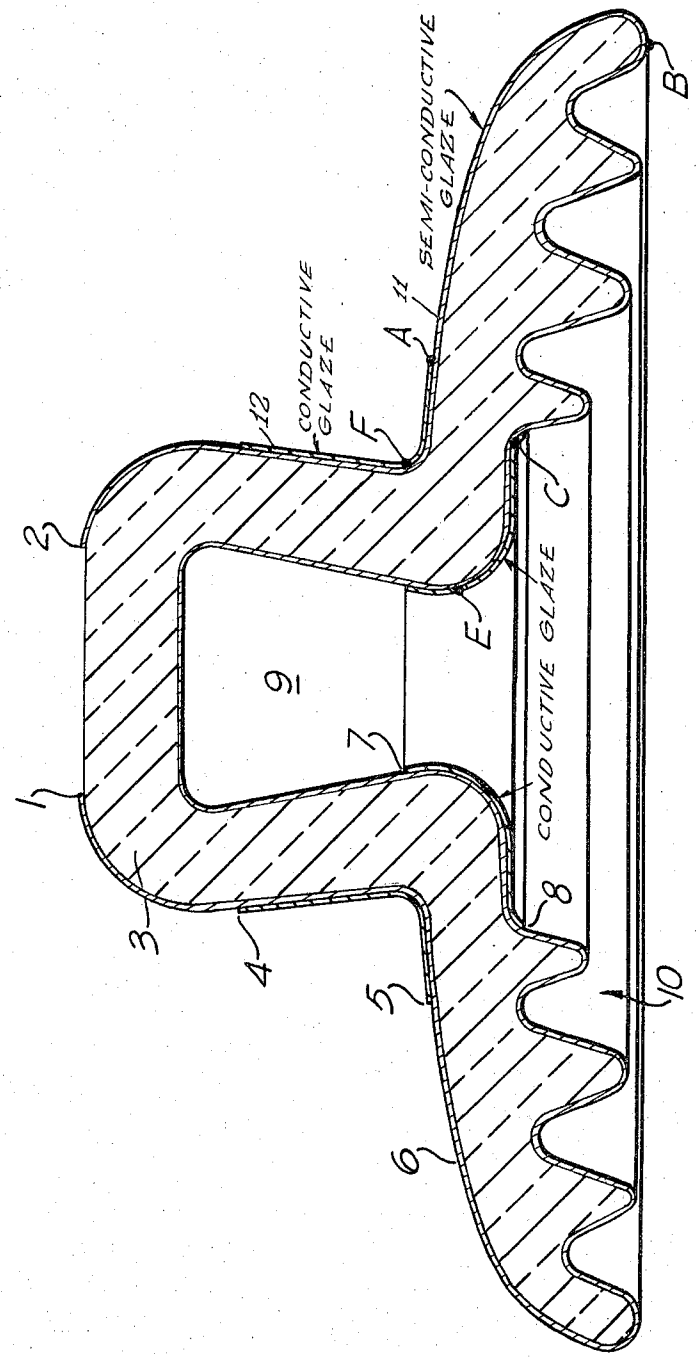
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ELECTRICAL INSULATOR HAVING IMPROVED SURFACE ELECTRICAL STRESS DISTRIBUTION

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ELECTRICAL INSULATOR HAVING IMPROVED SURFACE ELECTRICAL STRESS DISTRIBUTION

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ABSTRACT OF THE DISCLOSURE

An electrical insulator, having improved electrical stress distribution over its surface, has a layer of semi-conducting glaze over substantially its entire surface and a second layer of a glaze, having a higher conductivity, over those areas of the insulator which, when the insulator is in use, are subjected to comparatively high electrical stress. The insulator may be of the cap-and-pin disc type.

This invention relates to electrical insulators, particularly cap-and-pin disc insulators, or other insulators which may have areas of high electrical stress on their surfaces.

According to the present invention an electrical insulator has a semi-conducting glaze over substantially its entire surface and an additional glaze of higher conductivity over a zone, which zone, when the insulator is in use, is subjected to comparatively higher electrical stress than other zones of the insulator's surface.

In accordance with a preferred embodiment of the present invention, a cap-and-pin disc insulator which is self-heating and which will accordingly tend to keep itself dry when the insulator is in use, has a semi-conducting glaze over substantially its entire surface and an additional glaze of higher conductivity over a zone common to the head and the top of the shed of the disc insulator and/or over a zone common to the pin-hole and the under side of the disc insulator. Preferably the additional glaze is present over both of the zones just specified. By "zones" are to be understood in this specification substantially annular regions substantially coaxial with the insulator body.

The use of the two glazes in accordance with the invention has the particular advantage of avoiding unduly steep voltage-gradients being established near the cap and pin when the insulator is in use, and correspondingly of avoiding unduly high dissipation of power near the cap and pin. This may be contrasted with certain previously-proposed insulators on which a semi-conducting glaze was used, in which steep voltage gradients near the cap and pin have been found to be set up and to lead to one or more of the following undesirable phenomena:

(1) Failure due to thermal instability, the glaze having a considerable negative temperature-coefficient of resistance;

(2) Electrolytic corrosion, particularly around the pin-hole and around the cap, and consequent thermal run-away and failure (the regions around the pin-hole and around the cap are the regions of the highest current densities and are accordingly the most liable to electrolytic corrosion in humid polluted conditions, such corrosion increasing with current density);

(3) Sparking in the regions of the highest voltage gradients when the top of the shed is short-circuited in polluted conditions, this sparking causing degradation of the glaze and, given time, thermal failure.

Preferably the conductivity of the additional glaze used in accordance with the invention is at least 10 times that of the main glaze, e.g. 10 to 50 times that of the main glaze. The main glaze is preferably applied over the entire surface of the insulator with the exception of the top of the head. The main glaze may suitably be derived from a composition in the form of an aqueous dispersion comprising an orthodox glaze base together with mixed antimony and tin oxides to confer the requisite semi-conducting properties. The orthodox glaze base is, suitably, a calcium-alumino-silicate glaze in which the main constituents are silica, feldspar, calcium carbonate, china clay and ball clay. The relative proportions of the ingredients of the glaze depend on the firing temperature used. Thus, with a glaze base having the percentage composition by weight set out below the firing temperature would be in the range 1050° C.–1300° C:

Cornish stone	17.4
Feldspar	25.4
Ball clay	9.4
Quartz	23.4
Whiting	16.2
Barytes	4.7
Zinc oxide	3.5

A specific main-glaze composition which is highly satisfactory comprises 74% of glaze base and 26% of a mixture of tin oxide with 2½% of antimony pentoxide (i.e. 2½% on a molar basis referred to the tin and antimony oxides together); suitably these ingredients are mixed in a stirrer (although they may be milled in a ball-mill instead if desired) and the concentration is adjusted to 32 ounces per pint. A glaze produced on standard porcelain tiles after dipping in this glazing composition for 10 seconds and firing had an approximate resistivity of 14 megohm-cm. per cm. It should be understood that other glaze compositions and added oxide proportions can be used with equal effect. The molar proportions of antimony oxide to tin oxide in the glazing suspensions of the present invention may suitably be 1:99 to 5:95 (respectively), and the total weight of these oxides may suitably be 15% to 45% of the total weight of the solids in the glazing suspension (i.e. 15–45% of glaze base plus oxides).

The additional glaze may suitably be derived from a composition similar to that used for the main glaze but containing more of the ingredient conferring conductivity. Thus a specific additional-glaze composition which is highly satisfactory comprises 67% of glaze base and 33% of the mixture of oxides used in the specific main-glaze composition mentioned above. When used on standard-porcelain tiles in the same way as the latter, this additional-glaze composition gave an approximate resistivity of only 1.4 megohm-cm. per cm., i.e. afforded a glaze 10 times as conductive as that mentioned above.

The additional-glaze composition can be applied to the appropriate zones of the insulator when the main-glaze composition has been applied to the insulator and has dried. Masks are preferably fitted to ensure that the application of the additional-glaze composition, whether it is brushed or sprayed or otherwise applied, is confined to the selected zones. When the glaze compositions have been applied, the insulator can be fired in accordance with orthodox practice.

The width of the zone or zones over which the additional glaze is applied may be varied according to the potential distribution over the insulator's surface that is desired. In a typical case, however, an insulator having an overall diameter of 10 inches may suitably be given an additional glaze over zones having a width (measured along the curved surfaces of the insulator) of 2 to 2¾ inches in the case of the zone common to the head and the top of the shed of the insulator, and 1¾ to 2½ inches in the case of the zone common to the pin-hole and the under side of the insulator.

The invention is illustrated in the accompanying drawing, which is an axial section through a cap-and-pin disc insulator glazed in accordance with the invention.

The insulator shown in the drawing has a main glaze **11** over its entire surface with the exception of the circular area between **1** and **2** at the top of the head **3**. It has an additional glaze **12** over the zone between **4** and **5**, which is common to the head **3** and the top of the shed **6** of the insulator, and over the zone between **7** and **8**, which is common to the pin-hole **9** and the under side **10** of the insulator.

A standard 10-inch insulator as shown in the drawing, produced with the specific glaze compositions mentioned above, was found, when tested with annular electrodes contacting it at E and F, to have the following resistance distribution:

Limits of region:	Resistance as percentage of total resistance from E to F
F, B	25–40
B, E	70–60
F, A	2±½
A, C	95±1
C, E	3±½

What is claimed is:

1. An electrical insulator having a semi-conducting glaze over substantially its entire surface and an additional glaze, having a conductivity at least 10 times that of the main glaze, over a zone, which zone, when the insulator is in use, is subjected to comparatively higher stress than other zones of the insulator's surface, the main and additional glazes being deived from a composition in the form of an aqueous dispersion comprising an orthodox glaze base together with mixed antimony and tin oxides.

2. An insulator according to claim **1** wherein the molar proportion of antimony to tin in the glazing suspensions is in the range from 1:99 to 5:95 and the total weight of tin and antimony oxides is between 15 and 45% of the total weight of the solids in the glazing composition.

3. An electrical insulator having a semi-conducting glaze over substantially its entire surface and an additional glaze, having a conductivity between 10 and 50 times that of the main glaze, over a zone, which zone, when the insulator is in use, is subjected to comparatively higher stress than other zones of the insulator's surface, the main glaze and additional glaze being derived from a dispersion in the form of an aqueous dispersion comprising an orthodox glaze base and mixed antimony and tin oxides, the main glaze containing, by weight, 74% glaze base and 26% of a mixture of tin and antimony pentoxide and the additional glaze containing 67% glaze base and 33% of a mixture of tin and antimony pentoxide.

4. A cap-and-pin disc insulator provided with a semiconducting glaze over substantially its entire surface and an additional glaze, having a conductivity at least 10 times that of the main glaze, over an annular zone common to the head and top of the disc insulator and over an annular zone common to the pin hole and the under side of the disc insulator.

5. A cap-and-pin disc insulator provided with a semiconducting glaze over substantially its entire surface and an additional glaze, having a conductivity between 10 and 50 times that of the main glaze, over an annular zone common to the pin hole and the under-side of the disc insulator.

6. A cap-and-pin disc insulator provided with a semiconducting glaze over substantially its entire surface and an additional glaze, having a conductivity between 10 and 50 times that of the main glaze over an annular zone common to the head and the top of the disc insulator and over an annular zone common to the pin-hole and the under side of the disc insulator, the main and additional glazes being derived from a composition in the form of an aqueous dispersion comprising an orthodox glaze base together with mixed antimony and tin oxides.

7. A cap-and-pin disc insulator according to claim **6** in which the molar proportion of antimony to tin in the glazing suspensions is in the range from 1:99 to 5:95 and the total weight of tin and antimony oxides is between 15 and 45% of the total weight of the solids in the glazing composition.

8. A cap-and-pin disc insulator according to claim **6** wherein the main glaze composition comprises, by weight, 74% glaze base and 26% of a mixture of tin oxide and antimony pentoxide containing 2½ molar percent antimony pentoxide based on the combined and antimony oxides and the additional glaze comprises, by weight, 67% glaze base and 33% of a mixture of tin oxide and antimony pentoxide.

9. An insulator according to claim **1** having the form of a cap-and-pin disc insulator and having a head and a pin hole therein, and in which said semi-conducting glaze extends over the entire surface of the insulator with the exception of the surface area on the top and outside of said head immediately above said pin hole.

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