

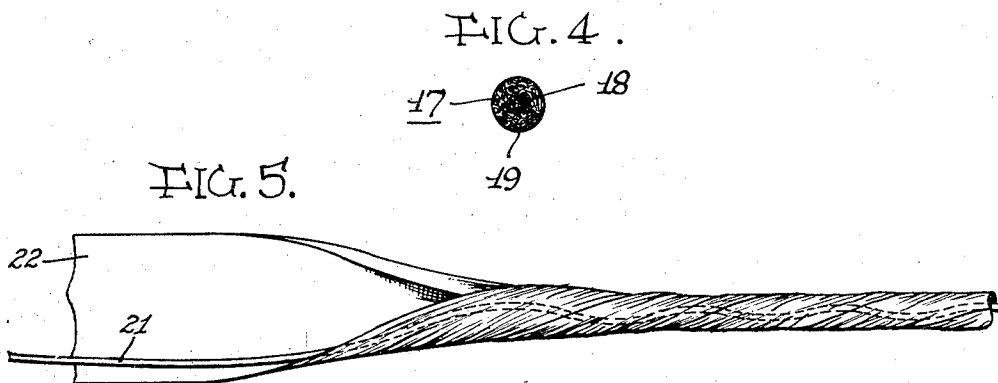
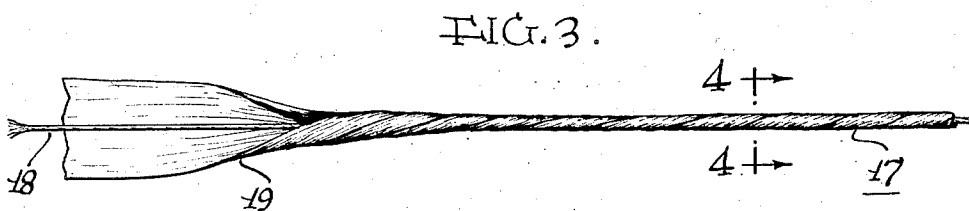
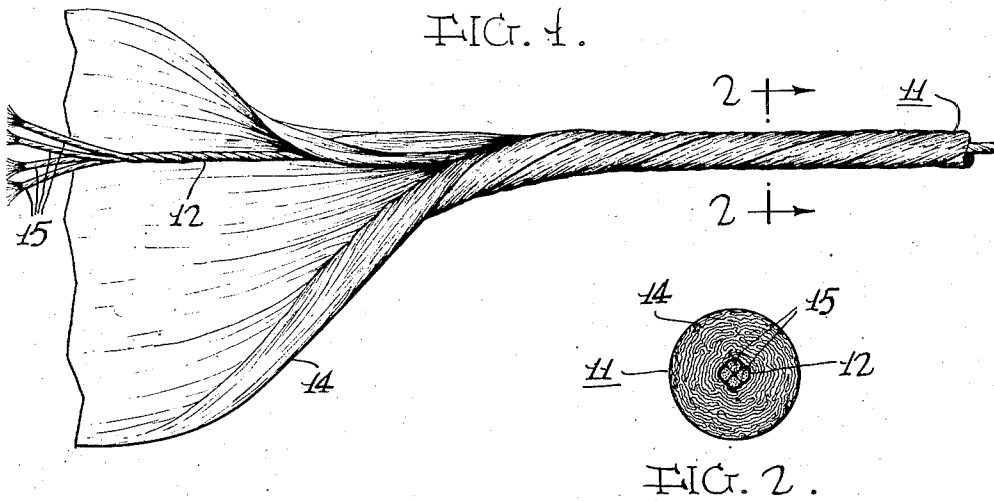
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COMPOSITE FIBER GLASS REINFORCED PAPER YARN

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COMPOSITE FIBER GLASS REINFORCED PAPER YARN

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The present invention relates to composite yarns of the type used in carpets for reinforcing and filling out the base fabric; in electric cables, for braiding the outer sheath of the cable, as a core or lateral filler in the interior of the cable to give bulk and formation and to protect the wires from kinking; in the braiding of hose for strengthening the hose and for insuring against undue stretching; as a reinforcing filler for plastics; and for other purposes.

A primary object of the invention is to provide a yarn of the stated class that is economical to produce and possessed of improved physical characteristics.

To this end, the invention contemplates a composite yarn that is relatively light, strong and compressible; is composed of materials of approximately equal stretch, said stretch being relatively low and substantially uniform throughout the length of the yarn; is dimensionally stable; is capable of formation with almost any degree of compressibility; and is durable yet susceptible of production at low cost.

Another object is to provide a yarn having a higher tensile strength for any given bulk than has been obtainable in prior yarns of the same class, such for example as those composed in whole or in part of jute or cotton, and which at the same time affords wide latitude in the choice of such properties as softness and hardness while maintaining the high tensile strength.

Still another object is to provide a composite yarn comprising a longitudinal component which is relatively susceptible to injury and deterioration by abrasion, and a second spirally twisted component of relatively high abrasion resisting properties which entirely envelopes and protects the first named component, and wherein the linear length of the inner component is substantially equal to the linear length of the strip material of the outer component prior to twisting, whereby tensile strains imposed upon the yarn are divided substantially equally between the components.

A still further object is to provide a composite yarn comprising an inner longitudinal component and an outer component consisting of a strip of sheet material, spirally twisted and completely enveloping the inner component, wherein the inner component conforms to the spiral convolutions of the said enveloping component.

The invention contemplates a composite yarn whereof the tensile strength is as great at least as the sum of the tensile strengths of the individual components.

These objects are obtained by the construction described in the following specification of which the attached drawing constitutes a part.

In the drawings:

Figure 1 is a view of a partially opened strand constituting one embodiment of the invention;

Figure 2 is an enlarged sectional view taken on the line 2—2 of Figure 1;

Figure 3 is a view of a partially opened strand constituting another embodiment of the invention;

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Figure 4 is a sectional view taken along the line 4—4, of Figure 3, and

Figure 5 is a view similar to Figures 1 and 3 showing a preferred method of introducing the core strand and envelope to the forming machine affording optimum tensile strength in the finished product.

Referring to the drawing, the embodiment illustrated in Figures 1 and 2 typifies a yarn to be used as a stuffer for electric cord and the like. For this purpose, the yarn 11 may comprise a fibre glass (Fiberglas) component 12, within a twisted paper component 14. The fibre glass component 12 may consist of a 150-4/4 fibre glass yarn made by twisting together four 150-1/0 continuous filament fibre glass strands to form a four ply yarn, and twisting four strands 15 of this yarn into the stranded product 12. If the individual strands 15 are formed with an S-twist, it is preferable to employ a Z-twist in forming the strands into the yarn 12. The paper component 14 is simultaneously folded and twisted about the core in conventional machine operation, preferably with an S-twist. Spun fibre glass is characterized by the fact that excessive twisting of the spun yarn will tend to fracture the glass fibres, seriously reducing the strength and durability of the yarn. The mode of twisting in the present embodiment, described above, will help to avoid such destructive action, and makes possible the use of high twist strands 15 in the glass component 12. Thus, when the S-twisted filament 15 are plied together to form the core 12, the twist of the plying will subtract from the S-twist of the individual filaments to effectively eliminate the possibility of over-twisting. Since the enfolding and twisting operation on the paper envelope 14 has a tendency to twist the core 12, the S-twist of the envelope tends to reduce the Z-twist of the plied fibre glass component to again preclude fracture of the individual fibres.

Since a high degree of compressibility, together with high tensile strength, is required in stuffer yarns of this type, the twist of the envelope is a relatively soft twist, such that the paper may conform more readily to the shape of the confining elements. The presently described yarn may have an outside diameter of 1/32", but it is apparent that this may be altered to the required dimension by changing the amount or twist of the paper. The paper used is preferably 16 pound creped tissue kraft paper, since this paper is light, ensures durability, and is relatively inexpensive. It is desirable that there be adhesion between the fibre glass component and the paper and to this end a suitable adhesive twisting solution may be used with the paper; or other means may be employed for effecting the desired adherence.

The glass component invests the yarn with a tensile strength that is inherently lacking in the paper. The yarn as described, comprising the 150-4/4 glass yarn and 16 pound creped tissue kraft paper envelope consisting of a strip approximately 2 1/2" wide with a twist of say 5 to 10 turns per ten linear inches, will have a strength of say 70 pounds, but by varying the fibre glass content and the structure of that component this strength may be altered to fit the needs of the product. It will be appreciated that the elasticity of the glass component i. e. the resistance of the component to stretching under load is approximately equal to that of the twisted paper component, so that upon stretching, the two materials elongate at equal rates, so as to avoid internal stresses within the yarn itself. Likewise spun glass is flexible and pliable to the extent required in stuffer yarns of this character.

It is apparent that a composite yarn of the above stated character satisfies the need for a light weight, inexpensive stuffer yarn. In the illustrated embodiment for example, 425 feet of yarn weighs one pound, and the cost is relatively little as compared to yarns made with natural fibres,

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Also by using synthetic materials it is possible to control the characteristics to attain a high degree of uniformity throughout the length and cross section of the yarn.

The yarn illustrated in Figures 3 and 4 is typical of the yarns to be used in weaving the backing for a carpet, or for the braiding in a rubber hose or electric cord. To this end the yarn 17 comprises a Z-twisted spun glass component 18, combined with an S-twisted paper envelope 19. The opposite twists make feasible the use of a high twist fibre glass yarn for the reason set forth above in connection with the previously described embodiment.

In yarns of this latter class, compressibility is not as important as strength. To this end, the paper component is hard twisted. In the illustrated yarn the approximate outside diameter is 0.030 inch, equivalent to the usual jute or cotton yarns for this same general purpose. The hard twisted paper adheres to the glass, and is fairly strong and resistant to deformation. A suitable envelope for composite yarns of this character is 24 pound kraft, which when hard twisted and with a reinforcing fibre glass component and properly treated is flame-resistant. The hard twisted paper is strong tensilewise and when reinforced by the spun fibre glass element is sufficiently strong for weaving and braiding processes.

The fibre glass component not only affords greater tensile strength in the yarn, but also adds body and stiffness to the yarn, affording a substantial dimensional stability. Similarly the relatively small extensibility of the glass component tends to preclude excessive stretching, and the fact that the elasticities of the glass and paper components are equal, as previously set forth, tends to distribute the stresses equally between the paper and the glass, so as to effectively eliminate internal stresses within the composite yarn.

A composite yarn of this character, being primarily formed of paper, is economical and the components are readily obtainable without the necessity of importing materials from foreign countries. The yarn is strong yet relatively light and resistant to functional deterioration.

I have found that composite yarns and cords of the aforescribed type are subject to refinements which materially affect the physical properties of the product. In twisted or plied fibreglass yarns, for example, the very twisting and plying operations cause some loss in tensile strength due to the inevitable rupture of some of the brittle filaments, i. e. individual fibres. This undesirable effect may be offset in some degree by reverse twisting as described above, but in general a twisted or plied fibre glass yarn is not as strong as original untwisted or only slightly twisted yarns from which they were formed. For maximum strength in the composite fibre glass and paper product, it is desirable therefore to use one or more ends, as required, of fibre glass yarn of very low or no twist. Preferably also the yarn is of the continuous filament type as distinguished from staple yarn produced from filaments of short lengths. A yarn suitable for the purpose is identified in the trade by the number 75-1/0 and consists of 75 continuous filaments drawn together into a single strand with a very low twist. In this case also it is desirable to have the twist of the paper reverse to that of the glass yarn so as to reduce the twist of the yarn to a minimum in the end product.

I have found also that for maximum strength the linear length of the paper and fibre glass components of the yarn should be the same. This correspondence of linear lengths may be obtained by the means hereinafter described. The twisting of the paper component of the composite yarn affects the length of this paper component in the finished product, the length being less than the linear length of the original paper strip. If, therefore, the fibre glass yarn is introduced as a core extending longitudinally at the approximate center of the composite yarn, the linear length of paper introduced into the yarn will exceed the linear length of the fibre glass yarn. There is a tendency in this case for the paper to strip off the core lengthwise.

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This disparity of linear lengths may be offset to a degree by regulating the tension under which the fibre glass component is introduced, but such control is not sufficiently accurate to ensure the desired result and there is a tendency for the relatively loosely tensioned fibre glass component to appear at the surface of the composite yarn, as in a plied yarn, where it is subject to abrasion which it is inherently incapable of resisting. Such method of producing the composite product has therefore proved to be impractical.

I have discovered that if the fibre glass yarn component is introduced into the paper component in the forming operation under a tension such that the fibre glass can spiral with the paper in twisting, and at a point laterally of the paper strip remote to the longitudinal center line of the latter or relatively close to one longitudinal edge of the strip as it passes to the twisting dye, as shown in Figure 5, the fibre glass yarn 21 will follow the spiral of the paper 22 with a high degree of accuracy and without tendency to depart from its normal enveloped position within the paper so that the linear lengths of the glass and the paper elements which go into the composite product are substantially the same. A composite yarn made by this process if viewed from one end will usually show the fibre glass component somewhat off-center in the composite structure but the effect is such that under tensile test the paper and glass components will rupture simultaneously. Thus, using a $\frac{3}{8}$ " strip of 23 pound kraft paper which of itself in twisted form will test approximately 7 pounds tensile, and a fibre glass yarn which tests from 6 to 8 pounds tensile, the combination, as made in accordance with the foregoing procedure, will show a resulting tensile strength of from 15 to 18 pounds, more than the sum of the individual tensiles. Furthermore a yarn made as described above exhibits a much higher dimensional stability than other known composite yarn materials, and has a higher tensile strength in the bulk than is possible with the other prior composite materials.

I have discovered further that by using single or multiple ends of continuous filament yarn, for example the 75-1/0 yarn mentioned above, it is possible to achieve greater tensile strength at lower cost than by use of twisted yarns of the character shown in the embodiments of Figures 1 and 3. I have found also that by incorporating the fibre glass yarn as described above so that the yarn conforms to the convolutions of the twisted paper, a greatly improved mechanical union is obtained between the fibre glass and the envelope than is otherwise possible so that there is no tendency for the envelope under tensile strain to strip from the fibre glass yarn. This bond may be further improved by the use of a suitable non-crystallizing adhesive on the glass, such, for example as asphalt or latex, which has the effect of anchoring the fibre glass to the paper.

The composite product will readily pass the rigid requirements of the underwriters for use in electric cables. A composite yarn particularly well adapted for this purpose may consist of a 16 pound crepe tissue kraft paper in a strip approximately 3" wide, and multiple ends of the 75-1/0 fibre glass yarn, say ten in number, the composite yarn having a twist of about five tenths to one turn per inch. This yarn, with a diameter of $\frac{3}{32}$ " and running approximately 475 feet to the pound, will exhibit a tensile strength of approximately 90 pounds and will be materially less expensive than the jute filler cord conventionally used for the same purpose.

It will be noted that composite paper and fibre glass yarns, being both light and strong, are susceptible to production and packaging in great lengths. The elimination of knots and snags affords even greater economies to the consumer. The drawing illustrates only two of a wide variety of composite yarns, and it is not intended to limit the invention, as defined in the appended claims, to the particular form of the illustrated embodiments.

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This application is a continuation-in-part of Serial No. 223,806, filed April 30, 1951, and now abandoned.

I claim:

1. A composite yarn comprising an inner component of fibrous glass in the form of a continuous filament fibre glass yarn having little or no twist, and an outer substantially cylindrical component in the form of a compacted and helically twisted strip of paper entirely enveloping the said inner component, the inner glass component having substantially the same linear length as the untwisted paper strip.

2. A composite yarn according to claim 1 wherein the inner glass component conforms to the helical twist of the outer paper component.

3. A composite yarn according to claim 2 wherein the glass component occupies a position relative to the paper component in proximity and substantially parallel to one edge of the said strip.

4. A composite yarn comprising an inner yarn component of fibrous glass, and an outer yarn component in the form of a compacted and helically twisted strip

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of paper entirely enveloping the inner component, the said inner component having substantially the same linear length as the untwisted paper strip.

5. A composite yarn according to claim 4 wherein the inner glass component conforms to the helical twist of the outer paper component.

6. A composite yarn according to claim 5 wherein the glass component occupies a position relative to the paper component in proximity and substantially parallel to one edge of the said strip.

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