Aug. 16, 1938. W. WHITEHEAD 2,126,850

CONDUCTOR AND FILAMENTS THEREFOR CONTAINING ORGANIC DERIVATIVE OF CELLULOSE

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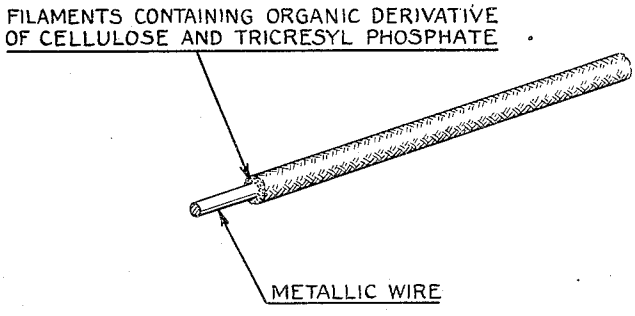

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CONDUCTOR AND FILAMENTS THEREFOR CONTAINING ORGANIC DERIVATIVE OF CELLULOSE

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4 Claims. (Cl. 173—264)

This invention relates to the manufacture of a flame-proofed artificial material, such as filaments, yarns and fabric, the base material of which is an organic derivative of cellulose and more particularly to filaments and yarns especially adapted for use as an insulating covering for electric conductor wires and the like.

An object of the invention is the economic and expeditious production of a yarn or filament that is an insulator of electric current, that is flame-proofed and that readily lends itself for braiding, wrapping and other operations to form a uniform and tight covering for electric wires. Other objects of the invention will appear from the following detailed description.

For electrical insulation, as a covering for wires, etc., there is required a yarn or group of filaments that has a low electro-conductivity, one that is not tacky, one that is not injurious to the hands of the operator and also one preferably composed of substantially continuous filaments so that closer, flatter and more uniform wrappings or braid may be formed. A further property desirable in a wire covering is low inflammability so that the covering will not support combustion but will cease burning upon removal of applied heat.

I have found that a specially prepared filament or yarn of an organic derivative of cellulose, which has the inherent property of being a non-conductor, may be made to have all the other desired properties along with such properties as good strength and pliability for passing through guides, etc. of a device for braiding or wrapping wires, etc. I have found that a yarn or filament containing a large percent of a phosphoric acid ester is flame-proofed and otherwise suitable for electrical purposes.

Yarns and filaments, made according to this invention, contain incorporated in the filaments the agent which reduces their inflammability. Moreover, they are not tacky or gummy and may be wound in packages and rewound without causing difficulty due to sticking together or to machine parts. The yarns are not stiff and gummy as a coated yarn, but are soft and pliable and capable of being flexed into sharp angles, as in braiding, without breaking or causing uneven braiding. In their passage through machines they do not deposit sticky material on the guides, needles, etc.

According to my invention I form filaments, a plurality of which may be grouped together either in untwisted or parallel relationship or in twisted form, of organic derivatives of cellulose, which filaments contain a large percentage of an aryl, alkyl or alkyl-aryl ester of phosphoric acid. Filaments and yarns thus formed will not support combustion unless a flame is applied thereto. As soon as the material is removed from the flame, it ceases burning.

This invention is particularly applicable to the production, for electrical insulation purposes, of a yarn containing a number of substantially continuous filaments held together by a twist preferably less than 5 turns per inch, which amount of twist is often desired in forming flat insulating coverings for wires. This invention is also applicable to the productions of threads, assemblies or bundles of a number of continuous filaments which may be in parallel relationship or which may be twisted together with any degree of twist, as well as artificial bristles, straws, short lengths of staple fibers, or yarn spun from such staple fibers.

The yarns, filaments, etc. are preferably formed of cellulose acetate. However, other organic derivatives of cellulose, such as the other organic esters of cellulose and cellulose ethers, may be employed. Examples of the other organic esters of cellulose are cellulose formate, cellulose propionate and cellulose butyrate, while examples of cellulose ethers are methyl cellulose, ethyl cellulose and benzyl cellulose.

The filaments, etc., may be formed in the usual manner of spinning filaments by either the wet or, more preferably, by the dry method of spinning. Thus, a spinning solution containing one part cellulose acetate and 3 parts solvent, such as acetone, may be formed. To this there may be added the flame proofing agent and the solution filtered and extruded through suitable orifices into an evaporative atmosphere for the solvent.

As the flame-proofing agent there may be employed a large amount, preferably from 20 to 60 per cent on the weight of the organic derivative of cellulose, of an alkyl, aryl or mixed alkyl-aryl ester of phosphoric acid or a mixture of such esters. The aryl ester of phosphoric acid may be a mono-, di- or tri-hydroxyl derivative of the benzene series. For example, the esters may be mono-, di- or tri-cresyl phosphate, mono-, di- or tri-phenyl phosphate, mono-, di- or tri-xylenyl phosphate and the phosphates of the hydroxy derivatives of the higher homologues of the benzene series. The ester may be formed of one of these hydroxy-benzene groups or each ester may contain a mixture of two or three different hydroxy-benzene groups such as would be produced by the reaction of phosphoric acid and such

hydroxy-benzenes as are found in coal tar acids, commercially sold under the name of cresylic acid. The esters may be homogeneous hydroxy-benzene phosphoric acid esters or they may be mixed hydroxy-benzene esters of phosphoric acid.

In connection with or as a substitute for the hydroxy-benzene phosphoric acid esters, there may be employed the alkyl esters of phosphoric acid, for example, trimethyl phosphate, triethyl phosphate and tributyl phosphate. Further, there may be employed the alkyl-aryl esters of phosphoric acid. These esters may contain the groups derived from an alkyl derivative of a hydroxy benzene and may be homogeneous or mixed esters. For example the esters may contain one to three groupings such as ethylphenyl, propylphenyl, methoxyethylphenyl, phenoxypropylphenyl or a monovalent radical of a monoalkyl or aryl ether of a polyolefine. Or the ester may contain one aryl group, one alkyl group and one alkyl-aryl group or other combinations.

For the purpose of illustrating the invention and not as a limitation, the following examples are given:

Example I

100 parts by weight of cellulose acetate is dissolved in 300 parts of a volatile solvent such as acetone. To this solution is added 20 parts of tricresyl phosphate or other ester of phosphoric acid. After filtering, the mixture is extruded through suitable orifices into an evaporative atmosphere to form filaments of 1.5 to 3. denier. The filaments are grouped in sufficient number to form the yarn of desired size and given from 1 to 5 turns per inch and wound into packages.

Example II

100 parts by weight of cellulose acetate is dissolved in 300 parts of a volatile solvent such as acetone. To this solution is added 50 parts of tricresyl phosphate and the same processed as in Example I.

Example III

The yarn from either Example I or II is rewound onto suitable braider tubes for use with any of the commercial machines and is wrapped spirally or braided upon a copper wire of any suitable dimension, say 1/40 inch diameter. During the forming operation of Example I or II or in rewinding, a lubricant of about 1 to 4 per cent oil, such as olive oil, may be applied to the yarn.

The wire is evenly, uniformly and tightly covered by the yarn, and the assembly is non-tacky and contains no coating material injurious to the skin of those that may handle it. Held vertically in a flame the covering slowly burns but combustion ceases as soon as the applied flame is removed. The yarn formed in Example I has a conductivity of 30,000 I. R. (Insulation Resistance) kilomegohms per end while the yarn formed in Example II has a conductivity of 12,000 I. R. kilomegohms per end.

Large amounts of the organic esters of phosphoric acid may be incorporated in the yarn via the spinning dope without destroying the stability of the spinning dope and without rendering the yarn weak or difficult to handle in textile manipulation. The cross section of the filaments remains the same as those formed from normal spinning solutions, giving the beautiful appearance to the product of the organic derivatives of cellulose.

The yarns or filaments, etc., may be colored, tinted or dyed prior to or after application to the wire or other object to be insulated. The wire may be coated with other insulators either before or after the covering of organic derivative of cellulose is applied. For example, a coating of rubber, enamel, etc., may be applied directly to the wire or to the wire covered with a wrapping of yarns containing organic derivatives of cellulose.

The yarns and filaments may be used, other than for electric wire covering, any place that a flame-proofed or slow burning material of a textile nature is required. The yarns and filaments may be woven, knitted, or netted, alone or in combination with asbestos yarns, fine wire and the like into draperies or curtains for theatrical purposes or other places where it is desired to greatly reduce fire hazards. These improved yarns are pliable and lend themselves to textile operations and are strong, lending strength to draperies, etc. containing them.

In order to further illustrate my invention, reference is had to the accompanying drawing which represents an electric conductor covered with the filaments of my invention.

It is to be understood that the foregoing detailed description is merely given by way of illustration and many alterations may be made therein without departing from the spirit of my invention.

Having described my invention, what I desire to secure by Letters Patent is:

1. Filaments of good electrical insulating properties containing an organic derivative of cellulose and tricresyl phosphate, in an amount equal to 50% of the weight of the cellulose derivative, as the sole plasticizer for the cellulose derivative.

2. Filaments of good electrical insulating properties containing cellulose acetate and tricresyl phosphate, in an amount equal to 50% of the weight of the cellulose acetate, as the sole plasticizer for the cellulose acetate.

3. An electric conductor comprising a metallic wire having a covering of filaments of good electrical insulating properties containing an organic derivative of cellulose and tricresyl phosphate, in an amount equal to 50% of the weight of the cellulose derivative, as the sole plasticizer.

4. An electric conductor comprising a metallic wire having a covering of filaments of good electrical insulating properties containing cellulose acetate and tricresyl phosphate, in an amount equal to 50% of the weight of the cellulose acetate, as the sole plasticizer.

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