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CIRCUIT CONTROLLING DEVICE

Original Filed May 29, 1925

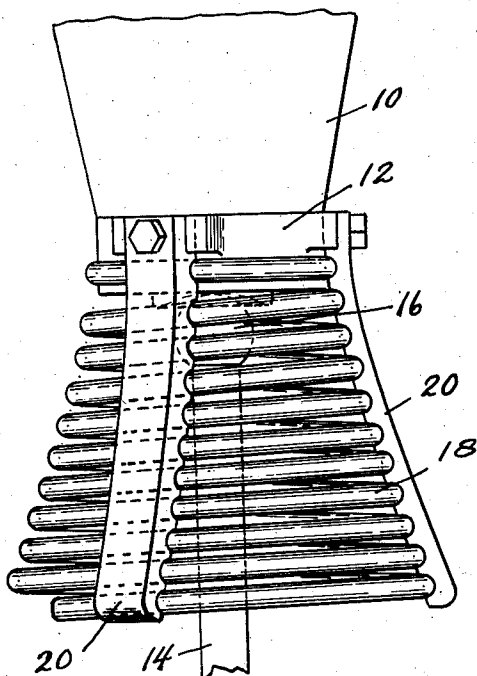


Fig. 1.

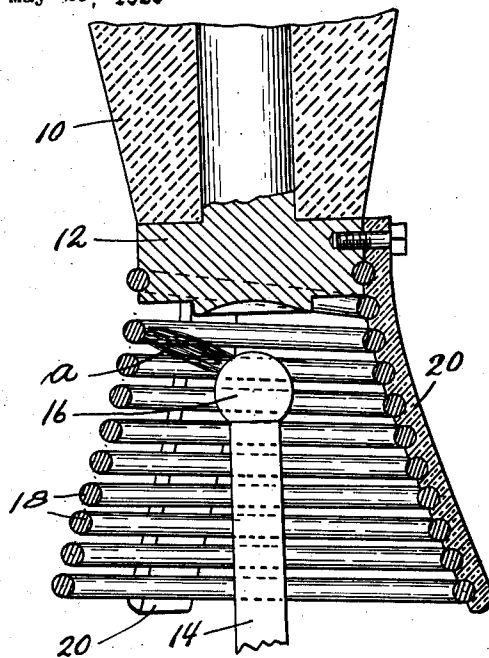


Fig. 2.

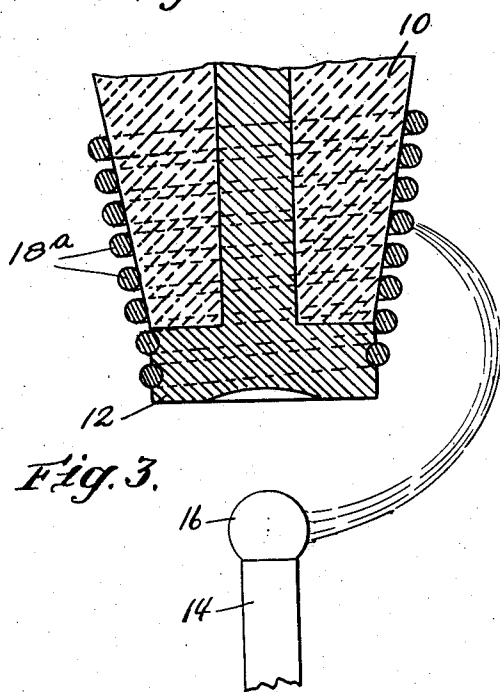


Fig. 3.

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CIRCUIT CONTROLLING DEVICE

Application filed May 29, 1925, Serial No. 33,848. Renewed September 11, 1931.

This invention relates to electric circuit controlling devices, as circuit interrupters, and has for an object the provision of means to facilitate the cooling and quenching of the circuit-interrupting arc.

A further object is the provision of means to introduce a progressively increasing value of current limiting resistance in the circuit of the interrupter during circuit-interrup-
10 tion.

A further object is to provide means whereby the circuit-interrupting arc is instrumental in introducing the resistance in the circuit and in increasing the value of the resist-
15 ance during circuit interruption.

A further object is to provide means to move the circuit-interrupting arc through cold masses of arc-quenching medium and over the surface of a current-limiting resistor.

A yet further object is to provide a resistor as one of the arcing members of the circuit-interrupter.

A yet further object is to provide a high resistance member which is arranged to rotate the circuit-interrupting arc thereabout and progressively along it whereby to progressively increase the value of the resistance in the circuit and decrease the current there-
20 in and simultaneously render the arc unstable and cause it to be extinguished.

A further object is generally to improve the construction and operation of circuit-controlling devices.

25 The basic idea of rotating an electric arc over an impedance is disclosed in my co-pending application Serial No. 755,353, filed December 11, 1924.

40 Fig. 1 is a side elevation of the stationary and movable switch members of a circuit-interrupter embodying the invention.

Fig. 2 is a vertical sectional elevation of Fig. 1.

45 Fig. 3 is a modified form of the invention, wherein the fixed arcing member is arranged to revolve the arc and also move it upwardly during circuit interruption.

50 As here shown the circuit interrupter embodying the invention includes a stationary switch member 10 provided at its lower end

with a fixed contact member 12. A movable contact member 14, which may also be an arcing member, is disposed to be moved into contact with the under face of said fixed contact member to complete the circuit through the interrupter and, when the contact members are separated under load, a circuit-interrupting arc is adapted to be drawn between said members. The movable contact member may be formed or provided with a spheroidally-formed tip 16 at which the arc is adapted to form.

In accordance with this invention, the stationary switch member is provided with a fixed arcing member which, preferably, is in the form of an open spiral conductor 18 or, at least, the convolutions thereof are maintained free from electrical contact as by the insulating spacer-members 20. Said spiral is disposed immediately beneath the switch member and is secured thereto, and the upper end thereof is electrically connected with the switch member or, more specifically, with the fixed contact member 12. The movable contact member is adapted to move within the spiral, preferably approximately along the axis thereof and is spaced from the convolutions thereof. Preferably the spiral has an increased diameter at its lower end so that the distance between the convolutions thereof and the movable contact member are greater than at the upper end. The spiral is adapted to surround the movable contact member preferably for a substantial portion of the length of movement of the movable contact member, although not necessarily for the entire length, so that as the movable contact member approaches its final open-circuit position it becomes withdrawn from the spiral.

Also in accordance with this invention, the convolutions of the spiral are composed of some relatively high resistance material as, for instance, steel; as a steel wire. Preferably the convolutions are of substantial thickness whereby to withstand the action of the arc and the mechanical stresses due to the current.

While the resistance of the spiral is defined as "high" it need be high only in comparison with the resistance of the normal current

path through the interrupter. A resistance of one ohm, say, is very effective in limiting the current flow in a high capacity circuit and a resistance of less value can be used beneficially.

The operation is essentially as follows: When the contact members are separated under load, a circuit-interrupting arc is drawn between them. As the contact members continue to separate the arc is elongated and eventually passes from the fixed contact member 12 to one of the convolutions of the spiral, as indicated at *a*; which point will be near the fixed contact member. The convolutions of the spiral included between the arc and the connection of the spiral with the fixed contact member constitute a solenoid through which the arc current passes. The reaction between the magnetic field of the solenoid and the arc causes the arc to rotate about the movable contact member and over the convolutions of the spiral. The spiral is formed in such a manner that the rotation of the arc thereabout causes the arc to include progressively an increased length of spiral. Since the arc is forced to travel always over cold surfaces of the spiral, it becomes unstable and has increased tendency to become extinguished. The arcing members are preferably immersed in a cold arc quenching medium, as oil, so that the arc is continually moved through the cold medium, which further enhances the instability of the arc. The spiral is enlarged at its lower end, so that the arc is elongated as it revolves about the spiral, which also tends to effect the extinguishing of the arc.

As the arc revolves about the spiral, and passes downwardly thereof, the number of the convolutions, or the length of the conductor included in the circuit of the interrupter is progressively increased; consequently the resistance included in the circuit is progressively increased whereby gradually to cut down the arc current.

All of the above factors tend toward the extinguishing of the circuit-interrupting arc in the minimum of time and with the minimum of disturbance both to the apparatus and to the circuit.

The spacer members 20 are arranged to have a substantial amount of mechanical strength whereby to prevent the contraction of the spiral, due to the current traversing it, should such contraction not be desirable.

The spacing between the convolutions of the spiral permit free circulation of the arc-quenching medium and the arc gases.

The spiral also functions as a reactor to reduce the flow of arc current.

In Fig. 3 the spiral 18*a*, corresponding to spiral 18 of Fig. 1, is disposed above the fixed contact member 12 so that the circuit-interrupting arc is revolved about the convolutions and moves upwardly, thereby elongat-

ing the arc more rapidly than with the construction shown in Fig. 1, as the movable contact member moves downwardly.

The construction may be otherwise modified without departing from the spirit of the invention.

I claim:

1. A circuit controlling device including an arcing member comprising a solenoid, which is adapted to set up a magnetic field and which has a resistance that materially opposes the flow of current through it, and a cooperating arcing member which is movable in the field of said solenoid and is arranged to support an arc between it and said solenoid in position to cause the arc to travel over said solenoid by its reaction with said magnetic field.
2. A circuit controlling device including an arcing member comprising a solenoid, and a cooperating arcing member disposed within said solenoid and its magnetic field, over which solenoid the arc is adapted to travel under influence of said magnetic field.
3. A circuit controlling device including an arcing member comprising an element arranged in spiral formation whereby to form a solenoid and to set up a magnetic field, and a cooperating arcing member arranged to establish an arc in the magnetic field between it and the solenoid in a position wherein the arc will be caused to revolve and move along the spiral by the magnetic field of the solenoid.
4. A circuit controlling device including an arcing member comprising a resistance element arranged in spiral formation whereby to form a solenoid which is adapted to set up a magnetic field and which has a resistance that materially opposes the flow of current through it, and a cooperating arcing member arranged to establish an arc in the magnetic field between it and the solenoid in a position wherein the arc will be caused to revolve and move along the spiral and increase progressively the resistance in the arc circuit by the magnetic field of the solenoid.
5. A circuit controlling device including an arcing member of spiral configuration which is small at one end and large at the opposite end and has its convolutions composed of resistance material, and a cooperating arcing member arranged to establish an arc with the convolutions thereof.
6. A circuit controlling device including an arcing member of spiral configuration which is small at one end and large at the opposite end, and a cooperating arcing member disposed within said spiral and arranged to establish an arc with the convolutions thereof.
7. A circuit controlling device including an arcing member of spiral configuration which is small at one end and large at the opposite end, and a cooperating arcing mem-

ber disposed for movement in and out of said spiral and arranged to establish an arc with the convolutions thereof.

8. A circuit controlling device including an arcing member of spiral configuration which has its convolutions composed of resistance material, and a cooperating arcing member disposed within the spiral and adapted to establish an arc which passes over the convolutions thereof.

9. A circuit controlling device including an arcing member of spiral configuration which has its convolutions composed of resistance material, a contact member disposed within the upper end of the spiral, and a movable arcing member disposed for movement in and out of said spiral and for contact with said contact member.

10. An electric switch comprising a fixed member including an arcing member of spiral configuration which has its convolutions composed of resistance material, a contact member disposed within and connected electrically with the upper end of said spiral, and a cooperating movable contact member disposed for movement into and out of said spiral and into and out of contact with said first contact member.

11. A circuit controlling device including an arcing member comprising a resistance solenoid, and a cooperating arcing member movable in and out of said solenoid, over which solenoid the arc is adapted to travel.

12. A circuit controlling device including an arcing member comprising a resistance element arranged in spiral formation, and a cooperating arcing member movable along the spiral and arranged to establish an electric arc between it and said spiral, which arc will be caused to move along the spiral.

13. A circuit controlling device including a pair of relatively separable contact members, and a resistance element encircling and spaced from the bodies of said contact members and arranged to be included in the electric circuit through the circuit-interrupting arc formed upon the separation of said contact members under load.

14. A circuit controlling device including an arcing member of spiral configuration which is small at one end and large at the opposite end and has its convolutions composed of resistance material, and a cooperating arcing member disposed within said spiral and arranged to establish an arc with the convolutions thereof.

15. The method of interrupting an electric circuit which consists in setting up an electric arc and simultaneously elongating it, causing it to travel over a resistor to include an increasing amount thereof in the arc circuit, and rotating the arc in a cooling medium.

16. The method of interrupting an electric circuit which consists in setting up an electric arc and simultaneously elongating it,

causing it to travel over a resistor to include an increasing amount thereof in the arc circuit, and rotating the arc in a magnetic field.

17. The method of interrupting an electric circuit which consists in setting up an electric arc and simultaneously elongating it, causing it to travel over a resistor to include an increasing amount thereof in the arc circuit, and generating a counter electro-motive force in the arc which is opposed to the arc-maintaining potential by rotating the arc in and by a magnetic field.

18. In an electric switch having separable arcing members, one of which comprises a spiral of material having relatively high electrical resistance, the method of extinguishing the arc established between said arcing members which consists in establishing the arc, elongating the arc by separating the arcing members, and forcing the arc to progress over the spiral in a direction to include a progressively increasing resistance thereof in the arc circuit.

In testimony whereof, I have signed my name to this specification.

TALMA T. GREENWOOD.

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