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CONDUCTOR INSULATED WITH FUSED MULTIPLE LAYERS

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FIG. 1

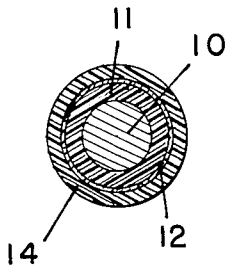


FIG. 2

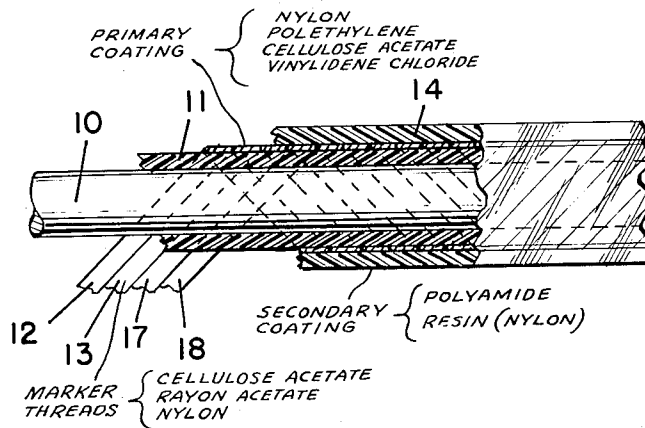
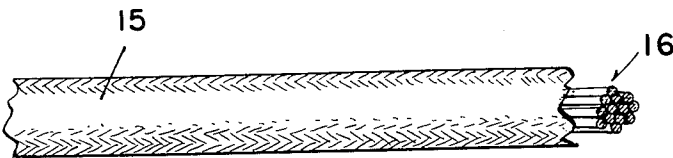


FIG. 3



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CONDUCTOR INSULATED WITH FUSED
MULTIPLE LAYERS

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1

This invention relates to thin wall, thermoplastic synthetic resin insulated conductors, and more particularly to insulated conductors having a spiralled layer of coding or identifying marks contained within the primary and secondary insulating walls, the combination thus to perform as a single compatible dielectric.

Insulated conductors of this type have widespread use as analyzer cables, low tension aircraft wire, calculating machine circuit wire, radio and telephone apparatus wiring, transformer lead wire, plus many others where identifying markers are essential to permit rapid installation and especially in preformed wire harnesses. The insulated conductor of the present invention is particularly applicable to telephone switchboard wires where a great number of wires in coded pairs are necessary, being incorporated in cables, and must each be readily identifiable.

A great variety of insulated wires having coding markers have been utilized up to the time of this invention but these types have inherent disadvantages which render them not wholly satisfactory. Some of the conductors heretofore used have had markers spiralled about an insulated core and subsequently impregnated and coated with a film applied from a solution bath or dip. The above type of wire, now in general use, is comprised of a bare or enameled conductor with a serving of silk or cotton woven over the conductor to provide a covering as well as a coding and then provided with a waxed or lacquered surface treatment to finish the product. Such a construction provides many drawbacks such as slow production rate, difficulty in soldering ends due to the enamel coating which must be removed chemically, poor resultant physical and chemical properties of finished surface, gradual lessening of dielectric properties under ordinary moisture exposures, a limited system of marking and large finished diameters. Other types of coded insulated wires have utilized plastic coatings alone having coloring material therein. Such wires are limited in the marking thereof and do not possess the desired electrical, chemical and physical properties as a separate insulating wall.

An object of the present invention is to provide a wire to overcome the above mentioned difficulties and to provide a satisfactory coded insulated conductor especially for radio and telephone apparatus use.

Another object of this invention is to provide a multi-color coded wire having long life service and stable high insulation resistance as

2

compared to the conventional silk served, cellulose acetate lacquer or wax impregnated wire.

A further object of the invention is to provide a wire having unlimited color-coding possibility and which will permit it to be fabricated at a rapid rate.

A further object is to provide a coded insulated conductor having a combination of coatings of synthetic thermoplastic resins sealing in the coding marker and which will have good electrical, chemical, thermal and physical properties.

Other objects will be apparent from the following detailed description when taken with the accompanying drawings in which:

Fig. 1 is a plan view partly in section of an insulated coded conductor provided in accordance with the present invention.

Fig. 2 is a cross sectional view of the insulated conductor, and

Fig. 3 is a plan view of several conductors of the present invention assembled in a cable for use in switchboard installations.

Referring in detail to the drawings, a conductor 10, of copper or other suitable conductive material is covered by a primary dielectric or insulation coating 11 of a thermoplastic synthetic resin having a high volume resistivity and a low loss factor. This primary coating should have the highest possible insulation resistance with a minimum change upon high humidity or immersion in water. There are several synthetic thermoplastic materials having some characteristics of this nature, each differing slightly, but such materials do not have all desired chemical, electrical and physical characteristics.

The primary coating or dielectric 11 may be applied in thin-wall dimension (.001-.004) by solution coating but preferably by extrusion for which purpose a thermoplastic resin is preferable. Suitable resins for this primary coating are cellulose acetate, low molecular weight polyethylene and vinylidene chloride. Each of these substances may be used but have slightly varying characteristics and the particular one used is chosen to give the most satisfactory results for a specific use. Also other similar substances may be used but must be carefully chosen.

Over the primary dielectric or coating 11, a coding or identifying marker 12 is spiralled. This marker is also a synthetic thermoplastic resin and preferably cellulose acetate, rayon acetate, or nylon yarns. This marker 12 is susceptible of production in many different colors thereby giving a wide field of marking. It is also possible

to have any number of these markers 12 spiralled on the primary dielectric 11 so as to provide a great number of different color combinations with a resultant increase in the possible number of markers or coded wires. In some applications it is desirable to provide complete coverage of the primary by the markers. Such a construction is shown in Fig. 1 wherein markers 12, 13, 17 and 18 are of different colors. The marker threads should have properties compatible to that of the primary insulation 11, since both are performing under similar dielectric stress. Also in order to eliminate any need for stripping of the insulation for soldering the thermal characteristics of the marker material should be the same as the primary and secondary coatings and the secondary coating or insulation must have at least as high a heat deformation temperature as the primary coating and the marker material. In addition the marker threads 12 should be single ended multi-plyed mono-filament yarn, untwisted, so as to be flat as possible thereby maintaining a uniform regular formed surface with a diameter as small as possible.

As previously pointed out the material chosen for the primary insulation 11 has very good dielectric properties but does not have the best of chemical or physical qualities. In switchboard wires or cables good chemical properties are needed in order to prevent deterioration in chemically reactive atmosphere and to resist propagation of fungus and corrosion. Physically the wires must be tough, rupture and abrasive resistant and have a high heat deformation temperature to facilitate soldering and protect the core stock from displacement during this operation. In order to provide the necessary physical and chemical properties to the insulated wire a thin transparent (.004) maximum secondary insulation 14 is applied over the marker 12. This coating 14 may be applied by any known method but preferably by extrusion for best dielectric performance. The markers 12 and the secondary coating 14 are applied simultaneously thus binding the properly seasoned (dry) markers securely between both insulating layers. In order to see the identifying markers the secondary coating must be transparent and in order to lend itself readily to the coating procedure should be a thermoplastic synthetic resin. Polyamide resins more commonly known as nylon are suitable for the secondary coating since they possess the desired characteristics. Nylon is a generic term for any long-chain synthetic polymeric amide which has recurring amide groups as an integral part of the main polymer chain, and which is capable of being formed into a filament or film in which the structural elements are oriented in the direction of the axis. Several types of polyamide resins are in commercial production such E. I. du Pont de Nemours & Co., Inc. All of these have slightly differing characteristics, but all possess some of the desired qualities. A super linear polyamide resin, heat and light stabilized is also a very satisfactory type.

Thus it may be seen that by the combination of dielectrics selected an insulated, circuit identifying, marked or coded wire is produced having very good electrical, chemical and physical properties. The individual properties of the different coatings are enhanced by the combination of the two and the possible color combinations for circuit marking are numerous. The individual coatings and the markers comprise a combination of synthetic materials performing as a single in-

sulation medium to provide in effect a single dielectric wall with additional advantages as herebefore set forth.

If desired the primary coating 11 may be omitted where low insulation resistance is not required. In this case the coding markers 12 would be fixed on the core 10 by the transparent coating 14. Such a wire would give satisfactory performance for many uses such as in transformers and motor coil winding.

It may readily be understood that low molecular weight polyethylene resins may be used as the primary coating since these resins have excellent electrical insulation characteristics, chemical inertness, and low moisture absorption. Preferably a low molecular weight polyethylene resin having good flow characteristics should be utilized.

In Fig. 3 of the drawings there is shown a section of switchboard cable having an outer sheathing 15 enclosing many twisted pairs of insulated coded conductors, generally designated 16, made in accordance with the present invention. The insulated conductors can be made with a very small overall diameter by the teaching of this invention thus materially decreasing the outside dimension of the cable but at the same time preserving the circuit coding and all desired electrical, chemical and physical properties of the conductors.

It is possible in accordance with the teaching of this invention to provide the conductor with an extruded film of nylon with colored nylon markers and a final jacket of nylon. Such a construction would be satisfactory on high humidity exposure due to the fact that the solid dielectric walls are uniformly separated and the vapor transmission rate of the somewhat permeable inner nylon film would be retarded considerably by the outer film and nylon yarn separation.

What I claim is:

1. An insulated coded electric conductor comprising an electric conductor, an extruded homogeneous primary insulating coating of a synthetic thermoplastic resin on said conductor, a spiralled circuit identifying marker of a synthetic thermoplastic resin having identifying means therein surrounding said primary coating and a transparent extruded homogeneous secondary insulation of a synthetic thermoplastic resin over said marker sealing said marker and said primary coating and forming a single dielectric and substantially single physical wall, said primary coating, said marker and said secondary insulation having compatible thermal characteristics and said secondary insulation having at least as high a heat deformation temperature as said primary coating and said marker, thereby permitting said conductor to be soldered without stripping said insulation.

2. An insulated coded electric conductor as claimed in claim 1, wherein said marker threads comprise untwisted single ended multi-mono-filament cellulose acetate yarn.

3. An insulated coded electric conductor as claimed in claim 1, wherein said secondary insulating coating comprises a super-linear polyamide resin, heat and light stabilized plastic.

4. An insulated coded electric conductor comprising an electric conductor, a primary extruded homogeneous dielectric coating of a super-linear polyamide resin having good flow characteristics, circuit identifying markers of colored untwisted single ended multi-mono-filament yarns of cellulose acetate plastic spiralled about said primary dielectric and substantially com-

pletely covering said primary coating, and a secondary extruded homogeneous dielectric coating of a super-linear polyamide resin, heat and light stabilized plastic over said primary dielectric and said markers, said layers forming a single dielectric and substantially single physical wall.

5. An insulated coded electric conductor as claimed in claim 4, wherein said markers cover a minimum of 90% of said primary dielectric.

6. An insulated coded electric conductor as claimed in claim 4, wherein said primary dielectric has thin wall dimensions between .001 inch and .004 inch and wherein said secondary dielectric has a thin wall dimension of .004 inch maximum.

7. An insulated coded electric conductor comprising an electric conductor, circuit identifying marker threads of cellulose acetate of synthetic thermoplastic resin yarns spiralled over said conductor and substantially completely covering said conductor and a transparent polyamide resin of compatible thermal characteristics having at least as high heat deformation as said marker threads over said threads sealing said marker threads to said conductor and forming therewith a single physical and dielectric wall.

8. An insulated coded electric conductor as claimed in claim 7, said spiralled marker threads comprising a plurality of different colored adjacent bands of said threads.

9. An insulated coded electric conductor as claimed in claim 7 wherein said primary coating comprises a super-linear polyamide resin, heat and light stabilized plastic.

10. An insulated coded electric conductor comprising an electric conductor, extruded homogeneous primary and secondary insulating coatings of a synthetic thermoplastic resin on said conductor, said secondary coating being transparent, and circuit identifying marker threads comprising a plurality of adjacent bands of different colored synthetic thermoplastic resin threads spiralled around said core over said primary coating, substantially covering said primary coating, secured and sealed between said primary and secondary insulating coatings, said marker threads substantially completely covering said primary coating, said layers having compatible thermal characteristics and forming a

single dielectric and substantially single physical wall.

11. An insulated coded electric conductor comprising an electric conductor, an extruded homogeneous primary insulating coating of a super-linear polyamide resin, heat and light stabilized plastic on said conductor, circuit identifying marker threads of cellulose-acetate yarns spiralled over said primary coating substantially completely covering said primary coating and a transparent extruded homogeneous secondary insulating coating of a super-linear polyamide resin, heat and light stabilized plastic covering said marker threads for sealing said marker threads and said primary coating and forming therewith a single dielectric wall of uniform characteristics, said primary and secondary insulating coatings and said marker threads having compatible thermal characteristics, said secondary coating having at least as high a heat deformation temperature as said marker threads.

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