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LIGHTNING ARRESTER ARC GAP

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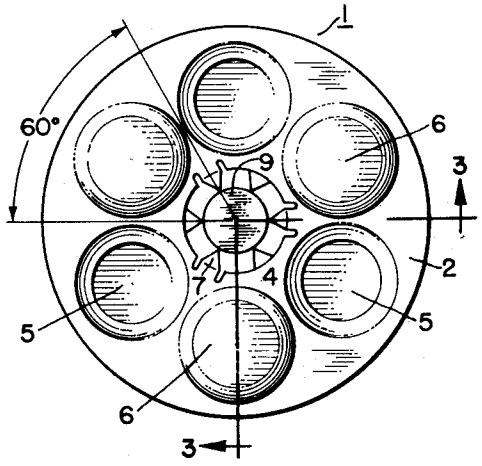


FIG. 1

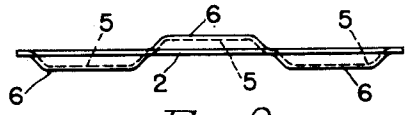


FIG. 2

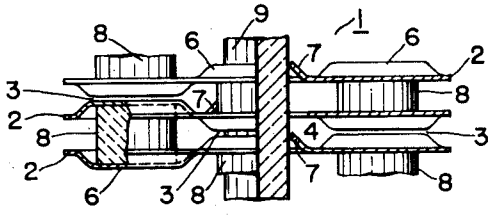


FIG. 3

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LIGHTNING ARRESTER ARC GAP

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5 Claims. (Cl. 315—52)

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This invention relates to lightning arresters and has particular reference to that part of the arrester known as the arc or spark gap and in particular to an improved spark gap which has a relatively low and consistant surge breakdown voltage and a relatively low impulse ratio.

Lightning arresters intended to meet severe conditions usually consist of a voltage sensitive resistance member and a spark gap device in series therewith. An arrester of this character is shown in U. S. Pyk Patent 2,324,108 intended for use in connection with power lines, transformers and other electrical devices to protect the same in case of excessive overvoltage, and is connected therebetween and the ground.

The spark gap performs a special and important function in connection with the voltage sensitive resistance member in that it (a) normally insulates the resistance member from the line or apparatus to which it is connected and prevents leakage to ground or reduces same to a small predetermined value; (b) permits a breakdown of the spark gap when a high voltage surge due to lightning, switching or other causes occurs thus connecting the voltage resistance to the line or other apparatus; (c) opens the circuit through the arrester to ground, thus preventing the flow of power current and re-establishing the arrester and its connection to ground to its normal condition.

These functions are performed by the Pyk apparatus which however is subject to improvement in order to effect a low and consistant breakdown voltage under surge conditions but should have a sufficiently high breakdown voltage to prevent spark-over of the gap under normal line-frequency of 60 cycle voltage.

Various spark gap devices have been proposed to accomplish the above results but this invention is confined to improving the operation of the Pyk device operating under normal and abnormal conditions by an improved spark gap pile and unit.

As shown in the Pyk disclosure, the spark gap comprises a plurality of superimposed metallic electrodes each of like construction to that of the others and spaced-apart by separators of suitable material. These parts are assembled with the separator means between each two adjacent electrodes and each electrode is so formed that when properly assembled one or more spark-gaps will result between each two adjacent electrodes. A sufficient number of electrodes and separator means are assembled to give the gap pile the necessary ability to operate as required.

In order to improve the characteristics of the

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gap pile as described above it is desirable to reduce the time lag of breakdown of the gaps between the normal line-frequency of 60 cycle breakdown voltage of the gaps and the voltage at which the gaps breakdown under a rapidly rising surge voltage. The ratio of the surge breakdown voltage to the normal breakdown voltage is known as the impulse ratio.

In order to reduce the time lag of breakdown of the gaps means is provided which will produce discharges in the gaseous space between the electrodes and sufficiently adjacent the gaps to assist in an early breakdown of the gaps under a rapidly rising surge voltage.

Gaps have been produced in which the discharge or radiation flux is formed by a specific relation between the separator and the electrodes but this invention provides entirely different means for effecting the early breakdown of the gaps under a rapidly rising surge voltage, and this means resides in associating with the several electrodes an axially disposed unitary dielectric or insulating member which is common to all the electrodes.

When this insulating member is contacted by one or more members associated with the electrodes the field between the electrodes is so distorted that the air or gaseous medium therebetween and in the gap spaces is ionized and considerably overstressed resulting in a reduced time lag before spark-over occurs.

A more specific description of this invention follows aided by the drawing in which:

Fig. 1 is a top plan view of a spark gap pile;

Fig. 2 is an edge view of a single electrode as for instance the top electrode shown in Fig. 1;

Fig. 3 is a side view in partial section of several assembled electrodes and separators and ionizing means forming two arc gap units also part of a more extensive spark gap pile. Such pile may consist of any number of assembled electrodes and separators necessary to assist in securing the required characteristics.

The arc or spark gap pile 1 comprises a plurality of spaced electrodes 2, and each electrode is like each of the others. Each electrode is formed from sheet metal, preferably high brass which has an arc quenching value of its own. The electrodes are so formed that when the electrodes are properly assembled there will be found one or more arc gaps 3 between each two adjacent electrodes.

Each electrode consists of a disc, preferably circular, with a central opening 4 and a plurality of impressions (6 shown), which form three depressions 5 and three projections 6 on

each face of the disc, a depression on one face being counter to the projection on the other face. The number of impressions per disc may vary but six has been found to be a convenient number.

Projecting inwardly from the periphery of the opening **4** of each electrode are one or more projections **7** (3 shown) uniformly spaced and referred to as ionizing tips. These tips project not only inwardly but obliquely to the plane of the disc and each tip terminates in a point which has been found to be most effective for ionizing purposes. A circle circumscribing the pointed ends of the tips will have a diameter less than that of the opening **4**.

When the electrodes are assembled in superimposed relation they are so related that the projections **6** on the face of one disc will be adjacent or opposite those of the adjacent disc to form spaced spark gaps **3** therebetween and the depressions on the said face of the one disc will be opposite those on the said adjacent disc to form recesses for separators **8** which are usually of a fragile or vitreous nature and nonmetallic.

The separators may be formed of insulating material such as porcelain or of a very high resistance material which will allow the flow of a very few amperes or a fraction of an ampere, this latter separator will have the tendency of equalizing a high voltage discharge between the various gaps of the pile but not so great as to cause excessive heating of the parts; the resistance may vary but a resistivity of approximately 1.5 megohms per kilovolt rating has been found to be practical.

The length of the separators is made such that the gap space will be that required and may be varied to meet such requirements. The contact faces of the separators are preferably metalized.

In assembling the electrodes and the separators, the ionizing tips should point in the same direction as shown in Fig. 3 and so positioned relatively that the tips on adjacent electrodes will be spaced circumferentially 60 degrees (Fig. 1) if each electrode has three tips, which is preferable to one or two tips as it gives a more balanced construction.

After assembly of the electrodes and spacers, central member or core **9** is positioned in the opening **4**. The member **9** is of insulating material such as porcelain which has a dielectric constant of about 6 above unity.

The radial spacing of the points on the tips is less than the diameter of the central member of the insulating material thereby requiring considerably longitudinal force applied to the end of the member to force it through the opening **4** into position with respect to each electrode since it requires forcing the tips to yield as the central member moves into position. The tips make a firm contact with the central member.

If desired the electrodes may be assembled on the central member by positioning one electrode at a time and placing the separators in position upon completing the positioning of each electrode.

The completely assembled pile of spark gaps may be assembled with one or more resistance members as shown by Pyk and the central member is self supporting through pressure thereon of the several electrode tips.

In the herein described construction, the central member **9** does not support or effect the spacing of the electrodes. The supporting and spacing of the electrodes is entirely the function of the separators **8**. Since the separators may be of insulating material or of a material of very high resistance value, the term "high resistance" in the claims is intended to include both types of separators, satisfactory for the purpose.

Each pair of adjacent electrodes provide three separate spark gaps as shown, and the ionizing tips contact the central member **9** in a plane substantially central with the gap spaces.

Each pair of adjacent electrodes constitute a spark gap unit therefor the three electrodes shown in Fig. 3 and their separators provide in fact two units, one electrode forming a part of each unit.

The construction herein disclosed provides a spark gap pile composed of a plurality of spaced electrodes with separators of a greater height than the space between the electrodes. The tips **7** are located on a radial line midway of two adjacent impressions.

When the pile of units or a single unit is subjected to a breakdown voltage there is a considerable concentration of voltage at the junction of contact between the tips and the central member of insulating material thereby producing high voltage gradients at and adjacent the said junction which appear to cause radiation or discharge of ions, effecting ionization of the air between the adjacent electrodes and also of the adjacent gap space resulting in a considerable reduction in the time lag of breakdown of the gap.

It will therefor be appreciated that the spark gap herein described is of simple and effective construction producing free ions in sufficient quantity to minimize the spark-over delay and to effect a low and consistant breakdown voltage.

Variations may be made from the specific construction shown and described, but which fall within the scope of this invention, therefore it is intended that the appended claims shall include all such variation and modification of equivalent construction.

I claim:

1. In a lightning arrester, a spark gap unit comprising a pile of disc shaped electrodes, means maintaining said electrodes in spaced relation to each other with adjacent parts of said electrodes forming spark gap surfaces, an insulating member extending longitudinally of said pile, and means projecting from each electrode and contacting said insulating member in a plane having a potential different from the potential of the electrode.

2. In a lightning arrester, a spark gap unit comprising a pile of disc shaped electrodes, means maintaining said electrodes in spaced relation to each other with adjacent parts of said electrodes forming spark gap surfaces, an opening in the center of each of said electrodes, an insulating bolt traversing said openings, and prongs extending obliquely from the edges of said openings and contacting said bolt in planes passing through said spark gaps.

3. In a lightning arrester, a spark gap unit comprising a pile of disc shaped electrodes, an opening in the center of each electrode, a plurality of spaced projections extending from said discs to form gaps with the projections extending from the adjacent disc, said projections also forming recesses, electrode separating members received and retained in said recesses, an insulating bolt traversing the central openings in said

electrodes, and oblique prongs extending from the edges of said openings and contacting said bolt in planes passing through said spark gaps.

4. A spark gap unit according to claim 1 in which at least some of said electrode spacing means are formed of resistance material.

5. A spark gap unit according to claim 1 in which the said longitudinally extending insulating member is made of porcelain.

GÖSTA RYDBECK.

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