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ELECTRIC SPARK GAP WITH INSULATION WHICH MAINTAINS ITS HIGH INSULATIVE CHARACTER THROUGHOUT ITS OPERATION

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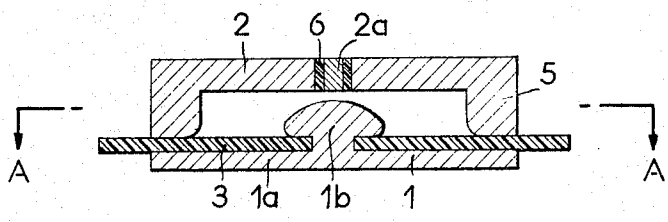


FIG.1

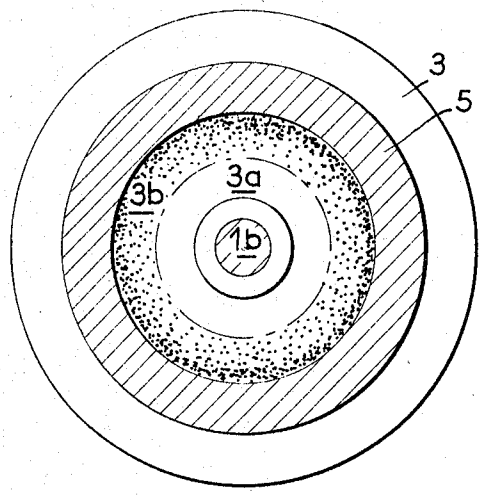


FIG.2

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ELECTRIC SPARK GAP WITH INSULATION WHICH MAINTAINS ITS HIGH INSULATIVE CHARACTER THROUGHOUT ITS OPERATION

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The present invention relates to an electric spark gap, the insulation of which persists after a large number of discharges and more particularly, a spark gap so designed that one zone of the insulation material which surrounds one of the electrodes remains free from any conductive deposit.

It is known that the maintenance of the insulation of electric spark gaps presents a frequently awkward problem for both the manufacturers and the users of such spark gaps. In actual fact, metallic particles are torn from the electrodes as a result of each discharge and are deposited on the insulator and thus make the surface of this latter conductive. Various geometrical arrangements of the spark gap elements have been proposed which tend to protect at least one zone of the insulator from such undesirable projections of metal. Continuous maintenance of the said insulator has nevertheless remained necessary.

It is well known that electric discharges increase the temperature in their vicinity. The present invention has for its object a spark gap which, by virtue of the increase in temperature which accompanies the discharge, prevents any deposition of conductive substances on at least one portion of the insulator.

The said electric spark gap with persistent insulation comprises a first electrode, an insulating plate which surrounds said first electrode, and a second electrode which is separated from the first by said insulating plate, and is characterized in that said insulating plate is formed of a material such that a fine surface layer thereof in the vicinity of said first electrode is vaporized under the action of the heat generated by the electric discharge between the two electrodes.

It will be understood that the electric qualities and subordinately contributive mechanical qualities of the subjacent layer must not become substantially impaired. The vaporized layer is naturally blown towards areas located at a distance away from the discharge by the pressure which results from this latter. A veritable scouring of the insulator is thus carried out as each discharge takes place. Since the vaporization becomes more intense as it takes place in closer proximity to the discharge, the said discharge must accordingly be correctly centered, while the diameter of the electrode which is surrounded by the insulating material must be sufficiently large to limit the rate of vaporization yet sufficiently small to ensure that the scoured zone provides the requisite insulation.

Reference being made to the accompanying diagrammatic FIGURES 1 and 2, the description which follows below relates to one example which is not given in any sense by way of limitation, of the electric spark gap with persistent insulation which forms the subject of the present invention. The constructional arrangements which will be described in connection with the said example must be considered as forming part of the invention, it being understood that any equivalent arrangements can also be employed without thereby departing either from the scope or the spirit of said invention. Only those elements which are necessary for a proper understanding of the invention have been illustrated in the accompanying drawings, in which:

FIG. 1 illustrates a diametral cross-section of a rotary spark-gap as constituting one form of embodiment of the present invention.

FIG. 2 illustrates a view in cross-section taken along the line A—A which is shown in FIG. 1.

As shown in FIG. 1, the spark-gap comprises an electrode **1** constituted by a plate **1***a* on which is formed a mushroom-shaped central projection **1***b*. The rounded top surface of said central projection **1***b* serves for the purpose of centering the discharge as will be made apparent below, in order to prevent said discharge from causing damage to the insulating material located between the electrodes.

The spark gap is provided with a second electrode **2** which is formed of a disc of the same size as the disc **1***a* and provided at the periphery thereof with a flange **5** designed to bear on an insulating plate **3** which closely fits round the base of the mushroom **1***b* and covers the disc **1***a*.

There is fitted inside said second electrode **2** a central conductive insert pastille **2***a* (which in the example described is removable), which is isolated from the electrodes **2** by means of a ring **6**. The electrodes **1**, **2** and **2***a* are preferably formed of an alloy of copper, nickel and tungsten, but could be of any other appropriate conductive materials.

The insulating plate **3** (which can also be constituted by a number of stacked layers) is made of a substance which is capable of vaporizing progressively under the action of the heat evolved, for example of polytetrafluoroethylene. This substances undergoes decomposition at 400° C. approximately and releases its constituent materials.

The electrodes **1** and **2** and the insulating plate **3** are assembled together by means of any insulating device which has not been illustrated in the drawing and which can consist of bolts of insulating material which join the two electrodes together across the plate **3**, or which preferably consist of insulating clamps applied against the electrodes and coupled together outside the device by means of bolts.

The electrodes **2** and **2***a* form a plasma gun which has the function of triggering the spark gap (that is, when a sufficient electric voltage is present between the electrodes *a* and **1**). Accordingly, when an electric potential pulse is applied, by means of a device which has not been illustrated in the drawings and which can be of any desired type (by means of a capacitor, for example), between the electrodes **2** and **2***a*, a discharge occures between said electrodes. The said discharge ionizes the gas which is present and thus produces a plasma-charged arc. A discharge then takes place between the electrodes **1** and **2** and can have a considerable intensity even if the potential difference applied between the electrodes **1** and **2** is small, inasmuch as the plasma mass resistance is low.

When an arc is struck between the electrodes **1** and **2**, there is formed from the center of the spark gap a decreasing temperature distribution which delimits around the electrode **1** a region of cylindrical symmetry designated by the reference **3***a* in FIG. 2 and in which the temperature ih higher than the temperature of decomposition of the polytetrafluoroethylene (400° C. approximately), thereby causing the destruction of a surface layer of this latter.

A fine surface layer of the insulating material accordingly decomposes in the said region **3***a*. In the case of a plate of polytetrafluoroethylene, the decompostion re-

sults in gaseous products (especially compounds containing fluorine) which are distributed in the discharge chamber as well as dust particles (especially carbon articles) which are carried away to the zone of lowest temperature, in which they are deposited on that region of the plate 3 which is located outside the high-temperature zone 3*a* (namely the region designated by the reference 3*b* in FIG. 2). The same process takes place in the case of the metallic particles which are torn from the electrodes and which are blown away from the zone 3*a* as a result of the overpressure which accompanies the formation of the discharge and which are driven up to the region 3*b*. A conductive layer progressively covers the said region 3*b* whereas the zone 3*a* retains its insulating property, does not vary as regards its composition and is subjected to modification only as regards its thickness; the said zone 3*a* in addition retains a white appearance since it is formed solely of "clean" polytetrafluoroethylene which retains its good insulating properties. On the other hand, the insulating material in the region 3*b* is blackened by the deposition of carbon and loses its insulating properties.

The spark gap nevertheless continues to work in a normal manner, while the surface area of the zone 3*a* is sufficient for the purpose of isolating the two electrodes 1 and 2.

It has in fact been observed after more than a thousand discharges each reaching a current intensity of 180,000 amps that the spark gap which is taken as an example had never been cleaned and withstood a potential difference of 20 kilovolts, the circle limiting the "clean" zone 3*a* having a diameter of 6 cms.

What I claim is:

1. An electric spark-gap with insulation which maintains its resistance to the passage of electric current, comprising: a first electrode; and insulating plate surrounding said first electrode and extending radially outwardly therefrom; and a second electrode spaced from said first electrode, said insulating plate being formed of a vaporizable material such that a fine surface layer thereof in the vicinity adjacent to said first electrode will be vaporized under the action of heat generated by an electric discharge between the two electrodes and said vapor will be blown from said vicinity together with any foreign matter torn from said two electrodes during said electric discharge by the pressure resulting from said electric discharge whereby the surface of said insulating plate is scoured clean in said vicinity.

2. An electric spark-gap as defined in claim 1 in which said insulating plate is larger than said vicinity and extends outwardly therefrom providing a collecting portion thereof for deposition thereon of said vapor and of said particles of foreign matter blown from said vicinity.

3. A spark gap in accordance with claim 1, in which the insulating plate is formed of polytetrafluoroethylene.

4. A spark gap in accordance with claim 1, in which the first electrode has the shape of a mushroom, the diameter of said insulating plate is larger than the diameter of said vicinity, and the other electrode is constituted by a metallic plate located in parallel relation to said insulating plate and provided with a flange adapted to bear on said insulating plate.

References Cited by the Examiner

UNITED STATES PATENTS

1,969,992 8/1934 Rovere ---------- 313—216 X

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