Oct. 13, 1942. G. R. BROWN 2,298,748

METHOD OF MAKING ELECTRIC CABLES

Filed Oct. 28, 1939

FIG. 1

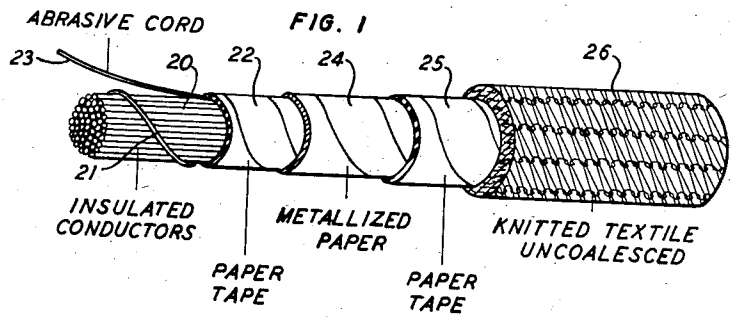


FIG. 2

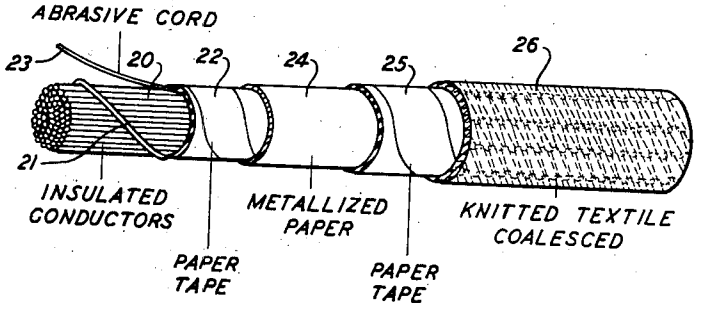
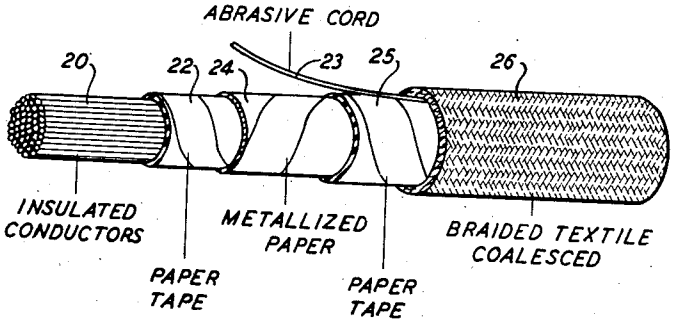


FIG. 3



INVENTOR
G. R. BROWN
BY E. R. Moulan
ATTORNEY

Patented Oct. 13, 1942 2,298,748

UNITED STATES PATENT OFFICE

2,298,748

METHOD OF MAKING ELECTRIC CABLES

George R. Brown, Newark, N. J., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York

Application October 28, 1939, Serial No. 301,749

3 Claims. (Cl. 96—3)

This invention relates to a method of making electrical conductors, and more particularly to a method of making compound insulated assemblies of multiple conductors such as the cables used especially in the construction of telephone switchboards and a method of making them.

Telephone switchboards and similar central station apparatus cannot ordinarily be made complete by mass production methods, since each such structure ordinarily has to be specially designed and assembled to meet the demands of the particular locality in which it is to be put in service. Such an apparatus will comprise a large number and variety of standard electrical devices of many kinds, mechanically mounted in a specially assembled frame or housing and interconnected by a complex web of electrical conductors. These conductors are usually individually insulated and assembled in cables, in which it is necessary that the multi-strand core be variously protected against mechanical injury during assembly and installation and in subsequent use, against variable atmospheric conditions, especially humidity variations, and also sometimes be electrically shielded to diminish inductive effects or the like. Such cables are ordinarily manufactured and stored in long lengths, from which pieces are cut as required for each apparatus to be assembled. It then becomes necessary to cut away the sheath or sheaths over the multi-strand core at each end of such a piece for a greater or smaller distance to gain suitable access to the individual strands for suitably connecting these into place in the apparatus.

An object of the present invention is to provide an improved method of making an electrical conductor cable, especially cable adapted for use as switchboard cable in the manner described, having one or more sheaths over a multi-strand core for mechanical and/or electrical protection of the same, which shall be simple and easy to manufacture by customary methods and which shall also be so constructed that the sheath or sheaths thereof may be readily and simply removed as desired without requiring special tools for that purpose, and which, furthermore, shall present an unusual degree of resistance to damage by changes in atmospheric environment.

With the above and other objects in view, an illustrative embodiment of the invention may be presented in steps of a method for making a multi- conductor cable comprising an axial core of conductor strands, a sheath or a wrapping of paper tape over the core, a sheath or wrapping of metallized paper tape or of metal tape over the paper sheath, a second sheath or wrapping of plain paper tape, and an outer sheath of textile threads preferably knitted but in some instances braided or served over the outer paper sheath. The outer textile sheath is preferably composed of knit textile threads which have been coated or impregnated with a suitable thermoplastic material such as cellulose acetate, vinyl acetate, ethyl cellulose or the like; and which, after having been knit into place, have been treated with heat and pressure and thus coalesced into a continuous, impervious sheath.

Other objects and features of the invention will appear from the following detailed description of one embodiment thereof taken in connection with the accompanying drawing in which the same reference numerals are used to indicate identical elements in the several figures, and in which

Fig. 1 is a diagrammatic perspective view of a piece of cable constructed in accordance with the invention, but before coalescence of the outer knitted sheath;

Fig. 2 is a similar view of the same after coalescence; and

Fig. 3 is a view similar to Fig. 2, but in which the outer sheath is braided.

The structure disclosed in Figs. 1 and 2 is a multi-conductor cable particularly adapted to be used in telephone switchboard construction. It comprises a central axial core **20** consisting of a plurality of individually insulated electrical conductors associated and compacted together into a substantially solid but flexible cylindrical mass. As shown, these conductors or wires are laid together parallel to their common axis and held together by a spiral binder strand **21**. The wires of the core **20** may, however, in some instances be intertwisted together helically in the familiar cable fashion. Also, in some instances, it will not be necessary to include the binder strand **21** and this may be omitted as in Fig. 3.

Over the conductor core **20** is a sheath **22** consisting of a paper tape wrapped around the core in a helix whose successive turns overlap each other to form the closed sheath.

A stripping strand **23** may be included with the conductors of the core under the sheath **22** and either under or over the binder strand **21**, as preferred.

Over the sheath **22** is wrapped a sheath **24**, also preferably of helically wound tape. According to the situation in which the cable is to be used, the principal function of this sheath may be to provide electrical shielding for the conductors, or protection against atmospheric humidity, or both,

Hence the tape of which this sheath 24 is composed may be of material appropriate to the particular purpose in hand, metal or metallized paper for electrical shielding, paper impregnated with paraffin or wax or cellulose acetate or the like, or a strip of cellulose plastic film or film of other suitable analogous material. In an extreme case the sheath 24 may be of rubber or gutta percha compound or the like, either formed into a tape and wound in place as in Fig. 1 or extruded directly as a seamless sheath as in Fig. 2.

In many instances a second sheath 25 of plain paper tape as used in the sheath 22 may be wound in place directly on the sheath 24; although in some instances this sheath 25 may be omitted where the sheath 24 is of a nature to pass without danger of injury through a knitting machine, braiding machine or the like.

In any case the cable is provided with the specially constructed outer sheath 26. Preferably this is composed of textile threads knitted into a seamless tubular fabric closely enveloping the cable structure within. The threads of which this sheath is knitted may be dyed before knitting with any desired color in case sheath color may be used as identification means to indicate the structure or purpose of the particular cable. Preferably the threads are pre-treated before the knitting by coating or impregnating them with some material such as cellulose acetate, vinyl acetate, ethyl cellulose or the like thermoplastic substance. After the sheath 26 is knitted in place (Fig. 1), it is treated with heat and pressure, as by drawing the structure of Fig. 1 through a heated die or between heated and grooved rollers. By this procedure, the thermoplastic compound on the knitted threads is softened, spread and interwelded so that the meshed, knitted sheath becomes a continuous impervious tube of the compound coalesced from and about a mechanically supporting skeleton of interknitted textile threads as indicated in Fig. 2.

A principal characteristic feature of the invention is that this outer coat or sheath of textile threads substantially embedded in and affording mechanical support to a continuous, impermeable tubularly laminar sheet of substantially structureless thermoplastic material is formed by the coalescence of the thermoplastic material carried by the threads, the material having been coalesced by heat and pressure after the material carrying threads have been knitted, braided or otherwise combined into a non-continuous sheath. Such a sheath is of a quite different character from one formed by knitting a web of plain textile threads about the core and subsequently impregnating and/or coating the web sheath thus formed with thermoplastic. The sheath of the invention is composed of a network of threads substantially wholly embedded within the coalesced thermoplastic; whereas, when a preformed sheath of untreated textile threads is coated and/or impregnated subsequently with thermoplastic, the latter does not enclose the threads completely, as these are then in contact with the core surface underneath. In fact, it may frequently be possible to abrade or strip the completed thermoplastic film in the latter case from the textile web; whereas when the sheath is made in accordance with the invention this is substantially impossible.

Since switchboard cable is manufactured and stored in long lengths to be cut off and used in short pieces of varying length, it is necessary to strip off the sheathing over the axial bundle of conductors at each end of each piece used, in order to connect the individual conductors as requisite. The outer sheath 26 when made in the manner described is remarkably tough. Hence the rip cord 23 is included in the structure, either under all the sheaths, as in Figs. 1 and 2, or immediately under the outside sheath only, as in Fig. 3. One suitable structure for the cord 23 takes the shape of a tough strand of textile fiber coated or impregnated with a suitable tough and flexible adhesive material, e. g., a plasticized glue or rubber adhesive or a cellulose acetate compound or the like, and having a suitably fine grained, sharp edged abrasive or cutting powder embedded in the adhesive material, e. g., powdered glass, carborundum, emery, or the like. Or the strand may be a metal wire of triangular or diamond shaped cross-section having the radially outwardly positioned edge of the wire smoothly or jaggedly sharp.

The structure shown in Fig. 3 is essentially like that of Figs. 1 and 2, except that it embodies minor variations. Thus in Fig. 3 the sheaths 22, 24 and 25 are alternately right and left hand helices instead of all alike as in Figs. 1 and 2. Also the textile skeleton of the outside sheath 126 is braided instead of knit. Also, as already noted, the rip cord 23 is over the sheath 25 instead of under the sheath 22. Once the outside sheath 126 has been stripped back as far as desired, there is no difficulty in unlaying the helical tapes under it. Hence it is often sufficient for the rip cord to cut only the outside sheath.

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

What is claimed is:

1. A method of making an electric cable having a core, which method comprises the steps of coating textile threads with thermoplastic material, combining the coated threads into a discontinuous sheath about a core, and subjecting the discontinuous sheath to heat and pressure to coalesce the thermoplastic material on the threads into a continuous seamless substantially structureless body having embedded therein as a skeleton the discontinuous structure of textile threads.

2. A method of making an electric cable having a core, which method comprises the steps of coating textile threads with thermoplastic material, interknitting the coated threads into a discontinuous sheath about a core, and subjecting the discontinuous sheath to heat and pressure to coalesce the thermoplastic material on the threads into a continuous seamless substantially structureless body having embedded therein as a skeleton the discontinuous structure of textile threads.

3. A method of making an electric cable having a core, which method comprises the steps of coating textile threads with thermoplastic material, interbraiding the coated threads into a discontinuous sheath about a core, and subjecting the discontinuous sheath to heat and pressure to coalesce the thermoplastic material on the threads into a continuous seamless substantially structureless body having embedded therein as a skeleton the discontinuous structure of textile threads.

GEORGE R. BROWN.