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METHOD OF MAKING COMPOSITE YARN

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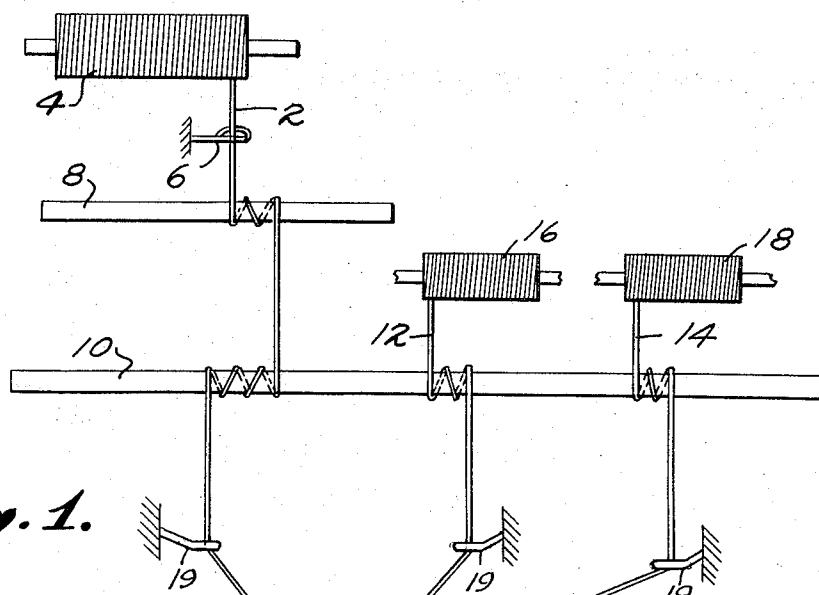


Fig. 1.

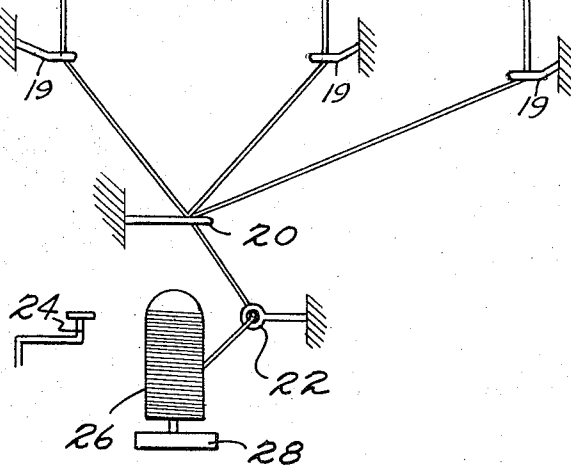


Fig. 2.



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METHOD OF MAKING COMPOSITE YARN

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This application is a continuation-in-part of Ser. No. 301,766, filed Aug. 13, 1963, the subject matter of which is incorporated herein by reference.

This invention relates to a novel type of composite stretch yarn and a method of making the same.

The preparation of an elastic yarn comprising a low twist multifilament continuous filament textile thread, e.g. nylon, twisted together with an elastic thread is described in U.S. Patent 3,011,302. According to said patent, the multifilament thread is relatively unstretchable and the elastic thread is capable of being stretched and contracted from the stretched condition.

The use of a continuous filament is considered essential in the process of 3,011,302 in order to maintain the composite yarn structure and obtain the desired results. However, according to the present invention, it has been surprisingly found that the use of one or more ends of spun yarn, as distinguished from continuous filament yarn, twisted together with an elastic core gives a highly advantageous and unique composite yarn which is distinguishable from prior products and peculiarly useful for the production of knitted and woven fabrics.

Broadly stated, the composite yarn of the present invention comprises an elastomer yarn and one or more ends of spun yarn twisted together while the elastomer yarn is in a stretched condition. The elastomer yarn preferably comprises a monofilament or multifilament polyurethane yarn having a denier of from about 15 to 400 in its relaxed state. This yarn is capable of stretching at least several times its original, relaxed length (e.g. five times) up to about 600 to 800% (i.e. 7 to 9 times its original relaxed length). Several suitable types of polyurethane yarns are known in the art including those available as "Lycra" and "Vyrene." In lieu of polyurethane yarns, other types of elastomeric yarns may be used.

In preparing the composite yarns of the invention, it is preferred to have the polyurethane yarn or the equivalent elongated by 50 to 400% (i.e. stretched to a length which is 1.5 to 5 times its relaxed length) when the yarn is twisted with the end or ends of spun yarn. The degree of stretch should be kept constant throughout the twisting operation and should not in any instance exceed 90% of the maximum elongation. Elongation of the polyurethane may be accomplished by feeding the yarn between two positive control points to insure uniformity in the final product. A ring twister, which is well known in the art, equipped with two sets of feed rolls can be effectively used to prepare the composite yarn of the invention.

The spun yarn may comprise any textile fiber or mixtures thereof in staple form. Such fibers include natural fibers such as cotton and wool as well as synthetic fibers such as rayon, nylon, polyethylene terephthalate and related polyesters, acrylics, acetate, etc., in the form of staple. In one advantageous embodiment, the spun yarn comprises 100% worsted fibers or 100% cotton. Blends of wool or cotton and polyester staple (e.g. 50-90% polyester, 10-50% cotton or wool, by weight) also give highly desirable products. Advantageously, the average length of the staple fiber or fibers in the spun yarn should fall in the range of 1½ to 9 inches.

To insure the desired results, it is important that the spun yarn have certain other characteristics. For example, the spun yarn should have a twist of about 6 to 30 turns per inch in the S or Z direction before it is twisted with

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the elastomer yarn. A yarn count in the range of 1/6 to 1/100 is also desirable for the spun yarn. The exact number of turns and the yarn count selected for any particular situation will depend on a variety of operating factors, e.g. end use for the composite yarn, the type of staple involved, etc. For example, if a 100% worsted yarn is to be twisted with the elastomer yarn, the worsted yarn should have a U.S.D.A. grade number between 36s and 80s, a count within the range of 1/6 and 1/100 and a spun twist in the S or Z direction of 6 to 30 turns per inch.

The composite yarn products of the invention preferably comprise two or more ends of spun yarn, with the same or different amounts and/or direction of spun twist, twisted together with the polyurethane or like elastomer yarn. The amount of twist applied in forming the final product may be varied but generally should fall in the range of from 2 to 20 turns per inch. Usually the twist applied at this stage should amount to from 10 to 90% of the original twist in the spun yarn. This amount of twist is usually sufficient to prevent undesired looping and slipping when the composite yarn is knitted or woven under tension. The direction of this twist may be either in the same direction as the twist initially present in the spun yarn or opposed thereto. The resulting composite yarn may be used as such in the preparation of stretch fabrics or it may be plied with another similar or different yarn.

In a preferred embodiment of the invention, one or more ends of 70/1 cotton having a spun twist of about 24 in the S direction and a 70-140 denier, essentially twist-free multifilament polyurethane yarn (e.g. "Lycra" yarn) are twisted together 2.5 to 15 turns per inch while the polyurethane yarn is elongated from 150-400%, the spun yarn being held in an extended or taut condition. Desirably, the resulting product comprises from 25 to 85% by weight of spun yarn and 15 to 75% by weight of the polyurethane or other elastomer yarn. When this type of product is relaxed, the polyurethane contracts in such a way as to draw up and open the spun yarn so as to give a stretch product which is characterized by its outstanding fluffiness and bulk. These properties are definitely and uniquely distinguishable from the products obtained by (a) twisting polyurethane yarn and a multifilament continuous filament yarn or (b) spinning filament or staple material about a polyurethane core. The present product is essentially a plied product while the elastomer yarn is in the stretched condition and when the elastomer is relaxed, the spun yarn loosely and substantially completely covers the elastomer yarn with sufficient association of the components to prevent separation and give a highly attractive product.

The invention is further described with reference to the accompanying drawings wherein:

FIGURE 1 is a schematic view of apparatus suitable for use in preparing the composite yarn of the invention; and

FIGURE 2 is a schematic view of the composite yarn of the invention in a partially stretched condition.

Referring more specifically to the drawings, the elastomer yarn 2, e.g. 70 denier multifilament "Lycra" yarn, is taken from creel 4 and passed through an appropriate guide 6 to the top feed roll 8 of a conventional two roll ring twister. Advantageously, the yarn is drawn off the creel end over end to give better delivery tension. Additionally, in order to insure even elongation, it is important that the elastomer yarn be in the relaxed state before reaching feed roll 8 and to insure proper control, the yarn should be wrapped around roll 8 several times after which the yarn is passed to the bottom feed roll 10.

The top roll 8 is geared to operate at a fixed speed with respect to the bottom roll and this relationship should be such as to permit a bottom roll surface speed

sufficiently greater than the surface speed of the top roll to give the desired yarn elongation. For example, the surface speed of the bottom roll may be from about .5 to 5 times greater than the surface speed of the top roll.

In the embodiment illustrated, two ends 12 and 14 of spun yarn (e.g. 70/1 cotton) are passed from suitable creels 16 and 18 or the like directly to the bottom feed roll 10 where the ends are wound around the roll several times to facilitate control. Advantageously, these ends are creeled so that they run on the same spindle position.

From the bottom roll, the elongated (e.g. 50-400%) elastomer yarn 2 and the ends of spun yarn 12 and 14 pass together through guide 20 and then through the traveller 22 of a ring 24 to a bobbin 26 on spindle 28. The speed of the bottom roll 10 and spindle 28 determine the turns per inch of twist applied by the ring twister. Thus, for example, at a spindle speed of 6M r.p.m. and a surface speed of 70 yards per minute for the bottom feed roll, the twist in the finished product as wound on the spindle amounts to 2.5 turns per linear inch. As indicated, tension on the yarns is maintained by means of guides 19 and 20.

As a typical illustration, it may be mentioned that a highly desirable product is obtained by twisting together with 10 turns S, a 70 denier "Lycra" polyurethane yarn stretched 200% and two ends of 70/1 cotton yarn having a spun twist of 24 turns per inch in the Z direction. The resulting product has a total denier of 175.19 when extended and comprises 86.69% cotton and 13.31% "Lycra." Another useful product can be obtained by replacing the two ends of 70/1 cotton in the foregoing example with two ends of 100% worsted yarn (1/60s-80s wool) or with two ends of an equivalent yarn comprising a 50/50 blend of wool and Dacron polyester.

The total denier of 175.19 for the product described above using the 70 denier "Lycra" and two ends of 70/1 cotton spun yarn can be determined by means of the following formula:

$$M = \frac{A}{B} + \left(\frac{X}{Y} \right) Z$$

wherein:

M=final denier of the composite yarn
A=denier of the elastomer yarn before elongation
B=percent elongation desired
X=number of 840-yard lengths (cotton count to denier)
Y=spun yarn cotton count
Z=number of ends of spun yarn

Thus in said example, the following values are given:

A=70
B=200%/100+1=3
X=Factor: 4,464,483 yds./lb./denier divided by 840 yds./hank (cotton count)=5315

Y=70/1 spun yarn (cotton count)
Z=2

Accordingly,

$$\begin{aligned} M &= 70/3 + (5315/70)2 \\ &= 23.33 + 151.86 \\ &= 175.19 \end{aligned}$$

The composite product of the invention is shown in the partially elongated condition in FIGURE 2. As illustrated the ends of spun yarn 12 and 14 relatively loosely wind around the "Lycra" yarn 2 when the latter is partially extended but, upon complete relaxation, the spun yarn is drawn in by the elastomer so that the spun yarn opens up or bulks and substantially completely covers the elastomer yarn to give a product which demonstrates exceptionally good bulk, hand and other characteristics and is useful in a variety of different types of knitted and woven goods, e.g. sock tops; support hose, surgical or otherwise; tricot, swimwear, etc.

It will be appreciated that various modifications may be made in the invention described herein.

Hence, the scope of the invention is set forth in the following claims wherein I claim:

1. The method of preparing a composite stretch yarn which comprises stretching an essentially twist-free elastomer yarn up to 90% of its maximum stretched length and twisting the thus stretched and essentially twist-free elastomer yarn with at least one spun yarn which has a twist therein of about 6-30 turns per inch, and keeping the degree of stretch in said elastomer yarn constant throughout said twisting.

2. The method of claim 1 wherein said elastomer yarn is polyurethane yarn which is stretched 50-400% of its relaxed length before said twisting and said spun yarn and polyurethane yarn are twisted together with from 2-20 turns per inch.

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