

# UNITED STATES PATENT OFFICE

2,464,455

## ELECTRICAL INSULATION

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1 Claim. (Cl. 260—31.8)

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The present invention relates to electrical insulation and more particularly to electrical conductors insulated therewith. The invention is directed to improved electrical insulation compositions comprising plasticized purified products of polymerization processes applied to vinyl halides and mixtures of vinyl halides with minor proportions of other polymerizable materials in which the polymerizable group is  $(CH_2=CH)$  and to improved electrical cables embodying such compositions as insulations.

The principal object of the invention is to produce an electrical insulation composition containing plasticized non-flame-supporting polymers and copolymers of vinylic compounds which exhibit low dielectric losses, low power factor, and high insulation resistance particularly and desirably so at elevated temperatures.

The foregoing and other features of my invention will now be described in connection with the accompanying drawing forming part of this specification in which I have illustrated my electrical insulation as it may be applied to a high tension electrical conductor, after which I shall point out in the claim those features which I believe to be new and of my own invention.

In the drawing the single figure is a cross section of a conductor 11 having my insulation 12 applied thereon.

Polymerized vinyl halides, for example, polymerized vinyl chloride, may be plasticized with various substances, for instance tricresyl phosphate, to produce a composition which has some physical properties similar to rubber but is not as susceptible to chemical attack as is rubber by oxygen or mineral oils.

Such compositions are electrically poor in character, since they exhibit high power factor, particularly at elevated temperatures. This is so pronounced that I have found these compositions to be unsuitable for insulation at voltage above 600 volts alternating current. Higher voltage cable insulated with such compositions show high dielectric losses which increase with increase in temperature and voltage.

Investigation of the compositions in question namely those disclosed in Semon 1,929,453; those disclosed in M. M. Safford Patent 2,118,017; those disclosed in Safford 2,231,595; those disclosed in Safford 2,269,990 has led to the important discov-

ery that substantial improvements in their usefulness for not only high voltage insulation but also for direct current insulation are attained by incorporating specific plasticizers with the polymerized vinyl resin and stabilizing ingredients other than those heretofore disclosed. By following a specific order of procedure in compounding the ingredients an insulation is obtained which exhibits a low power factor not only over a range of temperatures ( $-40$  to  $+80^\circ$  C.)—the range of usefulness—also further which possesses a high direct current insulation resistance comparable to that of high grade natural rubber insulations for the temperature range.

In accordance with the disclosure of the aforementioned Semon 1,929,453 patent, polymerized vinyl resin or resins are dissolved in a substantially non-volatile composition which will dissolve them at an elevated temperature, and after solution the mixture is cooled to room temperature forming a rubber-like gel.

As disclosed in Safford 2,118,017, one procedure for insulating a conductor with the compositions in question is to thoroughly compound the polymerized vinyl resin or resins, plasticizers, fillers, stabilizers etc. between differential rolls which may be heated. The material is then sheeted after proper compounding and may be applied to a bare or previously insulated conductor by means of an extrusion machine or a strip covering machine.

The compositions of Semon, 1,929,453; Safford 2,118,017; Fuoss 2,171,334, Safford 2,231,595; and Safford 2,269,990 that are plasticized and in some cases stabilized polymerized vinyl resins form good coverings or sheaths for conductors since they possess good mechanical properties, such as toughness and resistance to abrasion. However, because they exhibit high dielectric losses which change considerably with change in temperature, being low at some temperatures and high at others, said changes being related to temperature changes in a way which is characteristic only for a specific composition. They are not being used for high voltage alternating current insulation nor can they be used successfully for direct current insulation over the range of  $-40$  to  $+80^\circ$  C. An idea of the magnitude of the alternating current dielectric losses and direct current resistance of the best compositions disclosed in