E. THOMSON.

ELECTRIC SWITCHING DEVICE.

APPLICATION FILED OCT. 11, 1917.

1,375,983. **Patented Apr. 26, 1921.**

Fig. 1.

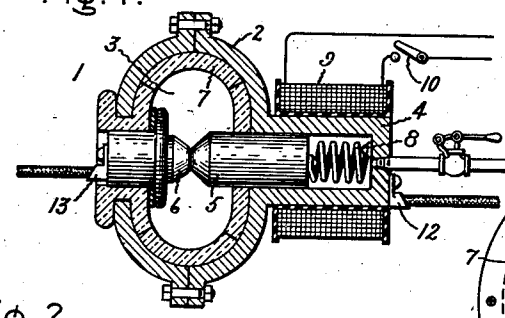


Fig. 5

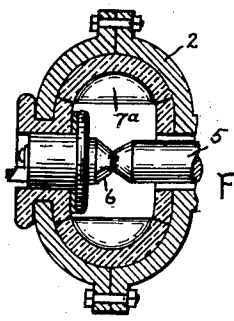


Fig. 6.

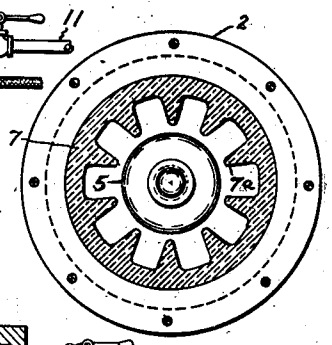


Fig. 2.

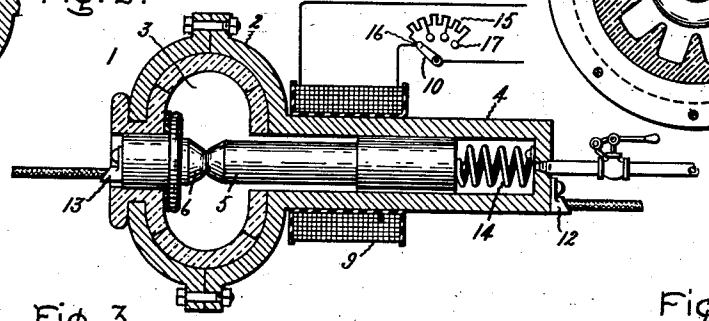


Fig. 3.

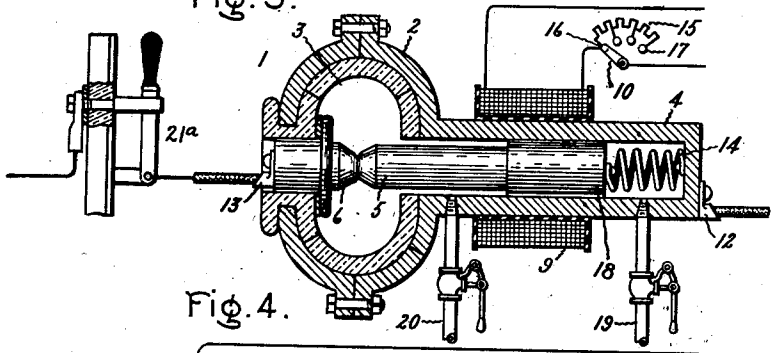


Fig. 7.

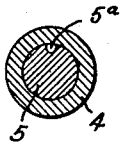
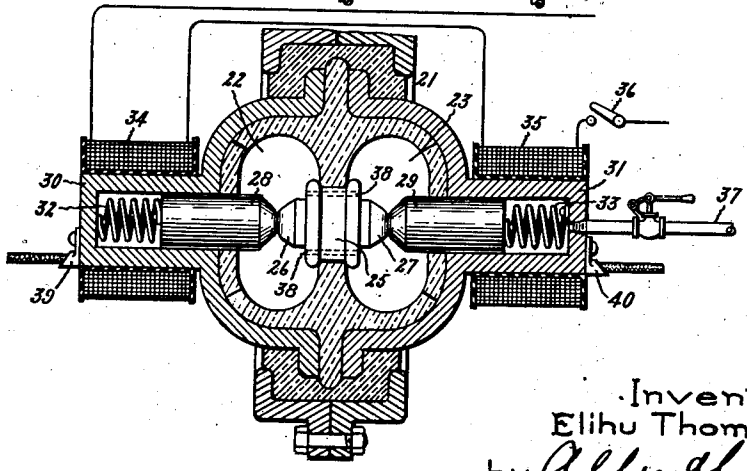


Fig. 4.



Inventor:
Elihu Thomson,
by Albert G. Davis
His Attorney.

UNITED STATES PATENT OFFICE.

ELIHU THOMSON, OF SWAMPSCOTT, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRIC SWITCHING DEVICE

1,375,983. Specification of Letters Patent. Patented Apr. 26, 1921.

Application filed October 11, 1917. Serial No. 196,056.

To all whom it may concern:

Be it known that I, ELIHU THOMSON, a citizen of the United States, residing at Swampscott, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Electric Switching Devices, of which the following is a specification.

My invention relates to electric switching means and has for its object to provide an electric switching device for high potential direct currents in which the circuit is interrupted in a high pressure atmosphere and in a strong magnetic field to produce an exceedingly effective arc extinguishing action. A further object of my invention is to provide a switching device of the magnetic blow-out type in which the blow-out means also controls the circuit of the switch.

The novel features of my invention will be definitely indicated in the claims appended hereto, while the features of construction and mode of operation will be understood from the following description taken in connection with the accompanying drawing, in which:

Figure 1 is a view, partly in section, of an electric switch of the single break type embodying the features of my invention; Figs. 2 and 3 are views, partly in section, of electric switches embodying modified forms of my invention; Fig. 4 is a view, partly in section, of a switch of the double break type embodying the features of my invention; Figs. 5 and 6 show a modification in the lining of the switch chamber, and Fig. 7 shows a detailed view of a portion of the switch.

In Fig. 1 the switch of my invention comprises a vessel or container 1 provided with a portion 2, approximately ellipsoidal in configuration, forming an arc extinguishing chamber 3, and a tubular portion 4 forming a compartment in communication with the arc extinguishing chamber. Within the compartment of the tubular portion 4 is movably disposed or slidably mounted, a contact member or electrode 5 of magnetic material in whole or part forming the movable contact member of the switch. The contact member 5 coöperates with a fixed contact member 6, supported by an integral portion of an insulating lining 7 for the arc extinguishing chamber 3, to control the circuit through the switch. The lining 7 is adapted to withstand the heat of the arc as the contacts separate, and is, therefore, made of heat resisting insulating material and preferably low expansion material such as fused quartz or admixtures of quartz and other constituents having similar properties. The contact member 5 is biased to circuit closing direction or in engagement with contact 6 by a biasing means or spring 8.

For actuating the movable contact member 5 in switch opening direction and controlling the operation of the switch, I provide an electroresponsive actuating means or electrical winding 9 energized from any suitable source of power and controlled by a switch 10. This electrical winding 9 is preferably carried on the tubular portion 4 of the vessel 1 which is of non-magnetic metal or metal of feeble magnetism and cooperates with the magnetic or movable contact member 5 to produce a flux therethrough and thereby a strong magnetic field within the arc extinguishing chamber 3 at the point of separation of the contact members 5 and 6. The winding 9, therefore, coöperates with the contact member 5 not only to control the circuit of the switch but also to produce a magnetic blow-out action on the arc formed as the contacts separate.

The arc extinguishing chamber 3 is also provided with an atmosphere which is maintained under high pressure through the connection of the vessel 1 to a source, for instance, of compressed air by means of a supply pipe 11 suitably insulated and extending through an opening in tubular portion 4 of the vessel. The atmosphere within the chamber may be of various pressures or densities but I prefer to maintain in the chamber a pressure of approximately 1000 pounds to the square inch when potentials of several thousand volts are to be interrupted.

The circuit terminals of my switching device comprise terminal member 12 which is connected to or in conductive relation with the tubular portion 4 of the vessel 1 and the terminal member 13 which is connected to the stationary or fixed contact member 6 so that the circuit through the switching device is from terminal member 12 to the tubular portion 4 of vessel 1, thence through the movable contact member 5 to fixed contact 6 and thence to terminal member 13. The electrodes 5 and 6 are normally biased

to circuit closing position by the spring 8. When the circuit through the switch is to be opened, the control switch 10 is closed to energize the electromagnetic means or winding 9, which thereupon attracts the magnetic member or movable contact 5 and moves it, against the force exerted by spring 8, out of engagement with the fixed electrode 6. The contacts separate in the arc extinguishing chamber 3 and the arc formed is blown or attenuated by the magnetic field set up by the winding 9 and contact member 5 in such a manner as to tend to wrap itself about the contacts, or in other words, is blown inside around the lining 7 of the chamber 3 and so extended that the potential of the arc is exhausted in the attempt to maintain an arc in the dense atmosphere and in the strong magnetic field. Due to the combined action of the magnetic field and the pressure of the atmosphere within the arc rupturing chamber 3, the arc formed in extinguished with great certainty. The member 5 may have flutings 5^a along its length, as shown in Fig. 7, to allow quick action in opening by equalizing gas pressures back of member 5 with the gas in the chamber 3.

In Fig. 2 is shown a switching device in which the tubular portion 4 of the vessel 1 is extended and in which the movable contact 5 is biased by a spring 14 in circuit opening direction out of engagement with the fixed contact 6. The control switch 10 is provided with a rheostat 15 to vary the current in the electrical winding 9. To close the circuit through the switching device, the control switch 10 is moved to the contact button 16 cutting out the resistance from the circuit of the winding 9 and causing the winding to be sufficiently energized to move the movable contact member 5 into engagement with the fixed contact 6. To open the circuit through the switching device, the control switch 10 is moved to contact 17, for instance, thus reducing the current in the winding 9 sufficiently to enable the spring 14 to move the contact 5 out of engagement with contact 6. As in Fig. 1, the switch is supplied with a compressed atmosphere by supply pipe 11 and the arc formed as the contacts separate is quickly extinguished in the arc extinguishing chamber 3 by the combined action of the magnetic field set up by the winding 9 and the density of the atmosphere within the chamber. The front part of member 5, or that part extending into chamber 3, and shown of less diameter, comprises a tube of iron, while the rear part slidable in the tubular portion 4, is a solid or massive iron core.

In Fig. 3 is shown a switching device embodying a further modification of my invention. This switch is provided with pneumatic actuating means. For this purpose I provide the movable contact 5 with a piston head 18 and upon each side of the piston head through suitable insulated openings in the side of the tubular portion 4 of vessel 1, extend air supply pipes 19 and 20 provided with suitable control valves. To control the switching device pneumatically, the pressure exerted from the supply pipe 19 is suddenly raised to exert a pressure on movable contact 5 to move it quickly into circuit closing position against the force exerted by the spring 14. To open the switch, the pressure exerted by supply pipe 20 is suddenly raised to exert a pressure on the contact member 5 sufficient to cause the contact 5 to move quickly in circuit opening direction assisted by the spring 14. The electro-magnetic means may be used in combination with the pneumatic means, controlled by its switch 10 and rheostat 15, as described in Fig. 2, to assist in maintaining the contact 5 in circuit closing position and provide the magnetic blow-out action. Or the pressure in chamber 3 and pipe 20 may be constant, and the closing and opening may be governed by raising or lowering of the air pressure in pipe 19, or the chamber in back of member 5, which it supplies, a portion of member 5 acting as a close fitting piston in tubular portion 4. In this figure, the arc interrupting switch is shown connected in series with an ordinary open circuiting and closing switch 21^a which can be opened at once after the former has done its work. In fact, the valve or other movements controlling the former can be connected to operate this ordinary switch and so obviate the necessity for keeping the arc interrupter contacts apart when the switch is left open, or the circuit is left broken, as when switch 21^a is left open.

In Fig. 4 I have shown the principles of my invention applied to a double break switch. In this type of switch a vessel 21 is provided having two separate arc extinguishing chambers 22 and 23 formed by an insulating lining 24 of fused quartz or similar material which also serves to divide the vessel 21 into two insulated portions. Between the two chambers 22 and 23 and supported by the central portion of the insulating member 24 is a fixed conducting member or block 25 which has contact engaging portions 26 and 27 extending into the chambers 22 and 23 respectively. Cooperating with the contact engaging portions 26 and 27 of member 25 within chambers 23 and 24, respectively, are movable contacts 28 and 29 movable within the compartments formed in the tubular portions 30 and 31, respectively, of vessel 21 and biased by springs 32 and 33, respectively, in circuit closing direction. These contacts are controlled as described relative to the switch of Fig. 1, by electrical windings 34 and 35

carried by the tubular portions 30 and 31 respectively. The windings 34 and 35 may be controlled in various ways, but I prefer to connect the two windings in series and control the circuit of both windings by a control switch 36 so that both windings 34 and 35 are simultaneously energized or de-energized. The windings 34 and 35 coöperate as described, with the movable contact members 28 and 29 to produce magnetic fields for the extinguishment of the arcs formed as the contacts separate. Air supply pipe 37 connected to the tubular portion of the vessel 21 provides an atmosphere of high pressure within the arc extinguishing chamber. In order to equalize the pressures within the two chambers 22 and 23, the contact block 25 is provided with openings 38 communicating between the two chambers. The circuit terminals 39 and 40 for the switch, are connected to the tubular portions 30 and 31 respectively of the vessel 1. As shown, the contacts 28 and 29 are biased to engage the portions 26 and 27 of member 25 to complete the circuit through the switch. To open the switch, the control switch 36 is closed and the electromagnetic means or windings 34 and 35 simultaneously energized to move both electrodes 28 and 29 away from the portions 26 and 27 of member 25, causing arcs to occur simultaneously in each arc extinguishing chamber 22 and 23 under a dense atmosphere and subjected to a strong magnetic blow-out action.

In Figs. 5 and 6 is shown a preferred configuration of the lining 7 of low expansion refractory material. To further elongate the arc on rupture the lining is provided with a number of projecting portions 7^a projecting radially inward and forming partial septa, against which and between which, the arc is thrown by the magnetic effect, thus contributing very effectually to the extinguishment thereof.

What I claim as new and desire to secure by Letters Patent of the United States, is—

1. In an electric switching device, relatively movable coöperating contacts, a substantially closed vessel inclosing said contacts and adapted to contain a high pressure atmosphere, and means for separating said contacts and producing a strong magnetic field which aids in attenuating the arc formed within the high pressure atmosphere of said vessel to extinguish it with great rapidity.

2. In an electric switching device, a vessel adapted to contain a dense atmosphere, means for providing a strong magnetic field within said vessel, and contacts controlled by said means and separable within said vessel to form an arc which is attenuated and extinguished by the combined action of said dense atmosphere and said magnetic field.

3. In an electric switching device, coöperating fixed and movable contacts, a vessel inclosing said contacts containing an atmosphere at high pressure, means controlling the operation of said movable contact and coöperating therewith to produce a strong magnetic field at the point of separation of said contacts.

4. An electric switching device comprising an electrical winding, a magnetic member movable in response to said winding and coöperating therewith to produce a strong magnetic field, a fixed contact member cooperating with said magnetic member to control the circuit of the switch, and a vessel adapted to contain a high pressure atmosphere within which said members are separable.

5. In an electric switching device, relatively movable coöperating contacts, means for producing a magnetic field at the point of separation of said contacts, a vessel surrounding said contacts having an atmosphere at high pressure, and a lining for said vessel of low expansion refractory material.

6. In an electric switching device, a vessel provided with an arc extinguishing chamber, electroresponsive means associated therewith, a fixed contact, a movable contact coöperating with said means to control the circuit through the switch and to produce a strong magnetic field within said chamber, and means for maintaining the atmosphere within said chamber at a high pressure.

7. In an electric switching device, a fixed contact member, a coöperating movable contact member of magnetic material, a vessel inclosing said contact members and providing an arc extinguishing chamber within which said contact members are separable, means for producing a dense atmosphere in said chamber, and electromagnetic means controlling said movable contact member and coöperating therewith to produce an intense magnetic field at the point of separation of said contacts.

8. In an electric switching device, a vessel supplied with an atmosphere under high pressure, a fixed contact carried by said vessel but insulated therefrom, a coöperating contact within said vessel movable into and out of engagement with said fixed contact, and means for controlling said coöperating contact and producing a magnetic field at the point of separation of said contacts whereby said arc formed as said contacts separate is attenuated and quickly extinguished by the combined action of said high pressure atmosphere and said magnetic field.

9. In an electric switch, the combination with a vessel having a portion forming an arc extinguishing chamber and a communicating tubular portion, a contact member of magnetic material movably disposed in said tubular portion, a fixed contact member

mounted in said arc extinguishing chamber and coöperating therein with said movable contact, means for maintaining within said chamber a high pressure atmosphere, and electromagnetic means mounted on said tubular portion and coöperating with said movable electrode to produce a magnetic field at the point of separation of said contacts.

10. In an electric switch, the combination with a vessel having a portion forming a closed arc extingnishing chamber, coöperating fixed and movable contacts separable within said chamber, an insulating lining within said chamber, a tubular portion for said vessel supporting said movable contact in conducting relation thereto, circuit terminals connected to said fixed contact and to said tubular portion respectively, means supplying said chamber with a dense atmosphere, and electromagnetic means carried by said tubular portion for causing said contacts to be separable in a strong magnetic field.

11. In an electric switch, the combination with a vessel having a portion forming a closed arc extinguishing chamber, coöperating fixed and movable contacts separable within said chamber, a tubular portion having a compartment for said movable contact, means for biasing said contact in one direction, electromagnetic means for moving said contact in the opposite direction, means for maintaining a high pressure atmosphere in said chamber, and means including said first mentioned means for producing a strong magnetic field at the point of separation of said contacts.

12. In an electric switch, the combination with a vessel having a portion forming a closed arc extinguishing chamber and a tubular portion having a compartment in communication with said chamber, means for maintaining a high pressure atmosphere within said vessel, a fixed contact within said chamber, a coöperating contact movably disposed within said compartment, electromagnetic means carried by said tubular portion coöperating with said movable contact to control the movement of the same and to produce a magnetic field at the point of separation of said contacts.

13. In an electric switching device, the combination with a vessel having a portion forming a closed arc extinguishing chamber, coöperating fixed and movable contacts separable within said chamber, means for maintaining a high density atmosphere within said vessel, and electromagnetic means for actuating said movable contact and for coöperating therewith to produce a strong magnetic field at the point of separation of said contacts.

14. In an electric switching device, the combination with a vessel having a portion forming a closed arc extinguishing chamber, coöperating fixed and movable contacts separable within said chamber, means for maintaining the atmosphere within said vessel at a high pressure, means normally biasing said movable contact in circuit closing direction, and means for moving said movable contact in circuit opening direction and providing a magnetic extinguishing action for the arc formed as said contacts separate.

15. An electric switching device comprising a vessel provided with separate arc estinguishing chambers, a fixed contact member within said vessel between said chambers and insulated from said vessel, contact engaging portions for said member extending into each of said chambers, movable contact members in each of said chambers coöperating with the contact engaging portions of said fixed contact, means coöperating with each of said movable contacts to produce magnetic fields at the part of separation of said contacts and operative to control the actuation of said contacts, and means for maintaining a high pressure atmosphere within said vessel.

In witness whereof I have hereunto set my hand this 9th day of October, 1917.

ELIHU THOMSON.