Nov. 17, 1931. T. T. GREENWOOD 1,832,200

METHOD AND APPARATUS FOR INTERRUPTING ELECTRIC CIRCUITS

Filed Dec. 1, 1926

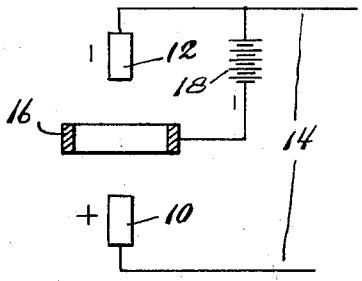

Fig. 3.

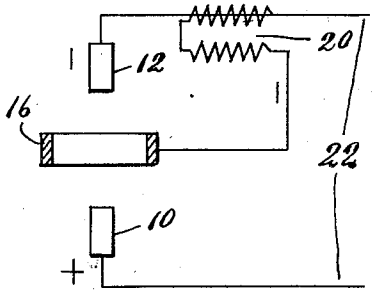

Fig. 4.

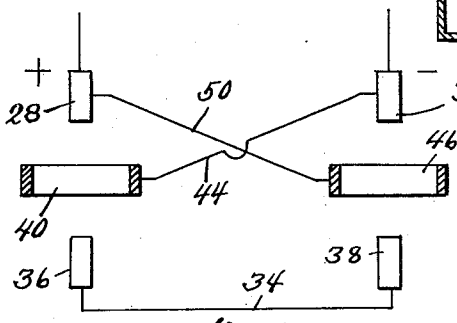

Fig. 6.

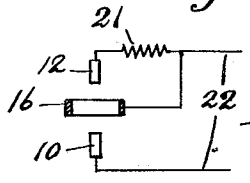

Fig. 5.

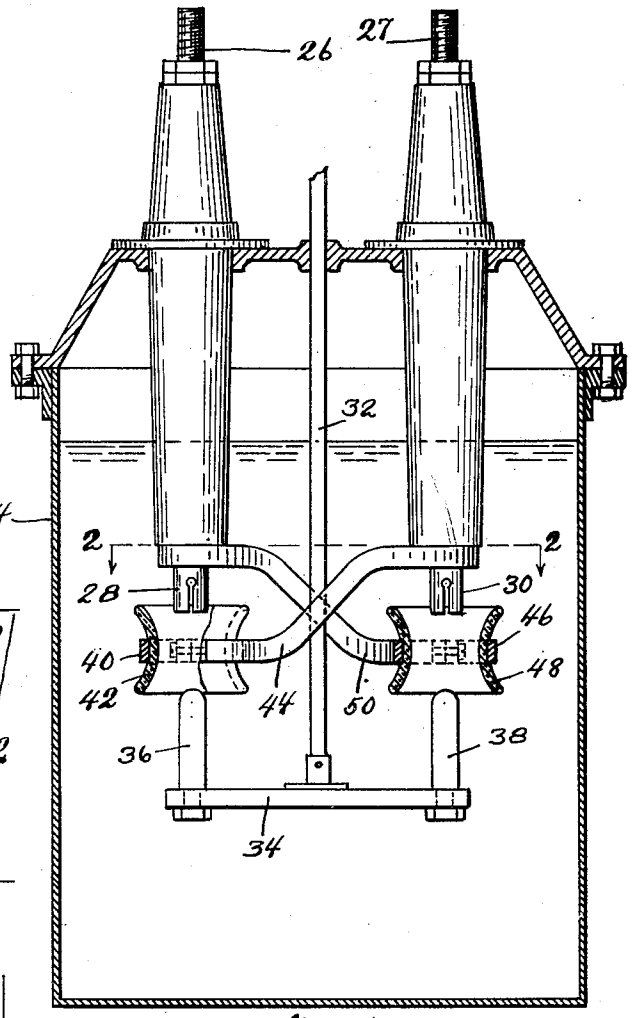

Fig. 1.

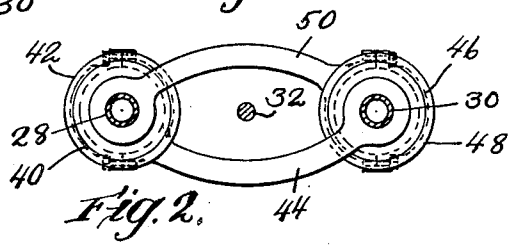

Fig. 2.

Inventor.

Talma T. Greenwood

Patented Nov. 17, 1931 1,832,200

UNITED STATES PATENT OFFICE

TALMA T. GREENWOOD, OF EAST TEMPLETON, MASSACHUSETTS, ASSIGNOR TO CONDIT ELECTRICAL MANUFACTURING CORPORATION, OF SOUTH BOSTON, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS

METHOD AND APPARATUS FOR INTERRUPTING ELECTRIC CIRCUITS

Application filed December 1, 1926. Serial No. 152,048.

This invention relates to electric switches and has particular reference to means for extinguishing the circuit interrupting arc.

An electric arc consists of a stream of electrically charged ions moving between the electrodes. When an electrostatic field is set up in the vicinity of the ionic stream, and the field is given a sufficiently high potential and is of the same sign as the ions, the ions are repelled by said field and are diverted out of their original path. If the electrostatic field is appropriately located the arc will be extinguished. It is an object of this invention to utilize this principle in electric switches for the purpose of rapidly extinguishing the circuit interrupting arc.

A further object is generally to improve the construction and operation of electric switches.

My concurrently filed application, Serial No. 152,049, discloses a specific structure operating in accordance with the principle herein set forth.

Fig. 1 is a sectional elevation through an electric switch embodying the invention.

Fig. 2 is a plan section taken along line 2—2 of Fig. 1.

Figs. 3 and 4 are diagrammatic representations of the separable arcing members of the switch and the means for creating an electrostatic field in the arc zone, Fig. 3 showing a battery to obtain the required potential of the field and Fig. 4 showing the use of a transformer for the same purpose.

Fig. 5 is a view similar to Figs. 3 and 4 but illustrating the use of an impedance to obtain the necessary potential for the electrostatic field.

Fig. 6 is a diagrammatic representation of the electrical circuits of the switch of Fig. 1.

Fig. 3 illustrates the principle of the invention wherein the movable arcing member 10 is adapted to be drawn in a vertical direction away from the fixed arcing member 12 and thereby to set up a circuit interrupting arc in the circuit 14. The movable arcing member is adapted to be moved through a metal field ring 16 which is disposed between the arcing members in their open-circuit position. Said field ring 16 is made more negative than the movable contact member 12, assuming said member to be negative, by a suitable source of potential as the battery 18 which battery is connected between said ring and fixed arcing member 12. Under these conditions an electrostatic field is set up in the zone between the arcing members. The electrostatic field is adapted to be at a higher potential than the negative arcing member 12. Consequently, when the arcing members are separated an arc will be drawn therebetween and the arc may persist until the movable arcing member is substantially within the electrostatic field of the ring. The negatively charged ions of the arc will then be subjected to the action of the electrostatic field. Since the potential of the field is higher than the potential of the ions and is of the same sign, the ions will be repelled from the vicinity of the field and can not pass to the positive arcing member. Consequently, the arc will go out.

Fig. 4 is essentially the same as Fig. 3 except that a current transformer 20 is utilized to charge the field ring and, therefor, to adapt the invention to the alternating current circuit 22 connected with the arcing members. Due to the phase relations between the primary and secondary windings of a transformer, the action of the electrostatic field is most effective at the time the arc current is zero, or the arc is out. In Fig. 3, however, the electrostatic field is acting at all times. In Fig. 5 the transformer 20 is replaced by an impedance 21.

In the preferred embodiment of the invention illustrated in Figs. 1 and 2, I have employed a switch having two points of circuit interruption connected in series and I have utilized the drop of potential across one of the circuit interrupting arcs to render effective the electrostatic field acting upon the other circuit interrupting arc.

The switch embodying the preferred form of the invention comprises an enclosing casing 24 which may contain oil or other insulating fluid. Insulated stationary switch terminals 26 and 27 are carried by the casing and depend thereinto and terminate at their lower ends in stationary arcing members 28

and 30. The movable switch member includes a switch operating rod 32 movable in a vertical direction between said switch terminals and terminated at its lower end in a horizontal conducting bar 34. Movable arcing members 36 and 38 are carried at the opposite ends of said bar and are adapted to be moved upwardly to a position within said stationary arcing members to complete the circuit through the switch and to be moved downwardly and away from engagement therewith to draw the circuit interrupting arcs and ultimately to interrupt the circuit through the switch.

In accordance with this invention, an electrostatic field ring 40 is disposed below the stationary arcing member 28 and in such position that the corresponding movable arcing member 36 is moved therethrough in the circuit interrupting movement thereof. An insulating tube 42 is disposed within said ring and serves to insulate it from direct contact with the circuit interrupting arc between said arcing members. Said ring 40 and its insulator are rigidly supported by a conducting arm 44 which is carried by the opposite stationary switch terminal 27 and is electrically connected with the arcing member 30 thereof. A corresponding field ring 46 is disposed between the other set of arcing members 30 and 38 and is provided with a corresponding insulating tube 48. Said ring and said insulating tube are carried by a rigid supporting and electrically conducting arm 50 that is carried by the opposite stationary switch member 26 and is electrically connected with the stationary arcing member 28 thereof.

Fig. 5 illustrates the circuit connections of the switch of Fig. 1. As thus arranged one-half of the potential drop between the stationary switch members occurs at the arc formed between the cooperating arcing members 28 and 36 and the other half between the cooperating arcing members 30 and 38.

The operation of the device is essentially as follows: Assuming the switch member 26 to be at positive potential and switch member 27 to be at negative potential at the instant of circuit-interruption, circuit interrupting arcs will be drawn between both sets of arcing members until the arcs are within the fields of the electrostatic rings 40 and 46. Since the electrostatic ring 40 is at higher negative potential than the movable arcing member 36, the negatively charged ions passing to the positive arcing member 28 will be repelled away from said arcing member, and consequently the arc will go out. If stationary switch member 27 happens to be the positive member at the time the circuit interrupting arc is drawn, the arc between the separable arcing members associated therewith will go out under similar conditions. The arc will be extinguished immediately after it is drawn and before it has been attenuated to the length heretofore necessary to obtain its extinction.

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

I claim:

1. An electric switch having the combination of a pair of separable arcing members between which the circuit interrupting arc is adapted to be drawn and means including an arc-control member which is located close to the zone between said arcing members and which is at a potential that is so different from the potentials of said arcing members that it establishes an ion controlling electrostatic field of such character in the arc zone that the arc is inhibited.

2. An electric switch having the combination of separable arcing members and electrostatic means to extinguish the arc between said members including a charged conductor that is excluded from the arc circuit and is disposed adjacent and arranged to establish an electrostatic field in the arc zone.

3. An electric switch having the combination of separable arcing members between which a circuit interrupting arc is adapted to be drawn, a conducting member that is excluded from the arc circuit and is disposed adjacent the arc zone and arranged to establish an electrostatic field in the arc zone that is independent of the electrostatic field of the arc and the arcing members, and means to apply a potential to said member sufficiently high to set up an electrostatic field in the arc zone of sufficient potential to control the ion flow in the arc and extinguish the arc.

4. An electric switch having the combination of separable arcing members, an electrostatic field ring through which the arc is adapted to be drawn, and means to impress an electrostatic charge of such character on said ring as to inhibit an arc discharge between said arcing members.

5. An electric switch having the combination of separable arcing members, an insulated electrostatic ring through which the arc is adapted to be drawn, and means to impress an electrostatic charge of such character on said ring as to inhibit an arc discharge between said arcing members.

6. An electric switch having the combination of separable arcing members, an insulating tube surrounding the path of movement of said arcing members, an electrostatic field ring surrounding said insulated tube between said arcing members, and means to impress an electrostatic charge of such character on said ring as to inhibit an arc discharge between said arcing members.

7. The method of interrupting an electric circuit which consists in drawing a circuit interrupting arc between a pair of separable arcing members, and establishing an ion con-

trolling electrostatic field in the arc zone by the potential drop across a second arc in series with the separable arcing members, the electrostatic field being independent of the electrostatic field of the arcing members.

8. The method of interrupting an electric circuit which consists in drawing a circuit interrupting arc between a pair of separable arcing members, and establishing an ion controlling electrostatic field in the arc zone by the current in the circuit, the electrostatic field being independent of the electrostatic field of the arcing members.

9. The method of interrupting an electric circuit which consists in drawing two circuit interrupting arcs in series between sets of separable arcing members and establishing an ion controlling electrostatic field in the arc zone between one set of arcing members by the potential drop across the other set of arcing members, the electrostatic field being independent of any electrostatic field of said first set of arcing members.

10. The method of interrupting an electric circuit which consists in establishing two electric arcs in series and establishing an ion controlling electric field that is independent of and is in the vicinity of one arc by the potential across the other arc.

11. An electric switch having the combination of two sets of separable arcing members connected electrically in series and arranged to establish two circuit interrupting arcs, an electrostatic field member disposed adjacent one set of arcing members in position to influence the arc therebetween by its electrostatic field, and means to apply a potential to said field member including means connecting said member with one of the arcing members of the other set.

12. An electric switch having two sets of stationary and movable arcing members electrically connected in series, electrostatic field rings adjacent to each set of arcing members and through which said movable members are adapted to be moved, and means electrically connecting the field ring associated with one set of arcing members with one of the arcing members of the other set.

13. An electric switch having two sets of stationary and movable arcing members electrically connected in series, electrostatic field members disposed adjacent to each set of arcing members and adjacent which said movable members are adapted to be moved, and means to electrically connect the field member associated with one set of arcing members with the stationary arcing member of the other set.

14. An electric switch having the combination of two sets of stationary and movable arcing members electrically connected in series, an electrostatic field member disposed in the vicinity of the arcing members of one set and means to support said field member from one of the arcing members of the other set.

15. An electric switch having the combination of two sets of stationary and movable arcing members electrically connected in series, an electrostatic field member disposed in the vicinity of the arcing members of one set and means to support said field member from the stationary arcing member of the other set.

16. An electric switch having the combination of two sets of stationary and movable arcing members electrically connected in series, electrostatic field members disposed adjacent said sets of arcing members, and supporting and electrically conducting means connecting the field members with the stationary arcing members of the opposite sets.

17. An electric switch having the combination of separable contact members, a conducting member disposed to set up an electrostatic field in the zone between said contact members, and a current transformer having its primary connected in series with said arcing members and having one end of its secondary connected to one of said contact members and its other end connected to said conducting member.

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

TALMA T. GREENWOOD.