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K. A. HAWLEY

INSULATOR

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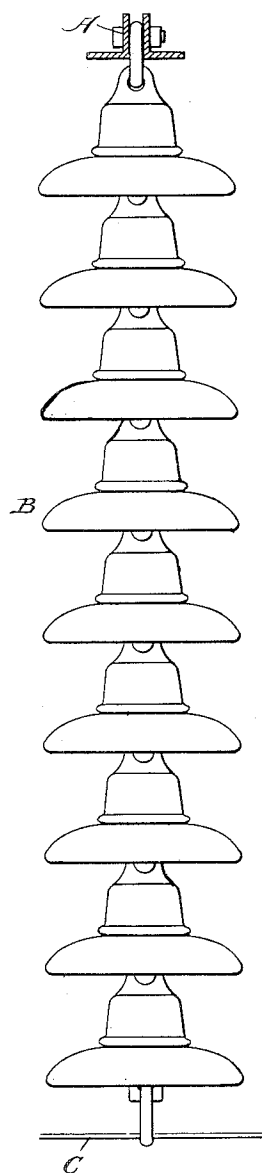


Fig. 1

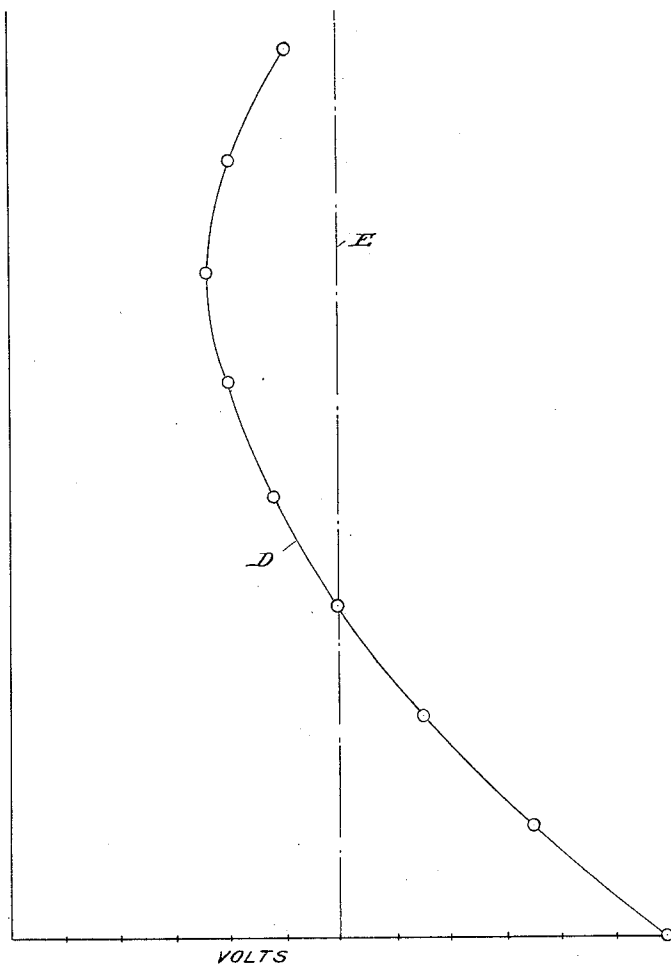
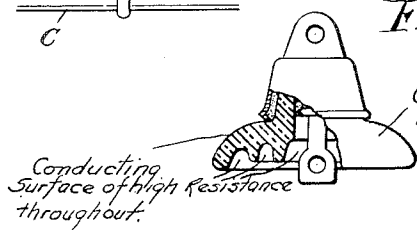


Fig. 2



Conducting Surface
of high Resistance

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UNITED STATES PATENT OFFICE.

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INSULATOR.

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The invention relates to grading means for high tension insulators, and more particularly to insulator units so constructed or formed as to provide means which, when a string is assembled and in use, will act to reduce the electrical stresses imposed upon the units closely adjacent the conductor by distributing these stresses throughout the series of units in the insulator string.

The principal object of my invention, broadly stated, is to provide a string of insulator units which have combined with the insulating body portions thereof, conducting elements, thus making the said surfaces slightly conducting, the said surfaces being adapted to act as elements of condensers when the insulators are in use.

Another object is to provide a grading means for insulator units so as to furnish each unit of a string of suspension insulators with means for minimizing the electrical stresses imposed upon the said insulator units adjacent the conductor, said means being adapted to proportion the said stresses among the insulating units.

The medium surrounding a conductor, such as a wire carrying electricity, has to withstand a certain pressure, potential or voltage. This pressure or voltage carried by the wire always tends to escape to the earth through the medium surrounding the conductor or through a grounded conductor, and it is therefore essential to insulate the conductor from the earth or grounded conductor by means of insulating units. The greater the pressure in the conductor the more efficient must be the insulators which prevent the escape of this pressure to the grounded conductor. In other words, there is a pressure between the conductor and a metallic structure or grounded conductor tending to complete an electric circuit. Each inch of the medium surrounding the conductor has to stand a part of this pressure. Hence if the conductor is insulated from the earth through insulators the pressure which each insulator has to bear depends upon its distance from the grounded support or conductor. It is known that the further the conductor which is carrying the electricity is from the grounded conductor the less pressure insulator nearest the grounded conductor has to bear and the greater pressure that the insulator adjacent the conductor or wire must withstand. Consequently in supporting high voltage conductors by a string of suspension insulators, the insulators adjacent the conductor carrying the electric current are subjected to a tremendous pressure tending to cause the breakdown of the insulator units adjacent the conductor, while the units which are farthest removed from the current carrying conductor have practically no pressure imposed thereon. The result of thus subjecting the unit or units adjacent to the conductor to the tremendous voltage which is now carried by high tension transmission lines has been that the insulators adjacent the conductor are stressed practically to their limit electrically, while the additional units in the string perform hardly any useful function electrically, their function being mechanical as they act as a support for the insulators adjacent the conductor. It is for this reason that it is impossible, without using some method of grading the insulators, to carry voltages through the wires which exceed the electrical resistance of the units adjacent the insulator, that is, the combined electrical resistance of the entire string of units cannot be used as a measure of the insulation obtained by these units.

Heretofore attempts have been made to avoid this difficulty by grading insulators of the suspension type by fastening to certain insulators metallic elements which act as elements of condensers, and certain other attempts have been made by using metallic elements connected to the supports or to the conductor, the metallic elements in both instances acting to distort the electro-static field and thus more uniformly distribute the electrical stresses throughout the insulators. All of these efforts have been directed in connection with the application to the insulator units or to the conductors of extraneous metallic members, and as far as I am aware no attempt has been made prior to my invention to grade insulator units without applying thereto these extraneous metallic elements.

In the drawings, Figure 1 shows a string of suspension insulator units and beside the same, coordinates, the horizontal coordinate

representing voltage and the vertical co-ordinate representing the number of insulators, and Figure 2 shows a section through one of the units.

5 The support or grounded conductor is diagrammatically illustrated by the reference character A, each insulator unit by the reference character B, and the conductor by the reference character C. The curved line
10 D indicates the voltage drop between the insulators B, and the vertical line E which crosses the curved line is intended to indicate the theoretically perfect grading between insulators.

15 It is impossible to so grade the insulator units that the actual voltage drop between units will lie along the theoretically perfect line; but by grading the units it is possible to make the voltage drop substantially uni-
20 form whereby a line D is obtained which will approach approximately to the average line, and it will of course be apparent to those skilled in this art that the nearer this line approaches the average the nearer per-
25 fect is the grading.

In carrying out my invention I apply to the insulator units, either in the formative stage or in the finished form, a high resist-
30 ance or slightly conducting ingredient, this ingredient being intimately associated with the entire surface of the insulator unit and not separable therefrom mechanically.

The slightly conducting ingredient is preferably mixed with and forms an integral
35 part of the glaze which is applied to the insulator unit, and I may use a graphite compound carried in suspension in the glaze. It is to be understood, however, that I do not limit myself to the use of graphite since
40 other equivalent elements may advantageously be employed in this connection. It is also possible to coat the entire surface of the insulator units with graphite prior to the application of the glaze, and all of these
45 methods I consider within the scope of my invention.

It will be understood that the insulating bodies of the units may be produced in any desired manner and that the special glaze is
50 applied to these units after the same are formed and is then baked or fired on the insulating body.

The result of applying this slightly conducting ingredient to the entire surface of
55 the insulator unit is to transform the non-conducting surface of the insulator unit into a partially conducting surface or one coated with an attenuated or film conductor. In other words, each insulating unit has on its
60 entire surface a conducting element of high resistance, which acts as a leakage path between the main conductor C and the support A. As each insulator unit will have approximately the same resistance over its
65 surface as each other insulator in the string,

it follows that there will be a continuous or unbroken path for leakage currents, and the voltage drop will be divided approximately equally between these different units, approaching the grading indicated by the
70 theoretically perfect line E. It will be possible to make this resistance so high that the electricity escaping through the resistance will not represent an appreciable power loss, yet it will be sufficient to overcome the
75 disturbing effect produced by the unequal voltage drop through the air.

I claim:—

1. Means for insulating and supporting a current carrying conductor from a grounded
80 conductor, comprising a string of insulator units each having a conducting surface of high resistance which forms a continuous and unbroken path for leakage current between the current conductor and the ground-
85 ed conductor.

2. Means for supporting and insulating a current conductor from a grounded support, comprising a series of insulator units interposed therebetween and connected therewith,
90 each unit having a high resistance conducting material embedded in its surface forming a continuous and unbroken path for leakage current between the conductor and the grounded support.
95

3. Means for supporting and insulating a current conductor from a grounded support, comprising a series of insulator units interposed therebetween and connected there-
100 with, each unit having a high resistance conducting surface forming a continuous and unbroken path for leakage current between the conductor and the grounded support, said high resistance surface being present on every exposed portion of each unit.
105

4. Means for insulating and supporting a current carrying conductor from a grounded support, comprising a string of insulator units each having a conducting surface of high resistance which forms a continuous
110 and unbroken path for leakage current between the current conductor and the grounded conductor, said high resistance surface consisting of slightly conducting material permanently united to and forming an in-
115 separable part of every exposed portion of the insulator.

5. Means for supporting and insulating a current conductor from a grounded support comprising a series of insulator units each
120 having a glazed surface embodying a conducting ingredient of high resistance to form a continuous and unbroken path for leakage current between the current conductor and the grounded support.
125

6. An insulator unit having its entire surface provided with a glaze embodying a high resistance conducting material.

7. An insulator for high voltage lines comprising a disc of insulating material
130

having a resistance substance forming a resistance path extending from the central portion across the upper surface to the periphery and then across the under surface and directly under the resistance path upon the upper surface to the central portion. 5

8. An insulator for high voltage lines comprising a disc of porcelain having a path of resistance material extending over its exposed surface from the central portion of the upper surface to the central portion of the lower surface. 10

In testimony whereof I affix my signature.

KENT A. HAWLEY.