No. 756,344. PATENTED APR. 5, 1904.

L. L. ELDEN.

CIRCUIT BREAKER.

APPLICATION FILED JUNE 20, 1901.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.

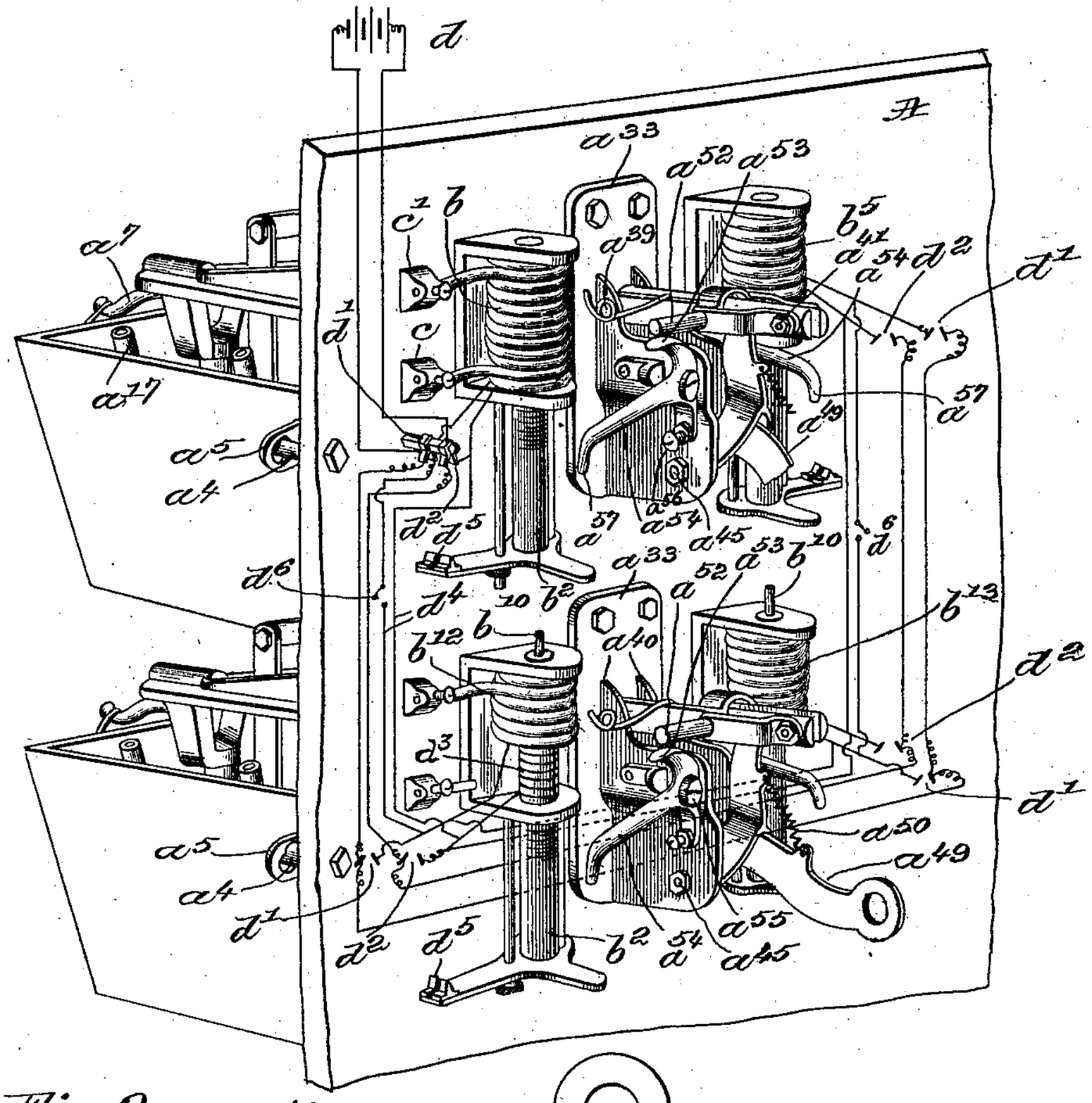
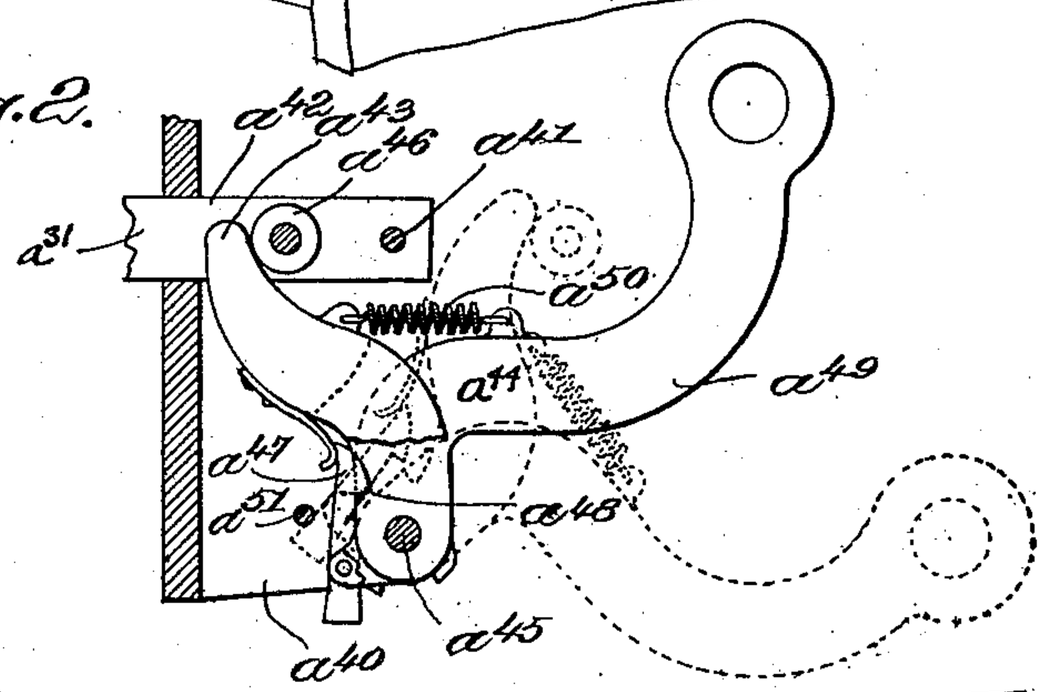


Fig. 2.



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NO MODEL. 3 SHEETS—SHEET 2.

Fig. 3.

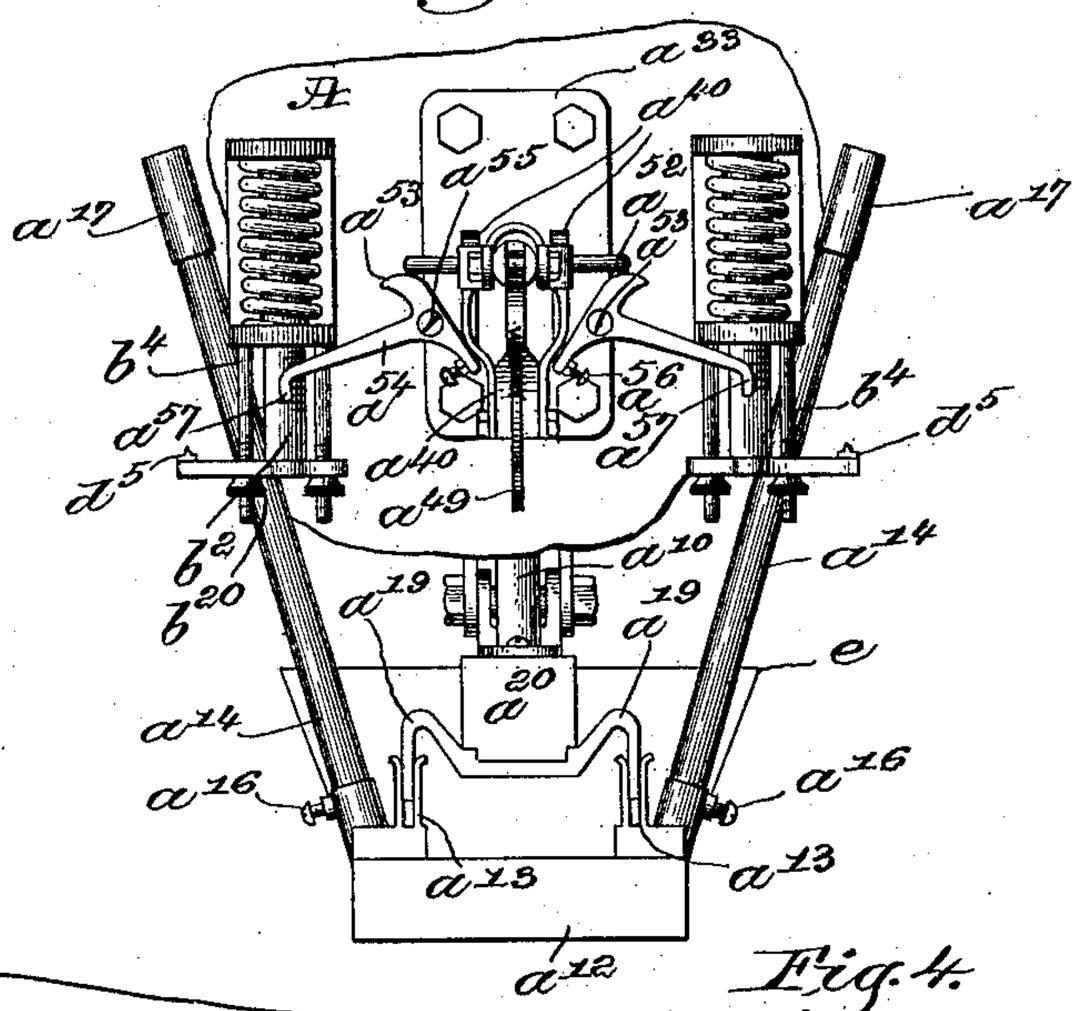
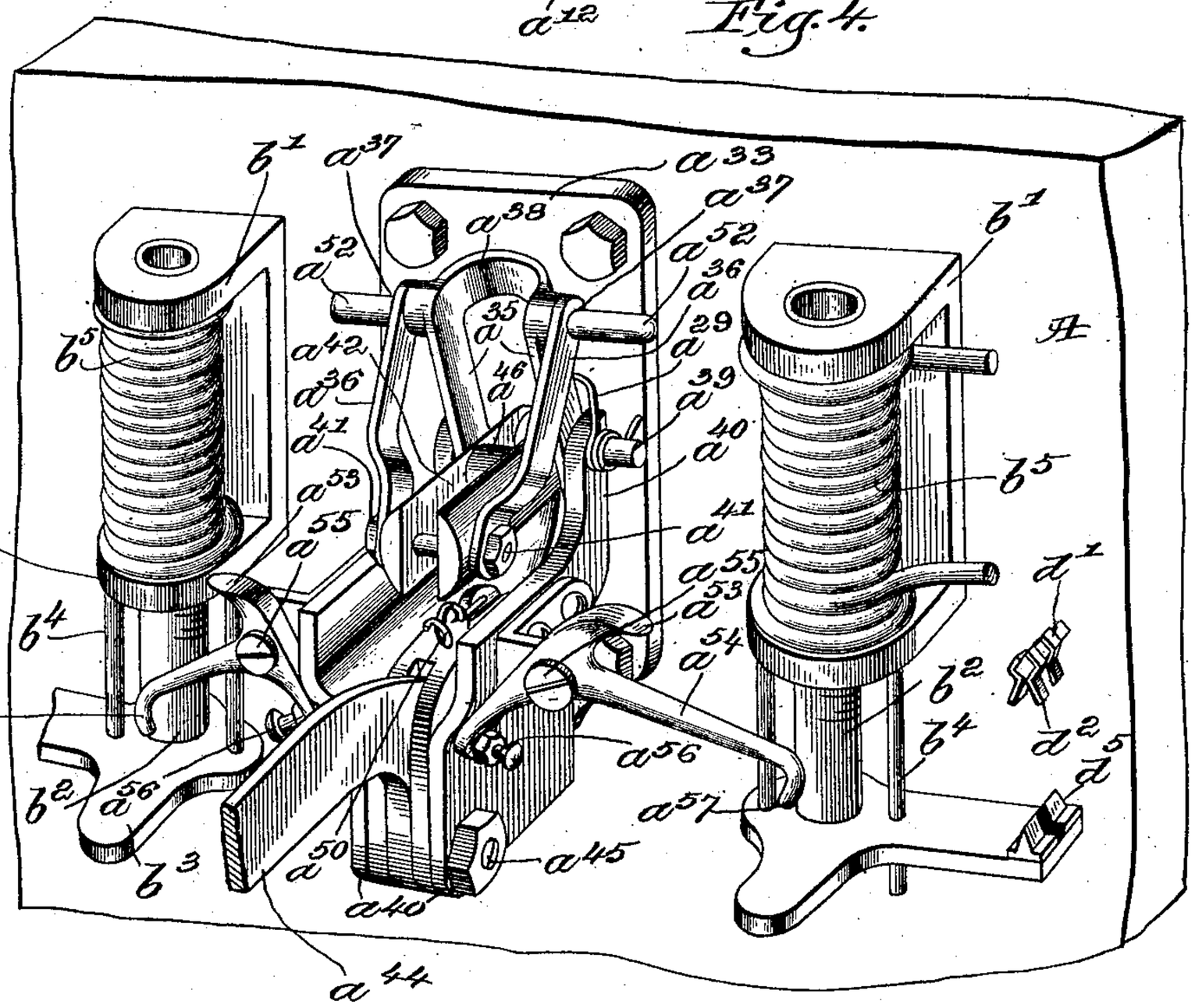


Fig. 4.



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CIRCUIT BREAKER.

APPLICATION FILED JUNE 20, 1901.

NO MODEL. 3 SHEETS—SHEET 3.

Fig. 5.

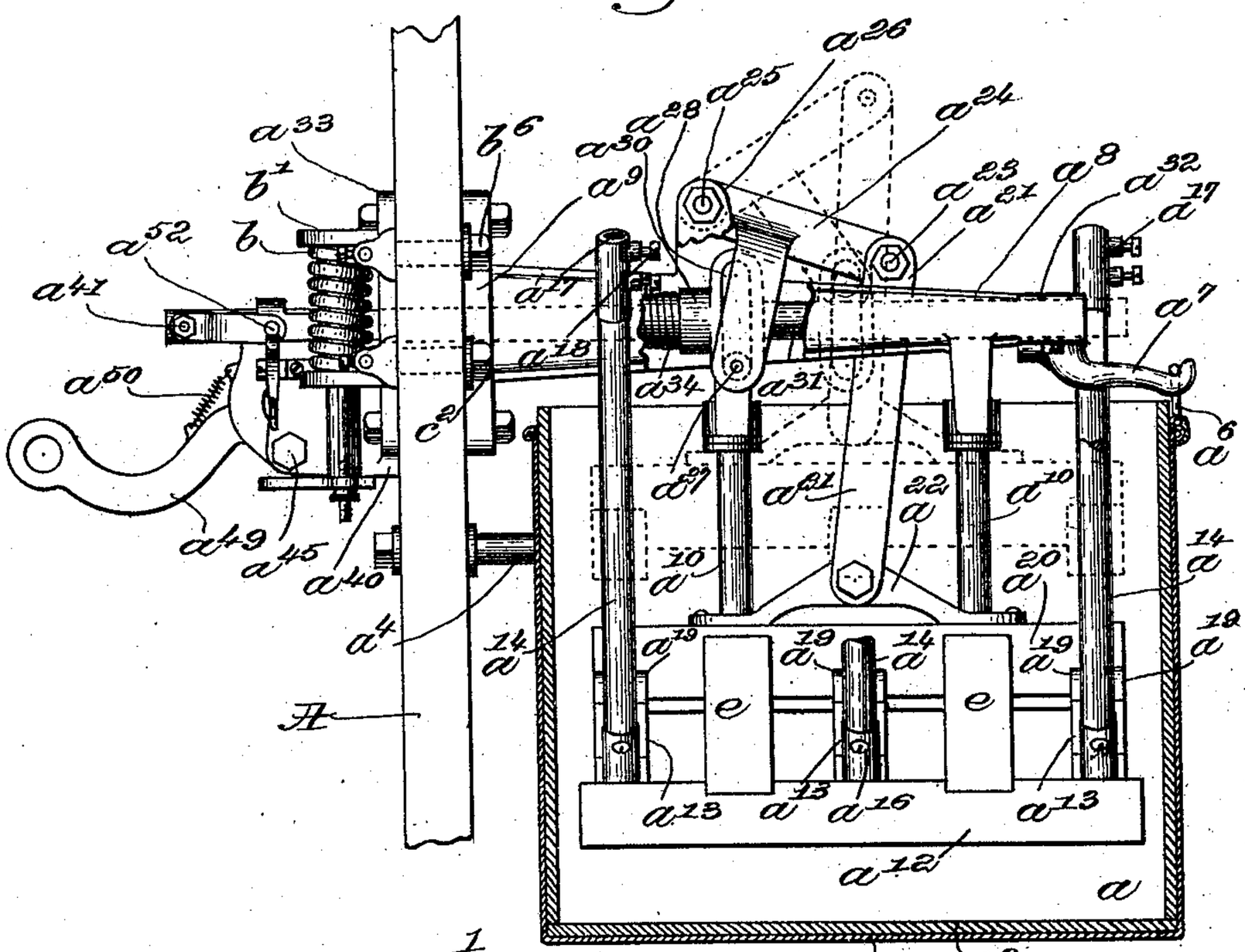
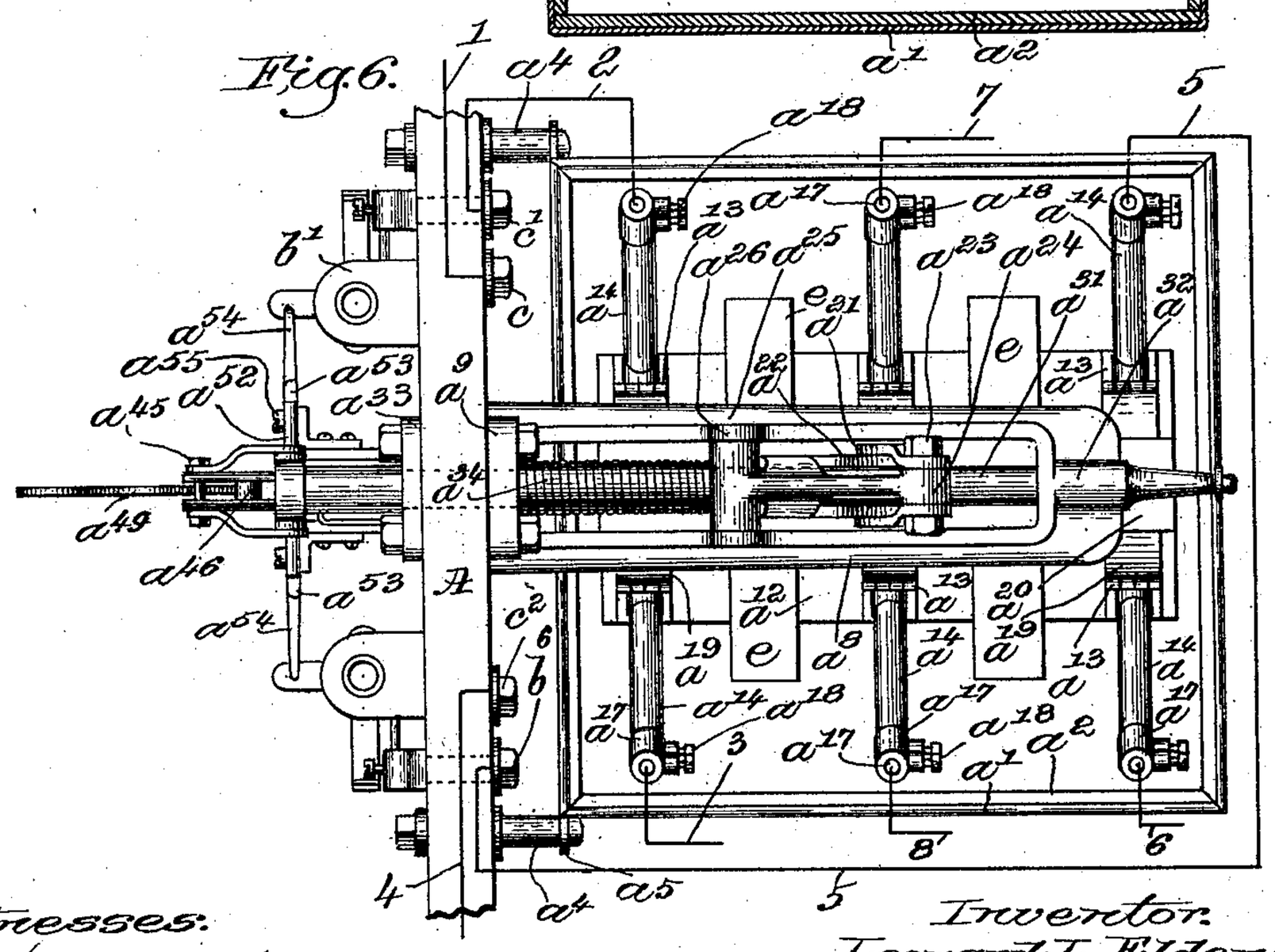


Fig. 6.



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UNITED STATES PATENT OFFICE.

LEONARD L. ELDEN, OF BOSTON, MASSACHUSETTS, ASSIGNOR OF ONE-HALF TO SEARS B. CONDIT, JR., OF SOMERVILLE, MASSACHUSETTS.

CIRCUIT-BREAKER.

SPECIFICATION forming part of Letters Patent No. 756,344, dated April 5, 1904.

Application filed June 20, 1901. Serial No. 65,241. (No model.)

To all whom it may concern:

Be it known that I, LEONARD L. ELDEN, a citizen of the United States, residing at Boston, county of Suffolk, State of Massachusetts, have invented an Improvement in Circuit-Breakers, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

My invention is an improvement in automatic circuit-breakers and includes a number of leading features, certain of which are not claimed herein, but have been covered in divisional and copending applications, this patent covering, broadly, the provision of a plurality of actuating-coils and their armatures, one in each circuit combination liable to be affected by an abnormal current and tripping mechanism automatically operated thereby for opening the circuit-breaker, and also covering a special quick-acting mechanism, including a lever capable of springing freely outward in one direction and moving past a dead-center in an opposite direction and means for operating it to actuate the switch-moving rod or movable member for the make-and-break contacts.

Also my invention includes various other special constructions and advantages, as will be more fully pointed out in the course of the following description, reference being had to the accompanying drawings, in which I have illustrated a preferred embodiment of my invention.

In the drawings, Figure 1 is a perspective view of one form of the apparatus viewing the same from the front. Fig. 2 is a detail in side elevation of a portion of the tripping device. Fig. 3 is a front elevation, the switchboard being broken away to reveal the rear part of the circuit-breaker and the insulating-pan and certain of the details also being omitted for clearness of illustration. Fig. 4 is an enlarged perspective view, parts being broken away, showing details of the operating mechanism. Fig. 5 represents the device in side elevation, parts being broken away and the insulating-receptacle being shown in central longitudinal section, said figure also illustrating in dotted lines the position assumed by the parts when the circuit is broken or the breaker is open; and Fig. 6 is a top plan view thereof.

For convenience of illustration I have herein shown one of my improved circuit-breakers in position on a switchboard A, the front of the switchboard being shown in Figs. 1 and 4. At the rear side thereof is hung a pan a, which may be composed of any suitable material, but is preferably made of metal a', as indicated in Fig. 5, and provided with a wooden or other non-conductive lining a^2. The pan is for holding oil (this part of my invention being claimed in my application, Serial No. 183,458, filed December 2, 1903) and is preferably supported at one end on bolts a^4 by means of ears a^5 and at its opposite end by a bail a^6, hung on a hook a^7, secured to the rear end of a bracket a^8, whose head a^9 is bolted to the switchboard. The bracket a^8 supports the rear portion of the circuit-breaker, being provided for this purpose, as herein shown, with vertical insulating-posts a^{10}, which support at their lower ends a base-block a^{12}, of wood, ebonite, or other proper insulating material. The block a^{12} carries on its upper side opposite contacts a^{13} in pairs, there being herein shown three pairs thereof, adapted to receive the wires from a three-phase generator or the wires of any other three circuits which may be interrelated in such a manner that it is desirable to make and break the same simultaneously. Each contact-spring a^{13} is provided with a post a^{14}, adjustably secured by a set-screw or other means a^{16} and provided at its upper end with a socket a^{17} and set-screws a^{18} for receiving and retaining the wires, preferably above and outside of the insulating pan or tank. Arranged to coöperate with the contacts are corresponding sets of contact-makers a^{19}, secured in proper position on an insulating-bar a^{20}, there being herein shown a gang of three of said contact-makers corresponding to the contacts below the same. The bar a^{20} is arranged to slide up and down on the stationary posts a^{10}, being guided thereby and operated by means of links a^{21}, secured at their lower ends in a plate a^{22}, fastened on the upper side of

the bar a^{20}, and at their upper ends at a^{23} to the free end of a bell-crank a^{24}, pivoted at a^{25} in ears a^{26}, extending rigidly from the bracket a^{8}. The opposite end of the bell-crank is bifurcated and the opposite free ends thereof provided with a roll a^{27}, operating in a slot a^{28} in a collar a^{30} of a plunger or reciprocating rod a^{31}, which is arranged to slide in a bearing a^{32}, provided for convenience in the bracket a^{8}. The plunger a^{31} passes out through the head a^{9} and through a plate a^{33}, which is secured in a similar manner to the front side of the switchboard A and is normally held under a tendency to move inwardly by means of a powerful spring a^{34}, which bears at one end against the collar a^{30}. The plunger a^{31} is connected with a toggle device, which, as herein and preferably constructed and arranged, serves to give extreme facility of operation, the toggle being composed of opposite pairs of links a^{35} a^{36}, pivoted to each other at a^{37} and connected together by a bridge a^{38} and at their opposite ends pivoted, respectively, at a^{39} to brackets a^{40} and at a^{41} to the extreme projecting end of the plunger a^{31} and normally maintained with a downward tendency by a spring a^{29}. The plunger a^{31} is provided with a slot a^{42}, in which operates the upper free end a^{43} of an actuating handle or lever a^{44}, pivoted at a^{45} to the brackets a^{40} and arranged to engage a bearing, herein shown as a roller a^{46}, mounted in the slot a^{42} of the plunger.

A further feature of my invention resides in so arranging and connecting the actuating member or lever a^{44} and the plunger a^{31} that when the lever is pulled down by the operator it will become inoperative, thereby rendering it impossible for the operator to accidentally lock the switch closed until the circuits are in safe normal condition, as will be presently described, (the same being covered in my divisional application, Serial No. 183,457, filed December 2, 1903.) For this purpose the portion a^{43} of the lever is separate from the rest of the lever, being pivoted at a^{45} and provided with a locking pawl or latch a^{47}, normally in engagement with a notch a^{48} in a part a^{49} of the lever a^{44}, said two parts being held together by a spring a^{50}. When the lever is pulled forward to its dotted-line position, Fig. 2, the lower end of the latch a^{47} strikes against a stop a^{51} and is thereby disengaged from the part a^{49} of the lever, so that the downward pull on said part has no control whatever on the part a^{43}, and accordingly the plunger a^{31} is thus automatically placed beyond the control of the operator. When the part a^{49} has been pulled down to close the circuit-breaker and an overload has immediately opened the latter, the part a^{43} is moved to the full-line position, Fig. 2, and the locking pawl or latch a^{47} automatically reëngages the part a^{49} when the operator releases the latter. My invention also enables the operator to ascertain at any moment whether the line has been restored to normal (after having been automatically tripped, for instance) by a simple movement of the actuating-lever, inasmuch as the operation of the lever serves to actuate the plunger a^{31}, which will be automatically locked in closed position if the difficulty has been removed; but if it has not been removed the plunger cannot be automatically locked, and hence upon the automatic escape therefrom of the actuating-lever will fly back to open position. In other words, I provide a construction in which a single hand-lever has entire control over the circuit-breaker at all times whenever the line is in normal condition.

The toggle at its pivot a^{37} is provided with a laterally-extending pin a^{52}, in position when the toggle is extended, as shown in Fig. 1, to engage the upper eccentric side a^{53} of a device herein shown for convenience as a lever a^{54}, pivoted at a^{55} to the adjacent bracket a^{40} and preferably provided with an adjusting-screw a^{56} for regulating the normal height of the surface a^{53}, which engages the pin a^{52}, and having a projecting end or arm a^{57} in position to be engaged and raised by any suitable automatic actuator. The actuator which I have shown is of the ordinary solenoid type, consisting of a coil b, carried by brackets b' on the switchboard. In the coil b operates a suitable core b^{2}, carrying at its lower end a projection or plate-armature b^{3} and guided on rods b^{4}, said plate b^{3} projecting in line with the end a^{57} of the lever a^{54}, so that when any accident occurs, such as a short circuit or other trouble tending suddenly to increase the current or cause liability of fire or other danger due to a sudden rush of current, the increased current flowing through the coil b will instantly raise the core b^{2} and armature, and thereby lift the eccentric-surface a^{53}, so as to raise the toggle-levers above their dead-center, permitting the spring a^{34} instantly to pull inwardly the plunger a^{31}, which (see Fig. 5) serves to turn the bell-crank a^{24} upwardly, and thereby raise the bar a^{20} and simultaneously cut out or break the circuits connected with the circuit-breaker thus operated. One main advantage of having the circuit-breaker simultaneously cut out all the wires, or, as shown, the three wires, is to kill the generator supplying said circuits, and thereby prevent any possible injury to the latter.

The wiring will be readily understood, viewing Figs. 1, 5, and 6, from which it will be seen that I have led the wire 1 to a binding-post c and thence to form the coil b, terminating at c', whence the wire 2 leads to the post a^{14}, next to the switchboard, and out at the wire 3. A wire 4 likewise leads to a binding-post c^{2}, which connects through the switchboard to form an opposite coil b^{5}, and thence back through the switchboard to the binding-post b^{6} and connecting by a wire 5 to the outer pair of posts a^{14} and out by the wire 6. As

herein shown, the intermediate wires 7 8 do not have any actuating-coils or solenoids on the switchboard, for the reason that the illustration which I have used in explaining my invention is supposed to be that of a three-phase generator, in which case nothing can affect the middle wire without affecting the outside wires, because said middle wire acts alternately as a return and a supply for the other two. It will of course be understood by those skilled in the art that these details of wiring and arrangement will be varied according to the particular kind of machine or sets of machines or other situation with which or in which my breaker is used, it being essential merely that each wire which can be affected by an overload, &c., shall contain a solenoid or that there shall be a solenoid in each arrangement of wires forming an outgoing and return current path connecting with the source of energy, so that a two-phase and three-phase system would require two solenoids and above these one solenoid for each phase, and even a single circuit might sometimes require two solenoids—as, for instance, in a circuit operating from one phase of a three-phase system.

In some cases (and, in fact, frequently) it will be desirable to use my breaker for one circuit only; but I have specially constructed and adapted my breaker to operate a plurality of contacts simultaneously, as this is of particular advantage in modern service, where the current-pressure is large and is frequently so great that it is difficult to maintain proper insulation, and hence by having the series or gang of contacts together and specially mounted in oil insulation the insulation difficulties are practically eliminated.

It will be observed that the construction of my breaker makes it an exceedingly simple matter to extend the series of contacts, as the bar a^{20} may be made of any length required, the pan a' and other parts corresponding, and as many contact-makers a^{19} may be mounted thereon as there are pairs of contacts carried by the base-block a^{12}. Again, viewing Fig. 1, it will be seen that the special construction of my breaker also renders it exceedingly feasible to operate any number thereof together, the latter feature, however, not being claimed herein, but, with certain limitations, being broadly claimed in my application, Serial No. 657,752, filed November 8, 1897, now Patent No. 680,652, (certain common features having been claimed in one and others in the other of these copending applications.)

I have herein illustrated in Fig. 1 two breakers as mounted upon the switchboard to be operated either separately or together. Both breakers are similar in construction, and hence no further description thereof is necessary. The cores b^2 of the coils of the lower circuit-breaker are shown as each provided with a pin or extension b^{10}, preferably removable, in position beneath the armature of the coil above it, so that if its coil b^{12} or b^{13}, as the case may be, were suddenly energized, thereby raising the core thereof, the projection b^{10} of the latter would instantly raise mechanically the core above it, and thereby operate the upper breaker. For still greater certainty I prefer also to employ a separate battery-circuit for connecting the several breakers electrically, although for usual purposes either the electrical or mechanical connection will be sufficient. For this purpose I provide a battery or any other independent source of energy d and arrange pairs of independent contact-springs d' d^2 on the switchboard, as shown at the upper left hand of Fig. 1 in perspective and shown adjacent the remaining coils diagrammatically, and connect the battery-circuit with these various contacts in multiple, (or it may be in series, if desired.) Leading from each set of contacts is a shunt-circuit of fine wire, which is wound underneath the coarse winding of the coil proper, as is clearly shown at d^3, Fig. 1, and then I connect these several shunt-windings in multiple by wires d^4. On each core b^2 I mount contact-makers d^5, separated by insulation, in position to engage the pairs of stationary contacts d' d^2. When, therefore, an accident occurs in any circuit of any one of the set of circuit-breakers which are connected together on the switchboard, (or it may be in any other situation or even at long distances apart,) the coil of that branch (or wire) of the circuit in which the accident occurs will instantly respond to the increasing current, thereby moving its core and automatically tripping its circuit-breaker, while at the same time the local or auxiliary battery-circuit or other circuit is made by the engagement of the contact-maker d^5 with the pairs of contacts d' d^2 thereof, thereby compelling the simultaneous breaking of all the circuits governed by all the circuit-breakers which may be coupled together or controlled by the mechanical or electrical connections (either near or remote) and also serving to compel certainty of operation in its own circuit-breaker, (all as set forth and claimed in my divisional application, Serial No. 184,648, filed December 10, 1903.)

I have already mentioned that the number of separate circuits which may be operated by one circuit-breaker simply by extending the bar a^{20} and number of parts carried thereby may be increased indefinitely, and while, as already explained, it would be unnecessary to have as many coils on the face of the switchboard as there were circuits, in case said circuits all led from a polyphase generator, this would not be the case if said circuits were each from separate sources of supply, and in the latter case there would be an actuating-coil for each wire of each circuit, said coils being preferably arranged, as shown in Fig. 1, below each other in pairs, the top pair b b^5

serving to operate the breaker directly and being themselves operated by any one of the other coils below them in case an accident should occur in the circuit of any one of said lower coils.

It will be understood that I have described thus far that construction which is most desirable for extreme efficiency; but while it is of importance in certain situations, especially in connection with polyphase generators, that the circuits should have an actuating-coil in each wire this is unnecessary in many situations.

The adjustment of the height of the eccentric-surface a^{53}, herein shown as accomplished by means of the set-screw a^{56}, although it will be understood that any other suitable means of adjustment may be employed within the spirit of my invention, is for the purpose of giving the circuit-breaker any degree of sensitiveness or responsiveness—as, for instance, if the trouble is only momentary, as when two line-wires might swing together and immediately swing apart again, it might be desirable that the breaker should not operate, and hence the surface a^{53} would be adjusted to a low position, so as to render the operation of the circuit-breaker not readily responsive, and hence although the increase of the current through the coil b or b^5 would raise the armature b^3 into contact with the lever a^{54} it would drop down again instantly and would not have had time to raise the lever a^{54} against the considerable resistance of the toggle device. Also to enable the breaker to be operated at any predetermined increase of current I provide on the lower ends of the guides b^4 threaded thumb-screws b^{20}, by means of which the core b^2 may be adjusted to correspond to a scale marked thereon, as is clearly shown in the drawings.

When a gang of breakers are operated together or when a gang of distinct circuits are operated together either by different breakers or by the same breaker, it is often desirable that part of them should be thrown out of automatic operation together, and hence I provide in the circuits d^4 switches d^6, which serve to cut out the separate shunt-coils of fine wire d^3.

I do not claim herein the operation together of a gang or series of circuit-breakers either by mechanical or electrical means, nor do I claim herein that portion of my invention which I have herein shown and described and which relates generally to the automatic releasing device for cutting off the control of the operating-lever or closing means responsive to predetermined current conditions, nor do I claim the removable oil-pan insulating means, as these various features are claimed elsewhere, as heretofore stated, where they are properly presented and their limitations defined.

In operation when a rise of current takes place in any wire it tends instantly to operate its coil—as, for instance, the coil b^{12}—thereby raising its core and armature into contact with the break-lever or tripping device a^{54}, and when the latter has been raised sufficiently to throw the toggle device over the dead-center the plunger a^{31} is instantly retracted by its spring a^{34}, thereby opening the circuit. If the circuit-breaker operates a gang of circuits, they are all simultaneously broken, and so likewise the raising of the armature of the coil b^{12} serves simultaneously to lift the mechanical actuator b^{10} into lifting engagement with the superposed armature and brings also instantaneously to the aid thereof the auxiliary circuit by the closing thereof, due to the contact of the maker d^5 with the pairs of contacts d' d^2, so that the shunt-coil of the upper coil b is operated, and this serves instantly to operate the upper breaker. Of course when the separate breakers of the series which are connected together are located at considerable distances apart it is impracticable to employ the mechanical connection, and they must therefore be coupled together electrically; but when possible I prefer to employ both to make more certain the operation of the whole device.

It will be understood that I do not limit myself to the particular form of surface a^{53} or connection thereof, as certain of my claims are intended to include any adjustable surface, and also while I prefer the form of toggle construction shown I am not limited thereto, as I intend certain of my claims to cover any construction in which a moving part may be moved past a dead-center sufficiently to lock the plunger or bolt-like device a^{31} in one position and when moved in an opposite direction will permit said device to spring forward for suddenly opening the circuit or circuits.

When the operator wishes to operate any of one of the circuit-breakers, he simply pulls down upon the lever a^{44}, thereby closing the breaker, and when the apparatus is constructed according to my preferred embodiment herein shown, in which the lever automatically becomes inoperative, it leaves the breaker free to open automatically in case any trouble should occur, and if said trouble does occur it is impossible for the operator to prevent the breaker from staying open by a simple movement, on his part, of the lever, inasmuch as the moment he lowers the lever a^{44} the plunger flies back automatically to open position, as the surfaces a^{53} being raised by the excessive current in the solenoids it cannot become locked.

As already stated, one special purpose of this invention is provide a construction capable of withstanding enormous currents without destructive arcing, and as a further precaution for insuring absolute safety, especially with high pressure and large current, I interpose a rigid insulator or barrier e between the successive pairs of posts a^{14}, secured

to a^{12}, as indicated in Figs. 5 and 6, this barrier being of ebonite, wood, or other insulating material and serving to prevent the accidental formation of a gap by the expulsion of the oil due to the gaseous decomposition of the oil by the breaking of an enormous current.

In situations where a regular switchboard cannot be put in position it is advantageous to mount the pan and actuating apparatus on the same side with the coils and lever, slight mechanical changes being made to permit the same, and in general it will be understood that I do not restrict myself to the precise mechanism herein described, as various modifications and rearrangements may be resorted to within the spirit of my invention.

I have shown the present construction, as it clearly exhibits all the constructional parts; but it will be understood that the same apparatus in its more vital details may be more compactly embodied without departing from the spirit and scope of my invention.

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

1. A circuit-breaker, comprising make-and-break contacts, an operating member therefor, a coil in each circuit of said circuit-breaker, one coil on each side thereof, armatures actuated by said coils, and two sets of tripping mechanism for said operating member, said sets of tripping mechanism being automatically operated respectively by said respective armatures.

2. A circuit-breaker, comprising make-and-break contacts, an operating member therefor, a plurality of coils, one in each circuit of said circuit-breaker, an armature actuated by each coil, and independent sets of tripping mechanisms one for each armature automatically operated thereby for opening the circuit-breaker.

3. A circuit-breaker, comprising make-and-break contacts, operating means for opening and closing said contacts, a plurality of coils, one in each circuit combination connected with said circuit-breaker, a plurality of independently-operable armatures, one actuated by each coil, and tripping mechanism automatically operated thereby for opening the circuit-breaker.

4. A circuit-breaker, having separable cooperative contacts, and means for moving one of them, said means including a longitudinally-movable rod, an operating-lever for moving said rod lengthwise in one direction to close a circuit, and quick-acting mechanism for moving the rod lengthwise in an opposite direction to break the circuit, said mechanism including a lever capable of springing freely outward in one direction to permit the opening movement of said rod and moving past a dead-center in an opposite direction, to hold the rod locked in closed position, and means for lifting said lever past said dead-center to permit the quick opening of the breaker.

5. A circuit-breaker, having separable cooperative contacts, and means for moving one of them, said means including a longitudinally-movable rod, an operating-lever for moving said rod lengthwise in one direction to close a circuit, and quick-acting mechanism for moving the rod lengthwise in an opposite direction to break the circuit, said mechanism including means tending forcibly to move the rod quickly toward open position, a lever capable of springing freely outward in one direction to permit the opening movement of said rod and moving past a dead-center in an opposite direction to hold the rod locked in closed position, and automatic means for lifting said lever past said dead-center to permit the quick opening of the breaker.

6. A circuit-breaker, having separable cooperative contacts, and means for moving one of them, said means including a rod, an operating-lever for moving said rod to close the circuit, and quick-acting mechanism for moving the rod to break the circuit, said mechanism including a lever capable of springing freely outward in one direction and moving past a dead-center in an opposite direction, and adjustable means for lifting said lever past said dead-center to permit the quick opening of the breaker.

7. A circuit-breaker, comprising a base, an insulator-bar, coöperating make-and-break contacts carried by said base and bar, guides for the bar, a lever pivotally connected to said bar for moving the same toward and from said base, a reciprocating member for actuating said lever, means maintaining said member under normal tendency to move for breaking said contacts, an operating-handle for moving said member in opposition thereto, a pivoted lever connected to said member arranged to swing past a dead-center for holding said member in position for closing the circuit-breaker, and means for moving said lever in an opposite direction for permitting the instantaneous opening of the breaker.

8. A circuit-breaker, comprising a base, an insulator-bar, coöperating make-and-break contacts carried by said base and bar, guides for the bar, a lever pivotally connected to said bar for moving the same toward and from said base, a reciprocating member for actuating said lever, means maintaining said member under normal tendency to move for breaking said contacts, an operating-handle for moving said member in opposition thereto, a toggle pivoted at one end to said member and at its other end to a stationary part, the movement of said toggle past the dead-center in one direction permitting the instantaneous opening

of the breaker, and the movement of said toggle past the dead-center in an opposite direction serving to retain the breaker closed.

9. A circuit-breaker, comprising a base, an insulator-bar, coöperating make-and-break contacts carried by said base and bar, guides for the bar, a lever pivotally connected to said bar for moving the same toward and from said base, a reciprocating member for actuating said lever, means maintaining said member under normal tendency to move for breaking said contacts, an operating-handle for moving said member in opposition thereto, a toggle pivoted at one end to said member, and at its other end to a stationary part, the movement of said toggle past the dead-center in one direction permitting the instantaneous opening of the breaker, and the movement of said toggle past the dead-center in an opposite direction serving to retain the breaker closed, and means for automatically moving said toggle.

10. A circuit-breaker, comprising make-and-break contacts, a movable member for actuating the same, a lever pivoted to said member and movable in opposite directions past the dead-center for locking said member in one position, or permitting its movement to an opposite position, an eccentric surface for limiting the movement of said lever in said locking position, an arm for raising said surface to swing said lever past the dead-center, a solenoid actuated by the current governed by the breaker, and an armature moved by said solenoid in the path of and to actuate said arm.

11. A circuit-breaker, comprising make-and-break contacts, a movable member for actuating the same, a lever pivoted to said member and movable in opposite directions past the dead-center for locking said member in one position, or permitting its movement to an opposite position, an eccentric surface for limiting the movement of said lever in said locking position, an arm for raising said surface to swing said lever past the dead-center, a solenoid actuated by the current governed by the breaker, and an armature moved by said solenoid in the path of and to actuate said arm, and means for regulating the position of said eccentric surface.

12. A circuit-breaker, comprising make-and-break contacts, a movable member for actuating the same, a lever pivoted to said member and movable in opposite directions past the dead-center for locking said member in one position, or permitting its movement to an opposite position, an eccentric surface for limiting the movement of said lever in said locking position and means for moving said surface to swing said lever past the dead-center.

13. A circuit-breaker, comprising make-and-break contacts, a movable member for actuating the same, a lever pivoted to said member and movable in opposite directions past the dead-center for locking said member in one position, or permitting its movement to an opposite position, an eccentric surface for limiting the movement of said lever in said locking position and means for regulating the position of said eccentric surface.

14. A circuit-breaker, comprising make-and-break contacts, a movable member for actuating the same, a lever pivoted to said member and movable in opposite directions past the dead-center for locking said member in one position, or permitting its movement to an opposite position, an eccentric surface for limiting the movement of said lever in said locking position, and automatic means for moving said surface to swing said lever past the dead-center.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

LEONARD L. ELDEN.

Witnesses:
GEO. H. MAXWELL,
ADOLPH C. KAISER.