

July 11, 1967

S. A. DUNWOODY, JR

3,330,104

FALSE-TWIST SPINDLE WITH AUXILIARY REVERSE-TWIST ELEMENT

Filed Sept. 30, 1964

2 Sheets-Sheet 1

Fig. 1.

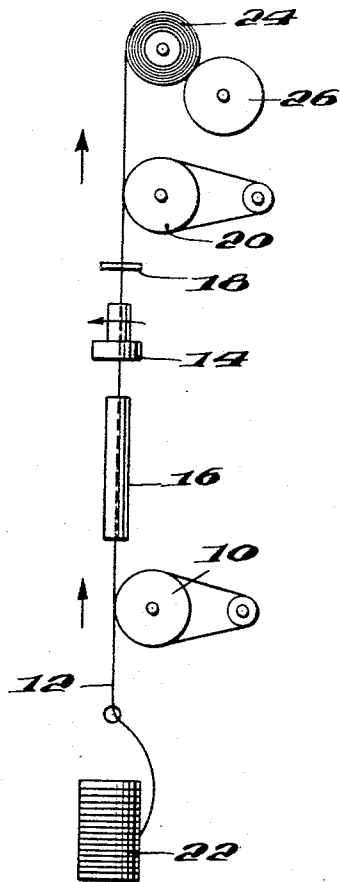
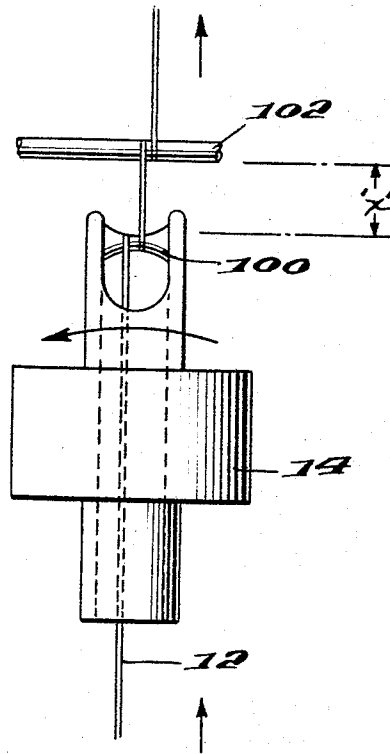


Fig. 2.



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Fig. 3.

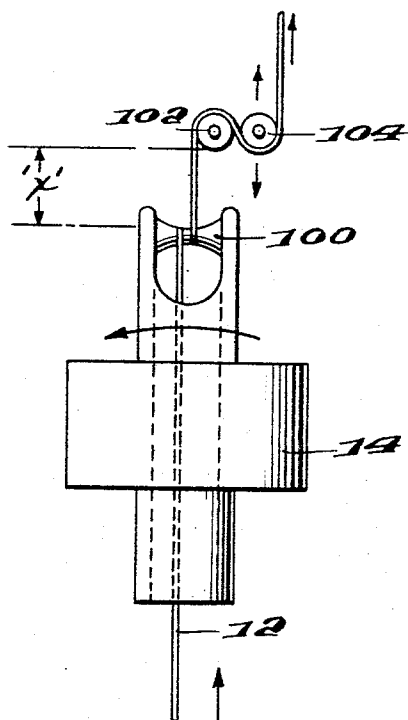


Fig. 4.

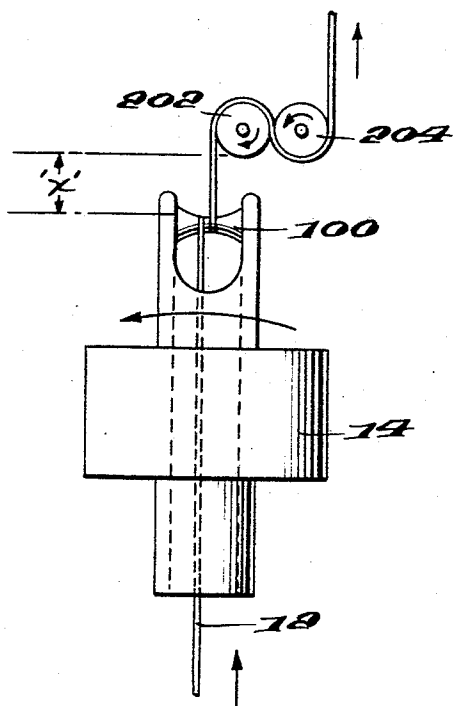
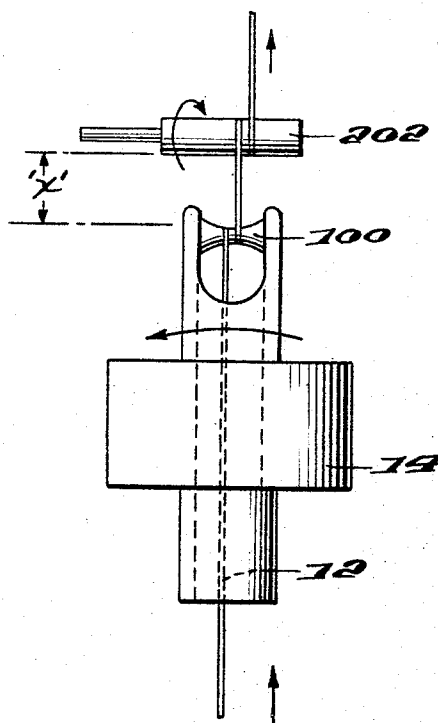


Fig. 5.

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FALSE TWIST SPINDLE WITH AUXILIARY REVERSE-TWIST ELEMENT

Samuel A. Dunwoody, Jr., Chattanooga, Tenn., assignor to E. I. du Pont de Nemours and Company, Wilmington, Del., a corporation of Delaware

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9 Claims. (Cl. 57—51.2)

This invention relates to the production of crimped thermoplastic yarns or, as they are well known in the textile industry, stretch yarns. It pertains especially to modification of the process and apparatus for making stretch yarn by the so-called false-twist heat-set process and, more particularly, the invention is concerned with improved means for uniformizing the quality of the yarn product.

It has been known to produce textured stretch yarns by highly twisting yarns, heat-setting the yarn while in the twisted state and then twisting the treated yarn in the reverse direction to the initial twisting. The process may be accomplished in separate steps or by application in sequence to a continuously running yarn. The process has attained considerable importance, particularly for crimping of continuous filaments of synthetic fibers, such as polyamides and polyesters, to yield a stretch yarn with a very stable crimp which is especially useful in the manufacture of knit goods and for woven fabrics which are particularly suited for wearing apparel, upholstery and other home furnishing fabrics.

In conventional continuous false-twist texturing processes, the yarn continuously passes between two stationary points as a twisting spindle inserts false-twist between these points. A heater is placed just before the twisting spindle where the yarn possesses real twist. This real twist is then heat-set and after the yarn passes the false-twisting zone the total yarn has zero twist, but has a tendency to return to the twisted condition in which it has been heat-set during the false-twist zone. This tendency gives the yarn its springiness or stretch characteristics which are highly useful. One problem that is frequently encountered in texturing certain yarns, particularly the heavier denier per filament yarns, by this process is variability in the textured effect particularly in localized segments containing a high degree of residual twist. This variation in turn leads to non-uniformities in the bulk and appearance of the textured yarn and variation in the appearance and dyeing qualities of fabrics therefrom.

A primary objective of this invention is an improved method and apparatus for making a bulky stretch yarn.

Another objective is to provide means for making a more uniform textured yarn.

Still another objective is to provide a convenient and economical device which may be used in combination with a false-twist spindle for producing textured yarn.

With these and other objects in view, the improved apparatus as provided herein includes means passing yarn along a path, false-twist means for imparting a false twist to said advancing yarn, heating means in advance of said false-twist means to heat-set said yarn, a twist trap element located near the discharge end of said false-twist means to impart a reverse twist to said yarn, means withdrawing said yarn from said twist trap element, and auxiliary reverse-twist means, located between said twist-trap element and withdrawing means transverse of said path, adapted to have said advancing yarn pass about it. Preferably, the auxiliary reverse-twist means is located not more than $\frac{1}{4}$ of the distance from the twist-trap element to the withdrawing means.

Details of various embodiments for carrying out these and other objectives are shown by way of example in the accompanying drawings in which:

FIGURE 1 is a schematic arrangement of the basic parts of a machine for use of the invention in processing yarns;

FIGURE 2 illustrates a preferred embodiment of this invention; and

FIGURES 3, 4 and 5 illustrate alternate embodiments of the invention.

FIGURE 1 illustrates the parts and sequences of the steps of a false-twist heat-setting machine such as may be used in conjunction with this invention. The apparatus generally includes feed rolls 10 for advancing yarn 12, a false-twist spindle 14, a heating device 16, a twist-trap element 100 (FIGURE 2), an auxiliary reverse-twist element 18, and delivery rolls 20.

Referring in more detail to FIGURE 1, yarn 12 is withdrawn from a supply package 22 by an arrangement of feed rolls 10. Yarn 12 may or may not have been pretwisted. The advancing yarn 12 passes through heating device 16 which is of conventional design and provided with appropriate heating elements. The yarn 12 is false-twisted by rotatable spindle 14 which may also be of conventional design. The rate of withdrawal of the yarn 12 is controlled by delivery rolls 20 from whence it passes to a takeup package 24 on a suitable windup such as drive roll 26. As will be described below, this invention deals with the placement of an auxiliary element such as a pin 18, transversely in the path of travel of yarn 12 subsequent to passage through the false-twist spindle 14.

In FIGURE 2 a preferred embodiment of the invention is illustrated. A cylindrical element 102 is placed in the thread path at a distance X from twist-trap element 100 within the false-twist spindle 14. In operation, yarn 12 moves continuously through the hollow core of the rotating false-twist spindle 14 and makes a wrap around twist-trap element 100. Since the feed and delivery rolls 10 and 20, respectively, temporarily hold yarn 12 under tension as spindle 14 rotates, the yarn 12 is caused to rotate about its own axis and become twisted in one direction upstream from the twist trap and in the opposite direction downstream from the twist-trap, the net result being zero twist in the threadline. By the insertion of auxiliary element 102 in the threadline and making a complete wrap of the yarn about this element, a superior textured yarn has been obtained. A stationary pin about $\frac{1}{32}$ " to $\frac{1}{16}$ " diameter has been found suitable for this purpose. However, other diameters, either larger or smaller, may also be used. It has been found that the use of pin 102 to restrict the length of the back twisting zone is critical in obtaining the desired result in the product. The maximum distance permissible to achieve significant improvement in the product varies somewhat with the weight of the yarn (total denier/filament) and texturing conditions, particularly yarn speed. However, regardless of the various controlling factors, the distance apparently should be less than about $\frac{1}{4}$ of the distance from the twist-trap element 100 to the delivery rolls 20 for maximum effectiveness. The pin 102 should be located transversely of the threadline so that a wrap of yarn may be taken about it. The pin may be canted at a slight angle, if desired. The cross-sectional shape of the pin may be round or elliptical but it should be free of sharp edges which may cut or abrade the yarn. For convenience a 360° wrap of yarn about the pin is preferable although a lesser or greater angle of wrap may be used. The material of the pin may be metal with an abrasion-resistant coating or plating. For longer service life a polished or matte ceramic material may be used.

FIGURE 3 illustrates an alternate embodiment in which two stationary pins are used. A second element 104 is placed in a position slightly spaced apart and parallel to element 102. As indicated in the figure, element 104 may be moved upward or downward to adjust the angle of wrap of yarn 12 as it moves from twist-trap element 100 of spindle 14 around pin 102 and in turn pin 104 en route to the windup.

FIGURES 4 and 5 show embodiments which are similar to FIGURES 2 and 3, respectively. In these embodiments, rotatable rollers 202 and 204 replace the fixed pins 102 and 104. In the embodiment of FIGURE 5 the rolls may be tangent to each other and a pressure means provided to urge one roll against the other. Under these circumstances, the pressure must not be so great as to damage the yarn passing between the rollers. The pressure, of necessity, varies with the yarn processed, the speed of operation and so forth.

The prior art has shown use of twist barriers to prevent twist from backing into the preceding zone. Van Dijk's U.S. Patent 3,020,700 shows a pair of rolls to confine the twist in the heating zone but makes no provision for controlling twist in the back twisting zone. Bley in U.S. 2,908,961 and U.S. 2,910,761 shows twist barriers above and below the false-twist spindle but also took

the pin and corresponding measurements of textured yarn quality are made:

Example	Distance "X" from twist pin in spindle to stationary pin, inches	"Tight Spots" per yard of Textured yarn
I-A	$\frac{1}{16}$ "	0
I-B	$\frac{1}{8}$ "	1.5
I-C	$\frac{1}{4}$ "	1.8
I-D	$\frac{1}{2}$ "	2.4
I-E	Control—No Pin (9" to delivery roll 20).	9

From these experiments, it may be seen that significant improvement in yarn quality is obtained with the use of the stationary pin above the false-twist spindle. A distance of $\frac{1}{16}$ " is seen to produce maximum effectiveness, although significantly improved quality is obtained at distances of the order of $\frac{1}{4}$ ", or about $\frac{1}{4}$ of the distance from the twist-trap element to the delivery roll.

Example II

Experiments similar to those of Example I, with X equal to $\frac{1}{8}$ ", are conducted to determine the utility of various materials and surface condition for the stationary pin:

Example	Stationary Pin		Surface Roughness RMS ¹	Winding Tension, gms.	Tight Spots per Yard of Textured Yarn
	Pin Material	Diameter, Inches			
II-A	Ceramic	$\frac{3}{16}$	9-12	58	0.0
II-B	do	$\frac{3}{16}$	30	57	0.5
II-C	do	$\frac{3}{16}$	30	75	0.0
II-D	do	$\frac{3}{16}$	75	>75	0.0
II-E	do	$\frac{9}{64}$	25	45	0.0
II-F	do	$\frac{9}{64}$	55	68	0.0
II-G	do	$\frac{9}{64}$	70	72	0.0
II-H	Steel	$\frac{3}{32}$	(Matte)	36	0.0
II-I	do	$\frac{1}{16}$	(Polished)	23	0.0
II-J	No Pin			18	8-9

¹ American Standards Association designation for roughness, root mean height of surface irregularities, microinches.

no cognizance of the value or importance of critically limiting the back twisting zone. In the examples which follow, it will be seen that the location of a barrier to the passage of twist can be particularly important to producing an improved product, a location relatively close to the false-twist spindle being more favorable.

In the examples, continuous filament nylon yarns were processed by the false-twist heat-set process on conventional machinery, as illustrated in FIGURE 1, to produce a bulky stretch yarn. The uniformity of the product was judged by visual examination of a representative length of the yarn and counting the frequency of "tight spots" per unit of length, a "tight spot" being defined as a section of the yarn in which the observed diameter is approximately equal to the diameter of the original unbulked feed yarn. Such "tight spots" appear to be highly twisted, indicating that this portion of the yarn was not effectively back twisted after being twisted and heat-set. These non-uniformities in the bulked yarn manifest themselves in non-uniformities in the textured appearance and dyeing of the yarn and fabrics produced from it. The "hand" or feel of the fabric is also improved by elimination of these non-uniformities.

Example I

Continuous filament, 70-denier, 17-filament, O-twist nylon yarn which has been interlaced by the process of Bunting & Nelson U.S. Patent 3,110,151 is processed at a speed of 50 yards per minute (y.p.m.) by the false-twist heat-set process. A polished steel pin, $\frac{1}{16}$ " diameter, is positioned at certain distances above the false-twist spindle in the back twist zone, a 360° yarn wrap is made around

From these experiments, it can be seen that the desired quality improvement can be obtained with different materials of construction, varying degrees of surface roughness and with varying pin diameters.

Example III

Nylon 70-denier 13 filament yarn with $\frac{1}{2}$ turns per inch producer twist is processed at a speed of 80 y.p.m. by the false-twist heat-set process. A polished steel pin, $\frac{1}{16}$ " diameter round, is positioned above the spindle in the back twisting zone with the following results:

Example	Distance "X"	Tight Spots per yd. of textured yarn
III-A	$\frac{1}{8}$ "	1.4
III-B	$\frac{1}{4}$ "	0.2
III-C	$\frac{1}{2}$ "	1.9
III-D	$\frac{3}{4}$ "	4.5
III-E	Control—no pin (about 4" to delivery roll 20).	5.6

In these examples, the maximum improvement in yarn quality is obtained at a $\frac{1}{4}$ " distance between the twist-trap and the auxiliary pin. However, a significant improvement in uniformity was obtained at other distances less than $\frac{1}{2}$ ", corresponding to about $\frac{1}{8}$ of the distance from the twist-trap element 100 to the delivery roll 20. The optimum location of the auxiliary element depends upon size and composition of the feed yarn and the speeds, temperatures, and other conditions of the process being used. Apparently the stationary means in the back twisting zone exerts a definite and effective reversing

torque on each discrete increment along the length of the yarn being processed and results in a more uniform product.

The invention may be used in conjunction with any of the conventional false-twist spindles and false-twist heat-setting processes. The invention may also be used with any textile fiber, such as polyamides, polyesters, polyolefins and others which may be textured by the false-twist heat-setting process. The apparatus finds particular usefulness in dealing with the heavier total denier per filament yarns where increasing difficulty occurs in back-twisting. The feed yarn may or may not have been pre-twisted as is seen from the examples.

Changes in form of the apparatus may be made without departing from the scope of the invention here involved and it is therefore intended that the foregoing description and the accompanying drawings shall be interpreted as illustrative and not in the limiting sense except as defined in the appended claims.

What is claimed is:

1. In apparatus for producing stretch yarn which includes means advancing yarn along a path, false-twist means having an inlet end and a discharge end adapted to receive said advancing yarn and impart a false-twist thereto, heating means located along said path in advance of the inlet end of said false-twist means adapted to receive and heat-set said advancing yarn, a twist-trap element located at the discharge end of said false-twist means and adapted to engage said yarn as it advances along said path to impart a reverse twist thereto, and means withdrawing said yarn from said twist-trap element; the improvement which comprises auxiliary reverse-twist means, located between said twist-trap element and said withdrawing means transverse of said path, adapted to have said yarn pass about it as it advances along said path, said auxiliary means being located not more than one-fourth of the distance from said twist-trap element to said withdrawing means.

2. Claim 1 wherein said auxiliary means is a cylindrical element having its axis transverse of said yarn path and is adapted to have said yarn make a complete wrap about as it passes along said path.

3. Claim 2 wherein said cylindrical element has a diameter of $\frac{1}{32}$ inch to $\frac{3}{16}$ inch.

4. In apparatus for producing stretch yarn which includes means for advancing yarn along a path, false-twist means having an inlet end and a discharge end adapted to receive said advancing yarn and impart a false-twist thereto, heating means located along said path in advance of the inlet end of said false-twist means adapted to receive and heat-set said advancing yarn, a twist-trap element located at the discharge end of said false-twist means and adapted to engage said yarn as it advances along said path to impart a reverse twist thereto, and means for withdrawing said yarn from said twist-trap element; the improvement which comprises a cylindrical element, located between said twist-trap element and said withdrawing means with its axis being transverse of said yarn path, adapted to have said yarn make a complete

wrap about it as it passes along said path and adapted to be rotatable about its axis.

5. In apparatus for producing stretch yarn which includes means for advancing yarn along a path, false-twist means having an inlet end and a discharge end adapted to receive said advancing yarn and impart a false-twist thereto, heating means located along said path in advance of the inlet end of said false-twist means adapted to receive and heat-set said advancing yarn, a twist-trap element located at the discharge end of said false-twist means and adapted to engage said yarn as it advances along said path to impart a reverse twist thereto, and means for withdrawing said yarn from said twist-trap element; the improvement which comprises a pair of cylindrical elements having their axes parallel to each other and transverse to said yarn path located between said twist-trap element and said withdrawing means, said cylindrical elements being adapted to have said yarn make a partial wrap about each one in turn as said yarn passes along said path.

6. Claim 5 wherein one of said cylindrical elements is adapted to be shifted back and forth in a direction parallel to said yarn path to adjust the angle of wrap of said yarn as it passes about said cylindrical elements.

7. Claim 5 wherein said cylindrical elements are adapted to be rotatable about their axes.

8. Claim 7 further comprising pressure means for urging said cylindrical elements together at a pressure sufficiently small enough to not damage said yarn.

9. In a process for producing stretch yarns which includes advancing thermoplastic yarn along a path; imparting twist to said advancing yarn; heat-setting said advancing yarn; passing said yarn about a twist-trap element to impart a reverse-twist thereto; and withdrawing said yarn; the improvement which comprises passing said yarn about an auxiliary element located transverse of said advancing yarn before it has traveled not more than one-fourth of the distance from said twist-trap element to said withdrawing means to remove the residual twist in said yarn.

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FRANK J. COHEN, *Primary Examiner.*