

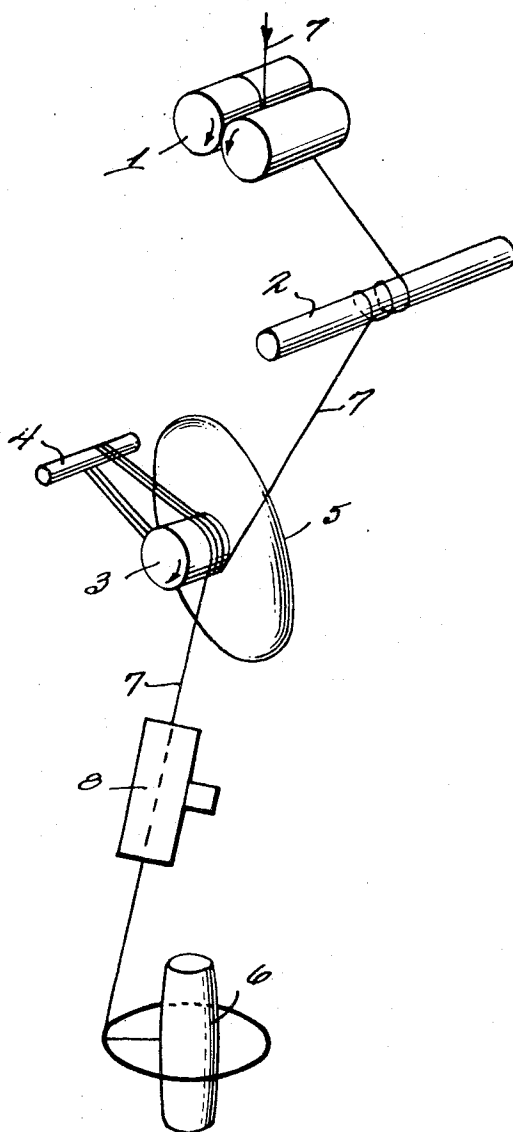
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PROCESS FOR YARN CRIMPING

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PROCESS FOR YARN CRIMPING

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6 Claims

ABSTRACT OF THE DISCLOSURE

A bulky yarn containing not less than two-thirds conjugate filaments having an out of phase helical crimp and a twist-liveliness of not more than 2.5 turns per inch is obtained by heating and applying false-twist to a supply yarn, allowing the filaments to separate and the yarn then relaxed to develop the latent conjugate filament crimp.

The present invention relates to improvements in crimped yarns containing heterofilaments and to processes for their manufacture.

In my co-pending application Ser. No. 544,721, filed Apr. 25, 1966, I have described a process for improving the crimp in yarns containing heterofilaments, which heterofilaments have the inherent ability to crimp on relaxation after drawing or when subjected to a hot relaxation process. In this process the filaments in the yarn are forced to be separated before the crimp is developed, thereby nullifying the effect of yarn cohesion, which normally prevents the development of a high crimp in such yarns. One method of achieving this filament separation described in the application was the insertion of temporary twist-liveliness into the yarn and particular reference was made to the use of apparatus for false-twist crimping described in the specification of British Patent No. 890,053, with the important difference that the yarn heating means between the draw and feed rolls was omitted, and the yarn optionally subjected to a hot retraction stage before being wound up.

However, I have now found that a small amount of permanent twist liveliness in the yarn can be tolerated without substantially reducing the heterofilament crimp, and is, in fact, beneficial since it produces a novel crimped yarn having an out of phase helical crimp.

In order that the yarn may be usefully employed in the singles condition it is necessary that yarn should have a twist-liveliness of not more than 2.5 and preferably less than 0.8 turn per cm.

Accordingly therefore from one aspect the present invention provides a crimped multifilament yarn containing not less than 66% of heterofilaments having an out of phase helical crimp. Preferably the yarn is twist lively, the twist-liveliness being not more than 2.5 and preferably less than 0.8 turn per cm. so that spirality, i.e. the distortion of stitches in a regular knitted pattern, will not be visible in the fabric, and in order to render doubling unnecessary before further processing or being formed into a fabric.

It is also preferred that the yarns have a crimp retraction of at least 15%. If the yarn contains significantly less than 66% of heterofilaments insufficient crimp is obtained, the crimping forces of the heterofilaments being too small to convolute the homofilaments in the yarn.

From another aspect the invention provides a process for the manufacture of a crimped multifilament yarn containing at least 66% of heterofilaments having a random out of phase crimp, wherein a supply yarn containing at least 66% of heterofilaments has a false-twist in-

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serted therein and is heated sufficiently during the insertion of the false-twist to retain some twist-liveliness, the filaments in the yarn forced to separate and the yarn subjected to a relaxation step to develop the heterofilament crimp.

Preferably the false-twist is applied to the yarn during the yarn drawing operation, for which purpose an undrawn yarn containing at least 66% of heterofilaments is used as the supply yarn.

Heat may be applied to the yarn during the relaxation step to further develop crimp in the heterofilaments, the heat applied to the yarn during false-twisting being sufficient in many instances to almost fully develop the heterofilament crimp.

The sole figure is a perspective view of apparatus suitable for carrying out the process of the present invention.

Heterofilaments are composite filaments consisting of at least two polymer components which exist in eccentric relationship contiguously along the length of the filament in a side-by-side or sheath and core arrangement. The polymer components are normally different polymers which differ in respect of those physical properties which will cause the filament to crimp, e.g. in shrinkage and/or recovery properties. The components may also be of the same polymeric material, but differing in respect of their degree of polymerisation. In the former heterofilaments the crimp is usually developed by subjecting the filaments to a relaxing process, e.g. overfeeding into a hot-air tube, after they have been drawn; and in it the latter mentioned type the crimp frequently occurs spontaneously when the tension in the filaments is released after drawing, although it may often be further developed by a hot relaxing process.

Heterofilaments useful in connection with the present invention include those consisting of two polyamide components such as polyhexamethylene adipamide and a copolymer of polyhexamethylene adipamide and polyepsilon caprolactam or two polyesters which may both, for example, be polyethylene terephthalate of differing molecular weights, the difference in molecular weights being sufficient to cause a monofilament to crimp spontaneously after drawing.

In general there is no restriction on the polymer pairs which may be employed in the heterofilaments provided that they are compatible, that is they do not tend to separate when processed, e.g. when drawn, and that their physical properties differ in a manner which will cause the drawn filaments to crimp either with or without the aid of a hot relaxation process.

The yarns may contain up to 34% of non-heterofilament filaments, homofilaments, which may be formed of the same polymer as one of the heterofilament components and may conveniently be extruded simultaneously with the heterofilaments through orifices contained in the same spinneret plate. Alternatively, of course, the homofilaments may be formed of a different polymeric material and conveniently doubled with the heterofilaments at some convenient stage in the process prior to the insertion of the false-twist.

The yarn, in fabric form if desired, may subsequently be subjected to a hot relaxation process to redevelop the crimp which is pulled out in the winding and other processes, e.g. in forming into a fabric.

Twist liveliness is determined according to the following procedure.

A sample of yarn is taken from the inside of a yarn package, care being taken not to allow twist to run out of the yarn, and clamped under a tension of 2 g./d. between two clamps 50 cms. apart. A weight of 0.01 g./d. is attached to the mid-point of the sample and the

clamps brought together. With the yarn between the clamps stationary, one clamp is moved slowly away from the other and the number of revolutions made by the weight recorded. The twist liveliness of the yarn is then calculated from the expression:

$$\frac{\text{No. of revolutions of weight}}{25}, \text{ turns per cm.}$$

Crimp retraction, which is a measure of yarn bulkiness, is determined as follows. A 50 cm. skein of yarn which has not been subjected to a hot relaxation treatment is boiled for one minute under a load of 1.2×10^{-3} g./d. dried in air for one hour under the same load and the length of the skein (b) measured. The same skein is then loaded to 0.33 g./d., in air and the length measured (c). Crimp retraction (C.R.) is then calculated from the expression

$$\text{C.R.} = \frac{c-b}{c} \times 100\%$$

Yarn shrinkage is determined by loading a 50 cm. skein to 0.33 g./d. in air and measuring its length (a). The skein is then boiled in water for one minute under a load 0.01 gm./d. and dried in air for one hour under the same load and its length measured under a load of 0.33 g./d. (c), shrinkage (S) is then calculated from the expression

$$S = \frac{a-c}{a} \times 100\%$$

The insertion of false-twist during drawing may conveniently be achieved using the apparatus described in the specification of British Patent No. 890,053, preferably using a heated snubbing pin to heat the yarn during the false-twisting.

Referring to the drawing suitable apparatus comprises means for drawing yarn consisting of a feed roll 1 and a draw roll 3 spaced a distance apart with a snubbing pin 2 therebetween. The draw roll 3, which is associated with a separator roll 4, is provided with a flange 5 which causes a yarn 7 in contact therewith to be rotated about its own axis.

In carrying out the process of the present invention using the above-mentioned apparatus, undrawn yarn, containing at least 66% of heterofilaments, in a substantially twistless condition is passed round the feed roll 1 to the snubbing pin 2 around which it makes about two passes and thence to the draw rolls 3. In its passage from the snubbing pin to the draw roll, the yarn makes frictional contact with the flange 5 which causes the yarn to rotate about its axis and imparts a false twist thereto rendering the yarn twist-lively. Depending upon the temperature of the snubbing pin the amount of permanent twist-liveliness can be varied. The snubbing pin should preferably have a temperature not greater than 140°C . After leaving the draw roll 3 the yarn may be subjected to a hot retraction treatment under low tension to develop or further develop the heterofilament crimp in the yarn. Conveniently this may be carried out by passing the yarn through a tube 8 through which hot air or steam can be introduced. The yarn is finally wound up as a cheese or on a bobbin 6, the crimp being largely pulled out during wind-up.

Alternatively false-twist may be inserted by means of a process employing a false-twist bush such as is described in the specification to British Patent No. 797,051, and heat may be applied to the yarn by means other than a heated snubbing pin. The said bush being positioned between the snubbing pin and draw roll, the latter acting also as a twist-stop.

The invention will now be more fully described in the following examples which are by way of illustration only and not of limitation.

Example 1

The yarn employed in this example was an undrawn 360 denier 30 filament yarn consisting solely of two component heterofilaments. The heterofilaments consisted of equal proportions of 66 nylon, being one component and an 80/20 copolymer of 66 nylon and 6 nylon, being the other component.

The yarn was drawn by passage from feed rolls to a heated snubbing pin around which it was caused to make two wraps and thence to a draw roll fitted with a flange, as described above.

The yarn was guided onto a flange to make frictional contact therewith and thereby rotated about its axis and a false-twist imparted. From the draw roll the yarn was passed through a tube into which steam was introduced and was allowed to retract and the crimp fully develop before being wound up on a surface driven roll to form a cheese. Details of the process and some yarn properties are given in Table 1 below.

TABLE I

Process conditions:

Snubbing pin temp. $^{\circ}\text{C}$.	80
Draw ratio	4.0
Drawing speed meters/min.	305
Percentage retraction in retraction tube	12.5

Yarn properties:

Crimp retraction percent	19
Shrinkage percent	8

The relatively low temperature of the snubbing pin allowed only a small amount of permanent twist-liveliness to be introduced into the yarn, which twist liveliness did not inhibit the development of the heterofilament crimp.

The yarn had a good bulk and was twist lively. After knitting into a fabric and immersed in boiling water for 5 minutes an increase in fabric bulk was observed. The fabric had a cotton-like handle, unusual in fabrics made from synthetic yarns.

Examples 2 and 3

In Example 2 the process of Example 1 was repeated, using the same yarn but with a snubber pin temperature of 120°C . and without the introduction of steam into the retraction tube. The percentage retraction in the tube was 12.5 as before. Example 3 is a repeat of Example 2 without insertion of false-twist to separate the filaments before the heterofilament crimp was developed.

The yarns from each example were knitted into a fabric and the bulk assessed visually after immersion in boiling water for 5 minutes and drying. Details of the yarn and fabric are given in the Table 2 below.

TABLE 2

Example	Crimp retraction, percent	Twist Shrinkage, percent	liveliness, turns/cms.	Fabric bulk
2.....	28	3.6	2.4	V. good.
3.....	8	2.2	0	Nil.

The use of too much heat in the retraction stage reduces both the twist-liveliness and shrinkage of the yarns.

Examples 4 and 5

In these examples which are included only for the purpose of comparison, false-twist crimp was not inserted into the yarn during drawing or before the heterofilament crimp was developed. Details of the process are given in Table 3 below.

TABLE 3

Example	Snubbing pin temperature, $^{\circ}\text{C}$.	Draw ratio	Drawing speed, meters/min.	Percentage retraction in retraction tube	Gas or vapour in the retraction tube
4.....	120	4.0	305	10.5	Hot air at 230°C .
5.....	120	4.0	305	10.7	Steam.

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The yarns were knitted into fabrics which did not show any evidence of bulk, and after immersion in boiling water for 5 minutes only a poor bulk developed.

In the following examples the heterofilaments used consisted of two polyesters components which differed only in respect of their molecular weights expressed in terms of intrinsic viscosity. One component had an inherent viscosity of 0.50 and the other component an intrinsic viscosity of 0.67.

Examples 6 and 7

The process of Examples 2 and 3 were followed, there being no separation of the filaments by the insertion of false-twist prior to crimp development in Examples 7. The yarns were knitted into fabrics which were immersed in boiling water for 5 minutes to redevelop the yarn crimp. Details of the yarn properties are given in the Table 4 below.

TABLE 4

Example	Crimp retraction, percent	Shrinkage, percent	Twist liveliness, turns/cms.	Fabric bulk
6.....	21.2	7.8	1.1	Good.
7.....	7.8	7.0	0	Nil.

Examples 8, 9 and 10

These examples indicate the effect of snubbing pin temperatures on percentage crimp retraction, shrinkage and twist liveliness. The procedure followed was the same as that in Example 2. Details are given in the Table 5 below.

TABLE 5

Example	Snubbing pin temp. °C.	Crimp retraction, percent	Shrinkage, percent	Twist liveliness, turns/cms.
8.....	95	17.7	11.7	0.5
9.....	115	21.2	7.8	1.0
10.....	140	20.0	7.5	1.1

What I claim is:

1. A process for the manufacture of a bulked multifilament yarn comprising inserting false twist in a supply yarn which comprises at least 66% of heterofilaments while heating the yarn so as to impart twist liveliness thereto and then reducing the tension on the yarn thereby

to allow the filaments to separate and retract so as to develop heterofilament helical crimp, the heat applied to the yarn during insertion of false twist being sufficient to cause the yarn to retain a twist liveliness of not more than 2.5 turns per cm. after the retraction step thereby effecting an out of phase helical crimp during the retraction step while not reducing the development of heterofilament crimp.

2. A process according to claim 1 wherein heat is applied to the yarn during the retraction process.

3. A process according to claim 1 wherein the supply yarn is undrawn and further including drawing said yarn while inserting a false-twist therein.

4. A process according to claim 3 including drawing the yarn between a feed roll and a draw roll having a snubbing pin positioned therebetween, the draw roll having a flange fitted thereto with which the yarn makes frictional contact in passage from the snubbing pin to the draw roll, rotating the yarn about its axis and imparting a false twist thereto.

5. A process according to claim 4 including supplying heat to the yarn during the false-twisting by heating the snubbing pin.

6. A process according to claim 5 wherein the temperature of the snubbing pin does not exceed 140° C.

References Cited

UNITED STATES PATENTS

2,904,953	9/1959	Groombridge et al.	57—157
3,038,240	6/1962	Kovarik	28—72 XR
3,061,998	11/1962	Bloch	57—140
3,094,834	6/1963	Deeley et al.	55—55.5
3,111,805	11/1963	Boyer	57—140
3,181,224	5/1965	Tanner.	
3,225,534	12/1965	Knospe.	
3,279,163	10/1966	Lulay	28—72 XR
3,330,896	7/1967	Fujita et al.	28—72 XR
3,350,488	10/1967	Breen	264—171

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