United States Patent

Paine et al.

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[54] METHOD OF REMOVING INSULATED MATERIAL FROM INSULATED WIRES

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[52] **U.S. Cl.**.....**29/624,** 29/412, 29/426, 29/527.2, 51/216, 51/320, 51/323

[51] **Int. Cl.**.....**H01b 13/00,** H05k 3/00

[58] **Field of Search**.....51/317, 318, 319, 320, 321, 51/323; 29/426, 624, 412, 527.2

[56] **References Cited**

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[57] **ABSTRACT**

A method of fabricating equal length insulated wires which have insulation removed from selected portions thereof. The method includes the step of supporting the wires on each of two notched wire-support structures or jigs by placing the two back-to-back and by winding wires about the two jigs. The wires' ends are cemented at the jigs' ends. After the cement hardens the jigs are separated from one another so that each carries a plurality of wires with each wire having portions thereof exposed through notches in the jig. Each jig is placed in the stream of an abrasive-material carrier. The carrier passes through the jig's notches causing the abrasive material to erode the insulation material from the portions of the wires which are exposed through the notches. After the removal of the insulation material, the bare portions of the wires are treated, prior to removing the wires from the jig by cutting them to equal lengths.

7 Claims, 4 Drawing Figures

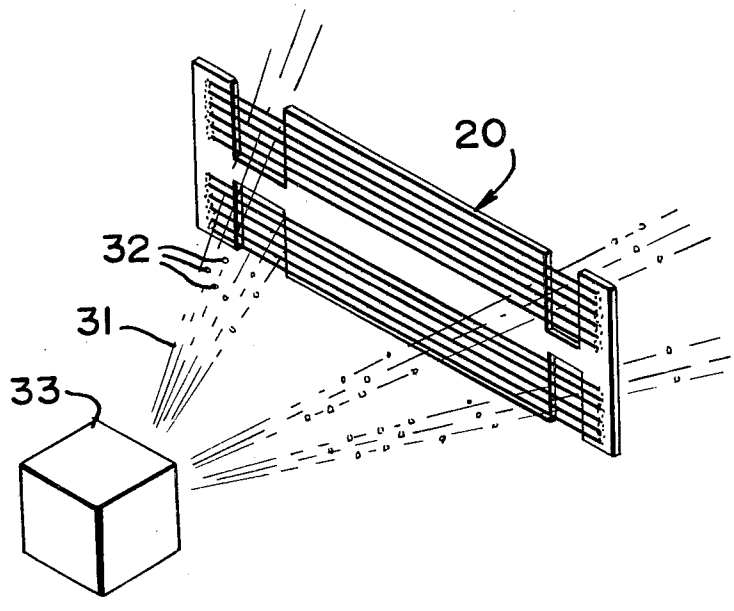


FIG. 1

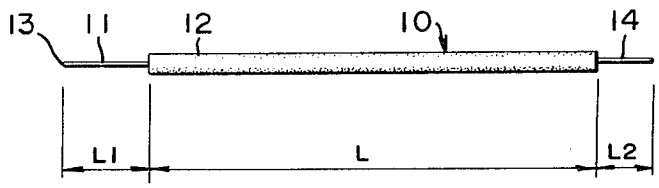


FIG. 2

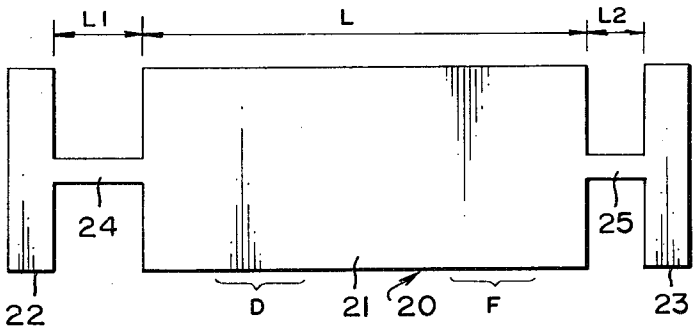


FIG. 3

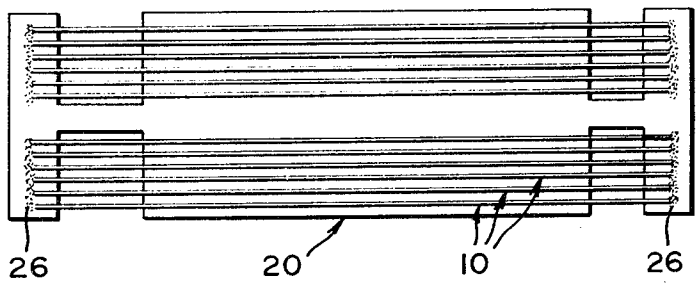
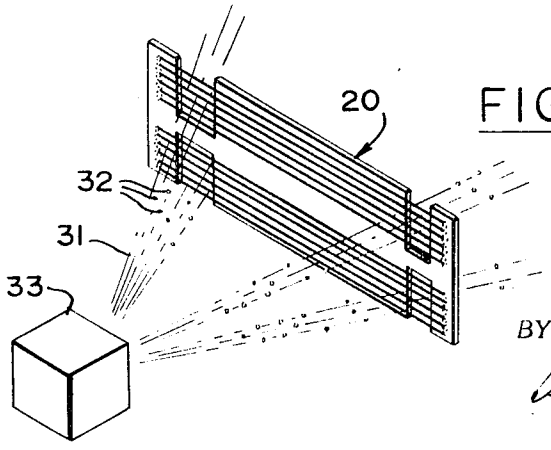


FIG. 4



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METHOD OF REMOVING INSULATED MATERIAL FROM INSULATED WIRES

ORIGIN OF THE INVENTION

The invention described herein was made in the performance of work under a NASA contract and is subject to the provisions of Section 305 of the National Aeronautics and Space Act of 1958, Public Law 85–568 (72 Stat. 435; 42 USC 2457).

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a method of processing wires and, more particularly, to a method of simultaneous removal of insulation from selected portions of wires coated with insulation.

2. Description of the Prior Art

There are many applications in which equal-length, fine insulated wires, which have selected lengths at opposite ends thereof treated, after insulation removal, are required. One such application is in EKG measurements of a living subject without encumbering the subject. In such an application a plurality of biopotential electrodes are attached to the subject's body. Each electrode is connected to one end of an insulated wire, after the insulation was removed therefrom, and the end properly treated. The other end of the wire, which was also treated after the insulation was removed therefrom, is generally attached to a connector or pin which is in turn electrically connected to the measuring instruments.

For optimum performance, it is important to control the length of each insulated wire as well as the lengths of its exposed treated ends. Herebefore, such wires are manually prepared, one wire at a time, as the need arises. This is time consuming and expensive. Furthermore, since wires are individually prepared and treated, significant differences between wires are not uncommon.

OBJECTS AND SUMMARY OF THE INVENTION

It is a primary object of the present invention to provide a new method of providing equal length insulated wires with treated ends.

Another object of the present invention is to provide a new method for the simultaneous production of a large number of insulated wires of uniform length, each wire having the insulation removed from selected portions near its opposite ends.

A further object is to provide a new method for the simultaneous production of a large number of equal length insulated wires from which the insulation at selected points is removed to expose the insulated wires.

These and other objects of the present invention are achieved by providing a method which includes the step of securing a plurality of insulated wires on a special-purpose support member or jig. The jig has notches, so that the portion of each wire which is to remain insulated rests against the jig's surface while the wire's portions from which the insulation is to be removed is exposed through the jig's notches.

After the wires are secured on the jig, the wires are honed to remove the insulation from the wire portions exposed through the jig's notches. This is accomplished by directing an abrasive-material carrier, such as air or liquid under pressure, toward the jig which is placed in the carrier path. Due to the carrier pressure, the carrier passes the jig through the notches therein. As it passes through the notches the abrasive material erodes the insulation off the wires, thereby removing the insulation therefrom.

After insulation removal the exposed wire portions from which the insulation was removed may be treated simultaneously, such as by electroplating silver thereon. Thereafter, the treated wires may be trimmed to control the lengths of the exposed ends of all the wires.

The novel features of the invention are set forth with particularity in the appended claims. The invention will be best understood from the following description when read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of one type of an insulated wire which is produced in accordance with the present invention;

FIG. 2 is a side view of a jig used to produce the type of wires shown in FIG. 1;

FIG. 3 is a side view of a jig with wires supported thereon; and

FIG. 4 is an isometric view of the jig when placed in a stream of an insulation-material carrier.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Before describing the novel method of the present invention, reference is made to FIG. 1 wherein numeral 10 designates a fine insulated wire comprising an electrically conductive wire 11 covered by insulation 12 over a selected length L. The insulation is shown removed from selected portions of lengths of the wire at its opposite ends 13 and 14. The length of the exposed wire at end 13 is designated L1, while the corresponding exposed wire length at end 14 is designated L2. Thus, the wire 10 comprises an insulated wire section of length L with exposed wire of lengths L1 and L2. Such wires have been found to be most useful in the manufacturing of biomedical electrodes.

The primary purpose of the method of the present invention is to provide a plurality of such wires, simultaneously. This is accomplished by providing a wire-support member, hereafter referred to as a jig, which is designated in FIG. 2 by numeral 20. The particular jig comprises three flat coplanar rectangularly shaped sections or members, including a central member 21, connected to end members 22 and 23 by means of connecting arms 24 and 25, respectively. The long sides of members 22 and 23 and the short sides of the central member 21 are equal in length and in parallel alignment. End member 22 is spaced from member 21 by a distance which is typically equal to and in no case less than L1, while end member 23 is spaced from member 21 by a distance which is typically equal to and in no case less than L2. The spaces between member 21 and the end members 22 and 23 represent notches if the jig is thought of as a single rectangularly shaped member.

The length of the long side of the central member is equal to L, representing the length of the wire on which insulation is to remain (see FIG. 1). The lengths of the short sides of end members 22 and 23 are selected to be only sufficiently long to secure thereon wire ends during the processing in accordance with this invention. The length of the short side of the central member 21 and therefore the width of jig 20 depends on the number of wires which are to be processed, simultaneously.

Once the jig is provided, a plurality of fully insulated wires 10 are secured thereon, as shown in FIG. 3. The opposite ends of each wire are secured at the jig's end members 22 and 23, such as by means of a fast-hardening cement designated by numeral 26. All the wires are substantially in parallel alignment. After the wires are secured on the jig, the jig is placed in the path of a stream of air or liquid. The air or liquid is used as a carrier of abrasive material which is supplied from a pressurized carrier source. The carrier, the abrasive material and the source are designated in FIG. 4 by numerals 31, 32 and 33, respectively. The carrier is drawn from source 33 through the jig 20 by creating a vacuum behind the jig.

The central member 21, as well as end members 22 and 23 block the flow of the carrier therethrough. Thus, the carrier, due to the vacuum behind the jig, is forced to pass through the spaces or notches between member 21 and adjacent end members 22 and 23. As the carrier passes therethrough, the abrasive material gradually erodes the insulation on the portions of the wires which are exposed across these spaces. This erosion step represents a wire-honing step, during which the insulation is removed, simultaneously from the opposite ends of all the wires on the jig. By controlling the distances between member 21 and end members 22 and 23 to be equal to L1 and L2, respectively, wire portions of such lengths have the insulation stripped therefrom, during the honing step.

If desired, after the insulation removal, the bare or exposed wires **11** may be treated, such as by electroplating silver thereon. Thereafter, the wires are removed from the jig by cutting them off along the long sides of end members **22** and **23** which are closest to the central member **21**. Thus, each wire is of a length L1+L+L2, with the central length portion L being covered by the insulation, while the wire's opposite ends are exposed along lengths L1 and L2.

From the foregoing it should be appreciated that the objects of the present invention are achieved by providing a special-purpose jig which is used to support a plurality of insulated wires for simultaneous processing. The jig has notches or openings through which selected portions of the wires are exposed from both sides of the jig. By placing the jig in the path of a stream of an abrasive-material carrier, the insulated wires are honed so that the insulation is eroded, by abrasive action, from the wire portions which are disposed about the jig's notches or openings. Clearly, by controlling the shape of the jig and the locations of the notches therein, as well as the notches' dimensions in the direction of the wires, the insulation may be removed from any selected portions of the insulated wires. Such wires may be used with great advantage in interconnecting terminals of an electronic assembly, with the insulated portions of the wires located between terminals to prevent short circuiting.

The jig **10** may be made of wood, plastic, metal, composition material, or any other material which is strong enough to prevent deformation of the jig while the wires are supported thereon. All the edges or sides of the various rectangularly shaped members of the jig should be smoothed to prevent damage to the wires' insulation. In one actual reduction to practice, the novel teachings, disclosed herein, were employed to remove the insulation from selected portions of a single strand, 36 gauge, soft-drawn copper magnet wire which was coated with an insulation material, sold by duPont under the trademark Teflon.

In the particular reduction to practice, two identical jigs were employed. Each jig was first prepared by wrapping masking tape around the end members **22** and **23** as well as around the ends of the central member **21**, with the tape slightly overlapping the short ends. The two jigs were then united, back to back, after proper alignment, by wrapping tape around the two jigs at locations D and F (see FIG. **2**).

Thereafter, wire was wound on the two united jigs along the jigs' length. The winding may be done either manually or by rotating the two united jigs about an axis of rotation which extends along the centers of the jigs and in a direction perpendicular to the long sides of members **21**. The wire should be wound to form closely spaced loops on each exposed side of each jig. Stacking of adjacent wire loops should be avoided. Also wire should not be wound about the support members **24** and **25**.

After the winding step, the wires on the end members **22** and **23** were covered with a fast-drying cement, such as Duco cement, that is not water soluble. After the cement was sufficiently dry, the two jigs were separated by cutting the edges of the tape at D and F and by cutting the wires across the outer ends of the jigs. Thus, after separation two jigs were available each with a plurality of wires, as shown in FIG. **3**.

Thereafter the wires on each jig were honed, as herebefore explained. The honing step can be performed with a dry carrier such as compressed air in a honing machine, known as the Direct Pressure Dry Honer, manufactured by Vacublast Company of Belmont, California. A satisfactory abrasive material is microbead glass particles in the micron range of 210–105 and W. S. Seive size 70+140. A liquid carrier, such as water, may be used with an abrasive comprising 1 part 150 B aluminized grit mixed with 9 parts of 1,250 B aluminized grit. The machine to be used with the liquid carrier may be the Vapor Blast Liquid machine, manufactured by Vapor Blast Company of Milwaukee, Wisconsin.

Following the honing step, an electroplating unit was used to plate the exposed or bare wire ends with silver. After the plating of the bare wire, which represents a wire treatment step, the wires were removed from each jig by cutting off the wire portions backed by end members **22** and **23**, so that the silver-coated portions of each wire conformed to specified lengths.

Although particular embodiments of the invention have been described and illustrated herein, it is recognized that modifications and variations may readily occur to those skilled in the art, and, consequently it is intended that the claims be interpreted to cover such modifications and equivalents.

What is claimed is:

1. The method of producing, simultaneously a plurality of equal-length insulated wires with the insulation material removed from selected portions of said wires, the steps comprising:

supporting a plurality of equal-length insulated wires on a notched support structure, with each wire having at least one selected portion thereof disposed at a selected notch of said support structure;

directing a carrier of an abrasive material at said support structure, so that the carrier passes said structure only through said notches thereby said abrasive material abrasively erodes the insulation material from the selected portions of said wires; and

removing the wires from said support structure.

2. The arrangement as recited in claim **1** wherein said wires are removed from said support structure by cutting all of said wires off said structure along selected points thereof so that all of said wires are of equal length and each wire has an equal portion with the insulation removed therefrom.

3. The arrangement as recited in claim **1** wherein said method includes the step of treating the exposed wires at the portions from which insulation material was removed prior to removing said wires from said support structure.

4. The arrangement as recited in claim **3** wherein said wires are removed from said support structure by cutting all of said wires off said structure along selected points thereof so that all of said wires are of equal length and each wire has an equal portion with the insulation removed therefrom.

5. The arrangement as recited in claim **3** wherein said support structure comprises two identical members which are secured to one another to form a unitary structure and wherein the wires are supported on said structure by winding the wires thereabout, whereby each member of said structure has wires supported on the front face thereof, the method including the step of securing the wires, which are supported on the front face of each member, at the member's opposite ends, and separating the two members from one another, so that each supports a separate set of wires, with each wire having at least one selected portion exposed through a notch in its supporting member.

6. The arrangement as recited in claim **5** wherein each member has two opposite ends with the opposite ends of each wire being supported at the member's opposite ends.

7. The arrangement as recited in claim **6** wherein each member is rectangularly shaped with the two opposite ends thereof being defined by the rectangle's short sides.

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