Nov. 15, 1960 A. C. SUTHERLAND ET AL 2,959,909

BULKED YARN AND METHOD FOR PRODUCING SAME

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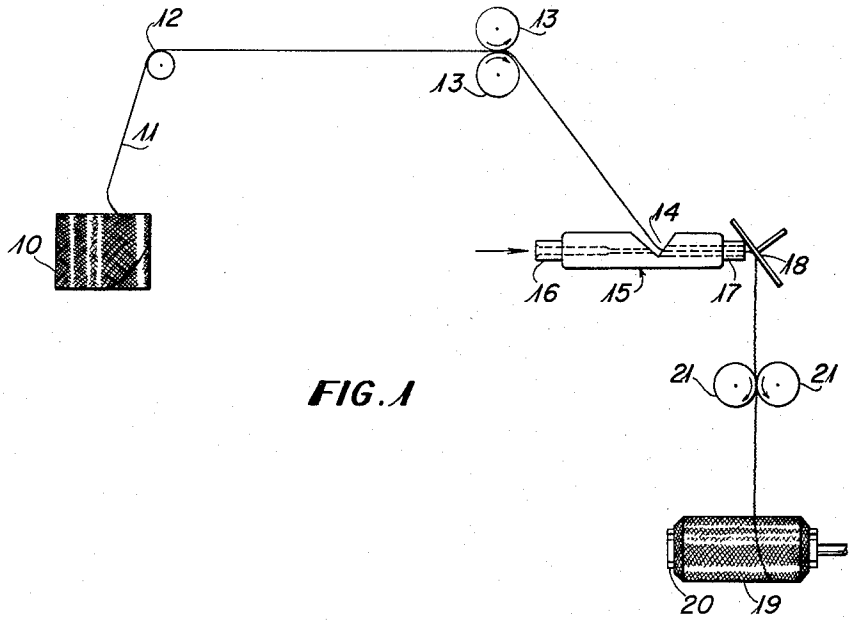

FIG. 1

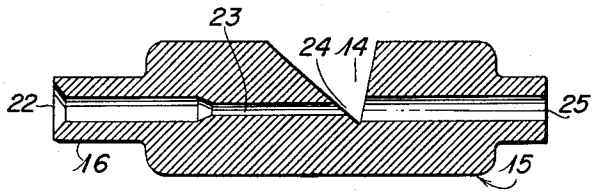

FIG. 2

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FIG. 3

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BULKED YARN AND METHOD FOR PRODUCING SAME

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This invention relates to a new and improved bulky continuous filament yarn and more particularly relates to a method for producing a new and improved relatively inelastic bulky yarn from a wet regenerated cellulose continuous multifilament yarn provided with some twist.

It is known to impart to synthetic continuous multifilament yarns some of the qualities of threads spun from natural fibers. One way of doing this has been to cut the continuous filaments of viscose rayon, cellulose acetate, nylon and the like into staple lengths. The cut fibers are then spun into yarn. This method is not only complex and expensive but many of the desirable properties which continuous filament yarn possesses over its spun yarn counterpart are lost. For example, a continuous yarn has greater strength than spun yarn made from the same material.

Other efforts have been directed towards modifying continuous filament yarn by twisting and crimping either by mechanical or chemical means. Recently, in U.S. Patent No. 2,783,609 there is described a product which has some of the sought after physical properties similar to spun yarn. The loopy or crunodal characteristics of the yarn according to that patent give the yarn some of the bulk and coverage properties associated with spun yarn. However, the loopy structures contribute only to a very small degree to the strength of the yarn. Although the yarn has improved bulk and higher covering power, an even higher bulk with the least possible increase in denier is desired for some yarn end products, one of which being tufted rugs where a high denier yarn with the greatest covering power per unit weight is desired.

Therefore, it is an object of the present invention to provide a method for producing a relatively inelastic bulked continuous multifilament yarn possessing many qualities of spun yarn while retaining many of the qualities associated with continuous multifilament yarn.

Another object of the present invention is to provide a method for producing a bulked continuous multifilament yarn having unusually high bulk and covering power.

A further object of the present invention is to provide this bulk and covering power without substantially increasing the weight of the yarn needed to accomplish this.

Still another object of the present invention is to provide a product having the aforesaid desirable properties.

These and other objects are accomplished in accordance with the present invention by directing freshly spun, aftertreated, but yet undried, pretwisted continuous multifilament yarn of regenerated cellulose through an air jet while passing a stream of gas under pressure through a confined zone in contact with the yarn. After the yarn emerges from the jet and while it is still under the influence of the gas, the direction of travel of the yarn is changed. The yarn is then collected and dried in a suitable manner.

The invention may be more completely understood by reference to the drawings, wherein:

Figure 1 is a schematic view illustrating a freshly spun, undried yarn being drawn from a cake and passed through a bulking yarn jet;

Figure 2 is a side view in section of a yarn jet per se; and

Figure 3 is an enlarged photograph of bulked yarn produced by the present invention compared with yarn bulked after it has been dried.

Referring now to Figure 1, numeral **10** designates a cake of freshly spun, twisted, yarn. The yarn **11** is withdrawn upwardly and around roller **12** which is freely rotatable and defines the direction of the yarn travel. Yarn **11** is propelled through positively driven feed rollers **13** and drawn into notch **14** of the jet generally indicated at **15**. Gas under pressure is supplied to inlet pipe **16** from a source not shown which propels the yarn through and out of exit conduit **17**. Shortly after leaving conduit **17**, the direction of yarn travel is changed while the yarn is still under the influence of the stream of gas. The yarn is impinged on and deflected from baffle plate **18**. The impinging against the plate causes the direction of the yarn travel to change and also disrupts the flow of the gas. The yarn is taken up in an orderly arrangement in a package **19** on a bobbin **20** which is rotated at a constant peripheral speed by a driving mechanism (not shown). Between bobbin **20** and baffle **18** there is positioned a pair of feed and delivery rollers **21** which are rotated at a lower peripheral speed than rollers **13** to provide an overfeed of the yarn to the jet and also permit some contraction due to bulking. The yarn, while on the bobbin, is thereafter dried in a suitable manner.

By separating the yarn from the stream of gas after striking baffle plate **18**, the filaments are disturbed and entangled to provide the bulking effect of the present invention. Preferably the direction of yarn travel is changed to a path which is at least 90° from the direction of the gas flowing from the jet.

Figure 2 shows in more detail the structure of jet **15**. Gas is supplied to inlet pipe **16** through opening **22** and into a reduced channel **23** which terminates at one side of notch **14**. Notch **14** is provided with a low pressure zone **24** which induces yarn **11** to pass into an enlarged channel **25**. A more detailed description of the bulking yarn jet and baffle together with other modifications thereof may be seen by referring to U.S. Patent No. 2,874,444.

Reference is now made to Figure 3 where the specific product shown is viscose rayon. A designates 2250/150 viscose rayon yarn which was bulked in a dry state in accordance with the procedure of Example II of the present application. Many of the exterior filaments are notably looped and curled. Furthermore, the filaments which are not looped or curled are in a compact arrangement.

In comparison the product of the present method is represented by the letter B. The yarn illustrated here is also 2250/150 viscose rayon and was bulked in accordance with the procedure of Example I of the present application. As seen, the product is characterized by an unusually high bulky structure. The filaments from the interior to the exterior thereof are disturbed, separated and entangled among each other. This entanglement provides an integrated, bulky body with substantially all of the filaments contributing to the strength of the yarn. Each filament is pronouncedly sinuated and undulated. The wavy structures which wind over and around adjacent filaments provide a great degree of inter-filament friction which enables the yarn to withstand transverse forces and still retain its well-defined strandular shape even though highly bulked.

It has been found that the success of the method herein described depends on the use of relatively high individual and total denier freshly spun yarn, i.e., yarn which is still in the primary swell state. In this respect experiments have shown that the greatly enhanced bulkiness of the present invention is not attained if relatively dry or rewet yarn is used. The minimum amount

of moisture content depends upon the type of yarn used and the amount of bulkiness desired. Freshly spun yarn which is saturated with a liquid may be conveniently and effectively bulked; also, yarn which has been hydro-extracted in the usual manner to wring out as much water as possible may also be bulked according to the present invention. Provided, however, the yarn has not been first dried.

The twist of the yarn before it is subjected to the bulking operation is of critical importance to the present invention. The filaments of untwisted yarn when bulked will separate without the entanglement and sinuation necessary for the yarn to retain its permanency of bulk and its well-defined strandular form. Also, the degree of bulk is greatly reduced when untwisted yarn is used. For example, by using untwisted viscose rayon the yarn when bulked by the present invention falls short to a considerable degree in obtaining the bulky characteristics imparted to the same yarn which has been pretwisted.

Ordinarily, for yarns having deniers of about 2000 to 4000, two to five turns per inch are sufficient to give the yarn the optimum bulk. Yarns of lesser deniers may have a greater twist; and, as a rule, a smaller number of twists should be used with yarns of higher deniers.

An important feature of the present invention lies in the fact that it may easily be adapted to conventional viscose rayon spinning schemes. For example, in one commercial method for producing continuous multifilament viscose rayon, a viscose solution is spun into yarn in a setting bath. The yarn thus formed is collected in a centrifugal pot which rotates at a high speed. The rotation of the pot causes the group of filaments to be twisted into yarn having a suitable twist, for example, two turns per inch. Normally the yarn is subjected to several aftertreatments consisting of washing, desulphurizing, bleaching and drying. In the present process the yarn is bulked just prior to the usual drying operation. This may be accomplished without an additional twisting operation and with only minor changes in the processing equipment.

The yarn produced by the present invention is more particularly characterized by its voluminous and inelastic body and relatively low increase in total denier. It has been found that the body diameter of yarn bulked according to the present invention is considerably greater than yarn bulked after it has been dried. The body diameter is the cross-sectional distance between the points at which the body of the yarn is well defined. The wavy filaments projecting at random intervals from the body of the yarn should be regarded as forming no part of the yarn's body.

A most surprising result of the present invention lies in the fact that the aforesaid increase in voluminosity does not necessarily require a large increase in denier. Experiments have shown that good bulking may be obtained with about a 5% or less increase in total denier.

The following examples are given as illustrative of the invention and should not be construed as limitative thereof.

Example I

2250/150 viscose rayon continuous filament yarn having a Z-twist of 2.0 turns per inch was withdrawn from a cake of freshly spun yarn which had been spun into a conventional spin pot. The yarn had previously been washed, bleached and partially hydro-extracted. The moisture content of this gel yarn was 55% by weight. The yarn was directed through the suction device of Figure 2. An air pressure of 75 pounds per square inch was supplied at a uniform rate to the air supply tube. The direction of the yarn was changed about 120 degrees after which the yarn was collected on a rotating bobbin driven at a constant peripheral speed. The yarn was dried on the bobbin in a tunnel drier.

The yarn take-up speed was 91 yards per minute with an overfeed of 18.5%. The average body diameter of the yarn dried without bulking was 0.85 mm. while the body diameter of the bulked yarn was 1.05 mm. for an overall body diameter increase of 23.5%.

The yarn so produced when observed under a low-power microscope, as seen in Figure 3B, showed an unusually high bulky structure. Also, it was noted that all of the filaments from the outermost to the innermost were disturbed and separated. A closer observation of the individual filaments revealed that each filament was pronouncedly sinuated and had a wavy and winding form. The waviness was present in the outer and inner filaments of the yarn.

Example II

For comparison purposes, 2250/150 viscose rayon continuous filament yarn having a Z-twist of 2.0 turns per inch was withdrawn from a cake of yarn which had been aftertreated and dried in the usual manner. Without wetting, the dry yarn was bulked in the manner described in Example I.

The yarn so produced when observed under a low power microscope, as seen in Figure 3A, showed a multitude of crunodal filament loops irregularly spaced along the outer filament. The bulky characteristics of this yarn was attributable almost exclusively to the disturbance imparted by the process to the outer filaments, inasmuch as the main body of the yarn remained substantially unchanged. The average body diameter of the yarn was 0.93 mm. with the increase in body diameter before and after bulking amounting to 9.4%.

Yarns from Examples I and II were tufted into carpet material. It was clearly observable that the yarn produced in Example I gave a much better coverage.

As used herein, freshly spun yarn or gel yarn refers to yarn which has never been dried subsequent to the formation thereof.

It is, of course, understood that various changes may be made in the material and process above described without departing from the spirit of the invention as defined in the claims.

What is claimed is:

1. A pretwisted voluminous yarn of high individual and total denier initially formed from freshly spun regenerated cellulose yarn having at least 55% by weight of moisture content and composed of a multiplicity of sinuous, continuous filaments, each of which being separated and disturbed from the interior to the exterior of the yarn, said yarn being characterized by its relative inelasticity, by its high increase in volume and low increase in denier as compared to a normal yarn of the same original denier, and by a substantial absence of crunodal loops.

2. A pretwisted voluminous yarn of high individual and total denier initially formed from freshly spun viscose yarn having at least 55% by weight of moisture content and composed of a multiplicity of sinuous, continuous filaments, each of which being separated and disturbed from the interior to the exterior of the yarn, said yarn being characterized by its relative inelasticity, by its high increase in volume and an increase in denier of less than 5% as compared to a normal yarn of the same original denier, and by a substantial absence of crunodal loops.

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