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CONTAMINATION AND MOISTURE RESISTANT INSULATOR

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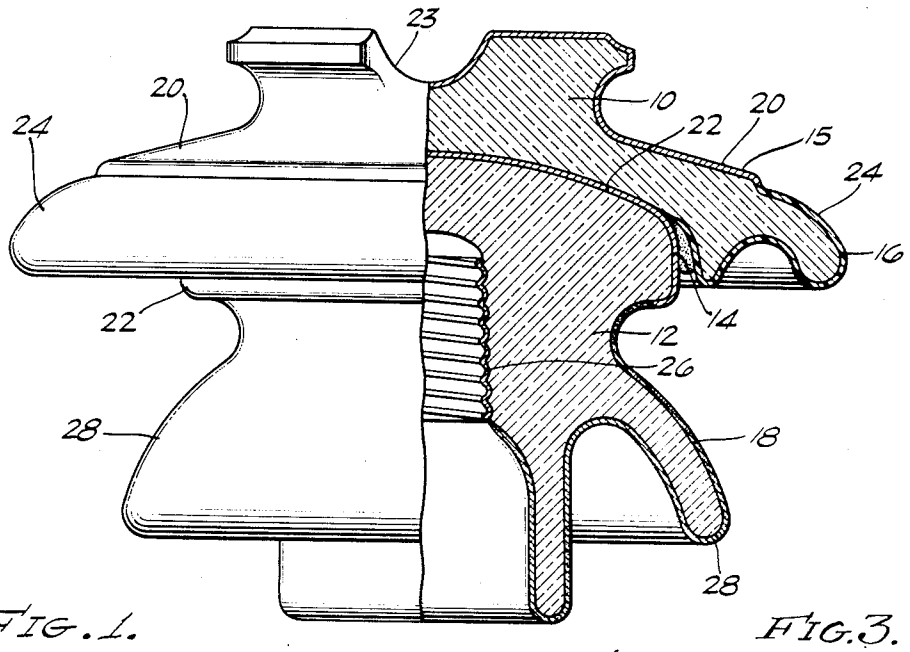


FIG. 1.

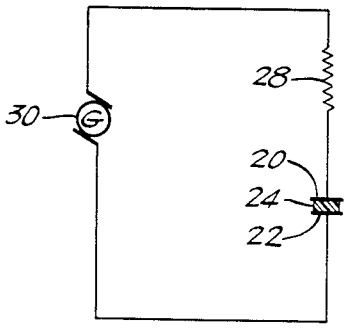


FIG. 2.

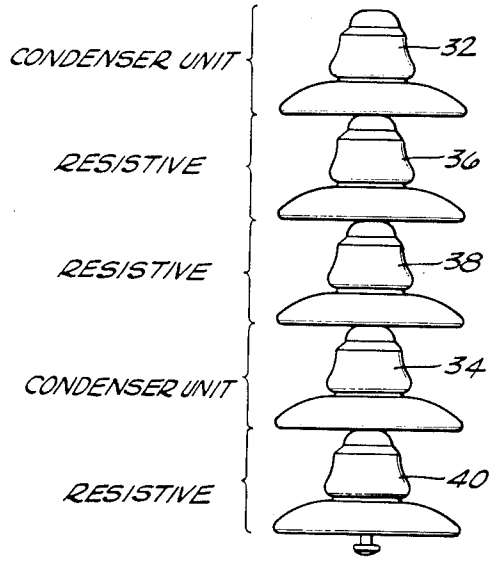


FIG. 3.

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CONTAMINATION AND MOISTURE RESISTANT INSULATOR

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This invention relates to outdoor electrical insulators and bushings which are used for electric transmission and distribution purposes, and, more particularly, to improvements therein.

Exposed insulators which are used to support or otherwise maintain electrical conductors carrying high voltage in position have surfaces which become contaminated by deposits of airborne materials, such as dust, salt, chemicals, soot, and the like. Sometimes weather conditions are such that moisture from the atmosphere condenses on the surfaces of insulators customarily used. Condensed moisture on the contaminated areas wets the contamination and makes it electrically conductive. The current which can flow as a result can reach a sufficient magnitude to cause a power arc-over at the insulator. Such arc-overs cause interruptions in the power being provided by the conductor supported by such insulators and the heat from such power arcs can also cause physical damage.

An object of this invention is to provide an insulator of the general type described which prevents injurious moisture condensation on all of its surface or an adequate portion thereof.

Another object of this invention is the provision of a novel composite insulator which senses the presence of moisture on a cold contaminated surface to further elevate the temperature of a warm surface sufficiently to assure that moisture will not condense thereon when weather conditions favor moisture condensation, thus limiting the use of additional energy to times when it is actually required for additional heatng.

Under moisture condensation conditions such as described above, insulators presently in use can have minor discharges occurring through the atmosphere on the surface of the insulators due to nonuniform distribution of voltage. Such discharges not only cause radio interference, but also produce audible noise.

Another object of the present invention is to provide a novel insulator construction which by maintaining a uniform voltage gradient over sufficient surface avoids surface discharges which can cause radio interference.

Yet another object of this invention is the provision of a novel, useful, and improved insulator.

These and other objects of the present invention are achieved by applying coatings to selected portions of the surface of the insulator to form a capacitor to which current is supplied through a resistor, whereby a current is enabled to flow through the resistance-coated portion of the insulator surface sufficient to raise the temperature of this portion of the insulator to the point where moisture condensation is deterred. The capacitor portion of the insulator remains cold and is so arranged that when moisture condenses thereon, the capacitor is short-circuited by a current path through damp contamination, thus allowing additional current to flow through the resistance-coated surface to further raise its temperature.

The novel features that are considered characteristic

of this invention are set forth with particularity in the appended claims. The invention itself, both as to its organization and method of operation, as well as additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawings, in which:

Figure 1 is a view in quarter-section of an embodiment of my invention;

Figure 2 is a diagram of the circuit formed on the surface of an insulator in accordance with my invention; and

Figure 3 is another embodiment of the invention.

Referring now to the drawing, there is shown in quarter-section a typical insulator incorporating this invention. This insulator is a medum voltage pin type made of two porcelain bodies **10**, **12**. Body **10** may also be made of glass with conductive coatings. Body **12** may also be made of special glass having high specific resistance such as used in aircraft windshields where defrosting is accomplished by electric energy dissipated in the resistive glass. These bodies are held together by cement in the annular space **14** that exists between them. The insulator has nonconducting surface **16** and resistance-coated surface **18** exposed to the elements on which contamination can deposit. As atmospheric conditions approach the dew point, moisture will condense on cold surface **16**, rendering it electrically conductive, if contaminated. In a preferred arrangement of my invention, the parts are so arranged that any electric current flowing over the cold, damp contaminated surface **16** will add to current used to warm surface **18** of the insulator. This additional current will further increase the temperature of the warm parts only when atmospheric conditions are such as to require the use of additional power to assure that the temperature of an adequate portion of the insulator surface remains above the condensation point.

In accordance with my invention, conductive coatings **20**, **22** are deposited on the surfaces of the insulator which are on either side of the surface **16**, which has deposited thereon an insulating glaze **24**. Thereby, a condenser is formed with the portion of the insulator body **10** between the conducting coatings acting as the dielectric. The dielectric will be short circuited by a current path through contamination on surface **16** when it is damp. As shown in the quarter-section, the conductive coating extends into the annular space **14**. The conductive coating is also deposited on the inner threaded portion **26** of the insulator. The remaining surface **18** of the insulator has a high-resistance glaze **28** deposited thereon. This high-resistance glaze covers sufficient of the area of the insulator to communicate between the two conductive coatings on the surfaces **26**, **22**.

The circuit made by the coatings is shown in Figure 2. The resistor formed by the coating **28** is in series with the condenser formed by the coatings **20**, **22** and dielectric **10**. The high voltage carried in the wire (not shown) supported by the insulator may be considered as the generator **30** which supplies current to the series circuit, including the resistor and capacitor.

When the weather is such that no moisture condenses on an insulator surface, an alternating electromotive force exists between the conducting surfaces **20** and **22**, which are the plates of the condenser. Charging current for this condenser will flow through the resistive glaze **28**. Power dissipated by the current required for charging the condenser will raise the temperature of the surfaces covered by this glazed portion. For any given operating voltage and frequency, the amount of power dissipated in the resistive coating **28** and the consequent temperature rise of the surface it covers is controlled by selecting suitable areas for, and spacing between, con-

ducting coatings 20 and 22. This amount of power is also controllable by selecting the cross-section and specific resistance of the glaze material 28 applied to surface 18.

It is preferable to make the thickness of the glaze 28, as well as its specific resistances, such that the voltage drop obtained is essentially uniform per unit of linear distance through the glaze between the two conducting surfaces 22 and 26. By providing for a uniform voltage drop per unit of linear distance, no overstressed locations can occur where disruptive discharges can take place which cause both radio interference and even audible noises. Thus, by this expedient, this invention enables the obtention of a nonradio interfering characteristic and silent operation of the insulators. For reasons to be explained below, it is only required that the surface covered by glaze 28 be slightly warmed under the conditions wherein either no moisture condenses or surface 16 is uncontaminated.

Assuming that the surface 16 becomes contaminated and weather conditions change to favor moisture condensation on a cold surface, moisture will condense on the surface 16 before it can condense on the warmer surface 18. Condensed moisture on the surface 16 will render any contamination thereupon electrically conducting, thus forming a path for electric current around the condenser formed by the conducting surfaces. When the condenser is bypassed by the conducting path over surface 16, the total electromotive force across the insulator is applied to resistance coating 28, causing an increase in the currents therethrough with consequent additional warming of the surface covered thereby as such times as the additional warming is required to maintain this surface above the dew point. Thus, effectively, by maintaining the temperature of surface 28 above the dew point, this surface even though contaminated never becomes damp and therefore conductive enough so that current of sufficient magnitude can flow thereover to cause a power arc-over.

While a typical medium voltage pin-type insulator made of ceramic materials is used to illustrate the invention, the principles described apply also to other types of insulators which might be made of other materials. For example, individual suspension insulator units can be modified forms of the insulator shown in the drawing with suitable connecting hardware cemented to the top and into the pinhole. The word "insulator" is intended to cover other arrangements employing a plurality of insulators, such as an insulator string. For example, referring to Figure 3, still another arrangement of the invention applicable to two or more suspension units in an insulator string is shown. This may consist of one or more "condenser units" 32, 34 to function as described for body 10 with conducting surfaces 20 and 22 on either side thereof connected in series through conducting linkages with one or more "resistance" units 36, 38, 40 to function as described for the high-resistance glazed portion of the insulating body 12. For making the glaze, special type glass or certain metallic oxides, combined with customary ceramic components, can serve as the materials having suitable specific resistance and desirable mechanical properties. These resistive glazes are well known in the ceramic art and will not be described herein.

For an insulator of the general type shown in the drawing, which has a 10" maximum diameter, a 7" over-all height, and which can be employed for 16.5 kilovolt, 60-cycle service, it was calculated that 125 square inches of high-resistance glazed surface having a resistance of 18 megohms under dry conditions would dissipate 1.25 watts of power. This would then warm the surface covered by the resistive glaze approximately three degrees F. above the temperature of the surface covered by the insulating glaze. Under the wet, contaminated condition, five watts of power would be dissipated in the resistive glaze, and the surface covered thereby would be warmed approximately twelve degrees F. above the temperature of the surface covered by the insulating glaze.

Accordingly, there has been shown and described a novel, useful, and improved electrical insulator which is resistant to arc-over in atmospheres where contamination and moisture can operate to cause such arc-overs.

I claim:

1. The combination with an insulator for high-potential transmission lines which is subject to arc-over due to contamination and moisture condensing on the surfaces thereof from the atmosphere, of a conductive coating on a portion of a surface of said insulator on both sides of one of said surfaces to form a condenser therewith, said condenser being exposed to contamination and moisture condensation from the atmosphere, and resistive coating means over remaining surfaces of said insulator in contact with said conductive coating on both sides of said one surface and in series with said condenser to enable a flow of current under operating conditions sufficient to evaporate moisture from the remaining surfaces of said insulator upon condensation of moisture on said one of said surfaces.

2. The combination with an insulator as recited in claim 1 wherein said means on remaining surfaces of said insulator is a high-resistance glaze through which a charging current to said condenser may flow.

3. The combination with an insulator as recited in claim 2 wherein said high-resistance glaze has a thickness and specific resistance adapted to provide a uniform voltage drop per unit of insulator surface covered.

4. In an insulator having high potentials applied to two spaced portions thereof, which is subject to arc-over due to contamination and moisture from the atmosphere condensing on surfaces intermediate said spaced portions comprising a conductive coating on portions of said insulator on each side of one of said surfaces to form a condenser therewith, one of said conductive coatings communicating with one of said spaced portions to which high potential is applied, and a resistive glaze over the other surfaces of said insulator, said resistive glaze being in series with said condenser and extending between said other conductive coating and the other of said spaced portions to which high potential is applied, the value of the resistance of said glaze being selected to limit the flow of current across said one of said surfaces in the presence of condensation to raise the temperature of the remainder of said surfaces above the condensation point.

5. In an insulator as recited in claim 4 wherein said high-resistance glaze has a thickness and specific resistance adapted to provide a uniform voltage drop per unit of insulator surface covered.

6. In an insulator string having high potentials applied to spaced portions thereof, which is subject to arc-over due to contamination and moisture from the atmosphere condensing on surfaces intermediate said spaced portions comprising means forming at least one of the insulators in said string into a capacitor, and a resistive glaze over remaining surfaces of said insulator string and in series with said capacitor, the value of the resistance of said glaze being selected to limit the flow of current across the surface of said one of said insulators in the presence of a condensation to raise the temperature of the remainder of said surfaces above the condensation point.

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