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METHOD OF MAKING FIREPROOF ELECTRIC INSULATED CABLES

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Fig. 1.

Fig. 2.

Fig. 3.

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METHOD OF MAKING FIREPROOF ELECTRIC INSULATED CABLES.

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My invention relates to sheathed electric cables and particularly to a method of making the same.

An object of my invention is to provide an electric cable that may be easily manufactured.

Another object of my invention is to provide a sheathed insulated electric cable that shall be fireproof and adapted to withstand high temperature.

Another object of my invention is to provide a sheathed electric cable that shall be of compact structure and water-proof.

In practicing my invention I provide an electric conductor of relatively large diameter, that is enclosed by magnesium metal and a metallic tubular member of such diameter as to enclose the magnesium metal and the electrical conductor. The magnesium metal is then subjected to an atmosphere of steam at a relatively high pressure and treated in accordance with the method disclosed in my U. S. Reissue Patent No. 16,340 and my corresponding Norwegian Patent No. 37,662. The action of the steam upon the magnesium is such that the magnesium metal is oxidized to magnesium oxide. It is characteristic of magnesium metal when oxidized in this manner to expand to approximately 200% of its original dimensions. By proportioning the respective diameters of the conductor and the metallic tube it is possible to so utilize the expansion of the magnesium metal that it will tightly wedge the conductor in the tubular member, thereby holding them in firm operative relation with each other.

After the magnesium metal has been oxidized to magnesium oxide, the entire tubular structure is reduced to a smaller diameter and increased proportionately in length by any well known drawing operation, or by a swaging and rolling process. The tubular structure may be drawn through a die, or swaged and rolled, a plurality of successive times and annealed between the drawing operations to properly condition the tube and conductor for further reduction in diameter and corresponding increase in length.

In the accompanying drawings,

Figure 1 is a partial view in vertical section of the device embodying my invention in the initial stage of the manufacturing process to which it is subjected.

Fig. 2 is a view illustrating the device shown in Fig. 1 after the magnesium metal has been subjected to an oxidizing operation and, Fig. 3 is a partial view, shown partially in section, of the device illustrated in Figs. 1 and 2 after it has been subjected to such operations as to reduce its diameter and to increase its length.

In the drawings, a sheathed electric cable 11 comprises an electric conductor 12, a plurality of magnesium helices 13 and 14 disposed therearound and a metallic tube 15 disposed around the magnesium helices and the conductor. Clearance spaces 16, 17 and 18 are provided whereby oxygenous vapor, such as steam, may be passed therethrough to oxidize the magnesium helices 13 and 14 and to permit the metal to expand as it becomes oxidized. The method to be used is more particularly disclosed and claimed in my Reissue Patent No. 16,340.

The conductor 12 may be made of any suitable material such as copper, aluminum, or other electric conducting material having relatively low ohmic resistance. The magnesium helices 13 and 14 may be made by winding a relatively thin and narrow strip of magnesium metal on a suitable mandril to provide a predetermined inside diameter of a helix so wound. The tube 15 may be made of material that may be readily drawn through a die to decrease its diameter and to increase its length.

In Fig. 2 of the drawings I have illustrated the device shown in Fig. 1 after the magnesium metal helices 13 and 14 have been oxidized to magnesium oxide 19 with an increase in volume of the magnesium oxide. The spaces 16, 17, and 18 have been completely filled and the conductor 12 and the tube 15 are rigidly maintained in operative relation to each other. The magnesium oxide 19 is of a fine grained crystalline structure, which structure extends radially from the conductor 12 to the tube 15. The magnesium crystals of oxide 19 are of relatively soft structure, so that when the cable 11 is drawn through a die to reduce its diameter and to increase its length, the crystals do not cut into the surface of the conductor 12.

It has been well known to fill tubular metallic members of relatively small diameter with powdered magnesium oxide for insulating the resistor member therefrom and then reduce the diameter of the tube and the resistor to further compact the powder about the resistor member. But, if tubes of rela-
tively long length are employed, it is not practicable to use a very fine grained magnesium oxide powder because the volume is too large for a given weight to fill the tube sufficiently. If a coarse grained magnesium powder is employed in an electric cable embodying a copper conductor, the individual grains lying next to the conductor 12 would embed themselves in the surface thereof, and when the tube 15 is drawn through a die there is danger of the granular magnesium severing the conductor because such conductors are relatively soft in structure as compared with conductors used for resistor purposes.

Since the magnesium oxide produced by oxidizing magnesium metal in an atmosphere of steam vapor at a relatively high temperature will produce magnesium oxide crystals that are soft in structure and that will not embed themselves in the surface of the conductor 12 when the cable 11 is drawn through a die to diminish its diameter and to increase its length, this danger is avoided.

Before the cable 11 is drawn through a die to reduce its diameter and to increase its length, the cable should preferably be annealed. If the cable 11 is not reduced to the proper dimensions with one drawing operation, several drawing operations may be employed. The cable 11 may be subjected to annealing operations between the drawing operations if it is found necessary or desirable.

It has been found that the magnesium crystals produced by the method described in my U. S. patent referred to above, flow in much the same manner that metal flows when being reduced by a drawing operation so that when the cable 11, illustrated in Fig. 2, is reduced in diameter and increased in length by such drawing operation, the magnesium oxide 19 flows longitudinally of the tubular member 15 and its diameter is thus reduced proportionately, substantially as shown in Fig. 3 of the drawing. I provide, therefore, a cable substantially as illustrated in Fig. 3 of the drawings, that comprises a conductor 12 of suitable dimensions, and predetermined current carrying capacity, a metallic sheath 15 and an insulating sheath 21 of magnesium oxide 19 that has a relatively high dielectric strength. The cable 11 illustrated in Fig. 3 of the drawing is substantially fire-proof and water-proof and may be successfully employed for conducting electrical energy in such places where atmospheric conditions are severe.

The sheathed electric cable illustrated in Fig. 3 of the drawings may be employed in the construction of coils for induction motors and similar translating devices, or of transformers where it is desirable to operate the coils at a very high temperature. It is possible to operate conductors of the construction illustrated in the drawings at temperatures up to 250° C. without injuring the structure thereof.

It is to be understood that the resultant dimensions of the conductor 12, the magnesium oxide insulation 19, and the metal tube 15 of the finished cable may be of any suitable dimensions. As an example, if a copper tube twenty meters long having inside and outside diameters of 15 and 18 millimeters respectively, and two magnesium sheaths made from magnesium ribbon 1.2 millimeters thick and a central conductor of copper having a diameter of 5 millimeters, are placed in position as illustrated in Fig. 1 of the drawings, and treated with steam to oxidize the magnesium metal with a consequent reduction in a drawing die, the finished cable may have an outside diameter of approximately 6 millimeters. The tubular member 15 and the conductor 12 will then have their lengths increased to approximately 142 meters and the outside diameter of the conductor will have been diminished to approximately 0.67 millimeters. The diameter of the conductor 12 will then have been reduced to approximately 1.86 millimeters and the thickness of the magnesium oxide to approximately 1.36 millimeters.

During the drawing process, the oxide is further compacted so that its volume is slightly diminished, the amount of which depends upon metal in the conductor and tube and also upon the hardness of the metals.

By my invention, I provide a sheathed electric cable that is simple in construction, compact and rugged. The cable is fire-proof and water-proof and lends itself to applications that are adverse to the successful operation of electric cables having fibrous insulation thereon.

Various modifications may be made in the device embodying my invention. I desire, therefore, that only such limitations shall be placed therein as are imposed by the prior art and the appended claims.

I claim as my invention:

1. The method of making fire-proof sheathed, insulated, electric cables which consists in enclosing an electric conductor of relatively large diameter within a tubular member of much larger diameter, loosely filling the space between the tubular member and the conductor with metallic magnesium, subjecting the tubular member, conductor and magnesium metal to steam at relatively high pressure until the magnesium metal has been completely changed to magnesium oxide, and then subjecting the cable to drawing operations to reduce the diameter and to increase the length thereof.

2. The method of making a fire-proof sheathed electric cable which comprises enclosing an electric conductor of relatively
large diameter within a metallic magnesium sheath, enclosing the magnesium sheath and conductor within a tubular member, subjecting the magnesium metal to an oxygenous vapor at relatively high pressure and temperature to completely oxidize the magnesium, and then reducing the diameter and increasing the length of the tubular member and conductor.

3. The method of making sheathed, electric conductors which comprises enclosing an electric conductor of relatively large diameter within a tubular member of greater diameter to provide a clearance space therebetween spacing the conductor from the tubular member with a helix of metallic magnesium, subjecting the tubular member, conductor and helix to oxygenous vapor at relatively high pressure and temperature, and then reducing the diameters of the tubular member and conductor and increasing the lengths thereof.

4. The method of making fire-proof, sheathed electric cables which comprises enclosing an electric conductor of relatively large diameter within a plurality of metallic magnesium sheaths, enclosing the sheaths and conductor within a tubular member, subjecting the sheaths to an oxygenous vapor at relatively high pressure and temperature to completely oxidize the magnesium, and then reducing the diameter and increasing the length of the tubular member and conductor.

5. The method of making fire-proof, electric conductors which comprises enclosing an electric conductor of relatively large diameter within a tubular member of greater diameter to provide a clearance space therebetween, spacing the conductor from the tubular member with a plurality of metallic magnesium helices, subjecting the helices to oxygenous vapor at relatively high pressure and temperature and then reducing the diameters of the tubular member and conductor and increasing the lengths thereof.

6. The method of making fire-proof, electric cable elements which comprises enclosing an electric conductor within a tubular member, inserting metallic magnesium into the space between the conductor and tubular member, and subjecting the magnesium metal to an oxygenous vapor at a relatively high pressure to oxidize the magnesium, and then increasing the length of the elements.

In testimony whereof, I have hereunto subscribed my name this 13th day of September, 1926.

CHRISTIAN B. BACKER.