

May 2, 1967

H. A. FREY

3,317,659

HIGH VOLTAGE INSULATOR WITH INTERNAL CORONA SHIELD

Filed Sept. 22, 1965

3 Sheets-Sheet 1

Fig. 1.

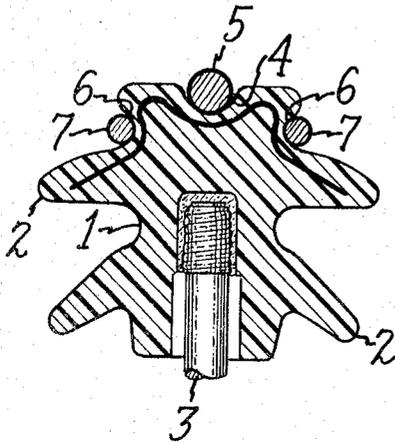


Fig. 2.

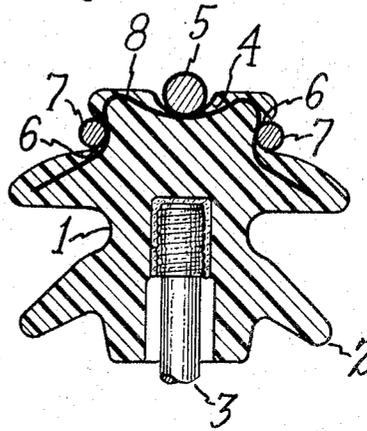


Fig. 3.

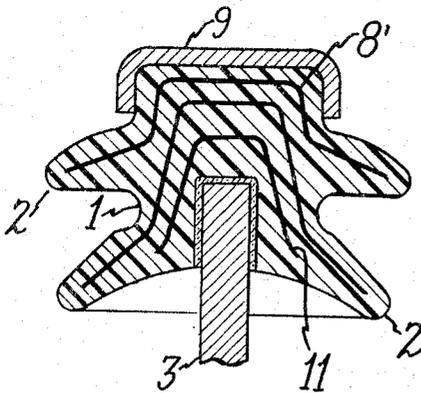
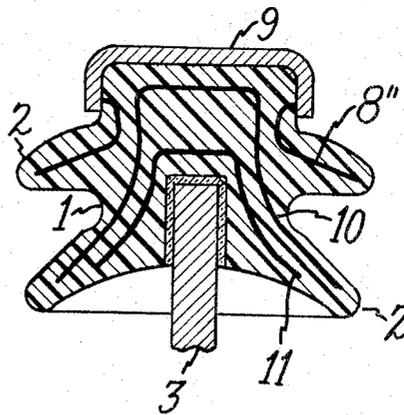


Fig. 4.



Inventor,  
Howard A. Frey,  
by Silbert P. Tarleton  
His Attorney.

May 2, 1967

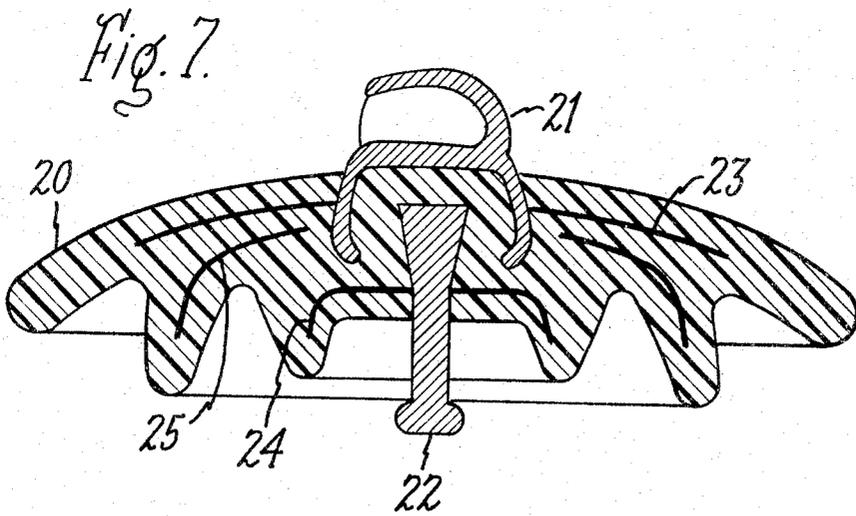
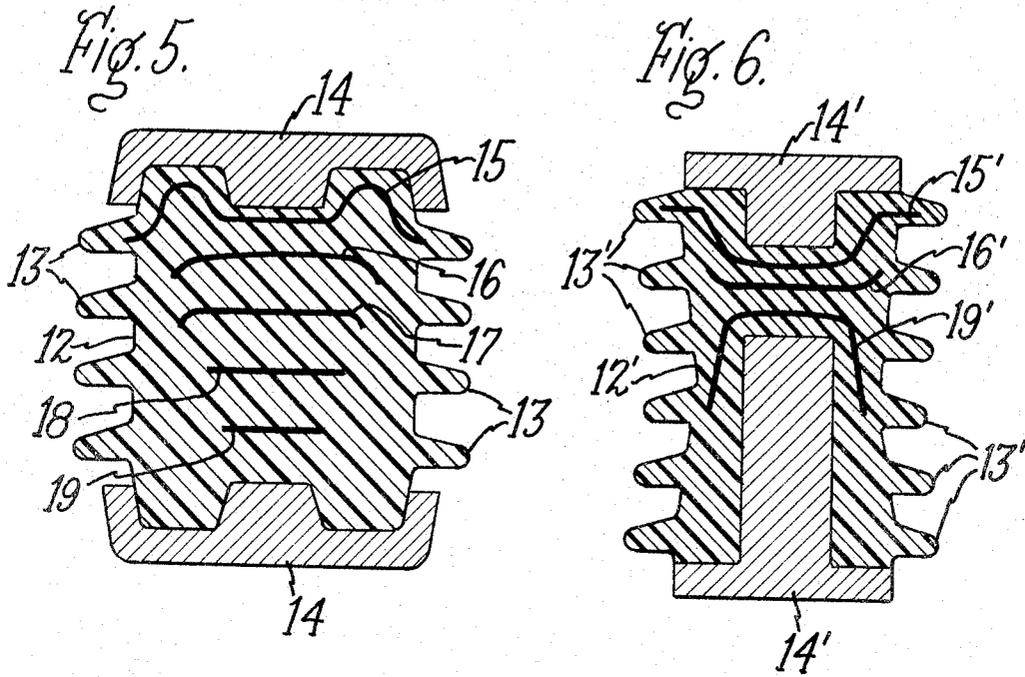
H. A. FREY

3,317,659

HIGH VOLTAGE INSULATOR WITH INTERNAL CORONA SHIELD

Filed Sept. 22, 1965

3 Sheets-Sheet 2



Inventor,  
Howard A. Frey,  
by Gilbert P. Tarkenton  
His Attorney.

May 2, 1967

H. A. FREY

3,317,659

HIGH VOLTAGE INSULATOR WITH INTERNAL CORONA SHIELD

Filed Sept. 22, 1965

3 Sheets-Sheet 3

Fig. 8.

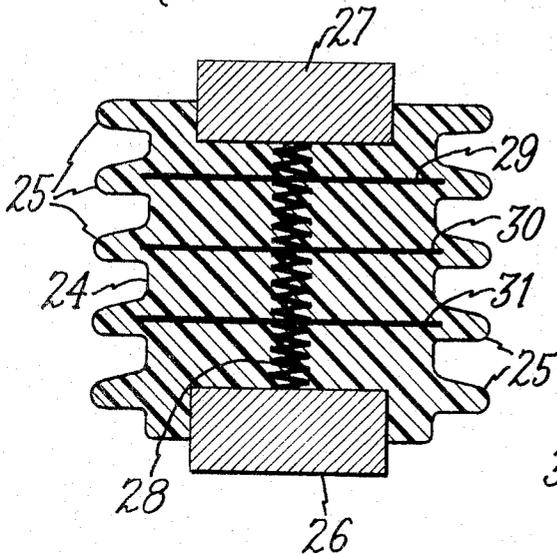
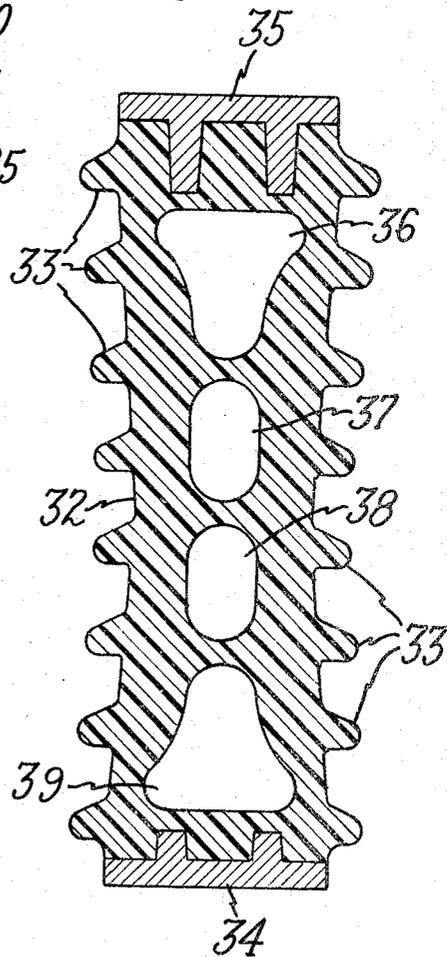


Fig. 9.



Inventor,  
Howard A. Frey,  
by Gilbert P. Tarleton  
His Attorney.

3,317,659

**HIGH VOLTAGE INSULATOR WITH INTERNAL CORONA SHIELD**

Howard A. Frey, Towson, Md., assignor to General Electric Company, a corporation of New York  
 Filed Sept. 22, 1965, Ser. No. 489,235  
 2 Claims. (Cl. 174-140)

This invention relates to electrical insulators and more particularly to improvements in corona shields for the end hardware of high potential power line insulators.

Such insulators, of either the strain or suspension type on the one hand or the post or column type on the other hand, usually have an end at ground potential and the other end at line potential. At the higher line potentials the potential gradient in the air adjacent the line end hardware fittings becomes high enough to cause corona discharge which is a high frequency disturbance disruptive of adjacent communication channels and therefore highly objectionable. Accordingly, it has been conventional to equip such line end hardware fittings with external corona shields which in general have smoothly contoured comparatively large conductive surfaces at line potential in proximity to the line end hardware for reducing the potential stress concentration in the air adjacent the line end hardware.

In accordance with this invention, I have found that similar results can be obtained by embedding an enlarged smoothly contoured conductive surface in the insulating material of the insulators adjacent the line hardware. Such embedded surface may either be conductively coupled or capacitively coupled to the line end hardware. In either case it increases the effective surface area of the line end hardware and thus constitutes an internal corona shield which reduces the potential gradient in the air surrounding the line end hardware.

Such an internal corona shield has numerous advantages over conventional external corona shields. Thus it is less costly, does not require separate installation as it is an integral built-in part of the insulator and also does not increase the size of the line end of the insulator so that icing and windage forces on the insulator are reduced.

Corona shields, in reducing the potential stress or gradient at the line end of an insulator, also inherently tend to grade the voltage stress along the insulator. In accordance with another feature of this invention, additional or auxiliary conductive surfaces may be embedded in the insulator which in cooperation with main internal corona shielding surface further grade the potential stress distribution along the insulator and thus enhances the corona shielding action of the main internal shielding surface.

An object of the invention is to provide a new and improved electrical insulator.

Another object of the invention is to provide an internal corona shield for a high voltage insulator.

The invention will be better understood from the following description taken in connection with the accompanying drawings and its scope will be pointed out in the appended claims.

In the drawings,

FIG. 1 is a vertical cross sectional view of a pin type insulator embodying the invention,

FIGS. 2, 3, and 4 are similar views of modifications of FIG. 1,

FIG. 5 is a similar view of a post type insulator embodying the invention,

FIG. 6 is a similar view of a modification of FIG. 5,

FIG. 7 is a similar view of a suspension type insulator embodying the invention,

FIG. 8 is a similar view of a modified post type insulator having an embedded resistor, and

FIG. 9 is a similar view of a column type insulator in which a number of conducting bubbles are provided for shielding and grading purposes.

Referring now to the drawings and more particularly to FIG. 1, there is shown therein an insulator of what is commonly called the pin type. It has a body 1 formed in any suitable manner, such as by molding, of insulating material of any suitable type such as porcelain or polymeric material. As shown it is provided with integral shields, petticoats, or rainhoods 2 and a metallic mounting pin 3, the upper surface including a groove or saddle 4 for receiving a high voltage line conductor 5 and side grooves or saddles 6 for receiving a tie wire 7 for fastening the line conductor 5 to the top of the insulator. A conducting film 8 is encapsulated in the insulating material. As shown, it is generally rounded and generally conforms to the adjacent shape of the high potential conducting parts of the assembly, namely the line conductor 5 and the tie wire 7, but is of substantially greater extent or surface area than those parts. The conducting film, therefore, reduces the electric stress in the air around the conductor 5 and tie wire 6 in order to raise the corona starting voltage and so eliminate radio or television interference at operating voltage. The conducting film may consist of foil, of formed sheet metal, of wire mesh or of a conducting film of high resistance material such as that known to the trade as Rescon<sup>®</sup> whose principal constituent is carbon black. As shown in FIG. 1, the conducting film 8 is completely insulated from the conductor 5 and tie wire 7 so that it floats at a potential near that of those parts because of its capacitance. Consequently, this comparatively large, comparatively smooth contoured surface at a potential substantially that of the line conductor 5 and tie wire 7 serves to reduce the potential gradient in the air surrounding the parts 5 and 6 below what it would be if the film 8 were not present.

In the modification shown in FIG. 2, the conducting corona shielding film 8 is brought to the surface of the insulating material 1 at the bottom of the grooves 4 and 6 so that the line conductor 5 and tie wire 7 may make direct mechanical and electrical contact therewith. In that case, of course, the parts 5, 7 and 8 are all at the same operating potential.

In the modification shown in FIG. 3, the body of insulating material 1 has a metallic cap 9 rather than grooves 4 and 6 at its top. Such an insulator is suitable for supporting bus bars and other conductors. It is provided with a corona shielding conductive film 8' corresponding to the film in FIG. 1 in that it is closely adjacent to and conforming in general shape to the extended surface of the cap 9 but it is not connected thereto. For further increasing the corona starting voltage of the insulator by incidentally grading the potential distribution through the insulation between the parts 9 and 3 additional spaced conductive films 10 and 11 are shown.

FIG. 4 is generally similar to FIG. 3 except that the main corona shielding embedded film is a ring 8'' which is electrically connected at its inner edge to the outer edge of the cap 9. In this manner, the effective surface of cap 9 is increased and the voltage at which corona will appear at its outer edge is materially increased.

FIG. 5 illustrates a post type insulator having a central body of insulating material 12 provided with petticoats 13 and with metallic end caps 14, the bottom one being normally at ground potential and the upper one being at line potential or at some other potential which is relatively great compared to ground. Embedded in the insulation 12 is a conductive film 15 of rounded contour following generally the shape of the underside of the cap 14 when extended for acting as a corona shield for the top cap 14. Additional potential grading films 16, 17, 18 and 19 may also be embedded in the insulation so that the capacitances

therebetween will serve to reduce the unit stress in the insulation and hence in the surrounding air adjacent the upper cap 15.

FIG. 6 is generally the same as FIG. 5 showing a somewhat modified type of column or post insulator in which the primed reference numbers correspond generally to the reference numbers in FIG. 5 but are of somewhat different shape.

FIG. 7 is a cross sectional view of a suspension type insulator unit in which a main disc like body of insulation 20 has embedded therein on opposite sides a metallic ball socket 21 and ball pin 22. Acting as a main corona shield for the ball socket member 21 is a corona shielding film 23 embedded in the insulation 20 and connected to the part 21. Similarly shielding the ball pin 22 is a conductive film 24 embedded in the insulation and connected to the part 22. An auxiliary potential grading film 25 is also shown between the films 23 and 24.

It is believed that this type of construction is particularly suitable for so-called fog type insulators which are required to operate in contaminated atmospheres where surface dirt and moisture on the insulators frequently badly distort the surface electric gradients.

In the modification shown in FIG. 8, the insulator 24 with its rainhoods 25 and metallic end hardware fittings 26 and 27 has embedded therein a high resistance element 28 extending between the hardware fittings 26 and 27 and connected respectively thereto at its ends. Connected at intermediate points on this high resistance element are conducting films 29, 30 and 31 which serve to control the corona starting voltage of the end hardware fittings 26 and also the potential distribution in the insulation 24, the potential difference between the films 29, 30 and 31 being determined primarily by the resistance potential divider effect of the resistor 28 rather than the capacitance coupling of the surfaces 29, 30 and 31. The resistor 28 may consist of an embedded Carborundum resistor or it may consist of tapes or bands of material coated with Rescon® or with similarly conductive material such as carbon black. It may be straight or zigzag as shown and in the latter case may consist of a very fine high resistance wire as shown.

In FIG. 9 is shown a column type insulator consisting of a main part of insulation 32 provided with petticoats 33 and hardware fittings or caps 34 and 35 and internal hollow conductive bubbles 36, 37, 38 and 39 which are devoid of solid insulating material. They may consist of hollow canisters made of foil, sheet metal, or other conductive material. Their size, shape and placement may be varied to obtain varying internal capacitance and so control gradient. Their ends are shown rounded or spherical in order to obtain the effect of a multiple sphere gap through the insulator. This construction has the further advantage of displacing expensive insulating material and reducing overall weight of the insulator.

In all of the illustrated species except FIG. 9, the conductive films may be made of perforated metal or of wire mesh so that the mechanical stress may be transmitted by the insulating material through the film without producing a fault plane. The conductive films may also consist of a system of radial or circumferential bands instead of solid areas. They may further be made in total or in part of high resistance material to gain further control of gradient. As an example of the latter, the insulated material may be made of some high resistance material such as Rescon® or of tapes, cloth, or fiber coated with Rescon®.

It is also possible in any one particular film to make part of the film of solid conducting material, such as foil, with other parts made of high resistance material such as

Rescon® in order to gain further control over gradient in this particular area. For example, the top and bottom conducting films shown in FIG. 7 might consist of an outer conducting ring with the inner part of the conducting film made of Rescon® or other high resistance material so that the radial gradient outward could be further controlled by the resistance of the inner high resistance portions of the conducting zone. Further, in species like that of FIG. 1, the outer periphery of the conducting film might be made of high resistance material to grade off the stress at the edges.

While there have been shown and described particular embodiments of the invention, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention, and therefore it is intended by the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An electrical insulator comprising a solid piece of electrical insulation having external metallic parts at opposite ends between which under operating conditions a large difference in electrical potential exists, and an integral internal corona shield for at least one of those parts comprising a conductor film embedded in said piece of insulation adjacent said one part, said film having a surface substantially larger than but conforming in general shape to the adjacent surface extended of said one part, said surface being reentrant and enclosing a space devoid of said solid insulation.

2. An electrical insulator comprising a solid piece of electrical insulation having external metallic parts at opposite ends between which under operating conditions a large difference in electrical potential exists, a first integral internal corona shield for at least one of those parts comprising a conductor film embedded in said piece of insulation adjacent said one part, said film having a surface substantially larger than but conforming in general shape to the adjacent surface extended of said one part, at least one auxiliary corona shielding conductive film is embedded in said insulator material between the first shield and the other external metallic part for additionally shielding said one part by incidentally grading the potential stress distribution in said insulator between said parts, both corona shielding films being curved reentrant surfaces enclosing spaces devoid of said solid insulation.

#### References Cited by the Examiner

##### UNITED STATES PATENTS

1,247,343	11/1917	Sonneborn	174—140
2,191,152	2/1940	Hammel	174—209 X
2,264,428	12/1941	Austin	174—30
2,317,799	4/1943	Pereles	174—30 X

##### FOREIGN PATENTS

326,650	2/1903	France.
333,015	9/1903	France.
467,516	3/1914	France.
1,237,914	6/1960	France.
132,417	9/1919	Great Britain.
527,357	10/1940	Great Britain.
916,079	1/1963	Great Britain.
947,319	1/1964	Great Britain.

LARAMIE E. ASKIN, *Primary Examiner.*