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LIGHTNING ARRESTER WITH PLURAL GAPS

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Fig. 1

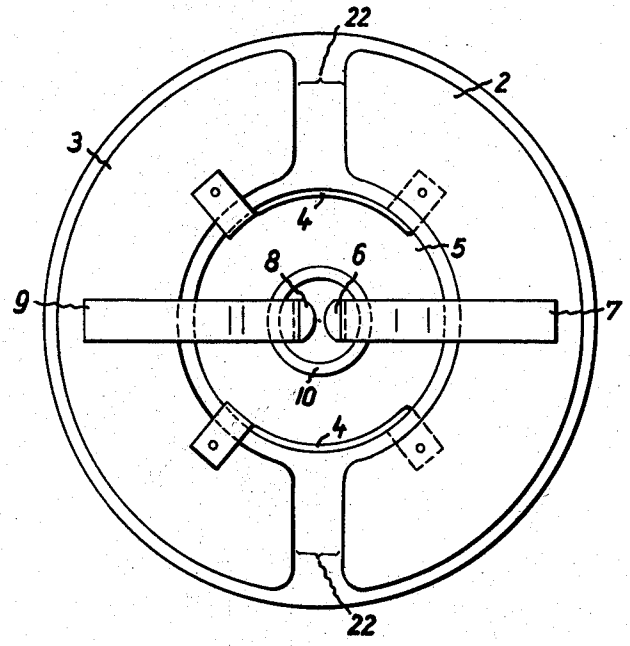
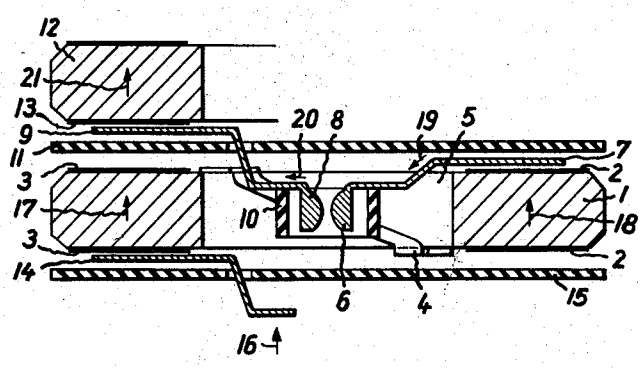


Fig. 2



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LIGHTNING ARRESTER WITH PLURAL GAPS

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The present invention relates to spark arresters.

There exist spark arresters or overvoltage protectors having a quenched spark gap and voltage-dependent or non-linear resistances, the overall height of which arresters, particularly in the case of arresters having a high rated voltage, can be reduced by using so-called compound resistance disks to make up the resistance pile. These compound disks have approximately the same height or thickness as the previously used simple resistance disks, but have a substantially greater diameter and, in general, are formed with a bore. The disks carry on opposite faces appropriately shaped metallic coatings, and this results in the formation of independent adjacent partial resistances. These resistances are connected in series-circuit by bands which pass through the central bore. Thus, the known type disk can be modified in such a manner that, instead of obtaining a single resistance within the dimension corresponding to the thickness of one disk, two serially connected partial resistances are provided, so that the overall height of the resistance pile is reduced by approximately one half. It is not possible to obtain a height reduction of exactly 50% inasmuch as the stacked compound disks must be spaced apart by insulating disks. The individually stacked compound resistance disks are then serially connected by strips which are suitably accommodated within the insulating disks.

The total height of the above-described known type spark arrester is thus equal to the thickness of the pile constituted by the above-described compound disks, plus the height of the arc-extinguishing gap which is equal to about two-thirds to three-fourths of the resistance pile.

Even though spark arresters as described above have a substantially smaller overall height than previously known arresters, this height is still much greater than that of other high voltage gear, such as pin-type, rod or bushing-type, insulators of the same rated voltage. Consequently, high voltage switching stations incorporating such spark arresters take up a relatively large amount of space.

There exist other spark arresters in which the overall height is reduced further by dividing the spark gap into individual sections which are accommodated within the bore of the compound resistance disks. In such arrangements, each composite disk houses one portion of the spark gap, the simplest case being that wherein each bore accommodates one spark gap. Thus, the entire arrester is composed of individual arrester units, each being constituted by a compound disk and one spark gap arranged within the bore of the disk. This arrangement has led to the development of a compound resistance disk which is divided into two disk halves by an insulator, with the spark gap being interposed in the connection which existed previously between the two resistance halves.

A spark arrester for a higher rated voltage was then formed with the help of a number of arrester units, as described above, in that these units were stacked one above the other and separated by insulating disks, the usual connecting strips being provided for serially connecting the individual arrester units, these strips likewise passing through the insulator disks. Thanks to such an arrangement, the overall height of spark arresters having spark gaps in their bores can be reduced 70% or more from the height of spark arresters of the same rated voltage but having simple compound disks, so that it is possible to produce spark gap-type arresters having overall dimensions which are substantially the same as insulators of the same rated voltage.

It is very difficult to manufacture a compound resistance disk having an insulating web passing therethrough. The base material of which these disks are made is granular silicon carbide, whereas the insulating webs are made of granular corundum or the like, each mixed with a ceramic binder which, during the baking phase, will fuse. Consequently, the disks must be pressed under high pressure in an appropriate mold. Great care must be taken to make sure that, during the filling of the mold as well as during the pressing, none of the resistance material, not even individual particles thereof, find their way into the insulating web, because this would bridge the resistances and produce a premature discharge or a short circuit, thus rendering the disks useless. Also, an electric boundary field will be formed at the outer edges of the disks at the transition from the insulating web to the resistance material, and such boundary fields can also result in undesired predischarges.

It is, therefore, an object of the present invention to provide a spark arrester which does not involve the manufacturing difficulties of the prior art, particularly, compound resistance disks having an insulating web in the middle and, with this object in view, the present invention resides mainly in a spark arrester which is made up of individual sub-assemblies or units each composed of a compound disk formed with a central bore and made of homogeneous resistance material. The compound disks each have spaced apart metallic coatings on opposite faces, thus dividing the disk into a plurality of partial resistances separated by a corresponding number of webs of homogeneous material. The individual partial resistances are connected in series-circuit with each other, and at least some of the disks have spark gap means in their bores which are connected to the series-circuit. Adjacent disks are separated by insulating disks, with the spark gap means having terminal lugs that pass through the insulating disks and connect with the series-circuit of an adjacent disk.

Additional objects and advantages of the present invention will become apparent upon consideration of the following description when taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a plan view of a compound resistance disk and spark gap means accommodated in its center bore.

FIGURE 2 is a sectional view showing one entire compound resistance disk together with its spark gap means, the two insulating disks on opposite sides of the compound resistance disk, and a portion of an adjacent compound resistance disk.

Referring now to the drawing, the same shows a compound resistance disk which is divided into two arc-shaped partial resistances by contact coatings 2 and 3 that are metallized onto the disk. The two partial resistances are serially connected by two connecting strips 4 which pass through the center bore 5 of the disk. This center bore 5 also accommodates spark gap means forming an arc extinguishing path and composed of an electrode 6 carried by a terminal lug 7 and an electrode 8 carried by a terminal lug 9, the lugs 7 and 9 being connected to a ring 10. As shown in FIGURE 2, the compound resistance disk 1 is insulated from the adjacent compound resistance disk 12, which is of the same structure as the disk 1 and which, generally, also accommodates a spark gap in its bore (not shown) by an insulating disk 11. Since the terminal lug 7 is connected to the upper coating 2 of the right partial resistance of the disk 1 and the terminal lug 9 passes through the insulating disk 11 and is con-

nected to the lower coating 13 of the left partial resistance of the disk 12, as viewed in FIGURE 2, the stacked resistance disks will, as soon as an arc-over takes place between the electrodes 6 and 8, be connected in series with each other. So long as there is no arc-over, however, the disks 1 and 12 will be insulated from each other by the insulating disk 11.

Similarly, the terminal lug 14 connected to the lower coating 3 of the left partial resistance 3 passes through an insulating disk 15 and carries an electrode (not shown) which, together with another electrode, forms the spark gap of the next lower compound resistance disk. The path of the current flowing upon the occurrence of an overvoltage and, consequently, an arc-over across the electrodes 6 and 8 is indicated by the arrows 16, 17, 18, 19, 20 and 21.

The partial resistances of each compound resistance disk are formed by spraying the four metallic coatings onto the homogeneous disk having the center bore, as described above, thereby forming disk sections which are separated from each other by non-metallized web portions 22. As a result, the compound resistance disk will, prior to arc-over when only very small currents flow, such as currents of the order of one milliampere or less, for practical purposes be a body which, with respect to the outside, has a single potential, i.e., the entire structure can be considered as an equipotential surface. The reason for this is that the very small current which does flow will produce practically no voltage drop, i.e., so long as there is no arc-over across the electrodes, the voltage appears across the electrodes.

Once arc-over does occur, however, the above-described disk structure acts in the manner of two independent serially connected resistances because current of the order of between about 100 and 20,000 amperes will flow, any leakage current flowing through the web portions 22 being negligible as compared to the current flowing along the path 16 to 21, described above.

The disk itself may be made of silicon carbide and the metal coatings are, for example, copper. The approximate dimensions of the disk may be as follows: outside diameter 225 mm.; inside diameter 80 mm.; thickness 18 mm. The thickness of the metallized coatings will be about 0.2 mm. and the width of the webs 22 will be about 35 mm. The spacing between the electrodes forming the spark gap will be approximately 1.5 mm. The insulating disks between the compound disks may be made of pressboard.

As stated above, overvoltage protectors for higher voltages can be constructed by using a correspondingly larger number of resistance disks and spark gaps. This means that a spark arrester for the very highest of rated voltages can be constructed by using a corresponding number of compound resistance disks and spark gaps.

In order to distribute the voltage across the entire spark arrester evenly among the individual spark gaps, particularly in the case of an alternating voltage, the individual spark gaps may be resistance controlled. This is accomplished by positioning the resistance across the electrodes right in the center bore 5; if desired, the ring 10 may serve as the control resistance by appropriately selecting the material of which the ring is made, as, for example silicon carbide.

According to one feature of the present invention, the assembly of the structure, particularly in the case of spark arresters of high rated voltage, may be considerably simplified by combining into a single unit the electrodes 6, 8, the terminal lugs 7, 9, the ring 10, any separate resistance across the electrodes, and one of the insulating disks 11, 15. It will then be a simple matter to form a stack of any desired number of disks and spark gaps by placing such a unit and a compound disk alternately one above the other.

If desired, not every one of the compound disks need be equipped with a spark gap, so that a spark arrester

according to the present invention may include disks, as described above, of which only every other one has a spark gap built into it. It that case, the spark arrester is composed of compound disks with every other insulating disk carrying the component parts making up the spark gap, with the remaining insulating disks carrying electrical connection means for connecting the partial resistances of adjacent disks, for example, the last-mentioned insulating disks may each carry a connecting strip in which the terminal lugs 7 and 9 are replaced by a single continuous strip.

It will be understood that the above description of the present invention is susceptible to various modifications, changes and adaptations, and the same are intended to be comprehended within the meaning and range of equivalents of the appended claims.

I claim:

1. In a spark arrester, the combination which comprises: a disk formed with a central bore and made wholly of homongeneous resistance material; spaced apart metallic coatings on opposite faces of said disk and dividing the same into two partial resistances separated by two webs of said homogeneous resistance material; means connecting said partial resistances in series-circuit with each other; and spark gap means arranged within said central bore and connected to said series-circuit.

2. A spark arrester composed of a stack of compound resistance disks each of which is made wholly of homogeneous resistance material, has a central bore and carries on its opposite faces metallic coatings which divide the disks into a plurality of partial resistances that are separated from each other by webs of homogeneous resistance material, there being connecting means connecting said partial resistances into a series-circuit, at least some of said disks having within their respective central bores spark gap means which are serially connected to the series-circuit of the respective disk as well as to the series-circuit of an adjacent disk.

3. A spark arrester as defined in claim 2, further comprising insulating disks arranged between consecutive disks of homogeneous resistance material.

4. A spark arrester as defined in claim 2 wherein said connecting means comprise conductive strips connected to corresponding metallic coatings and passing through the center bore of the respective disk.

5. A spark arrester as defined in claim 2, further comprising spark gap control resistance means connected across said spark gap means and arranged in the central bores of the respective disks.

6. In a compact spark arrester having spark gap means and voltage-dependent resistances, wherein the latter are constituted by stacked compound resistance disks having central bores within which said spark gap means are arranged, the improvement that each of the compound disks is made of a single piece of homogeneous resistance material, and that adjacent partial resistances are directly connected in series, said spark gap means being serially connected with said partial resistances and forming connecting means leading to the partial resistances of an adjacent compound resistance disk.

7. In a spark arrester, the combination which comprises: a body formed with a bore and made wholly of homogeneous resistance material; metallic coatings on said body and dividing the same into a plurality of partial resistances which are separated by webs of said homogeneous resistance material; and means serially connecting said partial resistances.

8. In a spark arrester, an assembly comprising, in combination: a compound resistance disk formed with a central bore and made wholly of homogeneous resistance material; first, second, third and fourth arcuate metallic coatings carried by said disk, said first and second coatings being arranged on opposite sides of said disk in axial alignment with each other to form between themselves a first partial resistance and said third and

fourth coatings being arranged on opposite sides of said disk in axial alignment with each other to form between themselves a second partial resistance, said partial resistances being separated by two webs of said homogeneous resistance material; connecting strip means passing through said bore and electrically connecting said second and third coatings, thereby connecting said first and second partial resistances to each other; and spark gap means comprising two spaced electrodes arranged within said bore, said electrodes being connected, respectively, to first and second terminal lugs, said first terminal lug being connected to said fourth coating and said second terminal lug being connectable to a coating of an adjacent assembly of similar construction, whereby upon the occurrence of an arc-over across said electrodes, a current will flow through a series-circuit composed of said partial resistances and said spark gap means.

9. An assembly as defined in claim 8, further comprising an insulating disk adjacent said compound resistance disk, said second terminal lug passing through an opening in said insulating disk.

10. An assembly as defined in claim 9, further comprising a mounting ring arranged within said bore and encompassing said electrodes.

11. An assembly as defined in claim 10 wherein said insulating disk, said terminal lugs, said electrodes and said mounting ring are combined into one unit.

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