July 7, 1931. H. M. KRANER 1,813,172

INSULATOR

Filed Aug. 29, 1927

Fig. 1.

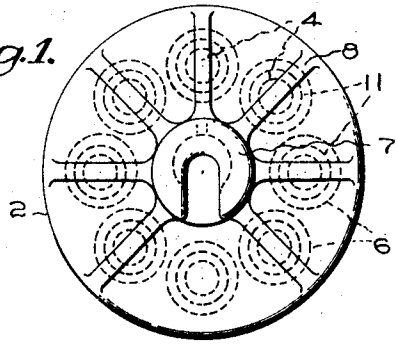


Fig. 2.

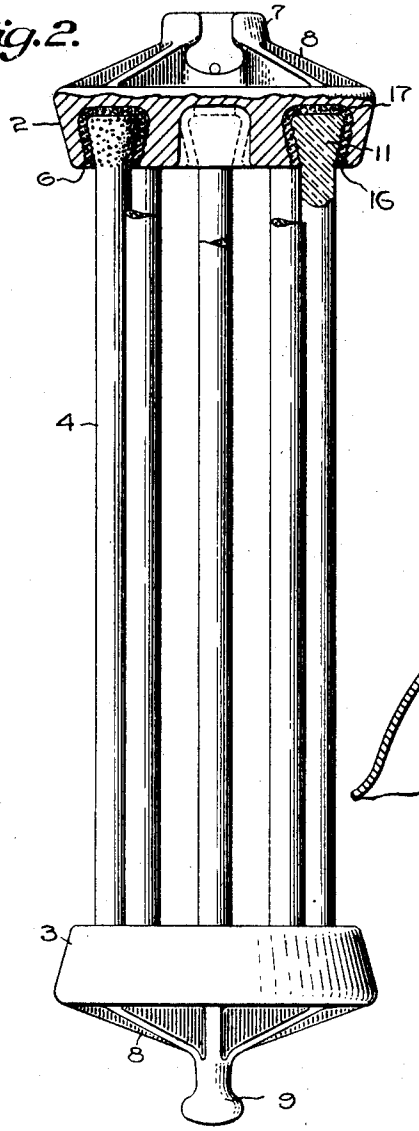


Fig. 3.

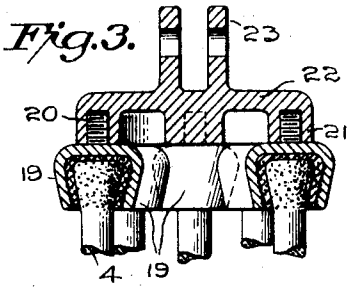


Fig. 4.

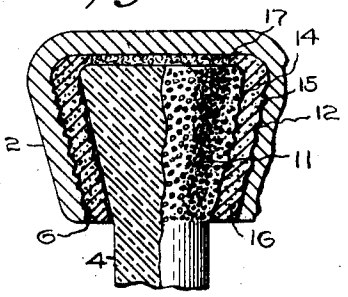


Fig. 5.

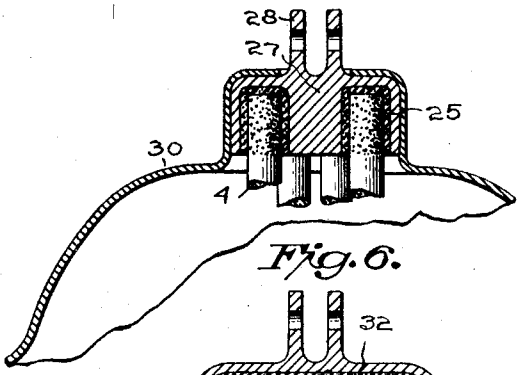
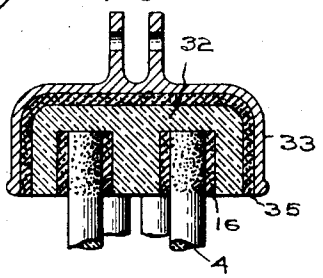


Fig. 6.



INVENTOR

Hobart M. Kraner

BY

Wesley Gibbs

ATTORNEY

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UNITED STATES PATENT OFFICE

HOBART M. KRANER, OF WILKINSBURG, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA

INSULATOR

Application filed August 29, 1927. Serial No. 216,137.

My invention relates to insulators and particularly to high-voltage insulators for operation under mechanical tension loads.

One object of my invention is to provide an insulator, of the above indicated character, that shall so employ a plurality of inorganic dielectric tension elements as to provide greater tensile strength than would be provided by a single element of the same total cross-sectional area and material.

Another object of my invention is to provide an insulator that shall embody a refractory, vitreous, ceramic or similar dielectric structure of ready manufacture and improved qualities.

Another object of my invention is to provide a tension insulator of inorganic, refractory or ceramic material that shall avoid the use of relatively great masses of the material and that shall be free of the uneven loading character of thick bodies of this character.

Another object of my invention is to provide a high-voltage tension insulator that shall embody a plurality of exposed insulating rods or elements of permanent moisture-proof character arranged to be free of lateral component forces tending to fracture the same.

Another object of my invention is to provide a tension insulator that shall subdivide the tension load and that shall also balance the load divisions relative to each other.

Another object of my invention is to provide an insulator that shall be simple and durable in construction, economical to manufacture and effective in its operation.

With such objects in view, as well as other advantages which may be incident to the utilization of the improvement, the invention consists in the parts and combinations thereof hereinafter set forth and claimed, with the understanding that the several necessary elements constituting the same may be varied in proportion, arrangement and texture without departing from the nature and scope of the invention.

In high-voltage insulator practice, and especially in outdoor transmission-line service, where the electrical and mechanical loads are comparatively heavy, the weather conditions, such as rain, snow, sleet and high winds, are difficult, and the positions of the insulators on towers or poles are relatively inaccessible, it is desirable to have the insulators as strong, weather resistant and permanent in character as possible.

To these ends, the dielectric parts may be constructed of inorganic material of vitreous, ceramic, refractory or frangible character, such as porcelain, glass, sillimanite, quartz and other materials, or of organic materials, such as wood, hard rubber, bakelite-micarta and certain other materials that are coated or covered with one of the inorganic substances above mentioned.

While in certain relatively-high-voltage service, the dielectric material is used under compression, there are applications where its use under tension is desired.

By reason of the relatively hard or unyielding character of the inorganic materials above mentioned, certain of them are not ordinarily so well adapted for use under mechanical tension but, by reason of their high dielectric property and weather resisting character, they are very much to be preferred for insulating high-voltage structures.

It is known that, in certain materials, the tensile strength in pounds per square inch of cross-sectional area increases with decreases of such area, this property being particularly pronounced in hard or brittle materials, such as porcelain or glass, while not so apparent in fibrous or softer materials. For instance, a quartz rod of one-quarter of an inch diameter has a tensile strength of more than twice that of a similar rod of one third of an inch in diameter.

It is one of my aims to provide a more effective use of the refractory, ceramic or vitreous materials in tension whereby stronger and more generally effective insulators are obtained.

Accordingly, in practicing my invention, I provide oppositely spaced terminal structures and a plurality of refractory or similar dielectric elements connected therebetween to so subdivide the tension load as to effect greater total tensile strength than may be obtained by the use of a single element or any

smaller number of elements of the same material and the same total cross-sectional area.

The invention also, contemplates the balancing of the subdivided loads relative to each other and other features, such as the prevention of lateral component forces which tend to fracture hard materials.

In order to make the invention more clearly understood, means are shown in the accompanying drawings for carrying the same into practical effect without limiting the improvements in their useful applications to the particular construction which, for the purpose of explanation, are made the subject of illustration.

Figure 1 is a top plan view of an insulator structure embodying my invention,

Fig. 2 is a longitudinal side view, partially in elevation and partially in section, of the structure shown in Fig. 1,

Fig. 3 is a view, similar to the top portion of Fig. 2, of a modified form of my invention,

Fig. 4 is an enlarged detail view, partially in elevation and partially in section, of a portion of the structure as shown in Figs. 2 and 3, and,

Figs. 5 and 6 are views, similar to Fig. 3, of further modified forms of my invention.

Referring to Figs. 1 and 2, the structure comprises, in general, a substantially squirrel-cage structure including oppositely spaced terminal structures 2 and 3 and a plurality of dielectric tension rods or elements 4 connected therebetween.

The terminal structure 2, preferably constructed of metal, is provided with a plurality of substantially frusto-conical openings 6 symmertically arranged on a circle having its center on the longitudinal central axis of the structure, a socket terminal portion 7 and radially disposed reinforcing webs 8 preferably constituting integral parts of the member 2.

The terminal structure 3 is constructed similarly to the member 2 with the exception that a ball terminal member 9 is substituted for the socket 7 for co-operation with a socket similar thereto. Other terminal attaching means such as a clevis and an eye, may be provided instead of the socket 7 and the ball 9.

The elements or rods 4, here shown as eight in number, are preferably constructed of porcelain of relatively small diameter having frusto-conical end portions 11 disposed in the openings 6. The elements 4, although not so restricted so far as the broadest aspect of my invention is concerned, are preferably exposed and constitute the only dielectric material operating or connected between the terminal structures, and each element is preferably constructed of only one homogeneous mass of its material.

The ends 11, as shown more clearly in Fig. 4, are preferably provided with grooved, serrated or roughened outer surfaces that may be constructed by glazing silica sand, porcelain particles or other ceramic aggregates of a granular nature thereto. Surfaces 12 on the member 2 in the opening 6 are also preferably roughened, as by attaching sand or other particles thereto by means of vitreous enamel or other suitably hard or durable material.

The ends 11 and the surfaces 12 are provided with layers 14 and 15, respectively, of asphaltum or other yieldable material and held together by bodies 16 of cement, metal alloy or other bonding material. The ends may also be clamped, screw-threadedly mounted or otherwise secured in position with cushioning means similar to the layers 14 and 15 disposed between the clamped surfaces, screw threads or other parts.

In the above described structure the sand or porcelain particles are preferably large enough and the interstices therebetween deep enough to permit effective interlocking thereof with the bodies 16, between the members 2 and 4, against tension forces, the layers 14 and 15 of yielding material assuming none of the load in shear. A yieldable pad or element 17 may be placed between the head of each element 4 and the bottom of its corresponding recess 2 to cushion relative longitudinal expansion or movement of the adjacent parts.

In the above described structure, since the elements 4 are of relatively small cross-sectional area, difficulties ordinarily occurring during the manufacture of relatively thick bodies are avoided and the total tensile strength of the structure is very materially increased over a similar structure having a single element 4 of the same material and of the same total cross-sectional area.

The elements are preferably arranged parallel to each other to subdivide the tension load and to avoid lateral component fracturing stresses which tend to disrupt the relatively hard material thereof. Further, since the yieldable films 14 and 15 are disposed between each end of each element 4 and the terminal structures 2 and 3, there are provided four yielding elements or means in series with each element 4 between the terminals 2 and 3. This construction compensates for minor discrepancies in the lengths and shapes of the rods 4 and tends to balance the subdivided tension loads relative to each other.

As shown in Fig. 3, the rods 4, instead of being permanently anchored in a unitary terminal structure, are severally provided with an individual metal cap or terminal element 19 in which they are similarly anchored or secured. The members 19 are provided with studs 20 for attachment to internally screw threaded bosses 21 constituting integral parts of a common terminal structure 22 hav-

ing a clevis terminal portion 23 thereon. This construction permits easier replacement of the individual rods 4 in case of damage thereto.

As shown in Fig. 5, in place of the frusto-conical ends 11 of the structure of Figs. 1 and 2, the elements 4 are provided with cylindrical ends 25 of substantially the same diameter as the body portions of the rods 1, are similarly provided with sanded or otherwise suitably roughened outer surfaces and are similarly secured to a common terminal structure 27 having attaching means 28 thereon. This construction permits the composite dielectric portion of the insulator, consisting of all of the elements 4, to be of smaller lateral dimension or diameter.

An electrostatic stress distributing shield or element 30, shown in connection with Fig. 5, to widely distribute the electrostatic field and keep it away from the rods 4 in a manner heretofore suggested may be also, provided in the other forms of my invention.

In Fig. 6, the structure is similar to that shown in Fig. 5 with the exception that, instead of the common metal terminal member 27, a common refractory or ceramic terminal structure 32 similar thereto is provided for the rods 4 and a single metal cap terminal member 33 is secured in position over the element 32. In this structure, in addition to the yieldable films between the elements 4 and the cement bodies 16 and between the cement bodies 16 and the element 32, similar yielding bodies may be placed between the element 32 and a cement body 35 and between the cement body 35 and the terminal member 33 thereby providing additional means for compensating uneven load and expansion forces.

By my invention, an exceedingly simple and effective insulator is obtained that is free of the defects occurring in the production of the large masses of porcelain and other materials, that provides increased surface holding contact between the parts, that has better loading characteristics and is, in general, an improvement over insulators heretofore suggested that employ dielectric material under tension.

It is further to be understood that, where the term "inorganic" is used in the claims, it is intended to include all of those relatively hard, ceramic, permanently water-proof or similar materials as distinguished from wood, hard rubber, bakelite micarta and other materials of similarly readily recognizable qualities not effectively suited to the purposes of my invention.

It is also, contemplated that rods or elements of organic or non-refractory nature coated with inorganic or refractory materials may be employed within the purview of certain features of my invention, such as that wherein the lateral component stresses, which might disrupt such coatings, are kept out of the elements.

I claim as my invention:

1. A tension insulator comprising oppositely spaced terminal structures, a plurality of insulating elements connected therebetween to subdivide the tension load and yieldable means between the insulating material of each element and the next adjacent part of one of the terminal structures to balance the load divisions relative to each other.

2. A tension insulator comprising oppositely spaced terminals including registering socket portions, a plurality of elongated insulating elements connected between the terminals with the opposite ends of each in registering sockets to subdivide the tension load and yieldable means between the insulating material of each element and the next adjacent part of one of its sockets to balance the load divisions relative to each other.

3. A tension insulator comprising oppositely-spaced terminals including registering portions providing substantially frusto-conical sockets, a plurality of elongated insulating elements connected between the terminals to subdivide the tension load and having frusto-conical ends in said sockets and yieldable means between the insulating material of each element and the next adjacent part of one of its sockets to balance the load divisions relative to each other.

4. A tension insulator comprising oppositely-spaced terminals, a plurality of elongated insulating elements connected therebetween in the form of a substantially squirrel-cage structure to subdivide the tension load and yieldable means between the insulating material of each element and the next adjacent part of one of the terminal structures to balance the load divisions relative to each other.

5. A tension insulator comprising oppositely-spaced terminals each including a disk-like member including a central outer-side mounting portion and inner-side attaching portions disposed about the longitudinal central axis thereof, a plurality of elongated insulating elements connected between the attaching portions of said terminals to subdivide the tension load and yieldable means between the insulating material of each element and the next adjacent part of one of the terminals to balance the load divisions relative to each other.

In testimony whereof, I have hereunto subscribed my name this 19th day of August, 1927.

HOBART M. KRANER.