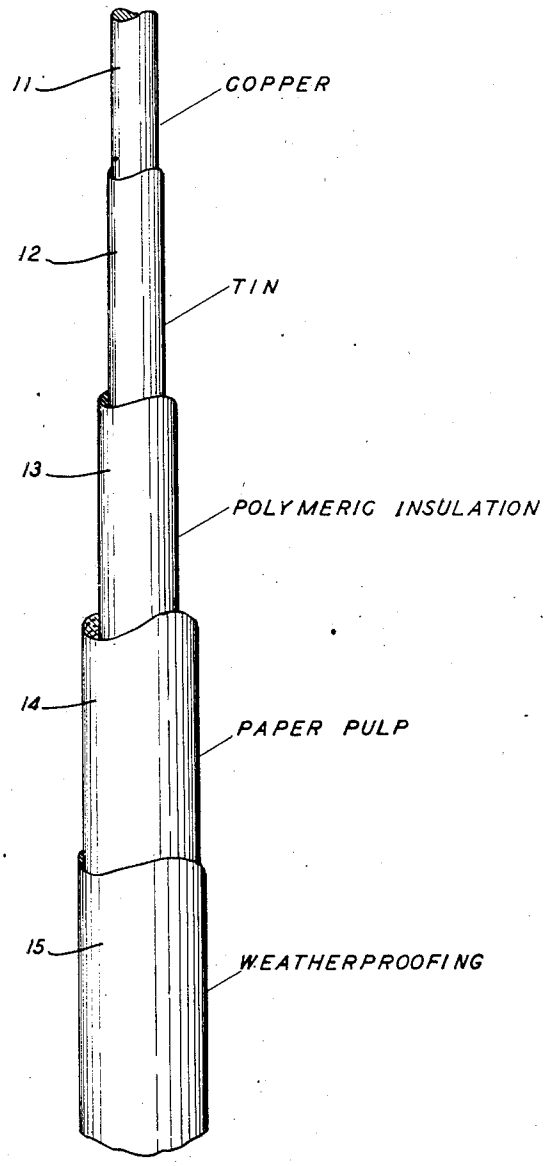
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ELECTRIC CONDUCTOR

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ELECTRICAL CONDUCTOR

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This invention relates to electrical conductors, and more particularly to insulated electrical conductors which are particularly adapted for use where the conductor proper is to be soldered for electrical connection.

In telephone apparatus, radio apparatus and other electrical apparatus, insulated wire is used in large quantities for interconnecting the electrical devices and units of which such apparatus are composed. In many instances such connector wires are preferably permanently connected to the terminal members to which they are attached, by soldering them thereto. This entails stripping the portions of the wire to be soldered of their insulating coatings and coverings.

An object of the present invention is to provide an insulated electrical conductor wire particularly adapted for such use, and having insulating sheathing thereon which is either readily removable or will not prevent or hinder soldering, without being previously removed.

In one embodiment of the invention a copper wire may be tinned, coated with an enamel-like material such as that commercially known as "nylon," or polyethylene ester, or that commercially known as "Vistanex," which is at the same time a satisfactory insulating material and also does not hinder the penetration of molten solder therethrough and may even act as a soldering flux to assist in making a good soldered connection. A wire thus coated may then be provided with a sheath over the coating, but not adherent thereto, of seamlessly interfelted paper pulp fibers, and this sheath may be externally coated with a suitable weatherproofing material, e. g. cellulose acetate, vinyl acetate, "nylon," polyester, or the like.

Other objects and features of the invention will appear from the following detailed description of an embodiment thereof in an insulated electrical conductor constructed in accordance with the invention, taken in connection with the accompanying drawing in which the single figure represents a portion of such a conductor and its various coverings.

In carrying out the invention as herein disclosed, a metal wire 11 of suitably conductive material, e. g. copper, is coated with tin as at 12, by dipping into a bath of molten tin or electrolytically or in any other suitable manner. Upon this tin coating is then formed a sheath or layer 13, which is so far as possible free from solutions of continuity of any kind, such as cracks, pin holes and the like, and which is tough, smooth, impervious and satisfactorily electrically insulating. The material of the sheath 13 should not soften or become tacky at temperatures about 100° C. or a little higher for reasons which will appear hereinafter. Also, for reasons to be set forth later, this material must be such as will not interfere with or hinder the satisfactory access of molten solder to the tin coating and successful soldering thereto, but should preferably act as a flux when in contact with molten solder.

Over the layer 13 is formed a seamless sheath 14 of interfelted fibers of cellulose material, e. g. paper pulp. A suitable method and apparatus to effect this are disclosed in U. S. Patent No. 2,180,554, granted November 21, 1939, to John N. Selvig.

Finally this sheath of felted fiber may be provided with an outer coating or film 15 of weatherproofing material such as cellulose acetate, vinyl acetate, or analogous material, which can be applied on the gross surface of the pulp sheath 14 without entering into its body to any appreciable extent and will thus form a continuous impervious exterior coating 15 which is substantially resistant to the passage therethrough of moisture and which also aids in improving the electrical value of the insulating complex on the metallic core. A suitable apparatus and method for forming the external coating 15 on the fiber sheath 14 are disclosed in detail in U. S. Patent No. 2,217,337, granted October 8, 1940 to Waldemar C. Ewaldson et al., to which reference may be had for details of the same.

In the forming of the sheath 14 over the layer 13, the formed sheath of wet, felted pulp is dried by passing the wet sheathed core through a heated oven so that substantially all the moisture is driven out of the felted pulp, leaving a seamless sheath of material much like a soft porous blotting paper, devoid of moisture. It is found in practise that the temperature at the inner surface of this sheath during this drying operation rises to values of the order of 90° to 100° C., but not appreciably over 100° C. Since it is usually desired that the pulp sheath 14 be not adherent to the layer 13 on which it rests, the material for the layer 13 is preferably selected to be such as will not soften appreciably or become tacky or sticky at temperatures of the order of 100° C.

The at present preferred material for the layer 13 is one of the substances or mixtures of substances, chemically superpolymers of polyamids, which are commercially known as "nylon." This material, as commercially available, is prepared to have melting points within a large range of values for different purposes and uses. That

preferred for the present invention may have a melting point preferably within the range from about 200° C. to about 350° C., although in some instances material melting below or above these values may be preferred for special uses.

Another material which may be satisfactorily employed in some cases for the layer 13, may be selected from the general class of superpolymers of organic polyesters, of which typical members are polymerized polyethylene sebacate and polyethylene succinate, for example. This class of materials also exists with members and mixtures of members showing a wide range of melting points, from which materials having the desired melting or softening points and other suitable characteristics may be selected.

A third class of materials from which members and mixtures of members suitable for layer 13 may be selected is that of the polymerized olefines. For example, there is commercially available at the present time a material commerically known as "Vistanex," a highly polymerized isobutylene. Highly polymerized ethylenes, amylenes and isoamylenes are also to be found having suitable physical characteristics.

Common characteristics of these materials which are of peculiar interest in the present invention are of three principal kinds. First, the layer 13 made from these materials has a high electrical insulating value and resistance to breakdown under electrical stress. Second, and notably in the case of "nylon," the layer 13 is mechanically tough, flexible and elastic over a wide temperature range, and may be bent, coiled and kinked with the wire core, and even materially stretched with the wire, without developing any cracks, tears or other solutions of continuity to damage its insulating value. Third, these materials have the curious property that they can be soldered through without material hindrance to the soldering operation or damage to the soldered joint. It even appears, especially in the cases of "nylon" and "Vistanex" that these materials act in some degree as soldering fluxes and so assist in the production of a sound soldered joint.

The mode of application used to form the layer 13 will depend to some extent at least upon the particular material selected in any given case, but requires no novel apparatus or method other than those usually employed in enamelling or coating strands with molten materials or with solutions or dispersions of them in a suitable volatile vehicle. However, a preferred mode of application of the layer over the core is by extruding the softened or molten material thereon without employing any vehicle.

In the preferred form of the invention, an important feature is that the layer 13 be wholly formed and set to a point where the sheath 14 can be deposited and wholly dried on it without any adhesion being effected between the layer and the sheath. Furthermore, it may be important that the method used to form the outer film or weatherproof coating 15 be such that substantially none of the vehicle used in this procedure shall penetrate the sheath 14 and reach the surface of the layer 13 to cause any softening or tackiness of this layer with consequent adhesion of the sheath thereto.

When the completed insulated conductor is constructed in the manner described, it is found to have an insulation of unusually high electrical strength and endurance. Furthermore, when such a wire is to be permanently connected to a metal member, the sheath 14 and coating 15 are easily removed from the end or other portion at which connection is to be made, since these adhere firmly together but are not adherent to the layer 13 underneath. The layer 13 need not be removed, and indeed should not be, before the soldering is undertaken, for the material of this layer melts and vaporizes without charring or leaving any residue, when in contact with molten solder, and even seems to act as a soldering flux, so that firm and sound soldered joints are made without the use of any flux in addition to the material of the layer 13.

As noted, in the preferred form of the invention, the sheath 14 is made to be non-adherent to, though closely embracing, the layer 13 in order that the sheath 14 and coating 15 may be easily stripped when necessary. However, there are procedures wherein the insulated conductor of the invention has distinct advantages even though there is adhesion of the sheath 14 to the layer 13. Thus in some cases, where a sheathed conductor is to be soldered or brazed to some metal members, it may be quicker and easier, as a manufacturing procedure, to burn off the sheath from the portions to be connected. In such a case, the peculiar property of this particular type of organic material of disintegrating and vaporizing without leaving any char or other solid residue, is of distinct importance and value.

Thus in its broadest phase the invention turns on the unusually high insulation properties of the composite insulation, together with its endurance of electrical stress and of mechanical stress, as well as its resistance to atmospheric moisture, which appear to be due to the combination of the layer 13 of this particular type of material, the sheath 14 of felted paper pulp fibers, and the outer weatherproof film or coating 15 adherent to but not interpenetrant into the substance of the fibrous sheath. In a narrower phase, the value of the invention derives from the residueless disintegration of the layer 13 when sufficiently heated, so that the compound sheath of insulation may be burned off as desired without interfering with subsequent soldering on the portion of the core thus made bare. Finally, and in the narrowest phase, the principal usefulness lies in the case where the sheath 14 is non-adherent to the layer 13, and the layer 13 need not be removed, after the sheath 14 and coating 15 are stripped, before soldering.

In the preceding are disclosed three specific kinds of material suitable, within the purview of the invention, for the layer 13, namely, the polyamide complexes commercially known as "nylon," the analogous highly complex polyesters of the type of polymerized polyethylene sebacate, and the related highly polymerized olefines, such as the isobutylene polymers commercially known as "Vistanex" and the highly polymerized ethylene or amylene products. Each of these presents individual members with melting points, sharp or vague, having a wide range, from materials which are soft at room temperatures to some that disintegrate at high temperatures without melting. Not all of these, and yet a large number and variety, are useful in applicant's invention. For use in the appended claims, applicant therefore selects the phrase "normally solid and non-charring polymeric insulating material" and similar phrases to represent that portion of the class of such substances which has the properties of being electrical insulators, of being a tough solid

at ordinary temperatures, and of disintegrating at temperatures of the order of that of melted solder without leaving a char or other solid residue.

The particular embodiments herein disclosed are illustrative and may be variously modified and departed from without departing from the spirit and scope of the invention as pointed out in and limited only by the appended claims.

What is claimed is:

1. An insulated electrical conductor for use in the manufacture of communications apparatus comprising a conductive strand and insulating means thereon consisting of a layer of normally solid and non-charring superpolymeric insulating material selected from the class consisting of superpolyamids, superpolyesters and superpolyolefines directly on the strand, a seamless combustible sheath of felted paper pulp fibers over the layer, and a coating of weatherproofing material on the gross outer surface of the sheath.

2. An insulated electrical conductor for use in the manufacture of communications apparatus comprising a conductive strand and insulating means thereon consisting of a layer of normally solid and non-charring superpolyamidic insulating material directly on the strand, a seamless combustible sheath of felted paper pulp fibers over the layer, and a coating of weatherproofing material on the gross outer surface of the sheath.

3. An insulated electrical conductor for use in the manufacture of communications apparatus comprising a conductive strand and insulating means thereon consisting of a layer of normally solid and non-charring superpolyesteric insulating material directly on the strand, a seamless combustible sheath of felted paper pulp fibers over the layer, and a coating of weatherproofing material on the gross outer surface of the sheath.

4. An insulated electrical conductor for use in the manufacture of communications apparatus comprising a conductive strand and insulating means thereon consisting of a layer of normally solid and non-charring superpolyolefinic insulating material directly on the strand, a seamless combustible sheath of felted paper pulp fibers over the layer, and a coating of weatherproofing material on the gross outer surface of the sheath.

5. An insulated electrical conductor for use in the manufacture of communications apparatus comprising a conductive strand and insulating means thereon including a layer of normally solid and non-charring superpolymeric insulating material selected from the class consisting of superpolyamids, superpolyesters and superpolyolefines directly on the strand, and a seamless combustible sheath of felted paper pulp fibers over the layer.

6. An insulated electrical conductor for use in the manufacture of communications apparatus comprising a conductive strand and insulating means thereon including a layer of normally solid and non-charring superpolyamidic insulating material directly on the strand, and a seamless combustible sheath of felted paper pulp fibers over the layer.

7. An insulated electrical conductor for use in the manufacture of communications apparatus comprising a conductive strand and insulating means thereon including a layer of normally solid and non-charring superpolyesteric insulating material directly on the strand, and a seamless combustible sheath of felted paper pulp fibers over the layer.

8. An insulated electrical conductor for use in the manufacture of communications apparatus comprising a conductive strand and insulating means thereon including a layer of normally solid and non-charring superpolyolefinic insulating material directly on the strand, and a seamless combustible sheath of felted paper pulp fibers over the layer.

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