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[54] **ELECTRICAL INSULATOR AND CONDUCTING TAR THEREFOR**

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[52] **U.S. Cl.**..... **174/140 C,** 106/277, 106/278, 174/182, 174/211

[51] **Int. Cl.**..... **H01b 17/42,** H01b 17/50

[58] **Field of Search**..... 174/140 R, 140 C, 141 R, 174/141 C, 182, 186, 188, 189, 196, 209, 211

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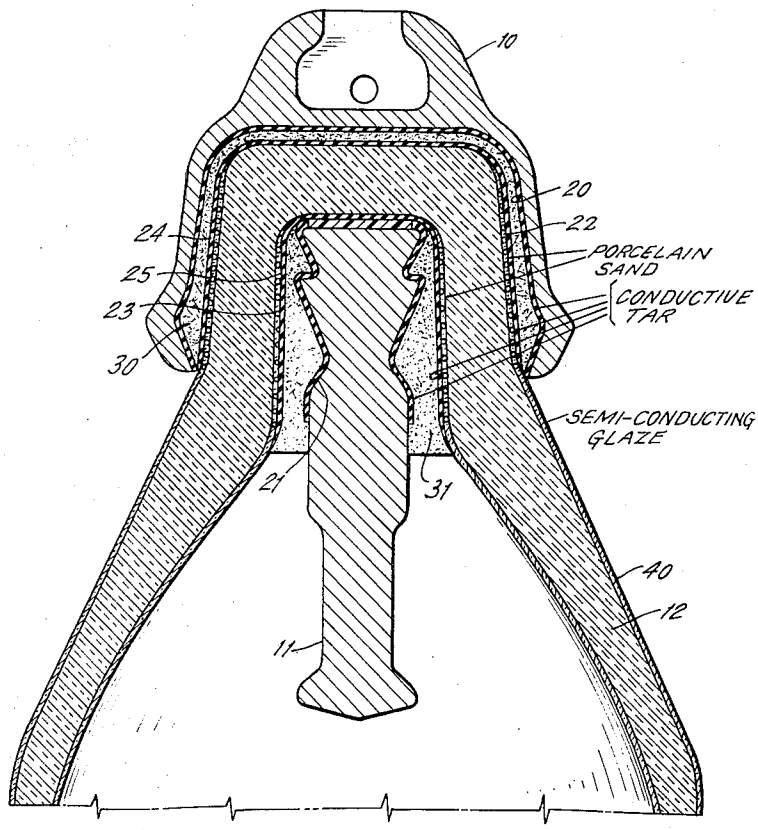
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[57] **ABSTRACT**

A conducting tar coating is placed on the surfaces of the conductive hardware of an insulator, and on the surfaces of an insulator shell connected to the hardware by a cement. The insulator surface has a semi-conducting coating. The conducting tar is formed by admixing carbon black in an asphalt base after dissolving the asphalt with a suitable solvent.

11 Claims, 2 Drawing Figures



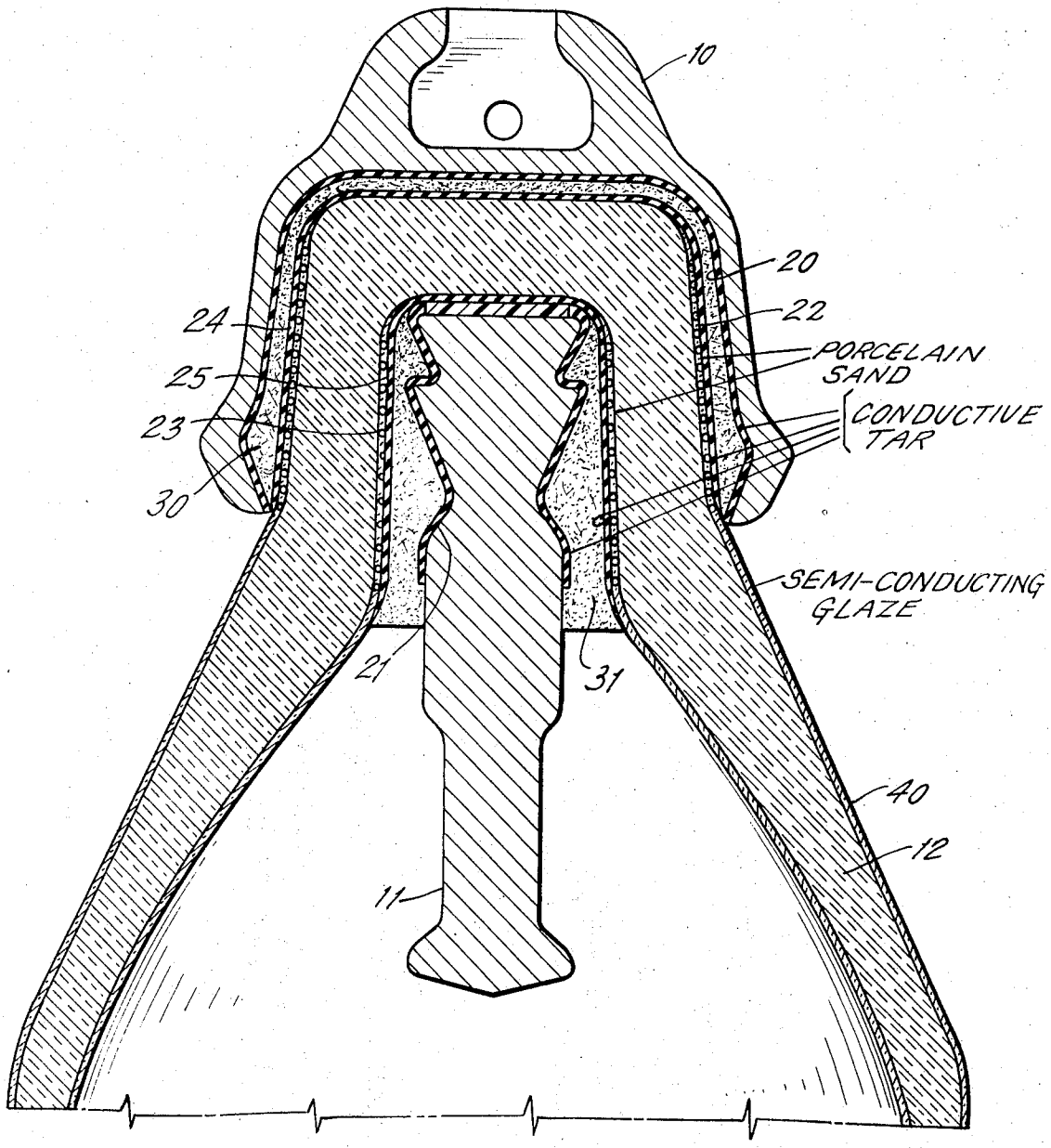

10
20
22
24
25
23
30
PORCELAIN SAND
CONDUCTIVE TAR
SEMI-CONDUCTING GLAZE
21
31
40
12
11

FIG. 1.

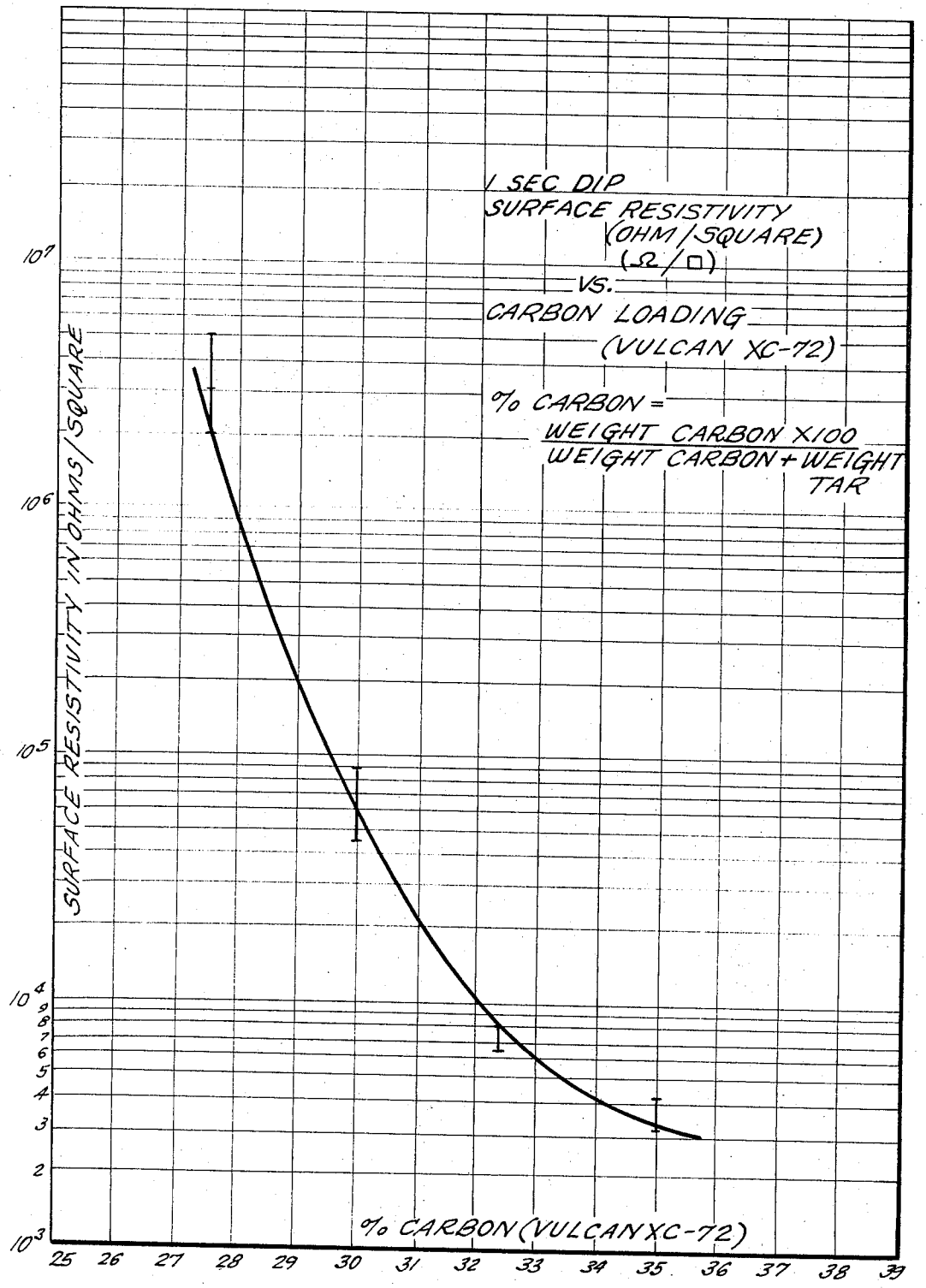

1 SEC DIP
SURFACE RESISTIVITY
(OHM/SQUARE)
(Ω/□)
VS.
CARBON LOADING
(VULCAN XC-72)
% CARBON =
WEIGHT CARBON X100
WEIGHT CARBON + WEIGHT TAR
SURFACE RESISTIVITY IN OHMS/SQUARE
10^7
10^6
10^5
10^4
9
8
7
6
5
4
3
2
10^3
% CARBON (VULCAN XC-72)
25 26 27 28 29 30 31 32 33 34 35 36 37 38 39

FIG. 2.

ELECTRICAL INSULATOR AND CONDUCTING TAR THEREFOR

BACKGROUND OF THE INVENTION

This invention relates to electrical insulators, and more specifically relates to a conductive tar on the surfaces of the insulator hardware and the surface of the insulator shell which are joined by cement.

Electrical insulators, such as suspension insulators, which are used individually or in strings to support electrical conductors from a support structure, generally consist of two conductive hardware members fastened by a cement to opposite surfaces of a suitably contoured insulator shell. The hardware members, typically an upper metal cap and a lower metal pin, are secured to the opposite surfaces of the insulator shell by a layer of cement. Commonly, however, the insulator surfaces and conductor surfaces are first painted with a tar or thin, strongly adherent layers of asphalt, which provides a cushion action to absorb forces due to thermal expansion and mechanical shock which might appear between the cement and the insulator shell or conductive hardware.

In order to improve the performance of the insulator, a semiconducting glaze can be applied to the insulator shell surface. This semiconducting coating then carries a small current which tends to heat the insulator surface so that it can perform better in various adverse environments. When a semiconducting glaze is used, it is necessary to make an electrical connection between the insulator shell surface and the conductive hardware. This connection has been made in a variety of ways, typically by metal layers sprayed over the nonconductive cement and tar layers to form a direct conductive path from the insulator shell to the hardware.

BRIEF SUMMARY OF THE INVENTION

In accordance with the present invention, the tar used to coat the insulator shell surface and hardware surface is loaded with a conductive material such as carbon black to enable a direct electrical path to be formed from the insulator hardware to the semiconducting surface of the insulator shell. The cement which joins the hardware to the insulator shell should also be conductive. Thus, the present invention avoids the prior complex electrical connectors needed to bypass the conventionally insulating tar paint.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross-sectional view of a suspension type insulator which uses the conductive tar of the invention.

FIG. **2** is a diagram showing surface resistivity as a function of carbon loading.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to FIG. **1**, there is shown a suspension insulator which has conductive hardware including an upper metal cap **10** and a bottom metal pin **11**, where cap **10** and pin **11** are formed conventionally so that their insulators can be secured in a string. An insulator shell **12**, conventionally of porcelain, is cemented between members **10** and **11**. This is the conventional form of a suspension-type insulator. It will be understood by those skilled in the art that the invention disclosed hereinafter is not limited to use with suspension insulators, but can be used in any type of insulator structure.

The interior surface of metal cap **10** is coated with a thin bituminous coating **20**. In a like manner, the outer surface of metal pin **11** is coated with a thin bituminous coating **21**. The outer cylindrical surface **22**, and inner cylindrical surface **23** of insulation shell **12**, are formed by porcelain sand layers, and these layers are in turn coated with thin bituminous coatings **24** and **25** respectively. The bituminous coatings **20, 21, 24** and **25** are strongly adherent to their respective surfaces.

The cap **10** is then secured to shell **12** by cement layer **30** while pin **11** is secured to shell **12** by cement layer **31**.

The above structure is generally old where the coatings **20, 21, 24** and **25** and cement layers **30** and **31** have insulation characteristics. As previously stated, it is known that shell **12** can have a semiconducting glaze **40** over its outer surface. In the past, where such a glaze is used, metal layers sprayed over the nonconductive cement layers **30** and **31** and the bituminous coatings **20, 21, 24** and **25** have been used to connect the glaze surface **40** to the cap **10** and the pin **11**.

In accordance with the present invention, it has been found that the coatings **20, 21, 24** and **24** can be made conductive without adversely affecting their shock resistant qualities. Thus, by also making the cement layers **30** and **31** conductive, as by loading carbon black or graphite fibres into the cement, the semiconducting glaze **40** is connected to both the cap **10** and pin **11** without the need for other connection means.

Generally, it has been found that the addition of conductive materials, such as carbon black or graphite powder in the tar, can increase the tar conductivity to acceptable levels for use as a conductive path from semiconductor glaze to metal hardware. The use of carbon black has been found superior to the use of graphite powder, and, in particular, carbon black used to produce conductive rubber or plastic has been found satisfactory in that it does not adversely interfere with the desired mechanical quality of the tar when used in certain proportions.

Two brands of carbon black which were tested are:

Conductex SC, made by Columbian Carbon Ltd., and Vulcan XC-72, made by Cabot Carbon Ltd. The Vulcan XC-72 is preferred in this application since it produces a more conductive film at lower carbon loading.

One typical formulation of a tar which was successfully used to form layers **20, 21, 24** and **25** in FIG. **1** was:

Carbon (Conductex SC)	37.5% (by weight)
Tar (Venezuelan Crude Asphalt)	62.5% (by weight)

In the above and hereinafter, the percentage carbon is calculated as the ratio of weight of carbon to the weight of carbon plus the weight of tar, with the ratio multiplied by **100**.

It was found that the carbon black content could vary from about 35 percent by weight to about 40 percent by weight when using Conductex SC and from about 20 percent by weight to about 35 percent by weight when using Vulcan XC-72. The upper limit is determined by cracking of the tar with too high a carbon loading while

the lower limit is determined by the minimum acceptable conductivity for the tar.

It was found that the Vulcan XC-72 carbon black can be used at a lower carbon content than the Conductex SC to produce similar conductivities. For example: Vulcan XC-72 at 30 percent (of the tar plus carbon by weight) produced a more conductive coating than 37.5 percent Conductex SC. Typical readings of the two carbon varieties are listed below. Resistances were measured on dry coated slides by an ohmmeter with probes spaced one inch apart on a one-inch wide strip:

37.5% Conductex (in tar)	80,000 ohms
32.5% Vulcan XC-72 (in tar)	20,000 ohms

The coatings were found to be adherent to ceramic substrates, including glazes or glass and also possess other necessary properties such as flexibility and resistance to cracking. Note that this type of coating could find uses in other areas than insulator manufacture, for example, as a general resistance coating. Since the base of the coating is asphalt, a high coefficient of thermal expansion is provided which is an advantage in an insulator application.

In order to prepare the tar, the tar component is dissolved in a suitable solvent, e.g., a mineral solvent such as naphtha. Other solvents could be used, such as carbon tetrachloride or benzol, taking appropriate precautions in the handling of these materials.

The solvent is preferably one having a low evaporation rate. Thus, the solvent will usually evaporate in three to five hours. In practice, about twelve hours of air drying is used to complete the evaporation process.

In one formulation, to form a tar with 37.5 percent by weight of Conductex SC, the following products were used:

Carbon (Conductex SC)	10.6% (by weight)
Tar (Venezuelan Crude Asphalt)	17.6% (by weight)
Naphtha (Technical Grade)	71.8% (by weight)

Another formulation using Vulcan XC-72 in which the carbon formed 32.5 percent by weight of carbon and tar was:

Carbon (Vulcan XC-72)	9.0% (by weight)
Tar (Venezuelan Crude Asphalt)	18.7% (by weight)
Naphtha	72.3% (by weight)

It was found that as the percentage of carbon black is increased, the conductivity of the tar, as measured by the surface resistance of a test coating, is increased. This decrease in surface resistivity and thus increase in tar conductivity is shown in FIG. 2 for different percentage loadings of carbon (Vulcan XC-72) in a tar base. The data reported in FIG. 2 was obtained by dipping a sample into a suitably fomulated paint for one second, and then air drying the paint layer and measuring its surface resistivity in ohms per square. Note that the surface resistivity reduced from about 2×10^6 ohms/square to about 3.5×10^3 ohms/square as the carbon loading increased from about 27.5 percent to about 35 percent by weight of carbon and tar.

The paint is prepared by dissolving the tar component in part of the naphtha after which it is mixed with a naphtha-carbon mixture, which is made by soaking the total batch of carbon in naphtha overnight. This mixture is milled in a ball mill for one hour and the remainder of the naphtha is added and milled for a further three to six hours. Samples of the paint are taken by dipping glass slides and the end point for the milling can be then determined by a conductivity measurement on the coating. A ball mill or other high shear mixer must be used in the preparation of the paint in order to produce a homogeneous mixture.

A layer of the paint is then applied, as by painting, to the surfaces of the insulator shell **12** and conductive hardware members **10** and **11** and is air dried. They could also be dried with warm air heaters. The layer could also be applied by dipping, or by any other desired process. The layer is applied to a thickness of about 1.0 mil and in a range of from 0.5 to 2.0 mils.

Although this invention has been described with respect to its preferred embodiments, it should be understood that many variations and modifications will now be obvious to those skilled in the art, and it is preferred, therefore, that the scope of the invention be limited, not by the specific disclosure herein, but only by the appended claims.

The embodiments of the invention in which an enclusive privilege or property is claimed are defined as follows:

1. An electrical insulator comprising, in combination: an insulation shell member having a semiconducting surface, a conductive hardware member, a cement layer cementing a first surface region of said insulation shell member to a first surface region of said hardware member and a conductive tar coating adhering to said first surface region of said insulation shell member and disposed between said first surface region of said insulation shell member and said cement layer; said conductive tar coating being in electrical surface contact with said semiconducting coating, said semiconducting surface being electrically connected to said conductive hardware member.

2. The electrical insulator of claim **1** wherein said cement layer is conductive.

3. The electrical insulator of claim **2** wherein a second tar coating is formed on said first surface region of said conductive hardware member and is disposed between said first surface region of said hardware member and said cement layer.

4. The electrical insulator of claim **2** wherein said tar coating consists of an asphalt base having carbon black admixed therein.

5. The electrical insulator of claim **1** wherein said tar coating consists of an asphalt base having carbon black admixed therein.

6. The electrical insulator of claim **5** wherein said tar coating contains carbon black from 20 percent to 40 percent by weight of said tar plus carbon.

7. The electrical insulator of claim **6** wherein said tar coating contains about 32 percent to 38 percent by weight of carbon black.

8. An electrical insulator comprising first and second metal members, an insulation member having a semiconducting glaze coating, a conductive tar coating on respective given surface regions of said first and second metal members and on first and second spaced regions of said insulation member and in contact with said semiconducting glaze coating, and first and second conductive cement layers connecting said given surface regions of said first and second metal members to said

first and second spaced regions respectively of said insulation member.

9. The insulator of claim **8** wherein said insulator is a suspension insulator and wherein said first metal member is a metal cap and wherein said second metal member is a metal pin.

10. The insulator of claim **9** wherein said conductive tar coating consists of a painted asphalt layer having carbon black admixed therein.

11. The insulator of claim **10** wherein said carbon black forms from 20 percent to 40 percent by weight of said conductive tar plus carbon.

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