W. M. SCOTT.

CIRCUIT BREAKING MECHANISM.

APPLICATION FILED MAR. 1, 1905.

963,476.

Patented July 5, 1910.

3 SHEETS—SHEET 1.

Fig. 1.

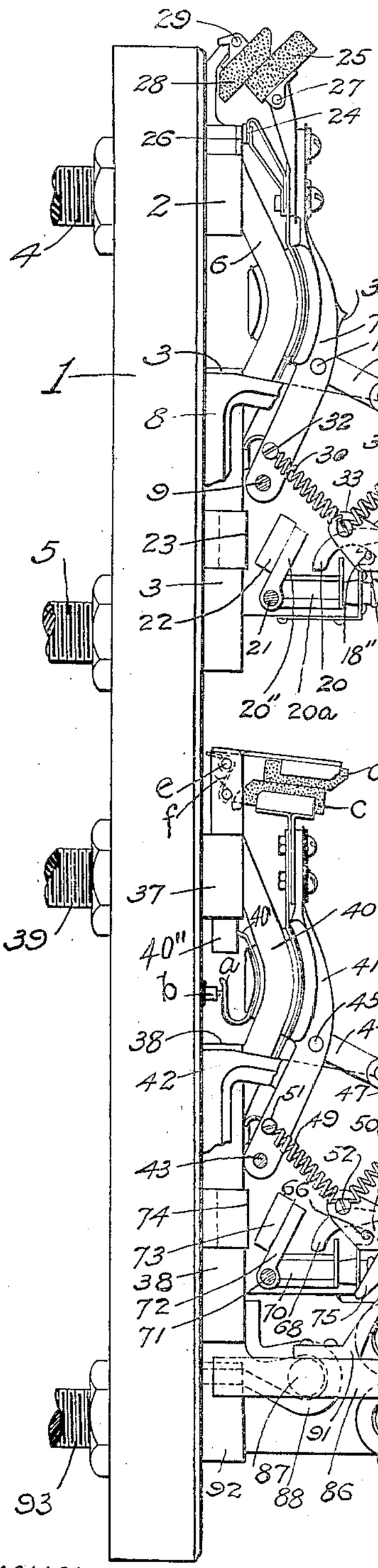


Fig. 1.a

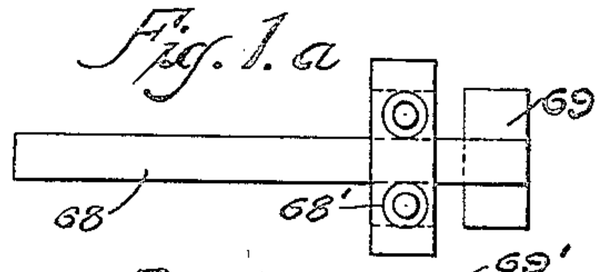


Fig. 1.b

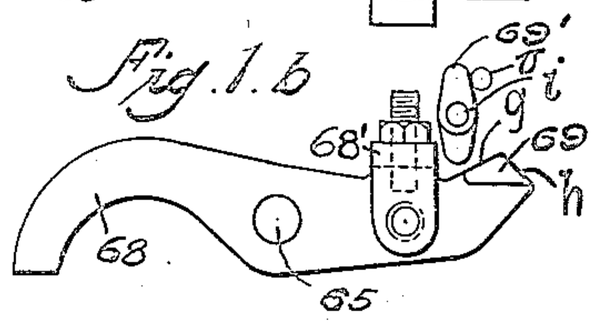


Fig. 1.c.

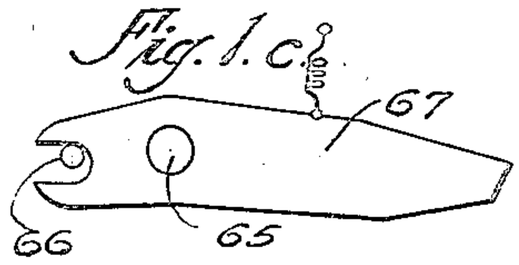


Fig. 1.d.

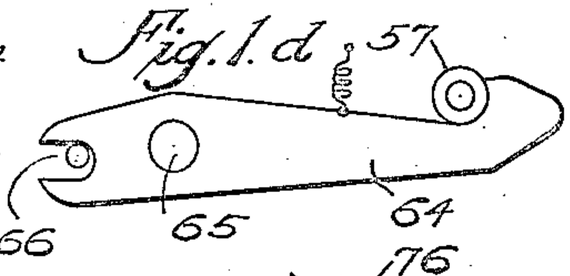


Fig. 1.e.

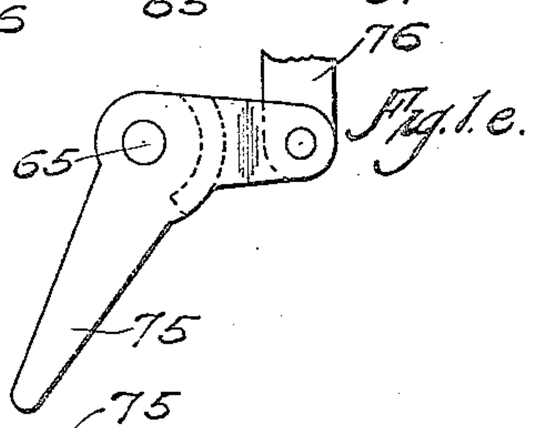
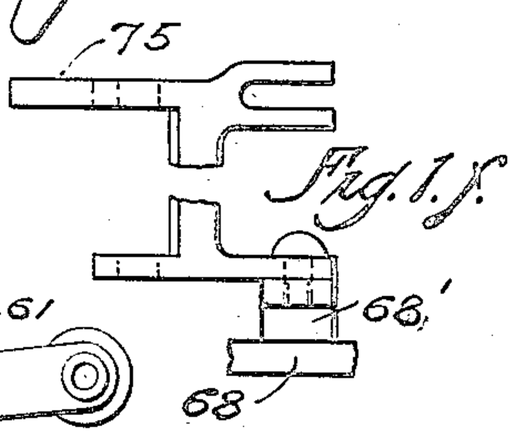


Fig. 1.f.



Witnesses

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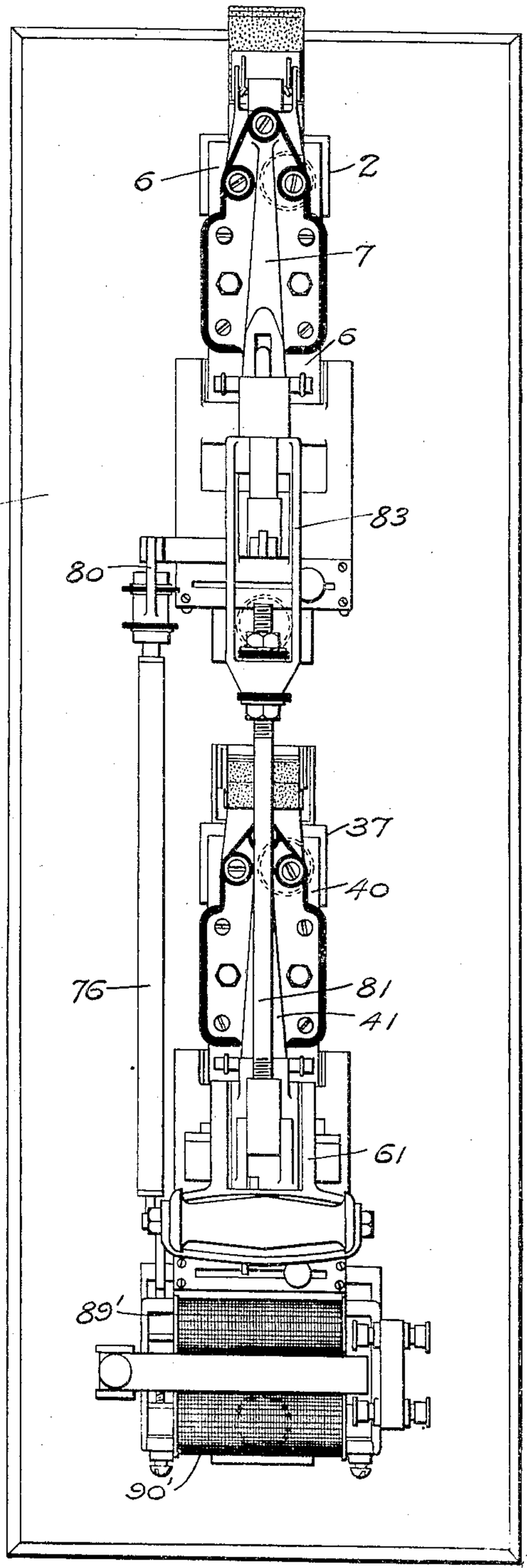
3 SHEETS—SHEET 2.

Fig. 2.



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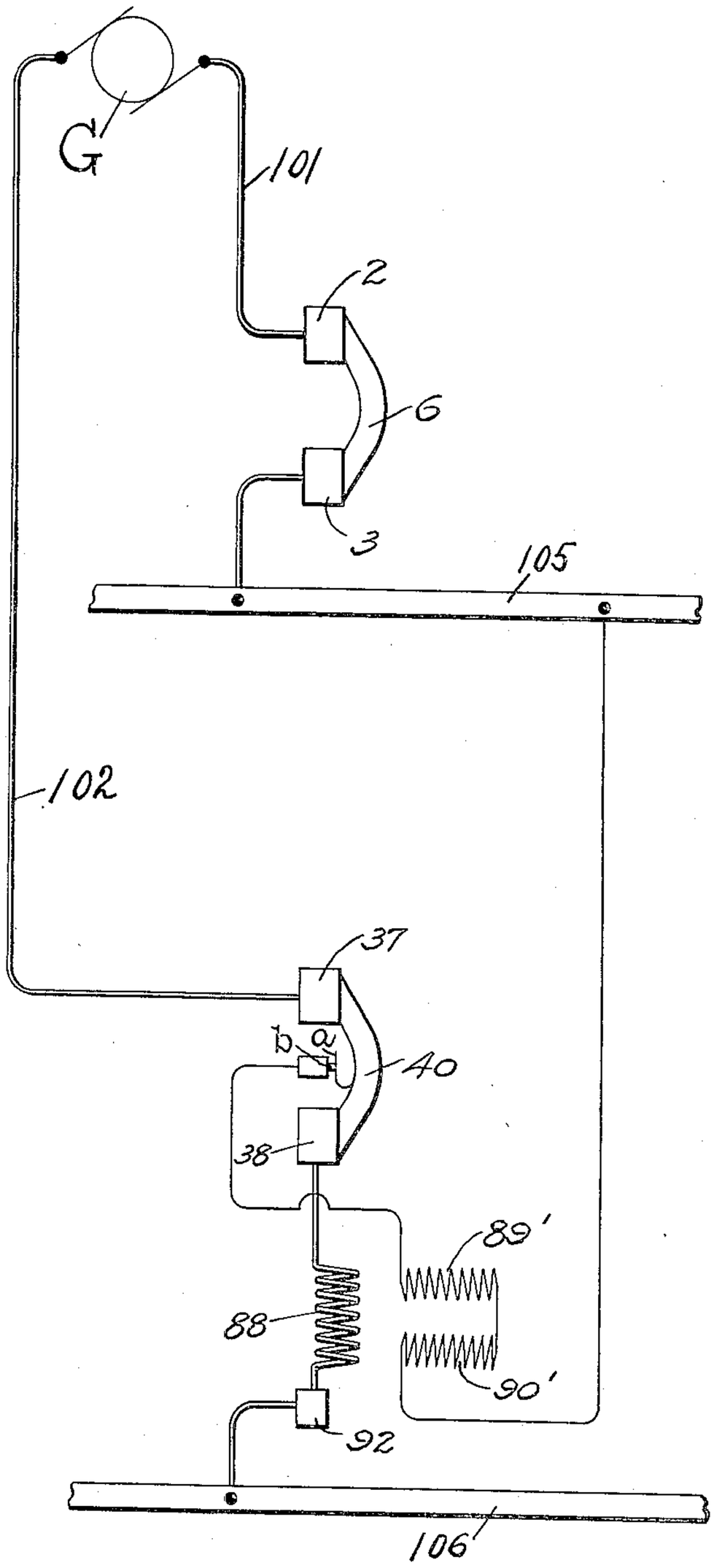
3 SHEETS—SHEET 3.

Fig. 3.



Witnesses
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UNITED STATES PATENT OFFICE.

WILLIAM M. SCOTT, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO THE CUTTER ELECTRICAL AND MANUFACTURING COMPANY, A CORPORATION OF NEW JERSEY.

CIRCUIT-BREAKING MECHANISM.

963,476. Specification of Letters Patent. **Patented July 5, 1910.**

Application filed March 1, 1905. Serial No. 247,914.

To all whom it may concern:

Be it known that I, WILLIAM M. SCOTT, a citizen of the United States, residing in the city and county of Philadelphia and State of Pennsylvania, have invented a new and useful Circuit-Breaking Mechanism, of which the following is a specification.

My invention relates to apparatus for controlling or breaking circuits carrying currents of large volume such as are employed in electric lighting, electric power transmission, and the like.

My invention resides in circuit breaking mechanism involving a plurality of interconnected circuit breakers, disposed preferably one vertically above another so as to economize space laterally upon a switch board or the like.

My invention resides also in interconnected circuit breakers so disposed that the response of one to certain circuit conditions will result in the tripping of another or others, and in the additional feature that one of a plurality of interconnected circuit breakers may respond to one kind or degree of circuit condition, while another may respond to another kind or degree of circuit condition.

My invention resides also in a plurality of interconnected circuit breakers whose tripping and operating mechanisms are so disposed that it shall be impossible to fully close the circuit breakers during the continuance of any one of a plurality of predetermined circuit conditions.

My invention resides in other features of arrangement and construction hereinafter described and pointed out in the claims.

For an illustration of one of the numerous forms my invention may take, reference is to be had to the accompanying drawings, in which:—

Figure 1 is a side elevational view of two interconnected circuit breakers. Fig. 1^a is a plan view of the lever 68 and its attachments. Fig. 1^b is a side elevation of the lever 68 and its attachments. Fig. 1^c is a side elevation of the lever 67. Fig. 1^d is a side elevation of the latch 64. Fig. 1^e is a side elevation of the lever 75 and its attachments. Fig. 1^f is a plan view of the lever 75 and its attachments. Fig. 2 is a front elevational view of the apparatus shown in Fig. 1. Fig. 3 is a diagrammatic view of circuit arrangements.

Referring to Figs. 1 and 2 of the drawings, 1 represents a base of insulating material, such as slate or marble and may be a portion of a switch board. 2 and 3 are switch terminal blocks or contact terminals consisting preferably of masses of copper secured to the front of the switch board or base 1 by means of bolts 4 and 5 respectively which serve also as means for conducting current to or from such terminal blocks. 6 is a laminated bridging member adapted to conductively connect the terminals 2 and 3 by engaging them upon their front faces. 7 is an arm pivoted to the frame 8 at 9 and supports the laminated bridging member 6, though insulated from it. 10 is a link pivoted to the arm 7 at 11, and at 12 to the lever 13 pivoted at 14 in the frame 8. The link 10 and the lever 13 constitute a toggle for cramping the laminated bridging member 6 into firm engagement with the terminals 2 and 3. When in the circuit closing position, as shown in Fig. 1, the toggle falls slightly short of being fully extended. 15 is an extension of the lever 13 and carries at its lower extremity a roller 16 pivoted at 17. 18 is a latch pivoted to the frame 8 at 19 and adapted to engage the roller 16 to lock the switch in the position shown in Fig. 1. The latch 18 terminates to the left of the pivot 19 in the jaw 18′ embracing the pin 18″ secured to the frame 8 and adapted to limit the travel of the latch 18. 20 is a lever pivoted at 19 independently of the latch 18 and carries at its outer end the screw 20′ adapted to strike the top of the latch 18. The lever 20 extends into the path of travel of the member 20^a pivoted to the frame 8 at 21. An extension 20″ of the member 20^a carries the iron armature 22 coöperating with the pole pieces 23 formed on a mass of iron held between the base 1 and the recessed terminal 3 and embracing the terminal 3, and thus constituting an electromagnet responsive to the current flowing from one terminal to the other through the bridging member 6. Supported by but insulated from the arm 7 and from the laminated bridging member 6 are the movable metallic and carbon shunt contacts 24 and 25 respectively, which are in permanent electrical communication with the lower contact block 3. The metallic shunt contact 24 engages the metallic member 26 supported upon or in electrical communication with the upper terminal block 2, and the movable

shunt carbon 25, pivoted at 27, contacts with the stationary shunt carbon 28, pivoted at 29 to a bracket supported upon and in electrical communication with the upper main contact 2, in the manner well understood in this art.

The apparatus thus far described constitutes an automatic magnetic circuit breaker which, upon the flow of a predetermined value of current through the laminated bridging member 6, is caused to interrupt such current. When the current strength reaches such predetermined value the armature 22 is attracted by the poles 23, causing the member 20[a] to move upwardly and strike upon the under side of the lever 20, which in turn, through the screw 20′, strikes upon the upper side of the latch 18, thus releasing the member 15. When this tripping mechanism is operated, the toggle 10, 13 collapses under the influence of the resiliency of the laminated bridging member 6, the springs 30 and 31, (under tension) and gravity, thus causing the laminated bridging member 6 to rotate about the pivot 9 away from the main terminals 2 and 3. Immediately after the laminated bridging member has separated from contact blocks 2 and 3, the metallic shunt contact 24 separates from its companion terminal 26, and finally the carbon 25 separates from the carbon 28, where the final break occurs in the manner well understood in this art. The spring 30 is connected at 32 to the arm 7, and at 33 to an ear on the frame 8. Similarly the spring 31 is connected at one end at 33 and at the other end at 34 to the toggle lever 13. When the circuit breaker has completed its opening movement the boss 35 on the arm 7 rests upon the lug 36 upon the lever 13.

Directly below the circuit breaker just described is mounted a second circuit breaker upon the base or switch board 1. In this lower circuit breaker 37 and 38 are the two main contact terminals secured to the base 1, and in practically vertical alinement with the blocks 2 and 3 of the upper switch. The bolt 39 secures the contact terminal 37 and serves also as means for electrical communication with the terminal block 37.

40 is a laminated bridging member, similar to bridging member 6, and is adapted to conductively bridge the terminal blocks 37 and 38. The laminated member 40 is supported by and insulated from the arm 41 pivoted to the frame 42 at 43.

44 is a link pivoted to the arm 41, at 45, and at 46 to the lever 47 pivoted to the frame 42 at 48. The link 44 and the lever 47 constitute a toggle for cramping the bridging member 40 into firm engagement with the terminal blocks 37 and 38.

At 49 and 50 are shown spiral springs under tension, the spring 49 being secured at 51 to the arm 41; and at its other end at 52 to an ear on the frame 42. The spring 50 is secured at its one end at 52 and at its other end at 53 to the toggle lever 47. The toggle lever 47 has the extension 54 carrying the roller 55 pivoted at 56, and the roller 57 pivoted at 58.

59 is a latch pivoted at 60 to the operator's handle or lever or actuator 61, and adapted to engage the roller 55 to lock the operator's handle 61 to the member 54. The operator's handle or actuator 61 is pivoted to the frame 42 at 48 concentric with and independently of the member 54.

62 is a web in the handle 61 through which extends the adjusting screw 63 for limiting the clockwise rotation of the latch 59, as viewed in Fig. 1. A spring holds latch 59 against the stop 63.

64 is a latch pivoted to the frame 42 at 65 and adapted to engage the roller 57 to lock the member 54 to the base in circuit closing position, as shown in Fig. 1.

The latch 64 terminates to the left of the pivot 65 in a jaw embracing the pin 66 in the frame 42 for limiting the travel of the latch 64.

67 is a lever pivoted at 65 independently from the latch 64 and terminates to the left of the pivot 65 in a jaw similar to that of latch 64 and is also limited in its motion by the pin 66.

68 is a lever pivoted at 65 independently from the latch 64 and the lever 67, and terminates at its outer end in the transversely extending piece 69. This piece 69 has the two inclined surfaces *g* and *h*.

69′ is a member pivoted at *i* upon the actuator 61 and is limited in its clockwise rotation about such pivot by the pin *o* also carried by the actuator 61. Upon a slight reversed movement of the actuator 61, the lower end of the member 69′ rides up upon the surface *g* thus rotating the lever 68 in a clockwise direction and actuating the latches 18, 59 and 64, with resultant opening of both circuit breakers. Upon the depression of the actuator 61 however, the member 69′ rides over the inclined surface *h* without effecting any result, and when the parts have assumed full circuit closing position the member 69′ has attained this vertical position as shown in Fig. 1[b]. Secured to the lever 68 is the transversely extending member 68′ which extends across above the lever 67 and the latch 64, and is provided with adjustable screws for striking upon the upper sides of the latch 64 and the lever 67. The tail of lever 68 is in the path of travel of the member 70 pivoted to the frame 42 at 71 and having the upward extension 72 carrying the iron armature 73, coöperating with the poles 74 of a mass of iron held between the base 1 and the terminal 38 to constitute an electro-magnet.

When the current through the bridging

member 40 reaches a predetermined value, the armature 73 is attracted toward the poles 74, causing the member 70 to strike the under side of the tail of lever 68, causing such lever to rotate in a clockwise direction upon the pivot 65. During this rotation of the lever 68 the transversely extending member 68′ causes the screws carried thereby to strike the upper sides of the latch 64 and the lever 67. This causes the latch 64 to release the roller 57, thereby releasing the member 54 and permitting the toggle 44, 47 to collapse and cause the laminated bridging member 40 to separate from the main terminals 37 and 38. Practically simultaneously with, or slightly after, the release of the member 54 from latch 64, the lever 67 strikes the tail of the latch 59, causing such latch to rotate in a counter clockwise direction about its pivot 60, thus disconnecting the actuator or operator's handle 61 from the member 54.

Soon after the laminated member 40 has separated from the stationary contact terminals, the movable metallic shunt contact 40′ separates from the stationary metallic shunt contact 40″ which is a downward extension from the main terminal block 37. The contact 40′ is in electrical communication with the bridging member 40 and terminates in the contact *a* coöperating with the resilient or plunger contact *b* secured upon the base 1. These contacts *a* and *b* control the circuit of the shunt windings 89′ and 90′, hereinafter described, and as shown in Fig. 3.

In electrical communication with the lower contact terminal 38, and supported by but insulated from the pivoted arm 41, is the movable shunt carbon contact *c* which coöperates with the stationary shunt carbon contact *d*, pivoted at *e* to a bracket secured to and in electrical communication with the upper terminal block 37. A spring *f* tends to keep the carbon *d* in its lowest position. The carbons *c* and *d* overlap each other to a considerable extent, and to a greater extent than the carbons 25 and 28 of the upper circuit breaker, for the purposes hereinafter pointed out.

75 is a lever pivoted at 65 and secured to the lever 68. To the outer extension of the lever 75 is pivoted the vertically extending rod 76 which is pivoted at its upper end at 77′ to the crank member 77 secured to the lever 20 and movable about the pivot 19. The upper end of the rod 76 is screw threaded to receive the nuts 78 and 79 which determine the position of the connecting member 80. The connecting member 80 is insulated from the rod 76. Similarly the vertically extending rod 81 is pivoted at its lower end at 81′ to the member 54 and at its upper end is pivoted to the member 15 at 82.

83 is a connector between the pivot 82 and the rod 81 and is insulated from the rod 81. The nuts 84 and 85, engaging screw threads upon the upper end of the rod 81, serve to adjust the distance between the pivots 81′ and 82.

86 is an armature secured to the core 87 which extends through the series winding 88. The armature 86 and core 87 are rotatable about the axis of the core 87.

89 and 90 are transversely extending cores surrounded by the shunt windings 89′ and 90′ respectively, and between these cores the armature 86 is adapted to play.

91 is an extension secured upon the armature 86 and serves to strike the lever 75 upon the occurrence of reversed current or reversed energy flow. The one terminal of the series coil 88 connects with the contact 92 secured to the front of the base or switch board 1 by means of the bolt 93 which serves also for electrical communication with contact 92. The other end of the series coil 88 is connected to the lower end of the main terminal block 38.

From the foregoing description it is apparent that a plurality of narrow edgewise type circuit breakers are arranged one vertically above the other, that is, in practically vertical alinement, upon a switch board, as is evident from an inspection of Fig. 2.

As seen in Fig. 3, a circuit breaker is connected in each side or conductor of a circuit, the two circuit breakers being interconnected in a pair as shown in Figs. 1 and 2. If an abnormal electrical condition obtains in either side or conductor of a circuit, both circuit breakers are tripped with the resultant opening of both sides or conductors of a circuit. Furthermore upon attempted closure during the continuance or existence of abnormal electrical conditions, both circuit breakers again spring to open circuit position.

The operation of the circuit breaking mechanism is as follows:—Assuming the parts in the position shown in Fig. 1, upon the occurrence of an excessive flow of current through the bridging member 6, the armature 22 is attracted with resultant release of the roller 16 from the latch 18, as heretofore described. Since the vertically extending rod 76 is connected with the lever 20 through the crank member 77, the attraction of the armature 22 causes, in addition to the actuation of the latch 18, the actuation of the rod 76 in a downward direction. This results in the transmission of a force or blow through the member 75 to the lever 68 of the lower circuit breaker. The lever 68 then, through the screws carried by the transversely extending member 68′, actuates the latch 64 to release the member 54, and the lever 67, which in turn actuates the latch 59 to disconnect the operating handle 61 from the member 54. Or if an excessive

current flows through the bridging member 40 of the lower circuit breaker, the armature 73 is attracted and delivers a blow to the lever 68, resulting in the actuation of latches 59 and 64 as described. Simultaneously however, the vertically extending rod 76 is actuated, and there is transmitted a force or blow to the latch 18 to release the member 15 of the upper circuit breaker. Or should there occur a reversal of current or energy flow, the armature 86 rotates in a counter clockwise direction as viewed in Fig. 1, causing the member 91 to strike the lever 75 with resultant actuation of latches 59 and 64 and a simultaneous actuation of the latch 18 of the upper circuit breaker, thus again causing both circuit breakers to fly to open circuit position.

It will be observed that the tripping mechanism connecting member or rod 76 is so connected, disposed and arranged that the weight of the rod 76 need not be overcome or lifted by any of the tripping magnets. On the contrary, the arrangement is such that the weight of the rod 76 exerts a force in such direction as to make the tripping more sensitive and easy.

Assuming the parts to be in the open circuit position, the operating handle 61 is disconnected from the member 54 and obviously also from the member 15. To close the circuit breakers the actuator or operator's handle 61 is raised until the latch 59 engages the roller 55 in the member 54. Then by depressing the actuator 61 the members 15 and 54 are simultaneously operated with resultant extension of the toggles 10, 13, and 44, 47, thus bringing the parts into circuit closing position, and when full circuit position is reached, the latch 18 engages the roller 16 to lock the upper circuit breaker, and similarly the latch 64 engages the roller 57 to lock the lower circuit breaker. If, however, during the closing movement, abnormal electrical conditions obtain, such as reversed current or energy flow, or excessive current flow, at the initial closure of circuit, as by the movable carbons of each circuit breaker touching their companion stationary carbons, the latch 59 will be actuated by any one of the three tripping magnets, with resultant disconnection of the actuator 61 from the members 54 and 15. The circuit breakers will then again fly to open position. An operator is therefore robbed of control of the circuit breakers if abnormal conditions obtain, and he is powerless to close the circuit or hold it closed during the continuance of such abnormal electrical conditions.

Since one circuit breaker is located directly below the other and since the arc formed at the final separation of the carbons tends to rise vertically, the carbons of the two circuit breakers are so disposed that the carbon pieces 25 and 28 of the upper circuit breaker shall separate after the separation of all the metallic parts of the upper circuit breaker and of the lower circuit breaker, but before the final separation of the carbon shunt contact pieces *c* and *d* of the lower circuit breaker. The result is that the principal arcing takes place at the carbons of the upper circuit breaker thus reducing the liability of injury to the parts of the upper circuit breaker immediately above the carbons of the lower circuit breaker. The upper circuit breaker is further shielded in this respect from the fact that the carbons of the lower circuit breaker overlap each other greatly so that the final break occurs at a considerable distance in front of the switch board, and at a safe distance away from the parts of the upper circuit breaker.

While the circuit breakers herein shown and described are of the "laminated" type it is to be understood that they may be of any other suitable type, such as the "knife blade" type.

Though the bridging members of the circuit breakers shown in Fig. 1 are connected in series with each other in the same electric circuit, (see Fig. 3), it is to be understood that the bridging member 6 may control a circuit separate and independent from the circuit controlled by the bridging member 40.

What I claim is:—

1. In combination, a plurality of interconnected electric switches disposed one vertically above the other and each comprising a main movable contact member and shunt contacts, the shunt contacts being adapted to separate after the main contact, and the shunt contacts of the several switches being so disposed that the shunt contacts of an upper switch separate before those of a lower switch.

2. In combination, a plurality of electric switches, each comprising main and shunt contacts located in vertical alinement, the switches being arranged one above the other, and the shunt contacts of an upper switch being arranged to open before the shunt contacts of a lower switch.

3. In combination, a plurality of electric switches each comprising main and shunt contacts arranged in substantial vertical alinement, and the main and shunt contacts of all switches arranged in substantial vertical alinement, the shunt contacts of an upper switch adapted to open before the shunt contacts of a lower switch.

4. In combination, a plurality of electric switches disposed one above the other and each comprising a main movable contact member and shunt contacts, the shunt contacts being adapted to separate after the main contact, and the shunt contacts of the

several switches being so disposed that the shunt contacts of an upper switch separate after the main contact of a lower switch.

5. In combination, a plurality of electric switches disposed one above the other each comprising a main movable contact member and shunt contacts, the shunt contacts being adapted to separate after the main contacts, and the shunt contacts of the several switches being so disposed that the shunt contacts of an upper switch separate after the main contacts of a lower switch but before the shunt contacts of a lower switch.

6. In combination, a plurality of electric switches disposed one above the other each comprising a main movable contact member and shunt contacts, a member connecting the movable contact members of the several switches, and the shunt contacts of the several switches being so disposed that the shunt contacts of an upper switch separate before those of a lower switch.

7. In combination, a plurality of electric switches disposed one above the other each comprising a main movable contact member and shunt contacts, a member connecting the movable contact members of the several switches and the shunt contacts of the several switches being so disposed that the shunt contacts of an upper switch separate after the main contacts of a lower switch but before the shunt contacts of a lower switch.

8. In combination, a plurality of electric switches disposed one above the other and each comprising a movable contact member and means for locking the same in normal position, means common to all the switches for simultaneously tripping the same, and electro-responsive means for operating said common tripping means, said common tripping means being so disposed that its weight exerts a force in a direction to assist said electro-responsive means.

9. In combination, a plurality of electric switches, each switch comprising a movable contact member and a latch for locking the same in normal position, a member for actuating the latches of all the switches, and electro-responsive means for actuating said member, said member being so disposed that its weight exerts a force in a direction to assist said electro-responsive means.

10. In combination, a plurality of electric switches disposed one above the other, each switch comprising a movable contact member and a latch for restraining the same in normal position, a pivoted latch actuator in each switch, and a member uniting the latch actuators of all the switches, said member being connected to said latch actuators in such position that its weight exerts a force in a direction to assist in actuating said latches.

In testimony whereof I hereunto affix my signature this 28th day of February, 1905.

WILLIAM M. SCOTT.

Witnesses:

EDITH N. BAHN,

ALICE S. MARSH.