

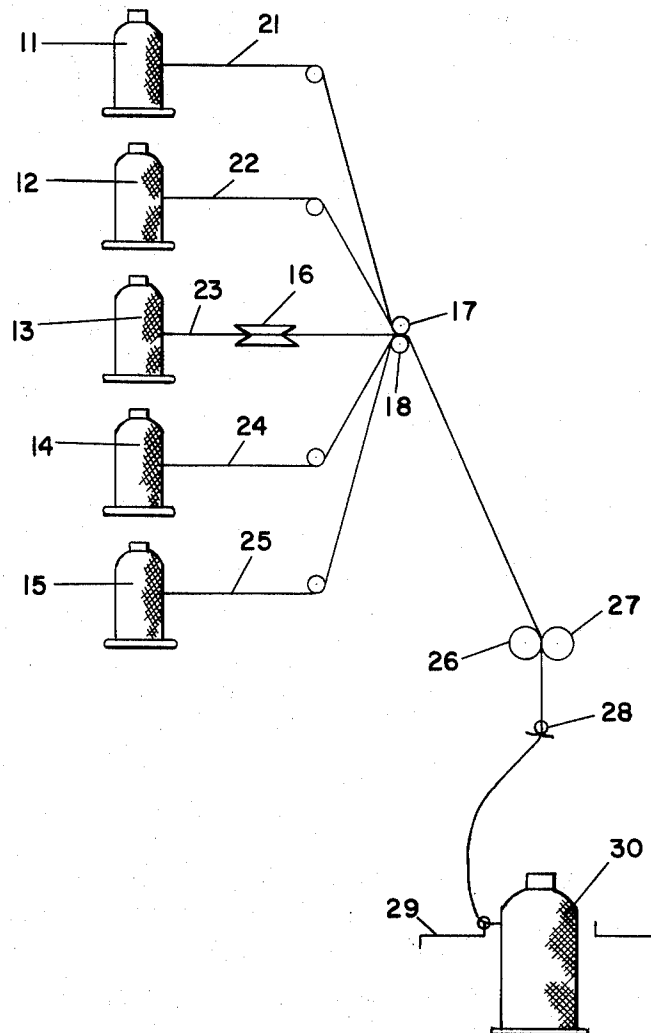
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PROCESS FOR MAKING ELASTIC YARN

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PROCESS FOR MAKING ELASTIC YARN

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This invention relates to a high bulk yarn having improved elastic characteristics and particularly to the process for producing an elastic high bulk yarn having high power.

It is known that elastic yarns capable of producing fabrics having a soft hand may be produced on conventional twisting apparatus by combining an untwisted continuous filament, multi-filament yarn and an elastic thread that has been extended to two or more times the length it has in the relaxed state. On relaxation of the elastic thread the multi-filament yarn forms a loose, helical wrapping which simulates a textured or bulk yarn to some degree. Structures of this nature are disclosed in United States Patent No. 3,011,302.

It is also known that elastic yarns can be formed by spinning one or more rovings of staple fibers as a sheath about a stretched core of elastic thread, so that when the composite yarn is relaxed the sheath fibers bulge outwardly to present a high bulk effect. United States Patent No. 3,038,295 discloses structures of this nature.

In such prior processes the elastic thread imparts to the finished yarn an effect similar to the desirable qualities of a textured continuous filament yarn.

Textured yarns are being used in continuously increasing amounts in the production of both woven and knit goods. Stretch fabrics woven or knitted from them find application in many types of wearing apparel. Such fabrics, however, lack the quick return ability or "power" of cloths made with conventional elastic threads.

By the present invention this defect of conventional textured yarns is overcome by the plying of preformed textured yarn with elastomeric thread in such manner as to cause the textured yarn, when stretched, to return quickly to its relaxed state while at the same time imparting a higher modulus than is possessed by the elastomeric thread itself. In the plying operation both the textured yarns and the elastic thread are stretched and on relaxation of the composite product both of its components return to the unstretched state in proportion to the degree of relaxation. There is, therefore, in the relaxed composite yarn no separation of strands, and what bulging occurs is the ordinary bulking of a textured fiber.

In plying the combined yarn, it is desirable to use an even number of textured yarns, half of which have an "S" twist and the other half a "Z" twist unless, of course, a no-torque stretch yarn is used. The elastomeric thread may, if desired, be given a twist prior to its being fed to the plying operation, equivalent to and in the reverse direction to that imparted during plying, so as to be free of twist in the combined yarn; but ordinarily this extra operation is unnecessary.

There are a variety of textured yarns commercially available, any of which may be combined with an elastomeric core thread in accordance with the present invention to produce a multi-ply yarn having the foregoing qualities. The "Conventional Helanca" stretch yarn, wherein a continuous multi-filament yarn is given a high twist (50 or more turns per inch), heat-set, and then untwisted, and the so-called "false twist" yarns, wherein the twisting, heat-set, and untwisting are simultaneously accomplished as the yarn is continuously passed through a heating zone and a rapidly rotating false-twist spindle, are particularly well suited for the production of multi-ply yarns having a high degree of stretch. A characteris-

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tic of these yarns is that they will stretch from 300 to 500 percent, thereby permitting a substantial retraction of the plied elastic yarns without substantial looping or separation of the hard yarns from the elastic core. The Agilon yarns of the crimped type produced by pulling the heated yarn over an edge are also of this category. Other textured yarns are produced by heat-setting crimps induced in other ways as the Ban-lon process of Joseph Bancroft & Sons Co., the process of the Spunize Company of America, and the knit-heat-set-unravel procedure. Any of these, to the extent that they possess the ability to retract when stretched, may be used in the present invention.

The textured yarn may be formed of any multi-filament, continuous filament yarn that is thermoplastic and capable of being heat-set in a curved state. The synthetic fibers, particularly the nylons, the polyacrylonitrile fibers, and the polyester fibers (Dacron), are particularly well suited. There are a large number of textured nylon yarns commercially available, and the ones best suited will depend on the desired characteristics of the finished yarn.

The elastic core component of the improved yarn may be made of rubber or a synthetic elastomer such as a synthetic rubber, a polyurethane elastic thread, or other segmented polymer. Many such elastomeric polymers are known, some being described in patents such as United States Patents Nos. 2,650,212, 2,953,839, and 2,957,852.

Preferably, the elastomeric fiber should be one which has good stability when exposed to high temperatures and chlorine, for this will make fabrics made therefrom more resistant to deterioration when submitted to repeated washings and/or dry-cleaning operations. One fiber having such special merit is known to be formed from an acrylonitrile-butadiene copolymer compounded as described in United States patent application Serial No. 265,610, filed March 18, 1963, and now abandoned.

The power or modulus of elasticity of fabrics woven or knitted from the plied yarns of this invention can be regulated by balancing the degree of stretch imparted to the textured yarns and elastic thread during plying. Normally, it is desired to perform the plying operation with the textured yarns in a fully stretched condition. The fibers of these yarns are then the limiting factor on the maximum stretch of the composite yarn. If the elastic thread is also prestretched to approach its maximum elongation, then fabrics woven or knitted from the resulting composite yarn will possess the maximum power. If the elastic thread is stretched to an elongation about equal to the elongation of the textured yarns, its elasticity will operate throughout the full range of stretch in the textured yarns; and high power will be present. On the other hand, when the textured yarn is combined in a fully stretched condition and the elastic thread is stretched only 100%, the power of the elastic thread will be lost when the composite yarn is relaxed to one-half its maximum elongation.

The composite yarns of this invention will normally be formed into fabric while in a stretched state and will shrink to a portion of their woven dimension on removal from the weaving or knitting machine. The degree of shrinkage will depend partly upon the modulus of elasticity of the composite yarn and partly upon the tightness of the weave or stitch. Where an improved ability to return to the original shape, rather than power in resisting stretch, is the important consideration, it may be desirable to have relatively low elongation of the elastic thread during formation of the composite yarn.

Usually, it is not desirable to impart a high twist during the ply operation. Sufficient twist is necessary to prevent separation of the component yarns and threads; i.e., about one-half turn per inch. Seldom will it be

desirable to exceed twenty turns per inch. A twist of from two and one-half to five turns per inch will normally be desired.

For a detailed description of the method of producing the improved composite yarn the accompanying drawing is provided. This drawing represents schematically a conventional plying machine modified to provide means to elongate the elastic thread prior to its being combined in the composite yarn. In the drawing 11, 12, 14, and 15 represent supply packages of textured yarn 21, 22, 24, and 25. Supply package 13 provides the elastic thread which passes through a suitable tensioning device 16 adjusted to provide the desired stretch to the elastic thread. The individual strands of textured yarn pass through suitable guides, as may be needed, to rolls 17 and 18, then to feed rolls 26 and 27. The combined yarns then pass through the pigtail guide 28 to the ring twister 29 and the take-up package 30.

As illustrated, four strands of textured yarn are represented as being combined with one strand of elastic thread. In such a combination, when the textured yarn is of the conventional Helanca or the false twist variety, two of the supply packages should have an S twist torque and the other two a Z twist torque. If desired, fewer or a greater number of strands of yarn may be combined and in some circumstances, particularly when using low denier of elastic thread, a plurality of elastic threads may be employed. Similarly, it is not necessary that there be a balancing of S twist yarns and Z twist yarns, and an uneven number of strands may be used.

To illustrate the invention, the following example is given. A conventional Down Twister was threaded with two packages of 70-denier, 34-filament, S-twisted nylon yarn that had been texturized on a Lessona No. 550 Superloft stretch yarn machine, two packages of similar, texturized nylon to which a Z twist had been imparted, and one package of elastic thread. The elastic thread was an acrylonitrile-modified butadiene polymer containing approximately 30% acrylonitrile and compounded with a reinforcing filler prior to curing. The filler was an anhydrous pyrogenic silica and represented approximately one-third of the cured elastomer. The relaxed elastic thread had a denier of approximately 280. A device for applying tension was applied to the elastic thread and adjusted so as to cause a 400% elongation during the plying operation. The machine was operated to apply two and one-half turns per inch to the composite yarn. The resulting yarn was 67% nylon and 33% elastomer and when tested by the conventional test

procedure for modulus of plied yarns, in comparison with the bare elastomer, gave the following values:

Elongation, percent	Composite, oz.	Core, oz.
50 out-----	0.4	0.4
100 out-----	0.6	0.5
150 out-----	0.7	0.6
200 out-----	1.0	0.8
250 out-----	3.0	1.2
200 in-----	1.2	0.9
150 in-----	0.8	0.7
100 in-----	0.5	0.5
50 in-----	0.3	0.3

The composite yarn had a Hand Stretch of 280% and a Break at 355% elongation. In this same manner a yarn containing about 50% elastomer was prepared by plying one end each of the S twist and Z twist textured nylon yarn with one end of elastomer, and one containing about 25% elastomer was made by plying three ends of each textured nylon yarn with one end of elastomer. The three combinations above-described were also plied in a composite yarn of five turns per inch.

The composite yarns may be used in ways well known for the production of a wide variety of fabrics. They may be used to perform the function of the conventional elastic thread to impart a powerful retractive force to the knitted or woven fabric or they may be used as is the conventional textured yarn. Close-fitting apparel of a wide range of retractive force can be produced, as also can decorators' and industrial fabrics.

I claim:

1. A process comprising elongating an elastic thread and at least two twisted continuous filament, multifilament textured yarns, part of said yarns having an S-twist torque and the remainder of said yarns having a Z-twist torque, and plying said thread and said textured yarns while elongated.

2. A process according to claim 1 wherein an even number of textured yarns are used, half of said yarns having an S-twist torque and half having a Z-twist torque.

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