(No Model.)

J. B. WILLIAMS.

INSULATED ELECTRIC CONDUCTOR.

No. 451,586. Patented May 5, 1891.

Fig. 1.

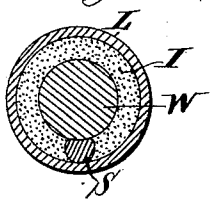


Fig. 2.

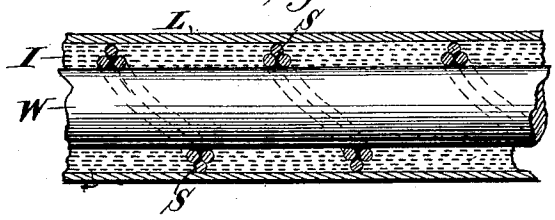


Fig. 3.

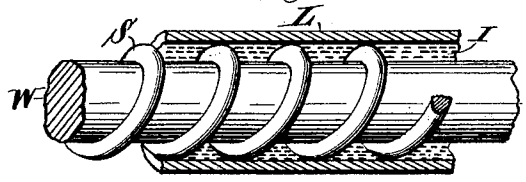


Fig. 4.

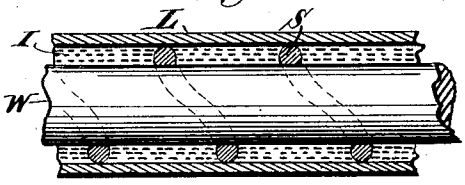


Fig. 5.

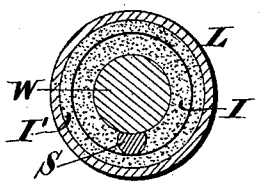


Fig. 6.

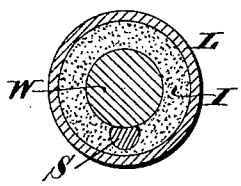
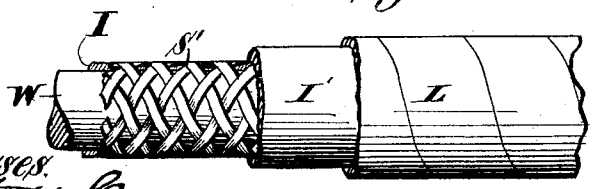


Fig. 7.



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UNITED STATES PATENT OFFICE.

JAMES B. WILLIAMS, OF OAKLAND, CALIFORNIA.

INSULATED ELECTRIC CONDUCTOR.

SPECIFICATION forming part of Letters Patent No. 451,586, dated May 5, 1891.

Application filed July 12, 1890. Serial No. 358,571. (No model.)

To all whom it may concern:

Be it known that I, JAMES B. WILLIAMS, a citizen of the United States, residing at Oakland, Alameda county, California, have invented certain new and useful Improvements in Insulated Electric Conductors; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters marked thereon, which form part of this specification.

My invention relates to insulated electric conductors; and its novelty consists in the means employed to keep the conductors substantially concentric with the dielectric employed to insulate it when the said dielectric is of such a nature that it is readily softened by the application of heat.

Insulated electric conductors of the class herein referred to consist of a central metallic conductor, which may be solid, stranded, or tubular, and which is substantially circular in cross-section, surrounded by a dielectric which is itself usually protected by a metallic sheath or a water-proof protecting-covering composed of other suitable materials. The dielectrics employed may be divided, primarily, into two classes—vulcanized and unvulcanized. The former contain india-rubber or gutta-percha, necessarily. The latter may or may not contain them. The former are not readily softened by heat, while the latter are. Dielectrics, whether vulcanized or not, may be divided, upon another principle, into those which are simple or formed of a homogeneous composition, and those which are compound or formed of layers of different materials—for instance, having an inner layer of one kind of material and an outer layer of another kind. Dielectrics which are simple and unvulcanized should be protected by a water-proof protecting-covering which is usually composed of lead; but if vulcanized they do not generally need such protection unless the electric conductors, which they insulate are placed underground or where they are exposed to the effects of moisture, gases, &c. Those which are compound, if the inner layer is unvulcanized and the outer layer vulcanized, likewise do not generally need this protection.

Under the usual conditions of use to which insulated electric conductors are subjected it will occur at times, either through outside influences or from the passage of currents of unusual strength through the conductor, that the dielectric will become heated and softened, and thus gradually offer less resistance to the weight of the conductor, which sinks down until it comes into sufficiently close contact with the exterior surface of the dielectric as to destroy its value. This is especially apt to occur when insulated electric conductors of great length are employed and which rest against hard substances, such as pipes in the ground and the like. This phenomenon has rendered impracticable the use, as dielectrics of many materials possessing good insulating properties, especially those which are readily softened by heat, except by the employment of large quantities of fibrous material mingled therewith and surrounding the conductor. My invention has for its object the overcoming of this difficulty by keeping the conductor in position and substantially concentric with its dielectric under conditions when the dielectric itself will become soft. When the dielectrics are composed of unvulcanized materials, are readily softened by heat, and require an outer water-proof protecting-layer, the conditions of their manufacture are different from those which obtain when vulcanized dielectrics are used, and I have made my invention in its relation to the latter class of dielectrics the subject of a separate application for Letters Patent of the United States, Serial No. 371,330.

I accomplish my purpose by placing around the conductor and embedded in the dielectric a centering device composed of fibrous material saturated with an insulating material having a higher melting-point than that of the dielectric employed in each case, and so arranged that it is in contact with the conductor at as few points as possible, still retaining its function of support. The simplest form of this centering device is a yarn or cord of fibrous material, like cotton, previously saturated with an insulating material not readily softened by heat, such as shellac dis-

solved in alcohol, which is wound around the conductor spirally and suitably secured thereto, when necessary, before the application of the dielectric. Then when the dielectric and its water-proof protecting-covering have been applied and a current is passed through the conductor of sufficient strength to heat the conductor and soften the dielectric, or if it is heated externally with a similar result, the insulating material of the centering device is not softened, and the centering device therefore keeps the conductor in place and prevents it from sinking through the dielectric and coming in contact with the exterior water-proof covering.

In the drawings, in which the same letters refer to similar parts in all the figures, Figure 1 is a central transverse section of an insulated electric conductor provided with my centering device. Fig. 2 is a central longitudinal section of the same, showing the device formed of three cords. Fig. 4 is a similar view showing the device made integral. Fig. 3 is a perspective view of the same. Fig. 5 is a central transverse section showing an intermediate protecting-layer I′. Fig. 6 is a similar view showing the centering device with its outer surfaces surrounded by an external layer of the dielectric, and Fig. 7 is a perspective view of the centering device when an "open" braid is used in place of the spirally-wound strip shown in the other figures.

In the drawings, W is the conductor surrounded by the dielectric I, and in some cases by an additional layer I′, composed of different materials than those of which the dielectric is composed, the whole being surrounded by a water-proof protecting-layer L, which is usually formed of lead. S is the centering device, consisting of a cord or cords wound spirally around the conductor W in the manner shown, and S′ is the centering device, composed of an open braid surrounding the conductor W.

The manner of placing my centering device in position will depend upon its nature and form and upon the kind of dielectric employed. In the majority of cases the centering device will first be placed in position and the dielectric applied afterward; but in some cases the reverse order must be employed and the centering device be embedded in the dielectric by means of suitable apparatus after the dielectric has been applied to the conductor. Each case has its own conditions, and a workman skilled in the art will readily select the proper method in any particular instance.

The manner of placing my centering device in position in its simplest form—that of a spiral—is as follows: The fibrous material of which the cord is composed is first thoroughly and completely saturated with its insulating material, so that its interstices are filled with the same, and while this is in a plastic state the cord is wound around the conductor in a spiral form. The pitch of the spiral will depend in each instance upon the thickness and kind of material used as a dielectric, the size of the conductor, and the conditions under which the insulated conductor is to be used. For instance, if the insulated conductor is to be kept straight, or nearly so, and to be used in comparatively cool situations the pitch of the spiral should be steeper than when it is to be frequently bent or used in situations where it is liable to be exposed to the effects of heat. An intelligent and skilled workman can readily determine the proper distance apart of the turns of the spiral in each instance, and no fixed rules, therefore, can be given. If the material with which the spiral is saturated does not of itself cause the cord to adhere closely to the conductor, when necessary, any suitable cement may be used to effect this purpose. The cord should be wound smoothly and evenly, and its outer surfaces should be substantially equidistant from the axis of the conductor.

If the thickness of the dielectric is such, or if for any other reason a single cord is not large enough, three cords may be used, as shown in Fig. 2, two cords being wound side by side, and when they are affixed in place a third cord being wound on top of them, as shown, forming a pyramid with its base against the conductor and its apex away therefrom. This form is desirable because the cords cannot twist over, and the surfaces of contact, if any, with the outer water-proof protecting-covering are as small and as few as possible. Another form may be produced by passing the fibrous material saturated with the insulating-varnish, after it is thoroughly dried, through hot rolls, which form it into shape.

It is evident that wide modifications may be made in the details of the construction of my device, and that other forms of the fibrous material saturated with the more refractory insulating material may be employed in different shapes than that of the specific device shown, which, in the present state of the art, I deem to be the most practicable for my purpose. I may, for instance, make the centering device in the form of an open braid, as illustrated in Fig. 7, rather than in the form of a spiral, and in some cases this form might have an advantage; or I may make it of paper which has been properly treated with a suitable insulating material and portions of which are embossed or thickened, whereby permanently-raised portions are formed on its outer surface and symmetrically disposed about the same; and other equivalent devices will readily occur; but, however the device is formed, it must be suitably secured to the conductor, when necessary, its outer surfaces must be substantially equidistant from the axis of the conductor, and it must be of such a nature that when dry the insulating material with which it is saturated will require a higher temperature to soften it than that required to soften the material of the dielectric itself.

I have not, for convenience of description, considered the centering device as forming a part of the dielectric, although it assists in the insulation of the conductor if its insulation resistance is equal to or greater than that of the dielectric, and in order that this additional function may be accomplished more thoroughly the outer extremities of the centering device should be entirely covered by the dielectric whenever possible, as seen in Fig. 6.

After the centering device is placed in position upon the conductor the dielectric may be applied thereto in a manner to be determined by the kind and quality of the material of which the dielectric is composed, as above stated.

One marked advantage of my invention I will refer to at this place. It is usual, when unvulcanized compounds are used as dielectrics and are protected by a lead sheath, to apply them to the conductors by first wrapping the latter with one or more layers of ordinary cotton yarn and then saturating the yarn with the dielectric liquefied by heat. In most cases the insulation resistance of the dielectric is much higher than that of the fibrous material saturated with it; but, on account of the comparatively large quantity of fibrous material usually present in this class of insulating-coverings, the efficiency of such coverings is not as high as it would be if the insulating material were in much greater proportion than the fibrous material. It is evident, therefore, that any device which will allow the proportion of insulating material to be greatly increased and the proportion of fibrous material at the same time to be much diminished in any particular covering must necessarily cause the efficiency of such covering to be raised. Furthermore, if the centering device herein specified were formed of fibrous material unsaturated with a high melting insulating-varnish—*e. g.*, a spiral formed of ordinary cotton yarn or of a tightly-twisted cord—the unsaturated fibrous material would absorb the material of the dielectric during the process of manufacture, and any temperature which would soften the material of the dielectric would necessarily soften that absorbed by the fibrous material, and consequently the conductor would become eccentric with the outer water-proof protecting-covering by reason of its own weight and the feeble support of such a centering device under the conditions named, except where a tightly-twisted rope is used, when it will keep the conductor concentric with the outer covering, but cause leakage, unless the insulation resistance of such a spiral is greater than that of the dielectric, which ought not so to be in practice; but if the fibrous material be first saturated with a high-melting insulating-varnish it will absorb but a very small quantity of the dielectric during the process of manufacture, and the centering device will remain firm and hard and keep the conductor substantially concentric with its outer covering when the dielectric is quite soft and in some cases entirely melted. After the centering device has been placed in position and embedded in the dielectric it may under some circumstances be desirable or even necessary to surround it with an additional layer of insulating material I′ to act as a support, and which is composed of different ingredients than those of the dielectric immediately surrounding the conductor—for instance, one or more layers of paper saturated with paraffine—and which secondary covering would always remain interposed between the centering device and the external water-proof covering, as illustrated in Fig. 5.

Having described my invention, what I claim as new is—

1. In an insulated electric conductor of the class described, the combination, with the conductor and its surrounding dielectric, of a centering device composed of fibrous material saturated with an insulating material not so readily softened by heat as the material of the dielectric, as shown and described.

2. In an insulated electric conductor of the class described, the combination, with the conductor and its surrounding dielectric, of a centering device embedded in the dielectric and composed of a structure of fibrous material saturated with an insulating material not so readily softened by heat as the material composing the dielectric and the outer surfaces of which are substantially equidistant from the axis of the conductor, as set forth.

3. The combination, with an insulated electric conductor of the class described, of a centering device consisting of a cord of fibrous material saturated with an insulating material not so readily softened by heat as the materials composing the dielectric of such conductor and wound spirally around its surface, as described.

4. In an insulated electric conductor of the class described, the combination, with a central metallic conductor and a surrounding unvulcanized dielectric and a water-proof protecting-covering, of the centering device shown and described, consisting of fibrous material also surrounding the conductor and embedded in the dielectric and saturated with an insulating material not so readily softened by heat as the materials composing the dielectric.

5. The combination, with an insulated electric conductor of the class described, provided with a centering device composed of fibrous material saturated with an insulating material not so readily softened by heat as the material composing the dielectric I, of an intermediate protecting-layer I′, composed of fibrous material saturated with an insulating material and which is interposed between the centering device and the external water-proof covering when the latter is used.

6. In an insulated electric conductor of the class described, the combination, with the di-

electric, of a centering device composed of three cords wound spirally around the conductor, two of said cords being wound side by side and the third on top of the same, the whole being saturated with an insulating material not so readily softened by heat as the material composing the dielectric, as shown and described.

7. In an insulated electric conductor of the class described, the combination, with the dielectric, of a centering device composed of a cord which is pyramidal in cross-section and having its broadest surface next to the conductor and its apex away therefrom, and which is saturated with an insulating material not so readily softened by heat as the materials composing the dielectric and wound spirally around the conductor, as and for the purposes set forth.

In testimony whereof I affix my signature in presence of two witnesses.

JAMES B. WILLIAMS.

Witnesses:
WM. RAIMOND BAIRD,
WM. M. ERNST.