July 2, 1946. R. F. WARREN, JR 2,403,317

ROPE

Original Filed June 19, 1940

Fig. 1.

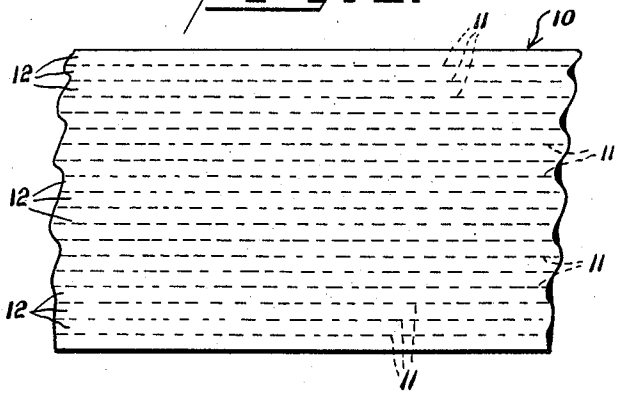


Fig. 2.

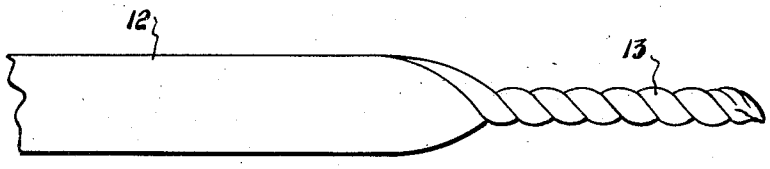
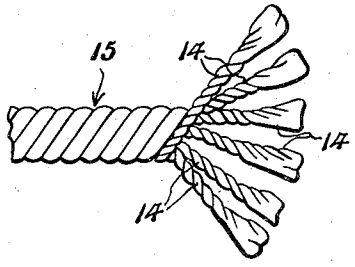


Fig. 3.



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2,403,317

ROPE

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Original application June 19, 1940, Serial No. 341,352. Divided and this application September 27, 1943, Serial No. 503,890

6 Claims. (Cl. 57—140)

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This invention relates to new and useful improvements in rope cores and method of making the same.

The 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 a satisfactory embodiment of the invention is 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 plan view of a section of a plastic material from which the core of the invention is to be made;

Fig. 2 is a plan view illustrating a step in the making of the present rope core; and

Fig. 3 is a perspective view showing a small section of the rope core of the invention.

The present application is a division of my application Serial Number 341,352, filed June 19, 1940.

The rope core of the invention is made of polymerized vinylidene chloride although other plastic materials, preferably synthetic polymerized plastic materials may be used as will hereinafter appear. The material used is capable of being formed into thin strips or into thin sheets from which strips are taken and is capable of being oriented by stretching.

In Fig. 1 a small section of such material is shown and the same in sheet form is designated 10. This sheet has been formed by rolling or the like from a mass of vinylidene chloride or the like and as the next step in my process is cut or otherwise formed into strips. To form the strips the sheet 10 may be cut along the dotted lines 11 and it is to be understood that the material of the sheet is oriented by the process of rolling and stretching used in the formation of the sheet.

Thus sheet 10 is oriented in the direction of its length and the dotted lines 11 extend in the direction of the length of the sheet. Cutting the sheet along the lines 11 results in the formation of a series of strips each designated 12. While these strips are shown as of substantially equal widths and this is a preferable characteristic the invention is not specifically limited to this feature.

Clearly the strips 12 are oriented in the directions of their lengths. These strips are twisted to form elements. As suggested in Fig. 2 the strip

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12 is being twisted and one portion 13 thereof is shown as twisted into an element portion. Clearly the twisting operation is carried out until the strip is twisted throughout its length. During the operation of twisting the strip or thereafter and while twisted the strip is stretched. This results in the formation of elements 14 each substantially round in transverse section and of the desired length and of a diameter depending on the width and thickness of the strip from which it is formed.

When all strips used are of the same width and thickness and are twisted and stretched to the same extent and under the same conditions as to heat and the like elements of uniform diameter and hardness result and these when twisted together (as will appear) provide for the construction of cores of uniform diameter and bedding value throughout their length.

Fig. 3 shows a construction wherein the vinylidene chloride, of which the core generally designated 15 is formed, has first been cut or formed into strips. Thereafter the strips are twisted to provide the elements 14 and any desired number of these are twisted together to provide the core. A core made by the twisting up of a single strip of the material may be used. However, for larger or main cores a plurality of strips are twisted together to provide the core with the desired solid characteristics and with the desired resiliency and elasticity.

In making the elements of twisted strips 14 the sheets from which the strips are to be taken are reduced to the desired thickness by repeated small reductions rather than by a single large reduction. These reductions take place while the material is heated or wetted (depending on the material being used). The finished sheets are cut to strips and the latter twisted into elements for use in cores or the like.

Preferably the strips are cut from the sheet in such manner as to have the direction of the length of the flow of the material of the sheet represent the longitudinal axis of the strips. Thereafter as the strips are twisted they are heated or wetted (depending on the material concerned) and are stretched whereby to further orient the molecules to have the latter oriented in the direction of the length of the twisted strip and on a bias with respect to that which was the longitudinal axis of the strip prior to the twisting thereof.

The purpose of this process is to give to the twisted strip or element greater tensile strength by the orienting of the molecules. Those mate-

rials which are capable of further elongation may be stretched to produce still further orientation along the tensile axis of the twisted strip. This may be accomplished by the drawing of the twisted strip through a die or by stretching during the passing of the twisted strip over drums having unequal linear or surface speeds.

While vinylidene chloride seems to be the best material available for my present purpose it is to be understood that other synthetic and natural plastic materials and mixtures thereof may be used for my purpose. Thus the various materials disclosed in the above mentioned parent application and particularly mentioned below may be used. The essential characteristic of material to be used is that the same be capable of being formed into strips or into sheets from which strips may be taken and that it have the characteristic of orienting while being sheeted and under stretching and remain oriented. Those materials which are capable of further orientation after being sheeted and cut to strips are stretched and this stretching may take place while or after twisting.

The materials used in the making of the twisted elements of the present invention are resilient organic polymers. These include vinyl compounds generally as the vinylidene chloride above mentioned as well as vinyl ester, vinyl butyrate, vinyl chloride, acrylic resins from vinylcarbonic acid ester, vinylcarbonic 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 resins 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.

Further I may use materials produced by the esterification of polybasic acids with polyhydric alcohols. Such materials are frequently called alhyd resins are obtained by the condensation of glycerin with phthalic anhydride and such materials also include adipic acid resins. Various natural and synthetic lastics such as rubber,

Balata, gutta percha, latex, polymerized chloroprene, polymerized butadiene, polymethylene polysulphide, chlorinated rubber, rubber hydrochloride, isomerized rubber and sulphonated rubber may be used.

Various cellulose derivatives may also be used. These include cellulose acetate, regenerated cellulose, nitrocellulose with other materials to reduce flammability, cellulose xanthate, benzylcellulose, ethylcellulose, cellulose hydrate, cellulose acetobutyrate, cellulose acetopropionate, hydrolyzed cellulose acetate with other cellulose esters and ethers. Further cellulose derivatives in alpha and beta stages may be used with other materials herein mentioned as fillers and to produce a tough mixture.

Certain protein substances such as nylon and Exton and resins from soy beans, oiticica nuts, and the like may also be used. Certain resins from petroleum may be used.

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

1. The method of making an element of a resilient organic polymer capable of being formed into strips and of being oriented by stretching, comprising forming a thin strip of said polymer, and simultaneously twisting and stretching said strip while the material thereof is in a ductile condition.

2. The method which comprises twisting a strand of a normally crystalline vinylidene chloride polymer while rendering ineffective any tendency of the strand to decrease its length so that the polymer is crystallized and helical orientation of the crystals about the axis of the strand, at least through a portion of its length, is provided.

3. The method which comprises twisting a strand of a normally crystalline vinylidene chloride polymer while maintaining at least the original length of said strand by tension to crystallize the polymer and to provide helical orientation of the crystals about the axis of the strand, at least through a portion of its length.

4. The method which comprises twisting a strand of a normally crystalline vinylidene chloride polymer while stretching the same, to crystallize the polymer and to provide helical orientation of the crystals about the axis of the strand, at least through a portion of its length.

5. The method which comprises providing a strand of a normally crystalline vinylidene chloride polymer, and stretching the strand while twisting the same, to crystallize the polymer and to provide helical orientation of the crystals about the axis of the strand, at least through a portion of its length.

6. A twisted strand of a normally crystalline vinylidene chloride polymer, wherein the crystals are oriented helically about the axis of the strand.

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