G. FACCIOLI.

MEANS FOR PREVENTING CORONA LOSSES.

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Fig. 1.

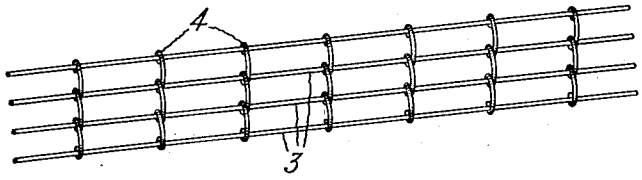
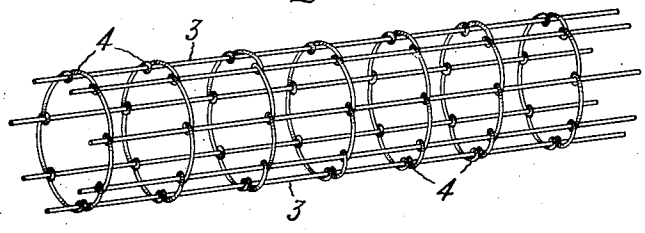


Fig. 2.



Witnesses:

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UNITED STATES PATENT OFFICE.

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MEANS FOR PREVENTING CORONA LOSSES.

1,190,135. Specification of Letters Patent. Patented July 4, 1916.

Original application filed April 27, 1911, Serial No. 623,630. Divided and this application filed May 11, 1912. Serial No. 696,552.

To all whom it may concern:

Be it known that I, GIUSEPPE FACCIOLI, a subject of the King of Italy, residing at Pittsfield, county of Berkshire, State of Massachusetts, have invented certain new and useful Improvements in Means for Preventing Corona Losses, of which the following is a specification.

This application is a division of my application filed April 27th, 1911, Serial No. 623,630.

My invention relates to the prevention and to the reduction of the corona losses which appear when high potential is applied to electrical conductors and electrical apparatus of the type heretofore commonly used. The corona or luminous discharge from the conductor or apparatus into the air represents considerable loss of energy and also facilitates short circuits and discharges from the conductor to ground.

Ordinary insulating materials break down and become conducting if subjected to high enough voltage and if the voltage between a wire of the transmission line, for example, and either the other wire or the ground is gradually increased, it ultimately passes beyond the point where the air is insulating, whereupon corona is produced because the air surrounding the wire breaks down and becomes a conductor. The conducting air envelop surrounding the wire is in turn surrounded by non-conducting air, but as the voltage gradually increases still further, the area of broken down or conducting air surrounding the wire spreads farther and farther from the wire, thereby enlarging the luminous zone of corona until this area spreads to such an extent that it merges with the corresponding area surrounding the other wire, or else touches a ground, and current can flow from the wire through the conducting air to the other wire or to ground.

For any given size of wire there is a certain critical voltage at which the air around the wire breaks down and luminosity begins. This is the critical voltage at which corona appears. At higher voltages the corona extends to greater distances from the wire and a greater volume of air becomes luminous. Up to the critical voltage there is practically no loss from corona, but beyond the critical voltage the corona losses increase very rapidly. A simple method of determining the critical voltage, or the voltage where corona forms, is to raise the voltage gradually in perfect darkness until the wire begins to be luminous. It is found that the point between where the wire is perfectly dark and where it is luminescent can be measured within the fraction of one per cent.

Within the limits of the sizes of wire ordinarily used in the construction of electrical apparatus and of transmission lines, the critical voltage of a small wire is lower than that of a large wire. In some kinds of apparatus, and particularly on a long transmission line, the corona losses on very high voltage conductors will be prohibitive unless the conductors are made much larger than would be necessary if their size were determined merely by the mechanical strength required or by the cross section of metal necessary to carry the current most economically.

The phenomenon of corona may also be considered with reference to the electrostatic field which surrounds a wire carrying current. When current is flowing the wire is surrounded by a magnetic field which may be represented by lines of force in the form of circles around the wire, while at the same time the voltage produces in the surrounding air a condition of electrostatic stress which may be represented by lines of electrostatic force issuing from the wire and perpendicular to its surface. The density of the lines of electrostatic force will be proportional to the voltage gradient or the voltage per centimeter length of the electrostatic circuit, and if the number of lines of electrostatic force per inch in air rises beyond a certain critical value the air ceases to be an insulator and becomes conductive, whereupon corona appears. At the critical voltage the density of the lines of electrostatic stress reaches the critical value which is necessary to cause the air to break down.

The object of my invention is to prevent all or practically all of the corona losses which occur on the conductors and in the electrical apparatus ordinarily used when high potential is applied; to provide a conductor of which the virtual diameter is greater than its actual diameter and to which much higher potentials may be ap-

plied without producing corona than can be applied to conductors of the same current carrying capacity and constructed in the ordinary manner; to provide a construction by means of which conductors adjacent to ground, such as conductors passing through entrance bushings and walls, or passing near the metal towers of a transmission line, may be subjected to much higher potentials without danger of a breakdown to ground than is the case with conductors constructed in accordance with the practice heretofore followed; to provide means to eliminate the corona losses which occur at the point where a conductor passes from one insulating medium into another; and in general to provide conductors and apparatus of which the critical voltage is much higher than the critical voltage of the conductors and apparatus generally used heretofore.

My invention will best be understood in connection with the accompanying drawings, in which merely for purposes of illustration I have shown some of the various forms in which my invention may be embodied and in which—

Figure 1 is a conductor made in the form of a network with the longitudinal current conducting elements tied together by metallic or conducting cross pieces; and Fig. 2 is a form of the conductor shown in Fig. 1 but modified to prevent the appearance of corona at the edges of the conductor.

The particular embodiment of my invention which I have illustrated in Fig. 1 shows a form of conductor having a critical voltage much higher than the critical voltage of a wire such as ordinarily used. In this particular form of my invention a plurality of longitudinal wires or conducting elements 3 are connected at intervals to transverse conductors 4 so that the entire conductor is in the form of a coarse network. I have found that if the wire or conducting element, such as the conducting element 3, is joined to a transverse wire or conductor, such as the cross piece 4, both the conducting element 3 and the transverse conductor 4 are shielded or protected for a considerable distance from the junction, so that when the voltage applied to the conducting element 3 is gradually raised until the appearance of corona, those portions of the conducting element or wire and the transverse conductor which are nearest the junction are the last portions to become luminous. In the form of conductor shown in Fig. 1 the transverse wires or conductors 4 are so spaced that the protected zones around each junction merge or overlap to a limited extent so that the critical voltage of the conductor as a whole is much higher than it would be if the transverse conductors or wires 4 were not present and very considerably higher than the critical voltage of a solid cylindrical conductor having the same cross section as the longitudinal conducting element 3.

Under some conditions in which the potential on the form of conductor shown in Fig. 1 is maintained at a point very close to the critical voltage of the conductor, it may be desirable to make the conductor in such a form that there will be no sharp bends or points at which the electrostatic stress may concentrate sufficiently to break down the air. In such cases the conductor will preferably be made in the form of a cylinder, as shown in Fig. 2, in which the coarse network is shaped into substantially a cylindrical or tubular form to render the distribution of the electrostatic stress due to potential on the conductor as uniform as possible throughout the air surrounding the conductor.

The various forms of my invention above shown are merely for purposes of illustration and the principles disclosed therein may be used in many other ways and for many other kinds of conductors than those illustrated. I therefore do not wish to be restricted to the precise arrangements disclosed, but aim in the appended claims to cover all modifications within the spirit and scope of my invention.

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

1. A conductor for high tension currents comprising a plurality of insulated current carrying elements connected in multiple and a plurality of transverse conductive mechanical supports spaced away from one another and along said elements at intervals in firm engagement therewith to electrically connect said elements and mechanically support and space them.

2. An insulated high potential conductor having smooth edged longitudinal conducting elements and transverse mechanical supports of metal in firm engagement with said longitudinal portions and forming an angle therewith, said supports being spaced away from one another along said conductor at intervals which cause said supports to mechanically hold said longitudinal portions in proper relation and renders the critical voltage of the conductor higher than that of a cylindrical conductor having a cross section equal to the combined cross sections of said longitudinal portions.

3. A high voltage conductor comprising a plurality of insulated longitudinal conducting elements arranged side by side and connected in multiple and a plurality of transverse conductive mechanical supports in electrical engagement with said longitudinal elements and spaced away from one another and along said longitudinal elements at intervals to mechanically hold said elements in definite relation and to render the critical voltage of said conductor higher than the

critical voltage of the wire having a cross section equivalent to the combined cross sections of said longitudinal elements.

4. A conductor for high tension currents comprising a plurality of insulated longitudinal current carrying elements mounted side by side and connected in multiple, and a plurality of transverse conductive mechanical supports, each looped around the said longitudinal elements to mechanically maintain said elements properly spaced and to make metallic connection therewith.

5. A high voltage conductor comprising a plurality of insulated longitudinal current carrying elements connected in multiple and mounted about a common axis to form a longitudinal conductor, and transverse conductive mechanical supports spaced away from one another and encircling said longitudinal elements and in metallic contact therewith, said members being spaced along said elements to render the critical voltage of said conductor higher than the critical voltage of the wire having a cross section equal to the size of the cross sections of said longitudinal elements.

6. A conductor comprising a plurality of insulated current carrying elements connected in multiple and arranged about a common axis to form a tubular conductor, and conductive mechanical supports in the form of loops looped around each of said longitudinal elements to make metallic contact therewith, said rigid loops being spaced along said elements to hold said elements in position and to affect the critical voltage of the current carrying elements.

In witness whereof, I have hereunto set my hand this 9th day of May, 1912.

GIUSEPPE FACCIOLI.

Witnesses:
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M. TAYLOR DANNRENTHER.