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METHODS OF MAKING INSULATED CONDUCTORS

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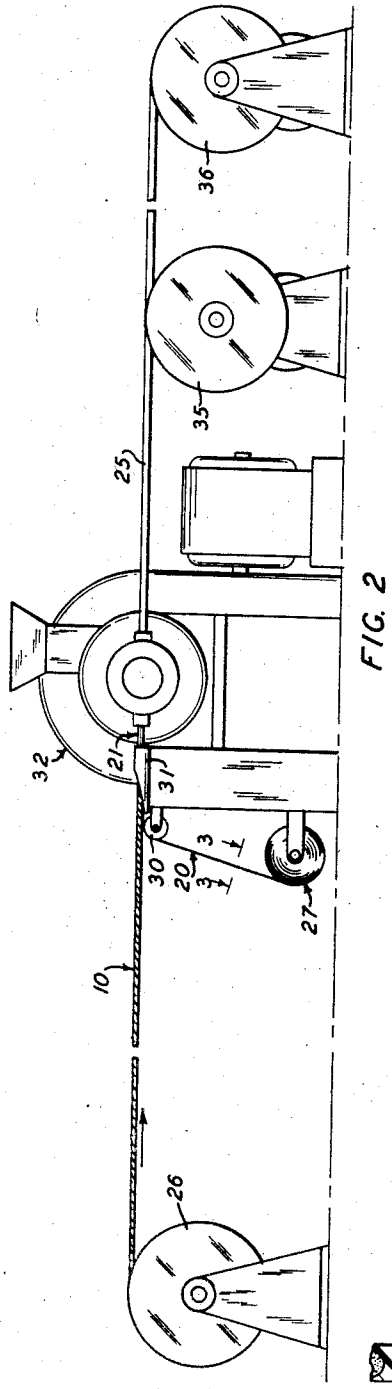


FIG. 2

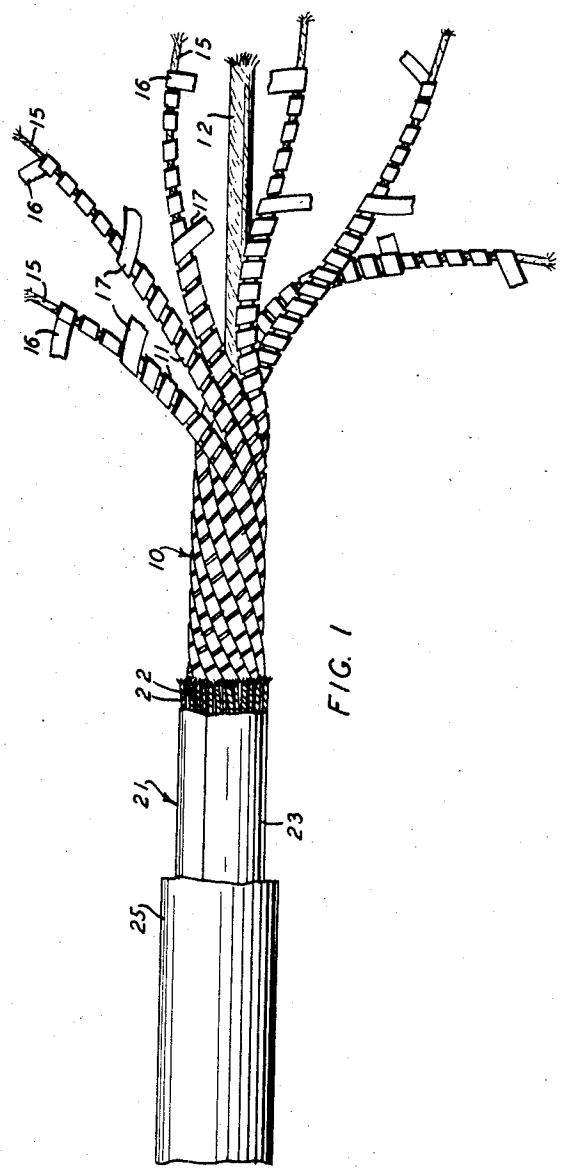


FIG. 1

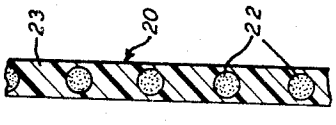


FIG. 3

INVENTOR.
V. S. MARTIN
BY
ATTORNEY

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METHODS OF MAKING INSULATED CONDUCTORS

Victor S. Martin, Towson, Md., assignor to Western Electric Company, Incorporated, New York, N.Y., a corporation of New York

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7 Claims. (Cl. 154—2.24)

This invention relates to methods of making insulated conductors, and more particularly to methods of making flexible tinsel conductors.

In the manufacture of certain types of tinsel conductors for use in communication devices, a plurality of tinsel ribbons are wrapped in various ways around textile strands, a cover of non-conductive material is knitted therearound and an outer covering of plastic insulating material is formed over the conductors while the knitted covering holds them in place. It has been found desirable to eliminate the knitting operation and to cover the twisted tinsel threads with longitudinally extending strands of material, such as cotton or the like. However, it would be difficult to maintain a plurality of longitudinal strands of this nature positioned around the conductors uniformly during the forming of the outer covering.

It is, therefore, an object of this invention to provide new and improved methods of making insulated conductors.

Another object of this invention is to provide new and improved methods of making flexible tinsel conductors.

A method of making insulated conductors illustrating certain features of the invention may include positioning a plurality of conductive strands along an axis, positioning strands held together by a binding material longitudinally of the axis and around the conductive strands, forming insulation around the material-held strands, and dissolving the binding material.

Other objects and advantages of the invention will appear from the following detailed description of a method of making insulated conductors forming a specific embodiment thereof, when read in conjunction with the appended drawings, in which:

Fig. 1 is a fragmentary view of a flexible conductor embodying the invention;

Fig. 2 is a schematic diagram of an apparatus with which methods embodying the invention may be practiced, and

Fig. 3 is an enlarged, fragmentary section taken along line 3—3 of Fig. 2.

Referring now to the drawings, a flexible tinsel conductor **10** consists of a plurality of flexible tinsel threads **11—11** wrapped helically around a center cord **12**. Fig. 1 shows six of such threads **11—11**, but any number could be wound around the cord **12**. The individual tinsel threads **11—11** have stranded cores **15—15** composed of a multiplicity of textile strands, such as cotton or the like. Inner layers **16—16** of tinsel ribbons, preferably of material having high conductivity and flexibility, such as copper, bronze, or the like, are wound in a somewhat helical fashion tightly about the stranded cores **15—15**. Outer layers **17—17** of similar tinsel ribbons are wound in identical fashion over the inner layers **16—16**. It will be noted that the outer layers **17—17** are so positioned as to cover the interstices between adjacent convolutions of the inner layers **16—16**. As far as the tinsel ribbons **16—16** and **17—17** are concerned, the stranded cores

15—15 are chiefly designed to provide tensile strength and to relieve the tinsel ribbons themselves of tensile stress, and at the same time afford minimum resistance to flexure.

A tape **20** is formed into a tube **21** around the flexible tinsel conductor **10**. The tape **20** consists of a plurality of strands **22—22** (Fig. 3), preferably of textile thread spun from cotton, or the like, placed in side-by-side position and secured together by a binding material **23**. The binding material **23** may be a heat-dissolving adhesive, such as glue, a thermoplastic material, or the like. The material **23** forms the body of the tape **20** with the strands **22—22** spaced uniformly across the tape and embedded therein. The tape **20** is formed into a longitudinally extending tube **21**, whereby the strands **22—22** are positioned uniformly around the flexible tinsel conductor **10** so that the axes of the strands are parallel to the axis of the center cord **12**, and the strands are so held initially by the binding material **23**. A covering **25** of insulating material is formed by a suitable process, such as extrusion, around the tube **21**. The insulating material **25** may be a vulcanizable material, such as a compound of rubber, neoprene or the like, or it may be a thermoplastic material, such as polyvinyl chloride, polyethylene, or the like.

In Fig. 2, apparatus is disclosed which may be utilized in performing the objects of the invention. A supply reel is shown at **26** to provide a supply of the conductor **10** consisting of the twisted tinsel threads **11—11** wound helically around the center cord **12**, as described above. A supply pad **27** of the tape **20** is provided, and the tape is passed therefrom over a guide roller **30** and through a suitable tube forming device **31**, which forms the tape into the tube **21** around the flexible tinsel conductor **10**. The flexible tinsel conductor **10** and the tube **21** formed therearound are then passed as a unit through an extruding machine **32**, and the covering **25** is extruded around the tube **21**. The completed conductor is wrapped around a capstan **35** which draws the conductor through the extruding machine **32**, and finally is wound on a takeup reel **36**.

The tape **20**, which consists of the longitudinal threads **22—22** held together initially by the binding material **23**, is relatively stiff at room temperature and may be formed readily into a tube without coming apart. However, the heat generated in the extruder **32** is sufficient to dissolve the material **23** holding the strands **22—22** together, so that the strands **22—22** are relatively free to turn or bend at will. This results in a flexible, insulated tinsel conductor.

As hereinbefore stated, the binding material **23** of the tape **20** may be an adhesive, such as glue, a suitable thermoplastic material, or other material capable of binding the strands together, but which decomposes, disintegrates or melts at a temperature no higher than that reached in the extruder. If the material is made of glue, the glue will disintegrate in the extruder **32** when the covering **25** is formed therearound, be reduced to small particles of powder-like form, and be dispersed within the covering. If the binding material is made of a thermoplastic material, the material will melt during the extruding operation and may become integral with the covering **25**. When a polymerized thermoplastic material is utilized to form the covering **25**, it may be desirable to use the same material of lower polymerization, or another low melting point plastic, for the binding material **23**, so that the binding material will melt at a temperature lower than that to which the covering material will be heated during the extrusion operation. By so doing, the material **23** will be assured of melting within the covering **25**. When the term "dissolving" is used herein and in the annexed claims, it is intended to mean a decomposition, disentegration or melting of the binding ma-

terial, as distinguished from the dissolving of a material in a solvent.

If the covering 25 is a vulcanizable material, such as rubber, neoprene, or the like, a vulcanizing chamber of conventional design would be placed between the extruder 32 and the capstan 35 to cure the material. If the covering 25 is a thermoplastic material, a water trough may be placed therebetween to cool the material.

The spacing between the strands 22—22 is greatly exaggerated in the drawings, and in fact is quite small. These strands, while lending flexibility to the finished tinsel conductor 10, also contribute great tensile strength thereto, They act further as a barrier between the metallic tinsel ribbons 16—16, 17—17 and the extruded covering 25. This barrier is necessary if, for example, the tinsel ribbons are made of copper or bronze and the covering of rubber has some sulfur therein. The sulfur would have a corrosive effect on the copper or bronze and this effect is prevented by interposing the strands 22—22 between the two. The strands also act as a mechanical barrier to protect the tinsel ribbons 16—16 and 17—17 against damage by crushing or other compressive forces to which the conductor 10 may be subjected in use.

It is manifest that the invention is not limited to the preferred embodiments hertofore described and various modifications may be made within the spirit and scope of the invention. Thus, the covering 25 may be applied in any manner as long as the requirement is satisfied that sufficient heat be generated during such application to dissolve the binding material 23.

Also, it is evident that the tinsel conductor may comprise a single textile core around which a plurality of tinsel ribbons are helically wound. For example, four tinsel ribbons may be wound around a textile core and the tape 20 and outer covering 25 applied therearound, as hereinbefore described.

What is claimed is:

1. The method of making insulated conductors, which comprises positioning a plurality of conductive strands along an axis, positioning strands held together by a binding material disintegrable at a predetermined temperature parallel to said axis and around said conductive strands, and forming insulation around said material-held strands at a temperature at least as high as said predetermined temperature so that said binding material is disintegrated.

2. The method of making insulated conductors, which comprises positioning a plurality of conductors along an axis, forming a tube of non-conductive strands secured together by a heat-disintegrable binding material disintegrable at a predetermined temperature around said conductors and parallel to said axis, and forming a plastic covering around said non-conductors at a temperature at least as high as said predetermined temperature such that the said material is disintegrated.

3. The method of making insulated conductors, which comprises positioning a plurality of conductors together, forming a tube of non-conductive strands secured together by a thermoplastic material disintegrable at a predetermined temperature around said conductors and longitudinally with respect thereto, forming a covering of insulating material around said tube at at least said predetermined temperature, and disintegrating said thermoplastic material during the formation of said covering.

4. The method of making insulated conductors, which comprises positioning a plurality of conductive strands along an axis, positioning strands held together by glue disintegrable at a predetermined temperature longitudinally of said axis and around said conductive strands, forming a covering of insulation around said glue-held strands at at least said predetermined temperature, and disintegrating said glue during the formation of said covering.

5. The method of making flexible conductors, which comprises winding a plurality of conductors helically around a center core, forming a tube of textile strands secured together by an adhesive disintegrable at a predetermined temperature around said conductors so that the axes of said strands are parallel to the axis of said center core, forming a covering of plastic material around said tube at at least said predetermined temperature, and causing said adhesive to disintegrate during the formation of said covering.

6. The method of making tinsel conductors, which comprises winding a plurality of tinsel ribbons helically around textile strands to form tinsel strands, winding a plurality of said tinsel strands helically about a center textile core, forming around said wound tinsel strands a tube made of a tape comprising thermoplastic material disintegrable at a predetermined temperature in which is embedded a plurality of textile strands having axes parallel to the axis of the core, and extruding an outer covering around said tube at a temperature at least as high as said predetermined temperature such that said thermoplastic material disintegrates.

7. The method of making flexible tinsel conductors, which comprises winding a plurality of flat tinsel ribbons helically around a cotton thread to form a tinsel strand, winding a plurality of said tinsel strands helically around a center textile core, forming a tape made of flexible, parallel cotton strands held together by glue disintegrable at a predetermined temperature longitudinally into a tube around said helically wound tinsel strands, passing said tube-covered tinsel strands through an extruding device to extrude a covering of insulation material therearound at at least said predetermined temperature, and disintegrating said glue during the extruding of said covering so that said glue is dispersed and said cotton strands are relatively free.

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