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EASILY STRIPPED INSULATED WIRE

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Fig. 1.

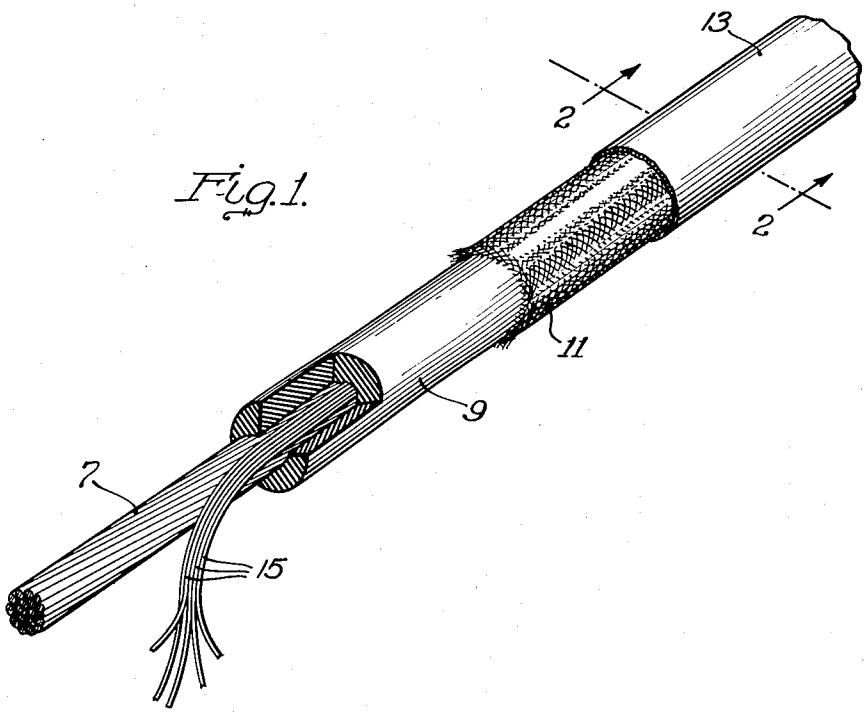
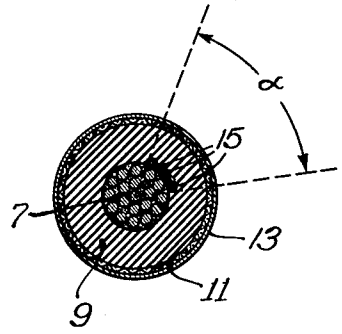


Fig. 2.



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EASILY STRIPPED INSULATED WIRE

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6 Claims. (Cl. 174—110)

The present invention relates, in general, to the manufacture of insulated wire and, more particularly, to improved hook-up and lead wire having insulation which can be easily stripped from the conductor section of the wire.

The designation "hook-up or lead wire" is generally employed in the wire-making art in connection with insulated wire suitable for use in wiring motors, electronic and other electrical equipment, and in providing leads for coils, relays, transformers, etc. One frequently used type of hook-up or lead wire includes a stranded conductor, which may be as small as 26 A. W. G., or as large as 14 A. W. G., a flexible insulating sleeve or jacket, which may be of rubber or other insulating compound, disposed about the conductor, a braided fabric covering overlying the insulation jacket, and a lacquer coating overlying the fabric braid.

Since lead and hook-up wire of this type is normally used in short lengths, it is of the greatest importance that the insulation shall be capable of being stripped easily and conveniently from the conductor. Of equal importance, since the connections which are made by the use of hook-up and lead wire are almost always soldered, it is essential that the conductor shall be tinned, and that the tinning shall be clean and in an easily solderable condition at the time the wire is put into use.

In the past, various procedures have been followed in an attempt to produce wire of this general type having the desired qualities of being easily stripped and easily soldered. However, the results have been far from completely satisfactory. Easy stripping wires have been produced, as for example, by enclosing the conductor in a sheath which prevented contact between the insulation and the wire, but in all instances where a satisfactory, easy-stripping wire has been so produced, it has been accompanied by oxidation or sulphurization of the tinned conductor, with the results that the wire was difficult to solder. Similarly, when the construction and manufacturing operations were such that the tinning was maintained bright and clean, so as to assure easy soldering, difficulty was encountered in stripping the insulation from the conductor.

The primary object of the invention, therefore, is to overcome these difficulties, and to provide an improved hook-up and lead wire, and especially a wire of this type which is insulated with a flexible jacket of rubber or like insulating compound, which shall be both easy to strip and easy to solder.

As will hereinafter appear, this object of the invention is accomplished by incorporating into the flexible insulating jacket a plurality of relatively inextensible strands or threads which desirably are in contact with the conductor and extend longitudinally therealong. These threads, when of certain materials and dimensions, and when positioned in certain relationships relative to the conductor, as will hereinafter appear, make possible the obtaining of an easy-stripping and easy to solder hook-up or lead wire, which is the object of the invention. The invention also contemplates the possible use of a relatively inextensible tape or the like as a substitute or equivalent for the threads.

A representative example of the invention is illustrated in the accompanying drawings, wherein:

Figure 1 is a perspective view, partially in section, of a length of hookup wire in accordance with the invention; and

Figure 2 is a sectional view of the wire taken along line 2—2 in Figure 1.

The hookup and lead wire illustrated in the drawings includes a central conductor 7, a flexible, insulating sleeve or jacket 9 which is disposed about the conductor 7, and a braided fabric covering 11 overlying the sleeve or jacket 9. A layer 13 of insulating varnish or lacquer, which may be of a heat resistant type, overlies and is bonded to the fabric braid. The conductor 7 may be of any convenient, cross-sectional dimension or gauge within the range usually employed for this type of wire, and it should be tinned to facilitate soldering. It may be stranded or solid, although easy stripping is generally more of a problem with stranded wire than it is with solid conductor wire.

In the particular embodiment illustrated in the drawings, the inextensible element comprises a plurality of threads which, as shown at 15, are incorporated into the insulating jacket 9, these threads being in contact with the central conductor 7, extending longitudinally therealong, and being bonded to the insulating jacket. As compared with the insulating compound of which the jacket is made, the threads 15 should be of a relatively inextensible material. The length of these relatively inextensible threads should approximate the axial length of the wire conductor with which the threads are associated.

During the manufacture of wire by the usual manufacturing operations, which involve drawing a conductor through an extrusion head and die, it will generally be found most convenient to parallel the threads and the conductor, and to draw both through the die as a single unit. During this operation, there may be some slight winding or wrapping of the threads around the conductor, and while this is not desired, a slight amount of such wrapping will not materially change the overall length relationship of the threads and the conductor or impair the stripping characteristics. Also, while it is preferred that the threads shall be in contact with the conductor, various of the advantages of the invention can be accomplished without such contact. It is important that the inextensible threads shall be bonded to the insulation jacket.

The dimensions, positioning and number of the relatively inextensible threads incorporated into the insulating jacket have an important bearing on the satisfactoriness of the stripping operation, and on the overall, physical properties of the wire. In general, it is important that the individual threads shall be of small diameter relative to the diameter of the central conductor, and that there shall not be an excessive number of threads, although a certain minimum appears to be required. Also, it is of considerable importance, as previously stated, that the threads shall be bonded to the insulation jacket.

The threads should be placed in side-by-side relationship, as illustrated in the drawings, and in the preferred construction, the threads are in contact with the periphery of the conductor. The threads should overlie an amount of the conductor surface which is at least equal to the surface area enclosed within a solid angle, measured along the central axis of the conductor, the angle α of Figure 2, of at least about 50°, and should not overlie a surface area greater than that included within a solid angle of about 120°. Stated somewhat differently, the longitudinally extending threads, when disposed in side-by-side relationship, should overlie less than approxi-

mately one-third and more than approximately one-seventh of the peripheral area of the conductor.

As previously suggested, an equivalent, fabricated tape or ribbon may be substituted for the individual threads. Hence, it will be understood that the terms "threads" or "a plurality of threads" as used herein includes individual threads, or combinations of threads into tapes, ribbons, and the like, having characteristics equalivalent to individual threads, as herein described.

For hookup and lead wire, embodying insulating jackets made of rubber-compound and similar materials, which are capable of substantial elongation before failure (i. e. in excess of about 100 percent), the usual jacket will have a radial thickness within the range of from about 1/64 of an inch to 5/64 of an inch, depending on the size of the conductor and the voltage requirements. The thinner jackets (1/64" to 1/32") will generally be used with the smaller conductors, and the thicker jackets will generally be used with wire having the larger conductors. For such jackets, relatively inextensible fiber thread, of the size within the range of from about 40 to 120 (British Cotton Count numbers) can usually be employed with good results, the smaller sizes being best for the thinner wall jackets.

The threads or strands used in obtaining the easy-stripping characteristics of the wire of the present invention are preferably made of an insulating material. In any event, the thread should be capable of bonding to the insulating jacket or sleeve within which it is embedded. Cotton is a particularly satisfactory material. Other useful materials includes glass fiber, linen and certain of the synthetic fibers such as nylon. It is very important, as previously stated, that the threads shall be relatively inextensible as compared with the rubber compound or other materials constituting the main insulation jacket on the wire. Thread capable of being elongated as much as 5–10% before failure will usually give satisfactory results. Materials which can be elongated as much as 15% before failure, for example rayon, are, in general, unsatisfactory. Best results are obtained with materials having an elongation at failure of not more than about 5–7%, and the top limit appears to be about 12–13%. It is desirable, although not essential, that the thread material shall be relatively resistant to abrasion.

In one commercial example of the product of the present invention, using a No. 16 A. W. G. stranded conductor, the conductor consisting of 26 strands of No. 30 wire, the main insulating jacket 9 was made from a rubber compound having an extension at failure of approximately 300%. This insulation, which was designed for 300 volt service, was applied so as to produce a jacket having a nominal thickness of 1/32 of an inch, and with the overlying braid and lacquer layer, the wire had a nominal outside diameter of .163. In this wire, the threads employed to accomplish the easy stripping characteristics comprised 7 strands of No. 80's cotton thread, this thread having a maximum extension at failure of approximately 5%, and a nominal strength at failure of approximately 3 lbs. The rubber compound jacket was applied to the wire in a continuous vulcanization apparatus which may be of the general type shown in Cherry Reissue Patent No. 19,820 or Forstrom Patent No. 2,069,087.

The conductor and the cotton threads were drawn through the extrusion die in contact with each other and under such relative tension that the threads had an unstressed length approximately equal to the axial length of the stranded conductor. The braid and lacquer were applied as separate operations.

This wire was found to be very easy stripping by any of the conventional stripping procedures employed in the electrical art, and the stripped insulation separated from the wire cleanly and freely. Also, there was a minimum of oxidation or sulphurization of the tinning, with the result that the wire was very easy to solder.

Other examples of the wire, involving stranded and solid conductors over a range from 26 A. W. G. to 14 A. W. G, inclusive, and made with rubber and other compound insulations, having a nominal thickness of from 1/64 of an inch to 5/64 of an inch exhibited equally good stripping and soldering characteristics.

The invention, as previously indicated, is of particular utility in connection with hookup and lead wire which includes a main insulating jacket of rubber or other compound, capable of substantial elongation before failure. Also, the invention finds particular application in connection with wire which includes a stranded conductor. The invention has overcome difficulties which have existed in the wire-making art for many years. In particular, it has made possible a flexible hookup and lead wire, insulated with a rubber compound or similar soft, stretchable insulation, which can be readily stripped and which, at the same time, is easy to solder.

Various of the features of the invention believed to be new are set forth in the accompanying claims.

We claim:

1. An insulated wire having easy-stripping characteristics comprising an elongated, metallic conductor, a flexible jacket of insulating material disposed about, and in contact with, said conductor, and a plurality of threads disposed in side-by-side relationship within said jacket so as to extend longitudinally along said conductor, said threads having a length approximately equal to the length of said conductor, being made of a material having a maximum extension at failure of less than about 13%, being bonded to said jacket, and overlying less than about one-third and more than about one-seventh of the peripheral area of said conductor.

2. An insulated wire having easy-stripping characteristics, comprising an elongated, stranded, metallic conductor, a flexible jacket of insulating material disposed about, and in contact with, said conductor, and a plurality of cotton threads positioned in side-by-side relationship within said jacket so as to extend along, and in contact with, said conductor, said threads having a length approximately equal to the length of said conductor, being bonded to said jacket, and overlying less than about one-third and more than about one-seventh of the peripheral area of said conductor.

3. An insulated wire having easy-stripping and easy-soldering characteristics, comprising an elongated, stranded, metallic conductor having a tinned surface, a flexible jacket of rubber-compound insulating material having a radial thickness within the range of approximately 1/64 to 5/64 of an inch, disposed about, and in contact with, said conductor, and a plurality of cotton threads positioned in side-by-side relationship within said jacket so as to extend along, and in contact with, said conductor, said threads having a length approximately equal to the length of said conductor, being bonded to said jacket, overlying less than about one-third and more than about one-seventh of the peripheral area of said conductor, and being of a size within the range of from size 40's to size 120's.

4. An insulated wire having easy-stripping characteristics, comprising an elongated, metallic conductor, a flexible jacket of insulating material disposed about, and in contact with, said conductor, and a plurality of threads disposed in side-by-side relationship within said jacket so as to extend longitudinally along, and in contact with, said conductor, said threads having a length approximately equal to the length of said conductor, being made of a material having a maximum extension at failure of less than about 13 per cent, being bonded to said jacket, and overlying less than about one-third and more than one-seventh of the peripheral area of said conductor.

5. An insulated wire having easy-stripping and easy-soldering characteristics, comprising an elongated metallic conductor having a tinned surface, a flexible jacket of insulating material disposed about, and in contact with, said

conductor, and a plurality of threads disposed in side-by-side relationship within said jacket so as to extend longitudinally along said conductor, said threads having a length approximately equal to the length of said conductor, being made of an insulating material having a maximum extension at failure of less than about 13 per cent, being bonded to said jacket, and overlying a total surface area of said conductor equal to the area enclosed within a solid angle measured along the central axis of said conductor within the range of from about 50° to 120°.

6. An insulated wire having easy-stripping characteristics, comprising an elongated, stranded, metallic conductor, a flexible jacket of insulating material disposed about, and in contact with, said conductor, and a plurality of cotton threads disposed in side-by-side relationship within said jacket so as to extend longitudinally along said conductor, said cotton threads having a length approximately equal to the length of said conductor, being bonded

to said jacket, and overlying less than about one-third and more than about one-seventh the peripheral area of said conductor.

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