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[54] **EXCESS VOLTAGE ARRESTERS**

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[58] **Field of Search** 317/61, 61.5, 62, 66, 68; 313/214, 220, 231.1

[56] **References Cited**

UNITED STATES PATENTS

3,289,027	11/1966	Jones	317/61 X
3,676,743	7/1972	Bahr et al.	317/61
3,691,428	9/1972	Bahr et al.	317/61
3,710,191	1/1973	Peche	317/61.5
3,780,350	12/1973	Sanger et al.	317/61.5

FOREIGN PATENTS OR APPLICATIONS

1,205,763	9/1970	United Kingdom	317/61.5

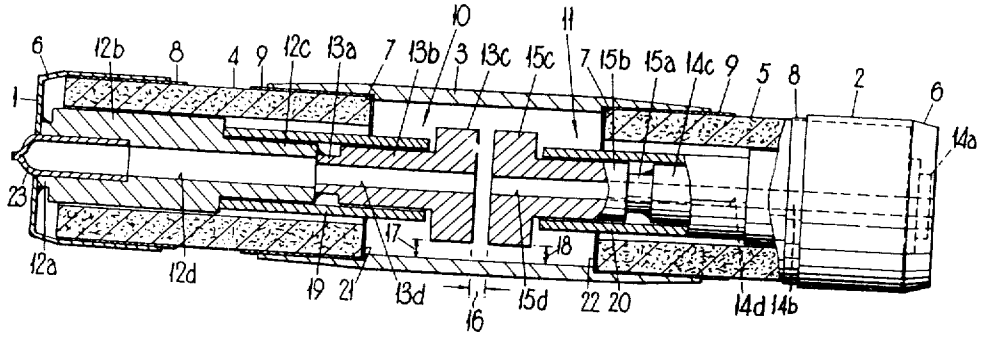
Primary Examiner—G. Harris

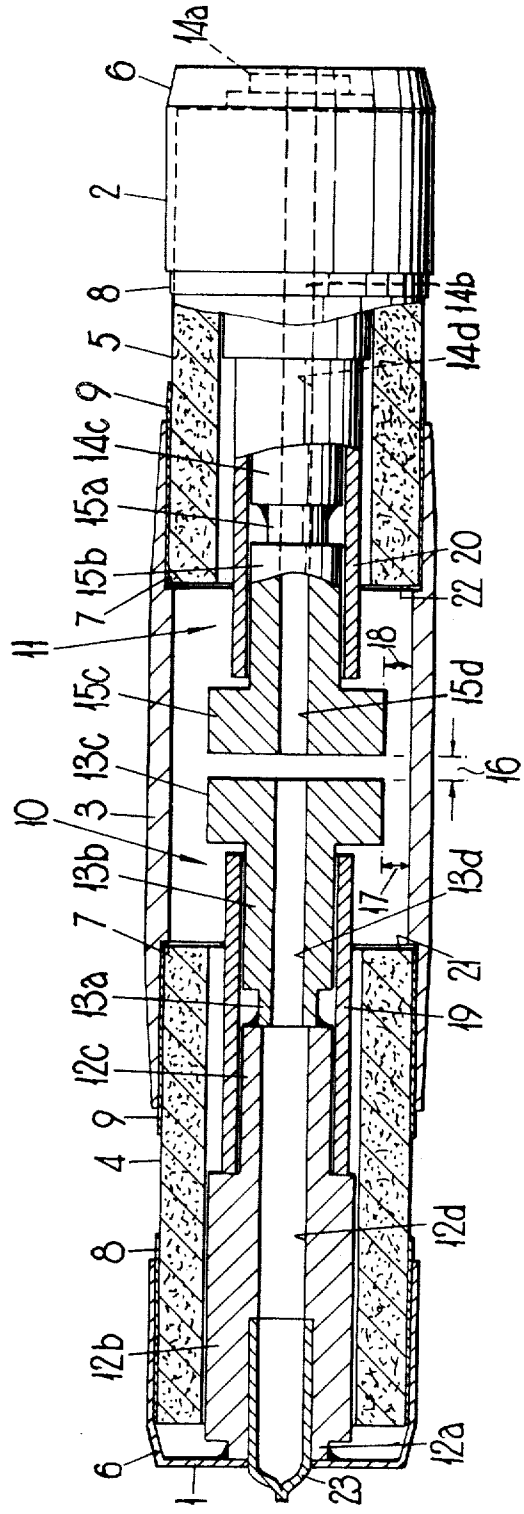
Attorney, Agent, or Firm—Kirschstein, Kirschstein, Ottinger & Frank

[57] **ABSTRACT**

An excess voltage arrester comprising a pair of spaced electrodes housed in a gas-filled enclosure wherein the electrodes carry sleeves of electrically insulating material to prevent reduction of the d.c. ignition voltage of the arrester due to the formation of conductive coatings on the internal surfaces of insulating portions of the envelope by sputtering from the discharge occurring in the arrester in operation.

5 Claims, 1 Drawing Figure




14a
6
2
8
5
9
14c
15a
15b
7
11
15c
13c
3
10
13b
7
13a
12c
9
4
8
12b
6
1
23
12a
14b
14d
20
22
18
15d
16
13d
17
21
19

EXCESS VOLTAGE ARRESTERS

This invention relates to excess voltage arresters.

A known form of excess voltage arrester comprises: a pair of spaced electrodes housed in a hollow cylindrical, gas-filled enclosure comprising: electrically conductive end portions and an electrically conductive tubular central portion which is sealed to and spaced from the end portions by respective tubular electrically insulating portions, the end portions constituting respective terminals for the two electrodes, the two electrodes extending towards each other through the insulating portions so that the gap between the electrodes lies within the central portion. Such an excess voltage arrester is hereinafter referred to as an arrester of the kind specified. One such arrester is described in U.K. Patent Specification No. 1,021,782.

In normal use of an arrester of the kind specified the two electrodes are respectively connected via their terminals to two lines, and the central portion of the enclosure is grounded. When an excess voltage appears between either one of the lines and the other line, or ground, a discharge occurs in the gas-filled enclosure, thus effectively grounding the lines.

In an arrester of the kind specified a discharge is intended to occur between the inner end of one or both the electrodes and the central portion of the enclosure, and the gap between these elements is chosen in conjunction with the pressure and composition of the gas filling to confer a desired operating voltage on the arrester.

It has been found that with known arresters of the kind specified, after a large number of discharges have occurred, subsequent discharges tend to occur at an intermediate point along the length of one or both electrodes, at a d.c. ignition voltage lower than the designed voltage.

It is an object of the present invention to provide an arrester of the kind specified wherein this difficulty is overcome.

According to the present invention in an arrester of the kind specified each electrode carries a sleeve of electrically insulating material which extends from a point near the inner end of that electrode to a point within the insulating portion of the enclosure through which that electrode extends.

In a preferred arrangement in accordance with the invention the outer end of each said sleeve lies adjacent a section of the associated electrode which is a sliding fit in the associated insulating portion of the enclosure.

The invention resides in the appreciation by the inventors that the failure of prior art arresters results from the formation by sputtering from the discharge of conductive coatings on the internal surfaces of the insulating portions of the enclosure. The formation of such films is enhanced by a tendency for the cathode spot of the discharge occurring in operation to run along the surface of the electrode on which it is formed towards the end of the arrester.

In an arrester in accordance with the invention the sleeves reduce the likelihood of the formation of conductive coatings on the internal surfaces of the insulating portions of the enclosure.

In a particular arrangement in accordance with the invention each said sleeve is effective to increase the breakdown voltage between any point on the surface of the electrode carrying that sleeve and a conductive coating which may be produced in operation on the internal surface of the adjacent insulating portion of the enclosure to a value above the d.c. ignition voltage across the gap between the inner end of that electrode and the adjacent part of the central portion of the enclosure.

One arrangement in accordance with the invention will now be described, by way of example, with reference to the accompanying drawing which is a sectional view of a gas-filled excess voltage arrester. Referring to the drawing, the arrester includes a hermetically sealed, hollow cylindrical, gas-filled enclosure comprising two cup-shaped metal end caps **1** and **2**, a tubular metal central member **3** and two tubular ceramic members **4** and **5**. The ceramic members **4** and **5** are sealed at one end into the end caps **1** and **2**, locating on chamfers **6**, and at the other end into opposite ends of the central enclosure member **3**. To this end, the outer surface of each of the ceramic members **4** and **5** is metallised in two bands **8** and **9**, annular seals being established between the inter-fitting parts by brazing during assembly.

Within the gas-filled enclosure are housed a pair of axially spaced electrodes **10** and **11**. The electrode **10** is formed in two parts **12** and **13** which are brazed together, end on. The outer part **12** lies mainly within the ceramic envelope member **4** and comprises three sections **12***a*, **12***b* and **12***c*. The central major section **12***b* is a sliding fit in the ceramic member **4**. The relatively short outer section **12***a* is of reduced external diameter and is brazed to the end cap **1**. The inner section **12***c* is of similarly reduced external diameter, has a length about half that of the central section **12***b*, and at its inner end is brazed to the other part **13** of electrode **10**. The part **13** also comprises three sections **13***a*, **13***b* and **13***c*, the section **13***a* adjacent section **12***c* of part **12** being of smaller diameter than section **12***c* and of relatively short length. The central major section **13***b* is of the same external diameter as section **12***c* and has a length such that the inner section **13***c*, which is of relatively large external diameter, lies near the centre of the metal member **3** of the enclosure. The parts **12** and **13** have communicating axial bores **12***d* and **13***d*, the bore **12***d* being enlarged at its outer end to accommodate a pumping stem **23** which is pinched-off in conventional manner after the required gas-filling has been inserted in the enclosure.

The other electrode **11** is brazed to the end cap **2** at one end and extends through the ceramic member **5** so that, its other end lies near to, but spaced from, the corresponding end of the electrode **10**, the electrode **11** being otherwise identical with the electrode **10** except that it is not provided with a pumping stem.

In the drawing the two parts of the electrode **11** are given reference numerals **14** and **15** with suffixes *a*, *b* and *c*, as for electrode **10**.

The gap **16** between the electrodes **10** and **11** is made to have the same d.c. ignition voltage as the gaps **17** and **18** between the central enclosure member **3** and the innermost sections **13***c* and **15***c* of the electrodes.

A ceramic sleeve **19** fits closely around sections **12***c* and **13***b* of electrode **10**, with its outer end abutting section **12***b*, and a corresponding sleeve **20** fits closely around sections **14***c* and **15***b* of electrode **11**.

In manufacture of the arrester each end cap **1** or **2** is first brazed to its associated electrode **10** or **11** (with ceramic sleeve **19** or **20** in position) and to ceramic

member 4 or 5 to form a sub-assembly, the brazing being carried out with the electrode axis vertical and the end cap lowermost, and with rings of a suitable brazing material placed around the sections 12*a* and 13*a* of electrode 10 and the corresponding sections of electrode 11. The two sub-assemblies are then sealed into opposite ends of the central member 3 of the enclosure, and the required gas filling is inserted via the pumping stem 23.

In use of the arrester, the end caps 1 and 2 are respectively connected to a pair of lines connected with the equipment which it is desired to protect against excess voltage, and the metal enclosure member 3 is grounded. On the occurrence of an excess voltage between either one of the lines and the other line, or ground, a discharge occurs between one or both electrodes 10 and 11 and the metal member 3 of the enclosure. It will be appreciated that while initially the discharge may occur between the two electrodes 10 and 11 the discharge will rapidly transfer to the gap between one or both electrodes and the grounded member 3. A desired d.c. ignition voltage for the arrester, that is the voltage at which a discharge is initiated, is obtained by appropriate choice of the pressure and composition of the gas-filling and the sizes of the gaps 16, 17 and 18.

When a discharge takes place in the arrester, sputtered material from the discharge forms electrically conductive coatings on the internal surfaces of the metal member 3 and the ceramic members 4 and 5 of the enclosure. The formation of these coatings is enhanced due to a tendency of the cathode spot of the discharge to run along the surface of the electrode on which it is formed towards the nearer end cap 1 or 2. It will be appreciated that the above-mentioned coatings are electrically connected to ground in operation via the metal member 3. Hence, if coatings are formed which extend along the inner curved surfaces of the ceramic members 4 and 5 towards the electrode sections 12*b* and 14*b*, the operating voltage of the arrester will eventually be very significantly reduced, and ultimately the arrester will short circuit the lines with which it is connected.

In accordance with the invention, the sleeves 19 and 20 substantially restrict the formation of such conductive coatings to the end faces 21 and 22 of the ceramic members 4 and 5. This is achieved partly by virtue of the gap between the sleeves 19 and 20 and the ceramic members 4 and 5 being too small to allow easy access of the sputtered material to the internal curved surfaces of members 4 and 5, and partly by virtue of the sleeves 19 and 20 preventing the cathode spot of the discharge from moving very far towards an end cap 1 or 2 in operation.

In addition, the presence of the sleeves 19 and 20 makes the shortest gap (via the gas filling) between a conducting coating on an end face 21 or 22 and the adjacent electrode 10 or 11 larger than the gaps 17 and 18. Thus, the presence of the sleeves 19 and 20 increases the breakdown voltage between a conducting coating on an end face 21 or 22 and the adjacent electrode 10 or 11 to a value above the d.c. ignition voltage set by the gaps 17 and 18, thus preventing the coating reducing the d.c. ignition voltage of the arrester.

In one particular arrester of the form shown in the drawing having a d.c. ignition voltage of 400 volts, the gas filling consists of a 10% hydrogen argon mixture at a pressure of 50 torr, the radial spacing between the external surfaces of the electrodes sections 12*c* 13*b*, 14*c* and 15*b* and the internal surfaces of ceramic members 4 and 5 is 0.95 millimetres and the sleeves 19 and 20 have internal and external diameters of 2.92 millimetres and 3.98 millimetres respectively and consist of 98% alumina.

In the arrester shown in the drawing the adjacent sections 13*c* and 15*c* of the electrodes 10 and 11 are of relatively large external diameter, but this need not be the case in an arrangement in accordance with the invention. Thus in alternative arrangements the portions of the electrodes projecting inwardly beyond the sleeves 19 and 20 may be of the same diameter as the portions within the sleeves.

It is pointed out that while the particular arrester shown in the drawing is designed for connection in an external circuit by means of clips or the like contacting the end caps 1 and 2 and the enclosure metal member 3, other arresters in accordance with the invention may be provided with lead wires for external connection.

We claim:

1. An excess voltage arrester comprising: a hollow cylindrical gas filled enclosure comprising a tubular electrically conductive central portion, a pair of electrically conductive end portions, and a pair of tubular electrically insulating portions by means of which said end portions are respectively sealed to and spaced from said central portion; a pair of spaced electrodes housed within the enclosure for which said end portions serve as respective terminals, said electrodes extending towards one another through said insulating portion of the enclosure so that the gap between the electrodes lies within the central portion of the enclosure; and a pair of sleeves of electrically insulating material carried on said electrodes respectively, each sleeve extending from a point near the inner end of the associated electrode to a point within the insulating portion of the enclosure through which the associated electrode extends.

2. An arrester according to claim 1 wherein the outer end of each said sleeve lies adjacent a section of the associated electrode which is a sliding fit in the associated insulating portion of the enclosure.

3. An arrester according to claim 1 wherein each said sleeve is effective to increase the breakdown voltage between any point on the surface of the electrode carrying that sleeve and a conductive coating which may be produced in operation on the internal surface of the adjacent insulating portion of the enclosure to a value above the d.c. ignition voltage across the gap between the inner end of that electrode and the adjacent part of the central portion of the enclosure.

4. an arrester according to claim 3 wherein each said sleeve projects inwardly beyond the inner end of the adjacent insulating portion of the enclosure by an amount sufficient to make the shortest gap, via the gas-filling, between said end and the electrode carrying that sleeve appreciably larger than the gap between the inner end of that electrode and the adjacent part of the central portion of the enclosure.

5. An arrester according to claim 4 wherein the portions of the electrodes projecting inwardly beyond the sleeves are of larger diameter than the portions of the electrodes within said sleeves.

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