July 21, 1936. R. R. PITTMAN ET AL 2,048,464

HIGH VOLTAGE SWITCHING DEVICE

Filed Jan. 11, 1935 2 Sheets-Sheet 1

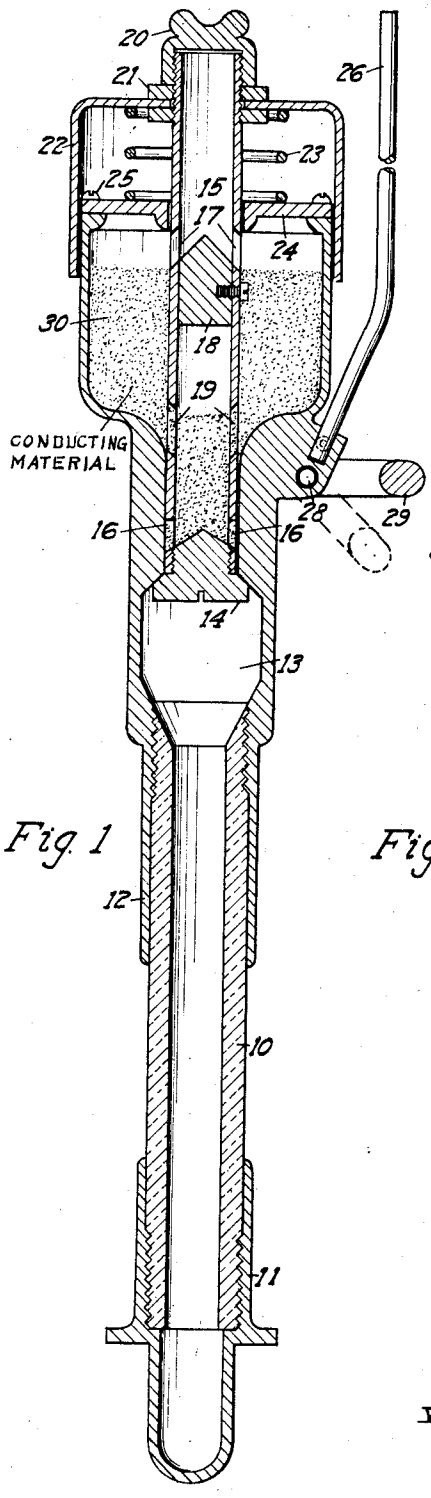

Fig. 1

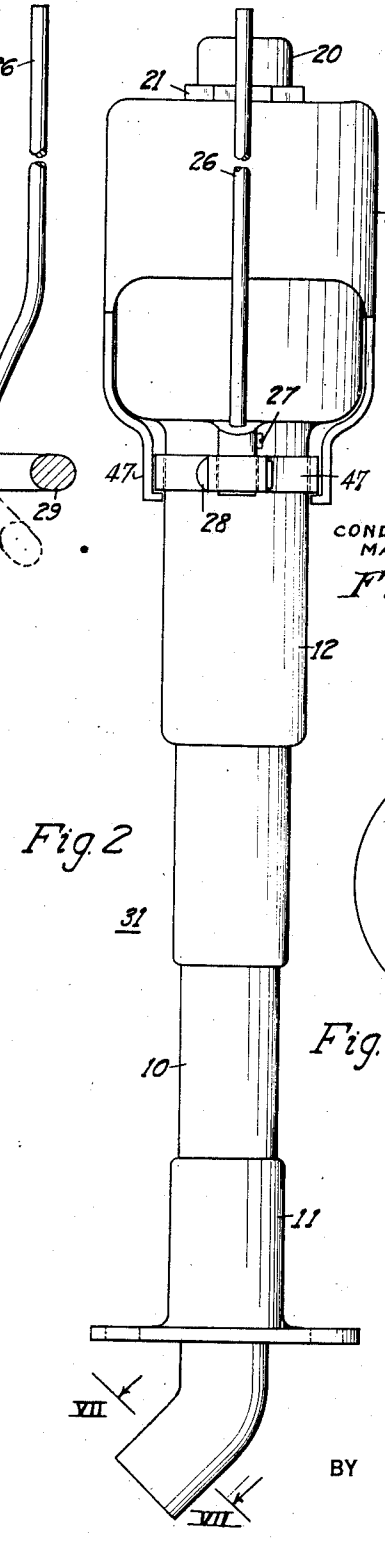

Fig. 2

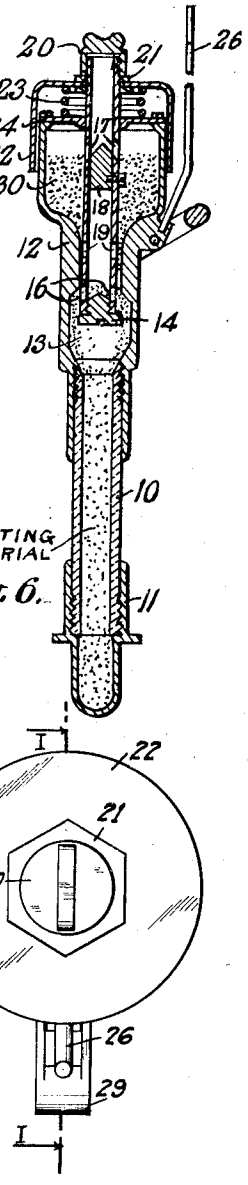

Fig. 6.

Fig. 3

Fig. 7.

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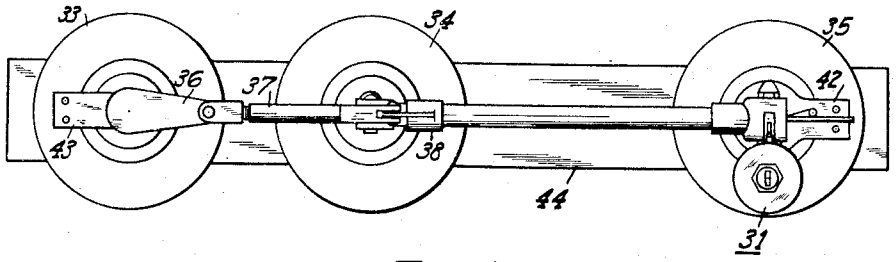

Fig. 4

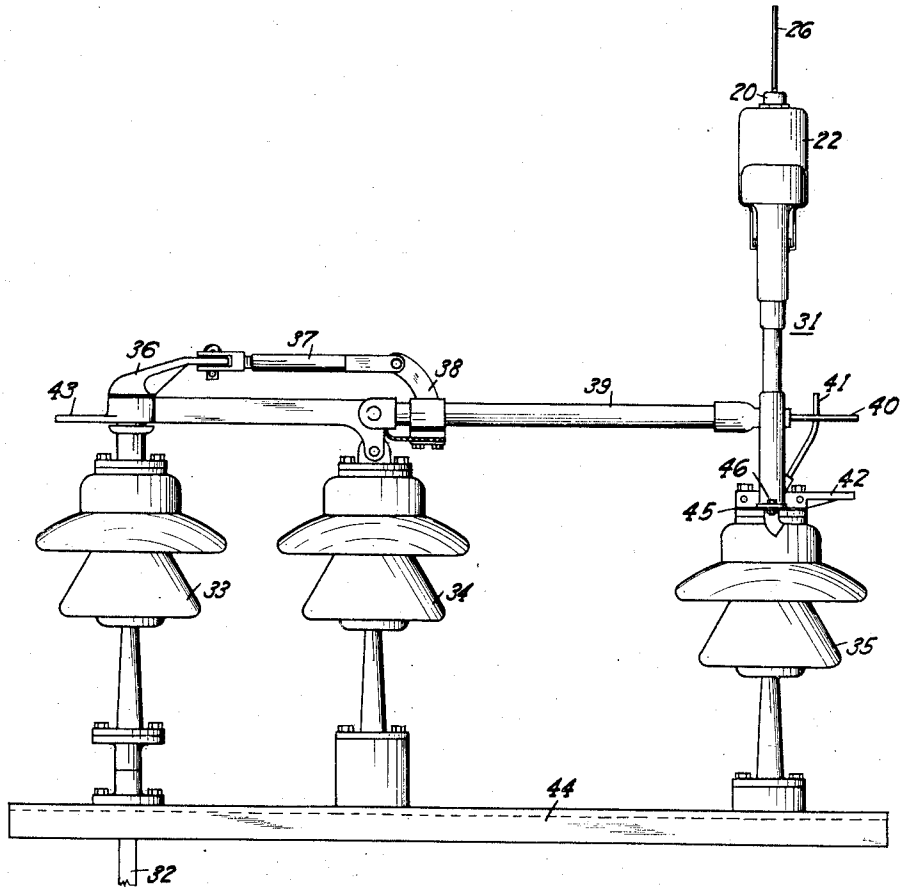

Fig. 5

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2,048,464

HIGH VOLTAGE SWITCHING DEVICE

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Application January 11, 1935, Serial No. 1,344

7 Claims. (Cl. 200—146)

This invention relates generally to switching equipment for use in connection with electric circuits, and particularly to high tension switching devices.

It is now well known that high voltage air-break switches which depend for their interrupting ability upon the elongation of the circuit-interrupting arc in the open air are ineffective circuit-interrupting devices, due to the fact that only a fractional part of the circuit voltage may be required to sustain the arc under such conditions. It is also well known that the arcs resulting from the opening of such switches may be long compared to economical clearances between live parts, and live parts and ground, and that the operation of these switches under certain conditions constitutes a hazard both to the operator and to the connected equipment.

It is an object of the present invention to provide means for transferring an open-air circuit-interrupting arc to a restricted space within a tubular insulator, to the end that the voltage required to sustain the arc therein is many times that required for an arc playing in the open air.

A further object is to provide means responsive to an opening movement of an air-break switch for reducing the dielectric strength of an associated tubular insulator, so that the length of arc required to effect the abovementioned transfer is greatly reduced.

A further object is the provision of a switching device embodying an arc suppressor in combination with a main current carrying switch, in which the arc suppressor changes in effect from a conductor to an insulator in response to the passage of current therethrough.

A further object is the provision of means responsive to a predetermined opening movement of a switch for interposing an arc suppressor in series relation with the contacts of the switch.

Another object is the provision of an arc suppressor having externally operable means for changing the conductivity of a path internally therethrough.

An additional object is the provision of a simple and effective arc suppressor or arc extinguishing device especially applicable for combining with high tension air-break switches in order to effect an increase in their interrupting capacity.

With the above and other objects in view which will appear as the description proceeds, our invention resides in the novel combination and arrangement of an arc suppressor with a switch to the end that a number of the parts making up the resulting switching device perform a plurality of essential and desirable functions, and in the novel features of construction of the arc suppressor itself.

In the description of the embodiment of the invention here presented, specific language will be used for the purpose of facilitating an understanding of its construction and operation, but it will be understood that various changes in the specific construction may be made without departing from the principles of the invention.

In the drawings (2 sheets):

Fig. 1 is an elevational view of the arc suppressor employed in the device, shown in section along the plane indicated by the line I—I in Fig. 3.

Fig. 2 is a side elevational view of the arc suppressor.

Fig. 3 is a plan view of the arc suppressor, viewed from above.

Fig. 4 is a plan view of the switching device, viewed from above.

Fig. 5 is a side elevational view of the switching device.

Fig. 6 is a sectional view of the device taken along the plane indicated by the line I—I in Fig. 3, illustrating the device with the valve open.

Fig. 7 is a sectional view of the lower electrode vent, taken along the plane indicated by the line VII—VII in Fig. 2.

Referring now in detail to the illustrations of the arc suppressor as shown in Figs. 1, 2, and 3, a hollow conducting electrode **11** is secured to the lower end of a tube of insulating material **10** by means of cooperating threads on the respective members. A desirable material for the tube **10** is hard fiber. For conveniently supporting the tube **10** in a vertical position, the electrode **11** is provided with an integral outwardly extending flange adapted to be secured to a flat surface, and in addition is provided with a downwardly and outwardly extending tube-like end portion for directing the discharge from the tube **10** away from contiguous live parts.

Adjacent the upper end of the tube **10** is secured, by means of cooperating threads, the hollow upper conducting electrode **12**. Both the electrodes **11** and **12** are provided with tube-like portions extending toward each other over the external surface of the tube **10** for the purpose of increasing the bursting force required to rupture the tube.

The upper electrode **12** is provided with an upwardly and outwardly extending integral wall to provide a container for a quantity of finely divided conducting material **30**, such as aluminum powder, and an enlarged recess **16** between the

upper portion forming the container and the lower portion adjacent the tube 10. A metal cover is secured to the top of the electrode 12, in any suitable manner, as by the screws 25.

Into the upper end of the recess 13 is fitted the valve 14, the latter being screwed into the lower end of the metal tube 15. Adjacent the upper end of the metal tube 15 is secured the metal housing 22 by the nuts 21, which are adapted to screw on the outside of the tube 15, and clamp the housing 21 rigidly between them. A spring 23 is interposed between the housing 22 and the cover 24, and the latter is provided with an opening through which the tube 15 may reciprocate. In this manner the spring 23 normally maintains the valve 14 in close engagement with the valve seat at the upper end of the recess 13. The cap 20 is arranged to be screwed on the outside of the tube 15, so that it may be removed for the purpose of pouring the finely divided conducting material therein. A plug 18 within the tube 15 diverts the conducting powder 30 through the openings 17 in the wall of the tube so that it may be deposited in the space surrounding the tube. A definite amount of the conducting material 30 flows back into the tube below the plug 18 through the openings 19 in the wall of the tube.

The housing 22, as shown in Fig. 2, is provided with downwardly and inwardly extending strap portions 47 having their ends bent inwardly normal to the axis of the tube 10 for the purpose of cooperating with the yoke member 48, the latter being pivotally mounted on an outwardly extending portion of the electrode 12 by means of the pivot 28.

From this description it will be seen that an upward movement of the outwardly extending portion 29 of the yoke member 48 will cause a downward movement of the housing 22 against the bias of the spring 23. Since the tube 15 and the valve 14 are rigidly secured to the housing 22, such a movement causes the valve 14 to move away from its seat, and permits the powdered conducting material to flow out of the openings 16 of the tube 15 into the recess 13. As the tube 15 moves downwardly the openings 19 are closed by the inner walls of the electrode 12 to prevent entrance of any additional material into the tube 15. Upon being discharged into the recess 13, the conducting powder is directed against and flows under gravity downwardly over the internal surface of the tube 10, in this manner greatly reducing its dielectric strength between the electrodes 11 and 12.

Referring now to Figs. 4 and 5, the base 44 supports in the usual way the insulators 33, 34, and 35, on the tops of which is mounted the live parts of a switch. The control rod 32 is rigidly secured to the insulator 33, and in response to a rotary movement of the former, motion is transmitted to the blade 39 through the movement of the crank 36, the connecting rod 37, and the bent member 38, causing the movable contact member 40 to move upwardly away from its cooperating contact member 41.

The arc suppressor, designated in its entirety by the numeral 31, is supported adjacent the top of the insulator 35 by means of the bolts 46 extending through both the outwardly extending flange of the electrode 11 and the flat member 45, the latter being rigidly secured to the top of the insulator 35.

The line terminals 42 and 43 provide in the usual way a means for connecting respectively a load and a line conductor to the switch.

Assuming that the switching device is connected in series relation with a conductor carrying current, the control rod 32 may be rotated in any suitable manner, causing an upward movement of the contact member 40 away from its cooperating contact member 41, as before described. An initial arc is thus established between the members 40 and 41, which continues through the opening movement of the switch until the member 40 engages and urges upwardly the outwardly extending portion of the yoke member 29, at which time a measured amount of conducting powder is discharged into the tube 10, as previously described. The relative position of the elements constituting the arc suppressor at this time are illustrated by Fig. 6. The conducting material coats the interior of the tube 10 and thereby lowers its electrical strength so that the voltage of arc between the contact members 40 and 41 is sufficient to break down a path inside of the tube 10 between the electrodes 11 and 12. In this manner the circuit-interrupting arc is transferred to the inside of the tube 10, where it is extinguished by the well known expulsion action.

The member 29 is arranged to move out of the path of the contact member 40 so that the latter passes the former in sliding engagement following the actuation of the valve 14. The arcing horn 26, which is electrically in contact with the upper electrode 12, and interposed in the path of the contact 40, is provided for the purpose of maintaining the latter in electrical connection with the upper electrode in the case that the opening movement is so rapid that the conducting material does not reach the lower electrode 11 before the contact member 40 has passed the yoke member 29.

A space is provided between the lower bent portions of the downwardly extending straps 47 of the housing 22 and the container-portion of the upper electrode 12 to permit the member 29 to move in a clockwise direction about the pivot 28 sufficiently to permit the contact member 40 to pass the member 29 in response to a closing movement of the switch, as shown by the broken lines in Fig. 1. The arrangement is therefore such that the valve mechanism is caused to deliver conducting material to the tube 10 only in response to an opening movement of the switching device.

The purpose of this arrangement is to assure a fresh coating of conducting powder on the interior of the tube in response to each opening movement of the switching device. In the absence of such an arrangement, vibration by winds or other causes may cause considerable portions of the interior coating to be lost from the inner surface of the tube 10 after the elapse of a period of time, and thus prevent the proper operation of the device.

It will be seen from the above description that our device depends for its operation upon the reduction of resistance of an insulating member bridged across the terminals of a circuit-interrupting arc resulting from the opening of the switch, in order to transfer the arc to the insulating member, and upon the resulting action of the arc upon the member to the end that the voltage required to sustain the arc in its new location is greater than the voltage available across the terminals of the device.

We claim as our invention:

1. The combination with a main current carrying switch having separable contacts, of an arc

suppressing device including a hollow tube of insulating material, movable means for actuating said main current carrying switch, and means responsive to a movement of said movable means in a direction to open said main current carrying switch for depositing a coating of finely divided conducting material on the internal surface of said hollow tube, said movement interposing said hollow tube between said separable contacts of said main current carrying switch.

2. The combination with a main current carrying switch of an arc suppressor including a hollow tube of insulating material, movable means for actuating said switch, and means responsive to a movement of said movable means for depositing a coating of finely divided conducting material on the internal surface of said hollow tube.

3. A switching device comprising a main current carrying switch and an arc suppressor associated with said switch, said arc suppressor including a hollow tube of insulating material, movable means for opening and closing said switch, and means responsive only to a movement of said movable means in a direction to open said switch for depositing a coating of finely divided conducting material on the internal surface of said hollow tube.

4. An arc suppressor comprising a hollow tube of insulating material, a chamber mounted on the upper end of said tube, a quantity of finely divided conducting material within said chamber, valve means normally preventing the passage of said conducting material from said chamber to said tube interposed therebetween, and means external of said suppressor for actuating said valve means.

5. An arc suppressor comprising a hollow tube of insulating material, a chamber mounted on the upper end of said tube, a quantity of powdered conducting material within said chamber, valve means interposed between said chamber and the interior of said tube, resilient means for normally maintaining said valve in closed position for preventing the passage of said powdered conducting material from said chamber to the interior of said tube, externally positioned valve actuating means associated with said valve, and means responsive to a movement of said valve actuating means for releasing a measured quantity of said conducting material into said tube.

6. A switching device comprising a main current carrying switch having a movable contact member, an arc suppressor associated with said switch, said arc suppressor comprising a hollow tube of insulating material, a hollow chamber mounted on the upper end of said tube, a quantity of conducting material within said chamber, valve means interposed between said chamber and the interior of said tube, resilient means normally maintaining said valve means in closed position for preventing the passage of said conducting material from said chamber to the interior of said tube, and valve actuating means positioned in the path of movement of said movable member, whereby a quantity of said conducting material is deposited in said tube in response to a movement of said movable contact member.

7. An arc suppressor comprising a hollow tube of insulating material, a chamber mounted on the upper end of said tube, a quantity of finely divided conducting material within said chamber, valve means normally preventing the passage of said conducting material from said chamber to said tube interposed therebetween, externally positioned valve actuating means associated with said valve means, and means responsive to a movement of said valve actuating means for releasing a measured quantity of said conducting material into said tube.

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