United States Patent

[11] 3,596,459

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[73] Assignee Teijin Limited, Osaka, Japan
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[33] Japan
[31] 42/14641, 42/14643, 42/14644, 42/43351, 42/43352 and 42/43353

[54] **PROCESS OF PRODUCING A NONSTRETCH OR LOW-STRETCH COMPOSITE YARN OF SUPER HIGH BULKINESS**

5 Claims, 12 Drawing Figs.

[52] U.S. Cl. 57/160, 57/12
[51] Int. Cl. B65h 81/06
[50] Field of Search ..... 57/12, 140 BL, 144, 160, 162, 163

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ABSTRACT: Process of producing a nonstretch or low-stretch composite yarn of super high bulkiness. At least one core yarn is fed, and at least one covering yarn having a plurality of filaments is tensioned and relaxed and is then fed in an overfed state to a wrapping point where it is wrapped around the core yarn. The rate of delivery of the covering yarn to the wrapping point is such that the ratio of the length of the covering yarn is from 110—300 percent of the length of the core yarn per unit length of the composite yarn. The composite yarn has a final twist imparted thereto.

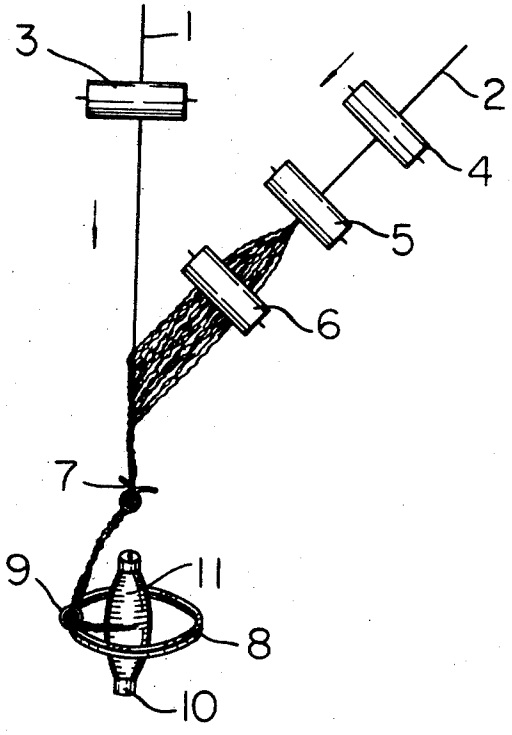


Fig. 1A

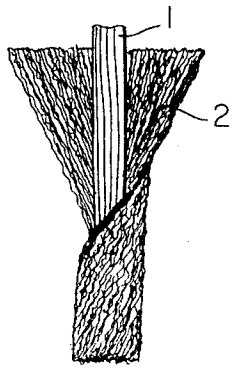


Fig. 1B

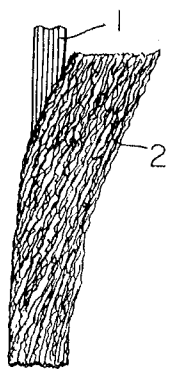


Fig. 2

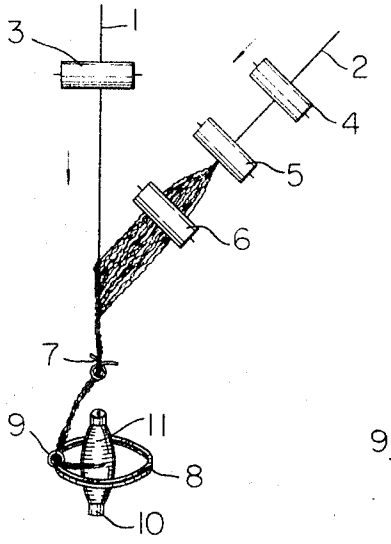
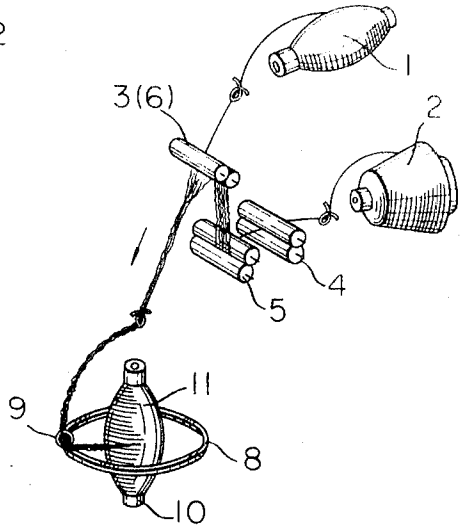


Fig. 3



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Fig. 4A

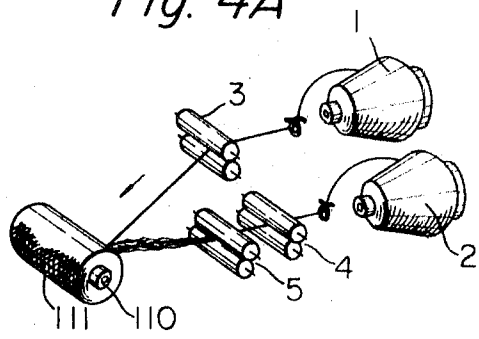


Fig. 4C

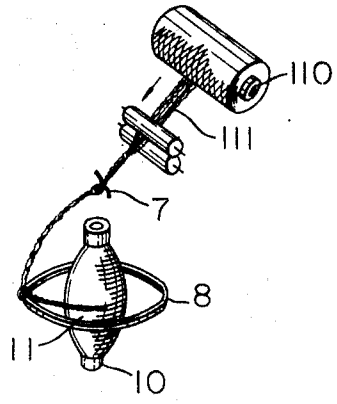


Fig. 4B

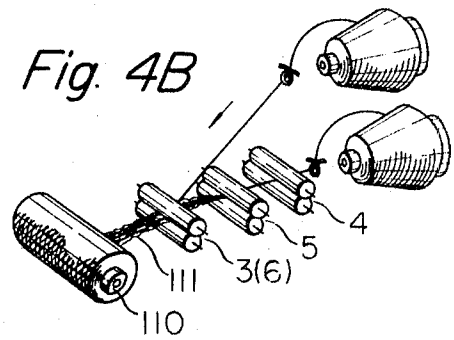
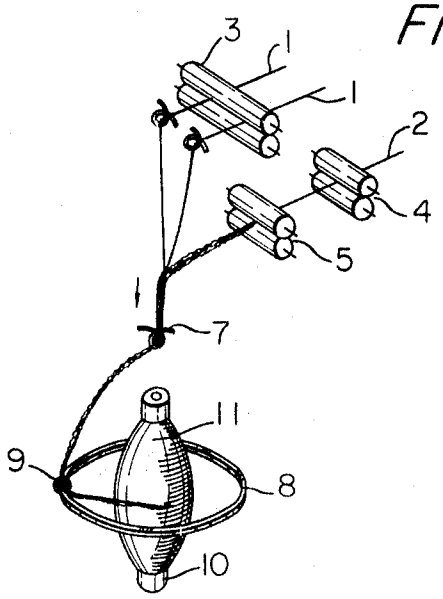


Fig. 5



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Fig. 6

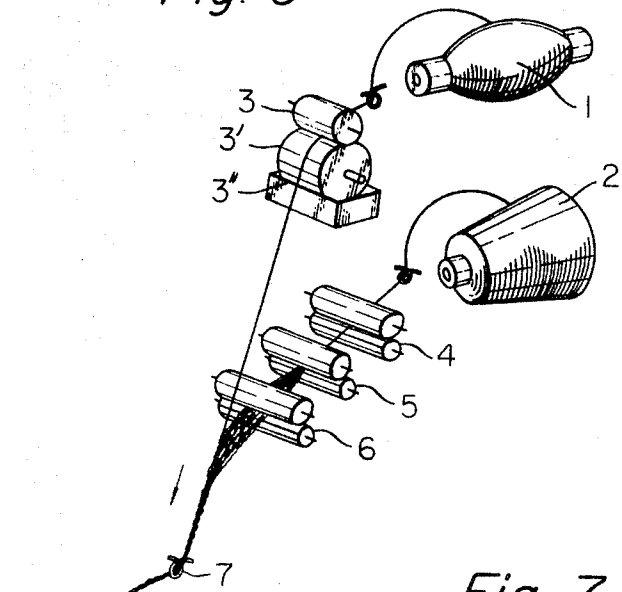
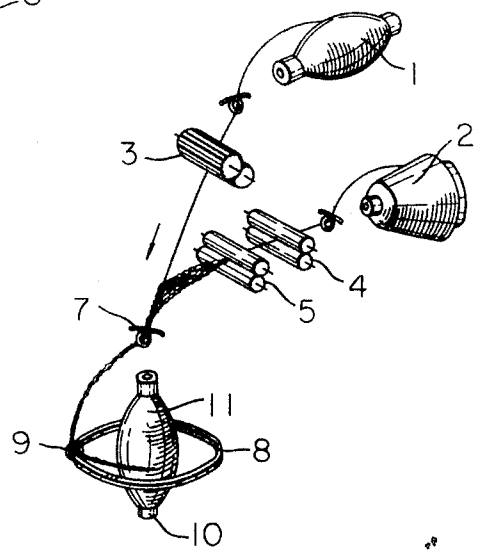


Fig. 7



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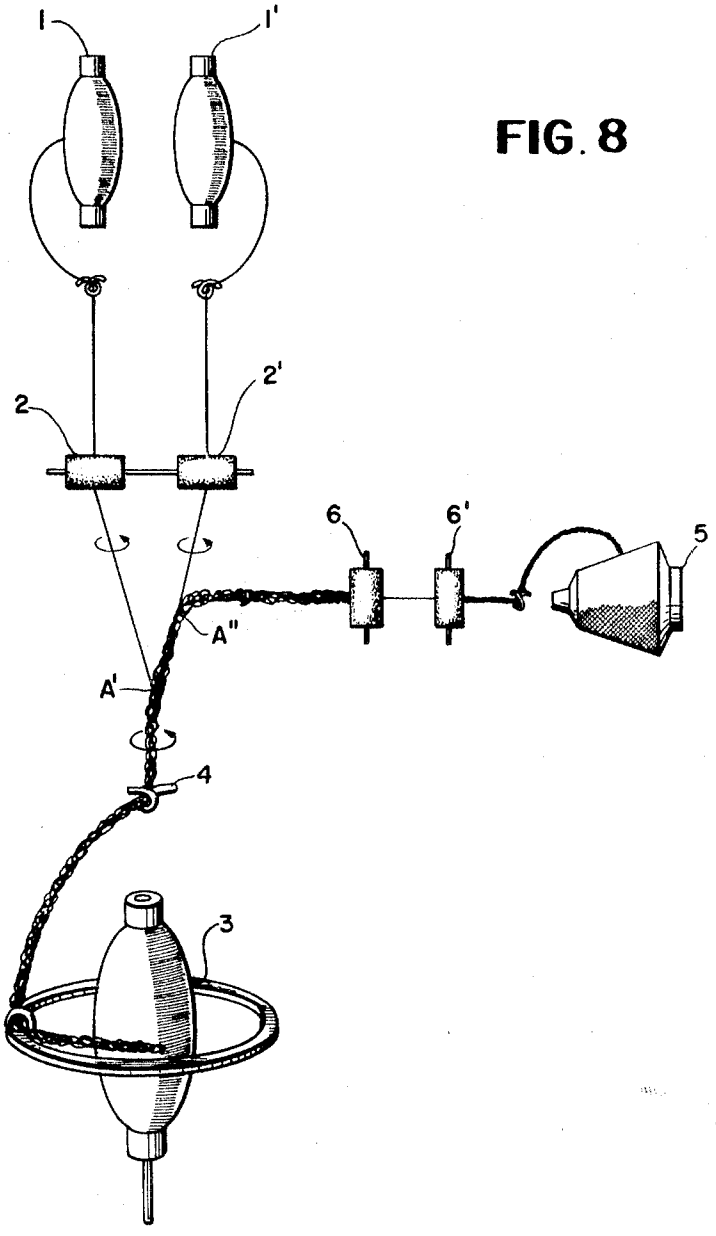


FIG. 8

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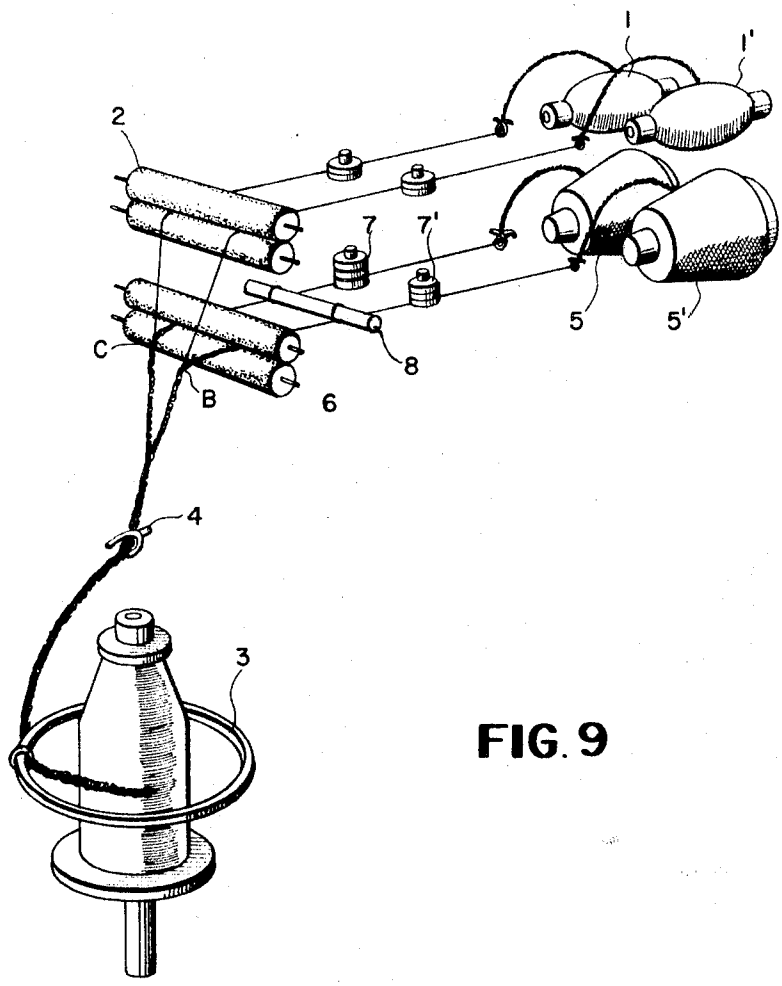


FIG. 9

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PROCESS OF PRODUCING A NONSTRETCH OR LOW-STRETCH COMPOSITE YARN OF SUPER HIGH BULKINESS

This application is a division of our copending application Ser. No. 710,138, filed Mar. 4, 1968, now U.S. Pat. No. 3,495,393.

BACKGROUND OF THE INVENTION

This invention relates to a non- or low-stretch composite yarn of super high bulkiness, and a process of producing said composite yarn. As used herein the term "inelastic yarn" refers to any mono- or multi-filament yarn, crimped or uncrimped, of fiber except polyurethane and rubber, and spun yarn of the same Fiber. For example such fibers include polyester fiber, polyamide fiber, polyacrylonitrile fiber, polyvinyl chloride fiber, polypropylene fiber, glass fiber, steel fiber. The term "crimped yarn" refers to any synthetic filament yarn crimped by presently known processes such as twisting and setting techniques, false twisting, stuffer box, or any other means of producing texturing.

The well-known crimped yarn has a soft feeling because of which it can be advantageously and beneficially used in some commercial fields. But it has the drawback that it has insufficient liveliness when it is fabricated into apparel, and this problem precludes wider application in commercial fields. A solution has been continuously demanded for this problem. Any suitable liveliness of crimped yarn can be attained as desired by increasing its denier in successive steps for increasing the degree of fineness. However, as the liveliness increases, the soft feeling inherently possessed by the crimped yarn disadvantageously decreases. Furthermore, the crimped yarn has a defect that the crimp does not keep the fabric in a bulky state due to excess tension throughout many steps of the manufacturing process for fabricating it into apparel.

The present invention is directed to a composite yarn in which a majority of the liveliness is imparted by the core and the soft feeling mainly by the covering yarn, so that the resulting yarn will have both liveliness and a soft feeling.

SUMMARY OF THE INVENTION

It is the most important object of the present invention to provide a process of producing a nonstretch or low-stretch composite yarn having both super high bulkiness and suitable liveliness.

The present invention is characterized by the fact that the cover filaments which are in a series of helical turns are relaxed consecutively as they are wrapped around the core and both the core and cover are gathered and finally twisted so that the cover is wrapped around the core to form a nonstretch or low-stretch composite yarn of super high bulk. The cover is overfed relative to the core during the wrapping operation so that significant bulkiness can be obtained. By "overfed" is meant that a length of covering yarn greater than the length of the core yarn is fed and wrapped around the core yarn.

Further objects and features of the invention will be apparent from the following description taken with the accompanying drawings, in which:

FIGS. 1A and 1B are two schematic views taken on the opposite side of a core yarn from each other, greatly enlarged, and showing the yarn according to the invention; and

FIGS. 2 to 9 are schematic views illustrating various modified apparatuses for practicing the process of the invention.

Throughout the Figures, similar numerals refer to similar parts of the apparatuses.

Referring now in detail to the drawing, a composite yarn is shown in FIGS. 1A and 1B which yarn includes a core 1 around which a covering yarn is wrapped. Each filament of the covering yarn is in a series of helical turns and in a bulky condition so that an unusual bulkiness is achieved. Any textile fiber available in staple or filament form can be used as a core

yarn regardless of whether it is crimped or not. Such fibers include natural fibers such as cotton and wool, and synthetic fibers such as polyester fiber, nylon fiber, polyvinyl chloride fiber, and such mineral fiber as glass fiber and steel fiber. As for the covering yarn, any filament available in crimped form can be included and any operation by which the crimp is originally formed can be used such as texturing, use of a stuffer box, gear crimping, torque crimping, edge crimping, or any other crimping process. The use of a core with filaments having a denier not less than twice that of the cover filament has been found beneficial in achieving a yarn with the desired properties. It has been found beneficial to limit the denier of the core filament to from 4 to 20.

Any synthetic yarn available in crimped form can be used as the cover filament, and it has been found desirable to limit the denier to less than 5.

The foregoing limitations on the fineness of the core and cover filament are most critical for giving to the resulting yarn the intended liveliness, due mainly to the core, and the soft feeling due mainly to the cover. When the critical factors of fineness of both core and cover are kept within these limits, the composite yarn resulting from the process of this invention has both high bulkiness and liveliness, provided that the final twist and the rate of the cover overfeed are suitably and reasonably regulated as the case requires. For example, it has been found that when each filament of the core yarn has a denier less than 4 or more than 20, the desired liveliness can not be achieved. It has also been found that when the filament of the cover has a denier more than 5, the desired soft feeling cannot be achieved. The cover filaments are longer by about 10 to 200 percent, preferably from 10 to 50 percent, than that of the core per unit length of the resulting composite yarn so that the cover is caused to cover the core. If the excess of the length of the cover falls below 10 percent of the core length per unit length of the resulting yarn, the covering throughout the full length of the core has been found to be insufficient. If it rises above 200 percent, the sheath formed by the covering yarn will be loose and the appearance of the yarn will deteriorate to such a degree that it cannot be used commercially. The excess of the cover length should be kept in the range of from 10 to 50 percent relative to the length of the core. Crimped yarns made by twisting and setting techniques can be advantageously used as a core to prevent the cover from sliding thereon, and such a core will produce added bulkiness. The use of two to three filaments with each filament having a denier from 10 to 20, has been found to be best for achieving liveliness, and the use of core having total denier of from 50 to 100 and a cover having a total denier of from 75 to 150 is best for achieving bulkiness.

It is to be noted that the length of the core and cover is measured under reasonable tension within the tolerance recognized in the trade.

Referring now to FIG. 2, there is shown an apparatus for producing a composite yarn in accordance with this invention by a twisting method. A core yarn 1 advances through a pair of nip rolls 3 from any package (not illustrated) and the covering yarn 2 also advances from any package (not illustrated), through a back pair of drafting rolls 4, and thence through an intermediate pair of rolls 5 to the front pair of rolls 6. The linear speed of the intermediate pair of rolls 5 is greater than that of the back pair of rolls 4 so that the covering yarn is tensioned when passing through the zone defined between the back pair and the intermediate pair of rolls. The tension load is within the range of from 0.5 to 2.5 gram per denier and the elongation is generally within the range of from 1.5 to 12 percent relative to the original length. The covering yarn 2 advances at an angle to the core axis at a faster speed than that of the core yarn to facilitate wrapping the cover therearound. The core and cover pass together through a snail wire 7, a ring traveler 9 and then are wrapped around the bobbin 10 to form a package 11 thereon. The core and cover are finally twisted together and cover 2 is twisted thereabout by rotating the bobbin through a driven pulley mounted on the spindle (not il-

lustrated). The ring traveler 9 is slidably mounted for rotation on a vertically movable ring rail 8 so that the ring traveler can move up and down in relation to the bobbin 10 to build up a package 11 thereon. A twist of from 50 to 1,500 turns per meter is given to the composite yarn. It has been found that if the number of turns falls below 50 per meter, the cover slides on the core and above 1,500 the soft feeling decreases. The rotational speed of the front pair of rolls 6 is less than that of the intermediate pair of rolls 5 so that the cover passed from the intermediate pair of rolls is immediately relaxed and is in an overfed or distended state. This makes the cover yarn bulge outwardly with each filament in a distended state so that the bulkiness achieved is significantly higher than that which could be expected from simply the inherent bulkiness. It should be noted that this phenomenon is ingeniously applied to the present invention to obtain unusually higher bulkiness.

The linear speed of the front pair of rollers 6 is significantly less than that of the intermediate pair of rolls 5, so that each of the covering filaments is urged outwardly so the yarn has a significantly higher bulkiness. By slackening immediately after the tensioning, each filament of the covering yarn is caused to separate laterally from the other filaments to achieve a higher bulkiness than that which is inherent in the covering yarn.

It should be understood that the unusually higher bulkiness of the cover yarn is achieved by enhancement of the inherent bulkiness. While pairs of rollers have been illustrated and described as a device for producing high bulkiness, it will be understood that any tension device can be used in place of roller devices, and the distance between the front pair of rolls 6 and the wrapping point can be changed as conditions may require. For example, the front pair of rolls 6 can be positioned immediately adjacent the wrapping point. It has been found that the front pair of rolls can be omitted for the purpose of simplifying the apparatus.

In FIG. 3 is shown another type of apparatus for practicing this invention, in which the front pair of rolls 6 additionally operates as a core feeding pair of rolls, and accurate wrapping of two yarns can be achieved. It is further found that the core can be positioned accurately near the axis of the cover at the nip of the front pair of rolls during the wrapping process. This prevents the core yarn from being displaced from the center of the resulting yarn toward the outside of the yarn.

It should be noted that the process does not necessarily require twisting immediately after the performance of the relaxing and wrapping procedures.

The apparatus shown in FIGS. 4A—4C carries out twisting separately after the core has been wrapped with the cover. It has been found beneficial to carry out the process in this manner to prevent the crimped cover yarn from being tensioned when the cover is unwound from package 110 for final twisting, since a majority of the unwinding load is borne by the core yarn 1. It has also been found that when the yarn 111 is unwound from the package on bobbin 110, it is beneficial to brake the yarn at the letoff position for preventing the core and cover from being separated from each other during the unwinding. The apparatus in FIG. 4B differs from the apparatus of FIG. 4A in the manner in which the front pair of feed rollers is used for feeding not only the cover but the core in order to achieve accurate maintenance of the core on the center axis of the cover during the wrapping process.

Now referring to FIG. 5, there is shown modified apparatus for producing the yarn of this invention. In this apparatus two core yarns are separately fed and the covering yarn enters the wrapping and twisting point so that the rate of over feed of the cover can be advantageously increased, even though a smooth monofilament yarn is used as the core yarns. For example, when the two monofilament yarns of polyethylene terephthalate are used as said two core yarns and crimped filaments of the same material are used as the cover, a rate of overfeed of greater than 10 percent can easily be obtained, while the 10 percent rate is found to be the absolute upper limit when the two monofilaments are doubled and twisted and then fed to the wrapping point.

Further for this purpose, the covering yarn need not be wrapped only at the doubling point of the core yarns, but can be wrapped at any point on one of the core yarns from the feed roll to the doubling point.

As shown in FIG. 8, core yarns are fed from packages 1 and 1' by feed rolls 2 and 2'. Covering yarn is fed from package 5 through feed rolls 6 and 6' and is wrapped on one core yarn at point A'' between core feed roll 2' and twisting point A'. The finished yarn is run through the snail wire 4 and ring traveler on rig 3 onto the yarn package. The covering yarn is preferably wrapped around the core yarn by the action of the torque of the core yarn transmitted from the twisting point A'.

Referring now to FIG. 6, there is shown another modified apparatus for carrying out the process of this invention. In the apparatus, the bottom roller 3' of the feed rolls has the lower portion passing through an adhesive agent in a tank 3'', so that the core is wetted with the agent when it passes through the nip of the feed rolls 3 and 3'. This has been found to be beneficial for lessening the number of twist turns per unit length of the resulting yarn and in preventing the cover from sliding on the core. Further it has been found that any material having a low melting temperature can be advantageously used on the core yarn so that adhesion can be effected between the core and cover by heating prior to the wrapping.

Referring now to FIG. 7, there is shown a further modified apparatus for carrying out the process of this invention. In the apparatus, a pair of fluted rolls 3 are used as feed rolls so that the core is crimped and slippage of the cover can be prevented during the twisting operation.

FIG. 9 shows another embodiment similar to that of FIGS. 5 and 8, in which in addition to the two core yarn packages there are two covering yarn packages 5 and 5'. Single feed rolls 2 and 6 are provided for both core yarns and both covering yarns. The respective core yarns and covering yarns are joined at points B and C and the two covered yarns doubled between points B and C and the snail wire 4.

One of the most preferred embodiments of this invention is a process for preparing a low-stretch high-bulk yarn, characterized in that there is used as the cover a crimped bulky multifilament yarn in which the individual filaments are distended and which is obtained by twisting in the S direction (or Z direction) heat-setting and untwisting, and as the core there is used a crimped multifilament yarn, and the monofilaments of which have a denier twice or more as large as the cover yarn and obtained by twisting in the opposite direction from the cover yarn, namely, Z (or S) direction, heat-setting and untwisting. The length of the cover yarn is 10—200 percent larger than the core yarn and the thus produced yarn has imparted thereto a twist of 50—1,500 turns per meter in the same direction as that in which the core yarn is twisted, namely the Z (or S) direction. A composite yarn obtained according to this process is bulky and has good liveliness because a crimped yarn having thick monofilaments is used as a core. It also possesses a soft feel because of the use of a torque crimped yarn having thin monofilaments as a covering yarn. When the core is wrapped with the covering yarn and twisted, the covering yarn is twisted in the direction opposite to that employed when originally preparing the covering yarn, and consequently the resulting yarn is more bulky. The core yarn is given a substantially larger torque than the covering yarn when it is twisted together with the covering yarn, and is twisted in the direction of twisting the core yarn, namely in the direction of less overall yarn torque. Thus, a yarn having an overall low torque is obtained.

Another of the most preferred embodiments of this invention is a process for preparing a low-stretch high-bulk yarn, characterized in that as the cover there is used a crimped bulky multifilament yarn in which the individual filaments are dispersed and which is obtained by twisting, in the S direction (or Z direction), heat-setting and untwisting, and as the core there is used a crimped multifilament yarn having a monofilament denier twice or more as large as that of the cover yarn and having a number of monofilaments less than one-half the

number of the first-mentioned yarn. The core yarn is twisted in the opposite direction, namely, the Z (or S) direction, heat-set and untwisted. The length of the cover yarn is 10—200 percent greater than the core yarn. The cover yarn is positioned surrounding the core yarn with the core yarn at the center, and they have imparted to them twist of from 50—1,500 turns per meter in the opposite direction to the twisting of the core yarn, namely the S (or Z) direction. When the core yarn is wrapped with covering yarn and twisted according to this process, the twist is imparted in the direction opposite to the twist of the core yarn for the purpose of untwisting the core yarn. Then the core yarn becomes very bulky, and it is possible to obtain a bulky composite yarn.

Example 1

A 45-denier/three-filament false twisted polyester yarn (Z torque) was used as core yarn, and covered with a 100-denier/48-filament false-twisted polyester yarn (Z torque). With the apparatus of FIG. 3, prior to wrapping the core yarn, the covering yarn had been widened to a width of about 7 mm. in a direction at right angles to the yarn axis by elongating it by 5 percent and relaxing it so that it was under no tension. The covering yarn was overfed by 30 percent relative to the core yarn, and the core yarn was fed into the center portion of the covering yarn. A low-stretch super high-bulk yarn was obtained by imparting to the composite yarn a final twist of 600 turns per meter in the Z direction. Two such low-stretch super high bulky yarns were doubled, and given a final twist of 480 turns per meter in the S direction to make a material for woven fabric.

A woven fabric of a matt weave was prepared from the said yarn, and subjected to an ordinary finishing process such as scouring, relaxing, heat-setting, dyeing and again heat-setting. It had the properties as shown in the following table. For the sake of comparison, a woven fabric was prepared from ordinary false-twisted yarns using the same technique both in weaving and in finishing. The said ordinary false-twisted yarn was prepared by imparting a twist of 200 turns per meter in the Z direction to a 150-denier/48-filament (Z torque) polyester yarn, and imparting a final twist of 160 turns per meter in the S direction to two of such polyester yarns which had been doubled.

RESULT OF TESTING OF WOVEN FABRICS

	Direction	Unit	Woven fabric prepared from the yarns of the present invention	Woven fabric prepared from the ordinary false-twisted yarns
Density	Warp	Ends/inch	74	74
	Weft	Picks/inch	72	72
Thickness		Mm.	0.51	0.46
Bulkiness		$Cm.^3/g$	2.6	1.9
Bending stiffness	Warp	$G.-cm.^2/cm.$	29.0×10^{-2}	21.8×10^{-2}
Bending recovery	Weft	Percent	90.0	83.2

The bending stiffness and bending recovery were measured in accordance with the description in the Journal of the Textile Institute, 1964, vol. 55, T 516.

As can be seen from the above results, the fabric woven from the yarns of the present invention has very good bulkiness, and an excellent liveliness. It is impossible to give a definite measured value to the liveliness since the liveliness can only be sensed by humans. It is generally said, however, that the liveliness is excellent when the bending stiffness is appropriate and the bending recovery is good. Incidentally, the fabric woven from the yarn according to the present invention was far softer and had an excellent hand as compared with the woven fabric prepared from the ordinary false-twisted yarns.

Example 2

A Z torque 75-denier/eight-filament false-twisted polyester yarn was used as a core. Using the apparatus in FIG. 2, and S torque 100-denier/48-filament false-twisted polyester yarn was overfed by 20 percent relative to the core yarn in the same manner as example 1, and a twist of 300 turns per meter was given in the Z direction. Thus, a low-stretch high-bulk yarn was obtained which had a very low torque, balance being maintained by the sum of Z torque of the core yarn, S torque of the covering yarn and S torque generated at the time of twisting.

Example 3

A 40-denier/two-filament polyester yarn was used as the core yarns. Using the apparatus in FIG. 5, a 75-denier/36-filament false-twisted polyamide covering yarn having a triangular cross section was overfed by 30 percent relative to the core yarn, and a twist of 200 turns per meter was given. Thus, a nonstretch high-bulk yarn was obtained. Prior to covering, the covering yarn had been elongated by 10 percent, and relaxed so that it was under no tension. The covering yarn was fed into a point where the two core yarns intersected each other. They were twisted together while part of the covering yarn was being held between the two core yarns, and were associated tightly into a covered yarn. The obtained yarn had good bulkiness, and had a soft feeling and unique luster. It was suitable as a material for woven fabrics.

Example 4

Using the apparatus in FIG. 4, a low-stretch high-bulk yarn was prepared in the same manner as in example 1 using a 75-denier/15-filament false-twisted yarn as a core and a 100-denier/36-filament side-by-side type conjugate filament yarn composed of a polyethylene terephthalate resin and a polyethylene naphthalate resin as a cover.

Example 5

A spun yarn of 64 S (metric count) from cut staples of polyethylene terephthalate (*4d*, 76 mm.) was used as a core, and a false-twisted 150-denier/48-filament polyethylene terephthalate was used as a covering yarn. Using the apparatus in FIG. 6, powder of polyethylene terephthalate with which 35 mole percent of isophthalic acid had been copolymerized was added to the surface of the core yarn, and the thus treated core yarn was wrapped with a covering yarn which had been overfed by 70 percent relative to the core. A nonstretch high-bulk yarn was obtained by covering in the same manner as in example 1. The twist imparted at this time was 300 turns per meter. The obtained yarn was dry heat-treated at 200° C., and coalesced points were developed partly on the core and covering yarns.

While several embodiments of this invention have been illustrated and described herein, it will be apparent that modification thereof may be made without departing from the scope of the invention as defined in the appended claims.

What we claim is:

1. A process of producing a nonstretch or low-stretch composite yarn of super high bulkiness, comprising the steps of feeding at least one core yarn, tensioning a crimped covering yarn having a plurality of filaments at a tension load of from 0.5 to 2.5 grams per denier to remove the crimps therefrom, and then relaxing said covering yarn, feeding the relaxed covering yarn with an overfeed to a wrapping point, wrapping said relaxed covering yarn around the core as a cover to form a composite yarn, and imparting twist to the composite yarn, the rate of delivery of the covering yarn to the wrapping point being such that the ratio of the length of the covering yarn is from 110 to 300 percent of the length of the core yarn per unit length of the composite yarn.

2. The process as claimed in claim 1 wherein the tensioned and relaxed covering yarn is fed into a pair of feed rollers and the separately fed core yarn is joined to the covering yarn at the feed rollers and is thereby covered with the covering yarn.

3. A process of producing a nonstretch or low-stretch composite yarn of super high bulkiness, comprising the steps of forming at least two separate yarns into a core yarn by separately and angularly feeding the separate yarns to a point and twisting them at said point; feeding said one core yarn; tensioning a crimped covering yarn having a plurality of filaments to remove the crimps therefrom and then relaxing said covering yarn; feeding the relaxed covering yarn in an overfed state to said twisting point and wrapping said relaxed covering yarn around the core as a cover to form a composite yarn, the rate of delivery of the covering yarn to the twisting point being such that the ratio of the length of the covering yarn is from 110—300 percent of the length of the core yarn per unit length of the composite yarn; and finally imparting a twist to the composite yarn.

4. A process of producing a nonstretch or low-stretch composite yarn of super high bulkiness, comprising the steps of feeding at least one core yarn by passing it through a pair of fluted nip rolls for crimping the core yarn, tensioning a crimped covering yarn having a plurality of filaments to remove the crimp therefrom and then relaxing said covering yarn, feeding the relaxed covering yarn in an overfed state to a wrapping point and wrapping said relaxed covering yarn around the core as a cover to form a composite yarn, the rate of delivery of the covering yarn to the wrapping point being such that the ratio of the length of the covering yarn is from 110—300 percent of the length of the core yarn per unit length of the composite yarn, and finally imparting a twist to the composite yarn.

5. A process of producing a nonstretch or low-stretch composite yarn of super high bulkiness, comprising the steps of forming at least two separate yarns into a core yarn by separately and angularly feeding the separate yarns to a point and twisting them at said point; feeding said core yarn; tensioning a crimped covering yarn having a plurality of filaments to remove the crimp therefrom and then relaxing said covering yarn; feeding the relaxed covering yarn in an overfed state to a point which lies ahead of said twisting point with respect to the feed direction and wrapping the relaxed covering yarn around the core as a cover to form a composite yarn, the rate of delivery of the covering yarn to the wrapping point being such that the ratio of the length of the covering yarn is from 100—300 percent of the length of the core yarn per unit length of the composite yarn; and finally imparting a twist to the composite yarn.