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J. SLEPIAN

1,669,493

CIRCUIT BREAKER

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Fig. 1.

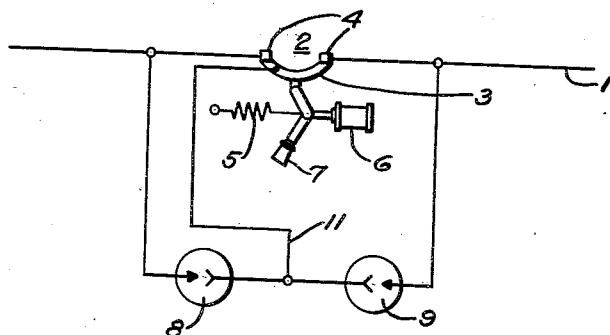


Fig. 2.

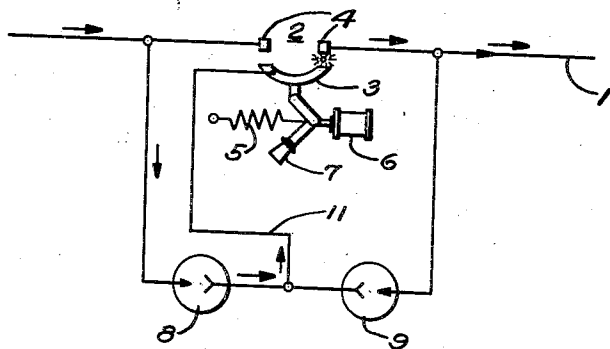
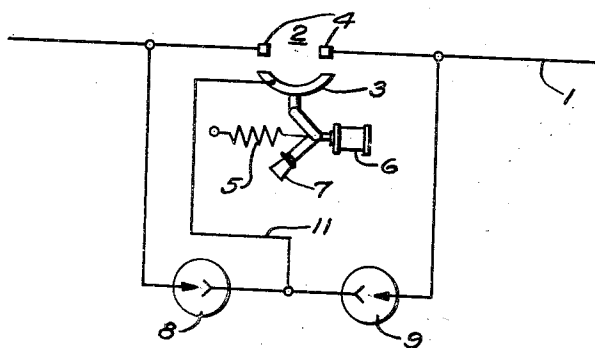


Fig. 3.



WITNESSES:

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CIRCUIT BREAKER.

Application filed October 15, 1923. Serial No. 668,556.

My invention relates to circuit interrupters, and more particularly to circuit interrupters having means for controlling electrical arcs generated upon the operation thereof.

One object of my invention is to provide a circuit interrupter that is capable of normally preventing re-ignition of an arc after the interrupted alternating current has passed through zero value.

It is a further object of my invention to provide a circuit interrupter having an asymmetric valve so placed as to prevent arc re-ignition after the interrupted alternating current has passed through zero value.

It is also an object of my invention to provide a circuit interrupter that is so designed that, in its open position, the insulating dielectric medium between any one pair of relatively movable contact members is stressed only during each alternate half-cycle of the interrupted current.

It is a still further object of my invention to provide a circuit interrupter which employs the unidirectional current-transmitting characteristic of mercury rectifiers for preventing arc re-ignition therein.

In the accompanying drawings,

Figure 1 is a diagrammatic arrangement of apparatus and circuits embodying my invention, the circuit interrupter being shown in the closed position.

Fig. 2 is a similar view, the circuit interrupter being in an intermediate position.

Fig. 3 is a similar view with the circuit interrupter in its open position.

In the several figures of the drawing, similar reference numerals indicate like parts.

In the preferred embodiment of my invention, an electrical transmission line 1 has therein a circuit interrupter 2, which comprises a movable bridging member 3 and a plurality of stationary contact members 4, a spring 5, an operating coil 6 and a handle 7. These parts may be of any conventional type as they do not form a part of my invention.

In parallel circuit with the circuit interrupter 2 are placed a pair of oppositely-disposed asymmetrical valves 8 and 9, such as mercury rectifiers, although any device which has the characteristic of transmitting electrical current in but a single direction may be employed, and it is my intention to embrace any such device within the term "asymmetric valve." A conductor 11 ex-

tends from a point intermediate the rectifiers 8 and 9 to the bridging member 3 of the circuit interrupter.

In the operation of a circuit interrupter embodying my invention, current normally traverses the conductor 1, stationary contact members 4, and the bridging member 3, and, by reason of the higher resistance of the asymmetric valves, very little current traverses the parallel circuits. Upon the operation of the circuit interrupter 2, the bridging member 3 moves away from the stationary contact members 4, whereupon an arc is drawn therebetween.

The position of the arc between the bridging member 3 and one of the stationary contact members 4 is determined by the direction of the current flow at the instant when the circuit interrupter is operated. In Fig. 2, it is assumed that the current is flowing from left to right, causing the arc to be drawn between the bridging member 3 and the right-hand stationary contact member 4. After initial current rupture takes place, the current traverses the mercury rectifier 8, the conductor 11, the bridging member 3, and the right-hand stationary contact member 4. Substantially no arc is drawn between the left-hand contact member 4 and the bridging member 3 by reason of the parallel circuit traced above. Current is prevented from passing through the mercury rectifier 9 for the reason that it is oppositely-disposed to the mercury rectifier 8.

Upon the movement of the bridging member 3 to its fully open position, as shown in Fig. 3, the arc which existed between the bridging member 3 and the stationary contact member 4 is broken down by reason of the increase in the path of the intervening dielectric medium, which is generally air, and by reason of the passage of the current through zero value.

The voltage of the interrupted circuit builds up in the opposite direction from that indicated by the arrows in Fig. 2. The potential gradient between the right-hand stationary contact member 4 and the bridging member 3 is very small for the reason that they are in parallel circuit, such potential difference as may exist being due to the voltage drop in the mercury rectifier 9 and the conductor 11. However, the normal voltage drop between the sections of the transmission 1 is impressed upon the dielectric

medium insulating the bridging member 3 and the left-hand stationary contact member 4. The mercury rectifier 8 prevents the passage of current in the circuit paralleling the circuit interrupter 2 by reason of its uni-directional current-transmitting characteristic.

When a reversal of voltage from the direction shown in Fig. 2 takes place, there are no hot gases between the left-hand stationary contact member 4 and the bridging contact member 3 to impair the dielectric qualities of the air and, accordingly, no arc is established therebetween. When electrical stresses are again applied during the next half-cycle, to the dielectric between the right-hand stationary contact member 4 and the bridging member 3, the dielectric medium will have sufficiently cooled, clarified and increased in length to prevent arc re-ignition.

Accordingly, the dielectric between either one of the stationary contact members 4 and the bridging member 3 is stressed only during each alternate half-cycle of the interrupted current, that is, only for half the period of any complete cycle of the interrupted current.

The advantage of this circuit interrupter will more clearly appear after a consideration of the characteristics of alternating current. As the current in any cycle approaches zero value, the rate of change in value is at a maximum. This means that the interval of time during which no current flows is practically negligible.

When an arc is drawn between two contact members, an ionized atmosphere is created by the vapors incidental to such arcs, thereby aiding arc re-ignition. In my circuit interrupter, the removal of the stresses tending toward arc re-establishment at each pair of contact terminals for periods of half cycle duration permits the dissipation and cooling of the arc gases adjacent to the contact members.

In the event that current is flowing in the opposite direction from that shown in Fig. 2 at the moment of circuit interruption, the mercury rectifier 8 will permit current to traverse the circuit extending through the rectifier 9, the conductor 11, the bridging member 3 to the left-hand stationary contact member 4.

It will thus be seen that, by the use of a pair of oppositely-disposed mercury rectifiers in the circuit relation here shown, any arc which may be drawn between the stationary contact members and the bridging member in the circuit interrupter 2 is destroyed when the current passes through zero value, and the relatively-movable contact members 3 and 4 have separated a sufficient distance to interpose a sufficient dielectric medium therebetween. With the

proper arrangement of mechanical parts, it is possible to insure the complete interruption of an electrical circuit in a half cycle by the use of my invention.

I do not wish to be restricted to the specific circuit connections or arrangement of parts herein set forth, as various modifications thereof may be effected without departing from the spirit and scope of my invention. I desire, therefore, that only such limitations shall be imposed as are indicated in the appended claims.

I claim as my invention:

1. The combination with a transmission line and a circuit interrupter therein, of a plurality of asymmetric valves in parallel relation to said circuit interrupter.

2. The combination with a transmission line and a circuit interrupter therein, of a pair of oppositely disposed asymmetric valves in parallel relation to said circuit interrupter.

3. The combination with a transmission line and a circuit interrupter therein, of a plurality of asymmetric valves in circuit with said circuit interrupter, said valves being so connected relative to said circuit interrupter that arc re-ignition in said circuit interrupter is prevented after the interrupted current has passed through zero value.

4. The combination with a transmission line and a circuit interrupter therein, of oppositely disposed uni-directional means in parallel circuit with said circuit interrupter, said means being so connected relative to said circuit interrupter that arc re-ignition in said circuit interrupter is prevented after the interrupted current has passed through zero value.

5. The combination with a transmission line and a circuit interrupter therein, of a pair of oppositely disposed asymmetric valves in parallel circuit with said circuit interrupter, and means for connecting a point intermediate said valves to said circuit interrupter.

6. The combination with a transmission line and a circuit interrupter therefor comprising a plurality of relatively movable contact members, of a pair of oppositely disposed asymmetric valves in parallel circuit with said circuit interrupter, and means for connecting a point intermediate said valves to a movable contact member of said circuit interrupter.

7. The combination with a transmission line, and a circuit interrupter therefor comprising a plurality of relatively movable contact members, of a pair of oppositely disposed mercury rectifiers in parallel circuit with said circuit interrupter, and means for connecting a point intermediate said rectifiers to a movable contact member of said circuit interrupter.

8. The combination with an alternating current transmission line, and a circuit interrupter therefor comprising a plurality of contact members and a relatively movable bridging member therefor, of means for selectively determining the location of the arc drawn between said bridging member and one of said contact members upon the operation of said circuit interrupter, and means for transferring the forces tending to arc development from said contact member to another contact member at a predetermined time.
9. The combination with an alternating current transmission line, and a circuit interrupter therefor comprising a plurality of contact members and a relatively movable bridging member therefor, of means for causing electrical stresses tending toward arc generation upon the operation of said circuit interrupter to be separately and consecutively impressed upon the dielectric mediums separating each of said contact members from said bridging member.
10. The combination with an alternating current transmission line, and a circuit interrupter therefor comprising a plurality of contact members and a relatively movable bridging member therefor, of means for causing electrical stresses tending toward arc generation upon the operation of said circuit interrupter to be separately and consecutively impressed upon the gaps separating each of said contact members from said bridging member, said impressions occurring once in each cycle of the electro-motive force in said transmission line.
11. The combination with an alternating current transmission line, and a circuit interrupter therefor comprising a plurality of contact members and a relatively movable bridging member, of means for selectively determining the location of the arc drawn between said bridging member and one of said contact members upon the operation of said circuit interrupter, and means for transferring the forces tending to arc development from said contact member to another contact member in accordance with the cyclic changes of the alternating current traversing said transmission line.
- In testimony whereof, I have hereunto subscribed my name this 9th day of October, 1923.
- JOSEPH SLEPIAN.