

July 7, 1931.

J. B. MacNEILL

1,813,181

HIGH SPEED CIRCUIT INTERRUPTER

Original Filed June 7, 1926

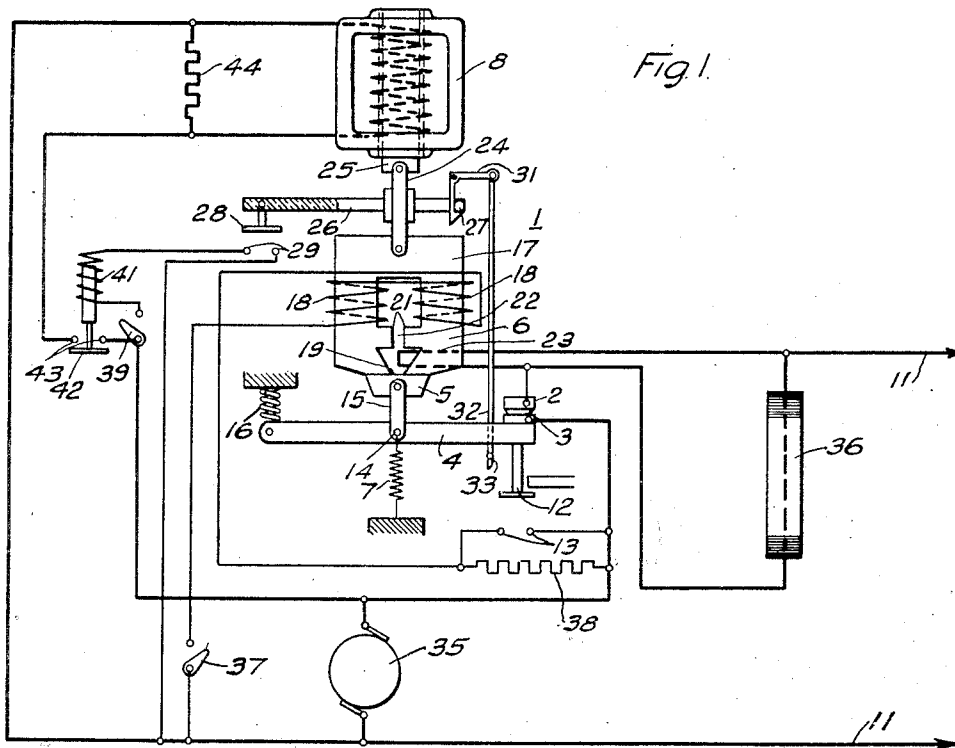
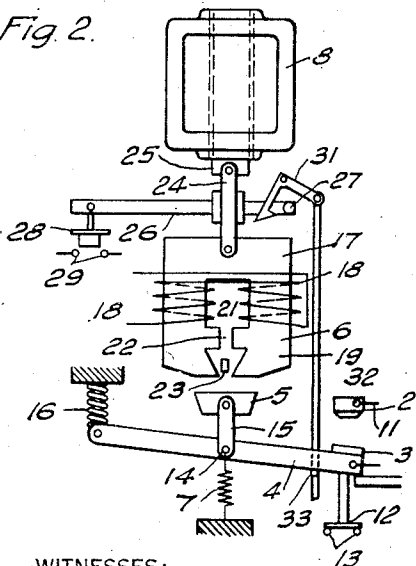


Fig. 2.

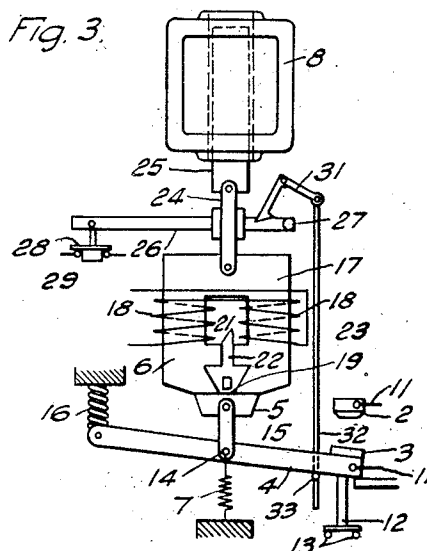


WITNESSES:

E. A. McSherry

Lester J. Rudlong

Fig. 3.



INVENTOR

John B. MacNeill

BY

Charles E. Barr
ATTORNEY

UNITED STATES PATENT OFFICE

JOHN B. MACNEILL, OF WILKINSBURG, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE
ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA

HIGH-SPEED CIRCUIT INTERRUPTER

Application filed June 7, 1926, Serial No. 114,045. Renewed November 3, 1930.

My invention relates to electrical protective apparatus and more particularly to high-speed circuit interrupters.

One object of my invention is to provide a high-speed circuit interrupter that shall be responsive to the rate of change of an electrical current traversing it.

Another object of my invention is to provide a circuit interrupter that shall be held in its circuit-closing position only by the magnetic attraction between the core and armature of an electro-magnet.

A further object of my invention is to provide a high-speed circuit interrupter, the holding electromagnet of which shall be moved into the circuit-opening position of its armature member after which the holding electro-magnet and armature are moved to their circuit-closing positions.

In constructing high-speed circuit interrupters that shall be capable of opening a power circuit in short intervals of time, of the order of ten one-thousandths (.010) of a second, it has been found most expedient to eliminate all mechanical latches and to depend solely upon magnetic forces in order to release the actuating members for the relatively movable contact members. The holding electro-magnets for such high-speed circuit interrupters are characterized by having portions of the load currents traverse conductors placed in air-gaps in the core structures, such that, when abnormal currents traverse the conductors, the total amounts of flux traversing the cores are not decreased, but are merely shunted from one air-gap to another, whereby the armatures are released and moved to their open-circuit positions by powerful accelerating springs.

In order to close such a circuit interrupter I propose to move the holding electro-magnet, in its entirety, to a position where it may seize its armature, after which it and the actuating means are moved into their circuit-closing positions. The armature comprises a portion of the actuating means for the relatively movable contact members.

In order to accomplish the foregoing results, I suspend the holding electro-magnet from a second electro-magnet so that, when

the second electro-magnet is deenergized, the holding electro-magnet is permitted to move downwardly and engage its armature. After the second electro-magnet is re-energized, it moves the holding electro-magnet, its armature and the contact-actuating means upwardly to their several circuit-closing positions.

My circuit interrupter differs from any other high-speed circuit interrupter of which I am aware in that the holding electro-magnet is moved to engage its armature instead of the armature being moved to engage the holding electro-magnet.

In the accompanying drawings,

Figure 1 is a diagrammatic view of circuits and apparatus showing my circuit interrupter in its circuit-closing position.

Fig. 2 is a diagrammatic view of the circuit interrupter in an intermediate circuit-opening position, and

Fig. 3 is a similar view of the circuit interrupter in its final circuit-opening position.

My invention comprises, in general, a circuit interrupter 1 having a stationary contact member 2, a movable contact member 3 and an actuating lever 4, therefor, that is attached to an armature 5 of a holding electro-magnet 6, both of which are biased to their lower, or circuit-opening positions by a coil spring 7, and an electro-magnet 8 for controlling the position of the electro-magnet 6.

The actuating lever 4 is of insulating material and carries the contact member 3 to which is secured one of the conductors of an electrical circuit 11 with which the circuit interrupter 1 is associated. A pilot switch 12 is dependent from the lever 4 and bridges a pair of stationary contact members 13 when the circuit interrupter is in its open position.

The coil spring 7 is connected to a pintle 14 positioned midway of the lever 4. The pintle 14 is also connected, by a link 15, to the armature 5. The other end of the lever 4 is connected to a resilient mounting 16 that serves to bias the lever 4 in a counter-clockwise direction about the pintle 14 when the circuit interrupter is in its circuit-closing position, thereby keeping the contact members 2 and 3 under spring pressure.

The holding electro-magnet 6 comprises a U-shape core 17 on the legs of which are mounted a pair of coils 18 that are accumu-
 5 tively wound to produce an electric flux that traverses an air-gap 19 in the core 17 adjacent to the armature 5. The air-gap 19 is of
 10 peculiar configuration. The outer walls of the air-gap 19 adjacent to the area of engagement with the armature 5 are relatively close to each other. From the outer orifice of the
 15 air-gap 19 the walls diverge and then abruptly terminate in shoulders 21 that are separated by a narrow air-gap 22.

A straight conductor 23 is inserted in the
 15 air-gap 19 so that its magnetic field opposes the flux produced by the coils 18. Upon the occurrence of abnormal conditions in the circuit 11, the amount of current traversing the
 20 conductor 23 varies suddenly, in a manner hereinafter described, and diverts the flux from the outer portion of the core 6 to the shoulders 21 and the air-gap 22, thereby releasing the armature 5.

The holding electro-magnet 6 is connected
 25 by a link 24 to an armature 25 of the electro-magnet 8. A cross-bar 26, attached to the link 24, supports a pin 27 at one end and, at its other end, a pilot switch 28 that cooperates
 30 with a contact member 29. The pin 27 cooperates with a latch 31 that is actuated through a rod 32 from a pin 33. The pin 33 is engaged by the operating lever 4 when the latter moves to its open position, thereby releasing the latch 31 from the pin 27.

Referring to Fig. 1, a generator 35 supplies
 35 current to the circuit 11 through stationary and movable contact members 2 and 3, the conductor 23 and a reactance 36 the latter being in parallel circuit with the conductor
 40 23. The reactance 36 is so proportioned that, upon the occurrence of slow changes in the current traversing the circuit 11, the relative proportions of the current traversing the conductor 23 and the reactance 36 does not vary.
 45 However, upon the occurrence of sudden changes in the value of the current traversing the circuit 11, the proportion of that current traversing the conductor 23 becomes materially greater than that traversing the
 50 reactance 36, with the result that the armature 5 is released. The operation of the reactance 36 and the conductor 23 depends upon the rate of change of current traversing the circuit 11 and, accordingly, the circuit
 55 interrupter 1 operates in anticipation of sudden overload or short-circuit currents.

The coils 18 of the holding electro-magnet 6
 60 are energized through a hand switch 37 and a resistor 38 that is connected in parallel circuit to the stationary contact members 13, whereby the amount of current traversing the coils 18 is determined by the value of the resistor 38. However, when the actuating
 65 lever 4 moves to its open position, the pilot

switch 12 completes a shunt circuit around the resistor 38.

The energization of the electro-magnet 8
 70 is controlled by a hand switch 39 and a time relay 41 having a bridging member 42 and stationary contact member 43. When the pilot switch 28, that completes a circuit between the stationary contact members 29 and the switch 39 is closed, the coil of the relay 41 is energized to complete a circuit through the
 75 bridging member 42, the stationary contact members 43 and the electro-magnet 8.

A resistor 44 is placed in parallel circuit
 80 with the electro-magnet 8 to provide a surge discharge path therefor.

Assuming the circuit interrupter to be in the closed position shown in Fig. 1, and a condition of short-circuit to have occurred in the circuit 11, the current-traversing the
 85 conductor 23 is suddenly greatly increased, with the result that the flux traversing the core 17 is caused to bridge the air-gap 22, rather than outer portions of the air-gap 19 and the armature 5, with the result that the armature 5 is released. Upon the release of
 90 the armature 5, the spring 7 contracts to accelerate the lever 4 into its lower or circuit-opening position. The circuit-opening movement of the actuating lever 4 is independent of any mechanical latches and depends entirely upon the electrical action of the electro-magnet 6 for its release.

When the actuating lever 4 reaches its circuit-opening position, it strikes the pin 3
 100 and releases the latch 31 from the pin 27. The armature 25 of the electro-magnet 8 and the electro-magnet 6 then drop down to the position shown in Fig. 3 where the core 18 again engages the armature 5. At the same time, the pilot switch 28 completes the circuit between the stationary contact members 29.

In order to re-close the circuit interrupter, the coils 18 are energized through the switch
 110 37 if they have not remained energized during the opening movement of the circuit interrupter 1. However, the coils 18 are traversed by a greater current when the circuit interrupter 1 is in its open position by reason of the shunt circuit around the resistor 38. This arrangement is necessary in order that
 115 there shall be a greater flux field available to seize the armature 5 than is necessary to retain it in its closed or seized position.

The switch 39 is then manipulated to close
 120 a circuit through the coil of relay 41, the stationary contact members 29 and the bridging member 28. Upon the energization of the relay 41, the circuit between the stationary contact members 43 is closed by the bridging member 42 and the electro-magnet 8 is energized to attract its armature 25 and raise sus-
 125 pended electro-magnet 6, armature 5 and actuating lever 4 against the tension of the spring 7.

When the bar 26 has been raised far enough 130

to cause the pin 27 to engage the latch 31, the circuit for the relay 41 is interrupted by the pilot switch 28, and the shunt circuit around the resistor 38 is opened by the switch 12.

means adapted to be moved to the circuit-opening position of, and engage, the actuating means and then be moved so as to move the actuating means to its circuit-closing position.

5 After an interval of time corresponding to the setting of the relay 41, the circuit of the electro-magnet 8 is interrupted between the stationary members 43, and the latter becomes deenergized. The operator should then open
10 the switch 39 in order to prevent the circuit interrupter 1 from closing automatically after its next circuit-opening operation. The coils 18 remain energized while the circuit interrupter 1 is closed in order to keep the
15 actuating lever 4 in its upper, or circuit-closing, position.

4. In a high-speed circuit interrupter, a pair of relatively movable contact members, actuating means for the contact members biased to its circuit-opening position, hold-
75 ing means for the actuating means, means for moving the holding means into the circuit-opening position of the actuating means and means for moving the holding means into their circuit-closing positions.

Accordingly, I have provided a circuit interrupter for high-speed operation in which the holding electro-magnet is moved to the
20 circuit-opening position of an actuating lever, that lever is then magnetically seized, and the holding electro-magnet and lever are returned to their circuit-closing positions by the action of a second electro-magnet. Since
25 the holding electro-magnet and the actuating lever are held in engagement only by magnetic forces, it is possible to cause their separation in a much shorter time than is required when mechanical latches must be ac-
30 celerated before the circuit-opening operation takes place. The resilient mounting of the actuating lever insures that the contact members are held in firm engagement when closed.

5. In a high-speed circuit interrupter, a pair of relatively movable contact members, actuating means for the contact members, biased to its circuit-opening position, a hold-
80 ing electro-magnet for the actuating means, means for moving the holding electro-magnet into the circuit-opening position of the actuating means and means for moving the holding electro-magnet and the actuating
85 means into their circuit-closing positions.

35 It is to be understood that various changes in the arrangement, connection, shape and outline of the component parts of my invention may be made within the scope of the appended claims.

6. In a high-speed circuit interrupter, a pair of relatively movable contact members, actuating means for the contact members biased to its circuit-opening position, a hold-
90 ing electro-magnet for the actuating means, means for moving the holding electro-magnet into the circuit-opening position of the actuating means and an electro-magnet for moving the actuating means and the hold-
95 ing electro-magnet into their circuit-closing positions.

40 I claim as my invention:

7. In a high-speed circuit interrupter a pair of relatively movable contact members, and actuating means therefor, a magnetic holding means for the actuating means and an electro-magnet for bodily moving the
100 magnetic holding means.

1. In a high-speed circuit interrupter, a pair of relatively movable contact members, actuating means for the contact members biased to its circuit-opening position, and
45 magnetic holding means for the actuating means adapted to be moved to the circuit-opening position of, and engage, the actuating means and then be moved so as to move the actuating means to its circuit-closing po-
50 sition.

8. In a high-speed circuit interrupter, a pair of relatively movable contact members, an actuating means therefor, an electromag-
110 netic holding means for the actuating means and means for moving the entire said electromagnetic holding means.

2. In a high-speed circuit interrupter, a pair of relatively movable contact members, actuating means for the contact members biased to its circuit-opening position, and a
55 holding electro-magnet for the actuating means adapted to be moved to the circuit-opening position of, and engage, the actuating means and then be moved so as to move the actuating means to its circuit-closing po-
60 sition.

9. In a high-speed circuit interrupter, a pair of relatively movable contact members, an actuating means therefor, a holding elec-
115 tro-magnet for the actuating means and an electro-magnet for moving the entire holding electro-magnet.

3. In a high-speed circuit interrupter, a pair of relatively movable contact members, actuating means for the contact members biased to its circuit-opening position, and an
65 electrical holding means for the actuating

10. In a high-speed circuit interrupter a pair of relatively movable contact members, an actuating means therefor, a holding elec-
120 tro-magnet for the actuating means and an biased to its circuit-opening position, a hold-electro-magnet and the held actuating means.

11. In a high-speed circuit interrupter, a pair of relatively movable contact members, an actuating means therefor biased to the
125 circuit-opening position and comprising an armature, a holding electro-magnet for controlling the armature, and a second elec-

tro-magnet for controlling the position of the holding electro-magnet.

12. In a high-speed circuit interrupter, a pair of relatively movable contact members, an actuating means therefor biased to its circuit-opening position and comprising an armature, a holding electro-magnet for controlling the armature, and a second electro-magnet for moving the holding electro-magnet and the armature from the circuit-interrupting position of the latter to its circuit-closing position.

13. In a high-speed circuit interrupter, a pair of relatively movable contact members, an actuating means therefor biased to its circuit-opening position and comprising an armature, a holding electro-magnet for controlling the armature, and a second electro-magnet which, when de-energized, permits the holding electro-magnet to move to the circuit-opening position of the armature and, when subsequently energized, moves the holding electro-magnet and attracted armature to their circuit-closing positions.

14. In a high-speed circuit interrupter, a pair of relatively movable contact members, and actuating means therefor biased to its circuit-opening position and comprising an armature, a holding electro-magnet adapted to retain the armature under normal conditions and to release it under abnormal conditions whereupon the actuating means moves to its circuit-opening position, and a second electro-magnet to permit the holding electro-magnet to follow the armature member and to return it to its circuit-closing position.

In testimony whereof, I have hereunto subscribed my name this 2nd day of June, 1926.

JOHN B. MACNEILL.