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METHOD OF MAKING ELASTIC CORE YARNS

Filed Nov. 27, 1963

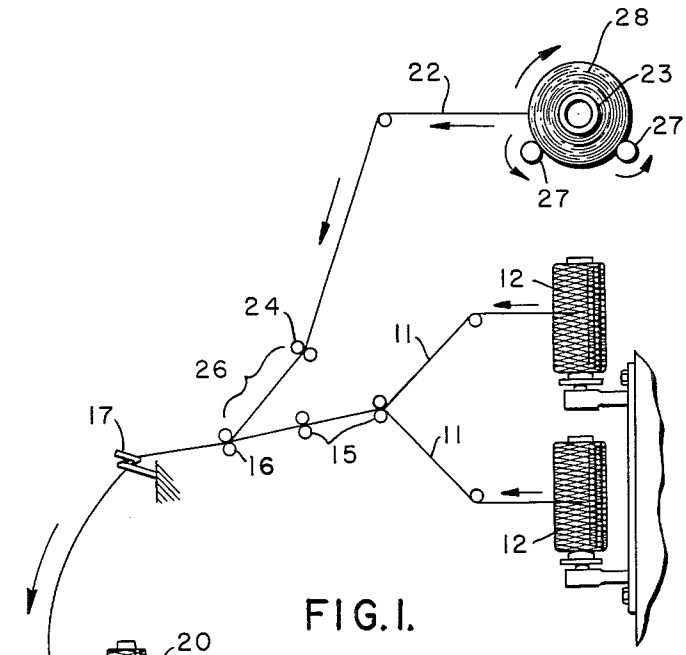
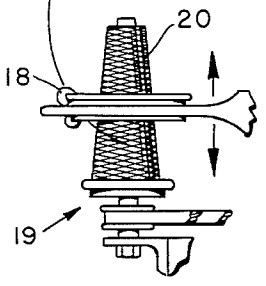


FIG. 1.



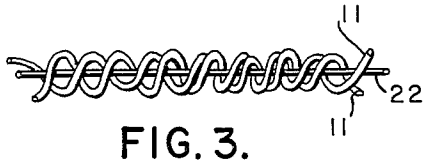


FIG. 3.

FIG. 2.

INVENTOR.
PETER P. HERMES

BY Robert L. Broad Jr.
ATTORNEY

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METHOD OF MAKING ELASTIC CORE YARNS

Peter P. Hermes, Decatur, Ala., assignor to Monsanto Company, a corporation of Delaware

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6 Claims. (Cl. 57—163)

This is a continuation-in-part of application Serial No. 287,910, filed June 14, 1963, now abandoned, by Peter P. Hermes for "Spinning of Textile Yarns."

This invention relates to the spinning of textile yarns and more particularly to the spinning of elastic high-bulk yarns.

A known method of spinning elastic high-bulk textile yarn is pulling a straight elastic filament through a tensioning device, combining this filament with a non-elastic roving and twisting the filament and roving on a spinning frame. During this process the elastic filament is maintained in a stretched condition. When the elastic filament is allowed to retract, the roving will form bights and loops to provide bulkiness. A primary disadvantage of this process is the fact that the elastic filament is run through the apparatus with different degrees of stretch along the length thereof, resulting in unevenness in the covering of the elastic filament by the roving. This erraticness in tension is caused by the fact that an elastic filament cannot be pulled through a tensioning device under uniform tension, as can a non-elastic filament.

When an elastic filament is pulled through a tensioning device, such as a disc tensioner, the filament will stretch until it slips in the tension device, whereupon a span of the filament will spurt through the tension device until the filament is retracted to a point where the tension device will again snub the filament. Tension in the filament increases until the filament slips, whereupon the tension again drops radically until the filament is snubbed. Thus, the tension in the elastic filament tends to erratically jump from one extreme to the other. This results in undesirable characteristics in the assembled yarn, which affects the appearance of the fabric made from the yarn.

A further disadvantage of prior methods of spinning elastic high-bulk yarns is that the elastic yarn is pulled longitudinally over the end of a stationary bobbin upon which the elastic yarn is wound. The elastic yarn, under certain conditions, tends to stick to the yarn package and this, combined with the friction involved as the yarn is pulled over the yarn package, causes the elastic yarn to come off the supply bobbin erratically. Pulling the elastic yarn off the bobbin in this manner tends to unduly stress the elastic yarn and thereby contributes to undesirable characteristics in the finished yarn. With this in mind, one of the objects of this invention is to provide a novel and improved process for spinning elastic yarns.

Another object of this invention is to provide a system for producing a high-bulk elastic synthetic yarn having uniform characteristics along the length thereof.

A further object of this invention is to provide a process for feeding an elastic filament under constant tension and elongation.

Still another object of this invention is to provide a process wherein an elastic filament fed at a constant speed and elongation is combined with one or more inelastic filaments to form a high-bulk elastic yarn.

Still another object of this invention is to provide a process wherein an elastic filament is combined under constant tension and elongation with a plurality of inelastic filaments to form a high-bulk elastic yarn.

Still another object of this invention is to provide a process for spinning elastic yarns wherein a tendency of the elastic yarn to adhere to the yarn supply package is utilized to achieve a superior yarn feeding operation.

A further object of this invention is to provide a process for spinning elastic yarns wherein the elastic yarn supply bobbin is positively driven.

One embodiment of this present invention contemplates a process wherein a synthetic elastic filament is withdrawn from a rotating yarn package and fed through a pair of top rolls to a pair of front rolls and joined with one or more inelastic filaments at the set of front rolls, the set of top rolls feeding the elastic filament to the front rolls at a constant speed so that the filament is under uniform and constant tension. The elastic filament is withdrawn from the rotating yarn package at such a speed that it comes off the package substantially radially. The elastic filament is stretched in the zone between the top rolls and the front rolls, so that the elastic filament is in a stretched condition when it is joined with the inelastic filaments. The amount of stretch or elongation is determined by the relative speeds of the top and front rolls. Since the top rolls feed the elastic filament into the stretch zone at a constant speed, the tension and elongation of the elastic filament is constant. The combined elastic and inelastic filaments are taken up under tension on a spinning frame to form an elastic high-bulk yarn.

Other objects and advantages of the invention will become apparent when the following detailed drawing is read in conjunction with the appended drawing, in which

FIGURE 1 is a schematic diagram of apparatus used to perform the process of the present invention, and showing the manner in which the elastic yarn supply package is positively driven.

FIGURE 2 is an enlarged view of the assembled yarn with the elastic core filament under a stretched condition, and

FIGURE 3 is a view of the yarn of FIGURE 2 with the core filament in a relaxed or retracted condition.

Referring now in detail to the drawing, a plurality of inelastic filaments or rovings **11** are shown being advanced from bobbins **12** through draw rolls **15** to a pair of front rolls **16**, the front rolls feeding the filaments through a guide **17** through a traveler ring **18** of a spinning frame **19** to a takeup bobbin **20**. By regulating the speeds of the front rolls **16** and the draw rolls **15** the inelastic filaments **11** can be drawn to the desired degree.

A synthetic elastic filament **22** is fed from a supply bobbin **23** between a pair of top feed rolls **24** to the front rolls **16** where the elastic filament is joined with the inelastic filaments **11**. The joined or assembled filaments **11** and **22** then pass through the traveler ring to the takeup bobbin **20** and are twisted in the process, the twisting operation winding the inelastic filaments **11** around the elastic filament **22** as shown in FIGURE 2.

The supply bobbin **23** rests on a pair of spaced drive shafts or rolls **27** so that the yarn package **28** is in driven engagement with the shafts **27**, the elastic yarn **22** being taken off the package **28** along a path lateral to the package **28**, rather than axially as is common practice. The shafts or rolls **27** are driven at such a speed relative to the top rolls **24** that the elastic yarn **22** comes off the package **28** along a path which is substantially radial to the bobbin **23**, rather than tangentially as might be expected. This result is achieved by correlating the speed ratio of the shafts **27** and the top rolls **24** with the tendency of the elastic yarn to adhere to the package **28**, this tendency being a function of the nature of the elastic yarn (denier, etc.) and the tension under which the yarn **22** is wound on the package **28**.

By withdrawing the yarn **22** from the package **28** in this manner it is insured that the yarn is removed from the package **28** under uniform and constant tension, thereby eliminating the overstretching of the yarn **22** which can occur when the yarn is pulled off the package

28 tangentially. Also, the operator can glance at the path of the yarn 22 leaving the package 28 and determine whether the yarn 22 is being taken off the package 28 under the correct tension. The desired yarn path, from the package 28, is illustrated in FIGURE 1. It can be seen from FIGURE 1 that an extension of the yarn path would intercept the axis of the package 28 or pass very close thereby.

The top rolls 24 are driven at a constant speed to feed the elastic filament 22 into the zone between the top and front rolls at a constant speed. This zone, which is designated by the numeral 26, might be referred to as the "stretch" or "elongation" zone, since the elastic filament 22 is stretched or elongated in this zone.

The amount of stretch or elongation imparted to the elastic filament 22 is a function of the speeds at which the filament 22 enters the zone 26 at the top rolls 24 and leaves this zone at the front rolls 16. The following equation shows the relationship of elongation and filament speeds:

$$e=S_2/S_1$$

where e is the ratio of elongation length to relaxed length, S_1 is the linear speed of the elastic filament 22 at the top rolls 24, and S_2 is the linear speed of the filament 22 at the front rolls 16.

The value of e may vary from about 1.25 to about 8 times the relaxed length of the elastic filament. In other words, a one inch length of the elastic filament in its relaxed state may be elongated from about 1.25 inches to about 8 inches. Thus,

$$1.25<S_2/S_1<8$$

The preferred range of elongation, however, is from 2 to 5 times the relaxed length of the elastic filament 22, or

$$2<S_2/S_1<5$$

By selecting the proper gearing for driving the top and front rolls 24 and 16, the speeds S_1 and S_2 can be changed to achieve the desired stretch or elongation of the elastic filament 22. Since the top and front rolls 24 and 16 are gear driven from a common drive (not shown) the speeds S_1 and S_2 do not fluctuate. Thus, the elongation e remains constant and unvarying. Because this elongation in the zone 26 is constant, the elastic filament 22 passes through the front rolls 16 under a constant amount of elongation.

Under a constant amount of twist (applied by the spinning frame), the amount of bulking in the composite relaxed yarn will be a function of the elongation of the elastic yarn 22 as it passes through the front rolls 16. The greater the elongation of the elastic filament 22, the greater will be the bulkiness in the yarn in the relaxed state, assuming that the proper twist is put into the yarn.

The inelastic filaments 11 may be any textile fiber in staple or continuous filament form, such as cotton, wool, rayon, nylon, etc. The segmented filament 22 is a segmented elastomer of a well known type and is, preferably, in straight, uncrimped, monofilament form. The segmented elastomers, which are known in the trade as Spandex, and methods of making them are well known.

A twist multiplier of about 4 or less is used. Greater amounts of twist result in less bulking of the staple filaments when the elastic filament is in a relaxed state. The ratio of the elastic filament to the inelastic filaments is about 2:3 or less by weight. In other words, the elastic filament will comprise about 40% or less of the weight of the composite yarn.

While a bulky yarn will be produced if a rubber filament is substituted for the segmented elastomer filament 22, this yarn will be unsuitable for many uses. This is because rubber filaments cannot be dyed and are affected by perspiration, sunlight, etc. Also, rubber filaments are available only in deniers above about 300. For these reasons, the preferred arrangement is to use a segmented elastomer for the filament 22. This process can be used

to produce high-bulk elastic yarns in deniers from well below 300 to above 900–1000. The use of the segmented elastomeric filament, rather than a rubber filament, allows the production of yarns having deniers well below 300 and, in deniers both below and above 300, overcomes the disadvantages inherent in a rubber filament.

The assembled filaments pass from the front rolls 16 to the spinning frame and are taken up on the bobbin 20 under enough tension to hold the elastic filament in an elongated or stretched condition. When the composite yarn is allowed to relax, the inelastic filaments 11 will bulge outward from the filament 22 as shown in FIGURE 3 to form a bulky yarn. Since the elastic filament passes through the stretch zone at a constant speed and elongation, the bulky effect is very uniform along the length of the yarn.

The manner in which the yarn supply bobbin is driven insures that the elastic yarn 22 will reach the stretch zone in good condition. The radial removal of the yarn 22 from the package 28 eliminates the scrubbing and scraping of the yarn inherent in the conventional method of axially pulling off the elastic yarn. It also overcomes the problems caused by the tendency of the elastic yarn, which is wound onto the bobbin 27 under tension, to stick or adhere to the package 28.

It is to be understood that the embodiment of the invention disclosed herein is merely illustrative and that numerous other embodiments can be contemplated without departing from the spirit and scope of the invention.

What is claimed is:

1. The method of withdrawing a segmented elastomeric yarn wound under tension into a yarn package, comprising rotating the yarn package about an axis at a first predetermined speed, and withdrawing the yarn from the package through a point spaced from the package at a second speed, said first and second speeds being correlated to each other and to the nature of the yarn and the yarn package tension in such a manner that said yarn leaves said package along a path substantially radial to said axis.

2. The method of making an elastic core yarn, comprising providing a supply of a segmented elastomeric yarn wound into a yarn package, providing a supply of inelastic yarn, rotating said yarn package at a predetermined peripheral speed, withdrawing the elastic yarn from the yarn package at a predetermined withdrawal speed, correlating said speeds with the nature of the elastomeric yarn and the yarn package tension in such a manner that said elastomeric yarn leaves said package along a path substantially radial to said package, feeding the elastomeric yarn through a stretch zone, tensioning the elastomeric yarn in the stretch zone to elongate said elastomeric yarn a predetermined amount, and winding the inelastic yarn around the elongated elastomeric yarn to produce an elastic core yarn.

3. A method of making an elastic high-bulk yarn, comprising providing a supply of a segmented elastomeric first filament wound into a yarn package, providing a supply of an inelastic second filament, rotating the yarn package at a predetermined speed, withdrawing the elastomeric yarn at a predetermined withdrawal speed and in a direction lateral to the axis of said package, said speeds being correlated with the nature of the elastomeric yarn and the yarn package tension in such a manner that said elastomeric yarn leaves said package along a path substantially radial to said package, feeding the first filament into a stretch zone at a constant first speed, withdrawing the filament from the stretch zone at a second constant speed, and winding the second filament around the first filament, said second speed being a predetermined amount greater than the first speed to thereby elongate the first filament a predetermined amount.

4. A method of making an elastic high-bulk yarn, comprising providing a supply of a segmented elastomeric first filament wound into a yarn package, providing a sup-

ply of an inelastic second filament, rotating the yarn package at a predetermined speed, withdrawing the elastomeric yarn at a predetermined withdrawal speed and in a direction lateral to the axis of said package, said speeds being correlated with the nature of the elastomeric yarn and the yarn package tension in such a manner that said elastomeric yarn leaves said package along a path substantially radial to said package, feeding the elastomeric filament into a stretch zone at a predetermined first speed, withdrawing said elastomeric filament from said zone at a predetermined second speed, and winding the inelastic filament around the segmented elastomeric filament, said speeds having the relationship

$$1.25<S_2/S_1<8$$

where S_1 is said first speed and S_2 is said second speed.

5. A method of spinning an elastic high-bulk yarn, comprising providing a supply of a segmented elastomeric first filament wound into a yarn package, providing a supply of inelastic staple filaments, rotating the yarn package at a predetermined speed, withdrawing the elastomeric yarn at a predetermined withdrawal speed, and in a direction lateral to the axis of said package, said speeds being correlated with the nature of the elastomeric yarn and the yarn package tension in such a manner that said elastomeric yarn leaves said yarn package along a path substantially radial to said package, feeding the elastomeric filament into a stretch zone at a constant predetermined first speed, withdrawing the elastomeric filament from said zone at a second constant predetermined speed, and winding the staple filaments around the elastomeric filament, said elastomeric filament being less than 40% by weight of the composite yarn, said speeds having the relationship

$$1.25<S_2/S_1<8$$

where S_1 is said first speed and S_2 is said second speed.

6. A method of spinning an elastic high-bulk yarn, comprising providing a supply of a segmented elastomeric first filament wound into a yarn package, providing a supply

of inelastic staple filaments, rotating the yarn package at a predetermined speed, withdrawing the elastomeric yarn at a predetermined withdrawal speed and in a direction lateral to the axis of said package, said speeds being correlated with the nature of the elastomeric yarn and the yarn package tension in such a manner that said elastomeric yarn leaves said package along a path substantially radial to said package, feeding the segmented elastomeric filament at a first constant speed into a stretch zone, withdrawing the elastomeric filament from the stretch zone at a predetermined second constant speed, and winding the staple filaments around the elastomeric filament to form a composite yarn, said yarn having a denier less than 300, said elastomeric yarn being less than 40% of the composite yarn by weight, said speeds having the relationship

$$1.25<S_2/S_1<5$$

where S_1 is said first speed and S_2 is said second speed.

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STANLEY N. GILREATH, *Primary Examiner.*

MERVIN STEIN, *Examiner.*

J. PETRAKES, *Assistant Examiner.*