Jan. 3, 1950 G. L. HILL 2,493,347

HIGH-VOLTAGE CIRCUIT BREAKER FOR DISTRIBUTION LINES

Filed Sept. 15, 1943

Fig. 1.

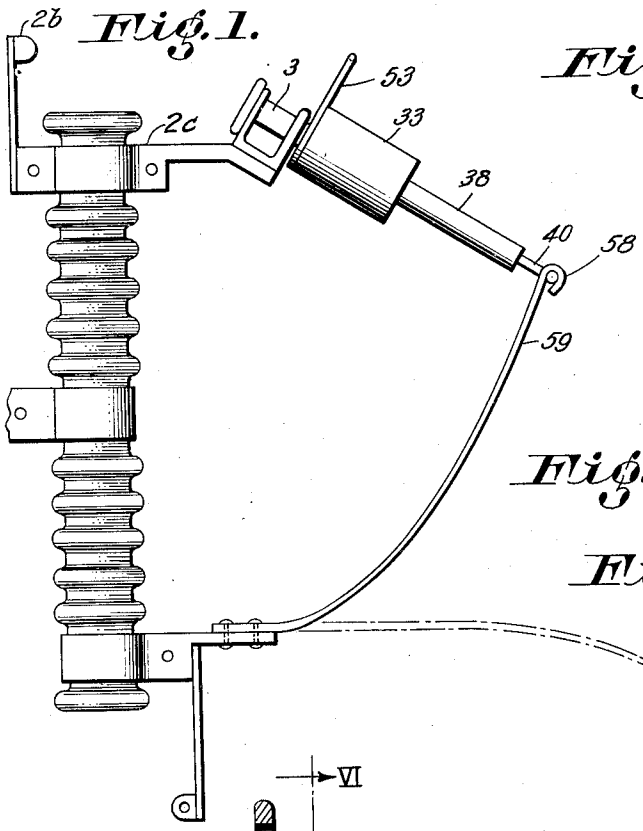


Fig. 4.

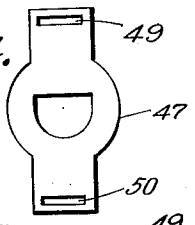


Fig. 6.

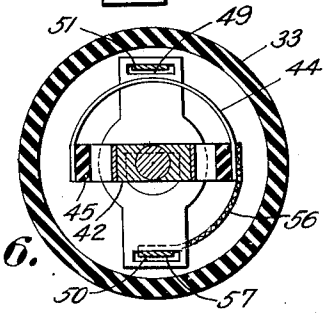
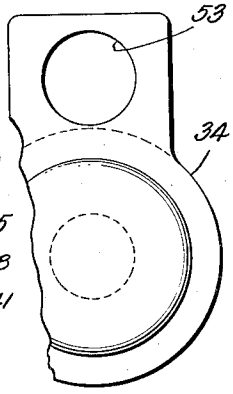


Fig. 5.



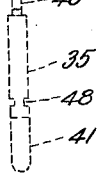


Fig. 2.

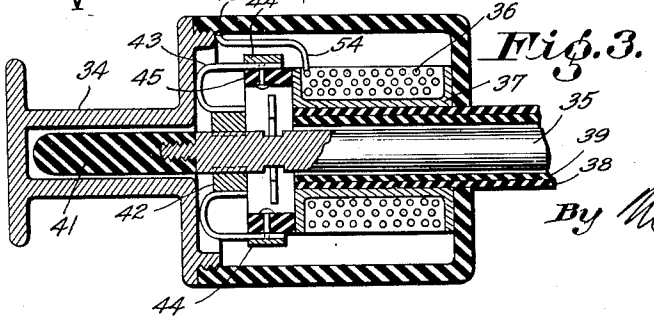


Fig. 3.

Inventor

George L. Hill

By Marcus Lothrop

Attorney

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HIGH-VOLTAGE CIRCUIT BREAKER FOR DISTRIBUTION LINES

George L. Hill, Oakland, Calif.

Application September 15, 1943, Serial No. 502,716

6 Claims. (Cl. 200—88)

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This invention relates to a new circuit breaker especially for use in connection with outdoor, overhead, high voltage distribution and transmission systems, and, more specifically, to a circuit breaker that has a drop-down arm which functions to provide an air gap in the high voltage electric circuit after circuit interruption.

The present application is a continuation in part of my co-pending application entitled "Circuit breaker and switch," filed January 2, 1940, Serial Number 312,073 which has resulted in Patent No. 2,331,778, dated Oct. 12, 1943.

The object of this invention is to provide a circuit breaker with a tensioned switch arm that may be actuated by current responsive thermal and/or electro-magnetic or manual tripping means; to provide a circuit breaker wherein there is the utilization of a tube or chamber to confine the arc path or stream during circuit interruption; to provide a means for the rapid de-ionization of the arc stream by introducing an insulating and de-ionizing medium in such a position that it will instantly reduce and confine the area through which the arc stream must nominally flow in order to complete the electric circuit; to provide means for the tensioned switch arm to actuate the movable electrode in the chamber or expulsion tube; to provide a circuit breaker that may be mounted on a cross arm that will visibly indicate whether the circuit is open or closed by a drop-down or a drop-out arm; and, further, to provide a circuit breaker which may be used an indefinite number of times to interrupt an electric circuit by simply re-latching the tripping means and re-inserting in the electric circuit. A very definite object of this invention is to provide means for the circuit breaker mechanism to be removed from the live terminals, re-latched and re-inserted in the live terminals with a typical switch stick or fuse tongs while the high voltage circuit remains energized.

The invention is shown by way of illustration in the accompanying drawings, in which:

Figure 1 is an assembly view of the circuit breaker, showing the device in a live high voltage circuit;

Figure 2 is an enlarged longitudinal section of the circuit breaker housing;

Figure 3 is a cross section taken on line III—III of Figure 2;

Figure 4 is a detail view of the tripping member;

Figure 5 is an end view at V—V of Figure 2, and

Figure 6 is a cross section on line VI—VI of Figure 2.

The device is mounted upon any cross arm or structure by a bracket 4*a*, and the circuit breaker mechanism is supported on an insulator 1*a*. An arm is provided which swings outwardly upon

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circuit interruption and automatically interjects an air break in the circuit in addition to indicating that the circuit is open.

The insulator 1*a* has the top terminal hardware 2*c* mounted on it for the purpose of supporting clips 2*d* and a line terminal 2*b*. The insulator 1*a* has similar hardware secured to its lower end for the purpose of supporting the spring arm 59 and a line terminal 3*a*.

Within a housing chamber 33 are mounted nested tubes 38 and 39, a tripping mechanism and the circuit interrupting parts. The tubes 38 and 39, in practice, may be the typical combination fuse tubing which usually is made of a paper or a fabric Bakelite impregnated outer covering over a horn fiber liner. They pass through one end of the housing 33. Spring actuated brush contacts 42 are provided and engage a metal electrode or conductor 35. Springs 43 actuating the contacts 42 are carried by a metal band 44 secured on insulating brackets 45 on an iron spool 37 encompassing the tube 38. A bi-metallic strip 57 is supported in the housing 33 near the band 44. On the free end of the bi-metallic strip is a latch member 47 which engages a notch or groove 48 cut or otherwise formed in the conductor 35. When the latch is engaged in the groove in the conductor, it holds the spring arm 59 in tension. The arm 59 is a strip of tempered, stainless steel for applying a tension to the metal electrode 35 at the connecting eye 40.

In addition to the bi-metallic strip 57, there is an electro-magnetic coil 36 of the solenoid type, assembled on the tubes 38 and 39 and mounted in the housing 33. This electro-magnetic coil is also used for tripping purposes and for that reason is provided with an armature 51. An extension of the armature 51 beyond its mounting pivot 52, passes through a slot 49 in the tripping or latch member 47. The bi-metallic strip 57 also passes through a slot 50 in the tripping member and the electrode 35 passes through a D-shaped hole formed in the center of the member 47. In its normal position, the tripping member 47 is pressed downwardly in the groove 48 to retain the electrode 35 in position for contact with the brushes 42.

Secured to the end of the electrode 35 is a member 41, constructed of insulating material and projecting into a metal end ferrule 34 of the housing 33. The inner end of the ferrule 34 has a shoulder or annular flange for aiding in inserting and retaining the ferrule in the terminal clips 2*d*. The outer end of the ferrule has an extension formed with a hole or opening 53 for the reception of a hook at the end of a typical switch stick.

With the arm 59 in the full line position shown in Figure 1, the electric current enters the device

through the top terminal 2b. It then passes through the top hardware 2c and the clips 2d to the ferrule 34. It then passes through a conductor 45 to the solenoid coil 36, and a conductor 55 to the bi-metallic strip 57. From there it goes through a conductor 56 to the band 44. It then passes through the springs 43 and the contacts 42 to the electrode 35. Finally it flows through the arm 59, and the lower hardware 3 and the terminal 3a. The circuit is thus completed from the upper terminal to the lower terminal.

The current flow heats the bi-metallic strip 57 to a certain degree, and this accordingly tends to spring upwardly. If an excess current flow is present, the heat will increase sufficiently to release the latch 47 thereby releasing the electrode 35. This allows the spring arm 59 to swing from the full to the dotted line position shown in Figure 1 thereby pulling the electrode 35 out of the inner tube 39. An arc tends to form between the contacts 42 and the electrode 35, but as the insulating member 41 is pulled outwardly through the inner tube 39, it confines the arc stream and deionizes it thereby causing almost instantaneous extinction of the arc stream.

The close proximity of the arc stream to the insulator 41 and to the surrounding walls of the tube 39 has a cooling effect upon the arc. The heat of the arc will tend to decompose the walls of the members 41 and 39 and gases will be evolved resulting in an exceedingly fast expulsion of the hot arc gases and also a rapid deionization of the arc stream, thereby interrupting the circuit in a rapid and efficient manner. It should also be noted that as the current passes through the coil 36 of the electro-magnet and through the conductor 35 in the core of the electro-magnet, a magnetic field is created which exerts a pull which attracts the armature 51 and if the pull is sufficient aids in pulling the latching strip 47 in an upward direction to cause release of the latch. The design of the electro-magnet 36 and the electrode 35 serving as a plunger or core for it may be such that in certain heavy short circuits, its pull may be exerted instantly to trip the latch 48 so that the circuit may be instantly interrupted. Also, it will be seen that the normal spring action of the bi-metallic element 57 retards and restrains the movement of the strip 47 on short time moderate over currents and the bi-metallic element 57 will not have time to heat and flex on short time moderate over current. The combination of these two actions prevents unnecessary tripping on moderate short time over currents. But on long time sustained over currents, the bi-metallic element 57 will flex and cooperate with the magnetic pull of the armature 51 and trip the circuit breaker. Another advantage of this combination is that the circuit breaker may be designed for low amperage ratings of the order of one, two, or five amperes without the danger that the bi-metallic strip 57 and the spring band 44 which carries the contacts 42 will fuse before the circuit is interrupted during heavy short circuits. It should be understood that the bi-metallic thermally actuated trip or the electro-magnetic trip may be jointly or separately used as desired, to meet various operating conditions in the distribution circuits to which the circuit breaker is applied.

The design of the device is such that the normal spring action of the bi-metallic strip 57 retards and restrains the movement of the armature 51

and the tripping device on short time over currents. Also, the bi-metallic strip does not have time to heat and flex on short over currents, but on long time, sustained over currents, it does heat and flex, moving the member 47 upward and tripping the breaker.

On large over currents, the armature 51 is drawn into the magnetic field of the iron spool 37 and from a certain predetermined position, it instantly closes the magnetic circuit thus actuating the tripping member 47 with a quick, snap action. Therefore, the two methods of tripping are combined in this embodiment of my invention.

The circuit breaker mechanism is connected in the circuit by holding the assembled housing 33 with fuse tongs and inserting the eye 40 in the resilient hook 58 of the spring arm 59, shown in the open (dotted) position, and by then inserting the hook on the switch stick in the hole 53 of the ferrule 34, and swinging the housing 33 upward and inserting the central part of the ferrule 34 into the terminal clips 2d. In this manner the circuit breaker mechanism may be connected to a live circuit in a very simple, efficient and economical method. The current path is then through the conductor 46, the wire 54, the electro-magnetic coil 36, and the wire 55 to the bi-metallic strip 57. From there it is through the flexible conductor 56, the metal band 44, the springs 43, the brush contacts 42, the electrode 35, and the spring arm 59. The electric circuit is completed when the terminal 2b is connected to the high voltage line and the terminal 3a is connected to a high voltage transformer or other load.

When the breaker mechanism is connected in the circuit, the normal load's current, for which the device is designed, will not trip the breaker, but a sustained over current will heat and flex the bi-metallic strip 57, energize the coil 36 and magnetize the core 37, swing the armature 51, move the tripping member 47 and allow the spring arm 59 to pull the members 35 and 41 out of the tubes 38 and 39. The members 35 and 41 and the spring arm 59 assumes the position shown by the dotted lines in Figure 1 after circuit interruption. It has been found by experience that the insulating member 41 should be a material that will not deteriorate and adsorb moisture to an undue degree, as the members 39, 35, and 41 may be in the open position a period of time before a service man will restore the device to the closed position. Materials such as lava, soap stone, and Mycalex have been used for the member 41.

To restore the electric circuit, the service man or operator removes the members 35 and 41 from the resilient loop 58 in the spring arm 59 with the typical fuse tongs. Then he removes the housing 33 from the clips 2d and inserts the members 35 and 41 in tubes 38 and 39 until the tripping member 47 is latched in the groove 48 in the member 35. Next he connects the loop or hook 58 with the member 40, and finally grasps the housing 33 with the fuse tongs and places the housing in a position with the ferrule 34 engaging the terminal spring clips 2d so reassuming the position shown in full lines in Figure 1. If the fault still persists, the circuit breaker will function again on over current and interrupt the circuit. The cycle may be repeated again by the service man, and if the fault still persists and the circuit breaker again functions, he may patrol the line. In the meantime, the open circuit position is clearly visible to any observer.

Having thus described and illustrated my invention, which I claim and wish to secure by Letters Patent is:

1. In a circuit breaker, a supporting insulator; terminal members on the insulator; a housing support on one terminal member; a housing insertable in said support for retention in a set position; a stationary conductor in said housing; an ejectable conductor in said housing; a spring arm connected to the other terminal and to said ejectable conductor and tending to pull the ejectable conductor out of the housing; said housing support, said stationary conductor, said ejectable conductor, and said spring arm all being in circuit with said terminal members; a tripping member normally retaining the ejectable conductor in said housing; and an electro-magnetic coil surrounding and responsive to current flow in said ejectable conductor for operating said tripping member to release said ejectable conductor.

2. In a circuit breaker; a supporting insulator; a pair of terminal members on said insulator; clips on one terminal member; a housing insertable in and having a portion engageable with said clips with said housing in a set position; an ejectable conductor in said housing; a spring arm connected to the other terminal and to said ejectable conductor and tending to pull the ejectable conductor out of the housing; means for including said clips, said ejectable conductor, and said spring arm in circuit with said terminal members; a tripping member normally retaining the ejectable conductor in said housing; a coil connected in said circuit and surrounding said ejectable conductor; a bi-metallic member responsive to current flow through said coil for actuating said tripping member; and an armature responsive to current flow through said coil and through said ejectable conductor for actuating said tripping member.

3. In a circuit breaker, an insulator, a terminal member secured at each end thereof, spring clips on one terminal member, a spring arm connected with the other terminal member, a housing insertable and retainable in said spring clips, a stationary and an ejectable conductor in the housing, said ejectable conductor passing through an electro-magnet responsive to current flow through said ejectable conductor, a tripping member releasable by said electro-magnet but normally retaining the ejectable conductor in the housing, said ejectable conductor having one end projecting from the housing and terminating in an articulation, and a member on one end of the spring arm engageable with the articulation and transmitting a pull from the spring arm to eject the ejectable conductor from the housing when the tripping member is released.

4. In a circuit breaker for use on a support, a housing having a portion removably engageable with the support in a set position, a conductor partly within and partly projecting from the housing, a spring on the support and articulated to the conductor and tending to pull the conductor from the housing, means for including the spring and the conductor in a circuit, a coil in said housing surrounding the conductor and responsive to current flow through the conductor, and a latch in the housing and releasable by the coil for normally engaging and holding the conductor within the housing against the pull of the spring.

5. In a circuit breaker, a supporting insulator, terminal members on the insulator, clips on a terminal member, a housing manually insertable and retainable in said clips, said housing consisting of a major insulating member and a minor insulating member extending therefrom, said housing containing a circuit breaking mechanism consisting of a stationary conductor, a slidable conductor in the minor insulating member and extending therefrom, an electro-magnet surrounding the slidable conductor, a tripping latch normally retaining the slidable conductor in the housing in contact with the stationary conductor, electro-responsive means for actuating the tripping latch, and a spring arm at one end attached to the slidable conductor and at the other end attached to one of the terminal members.

6. In a circuit breaker, a supporting insulator, terminal members on the insulator, clips on a terminal member, a housing manually insertable and retainable in the said clips, said housing consisting of a large tubular insulating member and a small tubular member extending therefrom, an electro-magnet in the housing, a stationary conductor in the housing, an ejectable conductor in the small tubular member normally in contact with the stationary conductor, said small tubular member and said conductor passing through said electro-magnet, a retaining member tripped by said electro-magnet for releasing the ejectable conductor, a spring arm, said ejectable conductor having one end projecting from the small tubular member and engaged with said spring arm, said spring arm being effective to pull said conductor from said small tubular member and thereby interrupt the electric circuit when the releasing member is tripped to release the conductor.

GEORGE L. HILL.

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