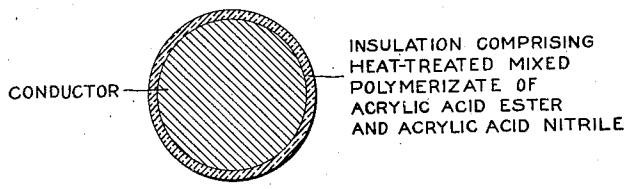
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ELECTRICAL INSULATION

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ELECTRICAL INSULATION

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5 Claims. (Cl. 174—125)

The present invention relates to electrical insulation. The invention is more particularly concerned with organically insulated electrical conductors wherein the insulating layer comprises a synthetic composition consisting of a combination of particular polymerized acrylic acid derivatives.

It has been suggested heretofore to use polymerized acrylic acid and its homologues and polymerized derivatives of acrylic acid and its homologues, for example polymerized methyl and ethyl esters of acrylic acid, alone or mixed with various modifying agents, as insulation for electrical conductors. Varnish made from such material, by dissolving the same in conventional solvents therefor, has the disadvantage that when applied to a bare copper wire or other conductor by means of commonly used wire-enameling apparatus the applied coating, dried in accordance with usual practice, retains traces of solvent. The solvent, even when present in minute quantities, detrimentally affects the properties (for example, hardness) of the varnish film. Such films also have an objectionable tendency to adhere to one another, or to other surfaces with which they may come in contact, particularly at elevated temperatures.

The present invention provides improved insulated electrical conductors comprising a metallic conductor and insulation therefor consisting of a mixture of polymerized acrylic acid ester and polymerized acrylic acid nitrile heated to the point of dissociation of the mixed polymerizate. In other words, the insulation comprises the residue of heating to incipient decomposition a mixture of polymerized ester of acrylic acid and polymerized acrylic acid nitrile (acrylonitrile).

The accompanying drawing illustrates in cross-section a conductor insulated with the heat-treated mixed polymerizate described above.

It was found that by selecting a suitable solvent for synthetic compositions of the kind with which this invention is concerned, the last traces of solvent can be removed from varnishes so produced by drying the varnish film at an elevated temperature and by continuing the action of heat up to the point at which dissociation of the basic varnish material begins. This dissociation readily can be recognized externally by the discoloration of the basic varnish substances, which in themselves are colorless. The discoloration upon dissociation is first yellow, then reddish brown and finally black. The heat required to attain the desired results depends not only upon the temperature to which the varnished articles are subjected but also upon the time of heating at that particular temperature. This is due to the fact that within certain limits it is possible to obtain practically the same ultimate results by lowering the temperature and increasing the time of heating as by employing a higher temperature and a shorter period of heating.

In using varnish of the kind to which this invention relates as coatings for electrical conductors, such as wires, sheets or the like, it is particularly important that the last traces of solvent be removed, since any remaining solvent has a detrimental effect upon the insulating properties of the varnish. On the other hand when heating the applied coating of synthetic material, unless care is exercised to restrict the heating only to the point at which dissociation of the basic material begins (that is, to or approaching the point of incipient decomposition), there is the possibility that objectionable dissociation products which will lower the insulating properties of the composition may be formed. For instance, in the case of a varnish consisting of polymerized acrylic acid ester or esters dissolved in a solvent, it is possible that heating the varnish above the point of dissociation (incipient decomposition) of the basic material may result in the formation of free monomeric acrylic acid and other objectionable substances. With conventional oil varnishes dried in substantially the same way this possibility does not exist, because of the entirely different structure of the oils and resins utilized for that purpose.

To obviate detrimental effects which may result from the formation of dissociation products which normally would reduce the insulating properties of polymerized acrylic acid esters when heated to the point of their dissociation, bare metallic conductors are insulated in accordance with the present invention with a superposed layer of dried varnish consisting of a polymerized ester of acrylic acid, for example polymerized acrylic acid methyl ester, ethyl ester, butyl ester, etc., or mixtures of such esters, and, in addition thereto, polymerized nitrile of acrylic acid. It has been found that, when polymerized acrylic acid nitrile is present in a varnish which also contains a polymerized ester of acrylic acid, the composition may be heated to the point of dissociation of the basic materials without lowering the insulating properties of the dried coating as a result of the presence therein of objectionable dissociation products. The hardened coating, which is an incipient decomposition product of the mixture of starting components, is practically free from such dissociation products.

In accordance with the present invention it is possible to use both mixtures of polymerized acrylic acid esters and polymerized acrylic acid nitrile and also mixed polymerizates resulting from the conjoint polymerization of monomeric acrylic acid esters and acrylic acid nitrile. Varnishes may be made from the monomeric or polymeric substances. The resulting composition has the characteristic property that it may be

freed of all detrimental traces of solvent without forming undesirable dissociation products even when the composition is heated to such an extent that the varnish film is almost black. By heating the applied liquid coating composition to the point of dissociation of the component materials, an advantageous increase in the density or compactness of the varnish film occurs, in addition to removal of final traces of solvent. Such increase in the density of the material possibly results from a fusion of the components at the temperature of drying. Varnish films proto conducting cores of copper or other metal. duced in the manner described adhere tenaciously The resistance of the dried films to solvents, oils, waxes, resins, vaseline, etc., is outstanding.

By a suitable selection of the ratio of acrylic acid ester to acrylic acid nitrile, and by controlling the degree of polymerization, it is possible to adapt the varnish films to the requirements of a particular service use, at least insofar as their mechanical and chemical properties are concerned. In this manner the hardness, elasticity and softening point of the dried film may be varied within wide limits. In all cases the percentage of acrylic acid nitrile in the composition is predetermined. The percentage thereof may be varied within wide limits depending upon the properties desired in the dried coating. It is preferable to use at least about 10 per cent by weight of acrylic acid nitrile, the remainder of the basic material of the composition consisting essentially of acrylic acid ester, preferably acrylic acid ethyl ester. Ordinarily, varnish used in carrying the present invention into effect will contain, by weight, not more than about 65 parts of acrylic acid nitrile to about 35 parts of acrylic acid ester or mixture of esters. The ratios mentioned refer to the components in monomeric, or in partially or completely polymerized state, that is, in whatever their particular state may be when made into a varnish composition.

As a result of the high resistance to solvents of the basic varnish materials used in practicing the present invention, which property is due particularly to the polymeric acrylic acid nitrile component, the selection of a suitable solvent or mixture of solvents for making the varnish causes considerable difficulties. The following solvent mixture has proved particularly advantageous for use in making a varnish adapted for carrying the present invention into effect:

	Per cent by weight
Diethylene dioxide (dioxan)	25
Monochlorbenzene	30
Cyclohexanone	30
Dichlordiethyl ether	10
Ethylene glycol diacetate	5

The stated percentage proportions are not limited thereto but may be varied with variations in, for example, the selected polymerized acrylic acid ester or mixture of esters and with variations in the ratio of the polymerized acrylic acid nitrile component of the varnish to such ester or esters. It is to be understood that this invention is not limited to the use of a varnish made with the particular solvent mixture which has been described and that, in lieu thereof, other organic solvents having approximately the same or equivalent solvent effect upon mixtures of polymerized acrylic acid ester (or esters) and polymerized acrylic acid nitrile may be used.

A liquid coating composition or varnish which is adapted for use in carrying the present invention into effect is disclosed and claimed in the co-pending application of Carlos Tobis, Serial No. 159,973, filed August 19, 1937, and assigned to the same assignee as the present invention.

Copper wires and other conductors insulated in accordance with the present invention have an insulating film thereon which is superior in its mechanical, chemical and electrical properties to dried films of conventional oil varnishes.

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

1. An insulated electrical conductor comprising a metallic conductor and insulation therefor comprising the residue of heating to incipient decomposition a mixture of polymerized acrylic acid ester and polymerized acrylic acid nitrile.

2. An insulated electrical conductor comprising a metallic conducting core and a layer of insulation superposed thereon, said layer comprising the incipient decomposition product of a mixture consisting of at least 10 per cent by weight of polymerized acrylic acid nitrile and the remainder polymerized acrylic acid ester.

3. Electrical insulation comprising the incipient decomposition product of mixed polymerizate of acrylic acid ester and acrylic acid nitrile.

4. The method of insulating an electrical conductor which comprises coating the bare conductor with a liquid coating composition comprising synthetic resinous material consisting of a mixture of polymerized acrylic acid ester and polymerized acrylic acid nitrile and, in addition thereto, an organic solvent for said synthetic material, and heating the coated conductor to incipient decomposition of the mixed polymerizate thereby to evaporate the solvent and to form a hardened coating thereon practically free from dissociation products tending to lessen the electrically insulating properties of said coating.

5. An insulated electrical conductor comprising a metallic conductor and insulation therefor comprising the incipient decomposition product of a mixture consisting, by weight, of at least 10 per cent and not in excess substantially of 65 per cent polymerized acrylic acid nitrile and the remainder polymerized ethyl ester of acrylic acid.

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