Sept. 17, 1929. F. G. BAUM 1,728,522

INSULATOR FOR HIGH VOLTAGE SYSTEMS

Filed Aug. 19, 1921

Fig. 1.

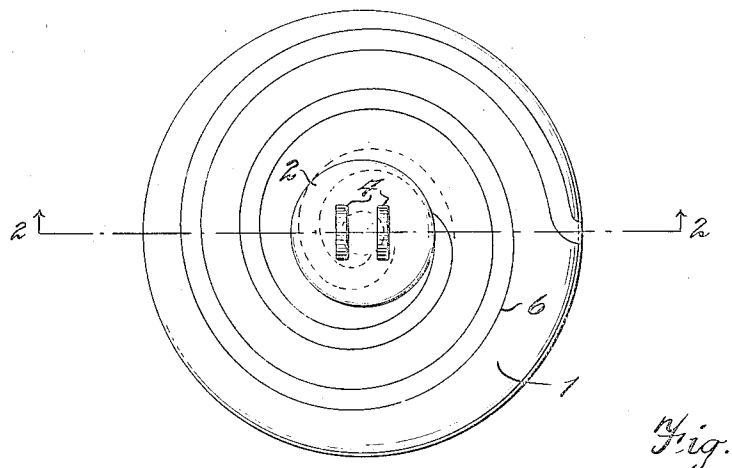


Fig. 2.

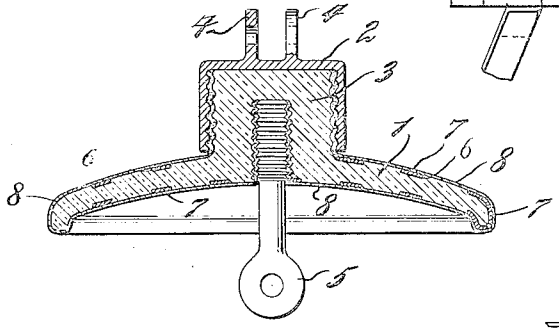


Fig. 4

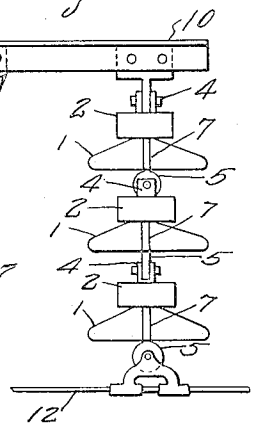
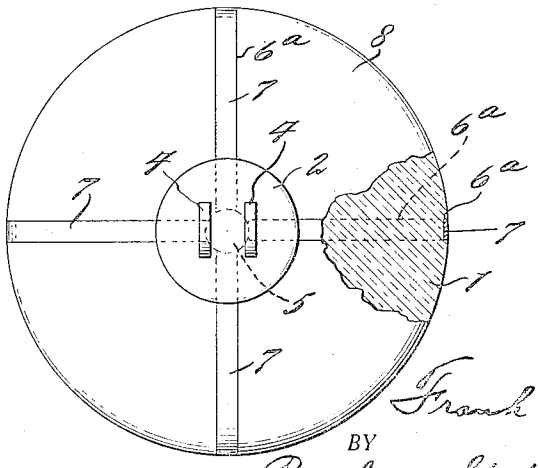


Fig. 3.



INVENTOR.
Frank G. Baum
BY
Rowekam, Stockbridge & Bond
ATTORNEYS.

Patented Sept. 17, 1929 1,728,522

UNITED STATES PATENT OFFICE

FRANK G. BAUM, OF SAN FRANCISCO, CALIFORNIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA

INSULATOR FOR HIGH-VOLTAGE SYSTEMS

Application filed August 19, 1921. Serial No. 493,613.

This invention relates to insulating supports for transmission lines carrying high voltages. These supports now generally consist of a series of porcelain discs which are fastened together in a string by metallic parts. The cap and pin and the link types are most commonly used. When the type of insulator used for high voltage lines was changed from the pin type to the disc type, it was assumed that the addition of more voltage to the line merely required the addition of more units or discs in order to provide the necessary insulation, but it was found that the results were not at all in proportion to the number of units or discs in the string. Upon an investigation of the cause it was found that the voltage tended to "pile up" on the insulator units or discs adjacent the line wire instead of being evenly distributed over the entire string. With a great fall in voltage over any insulator unit, particularly those units adjoining the high potential wire, the likelihood of serious damage to an insulator unit from flash-over currents, following abnormal increases in voltage, such as those due to lightning or other causes, is very much increased. The insulator units which are commonly formed of glass or porcelain, are refractory and thus easily injured by the heavy current following a flash-over or puncture by the breaking down of the dielectric strength of the insulator with the abnormal increase of voltage. The piling up of the excess voltage on the insulator units adjacent the line wire breaks down the air at the metal fittings where it is highly stressed with the result that the air is broken down serially from one unit to another by transferring the high electric stress from one to another in the string. Tests upon insulator strings have shown the voltage distribution among the separate units to be very uneven, the maximum being from five to ten times the minimum. This causes uneven stress and a wide variation in the leakage resistance over the surface of the insulators under outdoor conditions. It has been found that with a string having dirty surfaces, the wetting and drying out of the string due to weather changes causes a variation in the potential distribution of the string, the distribution improving with the increase of moisture. It will therefore be seen that if the voltage stresses could be more uniformly distributed over the units of the insulator string or column, the length of the string or column could be increased to permit of the use of almost any desired voltage on the wire, or the equivalent or effective length of any string or column could be increased.

In the present constructions the capacity currents through the several units determine the distribution of voltage, but the capacity currents from the metal parts to ground and from line to metal parts have the greatest influence. These currents are extremely small and since they cannot be varied widely, some other means of controlling the voltage distribution is necessary.

An object of the invention is to provide an insulator construction in which the distribution of voltage over the separate units will be as nearly uniform as possible and this uniform distribution maintained for all conditions in practice. A further object is to provide an insulator construction which is simple, durable, efficient and inexpensive, and which can be used without any changes in the methods of suspension now commonly used. Further objects and advantages will be apparent from the following description of embodiments of the invention and the novel features of the invention will be particularly pointed out in claims.

In the practical application of the invention I propose to provide on the insulator surface a definite high resistance conducting or current leakage path between the metal parts of each unit, with the leakage current through this path large enough to control the voltage distribution over the insulator string under all conditions. That is, the leakage current over the combined resistance of a series of units would uniformly distribute the fall of potential over the string and while it would be larger than the capacity currents over the string the total amount of power lost in this manner would be little more than that lost in present constructions. For further details of the man-

ner of application of the invention to practice, reference may be had to the accompanying description of two embodiments of the invention.

In the accompanying drawing:

Fig. 1 is a plan of an insulator unit which is constructed in accordance with the invention.

Fig. 2 is a section of the same taken substantially along the line 2—2 of Fig. 1.

Fig. 3 is a plan of a slightly modified embodiment of an insulator unit.

Fig. 4 is a side elevation of a plurality of insulators, such as that shown in Fig. 3, in the relation thereof to a transmission line and a supporting tower.

In the embodiment illustrated in Figs. 1 and 2 an insulator disc of the cap and pin type has a body portion 1 of suitable insulating material, such as glass or porcelain. The cap 2 which is secured in a well known manner, such as by cement, to a boss 3 upon the upper face of the disc, is provided with spaced ears 4 arranged to cooperate with an eye 5 depending from the under side of an adjacent insulator unit. The insulator body is provided in its upper surface with a groove 6, which extends from the central portion where it is in contact with the metallic cap, spirally and outwardly across the upper surface of the periphery, then over the peripheral edge and spirally and inwardly across the under face to the central portion of the disc where it contacts with the metal connecting pin, the convolutions upon the under face being preferably directly beneath the convolutions in the upper face. This groove is filled with a suitable resistance material 7, such as carborundum, graphite or the like, and is held against displacement from the groove in any suitable manner, such as by a protective coating 8 applied to the surface of the unit.

In Fig. 3 a slightly different arrangement of the resistance path is provided, the groove 6^a extending from the central portion in contact with the metallic cap, radially and outwardly to the periphery, then over the peripheral edge and inwardly across the under face to the central portion where it contacts with the connecting pin 5. The groove may also obviously have other shapes and paths dependent upon individual conditions and selections.

When the insulator body 1 is of porcelain it may be made up into the desired shape and size and dipped in glaze in the usual manner, but before firing, a band or groove is cut out of the glaze, or out of the glaze and porcelain, having the desired path, after which the unit would be fired. After this firing the grooves are filled with the resistance material 7, such as the carborundum or graphite, and the unit is again glazed and fired to protect and fix the resistance within the groove. These steps may be varied to some extent or some of them eliminated in some instances.

While I find it advisable to have the resistance path upon the under face disposed directly under the resistance path upon the upper face, good results may be obtained nevertheless when the paths are not so arranged, providing that the paths extend across the surfaces of the disc between the connections. The proportions of the paths, their disposition on each unit and the selection of the resistance material may be varied in accordance with variations in the regular voltage and other operating conditions.

In Fig. 4, a plurality of insulators, such as that shown in Fig. 3, are connected in series relation between a grounded supporting tower 10 and a transmission-line conductor 12 in a usual and well known manner. However, since the resistance material 7, on each of the insulator units, extends from the cap to the pin thereof, this arrangement provides a continuous and unbroken path for leakage current between the conductor 12 and the grounded support 10.

I have illustrated and described the invention as applied to line insulators in order to explain the nature of the invention but this is intended for the purpose of explanation only and by the use of the term "insulator" I mean not only line wire insulators but other insulating devices for use with high voltages such as, for example, the bushings for transformers, over which it is also desirable to prevent variation of potential. It will also be understood that this invention is applicable to a single unit or a series of units.

It will be obvious that various changes in the details and arrangements herein described and illustrated may be made by those skilled in the art within the principle and scope of the invention.

I claim:

1. Means for supporting and insulating a current conductor from a grounded support comprising a series of insulator units interposed therebetween and connected therewith, each unit having an insulating surface and a high-resistance surface of conducting material forming a continuous and unbroken local path along said insulating surface for leakage current between the conductor and the grounded support, the width of said path being relatively small in comparison to the diameter of the insulator.

2. A high-voltage insulator including an insulating body member and means for grading the voltage distribution in predetermined manner over the insulator embodying a strip of resistance substance of negligible watt consumption extending, and energized in response to the difference of potential, between the insulator terminals and constituting a

local path for leakage current on the surface of said body member, the total outer surface area of the strip being appreciably less than the total surface area of the insulating body between the terminals.

3. A high-voltage insulator including an insulating body member and means for grading the voltage distribution in predetermined manner over the insulator embodying a strip of resistance substance of negligible watt consumption extending, and energized in response to the difference of potential, between the insulator terminals and constituting a local path for leakage current on the surface of said body member, said strip extending windingly across said surface.

4. A high-voltage insulator including an insulating body member and means for grading the voltage distribution in predetermined manner over the insulator embodying a strip of resistance substance of negligible watt consumption extending, and energized in response to the difference of potential, between the insulator terminals and constituting a local path for leakage current on the surface of said body member, said strip being of substantially sheet construction having its sides conforming to the surface of the body member and of appreciably less total outer surface area than the total surface area of said insulating body member between the terminals.

In witness whereof I hereunto subscribe my signature.

FRANK G. BAUM.