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COATED METAL WIRE

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The present invention relates to wire or baking enamels and the products obtained by coating a wire with the same.

The invention is concerned particularly with providing an insulating coating directly upon copper magnet wire used for electrical apparatus such as motors, magnets, electric coils and the like.

One of the constituents of our wire coating composition is a member of the class of materials known, generally, as synthetic linear condensation superpolyamides. Such superpolyamides are described, for example, in United States Patent 2,130,523, Carothers.

As pointed out in the Carothers patent, superpolyamides are derived from the reaction of diamines of the formula $NH_2CH_2RCH_2NH_2$ and dicarboxylic acids (and their amide-forming derivatives) of the formula $HOOCCH_2R'CH_2COOH$ in which R and R' are divalent hydrocarbon radicals and in which R has a chain length of at least two carbon atoms. Within this class the most desirable superpolyamides for carrying the present invention into effect are those prepared from diamines of the formula $NH_2(CH_2)_xNH_2$ and dicarboxylic acids of the formula $HOOC(CH_2)_yCOOH$ in which x is at least 4 and y at least 3. A preferred superpolyamide is a reaction product of hexamethylene diamine and adipic acid.

These superpolyamides possess properties such as toughness, abrasion resistance, insolubility in most solvents and high melting point that make them attractive as coatings for magnet wire and certain compositions containing superpolyamides have previously been proposed for this purpose. Patent 2,169,097, Hall et al., for example, discloses a slot and magnet wire insulation for motors containing such materials. The superpolyamides are crystalline materials with definite melting points and in this respect differ from typical resins ordinarily used in wire coatings. The crystallinity of the subject materials is readily apparent when the pure materials are cooled from a melt or deposited from a solution.

However, when a solid superpolyamide is applied to a conductor by extrusion from a melt thereof by processes adapted to such materials, the coating is colorless and does not adhere to the wire except by what may be termed "shrink fit." If the coated wire is stretched, the nonadhering coating may be readily slipped off the wire in the form of a tube. When a superpolyamide is dissolved in a solvent consisting chiefly of cresol and is applied to a wire by the ordinary dip and bake process commonly used in coating wire with enamel compositions, the final baked coating is black and adheres to the wire, but has a dull unattractive appearance irrespective of the speed of the wire, concentration of the solution, temperature of the oven or number of coats. However, by proper reduction of the speed of the wire through the baking oven or by suitable increase in the temperature of the oven as described and claimed in the copending application of William J. Scheiber, Serial No. 332,978, filed concurrently herewith and assigned to the same assignee as the present invention, a substantially black film of increased flexibility and adhesion may be obtained. In accordance with the teachings of the Scheiber application, the coated wire is baked for such time and at such a temperature as to obtain a substantially black coating having certain improved properties believed to be the result of a partial oxidation or decomposition of the coating material.

We have now found that of all the modifying ingredients we have tested, shellac, which alone is unsuitable for wire insulation, will, when associated with a superpolyamide, impart a number of desirable characteristics to an insulating coating prepared therefrom. When the composition is applied to wire by the dip and bake process, there is obtained a coating which retains all the desirable properties inherent in an unmodified superpolyamide coating and, in addition, the film tightly adheres to the wire and possesses a very attractive, highly reflecting, black surface. These results, which are peculiar to the shellac-modified superpolyamide, are obtained when the quantity of shellac ranges from 10 to 40 per cent by weight of the superpolyamide.

Wires coated with compositions of shellac and superpolyamide have certain definite advantages. The unusually high reflecting black color possessed by the shellac-modified superpolyamide coating permits rapid inspection of the coated wire for discontinuities in the film. Owing to the contrasting colors of the glossy black film and the bright copper, such discontinuities are more visible than with dull films or coatings. The smooth, glossy surface facilitates winding of the coated wire into coils and the like, as the turns slip easily into place. Abrasive wear on the winding machinery also is reduced. Excellent adhesion between the coating and the wire permits stretching the wire during winding without separation of the film from the surface of the wire. The coated wire may be rolled or otherwise mechanically altered in cross section without loss

of this adhesion whereas, although the rolling of a "shrunk fitted" wire flattens the conductor, the "shrunk fitted" film or coating becomes loose and does not assume the shape of the wire. The coated wire of our invention is particularly valuable from the commercial standpoint as its attractive appearance is suggestive of good workmanship and design in an apparatus containing the coated wire. Finally, the addition of the relatively inexpensive shellac permits a higher proportion of solids in the coating material and reduces the cost of the finished wire.

A suitable coating solution within the scope of our invention may contain the following ingredients:

	Parts by weight
Superpolyamide	15
Shellac	5
Cresol	64
Coal tar naphtha	16

This solution is continuously applied to a copper wire by the usual process and the coated wire is continuously baked in an oven at 300° to 350° C. Six coats applied to a 0.032 inch copper wire increase the diameter of the wire by 0.0036 inch.

Although in the above example the proportion of shellac which we prefer for this solution is about 33 per cent based on the weight of the superpolyamide, satisfactory results may be obtained when the quantity of shellac ranges from 10 to 40 per cent of the amount of superpolyamide.

It is to be understood that any solvents in which both the superpolyamide and shellac are soluble may be used, although we prefer a solvent mixture consisting chiefly of cresol. The shellac used in the above example is ordinary dewaxed orange shellac. Other shellacs may be used, preferably in the dewaxed condition.

Besides possessing the properties hereinbefore described, wires coated with our improved wire enamel possess good flexibility, heat shock and abrasion resistance. The dielectric strength of the baked enamel is about 3000 volts per mil. The coated wires are particularly useful in the fabrication of electric coils, dynamo-electric machines and the like.

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

1. Copper wire having a smooth, glossy, continuous, flexible coating tightly adhering thereto comprising a superpolyamide modified with 10 to 40 per cent by weight shellac based on the superpolyamide.

2. Copper wire having a smooth, glossy, black, continuous flexible coating tightly adhering thereto comprising approximately 15 parts by weight of superpolyamide and 5 parts by weight of shellac.

3. Copper wire having a coating thereon comprising superpolyamide and from 10 to 40 per cent shellac based on the weight of the superpolyamide, said coating being baked to a smooth, glossy, flexible, abrasion-resistant state.

4. A composition of matter comprising a superpolyamide obtained by reacting hexamethylene diamine with adipic acid and from 10 to 40 per cent by weight shellac based on the super polyamide.

5. A composition of matter suitable for coating wire comprising, by weight, 15 parts superpolyamide, 5 parts shellac, 64 parts cresol, and 16 parts coal tar naphtha.

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