, and on account of the high voltages commonly used for three-phase circuit, the housing A' is preferably divided into a plurality of adjoining compartments by suitable partitions 54 slidably disposed between the several sets of insulation-blocks 5', 6', each compartment providing a chamber for a respective unit circuit-breaker, each of which circuit-breakers includes, as in the present instance shown, a plunger-block 10', contact-members 15', and their associated parts as hereinbefore described, two shiftable partitions 41 in suitably spaced relation being provided upon the block 10', in lieu of the one partition 41 as described, which partitions, in turn, are adapted for wall forming relation with the beveled lower edge of fixed wings 23'' on elevation of the block 10' on the breaking of the circuit as on an overload, all substantially in the same manner as herein described in connection with the one partition 41 and the co-operating wing 23'.

The tripping and trigger mechanisms are preferably located exteriorly of the housing A', are preferably mounted on the top wall 2' thereof, and may be suitably enclosed, if desired. Each of such trigger mechanisms includes a yoke 55, mounted upon which for oscillation is the toggle-lever 24'. The lower toggle arm 29'', which is pivotally connected at its one end to block 10', is lengthwise extended to project outwardly of the housing A' through a slot provided for the purpose in the housing wall 2', and pivotally connected to the upper end of the arm 29'', are the arms 26', all as previously described. Fixed upon one leg of the yoke 55, is the magnet D, and suitably mounted for oscillation, as best seen in Figure 14, in the plane of the hinge joint 28', is the armature-bar 39.

It is necessary that all three-phases of the

circuit be opened at the same time, and to such end I provide a rod 55 which connects the three pivot points 27' between the levers 24' and the arms 26' of the respective trigger-mechanisms. One of the levers 24' is extended, as shown, and similarly equipped with a handle 36, the bight of the yoke having a slot or other suitable means providing stop-abutments for limiting the movement of the lever-extension to open and closed positions, respectively. Thus, by grasping the handle 36, the several levers 24 may be simultaneously moved to effect circuit-opening actuation of the circuit-breaker, as shown by dot and dash lines in Figure 13, or simultaneously returned to circuit-closing position, as indicated in full lines in Figure 13.

In order that an overload or other abnormal condition in one phase may trip all the breakers at the same time, I provide a tripper-bar 57 connecting the hinge-joints 28' of the respective toggle-mechanism. When the toggles are set to close the circuit, the bar 57 is located adjacent the electromagnets and aligned with the trigger armatures 39. Lugs 58 on the bar 57 are adapted for impingement by one of the other of the trigger armatures 39 on the occurrence of an overload or other abnormal condition in the respective electromagnets, the trigger-armatures 39 acting in the same manner as the trigger armatures heretofore described.

Preferably such circuit-breakers are remote controlled, and hence I do not deem it necessary to indicate the time delay devices or relays and the like, the use of which is well known to the art. It will be readily understood that an overload or other abnormal condition in one phase will energize the electromagnet connected to that phase to impinge its trigger armature 39 against the corresponding lug 58 on the tripper-bar 57, thus simultaneously breaking all three toggles to open their respective circuits as hereinbefore described and indicated in dotted lines in Figure 13.

I may here state that the housing A' may be made oil tight and oil used as a dielectric instead of air. In such use it will be readily apparent that the oil will be circulated in the chamber at each "break" and thus its dielectric strength will be maintained at a constant value. I may add that preferably the leads B to the respective contact-chambers all come into the housing A' from the same side. Likewise the leads C all come in on the other side. Thus there is no danger of a flash over the partitions 54 from adjacent compartments.

I may add that the manner in which the contact-members of the breaker are link-connected to the plunger, which connection provides a multiple ratio of leverage between the contact-members and their actuating plunger further increases the speed of separation

of the contact-members to break the circuit as on an abnormal condition occurring therein.

The use of my invention and the manner of operating the same have been fully set forth as the description proceeded. It is obvious that my invention may be employed in other forms and arrangements than those disclosed, and it is, therefore, to be understood that changes in the form, construction, arrangement, and combination of the several parts of my new circuit-breaker may be made and substituted for those herein shown and described without departing from the nature and principle of my invention.

Having thus described my invention, what I claim and desire to secure by Letters Patent is,—

1. An electric circuit-breaker comprising, in combination, a pair of co-operable movable contact-members, means for actuating both said members into and out of engaging relation for respectively closing and opening the circuit, and means for mechanically breaking an arc occurring on separation of said members.

2. An electric circuit-breaker comprising, in combination, a pair of co-operable movable contact-members, means for actuating both said members into and out of engaging relation for respectively closing and opening the circuit, and means including an insulation body for mechanically breaking an arc occurring on separation of said members.

3. An electric circuit-breaker comprising, in combination, a pair of co-operable swingable contact-members, means for swingably actuating both said members into and out of engaging relation for respectively closing and opening the circuit, and means including an insulating body shiftable intermediate the spaced ends of said members on separation thereof for breaking an occurring arc.

4. An electric circuit-breaker comprising, in combination, a pair of co-operable swingable contact-members, means including a shiftable member for swingably actuating the contact-members into and out of engaging relation for respectively closing and opening the circuit, and means including an insulating body having connection with the shiftable member adapted, on separation of the contact-members, for interposition between the engageable ends thereof for mechanically breaking an occurring arc.

5. An electric circuit-breaker comprising, in combination, a pair of co-operable swingable contact-members, means including a shiftable block for swingably actuating the contacting members into and out of engagement for respectively closing and opening the circuit, said contact-members having pivoted connection with the block, and means including an insulating body also having connection with the block adapted, on actuation

of the contact-members out of engagement, for interposition between the spaced ends thereof.

6. In an electric circuit-breaker, in combination, a shiftable member, co-operable contact-members having pivoted link-connection with said member and adapted on shiftable movement thereof for swingable separation in opposed directions to open the circuit on an abnormal condition therein, and means including an insulating body having connection with the shiftable member adapted, on separation of the contact-members, for interposition between the engageable ends thereof.

7. In an electric circuit-breaker, in combination, a shiftable member, co-operable contact-members having pivoted link connection with said member and adapted on shiftable movement thereof for swingable separation in opposite directions to open the circuit on an abnormal condition therein, and means including co-operable relatively foldable insulation members having connection with the shiftable member and adapted on separation of the contact-members to form a partition intermediate the engageable-ends thereof.

8. In an electric circuit-breaker, in combination, a housing, co-operable contact-members within the housing adapted for separation to open the circuit, and means for dividing the housing into compartments for isolating the contact-members one from the other on separation thereof.

9. In an electric circuit-breaker, in combination, a housing, co-operable contact-members within the housing adapted for separation to open the circuit, and means for dividing the housing into compartments for isolating the contact-members one from the other on separation thereof, said means comprising co-operable insulating members, one of which is movable relatively to the other.

10. In an electric circuit-breaker, in combination, a housing, an insulation member fixed within the housing, co-operable contact-members within the housing adapted for separation to open the circuit, and insulating means movable within the housing adapted for co-operation with said fixed insulation member and the housing for dividing the housing into compartments for isolating the same the one from the other on separation thereof.

11. In an electric circuit-breaker, in combination, a housing, an insulation wing fixed within the housing, a member shiftable within the housing, co-operable contact-members adapted on shiftable movement of said member for separation to open the circuit, and insulation means having connection with the shiftable member adapted for co-operation with said wing and the housing for dividing the housing into compartments for isolating

the same the one from the other on separation thereof.

12. In an electric circuit-breaker, in combination, a housing, an insulation wing fixed within the housing, a member shiftable within the housing, pivoted co-operable contact-members adapted on shiftable movement of said member for swingable separation in opposite directions to open the circuit, and insulation means having connection with the shiftable member adapted for co-operation with the wing in the formation of a partition intermediate the contact-members for isolating the same the one from the other on separation thereof.

13. In an electric circuit-breaker, in combination, a housing an insulation wing fixed within the housing, a member shiftable within the housing, pivoted co-operable contact-members having pivoted link connection with said member and adapted on shiftable movement thereof for swingable separation to open the circuit, and insulation means including relatively foldable vanes having connection with the shiftable member adapted for co-operation with the wing in the formation of a partition intermediate the contact-members for isolating the same the one from the other on separation thereof.

14. In an electric circuit-breaker, in combination, a housing, an insulation wing fixed within the housing, a member mounted for reciprocable movement in the housing, pivoted co-operable contact-members having pivoted link connection with said member and adapted on shiftable movement thereof for swingable movement to respectively close the circuit and for separation to open the same, and means for actuating the shiftable member in one direction to swingably actuate the contact-members into engaging relation to close the circuit, said means including relatively foldable insulation vanes adapted, on actuation of the shiftable member in the opposite direction to separate the contact-members, for co-operation with said wing in the formation of a partition intermediate the separated contact-members for isolating the same the one from the other.

15. An electric circuit-breaker comprising, in combination, a housing, co-operable contact-members adapted for swingable separation in opposed directions to open the circuit, and means including an insulation wing fixed within the housing for partly providing a partition between the contact-members on separation thereof.

16. In an electric circuit-breaker, in combination, a housing, co-operable contact-members pivoted within the housing for swingable separation to open the circuit, and means including a member shiftable in the housing adapted to effect fluid circulation within the housing on separation of said members for dispersing the gases of an occurring arc.

17. In an electric circuit-breaker, in combination, a housing, co-operable contact-members pivoted within the housing for swingable separation to open the circuit, and means including a member shiftable in the housing for effecting air circulation within the housing on separation of said members for dispersing the gases of an occurring arc.

18. In an electric circuit-breaker, a housing having an aperture, a member shiftable in the housing, and co-operable contact-members each pivoted within the housing and having connection with said member, said contact-members being adapted, on actuation of said member in one direction, for swingable separation to open the circuit, said member being adapted on said circuit-opening movement thereof to create a circulating air pressure wave for dispersing from the housing the gases of an occurring arc.

19. In an electric circuit-breaker, a housing having an aperture, a block mounted for reciprocation in the housing, pivoted contact-members having connection with said member for swingable engagement and disengagement, to respectively close and open the circuit, means for actuating the block in one direction to effect circuit-closing-engagement of the contact-members, and means for actuating the block in the opposite direction to effect circuit opening-disengagement of the contact-members, said block being adapted on circuit-opening actuation thereof to create a circulating air pressure wave for dispersing from the housing the gases of an occurring arc.

20. In an electric circuit-breaker a housing having an aperture, a spring-pressed block mounted for reciprocation in the housing, pivoted contact-members having pivoted link-connection with said member for swingable engagement and disengagement to close and open the circuit, and means for actuating the block against the tension of said spring to effect circuit-closing engagement of the contact-members, the block being yieldingly movable in the opposite direction to effect circuit-opening disengagement of the contact-members and adapted on such latter actuation to create a circulating air pressure wave for dispersing from the housing the gases of an occurring arc.

21. In an electric circuit-breaker, a housing, a member yieldingly reciprocable in the housing, pivoted co-operable contact-members adapted on reciprocations of said member for swingable actuation toward and from each other to respectively close and open the circuit, and means including a lever and a foldable link for actuating the reciprocable member for effecting swingable actuation of the contact-members for closing the circuit.

22. In an electric circuit-breaker, a housing, a block yieldingly reciprocable in the housing, contact-members pivoted within the

housing and having pivoted link connection with said member for swingable engagement and disengagement to respectively close and open the circuit on reciprocation of said member, and means including a lever and a foldable link for reciprocating the block to effect circuit-closing-engagement of the contact members.

23. In an electric circuit-breaker, a housing, a spring-pressed block reciprocable in the housing, contact-members pivoted within the housing and having pivoted link connection with said member for swingable engagement and disengagement to respectively close and open the circuit on reciprocations of said member, and means including a pivoted lever and a foldable link for actuating the block in one direction against the tension of said spring to effect circuit closing-engagement of the contact-members, the block being shiftable in the opposite direction under the tension of said spring to effect circuit-opening-disengagement of the contact members.

24. In an electric circuit-breaker, in combination, co-operable contact-members adapted for engagement for closing the circuit, a shiftable block having connection with the contact-members, and means including a toggle for shifting the block to actuate the contact-members into circuit closing-engagement.

25. In an electric circuit-breaker, co-operable contact-members adapted for engagement for closing the circuit, a shiftable block having connection with the contact-members, and means for shifting the block to actuate the contact-members into circuit closing-engagement, said means including a pivoted lever, and a toggle link-connection between the lever and the block.

26. In an electric circuit-breaker, pivoted co-operable contact-members adapted for swingable engagement for closing the circuit, a shiftable block having pivoted connection with the contact-members, and means for shifting the block to swingably actuate the contact-members into circuit-closing engagement, said means including a pivoted lever, and a toggle link-connection between the lever and the block.

27. In an electric circuit-breaker, pivoted co-operable contact-members adapted for swingable engagement and disengagement for respectively closing and opening the circuit, a spring-pressed shiftable block having pivoted connection with the contact-members, and means for shifting the block against the tension of the spring to actuate the contact-members into circuit-closing engagement, said means including a pivoted lever, and a toggle link-connection between the lever and the block.

28. In an electric circuit-breaker, a spring-pressed reciprocable member, pivoted co-op-

erable contact-members having pivoted link connection with said member adapted on reciprocations of said member for swingable actuation toward and from each other to respectively close and open the circuit, and means for actuating said member against the tension of the spring for effecting swingable actuation of the contact-members into circuit-closing engagement, said means including a toggle-link having pivoted connection at an end with the member, and a pivoted lever having pivoted connection at an end with the opposite end of the link, the toggle being extended and said member depressed against the tension of said spring and the toggle being flexed and said member shifted under the tension of said spring as said lever is pivotally shifted in opposite directions.

29. In an electric circuit-breaker, a spring-pressed reciprocal member, pivoted co-operable contact-members having pivoted link connection with said member adapted on reciprocations of said member for swingable actuation toward and from each other to respectively close and open the circuit, and means for actuating said member against the tension of the spring for effecting swingable actuation of the contact-members into circuit closing-engagement, said means including a pair of pivotally connected toggle-links having pivoted connection at an end of one of the links with said member, a pivoted lever having pivoted connection at an end with the other of said links, and co-operating abutments in said links for limiting relative pivotal movement thereof in one direction, the links being extended and said member depressed against the tension of said spring and the links being flexed and said member shifted under the tension of said spring as said lever is pivotally shifted in opposite directions.

30. In an electric circuit-breaker, a spring-pressed reciprocal member, pivoted co-operable contact-members having pivoted link connection with said member adapted on reciprocations of said member for swingable actuation toward and from each other to respectively close and open the circuit, and means for actuating said member against the tension of the spring for effecting swingable actuation of the contact-members into circuit closing-engagement, said means including a pair of pivotally connected toggle-links having pivoted connection at an end of one of the links with said member, a pivoted lever having pivoted connection at an end with the other of said links, and pairs of co-operating abutments on the links and lever for limiting relative pivotal movement thereof, the links being extended and said member depressed against the tension of said spring and the links being flexed and said member shifted under the tension of said spring as said lever is pivotally shifted in opposite directions.

31. In an electric circuit-breaker, co-operable contact-members movable in opposed directions for engagement and disengagement for respectively closing and opening the circuit, means including a toggle comprising a pivoted lever and a foldable link for actuating the contact members into circuit-closing engagement, and means for automatically tripping the toggle to effect disengagement of the contact-members to open the circuit.

32. In an electric circuit-breaker, co-operable contact-members swingable in opposed directions for engagement and disengagement for respectively closing and opening the circuit, means including a toggle comprising a pivoted lever and a foldable link for swingably actuating the contact-members into engaging and disengaging relation, and means for automatically tripping the toggle for effecting disengagement of the contact-members to open the circuit.

33. In an electric circuit-breaker, co-operable contact-members adapted for swingable engagement and disengagement for respectively closing and opening the circuit, a spring-pressed reciprocable block having pivoted link connection with the contact-members, means including a toggle for actuating said block against the tension of the spring for moving the contact-members into circuit-closing engaging relation, and means for automatically tripping the toggle for permitting movement of the block under the tension of the spring for effecting disengagement of the contact-members to open the circuit.

34. In an electric circuit-breaker, co-operable contact-members adapted for swingable engagement and disengagement for respectively closing and opening the circuit, a spring-pressed reciprocable block having pivoted link connection with the contact members, means including a toggle for actuating said block against the tension of the spring for swingably actuating the contact-members into circuit-closing engaging relation, and means including an electrically actuated armature-bar for automatically tripping the toggle for permitting movement of the block under the tension of the spring for effecting disengagement of the contact-members to open the circuit.

35. In an electric circuit-breaker, co-operable contact-members adapted for swingable engagement and disengagement for respectively closing and opening the circuit, a spring-pressed reciprocable block having pivoted link connection with the contact-members, means including a toggle for actuating said block against the tension of the spring for swingably actuating the contact-members into circuit-closing engaging relation, said toggle having a rule-joint intermediate its ends, and means including an

electrically actuated armature-bar for automatically tripping the toggle at said joint for permitting movement of the block under the tension of the spring for effecting disengagement of the contact-members to open the circuit.

36. In a circuit-breaker, a pair of movable contact-members, and an operative mechanism associated with said contact-members, said mechanism including a toggle coupled to said contact-members, said toggle including a lever and a foldable link, the contact members being movable towards each other as said lever and link approach linear direction.

37. In a circuit-breaker, separable contact-members movable in opposed directions for engagement and disengagement for respectively closing or opening the circuit, a trip operative means including a pivoted lever and a foldable link for opening said contact-members, and a separately operable trigger mechanism associated with said trip operative means.

38. In a circuit-breaker, in combination, separable contact-members movable in opposed directions for engagement and disengagement for respectively closing or opening the circuit, and a spring set toggle including a lever and a foldable link coupled to said contact-members, said contact-members being engaged when said lever and link are disposed in linear direction against the pressure of said spring, said link being foldable to permit said spring to act to separate said contact members.

39. In a circuit-breaker, in combination, separable contact-members movable in opposed directions for engagement and disengagement for respectively closing or opening the circuit, a spring set toggle including a lever and a foldable link coupled to said contact-members, said contact-members being engaged when said lever and link are disposed in linear direction against the pressure of said spring, said link being foldable to permit said spring to act to separate said contact members, and a trigger mechanism adapted to cause said link to fold.

40. A circuit-breaker comprising contact-members swingably movable in opposed directions for engagement and disengagement to close and open the circuit, and a trip mechanism for actuating the contact-members, said trip mechanism including a toggle comprising a pivoted lever and a foldable link, the contact-members being in circuit-closing engagement when said lever and link are disposed in linear direction, said link being hinged to fold in one direction to disengage the contact-members to open the circuit, said toggle flexing in an opposite direction to also open the circuit at the contact-members, and means on said lever coacting with

said link to extend the link from folded position as said toggle is flexed.

41. In a circuit-breaker, a plurality of pairs of separable contact-members, the contact members of each pair being movable in opposed directions for engagement and disengagement for respectively closing and opening the circuit, an operative means associated with each of said pairs, said operative means including a toggle mechanism comprising a lever and a foldable link, and means coupling the several toggle mechanisms for simultaneously actuating the several respective pairs of contact-members into engaging relation.

42. In a circuit-breaker, a plurality of pairs of separable contact-members, the contact members of each pair being movable in opposed directions for engagement and disengagement for respectively closing and opening the circuit, an operative means associated with each of said pairs, said operative means including a toggle mechanism comprising a lever and a foldable link and a trigger mechanism for tripping said toggle mechanism, and means coupling the several toggle mechanisms adapted to be engaged by any one of the trigger mechanisms for simultaneously separating the several respective pairs of contact-members.

43. In an electric circuit-breaker, co-operable contact-members adapted for movement into and out of engagement for respectively closing and opening the circuit, means for manually actuating the contact-members into and out of engagement for normally closing and opening the circuit, said means including a toggle, a yieldingly reciprocable block, a pivoted lever, and a foldable link intermediate the block and lever and means for automatically tripping the toggle for actuating the contact-members to open the circuit on the occurrence of an abnormal condition therein.

44. In an electric circuit-breaker, co-operable contact-members adapted for swingable movement into and out of engagement for respectively closing and opening the circuit, means for manually actuating the contact-members swingably into and out of engagement for normally closing and opening the circuit, said means including a toggle, a yieldingly reciprocable block, a pivoted lever, and a foldable link intermediate the block and lever, the contact-members having pivoted connection with the block and means for automatically tripping the toggle for actuating the contact-members swingably to open the circuit on the occurrence of an abnormal condition therein.

45. In an electric circuit-breaker, co-operable contact-members adapted for swingable movement into and out of engagement for respectively closing and opening the circuit, means including a yieldingly reciprocable

block, a pivoted lever, and a foldable toggle-link connection between the block and lever for manually actuating the contact-members swingably into and out of engagement for
 5 normally closing and opening the circuit, and electrically operable means for automatically tripping said connection for actuating the contact-members swingably to open the circuit on the occurrence of an abnormal condition therein.

46. In an electric circuit-breaker, co-operable contact-members adapted for swingable movement in opposed directions for engagement and disengagement for respectively
 15 closing and opening the circuit, means including a pivoted lever and a foldable toggle-link connection for manually actuating the contact-members swingably into and out of engagement for normally closing and opening the circuit, and electrically operable
 20 means for automatically tripping said connection for swingably actuating the contact-members out of engagement to open the circuit on the occurrence of an abnormal condition therein, said lever being inactive on
 25 automatic actuation of said connection and said connection being trip-free relatively to said lever.

47. In an electric circuit-breaker, a housing, co-operable contact-members disposed within the housing for swingable movement into and out of engagement for respectively closing and opening the circuit, means for automatically actuating the contact-members
 35 swingably to open the circuit on the occurrence of an abnormal condition therein, and means including a member movable outwardly of the housing on disengagement of the contact members for visionally indicating exteriorly the housing the out of engagement
 40 relation of said members.

48. In an electric circuit-breaker, in combination, co-operable contact-members simultaneously movable in opposed directions into
 45 and out of engagement for closing and opening the circuit, and means including a toggle comprising a lever and a foldable link for simultaneously moving the contact-members into and out of engagement.

49. In an electric circuit-breaker, in combination, co-operable contact-members simultaneously swingable in opposed directions into and out of engagement for closing and opening the circuit, and means including a
 55 toggle comprising a lever and a foldable link for simultaneously swinging the contact-members toward and from each other and into and out of engagement.

50. In an electric circuit-breaker, in combination, a housing, a member mounted for reciprocable movement in the housing, co-operable contact-members mounted pivotally in the housing for swingable movement into and out of engagement to close and open the
 65 circuit, links pivotally connected to the shift-

able member and to the contact-members, and means comprising a pivoted lever and a foldable link pivotally connected to the lever and to the reciprocable member for reciprocating the shiftable member.

In testimony whereof, I have signed my name to this specification.

LYMAN C. REED.