C. T. HENTSCHEL.

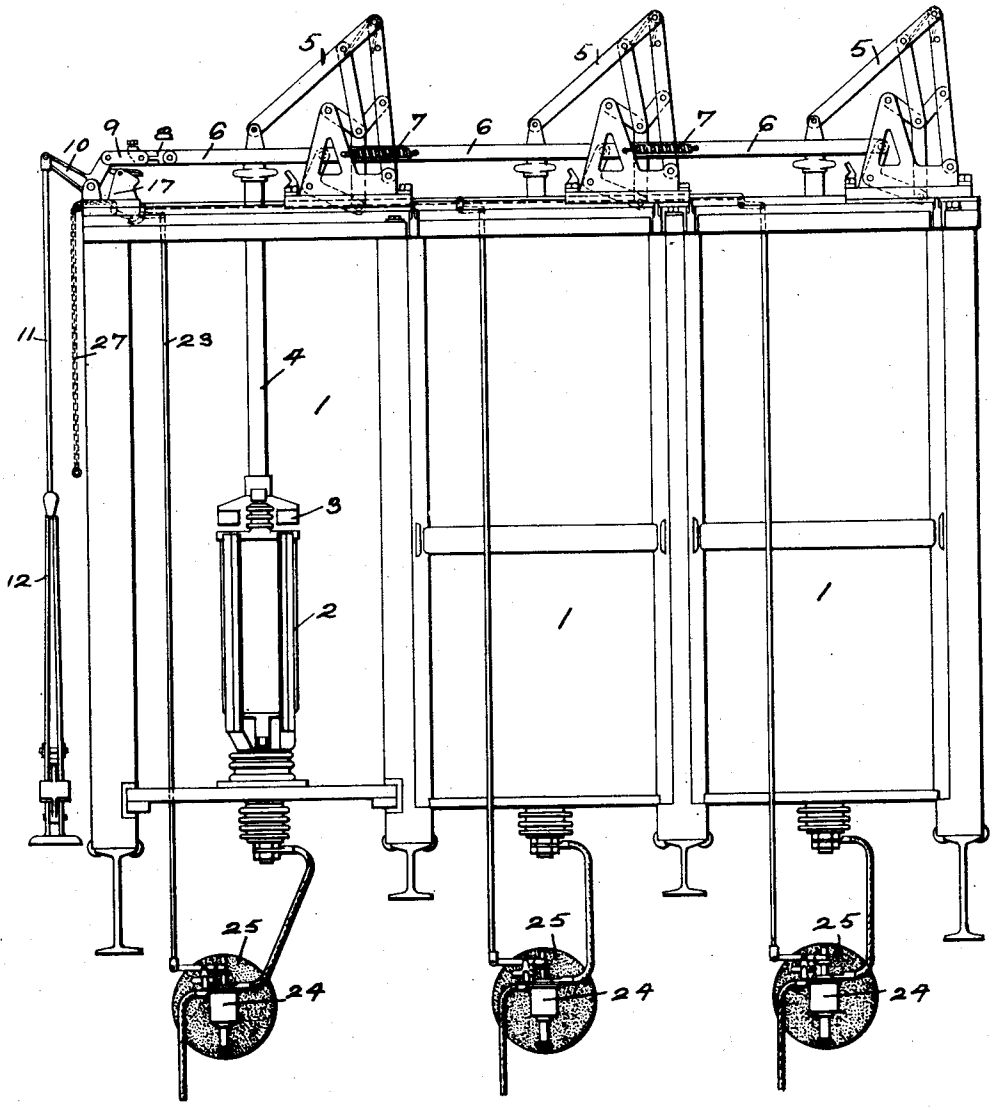
AUTOMATIC CIRCUIT BREAKER.

APPLICATION FILED SEPT. 10, 1908.

957,335. **Patented May 10, 1910.**

3 SHEETS—SHEET 1.

Fig. 1.



WITNESSES:

Benjamin B. Hull

Margaret E. Hoolley

INVENTOR:

CHARLES T. HENTSCHEL.

BY Albert G. Davis

ATTY.

C. T. HENTSCHEL.

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3 SHEETS—SHEET 2.

Fig. 2.

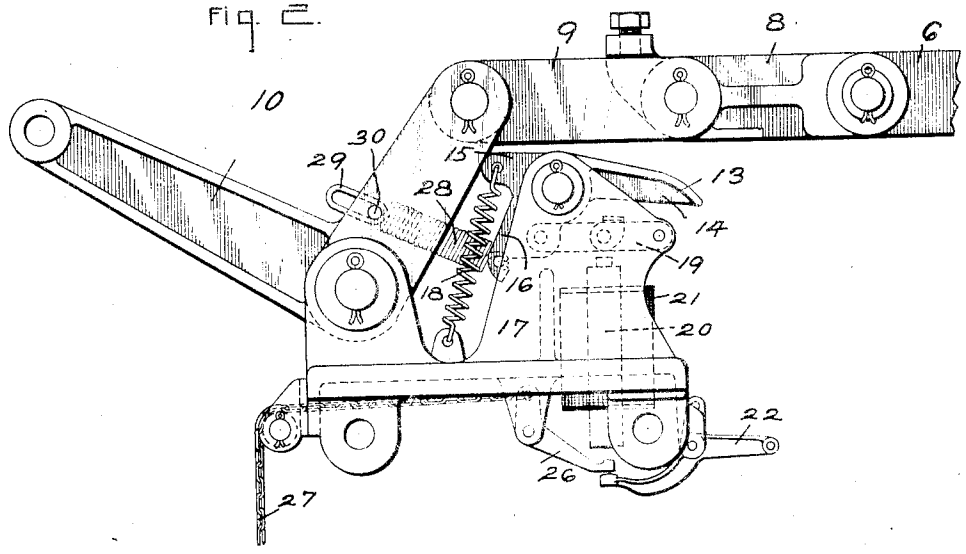
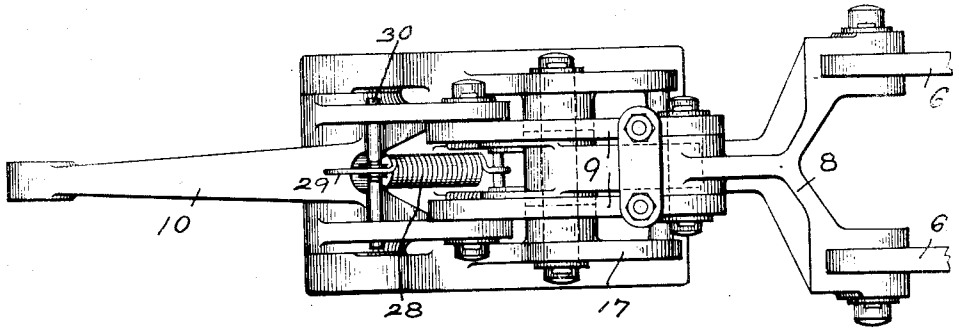


Fig. 3.



WITNESSES:

Benjamin B. Hull

Margaret E. Woolley

INVENTOR:

CHARLES T. HENTSCHEL.

BY Allen A. Dann

ATTY.

C. T. HENTSCHEL.

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3 SHEETS—SHEET 3.

Fig. 4.

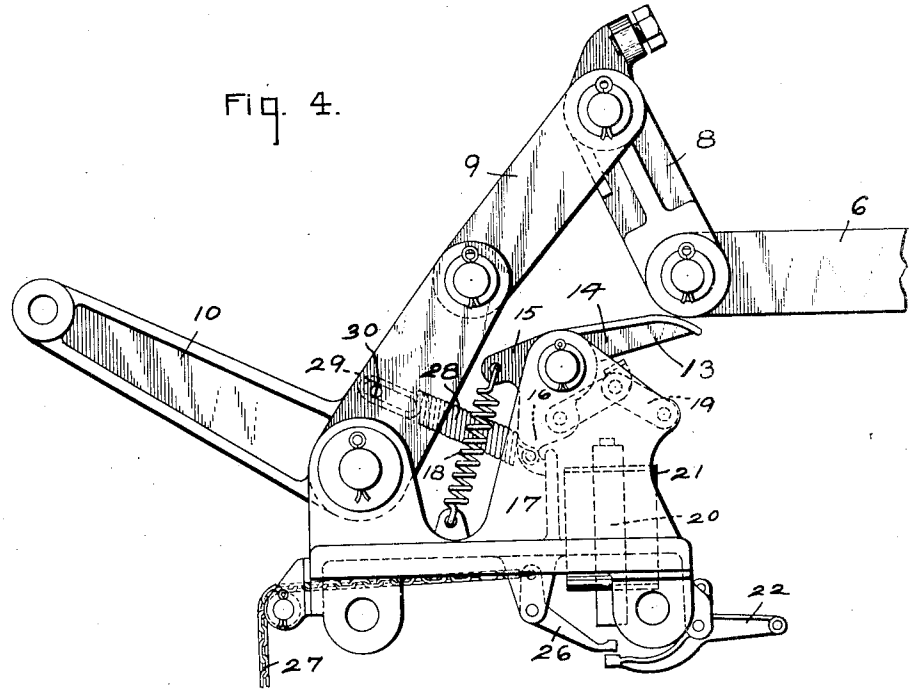
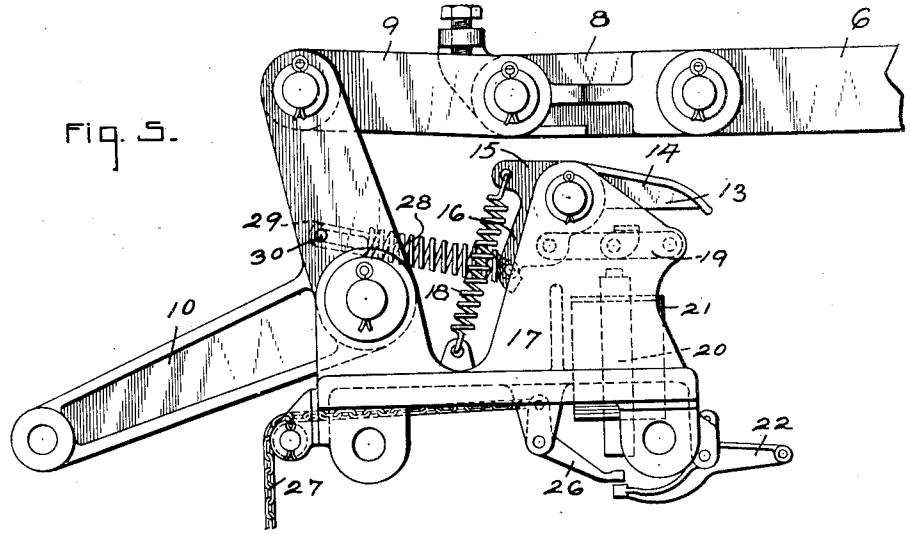


Fig. 5.



WITNESSES:

Benjamin B. Hull

Margaret E. Hoolley

INVENTOR:
CHARLES T. HENTSCHEL

BY Albert G. Davis

ATTY.

UNITED STATES PATENT OFFICE.

CHARLES T. HENTSCHEL, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

AUTOMATIC CIRCUIT-BREAKER.

957,335. Specification of Letters Patent. Patented May 10, 1910.

Application filed September 10, 1908. Serial No. 452,396.

To all whom it may concern:

Be it known that I, CHARLES T. HENTSCHEL, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Automatic Circuit-Breakers, of which the following is a specification.

My invention relates to automatic circuit breakers, and more particularly to circuit breakers which are rendered non-closable on overload by a disengageable connection between the operating handle and the contacts of the circuit breaker, with a trip coil arranged to actuate the disengageable connection and thereby disconnect the operating handle from the contacts when an attempt is made to close the circuit breaker while an overload is on the circuit.

The great pressure which the operating handle must exert on the contacts in order to close a large circuit breaker tends to lock the disengageable connection and a large and expensive trip coil must be used to furnish the power required to disconnect the operating handle from the contacts. Since a large trip coil is expensive and consumes considerable current, the object of my invention is to improve and simplify non-closable circuit breakers by providing a tripping mechanism which is operated by a small and cheap trip coil, and which will have sufficient power to positively disconnect the handle from the contacts under all conditions.

In carrying out my invention the tripping member which disconnects the operating handle from the contacts is actuated by stored energy, and the only function of the trip coil is to release the tripping member and permit it to act when the current in the circuit exceeds a predetermined limit. The work required to disconnect the handle from the contacts is performed by the energy stored in the tripping mechanism, and since the amount of this energy may be made as great as desired the operating handle is positively disconnected from the contacts, even where great pressure is exerted on the contacts by the operating handle. The energy for operating the tripping mechanism is preferably derived from the operating mechanism of the switch by any suitable connection and is stored in any suitable operating device, such as a spring put under strain by the operating mechanism of the switch and normally prevented from operating the tripping mechanism by means of a latch or detent controlled by the trip coil.

In the preferred construction the disengageable or collapsible connection between the operating handle and the contacts of the circuit breaker is a toggle, which is normally slightly overset to form a rigid and positive connection between the operating handle and the contacts, but which in effect disconnects the handle from the contacts when collapsed or broken by the tripping device. The parts are preferably so arranged that the tripping mechanism strikes the toggle a hammer blow and thereby causes it to collapse even though the operating handle is exerting great pressure on the contacts through the toggle. After the circuit breaker is opened, due to the breaking of the collapsible toggle, the operating handle must be moved to straighten out the toggle before the circuit breaker can be closed, and in the preferred arrangement this preliminary movement of the operating handle incident to the closing of the switch is utilized to restore the tripping mechanism to its normal condition and to store up in a spring or similar operating device enough energy to enable the tripping mechanism to break the collapsible toggle. By the time the toggle is straightened and forms a rigid connection between the operating handle and the contacts the tripping mechanism is set and ready to operate, and as the operating handle is moved to close the circuit breaker the trip coil will release the tripping mechanism as soon as the contacts engage if an overload is present on the circuit, thereby causing the collapsible toggle to break and open the circuit breaker.

My invention will be best understood in connection with the accompanying drawings, which illustrate one of the various forms in which it may be embodied and in which—

Figure 1 is an elevation of an oil switch or circuit breaker embodying my invention; Fig. 2 an enlarged view in elevation of the collapsible toggle and tripping mechanism; Fig. 3 a plan view of the device shown in Fig. 2; Fig. 4 a side view in elevation, showing the collapsible toggle and the tripping mechanism with the circuit breaker open and Fig. 5 is a side view in elevation, show-

ing the relation of the parts after the collapsible toggle has been straightened and before the operating handle is moved to close the circuit breaker.

The specific form of automatic circuit breaker shown in the drawings is a hand operated oil switch for handling heavy currents in a three-phase circuit, and comprises three masonry cells 1 side by side, each cell containing two oil pots 2 and a movable bridging contact 3 for controlling one phase of the circuit. The movable contact in each cell is carried on a wooden rod 4 extending through the top of the cell and connected to a parallel motion mechanism 5, the three wooden rods being operated simultaneously by operating mechanism which comprises horizontal actuating rods 6 connected to the three parallel-motion mechanisms. The circuit breaker is given a normal tendency to open by springs 7, each connected at one end to the framework of the parallel-motion mechanism, and at the other end to the actuating rods 6, which in turn are connected through any suitable form of disengageable or collapsible connection to a suitable operating handle, which resists the thrust of the springs 7. The preferred form of collapsible connection, as shown in the drawing, is a collapsible toggle normally slightly overset and having a link 8 connected to the actuating rods and a link 9 connected to one arm of a bell-crank actuating lever 10, which is pivotally mounted on the framework of the circuit breaker and has the other arm connected by a rod 11 to an operating handle 12 mounted adjacent the end of the switch in a convenient position. When the switch is closed, as shown in Fig. 1, the strain of the springs 7 tending to open the switch is transmitted through the collapsible toggle to the locked operating handle 12 while the breaking of the collapsible toggle permits the springs 7 to move the actuating rod 6 to the left, thereby raising all of the movable contacts simultaneously and opening the circuit breaker.

The preferred form of tripping mechanism for breaking the collapsible toggle when the current in the circuit exceeds a predetermined amount is best shown in Figs. 2 to 5, inclusive, and comprises a movable trip member 13 actuated by stored energy to strike the overset collapsible toggle a hammer blow, thereby throwing it over center and permitting the circuit breaker to open. In the specific form shown in the drawings the trip member 13 is made in the form of a bell-crank lever having three arms 14, 15, and 16, and in such a position that the arm 14 pivotally mounted in a frame 17 is thrown against the collapsible toggle with a hammer blow by means of any suitable energy-storing device, such as a spring 18, having one end connected to the frame 17 and the other end to the arm 15 of the trip member 13. The trip member is held in normal position with the spring 18 under strain by any suitable latching means, such as a latching toggle 19, with one end connected to the arm 16 of the trip member and the other end to the frame, as shown in Figs. 2, 4 and 5. When the trip mechanism is in normal condition, as shown in Figs. 2 and 5, the overset latching toggle holds the trip member immovable against the strain exerted by the power-storing spring 18, while the breaking of the latching toggle releases the trip member 13, whereupon the spring 18 contracts and causes the arm 14 of the trip member to strike the collapsible toggle a heavy hammer blow.

The latching toggle 19, which holds the trip member against the strain of the spring 18, is preferably controlled by a slidable bolt 20 mounted in the frame 17 with its upper end in a position to engage and break the latching toggle. The bolt may be lifted in any desirable way to break the latching toggle, preferably by some electroresponsive device which acts when the current in the circuit exceeds a predetermined amount. Where the switch is used on low potential circuits the electroresponsive device is preferably made in the form of a trip coil 21 mounted in the frame 17 around the bolt 20, which forms the core of the coil and is lifted by it upon the occurrence of an overload. Where the switch is used to control a high potential circuit a bell crank 22 is pivoted to the frame 17, as shown in Fig. 2, with one arm in a position to engage and lift the bolt 20, and the other arm connected, as shown in Fig. 1, through any suitable system of rods and levers 23 to trip coils 24 carried on high potential insulators 25 and connected directly in series with the leads of the circuit. In either case only a small trip coil is required, since the only work the trip coil has to do is to lift the bolt 20 and break the latching toggle 19, whereupon the work of breaking the collapsible toggle to permit the circuit breaker to open is performed by the spring 18. The switch may also be tripped by hand when desired by means of a hand trip lever 26 with one end beneath the bolt 20 and the other end connected to a chain 27 which extends to a point where it may easily be reached by the operator.

The energy for operating the trip member 13 may be stored in the spring 18 in any suitable way, but is preferably derived from the operating mechanism by means of some suitable connection between the operating mechanism and the energy-storing device or spring which operates the trip member 13. With the construction shown in the drawing any suitable connection be-

tween the operating mechanism and the trip member 13 may be used which will as a result of the movement of the operating mechanism incident to the closing of the switch move the trip member from the tripping position shown in Fig. 4 back to the normal position shown in Figs. 2 and 5, where the spring 18 is under tension and then leave the trip member free to move when released by the latching toggle 19. In the preferred construction energy is stored in the spring 18 during the movement of the bell crank lever 10 to straighten out the collapsible toggle by any suitable connection between the bell crank and the trip member 13 such as the lost-motion connection shown in the drawing, in which a strong spring 28 forming a resilient connection between the bell crank 10 and the trip member, and stiff enough to overcome the spring 18, is connected at one end to the arm 16 of the trip member 13 and is provided at the other end with a loop 29 which surrounds a stud or pin 30 on one arm of the bell crank lever 10. The parts are so proportioned that counterclockwise movement of the bell crank lever 10 will straighten out the collapsible toggle and at the same time exert a strain on the trip member which moves it about its pivot and puts the spring 18 under tension. As a result of this movement the trip member 13 is drawn from the tripping position shown in Fig. 4 into its normal position shown in Fig. 5, where energy is stored in the spring 18, which is under tension, and the latching toggle 19 is overset to hold the trip member 13 stationary, while the collapsible toggle is overset to form a rigid connection between the operating handle and the actuating rods 6 of the switch mechanism. The resilient connection between the operating handle and the trip member is preferably so proportioned that the trip member is set in normal position by the time the operating mechanism has made only a part of the movement necessary to straighten out the collapsible toggle and further movement of the operating mechanism merely stretches the spring 28 and leaving the trip member 13 operating mechanism need not necessarily bear a very accurate relation to the movement of the trip member, as would be the case if the connection between the operating mechanism and the trip member were rigid. Movement of the operating handle to close the circuit breaker causes the bell crank lever 10 to turn about its pivot in a clockwise direction, thereby causing the pin 30 to travel along the loop 29 toward the spring 28 and leaving the trip member 13 free to swing up into tripping position if the latching toggle 19 is broken.

The operation of the device is as follows: When the circuit breaker is closed, as shown in Fig. 1, the parts of the tripping mechanism are in the position shown in Fig. 2, with the spring 18 tending to throw the trip member up into engagement with the collapsible toggle, this tendency being resisted by the overset latching toggle 19, which holds the trip member stationary. If the current in the circuit exceeds a predetermined amount the bolt 20 is lifted and breaks the latching toggle, whereupon the trip member 13 is free to swing about its pivot as the spring 18 contracts. This movement is not resisted by the spring 28, owing to the lost-motion connection between the spring and the bell crank lever 10, while the lost motion between the arm 14 of the trip member 13 and the collapsible toggle permits the trip member to deliver against the collapsible toggle a heavy hammer blow which will break the toggle even though a great strain is exerted upon it by the springs 7. When the collapsible toggle breaks, the circuit breaker opens automatically and the parts assume the position shown in Fig. 4. To close the circuit breaker the operating handle is moved to rotate the bell crank lever 10 in a counterclockwise direction, thereby straightening out the collapsible toggle and causing the spring 28 to rotate the trip member about its pivot against the tension of the spring 18, whereby energy is stored in the spring. As the trip member is drawn into normal position the latching toggle 19 is overset and the trip member is then held stationary. As the operating handle is moved in the other direction and the bell crank lever 10 rotates in the clockwise direction, the overset collapsible toggle forms a positive connection between the operating handle and the actuating rods 6, while the tripping mechanism is set and ready to break the collapsible toggle as soon as the contacts engage if there is an overload on the circuit to cause the trip coil to break the latching toggle 19.

My invention may be embodied in many other forms than that shown and described, and I, therefore, do not wish to be restricted to the precise arrangement disclosed, but intend to cover by the appended claims all changes and modifications within the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is,

1. In an automatic switch or circuit breaker, the combination with switch operating mechanism and restraining means for holding the switch closed, of trip mechanism comprising a trip member biased by stored energy to move from normal position to tripping position and thereby engage said restraining means to trip the switch, and a resilient connection between said member and said mechanism whereby said member is reset in normal position by the movement

of said operating mechanism incident to the closing of the switch.

2. In an automatic switch or circuit breaker, the combination with switch operating mechanism and restraining means for holding the switch closed, of a trip member biased by stored energy to move from normal position to tripping position and thereby actuate said restraining means to trip the switch, a resilient connection between said member and said mechanism whereby said member is reset in the normal position by the movement of said operating mechanism incident to the closing of the switch, and electroresponsive means for controlling the movement of said trip member from normal position to tripping position.

3. In an automatic non-closable circuit breaker having separable contacts, the combination with an operating member and a normally positive collapsible connection between said member and said contacts, said connection being set in non-collapsed position by movement of said member in one direction, whereby movement of said member in the other direction actuates said contacts, of a trip member for collapsing said connection, an energy-storing operating device for said trip member, and a resilient connection between said operating member and said trip member whereby said operating member during its movement to set said connection in non-collapsed position stores energy in said operating device.

4. In an automatic non-closable circuit breaker having separable contacts, the combination with operating mechanism for the contacts comprising a normally positive collapsible connection, of a trip member biased by stored energy to move from the normal position to tripping position to collapse said connection, and a resilient connection whereby said operating mechanism during its movement to set said collapsible connection in non-collapsed position sets said trip member in normal position and thereby stores energy for moving said trip member into tripping position.

5. An automatic non-closable circuit breaker comprising separable contacts, an operating handle, a collapsible toggle for connecting said handle and said contacts, a trip member operated by stored energy to collapse said toggle, an energy-storing operating device for said trip member and means whereby the movement of said operating handle to straighten said toggle stores energy in said operating device.

6. An automatic non-closable circuit breaker comprising separable contacts, an operating handle, a collapsible toggle for connecting said handle and said contacts, a trip member for collapsing said toggle, a spring for moving said trip member into tripping position, means whereby said operating handle during its movement to straighten said toggle places said spring under strain and thereby stores energy for operating said trip member, latching means for holding said member against the strain of said spring, and an electroresponsive device for controlling said latching means.

7. In an automatic non-closable circuit breaker having separable contacts, the combination with operating mechanism for the contacts comprising a normally positive collapsible connection, of a trip member arranged to collapse said connection and thereby separate the contacts, a spring connected to said member to move it into tripping position, latching means for holding said member in normal position against the strain of said spring, electroresponsive means for causing said latching means to release said member, and a lost motion connection between said trip member and said operating mechanism whereby when said circuit breaker is open said operating mechanism moves said member into normal position and strains said spring and when the circuit breaker is closed said mechanism leaves said member free to move when released.

8. An automatic non-closable circuit breaker comprising separable contacts, an operating handle, a collapsible toggle for connecting said handle and said contacts, a pivoted trip lever mounted to strike and collapse said toggle, a spring arranged to throw said trip lever against said toggle, a latching toggle for locking said trip lever in normal position, electroresponsive means for controlling said latching toggle, and a lost motion connection between said trip lever and said operating handle whereby said handle in straightening said collapsible toggle sets said member in normal position with said spring under strain and in closing the circuit breaker leaves said trip lever free to collapse said toggle when said trip lever is released.

In witness whereof, I have hereunto set my hand this 9th day of September, 1908.

CHARLES T. HENTSCHEL.

Witnesses:

BENJAMIN B. HULL,

MARGARET E. WOOLLEY.