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METHOD OF PRODUCING CRIMPED YARN

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This invention relates to a method of preparing bulky yarn consisting of thermoplastic synthetic fibers which yarn has greater elongation and elasticity recovery rates than conventionally available bulky stretch yarns.

Numerous methods have been proposed and have been practiced in the past for obtaining bulky yarns. Particularly, the twisting method commonly referred to as the false twist process is typical, it being that most widely practiced together with its many improvements.

Since the bulk and stretchability of the bulky stretch yarn produced by previous twisting methods can be regulated to a certain extent with relative ease by adjusting the number of turns and the degree of heat setting given, they have been recognized generally as having multipurpose adaptability. However, the actual range in which adjustment has been possible hitherfore has not necessarily been a wide one, it being at most only of an extent in which the bulkiness of the yarn was adjustable to meet the requirements as to its handle that was required for the final product. For instance, since the handle that is necessary differs between the yarn for sock use and that for sweater use, the handle was merely adjusted suitably by varying the number of turns imparted and the extent of heat setting given.

It is an object of the present invention to provide a bulky stretch yarn which differs from conventional yarns of such types in that the present yarn is characterized by stretchability and stretch recovery rates which are so large that it can be used for fabric and knitted goods which hitherto were made using rubberized yarn.

The bulky yarn of the present invention, is attained by imparting to filaments of thermoplastic synthetic fibers a preliminary twist of from about 300 t./m. to 800 t./m., associating 2 or more ends of such filaments and imparting thereto a high twist of more than 800 t./m. in the same direction as that of the preliminary twist, followed by setting the resultant highly twisted composite filament bundle, and thereafter untwisting the resulting bundle and separating the filament bundle at least into 2 ends each of the original filaments. In a specific embodiment of the invention, a bulky yarn is provided by separating the associated filaments into each of the original filaments after untwisting as above, then imparting a twist in the opposite direction of about the same number of turns as was given thereto as the preliminary twist and thereafter setting the thus twisted filaments. According to the invention, as a further modification of these methods it is also possible to combine (a) a crimped filament yarn which has been obtained by associating 2 or more ends of filaments of thermoplastic synthetic fibers to which an S twist of less than 800 t./m. initially has been imparted, then imparting to the resultant filament bundle a high twist of more than 800 t./m. in the same direction as that of the preliminary twist, followed by setting the resulting highly twisted bundle, and thereafter untwisting and separating the bundle into each of the original filaments, with (b) a crimped filament yarn

which has been obtained by similarly treating filaments to which a Z twist initially was imparted.

The term "filaments" as employed herein in the specification and claims include the monofilaments and multifilaments of thermoplastic synthetic fibers. The use of multifilaments is preferred. Specific examples of such thermoplastic synthetic fibers include those of the polyamides, the polyethylene terephthalate esters, the polypyridine chlorides, the polyolefines, etc., with nylon 6, nylon 66, polypropylene and the like of 30–300 denier being particularly preferred.

As mentioned hereinbefore, the preliminary twist that is initially imparted to the filaments in accordance with the method of the invention is a twist of from 300 t./m. to 800 t./m. The preferable order of the preliminary twist is 600 to 700 t./m., as shown by the examples below. To be sure, the most desirable actual number of turns will differ depending on the size of the filament. Generally, the larger the size, the less will be the number of turns necessary.

By first imparting to the filaments a preliminary twist of the above-defined extent, not only is the handling of the heat-set highly twisted filaments facilitated when the filaments of the highly twisted bundle are being separated, but also the preliminary twisting contributes toward obtaining the great stretchability and recovery properties of the final bulky yarn.

Two or more of the filaments to which have been imparted the preliminary twist are next combined and a high twist then is imparted thereto in the same direction as that of the preliminary twist. What is regarded as being a high twist in accordance with the present invention is one which is more than 800 t./m., a twist of more than 1200 t./m. being particularly preferred. Under certain circumstances, the extent of the twist can be so high that at least a part of the filament bundle becomes twisted with a double layer of turns. The filaments which are associated prior to being imparted a high twist suitably may be of the same number of turns, size and kind or they may be different. By making various changes in the combination of the foregoing conditions a wide variety of crimps are imparted to the final yarns depending upon the extent of the high twist that is employed.

The highly twisted filaments, while in this highly twisted state, are heat set, after which they are untwisted by being imparted in the opposite direction about the same number of turns that were given previously. Heat setting suitably may be carried out in the conventional manner, the conditions thereof being suitably selected according to the kind of filament.

The resultant untwisted filament bundle thereafter is separated into 2 or more ends each or into each of the original monofilaments or mutifilaments. For normal uses, the intended bulky yarn is obtained by separating the filament bundle into the original filaments, for example, into 2 or 3 ends, which are then wound up. It is also contemplated in embodiments wherein multifilaments are employed to separate the untwisted filament bundle into each of the original multifilaments, impart to each of the separated multifilaments a twist of the same degree as the initial preliminary twist in the opposite direction and then set the filaments. In such a case, a bulky yarn of the invention of still greater bulkiness is obtained.

Alternatively, by combining (a) filaments produced by first imparting to starting filaments a preliminary twist in the S direction, associating 2 or more ends of such twisted initial filaments and giving the combined bundle a high

twist in the same direction as that of the preliminary twist, and thereafter carrying out the above-described setting, untwisting and separation steps whereby the highly twisted bundle is separated into each of the original filaments, with (b) filaments obtained similarly using a preliminary twist in the Z direction, a bulky yarn with no distortions at all is formed. In this case also, the alongation of the yarn obtained is at least 50% greater than that obtained conventionally by merely imparting a high twist, setting and untwisting.

According to the present invention, in each of the filament bundles that have been associated prior to imparting the high twist are formed large bends of the same size by means of the high twist that is imparted as described hereinabove. Thus, by untwisting after setting, a yarn having bends like metallic wire coils is obtained.

For purpose of comparison, the properties of bulky yarn according to the method of the present invention and that of a process of preparing a bulky yarn by imparting a high twist, heat setting and untwisting which is generally called a false twist process are shown in the following table.

Load mg./d	Elogation (percent)					Recovery (percent)				
	2	4	8	20	40	2	4	8	20	40
False Twist Process	8.0	20.0	39.0	69.0	85.0	73.0	70.0	69.0	67.0	62.0
Method A of Present Invention	11.0	38.0	65.0	85.0	109.0	83.0	79.0	76.0	72.8	64.5
Method B of Present Invention	49.0	93.0	117.0	136.0	144.0	90.0	86.0	80.0	73.0	69.0

In the experiment the results of which are shown in the above table, the filament used was nylon 6 of 110 d./30 f., the number of high twists was 2000 t./m. in the S direction and the setting was carried out for 20 minutes at 120° C. Two yarns were combined in case of the methods according to the present invention, and the preliminary twist in case of A was 300 t./m. in the S direction while in the case of B it was 600 t./m. in the S direction.

As apparent from the data of the above table, even though the high twisting, setting and untwisting conditions are the same, the bulky yarn according to the method of the present invention is far superior to that of a process of preparing a bulky yarn by imparting a high twist, heat setting and untwisting which is generally called a false twist process in the rates of elongation as well as recovery.

Thus, the present invention is characterized in that not only are the properties of the bulky yarn obtained excellent but also notwithstanding its being a special yarn its productive efficiency does not suffer. This is due to the fact that this invention can be practiced using either a throwing machine, a ring twister, a false twister or the like whereby the production of a large quantity of this special yarn is possible in a single operation.

For a clearer understanding of the invention, the following specific examples are given, it being understood however that these are merely given in an illustrative sense and not in limitation of the invention.

Example 1

A multifilament of nylon 6 of 110 d./24 f. was imparted 630 t./m. of S twist. Two ends of these were then associated and given a high twist of 1950 t./m. in the S direction by means of a ring twister. While in this state, the yarn bundle was steamed for 20 minutes at 120° C., after which it was untwisted. The yarn obtained by separating into the single ends had an elongation of 135% and a recovery of 85% under a load of 20 mg./d.

Example 2

A multifilament of nylon 6 to 50 d./12 f. was given 500 t./m. of S twist, after which 3 ends of these were associated and imparted a high twist of 2800 t./m. in

the S direction by means of a false twister, then set at 170° C., following which the yarn bundle was untwisted and thereafter separated into the single ends.

Next, these separated yarns were imparted a Z twist of 650 t./m. and heated for 10 minutes with steam at 105° C. The so obtained yarn showed an elongation of 140% and a recovery of 85% under a load of 20 mg./d., and manifested very great bulkiness without any distortions. When this was used for a corset, there was no need at all for rubberized yarn.

Example 3

Two ends of multifilaments of nylon 6 of 70 d./16 f., to which had been imparted a preliminary twist at 700 t./m. in the S direction, where associated. These associated filaments were given a high twist at 1900 t./m. in the S direction on a false twister and set at 180° C. Then the set filament bundle was untwisted and separated into the two original filaments. (These two separated multifilaments were named filaments S.) Separately, two ends of multifilaments of nylon 6 of 70 d./16 f., to which had been imparted a preliminary twist at 700 t./m. in the Z direction, were associated. These associated filaments were given a high twist of 1900 t./m. in the Z direction on a false twister and set at 180° C. Then the set filament bundle was untwisted and separated into the two original multifilaments. (These two separated multifilaments were named filaments Z.) Two strands selected respectively from filaments S and filaments Z were twisted together to form two finished yarns.

This yarn was completely without any distortions and moreover was very elegant. When the fabric using this yarn was made into corsets, the corsets obtained not only were of very pleasing appearance but also exhibited elasticity that was fully satisfactory.

Example 4

Dacron yarns of 70 d./16 f. and 110 d./24 f. were imparted respectively an S twist of 700 t./m. and a Z twist of 600 t./m., then associated and strung up on a false twister. The number of turns was 2000 t./m., the direction of the twist being in the S direction, and the setting temperature was 200° C.

The yarn obtained by untwisting and separating the foregoing yarn bundle showed in the case of the 70 denier yarn an elongation of 148% and a recovery of 88% under a load of 20 mg./d., while in the case of the 110 denier yarn the elongation was 145% and the recovery was 85%.

Since it is apparent that many changes and modifications can be made in the above-described details without departing from the nature and spirit of the invention, it is to be understood that the invention is not to be limited to said details except as set forth in the appended claims.

What is claimed is:

1. A method of producing an undistorted bulky yarn having a high stretchability which comprises (a) imparting to separate thermoplastic synthetic multifilaments a preliminary twist at 300 to 800 t./m. in the S direction, associating 2 or more ends of the twisted multifilaments, imparting to the associated multifilaments a high twist at more than 800 t./m. in the S direction, setting the resulting high twisted filament bundle, untwisting the set filament bundle and separating the untwisted bundle into the original multifilaments to obtain filaments S, (b) imparting to separate thermoplastic synthetic multifilaments a preliminary twist at 300 to 800 t./m. in the Z direction,

associating 2 or more ends of the twisted multifilaments, imparting to the associated multifilaments a high twist at more than 800 t./m. in the Z direction, setting the resulting high twisted filament bundle, untwisting the set filament bundle and separating the untwisted bundle into the original multifilaments to obtain filaments Z, and (c) thereafter combining filaments S with filaments Z.

2. The method according to claim **1** wherein said preliminary twist in the S direction and said preliminary twist in the Z direction are in the range of from about 600 to about 700 t./m.

3. The method according to claim **1** wherein said high twist in the S direction and said high twist in the Z direction are more than 1200 t./m.

4. The method according to claim **3** wherein said high twist in the S direction and said high twist in the Z direction are such that at least portions of the resultant twisted filament bundles are twisted with a double layer of turns.

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