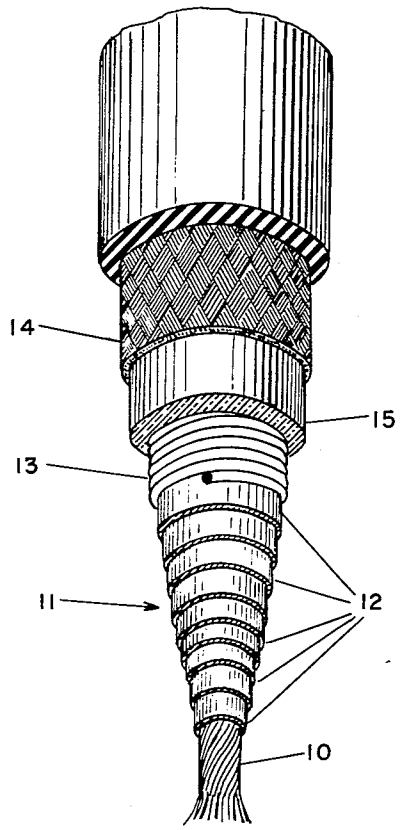
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DELAY CABLES

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DELAY CABLES

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This invention relates to delay cables and more particularly to high impedance transmission means providing low loss delay elements for use in communications and high frequency applications.

Delay cables known in the art include as a core element thereof, a mixture of a suitable dielectric binder and finely divided magnetizable material, the mixture being preformed to produce the core element by an extrusion or molding procedure. It has been found that such core elements have non-uniform physical dimensions due to the stresses incident to the reeling and other necessary mechanical operations which tend to deform the core elements and cause non-uniform elongation thereof. Such variations in the physical dimensions of the core elements appears to adversely affect the electrical characteristics of the completed cable.

Accordingly, one object of this invention is to provide an improved core element for delay cables which include means in the form of an elongated, substantially inextensible base member to which the core material is applied, thereby insuring a core element resistant to deformation and elongation and providing in the completed cable uniformly excellent operating electrical characteristics.

It has also been found that the conventional method of forming core elements by extrusion or molding procedures apparently results in a maldistribution of the magnetizable material in the dielectric binder which results in cable having impaired electrical properties.

Accordingly, another object of this invention is to provide an improved core element for delay cables wherein the admixture of dielectric binder and finely divided magnetizable material dispersed therein, is subdivided into a plurality of very thin, independent layers, the layers being superposed to form the core element and providing for uniform distribution of the magnetizable material in the binder matrix.

A further object of this invention is to provide an improved method of forming core elements for delay cables by using an inextensible base member on which is applied a plurality of independent, superposed coatings of an admixture of dielectric binder and finely divided magnetizable material uniformly dispersed therein, each coating being separately dried and of a thickness ranging between about 0.01 to about 0.10 millimeter.

Other objects of this invention will in part be obvious and in part hereinafter pointed out.

In the drawing the figure shows an enlarged view of a delay cable embodying the invention.

In accordance with the instant invention, as shown in the figure an elongated base member **10** is provided which may take the form of silk, rayon, linear polyamide, asbestos or glass fibers which are twisted together to form a substantially inextensible member having high tensile strength and resistance to distortion.

There is then applied to such base member an admixture of a dielectric binder and finely divided magnetizable material generally indicated at **11**. The binder may be

a cellulose lacquer or a synthetic plastic such as polyvinyl acetate, polyisobutylene, ethyl cellulose, benzyl cellulose, polyvinyl chloride, after chlorinated polyvinyl acetate, polystyrene, polyethylene, polyurethane, oil containing or oil free polyester resins, plasticized phenolic or urea resins, epoxy resins, melamine condensation products, diisocyanate polyester adducts, and mixtures thereof. The binder may be dissolved in a suitable solvent or may be in the form of a liquid dispersion or molten mass.

The magnetizable material which is dispersed in the binder, may be carbonyl iron powder having a fineness ranging between about 0.001 mm. to about 0.010 mm. Ferrites, iron oxide powders and the like may also be used. The individual particles of magnetizable material may bear an insulating coating which may result from a phosphatizing treatment of the particles. The magnetizable material and binder are combined in suitable proportions to attain the desired electrical characteristics in the final product, the powdered material being well dispersed in the binder.

The mixture of binder and powdered material is placed in a tank of suitable dimensions and an elongated base element of twisted glass fibers or the like, is passed through the dispersion in the tanks by means of suitable reeling and unreeling equipment known in the coating art. The coating produced on the base element is quite thin and the thickness thereof may be regulated in accordance with the viscosity of the dispersion, the rate of travel of the base element in the tank and the dimensions of the tank.

The coated base element leaving the tank is then passed through a drying oven which may be gas fired or provided with ultra violet lamps or the like, to dry the applied coating. The coating tank and drying oven are suitably arranged to permit a repetition of the coating operations until a desired number of independent coatings **12** are superposed on the base element. Thus there may be produced a core element for a delay cable of selected dimensions in accordance with the electrical characteristics desired of the final product.

The drying oven is maintained at a temperature such as to insure substantial elimination of solvent from the individually applied coatings. It is undertsood that such drying temperature will vary with the binder composition and the solvent or dispersing medium present in such composition as well as the rate of travel of the coated base element through the drying oven.

By building up the core element in the form of thin individual layers, it has been found that the finely divided magnetizable material is so well dispersed in the dielectric binder as to insure uniformity in the electrical operational characteristics thereof. Furthermore, it is possible to increase the proportion of the magnetizable material carried by the binder without concern for maldistribution of the material in the binder. It is understood that the greater the proportion of magnetizable material in the core element, the greater the permeability thereof.

The core element of the instant invention is used to make delay cables by winding an insulated wire **13** helically over the element to form an inner conductor of the cable, there being further provided an outer conductor **14** and spacer dielectric **15**, applied in a manner known in the art. With cores of the instant invention, it has been found that the completed cables show an unusual increase in impedance and time delay while maintaining low losses. Furthermore, the cable has a linear phase characteristic in the entire applicable frequency range and therefore a very low signal distortion.

If desired, several of the core elements made in accordance with the instant invention, may be twisted together to form the base to which the helically wound inner conductor is applied.

While the coating procedure described above produces a core element of circular cross section, such cross section may be varied by passing the coated core base through dies of selected section.

It will be apparent that there has been provided delay cables and methods of making the same in which the several objects of the invention have been achieved and which are well adapted to practical usage.

As various possible embodiments might be made of the above described invention and as changes might be made in the embodiments herein set forth, it is understood that all matter herein set forth is to be interpreted as illustrative and not in a limiting sense.

Having thus described our invention, we claim as new and desire to protect by Letters Patent:

1. A delay cable comprising an inner conductor including a core element and a conductor wound on said element, an outer conductor, and dielectric means spacing said inner and outer conductors, said core element including an elongated, substantially inextensible base member of dielectric material and a mixture of finely divided magnetizable material and a dielectric binder on said base member, said magnetizable material being uniformly distributed through said binder, said cable having uniform electrical characteristics along the length thereof.

2. A delay cable comprising an inner conductor including a core element and a conductor wound on said element, an outer conductor, and dielectric means spacing said inner and outer conductors, said core element including an elongated, substantially inextensible member of twisted glass fibers and a dispersion of finely divided magnetizable material in a dielectric binder enclosing said member, said dispersion being free from mechanical stresses and deformation and said cable having uniform electrical characteristics along the length thereof.

3. A delay cable comprising an inner conductor including a core element and a conductor wound on said element, an outer conductor, and dielectric means spacing said inner and outer conductors, said core element including an elongated, flexible, substantially inextensible base member and a magnetizable core on said member comprising a plurality of superposed, thin layers of a mixture of finely divided magnetizable material and a dielectric binder, said layers having similar magnetic properties.

4. A delay cable comprising an inner conductor including a core element and a conductor wound on said element, an outer conductor, and dielectric means spacing said inner and outer conductors, said core element including a plurality of superposed, individual thin layers of material, each layer comprising a similar mixture of finely divided magnetizable material and a dielectric binder.

5. A delay cable comprising an inner conductor including a core element and a conductor wound on said element, an outer conductor, and dielectric means spacing said inner and outer conductors, said core element including a plurality of superposed, dried thin layers of a uniformly similar mixture of finely divided iron carbonyl powder and a resin binder.

6. A delay cable comprising an inner conductor including a core element and a conductor wound on said element, an outer conductor, and dielectric means spacing said inner and outer conductors, said core element including a plurality of superposed, thin layers of magnetizable material having similar magnetic properties, each layer including finely divided magnetizable particles bearing an insulating coating and uniformly dispersed in a dielectric binder.

7. A delay cable comprising an inner conductor including a core element and a conductor wound on said element, an outer conductor, and dielectric means spacing said inner and outer conductors, said core element including an elongated, substantially inextensible dielectric base member and an elongated magnetizable covering enclosing said base member and supported thereby, said covering comprising a mixture of a dielectric binder and finely divided magnetizable material uniformly distributed therethrough to provide uniform magnetic properties throughout the thickness of said covering and to provide uniformity of electrical characteristics of said cable throughout the length thereof.

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