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ELECTRICAL DISCHARGE DEVICE

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Fig. 1.

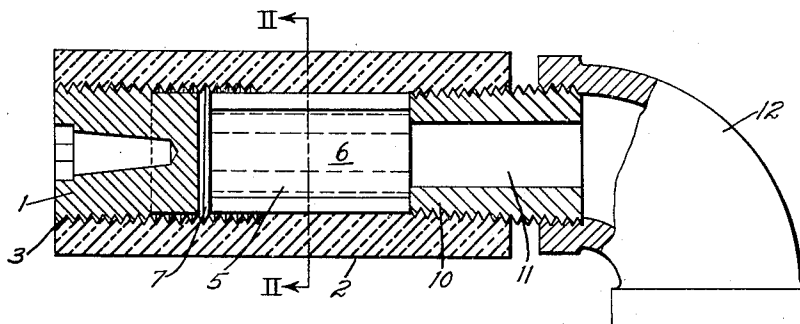


Fig. 2.

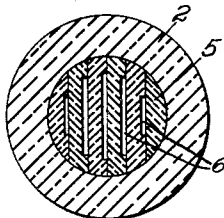


Fig. 3.

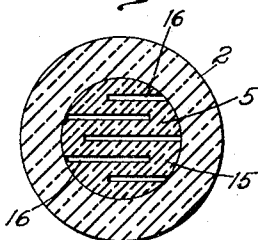


Fig. 4.

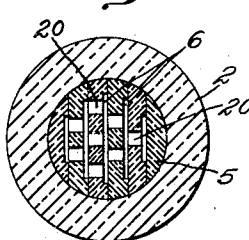
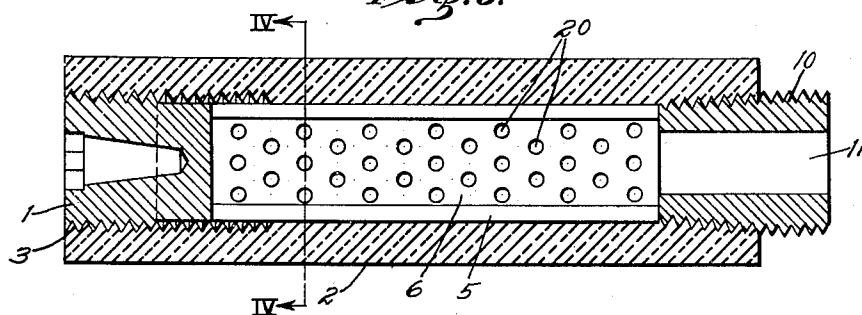


Fig. 5.



WITNESSES:

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ELECTRICAL DISCHARGE DEVICE

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9 Claims. (Cl. 175—30)

My invention relates to an electrical discharge device and particularly to an arc discharge device having a self-interrupting characteristic.

In the distribution and utilization of electrical current, particularly at high voltages, it is customary to protect distribution lines and apparatus connected thereto with various kinds of over-voltage discharge devices. Of the various devices which have heretofore been used, the simple arc gap is most efficient for initiating and discharging the over-voltage. However, after break-down, the simple gap has many undesirable characteristics, the chief among which is that it permits the dynamic voltage of the line to maintain the arc; and consequently dynamic current is discharged by the device.

Not only is the dynamic current likely to damage the discharge device, but the flow of dynamic current through the arc may cause an outage on the electrical system to which it is connected. It is of utmost importance to maintain continuity of service on the electrical system, and as a consequence, simple arc discharge devices are seldom used for protective purposes.

I have found that certain substances when subjected to the action of an electric arc, evolve large quantities of un-ionized vapor.

I have further found that when a blast of un-ionized vapor is caused to flow through the arc path, the arc path becomes rapidly deionized with the result that the arc is blown out and must reestablish in order to maintain itself. If the voltage across the arc then falls below the normal break-down voltage of the arc, the arc will remain extinguished and no dynamic current will flow in the arc.

The discharge device according to my invention utilizes the blow-out effect of certain substances, such as pressed fiber or boric acid, which when subjected to an electric arc evolve large quantities of non-ionized gas. As a consequence, when a discharge is initiated by an abnormal voltage, the power flow current that flows because of the normal voltage will be extinguished when the voltage passes through zero at the end of the half-cycle and the flow of non-ionized gas will sweep away the ionized arc path and restore the insulating properties of the device so that the arc will not reestablish when the voltage rises on the succeeding half-cycle.

Preferably, the gas-evolving material is provided with a plurality of comparatively narrow parallel discharge paths, so that the arc through the material will be substantially unrestricted. One or both of the electrodes are provided with

a passage to permit the escape of the gas evolved from the filler material. Preferably, the entire device is enclosed in a suitable insulating casing.

Other objects and advantages of my invention will be apparent from the following detailed description taken in conjunction with the accompanying drawing, in which

Figure 1 is a sectional elevation of a discharge device comprising my invention,

Fig. 2 is a sectional view taken on line II—II of Fig. 1 showing the parallel arc passages through the gas-evolving material,

Fig. 3 is a view similar to Fig. 2 showing a modification and an arrangement of a discharge passage,

Fig. 4 is a cross section, taken along line IV—IV of Fig. 5, showing distributed arc spreading openings, and

Fig. 5 is a sectional elevation of the modification shown in Fig. 4.

The apparatus disclosed on the drawing comprises a metallic electrode 1 adapted to be connected to an electrical conductor (not shown). The electrode 1 is firmly connected to a casing 2 of suitable insulating material.

I have found an ordinary hard fiber is suitable for this casing. Preferably, I join the electrode 1 to the casing 2 in gas-tight relation by means of suitable threads 3. Spaced from the electrode 1 in the casing 2 is a suitable gas-evolving filler body 5 having narrow arc passages 6 extending longitudinally therethrough. The opposite end of the casing 2 is provided with a second electrode 10 also preferably connected by suitable threads.

The electrode 10 is preferably in mechanical contact with the gas-evolving body 5 so that the same is mechanically supported thereby.

The electrode 10 is provided with a suitable passage 11 for venting the gases evolved from the body 5. If desired, the electrode 10 may be provided with a suitable connection 12 for deflecting the gases or for preventing rain or like substances from entering the discharge device.

The gas-evolving body 5 is spaced from the electrode 1 for permitting the electrical discharge to divide and pass through a plurality of the arc passages 6. In operation, break-down is believed to occur through only one of the arc passages. However, the passage of the arc adjacent to the gas-evolving material produces a large quantity of gas. A portion of this gas flows into the space 7 between the electrode 1 and the gas-evolving filler 5 and out through the parallel arc passages. The gas in contact with the arc will be highly

ionized and consequently considerable ionized gas will find its way into the parallel arc passages, thus facilitating the arc breaking down through the various passages.

5 As shown in Fig. 2, the gas-evolving filler body 5 is of stratified or laminated construction, with the arc passages 6 formed by grooves cut in the faces of the strata or laminations.

10 The evolution of gas by the presence of the device which, in turn, causes the gas to flow through the passages and through the vent opening at high velocity. The swiftly moving gas carries away the ions produced by the arc so rapidly that when the abnormal voltage across the gap is dissipated, the insulating properties of the arc are restored at the end of the half cycle so that the dynamic voltage of the line will not reestablish the arc so as to maintain a flow of current after the disappearance of the abnormal voltage on the system.

15 In the modification shown in Fig. 3, the gas-evolving body is in the form of a rod or cylindrical block 15 with the parallel arc passages formed by milling narrow interleaved slots 16 in opposite sides of the bar. However, it is apparent that the slots may be in any desired pattern and might be molded in the bar instead of milled or cut in a solid bar. Also, in order to secure maximum surface area of the passages, it might be desirable to provide a plurality of small cylindrical openings instead of the slots.

20 The modification shown in Figs. 4 and 5 differs from that shown in Figs. 1 and 2 only in that the space 7 has been replaced or supplemented by a plurality of transverse openings 20 between the parallel arc passages. The gas passing from the active slot through the opening 20 substantially fills the adjacent slots with ionized vapor and thereby facilitates break-down therethrough.

25 While I have shown and described several specific embodiments of my invention, it is apparent that changes and modifications can be made therein without departing from the spirit and scope of my invention. I desire, therefore, that only such limitations shall be imposed as are contained in the accompanying claims or as may be necessitated by the prior art.

I claim as my invention:

30 1. An electrical discharge device comprising an insulating casing, having a longitudinal passage therein, a block of non-conducting material blocking said passage, said non-conducting material being capable of evolving gas when subjected to an electric arc, an electrode in said passage spaced from said block, a second electrode adjacent the opposite end of the block, said second electrode being adapted to mechanically brace said block, said block having a plurality of parallel arc passages therethrough, at least one of said electrodes being vented.

35 2. An electrical discharge device comprising a casing, an electrode extending into one end of said casing, a block of gas-evolving insulating material in said casing in spaced relation to said electrode, said block having a plurality of narrow parallel openings therethrough, and a second electrode in the casing, said second electrode having a passage therein for the passage of gas evolved from the insulating block.

40 3. An electrical discharge device comprising a casing, a non-conducting body therein capable of evolving gas when subjected to an electric discharge, an electrode spaced from said body, a

second electrode adjacent the opposite end of said body, said body having a plurality of arc passages therethrough, at least one of said electrodes being vented.

4. An electrical discharge device comprising a 80 tubular dielectric element, an electrode in threaded engagement with one end of the tubular element and closing the same gas-tight, a filler of non-conducting material which evolves gas in the presence of an electric arc, there being a 85 plurality of narrow longitudinally extending passages therethrough, and a vented electrode in the open end of the tubular element.

5. An electrical discharge device comprising a 90 tubular dielectric element, an electrode closing one end of the tubular element, a filler of non-conducting material in said tube, said filler being composed of material which evolves gas in the presence of an electric arc, there being a plurality of narrow longitudinally extending passages therethrough, and a second electrode in contact with the filler, said second electrode having a passage therethrough for venting the gas evolved from said filler.

6. A self-extinguishing electrical discharge device 100 comprising an insulating tube, an electrode extending into one end of the tube and rigidly connected thereto, a block of insulating material having longitudinally disposed slots disposed in said tube in spaced relation to said electrode, said 105 block and said tube being composed of material which evolves gas when in the presence of an electric arc, and a tubular electrode in the remaining end of the tube the opening in said tubular electrode serving as a vent for gases evolved in said device.

7. An excess-voltage protective device for an alternating-current system, comprising a pair of spaced electrodes, an insulating body having a communicating channel extending therethrough, 115 said body comprising a material which emits substantially non-ionized gas in the presence of an electric arc, said body being stratified in the direction of said channel and said channel being provided by a groove in the face of one of said strata, said body being so disposed that said 120 channel provides a restricted spark-gap between said electrodes, and insulating means for so encompassing the electrodes as to compel any sparkover that occurs to occur in said communicating channel.

8. The invention substantially as defined in claim 7, characterized by at least one of said electrodes being vented for providing for the escape of evolved gases.

9. An excess-voltage protective device for an alternating-current system, comprising a pair of spaced electrodes, an insulating body having a plurality of communicating channels extending 135 therethrough, said body comprising a material which emits substantially non-ionized gas in the presence of an electric arc, said body being so disposed that said channels provide a group of a plurality of restricted arcing paths between said electrodes, insulating means for so encompassing the electrodes as to compel any sparkover that occurs to occur in said group of restricted arcing paths, and intercommunicating means between 140 a plurality of said arcing paths, characterized by at least one of said electrodes being vented for providing for the escape of evolved gases.

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