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INORGANIC FIBER ROPE

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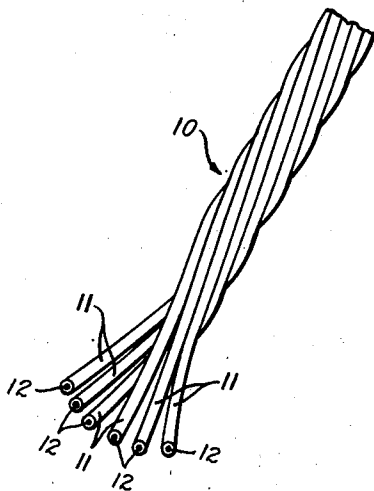


Fig. 1

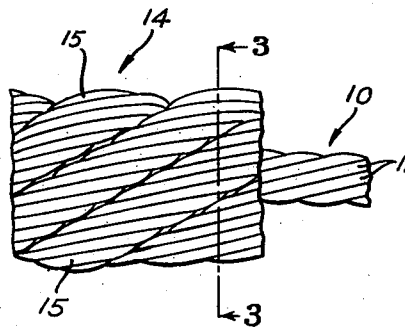


Fig. 2

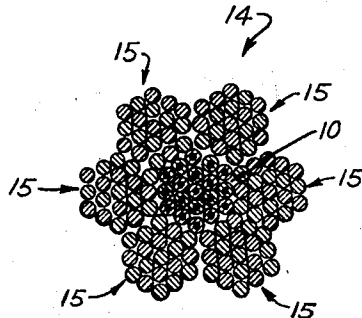


Fig. 3

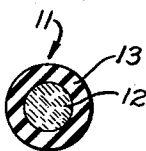


Fig. 4

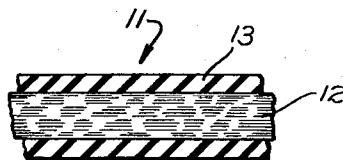


Fig. 5

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INORGANIC FIBER ROPE

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Application September 3, 1942, Serial No. 457,199

12 Claims. (Cl. 57-147)

This invention relates to new and useful improvements in ropes and has for an object the providing of a rope of long useful life and of exceptional tensile strength.

Other objects and advantages of the invention will become apparent from a consideration of the following detailed description taken in connection with the accompanying drawing wherein satisfactory embodiments of the invention are shown. However, it is to be understood that the invention is not limited to the details disclosed but includes all such variations and modifications as fall within the spirit of the invention and the scope of the appended claims.

In the drawing:

Fig. 1 is a perspective view showing a rope core made in accordance with the invention;

Fig. 2 is a side elevational view showing a short section of a rope made in accordance with the invention a portion of the rope being broken away to expose the core;

Fig. 3 is a transverse sectional view taken as along the line 3-3 of Fig. 2;

Fig. 4 is a transverse sectional view through a single filament of the improved rope core but on a greatly enlarged scale; and

Fig. 5 is a longitudinal sectional view through the strand of Fig. 4.

This application is a continuation-in-part of my application Serial Number 341,352, filed June 19, 1940.

The present invention resides, essentially, in a core for a rope, as a stranded wire rope, and to a rope including said core. Referring in detail to the drawing the rope core of the invention is generally designated 10 and the same comprises a plurality of filaments 11 each including an inner thread or filament 12 and an outer coating or covering 13.

Any desired number of the filaments 11, depending on their diameter and the diameter of the core desired, are laid together into a single rope core. The filaments are laid together in a long spiral arrangement and are not twisted tight together. Filaments 11 need not all be of the same diameter in any particular core.

Therefore the core 10 has many desirable characteristics. Particularly where the core is made of a large number of relatively small diameter filaments it is substantially circular in transverse section, without hills and dales, and provides a uniform support for strands laid about it. However, since the filaments are not twisted up tight into the core, care should be taken in handling the core (unless the filaments are adhered to one

another) as in unreeling it, so that it does not untwist, whereby it is kept with the foreheart originally laid into it.

Figs. 2 and 3 show a complete stranded wire rope including core 10. In such figures the rope is generally designated 14 and the same in addition to core 10 includes strands 15 laid about the core as is usual in the art. Each strand 15 comprises a desired number of filaments of inorganic material or of metal, laid together and such strands are shown as without individual cores.

The inner threads or fibers 12 of the individual filaments are of glass, fused quartz or the like and have great tensile strength. Each fiber 15 is preferably separately coated or covered and the coverings or casings 13 are of a plastic material which is resilient or has cushioning properties. Various plastics suitable for this purpose will be hereinafter considered. In making fibers or threads 12 the glass or quartz is first made plastic by heat and is then spun or extruded into the fibers or threads.

Any desired number of the filaments 11 are bunched or laid together in the manner described to form core 10. In the core it will be noted that each fiber or thread 12 is separated from the next adjacent such thread by the plastic coatings of the threads. Preferably these filaments 11 are bunched into the core while the coatings 13 are yet in a somewhat soft and sticky state so that the coatings in addition to adhering to the fibers or threads 12 adhere to one another.

The fibers or threads 12 and the coatings or coverings 13 are preferably oriented in the direction of the length of the core 10. Thus each of the glass, quartz or the like inorganic threads is oriented to as large an extent as is possible or feasible and in addition each such fiber or thread is coated with a cushioning plastic so that in the core the fibers or threads 12 are maintained from contact with one another. The presence of the oriented threads or fibers very greatly increases the tensile strength of the core 10 and thus of the rope or cable into which the core may be incorporated. In addition the filaments 11 are each preformed into the helix it will occupy in the completed core 10 whereby to lie in a neutral unstressed condition.

It is notable that a single glass fiber or thread has enormous tensile strength, far superior to any other fiber but in massing these fibers in the customary methods of rope making, the loss in strength due to crushing is so great that a very poor core tensile strength results. If the

fibers 12 are oriented and carefully agglomerated in plastics, this strength is materially increased.

Since as herein disclosed the quartz or glass fibers are spaced from one another they may not cut, fracture or chip or score or otherwise damage one another. Thus the useful life of the fibers in the core is increased or at least such useful life will not be reduced or cut short as it would be if the fibers could bear against one another as the rope 14 is subjected to twisting and lateral strains during use. Also the plastic covering protects the fibers from shearing strain caused by the tensioning of a rope including steel or inorganic strands or elements and serves to some extent to prevent the fibers slipping on one another during fabrication of a core or strand and thus facilitates rope and core manufacture.

The plastic with which the individual glass or quartz fibers or threads are enclosed or encased is preferably the vinyl derivative polyisobutylene or polyisobutadiene sold commercially as Vistanex although as will appear other plastics may be used for the described purpose. These other plastics that may be used include various organic plastic materials comprising synthetic resins, natural and synthetic lastics, cellulose (as ethyl cellulose) and its derivatives, protein plastic substances (as nylon), and petroleum plastic derivatives. Generally polymerization resins and particularly those of the vinyl group and its derivatives (which includes Vistanex) are preferred for my purpose.

Vistanex is waterproof, has elasticity, is bacteria and germproof and will not support fungus growth and is not subject to decay through biochemical attack. In addition it is acid and alkali resistant, will not oxidize, is not adversely affected by light.

There are several chemical types of synthetic resins such as (1) phenol aldehyde resins, (2) amino-aldehydic resins, (3) hydroxy-carboxylic resins, (4) sulphonamide resins, (5) resins from sugar, (6) vinyl resins including resins from vinyl derivatives, (7) indene resins, and (8) lignin plastic substances. The polymerization resins are preferred for my purpose.

Under the type (1) may be included resins such as phenol formaldehyde, cresol and cresylic acid, other tar acids and formaldehyde, phenol furfuraldehyde or other tar acids and other aldehydes. Under type (2) is included urea and formaldehyde resins, and aniline resins obtained by condensing aniline and formaldehyde and other anilines or amines and other aldehydes.

Under type (3) I include materials produced by the esterification or polybasic acids with polyhydric alcohols. Such materials are frequently called alkyd resins, this title including adipic acids resins obtained by the condensation of adipic acid and glycerin or by the condensation of glycerin with phthalic anhydride. Type (4) includes the sulphonamide resins developed from para toluensulphonamide. The resins from sugar, type (5) above, are obtained by condensing saccharide with aldehydes and urea.

Polyisobutylene or polyisobutadiene (sold commercially as Vistanex) is included in the group of vinyl resins (type 6) including resins from vinyl derivatives and such group also comprehends vinylidene chloride (sold commercially as Venalloy), vinyl ester, vinyl butyrate, vinyl chloride, acrylic resins from vinylcarbonic acid ester, vinyl carbonic acid, vinyl benzole or polystyrol, divinyl or butadiene, vinyl ester or vinyl chloride,

copolymerized polyvinyl chloride and polyvinyl acetate (known commercially as Vinylite), vinyl acetate, polymers of vinyl halides combined with different percentages of plasticizers (known commercially as Koroseal) the commercial products known as Vinyon (a copolymer of polyvinyl chloride and polyvinyl acetate), Butacite (a reaction product of vinyl acetate resin with butyraldehyde), and Rezel (resulting from the fact that the introduction of an unsaturated resinous ester of the maleate polyester type into a compound of the type $(R-CH=CH_2)$ has the property of curing the latter), the polymer of ester of acrylic acid known commercially as Plexigum, polymers of the esters of methacrylic acids such as the polymethacrylic resin sold as Lucite and Plexiglass. Isobutyl methacrylic resins, certain plastics obtained by mixing the monomer of styrene with vinylidene chloride and with ethylene glycol and maleic acid and copolymerizing the mixture, styrene and in addition thereto the resin known as polystyrene. More particularly Vistanex comprises polyisobutylene copolymerized with boron trifluoride and also polyisobutadiene having a tacky to rubber-like structure.

Resins of the indene group (type 7) include polyindene and poly-cumaron. Under type (8) I include lignin and its derivatives extracted from paper mill waste waters and other sources. The lignin may be separated into various chemical components of no value to me here but also into colored gums and by various treatments into clear transparent resins useful for my purpose. Lignin is hydrogenated with Raney nickel catalyst, in aqueous solution yielding methanol, propylcyclohexane, hydroxy propylcyclohexanes, and a colorless resin which may be again separated into an alkali soluble in an alkali insoluble component. I use either of these components in the production of resins to be used in the inorganic fiber coatings of the invention.

Under the heading of natural and synthetic lastics I include as natural lastics—balata, rubber, gutta percha and latex to be used alone or as coating or cushioning means when processed or compounded with other materials. As the synthetic lastics I mention polymerized chloroprene (of the type sold as neoprene); polymerized butadiene (of the type sold as Buna or Perbunan); polymethylene polysulphide (of the type sold as Thiokol); chlorinated rubber (of the type sold as Tornesit); rubber hydrochloride (of the type sold as Pliofilm); and isomerized rubber (of the type sold as Plifilm) and any latex of these.

These lastics are particularly useful for my purpose. They are especially adapted for the operation of coating the glass or other inorganic fiber. When using the latex the fibers are coated and while the latex coating is yet fluid the fibers are bundled to bring their coatings into contact. Then as the latex coatings coagulate the filaments are adhered to one another. The lastics act as cushions for the inorganic fibers and maintain them spaced from one another.

Certain materials sometimes called synthetic lastics I prefer to include under the heading of vinyl derivatives. For example, it appears that the polymerized vinyl derivative known as Vistanex (polyisobutylene and polyisobutadiene) might be included under either group.

Under the heading of cellulose and its derivatives I include cellulose acetate; regenerated cellulose; cellulose xanthate; benzylcellulose; ethylcellulose; cellulose hydrate; cellulose tri-

acetate; cellulose acetobutyrate; cellulose aceto-propionate; hydrolysed cellulose acetate and others of the cellulose esters and ethers. Rallan a rayon made from cellulose extracted from sugar cane may also be used. Most of these materials may be used alone for my purpose. In addition certain of these materials may be used with other materials herein mentioned for the purpose of toughening the latter and strengthening the more brittle or hardening the more pliable and preventing or eliminating cold flow.

Nitrocellulose compounded with other materials of a less flammable nature or of a nature to prevent flammability, may be used. Halowax or the like may be used for compounding with nitrocellulose and it is noted that the latter is so far as cost, strength and the like are concerned, a desirable material for my purpose. Other non-inflammable plasticizers which may be compounded with nitrocellulose for my purpose are monophenyl phosphate and di (para-tertiary butyl phenyl) mono 15 tertiary butyl 2 xenyl phosphate. The flammable nature of nitrocellulose may be weakened or lessened by mixing with varying proportions of cellulose acetate. Under this class may also be included Gel Cellulose which may be used for my purpose. This material may be used as a filler with other materials herein named.

Under the heading of protein plastic substances, I include casein preferably in the form of Lactofil, Lanital or Zein which is converted into a viscous mass for use here. Polypentamethylene sebacamide sold as nylon may be used. Regenerated silk made by reducing waste silk and waste cocoons containing silk is also believed to fall under this heading.

That group of compounds of which at least one is obtained by condensation polymerization from a diamine and a dibasic carboxylic acid and of which one is now sold under the trade-mark Exton is very useful for my present purpose.

Another protein plastic which may be used is obtained by extracting the protein from the refuse remaining after the oil has been extracted from soy beans, oilseeds, nuts, and other protein bearing substances. The extracted protein is properly reacted to form plastic substances. Here it is noted that oilseeds oil may be used as a plasticizer with styrene to make the latter more suitable for my purpose.

The petroleum plastic derivatives include those gums or resins obtained by the oxidation or controlled polymerization of certain distillates of petroleum cracking. Thus I may use the commercially known Santoresins produced by this method as well as Petropol which is a softer type of the same material. These materials are, when used for my purpose, to be mixed with other materials listed herein whereby the resultant mass may be extruded or otherwise applied to the fibers or threads 12.

Also cracking coal tar resins of high aromatic content and condensing them with formaldehyde or other aldehydes forms resins useful for my purpose. Similarly, I may use heavier petroleum products cracked and then condensed with formaldehyde or other aldehydes, hydrogenated or chlorinated either at elevated temperatures or by the addition of metallic halides.

Plastics comprising nitrogenous condensation products are also suitable for use in the making of coatings or cushions of the invention. One such plastic is now on the market under the name Nulamine.

Various combinations of the materials disclosed may be used for the purpose of regulating resiliency, stiffness, bacteria growth, fungus growth, water-proofness, controlling the melting or softening point, control of strength factors, as elasticity, tensile and shear strength, aiding in lubrication and the like. Many of the materials disclosed herein and which are chemically incompatible with one another are mechanically miscible to form a homogeneous mass adapted to be fabricated into coatings meeting any of the above requirements as to combinations of physical and chemical characteristics.

Thus materials which may not be used alone for my purpose by reason of being too brittle and the like may be mixed with other materials and in that way utilized for the characteristic they impart. For example those resins identified above as (1), (2), (4), (5), (7), (8) along with the coal tar resins are used with other materials, as Vistanex, to limit or eliminate cold flow or for the other characteristics they may impart but are not used alone in the present instance.

Formaldehyde and urea resins as well as any chlorinated material (certain synthetic lastics) and the like have germicidal properties and when used with other materials included herein will serve to prevent or arrest bacteria growth and thus decomposition of the coatings due to the action of bacteria or fungus. Whether the action of said materials merely arrests bacteria growth or completely eliminates bacteria will depend on the materials and the quantities used in the mixture.

The various fibers 12 are oriented. Where pre-formed structures are employed it is preferred that the molecules of fibers 12 be oriented in a direction parallel to the axial centers of the fibers. That is, the molecules are oriented in a direction parallel to the center of a helical line (the longitudinal center line of the fiber) rather than in parallel relation to a straight line. This is accomplished by stretching the material while ductile through a helical die. Thus in my pre-formed fibers I avoid obstinate internal stresses. The cores made of filaments the fibers of which have been oriented as described will have increased tensile strength and extra resistance to twisting and bending, and will lay in a rope without opposing stresses tending to open the rope.

Having thus set forth the nature of my invention, what I claim is:

1. A rope element comprising a bundle of spirally arranged filaments, each of said filaments comprising a fiber of an inorganic material, a cushioning material separating said fibers from one another in said bundle, and each of said fibers preformed into the spiral it occupies in said bundle.

2. A rope element comprising a bundle of spirally arranged filaments, each of said filaments comprising a fiber of an inorganic material, a cushioning material separating said fibers from one another in said bundle, each of said fibers preformed into the spiral it occupies in said bundle, and said fibers spirally oriented along said spiral lines.

3. In a wire rope, a core comprising fused quartz fibers laid spirally together, an organic plastic material in said core about and separating said fibers from one another, and a plurality of strands of wires laid spirally about said core.

4. In a wire rope, a core comprising brittle inorganic fibers laid spirally together, Vistanex in said core about, adhering to and separating said

fibers and cushioning them from one another, and a plurality of strands of wires laid helically about said core and adhered to and spaced from said fibers by said Vistanex.

5. A rope element comprising a bundle of filaments, each of said filaments including a fiber of inorganic material, and a coating of Vistanex on each of said fibers and adhering them to but spacing them from one another while lubricating them for movement on one another.

6. In a wire rope, a core comprising fused quartz fibers laid spirally together, a vinyl derivative coating on each of said fibers and separating them from one another, and a plurality of strands of wires laid helically about said core.

7. In a wire rope, a core comprising brittle inorganic fibers laid together, an organic plastic material in said core about and separating said fibers from one another, and a plurality of strands of wire laid spirally about said core.

8. In a rope element, a core comprising a bundle

of filaments each including a fiber of an inorganic material and a cushion of a synthetic organic chemical polymer separating said fibers from one another in said bundle.

5 9. In a rope element, a bundle of filaments, each of said filaments comprising a fiber of an inorganic plastic material, and a coating of a chemical polymer on each of said fibers and adhering said filaments to one another.

10 10. A rope element comprising glass fibers separated from one another by an organic plastic.

11. A rope element comprising a bundle of filaments each comprising a fiber of an inorganic plastic material, and a coating of an organic plastic material enclosing each of said fibers.

15 12. A rope element comprising a bundle of filaments each comprising a fiber of inorganic material of glass-like nature, and an organic plastic material in said bundle and separating said fibers.

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