

Jan. 6, 1948.

R. R. PITTMAN

2,434,010

VOLTAGE-LIMITING ARC INTERRUPTER

Filed Jan. 19, 1945

Fig. 1

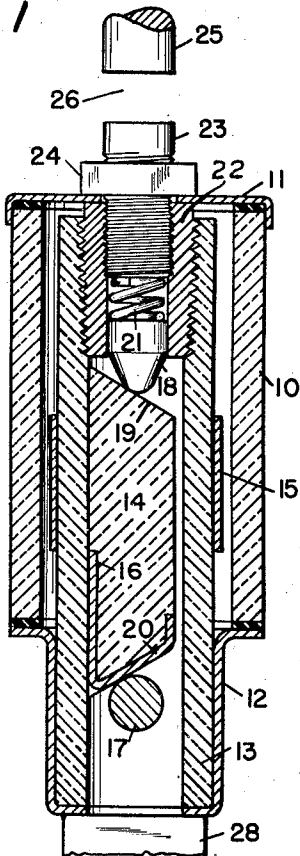


Fig. 2

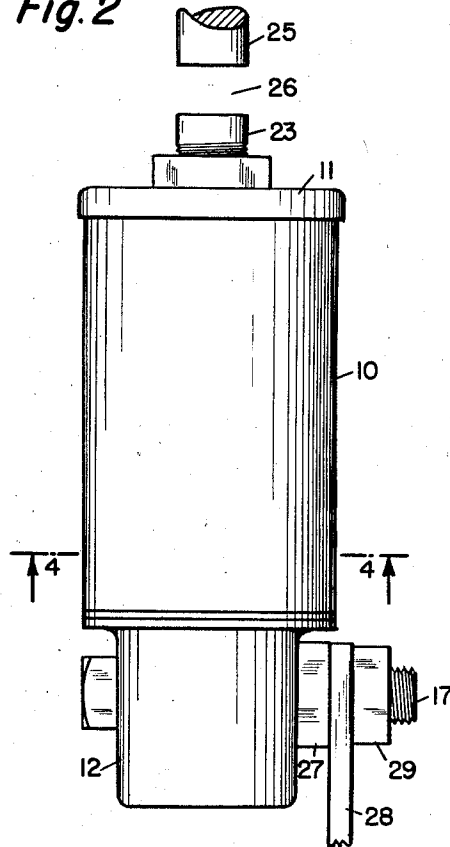


Fig. 4

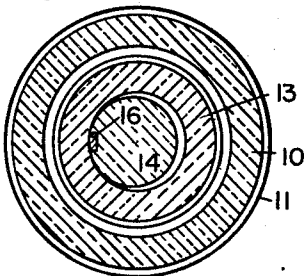
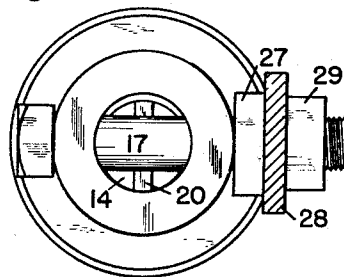


Fig. 3



INVENTOR

Ralph R. Pittman

UNITED STATES PATENT OFFICE

2,434,010

VOLTAGE-LIMITING ARC INTERRUPTER

Ralph R. Pittman, Park Hill, Ark.

Application January 19, 1945, Serial No. 573,572

5 Claims. (Cl. 175-30)

1

This invention relates generally to lightning protective devices of a character adapted for use with energized electrical circuits for the purpose of limiting the voltage rise of an associated conductor by discharging abnormal or superimposed energy and interrupting the passage of energy when normal conditions are restored.

The present invention is an improvement on the construction described in Patent No. 2,164,720, issued to Ralph R. Pittman, and dated July 4, 1939.

Among the objects of the present invention may be noted: (a) the provision in a tube-filler, arc-elongating device of the character described of means for supporting the filler such that the exhaust gases react to hold the filler in the desired initial position; (b) the provision of an improved arrangement for combining the filler with the terminal members of the device; (c) the provision of a construction having venting characteristics favorable for arc-elongation and (d) the provision of a simple, efficient and inexpensive structure in which more than one function is performed by each of several individual elements.

With these and other objects in view which will appear from the description, my invention resides in the novel form, combination and construction of the parts of the device, and the scope of the invention will be indicated by the appended claims.

The drawing illustrates to actual scale an embodiment of the invention suitable for alternating current circuits operating up to 9 kv. R. M. S. Fig. 1 is an elevational view of the device, shown partly in section; Fig. 2 illustrates in elevation the external appearance of the device; Fig. 3 is a view of the lower end of the device; Fig. 4 is a section along the line 4-4 of Fig. 2.

In the embodiment of the invention illustrated, an upwardly extending tube 13, of insulating material, e. g. hard fiber, is open at its lower end, and the upper end is internally threaded to receive the threaded guide sleeve 22. A guide block 18 is adapted for reciprocable vertical movement in the lower end of the sleeve 22, and the terminal bolt 23 threadedly engages an upper portion of the sleeve 22, extending upwardly above the upper end of the tube 13. A spring 21 is interposed between the upper end of the guide block 18 and the lower end of the terminal bolt 23, and continuously urges the guide block 18 downwardly. The sleeve 22, the guide block 18, the terminal bolt 23 and the spring 21 constitute a conducting assembly which closes the bore of the tube 13 at its upper end.

2

Near and somewhat above the lower end of the tube 13, the lower terminal bolt 17 extends transversely therethrough. The diameter of that portion of the bolt 17 within the bore of the tube 13 is smaller than the bore, so that a laterally extending space is provided at each side of the bolt 17 within the tube 13.

A cylindrical filler 14, of insulating material, extends longitudinally within and partially closes the bore of the tube 13 between the terminal bolt 17 and the guide block 18. The respective ends 19 and 20 of the filler 14 are cut so that the end surfaces lie in intersecting planes, similar to portions of the sloping surfaces of a wedge, and the downwardly-biased guide block 18 cooperates with the terminal 17 through the respective sloped ends of the filler 14 to urge the latter laterally to longitudinal abutment with the inner surface of the tube 13. A conducting member 16 embraces the lower end of the filler 14 in contact with the terminal member 17, and extends upwardly along the line of abutment of the latter with the tube 13 toward and in spaced relationship with the guide block 18.

A flanged sleeve 12 is fitted over the lower end of the tube 13 and fastened in place by the extension of the terminal bolt 17 therethrough, and a cover 11, between the nut 24 and the upper end of the guide sleeve 22, extends outwardly beyond the tube 13. A housing 10, of insulating material, for example, porcelain or glass, encloses that portion of the device between the cover 11 and the upper end of the flanged sleeve 12. If desired, the wall strength of the tube 13 may be reinforced by pressing thereon a steel sleeve 15, externally of the tube and between the guide block 18 and the conducting member 16.

While various mounting arrangements may be used as desired, the device is here shown so that the upper terminal 23 is spaced from the conductor 25 by the air gap 26 for the purpose of limiting the voltage rise of the conductor. The device is supported from the lower end by means of the mounting bracket 28 (partially shown), which is clamped between the lower terminal nuts 27 and 29.

To assure proper operation, the device should be constructed so that the weakest electrical path through the device includes the gap adjacent to the line of abutment between the upper end of the initiating electrode 16 and the lower end of the upper conducting closure, however the latter may be constructed. Following initial spark-over along the line of abutment, any ensuing arc is quickly moved along with the evolved gas to-

ward the path of least restriction, which in the device illustrated is opposite the line of abutment. In so doing, the arc is cooled to extinguishment. This phenomenon of arc elongation is more fully described in the above-mentioned Patent No. 2,164,720.

As the accompanying drawing shows to actual size, the length of the initial arc path is $1\frac{1}{2}$ "', the length of the final arc path (path of least restriction) is 2"', the bore of the tube is $\frac{3}{4}$ "', and the diameter of the filler is $\frac{1}{8}$ ". In its movement around the filler, the arc moves peripherally between and over about one inch of fiber surfaces, which movement cools the arc sufficiently to render the device inherently current-limiting within the voltage gradients existing on 9 kv. R. M. S. 60 cycle circuits.

Gas evolved during operation is discharged through the open end of the device, moving downwardly along the filler 14, and tending to expel the filler from the tube. Advantage is taken of this fact by sloping the lower end of the filler 14 at its contact with the terminal 17 so that its lower end is driven by gas discharge tightly against the line of abutment, thus not only providing maximum shielding of the initiating electrode 16, but also assuring high pressure contact of the initiating electrode with the terminal member when these elements are carrying current.

For best operation, it is desired that nothing move in the device except the arc. The resilient guide-block construction here shown is not necessary for this type of operation, but is desirable to compensate for the change in dimensions of the fiber parts which accompanies change in humidity. Hard fiber is the best material I have so far discovered for the tube and filler, but should some nonhygroscopic material having other suitable physical characteristics be used, the conducting closure holding the upper end of the filler in place may be of rigid construction.

While only one embodiment of the invention has been herein described in detail, it will be apparent that the construction shown may be readily modified by simple dimensional changes to adapt the device for use with circuit voltages other than the 9 kv. previously mentioned. It is intended that the drawing and description of the invention here presented will be regarded as generally illustrative, rather than specifically limiting.

I claim, as my invention:

1. A voltage-limiting arc interrupter comprising a tube of insulating material open at the lower end thereof, a closure of conducting material at the upper end thereof, a cylindrical filler of insulating material partially closing the bore of said tube and positioned in lateral abutting engagement with the inner surface thereof, said filler being so formed that the upper end surface of said filler slopes downwardly from the line of abutment of said filler with said tube and the lower end surface of said filler slopes upwardly from said line of abutment, means cooperating with said filler and engaged with the respective end surfaces for holding said filler in lateral abutting engagement with said tube, said last-named means including a conducting member extending endwise into said tube to engagement with the upper sloped surface of said filler and a conducting terminal member extending transversely across and in engagement with the lower sloped surface of said filler, and structural means for causing sparkover to occur along said line of abutment, said structural means including a conducting member extending upwardly along a por-

tion of said line of abutment and in spaced relationship with said conducting closure.

2. A voltage-limiting arc interrupter comprising a tube of insulating material open at its lower end, a terminal member having a diameter less than the bore of said tube extending diametrically across the bore of said tube near the lower end thereof, a filler carried by said terminal member within said tube, said filler partially closing the bore of said tube and having the respective ends thereof sloped so that the end surfaces lie in intersecting planes, conducting means closing the upper end of said tube, said conducting means including a longitudinally extending conducting member in endwise engagement with the upper sloped surface of said filler cooperating with said terminal member in engagement with the lower sloped surface of said filler for holding the filler in longitudinal abutment with said tube, and structural means for causing sparkover to occur adjacent to the line of abutment of said filler with said tube, said structural means including a conducting member extending upwardly along a portion of said line of abutment and in spaced relationship with said conducting means.

3. A voltage-limiting arc interrupter comprising a tube of insulating material open at its lower end, a terminal member having a diameter less than the bore of said tube extending diametrically across the bore of said tube near the lower end thereof, a filler carried by said terminal member within said tube, said filler partially closing the bore of said tube and having the respective ends thereof sloped so that the end surfaces lie in intersecting planes, a guide sleeve of conducting material fitted into the upper end of said tube, a reciprocally movable guide block extending upwardly into said guide sleeve, resilient means concurrently urging said guide block to engagement with the upper sloped surface of said filler and the lower sloped surface of said filler against said terminal member whereby said filler is urged laterally along a line of abutment against the inside of said tube, and structural means for causing sparkover to occur adjacent to said line of abutment, said structural means including a conducting member extending upwardly along a portion of said line of abutment and in spaced relationship with said guide sleeve.

4. A voltage-limiting arc interrupter comprising a tube of insulating material, a longitudinally extending filler of insulating material having a diameter less than the diameter of said tube positioned within said tube in lateral abutting relation along a line of abutment with the inner surface of said tube, said filler having an upper end surface sloping downwardly and outwardly from said line of abutment and a lower end surface sloping upwardly and outwardly from said line of abutment, a terminal member supporting said filler, said terminal member having a diameter less than the diameter of said filler and extending transversely across the lower sloped end of said filler, a conducting member extending coaxially within said tube in engagement with the upper sloped end of said filler, and structural means for causing sparkover between said conducting member and said terminal member to occur along said line of abutment, said means including an electrode resting on said terminal member and extending across the lower surface of said filler in a direction normal to the axis of said terminal member toward said line of abutment and thence upwardly therealong in spaced relationship with said conducting member.

5

5. A voltage-limiting arc interrupter comprising a tube of insulating material, a longitudinally extending filler of insulating material having a diameter less than the diameter of said tube positioned within said tube in lateral abutting relation along a line of abutment with the inner surface of said tube, said filler having an upper end surface sloping downwardly and outwardly from said line of abutment and a lower end surface sloping upwardly and outwardly from said line of abutment, a conducting terminal member supporting said filler, said terminal member extending horizontally across the lower sloped end of said filler, a conducting member supported from the upper end of said tube and extending longitudinally within said tube in engagement with the upper sloped end of said filler, said conducting member being resiliently pressed in endwise direction for wedging said filler from its respective sloped ends against said tube along said line of abutment, and structural means for causing

6

sparkover between said conducting member and said terminal member to occur along said line of abutment, said structural means including an electrode of conducting material resting on said terminal member and extending across the lower surface of said filler in a direction normal to the axis of said terminal member to said line of abutment and thence upwardly therealong in spaced relationship with said conducting member.

RALPH R. PITTMAN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,002,042	Pittman	May 21, 1935
2,164,720	Pittman	July 4, 1939
2,169,110	Pittman	Aug. 8, 1938
2,338,479	Ackermann	Jan. 4, 1944