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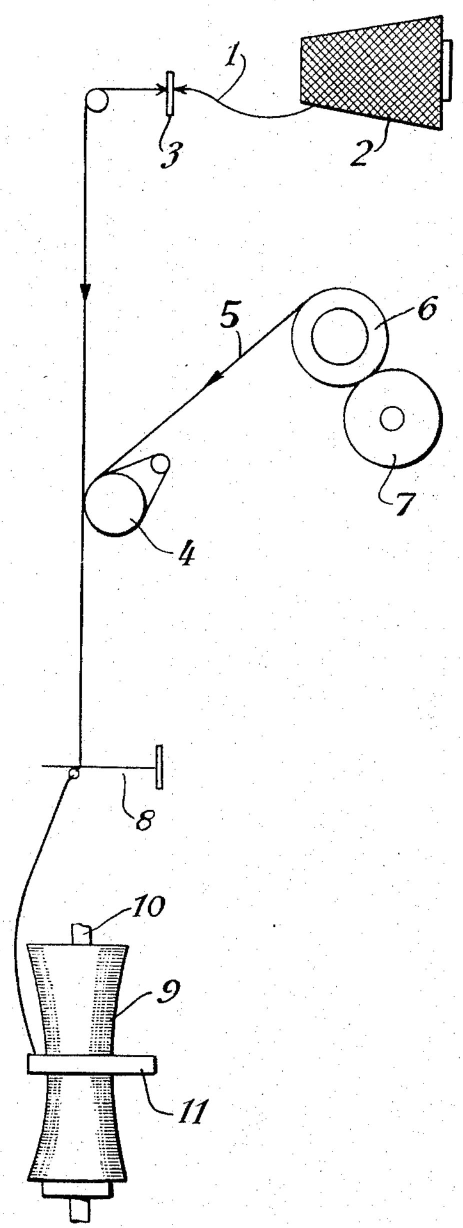

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COMPOSITE ELASTIC YARNS

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This invention relates to the production of textile yarns and particularly to elastic yarns consisting of an inner continuous elastic filament and an outer covering consisting of a bulked thermoplastic yarn, and preferably a bulked continuous multifilament thermoplastic yarn.

Methods of producing composite elastic yarns are known in which the elastic filament is formed from segmented, polyurethane elastomers typified structurally by the presence of low-melting amorphous segments joined to high-melting crystalline segments. Such elastomers are sometimes referred to as spandex elastomers. When filaments made from spandex elastomers are to be incorporated into a fabric, at present several practices are adopted. One of these necessitates the use of spandex core spun yarns, which are not suitable for all desired types of fabrics, and another employs spandex covered yarns, which involves substantial expense in the wrapping or covering process, and if a yarn of desired bulk is to be obtained they generally require the use of staple fibre yarns. A further practice involves the employment of spandex feed or furnishing devices in the production of fabrics which are only presently being developed and are likely to involve expensive production costs.

It is an object of the present invention to dispense with the need for special spandex furnishing devices in the production of textile fabrics from yarns where the outer covering of the elastic filament is a thermoplastic yarn or yarns composed of, for example, filaments or fibres formed from nylon, synthetic linear polyesters, such as Terylene (registered trademark), cellulose acetate, polyethylene, polypropylene, or acrylonitrile polymers or copolymers.

It is another object of the invention to enable a composite yarn consisting of an elastic filament and at least one thermoplastic yarn to be produced economically.

It is still another object of the invention to produce composite elastic yarns demonstrating a high degree of yarn evenness as well as substantial bulk, both of which provide desirable physical properties to the fabrics produced therefrom.

According to the present invention there is provided a method for the production of a composite elastic yarn comprising the steps of providing at least one bulked thermoplastic yarn wound on a package, unwinding said yarn from said package so as to reduce the bulk of the yarn to zero, feeding said yarn to a series of capstan rolls, providing an elastic filament wound on a rotatably driven package geared to said capstan rolls, feeding said elastic filament to said capstan rolls to join said yarn, the ratio of the surface speed between said capstan rolls and the rotatably driven package being variable to cause the elastic filament to be stretched to a predetermined amount between the capstan rolls and the rotatably driven package, feeding said composite yarn to a take-up package and imparting twist to said composite yarn, allowing the composite yarn to relax so as to permit the elastic filament to contract and the thermoplastic yarn to return to a bulked condition exceeding its original bulk. The invention also includes the product of the said method having a high degree of yarn evenness and bulk exceeding that of the original thermoplastic yarns.

The accompanying drawing is a diagrammatic representation of an apparatus suitable for carrying out the invention. Referring to the drawing, a bulked thermoplastic yarn **1** is fed from a supply package **2** through a tension device **3** whereby the bulk of the yarn is reduced to zero. The yarn **1** is then fed to capstan rolls **4**. At this point the yarn **1** is joined by a continuous elastic filament **5** in a stretched condition, the yarn **1** and the elastic filament **5** being both passed together around the capstan rolls **4**. The elastic filament is delivered from a supply package **6** which is surface driven by rolls **7** each mounted on a spindle, the rolls **7** being geared directly to the capstan roll shaft so that the ratio of the surface speed between the capstan rolls and the elastic filament feed rolls can be varied in such a manner that the surface speed of the capstan rolls with respect to the surface speed of the elastic filament feed rolls are in the ratio of 1.5:1 and 5.0:1. The capstan rolls are so geared as to deliver the composite yarn through a thread guide **8** to a take-up package **9**, twist being imparted to the yarn due to the revolution of the take-up package spindle **10** and the ring and traveller **11**. This plying twist may suitably vary from about 3 to as much as about 10 turns per inch either Z or S.

The variation in surface speed between the elastic filament feed rolls and the capstan rolls causes the elastic filament to be stretched from 50 percent to 400 percent between the two points depending on the selection of gears. The elastic filament will be maintained at a constant rate of extension throughout the production of the composite yarn. Thus, at the point where the yarn **1** and the continuous elastic filament **5** are fed to the take-up package, the originally bulked yarn **1** will no longer be in a bulked condition and the elastic continuous filament will be in a stretched condition. When the composite yarn is allowed to relax, the elastic filament will contract to its original length, causing the inelastic yarn to reach a bulked condition, the extent of which is even greater than that possessed by the inelastic yarn prior to being subjected to tension.

The bulked thermoplastic yarn can be composed of filaments or fibres formed from nylon, synthetic linear polyesters, such as Terylene (registered trademark), cellulose acetate, polyethylene, polypropylene, and acrylonitrile polymers and copolymers, but is most preferably a yarn composed of continuous multifilaments of one of the named materials. Thermoplastic inelastic yarns which are bulked in some manner to afford a certain degree of stretch to the yarn are originally employed. In the case of staple fibre yarns they may be blends of unshrunk and highly shrinkable or high-bulk fibres. Preferably they are bulked continuous multifilament yarns prepared by crimping by any known means, such as false twisting, stuffer crimping, gear crimping, etc., or otherwise inducing bulk into the continuous multifilaments, such as by tangling by an air jet with hot air or other fluid. Whilst in the embodiment described and illustrated the elastic filament is sheathed by a single thermoplastic bulked yarn, it will be understood that a plurality of thermoplastic bulked yarns may be employed by feeding two or more ends of bulked thermoplastic yarn with one end of the elastic filament so as to produce multiend composite yarns.

The elastic composite yarns of the invention demonstrate very desirable physical properties in that they have increased bulk and increased modulus over the inelastic thermoplastic bulked yarns employed as starting yarns and they demonstrate a very high degree of yarn evenness having no thick or thin segments and no "cockles" in the yarns. These excellent physical properties demonstrated by the composite elastic yarns are carried over into fabrics produced therefrom either by knitting, weaving or other means.

The invention is further illustrated by the following example.

EXAMPLE 1

A composite elastic filament was produced by the present method employing an apparatus as illustrated in the attached drawing. In this instance an elastic filament of 70 denier spandex was extended 250 percent and joined at the capstan rolls by one end of 70 denier, 34 filament nylon continuous multifilament bulked yarn which had been bulked by the false twist-heat set-untwist process. The downtwister take-up inserted 5 turns per inch of Z doubling twist while the extension of the spandex filament was maintained. Upon removal from the package the resulting elastic composite yarn recovered to the original length of the spandex filament and constituted an elastic composite yarn which was quite even, demonstrating no "cockles" or thick and thin segments even when extended to 230 percent of the recovered length and greater bulk than the initial bulked nylon yarn.

Samples of the above yarn were knitted into a double knit fabric on an 18-gauge double knitting machine. The resulting double knit fabric demonstrated a wet stretch of 171 percent in width and 110 percent in length, dry stretch of 150 percent in width and 96 percent in length, a recovery after stretch loading for 30 minutes of 93 percent in width and 95 percent in length using standard swimwear test methods. The fabrics showed a smooth appearance in the greige and after finishing and were suitable fabrics for swimwear or other stretch garments.

Other samples of the same yarn were warp knitted into fabrics with 40/13 filament nylon demonstrating a stretch of 100 percent in both directions, a recovery after stretch loading of 93 percent in both directions, and a warp way stretching modulus of 1.5 pounds at 40 percent and 3 pounds at 60 percent extension. The finished fabrics were suitable for stretch underwear or lingerie. Additional samples of the same yarn were woven as weft into rayon warp fabrics which demonstrated a stretch in the weft direction of 40 percent after finishing and an immediate recovery from stretch of 96 percent. These finished fabrics were suitable for stretch slacks, jackets and other such garments.

EXAMPLE 2

In this example a composite elastic filament was produced from an elastic filament of 140 denier spandex extended to 300 percent and joined at the capstan rolls by a 2 ply yarn of 30 denier, 10 filaments in each ply of bulked continuous multifilament nylon which 2 ply yarn had been bulked by the false twist-heat set-untwist process. The downtwister take-up inserted 5 turns per inch of Z doubling twist while the extension of the spandex filament was maintained. Upon removal from the package the resulting elastic composite yarn recovered to the original length of the spandex filament and constituted an even elastic yarn capable of 270 percent extension of the final recovered length.

Samples of the above yarn were knitted with a 2 ply 30 denier 10 filament crimped nylon yarn in alternate courses into surgical stockings on a circular knitting seamless stocking machine. This surgical stocking demonstrated satisfactory stretch properties and control.

EXAMPLE 3

A composite elastic filament was produced in the same manner as the above examples employing an elastic filament of 280 denier spandex extended 360 percent and joined at the capstan rolls by a one end of 70 denier, 34 filament bulked continuous multifilament nylon yarn which had been bulked by the false twist-heat set-untwist process. Downtwister take-up inserted 5 turns per inch of Z doubling twist while the extension of the spandex filament was maintained. Upon removal from the package

the resulting elastic composite yarn recovered to the original length of the spandex filament and constituted an even elastic composite yarn demonstrating a stretch of approximately 330 percent and greater bulk than the initial bulked nylon yarn.

Samples of the above yarn were double knit on an 18 gauge double knitting machine to produce a double knit fabric which demonstrated a wet stretch of 210 percent in width and 115 percent in length and a dry stretch of 190 percent in width and 100 percent in length and a recovery after stretch loading of 98 percent in width and 97 percent in length when using standard swimwear tests. The fabric showed a smooth appearance in the greige and after finishing, and suitable for swimwear. Other samples of the same yarn were laid in on circular knit half hose machines to elasticize half hose tops demonstrating good stretch and recovery characteristics therein.

What is claimed is:

1. A method for producing a composite elastic yarn which comprises the steps of:
   (a) providing at least one bulked thermoplastic yarn on a package,
   (b) unwinding said yarn from said package so as to remove the added bulk of the yarn,
   (c) feeding said yarn to a series of capstan rolls,
   (d) providing an elastic filament on a rotatably driven package geared to said capstan rolls,
   (e) feeding said elastic filament to said capstan rolls to join said thermoplastic yarn, the ratio of the surface speed of the capstan rolls to the surface speed of the rotatably driven package being variable to cause the elastic filament to be stretched a predetermined amount between the rotatably driven package and the capstan rolls,
   (f) feeding said joined filament and at least one yarn to a take-up package and imparting plying twist to said filament and yarn to form a composite yarn, and
   (g) thereafter allowing said composite yarn to relax so as to permit the elastic filament to contract and the thermoplastic yarn to return to a bulked condition exceeding its original bulk.

2. The method of claim 1 wherein the bulked thermoplastic yarn is composed of filaments selected from the group consisting of nylon, polyesters, cellulose acetate, polyethylene, polypropylene, and acrylonitrile.

3. The method of claim 1 wherein the bulked thermoplastic yarn is a bulked continuous multifilament nylon yarn.

4. The method of claim 1 wherein the elastic filament is a segmented polyurethane filament.

5. The method of claim 1 wherein the ratio of the surface speed of the capstan rolls to the surface speed of the rotatably driven packge is from 1.5:1 to 5.0:1.

6. The method of claim 1 wherein the elastic filament is stretched from 50 percent to 400 percent.

7. The method of claim 1 wherein there is imparted from about 3 to about 10 turns per inch of plying twist.

8. A composite elastic yarn produced by the method of claim 1.

9. A fabric made from the yarn of claim 8.

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