Nov. 21, 1939. S. N. BARUCH 2,180,661

VACUUM SWITCH

Filed May 11, 1938 2 Sheets-Sheet 1

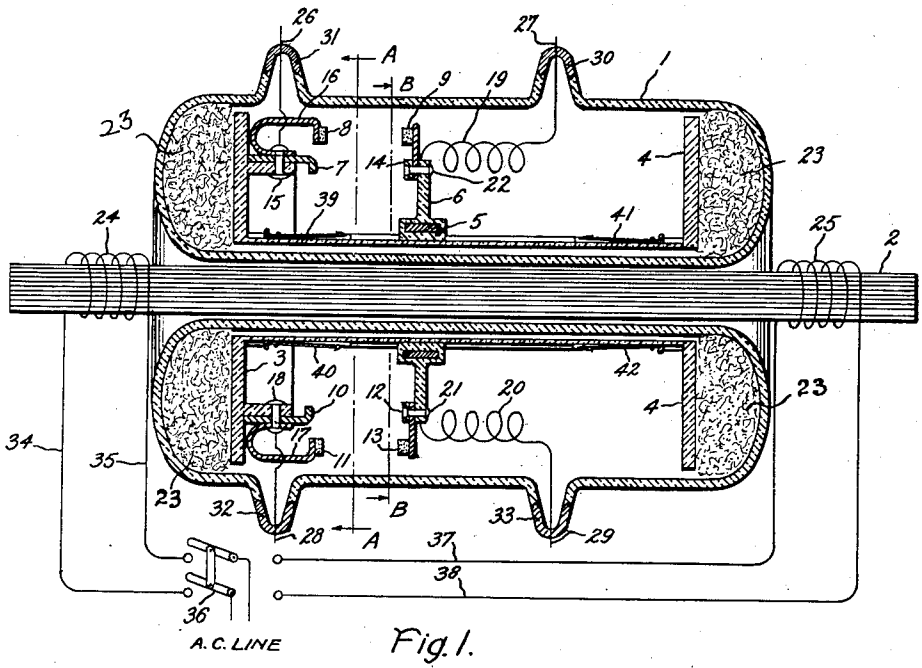

Fig. 1.

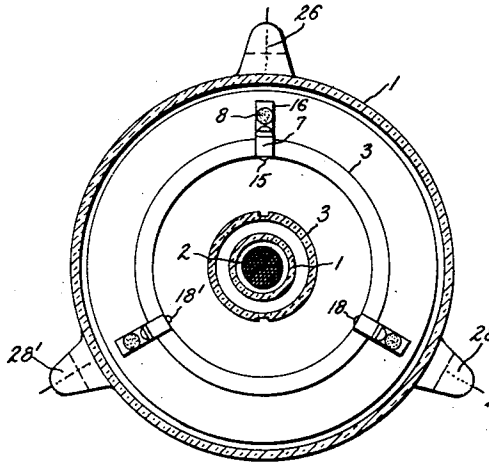

Fig. 2.

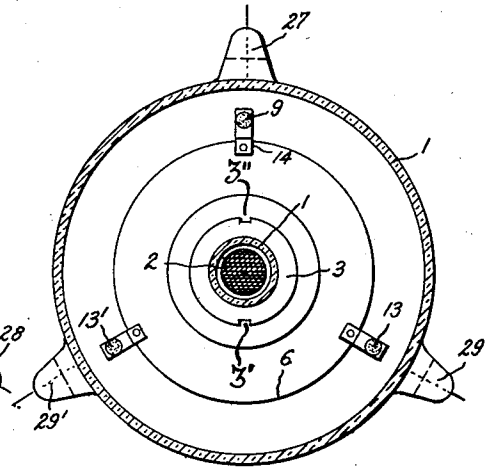

Fig. 3.

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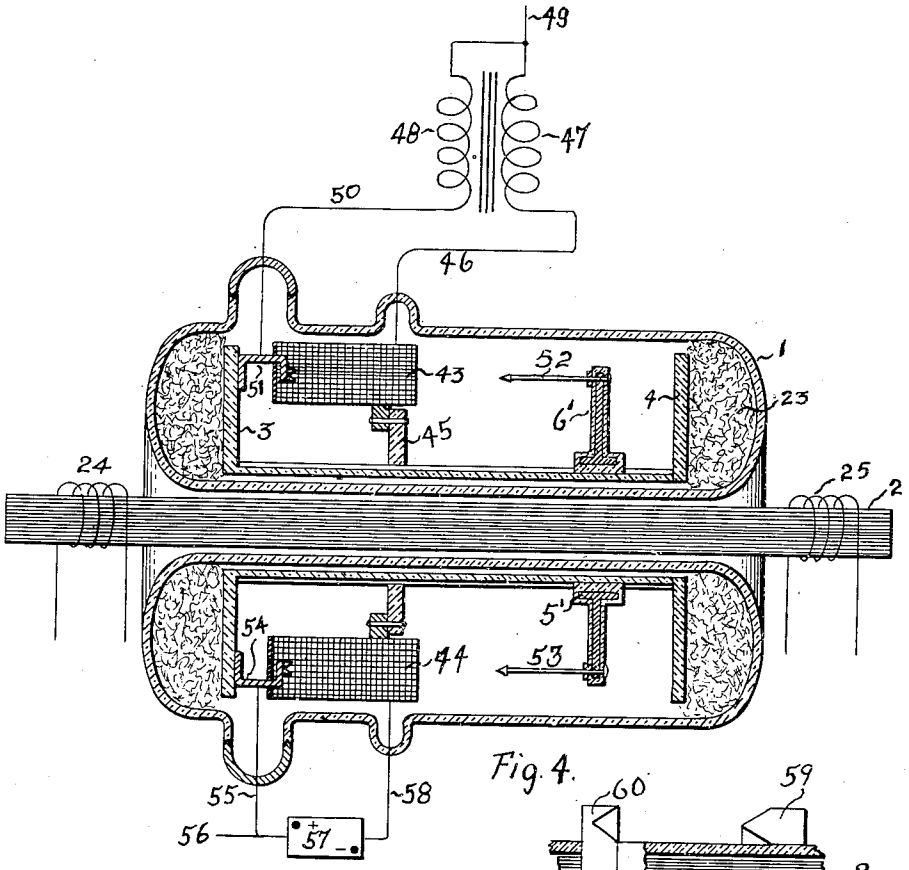

Fig. 4.

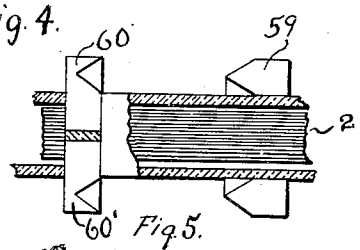

Fig. 5.

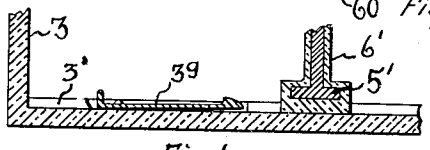

Fig. 6.

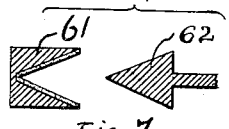

Fig. 7.

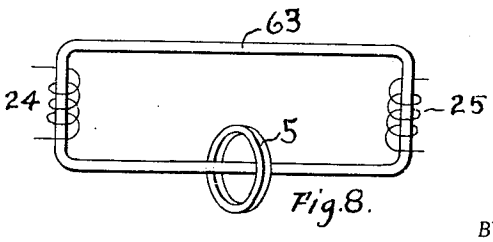

Fig. 8.

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UNITED STATES PATENT OFFICE

2,180,661

VACUUM SWITCH

Sydney N. Baruch, New York, N. Y., assignor to Nortron Patents Corporation, New York, N. Y., a corporation of New York

Application May 11, 1938, Serial No. 207,263

11 Claims. (Cl. 200—91)

This invention relates to the construction and operation of vacuum switches and, particularly, to switches suitable for connecting and interrupting transmission line service for either alternating or direct current, and for any other place or service where ordinary switches are used and where switches are desired that will not produce a spark in the surrounding atmosphere outside of the envelope of the switch itself.

The object of my invention is to produce a circuit-making and breaking device which will carry large currents and high voltages as well as low voltages and currents and to reduce the arc usually formed when said circuits are open.

Another object of my invention is to produce an arcless switch which can take the place of the ordinary oil switches used on alternating current circuits and transmission lines.

Another object of my invention is to produce a practical circuit-making and breaking device for high tension D. C. current transmission lines.

A further object is to produce a switch that will carry out the foregoing objects and still be automatic and have transformer characteristics for its activating means.

Another object is to produce a vacuum switch with protective screen grid characteristics.

Another object of the invention is to open up the transmission circuit on one line and connect in the circuit on another transmission line. Also to provide a switch for industrial purposes where a double pole or multi-pole switch is necessary. Heretofore vacuum switches have been made to only open or break a single line of a circuit. Though my invention can be used to open a single line, its primary purpose is that of a multiple pole switch. In the switches heretofore known in the art, there is a scintillating effect due to the vibration in closing the switch which causes minute sparks between the contacting surfaces and a freezing effect. The switches made heretofore, though they use hammer blows, etc. to open the switch often fail. Furthermore, their construction is such that they have only a slight surface contact; therefore, the resistance in contact causes undue heating and freezing. My contacts are such that even though, in closing the switch, there may be excessive vibration it is parallel to the contacting surfaces and, therefore, tends to prevent any freezing. The tendency of vacuum switch contacts to become welded together is due to the lack of oxidation at the points of contact. Therefore, the use of carbon at the points of contact eliminates the possibility of freezing and the necessity of a hammer-like blow to break the contact.

An important feature of this switch is that stationary contacts can be placed at both ends of the switch so that the switch then becomes a double-throw either for single or double throw operation. When the switch is closed and it is desired not to throw over another circuit, by energizing both primaries the short-circuited ring disconnects and flies toward the centre where the inductance effect changes and comes to a quivering rest in the centre of the switch. This is true where the short-circuited secondary itself is a part of the switch circuit or where it acts as a carrier for the switch contacts and is insulated therefrom.

It is well known that no perfect evacuated envelope can be manufactured for commercial purposes and that with the highest of evacuation there still remain millions of molecules of gas within the evacuated chamber. Therefore, a negative charge on the grid will retard electronic emission.

Furthermore, should electrons be emitted from any hot spot on the contacts and ionize the remaining molecules within the chamber, the negative charge on the grid structure will attract such ionized particles and prevent current flow.

It is also well known in the art that in vacuum type switches the contacts heat and freeze. Great effort has been made to produce a switch where sufficient force can be exerted to break the contact and I have developed a transformer type of switch wherein the magnetic field and pole are continuous throughout the total length of the travel of the part or parts in my invention.

I have also endeavored to show where more than one break in the same circuit can be made and still keep the construction of the switch simple.

In another form, a constant negative bias is kept on the protective screen grid to prevent an ionized path forming between the contacts after they have separated. In another form, the negative bias is on the protective screen grid at the opening of the switch or when the switch is open. To eliminate a great amount of heating and time for de-gassifying the metallic elements within the envelope, I encase them in porcelain or enamel insulation.

Figure 1 is a cross-sectional view of a triple pole single throw switch parallel to its axis embodying my invention.

1 is the envelope of a toroidal shaped evacuated vessel. 2 is an iron core serving as an

axis for the vessel. 3 is a porcelain insulator. 4 is a porcelain flange or washer. 5 is a mobile heavy metallic ring or short-circuited secondary. 6 is the insulation which prevents the escape of occluded gases from the ring during evacuation and use, and also serves as a support for the contact members 9, 12, 13, 14 and bolts 21 and 22, which contacts are connected to the incoming leads 27 and 29 through the Housekeeper seals 30 and 33 and flexible connections 19 and 20. Contacts 7, 8, 10 and 11, and springs 16 and 17, are fastened to the porcelain insulation flanged tube 3 by bolts 15 and 18. The contact bolt 15 is connected to the lead 26 through Housekeeper seal 31. The contact bolt 18 is connected to lead 28 through Housekeeper seal 32. 23 is glass wool which serves as a buffer to take up the shock. 39, 40, 41 and 42 are latches which hold the movable member 5 either in open or closed position. 24 is a primary connected to the A. C. source of supply through switch 36, conductors 34 and 35, to open the contacts and primary coil 25, conductors 37 and 38 through switch 36 connected to the A. C. source to close the contacts.

Figure 2 shows a cross section at A—A at right angles to the axis. 31, 32 and 32' are the copper Housekeeper seals. 1 denotes the envelope walls. 2 is the magnetic core. 3 is the porcelain insulator. Contact parts held by bolts 15, 18 and 18' on to insulator 3.

Figure 3 is a cross section through the line B—B at right angles to the axis. 30, 33 and 33' are copper Housekeeper seals through which the leads make entry. 9, 13 and 13' are the contacts carried on the insulation 6.

Figure 4 is a cross section parallel to the axis of another form of my invention showing screen grids 43 and 44 and a biasing transformer attached to the grid 43 and a storage battery 57 biasing grid 44.

Figure 5 shows a sectional view of my invention in which the switching is accomplished directly by the short-circuited secondary 59 closing the circuit between the stationary contacts 60 and 60' which are insulated from each other as shown.

Figure 6 is a part of the porcelain insulator, as in Figure 1, indicating the relative position of latch 39.

Figure 7 is a detail of a different form of contact members 61 and 62.

Figure 8 is a perspective view of a complete magnetic path 63 showing the relative position of primaries 24 and 25 as to short-circuited secondary 5.

The operation of one form of my switch is as follows:

In Figure 1, switch 36, connected to an alternating current source, closes the circuit through conductor 37, primary 25 and conductor 38. This induces current in short-circuited secondary 5 causing it to move away from primary 25, closing circuits through conductor 17, carbon contacts 8 and 9, spring 16, and conductor 26, and then thereafter closing the copper contacts 7 and 14, this action taking place similarly on all poles. At the same time latch 39 holds the secondary firmly in place upon the opening of switch 36. To release, switch 36 is thrown so as to complete a circuit on the main line through conductor 35, primary 24 and conductor 34 then, due to the continuous magnetic flux through the transformer core or axis of the switch, magnetic latches 39 and 40 are attracted toward the core releasing magnetically the secondary 5 into which current is induced and it very rapidly moves away from the contacts, breaking firstly the copper contacts 7 and 14 and, secondly the carbon contacts 8 and 9.

In Figure 4, the method of operation is the same as in Figure 1 except that, due to the auto transformer formed by primary coil 48 and secondary 47, a negative charge is supplied to grid 43 through conductor 46 when conductor 50 is carrying positive current. On the opposite side of the same switch storage battery 57 supplies negative charge to the grid 44 through conductor 58. I may supply alternating current, arranged with the coils 47 and 48 as shown, to both of the grids, or I may supply direct current, as shown at 57, to both of the grids, or I may supply alternating current to either grid and direct current to the other. A grid 43, 44 may be employed for each stationary contact 51, 54 so that there will be a constant negative bias on one of the grids at all times that there is a potential flowing from the switch contacts. In all cases the contacts at one end of the envelope may be duplicated on the other end so as to make a double throw switch of any number of poles desired depending on whether the form of contact support, as in Figure 1, is used, or in Figure 4 is used. However, the form shown of the section in Figure 5 may be duplicated so that the secondary 59 may work as a short-circuiting member for a single pole switch, either single or multiple pole, single or double throw.

There is a certain lapse of time between the release of the secondary by the latches which permits the induced current in the secondary to reach a high level so that it is very rapid and powerful in its disconnection of the switch contacts.

I am aware that vacuum switches have been made prior to my invention which operate magnetically and for small carrying capacities but none of the character or kind such as I have invented and, therefore, I claim:

1. A vacuum switch comprising a rarefied envelope, a magnetizable core extending through the axis of said envelope, but not within the envelope, leads, contacts, and means for magnetizing said core to open said contacts.

2. A vacuum switch comprising a rarefied envelope, a magnetizable core extending through the axis of said envelope, but not within the envelope, leads, contacts, and electrical means for magnetizing said core to close said contacts.

3. A vacuum switch comprising a rarefied envelope, a magnetizable core extending through the axis of said envelope, but not within the envelope, leads, contacts, and means for magnetizing said core to open and close said contacts by electromagnetic induction.

4. A vacuum switch comprising a transformer, a rarefied envelope, a core extending through the axis of said envelope, but not within said envelope, and constituting one leg of said transformer, a primary winding on each end of the core, a movable closed secondary on the core within the envelope, switch contacts fixed within said envelope, contacts connected to said closed secondary and insulated therefrom and electrical means for magnetizing said core to operate said switch.

5. A vacuum switch comprising a sealed envelope, stationary switch contacts, a movable short-circuited switch ring within the envelope, a magnetizable core outside of said envelope and extending along the axis thereof, coils on opposite ends of said core, and means for energizing said coils whereby the short-circuited ring will operate said switch.

6. A vacuum switch comprising a sealed envelope, stationary switch contacts, a movable short-circuited switch ring within said envelope, a single magnetizable core outside of said envelope, a coil on opposite ends of said core, and means whereby the short-circuited ring will open and close the switch.

7. An electro-magnetic vacuum switch consisting of a toroidal vacuum envelope surrounding a magnetic core, said core having primary coils on opposite sides of the envelope and on the ends of the core movable secondary contacts co-acting with stationary contacts within the envelope, and means for energizing said primary coils to operate said switch.

8. A vacuum switch consisting of an evacuated envelope containing co-acting contacts mounted for relative movement, a transformer having a secondary within said envelope, a core extending throughout the length of and beyond said envelope, but not within the envelope, primary windings on said core at opposite ends of said envelope and means for energizing said windings to operate said switch.

9. A high vacuum switch consisting of a transformer, one leg of which is surrounded by but not within an evacuated envelope, a primary at each end of said leg and outside of said envelope, a single secondary within said envelope, co-acting and relatively moving contacts carried thereby and means for energizing said primaries.

10. A vacuum electric switch comprising a toroidal evacuated envelope, a magnetizable core extending along the axis of said envelope through the central opening thereof, a closed conductive ring mounted within said envelope and surrounding said core for movement therein to close the contacts of said switch, and glass wool in each end of said envelope to serve as a shock absorber.

11. A vacuum electric switch comprising a toroidal evacuated envelope, a core extending along the axis of said envelope and through the central opening thereof, a closed conducting ring within said envelope and surrounding said core, means for magnetizing said core whereby said ring is moved to operate said switch, and a magnetizable latch within said envelope operated by the magnetization of said core to restrain the movement of said ring.

SYDNEY N. BARUCH.