Nov. 3, 1970 HIROSHIRO KIMURA ET AL 3,537,251

PRODUCTION OF MECHANICALLY BUNDLED YARNS

Filed June 4, 1968 2 Sheets-Sheet 1

Fig. 1

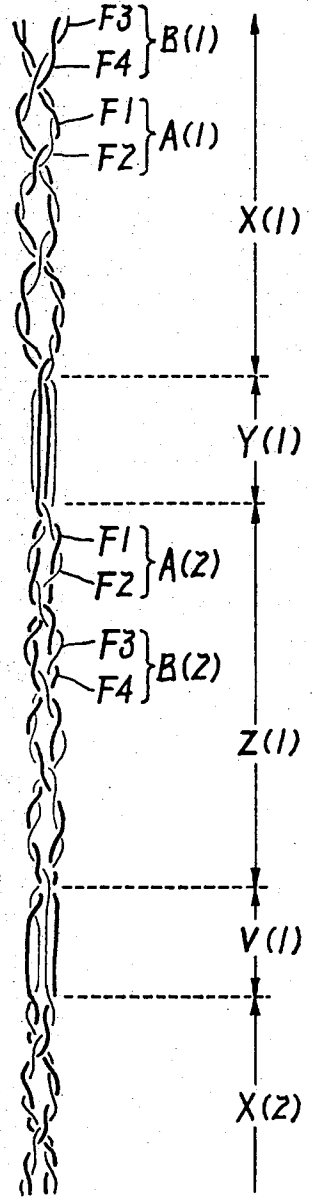


Fig. 2

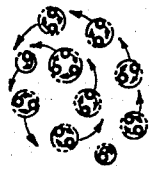


Fig. 3

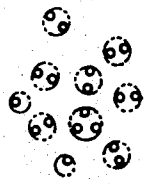


Fig. 4

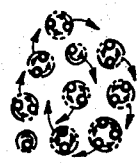


Fig. 5 PRIOR ART

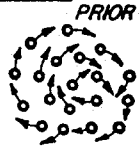


Fig. 6 PRIOR ART

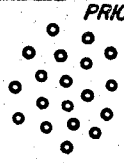
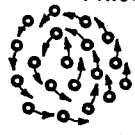


Fig. 7 PRIOR ART



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Fig. 8

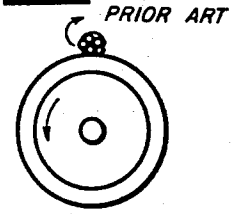


Fig. 9

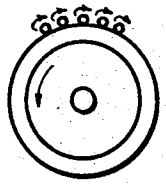


Fig. 10

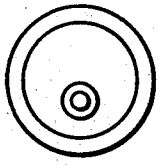


Fig. 11

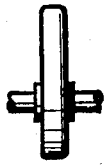


Fig. 12

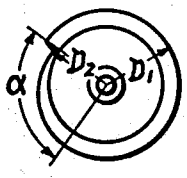


Fig. 13

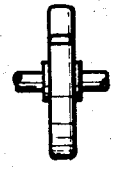


Fig. 14

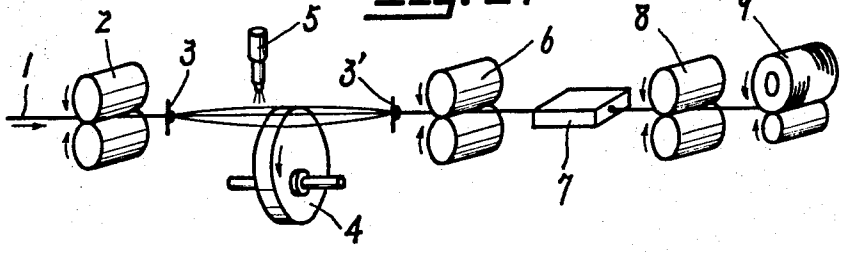
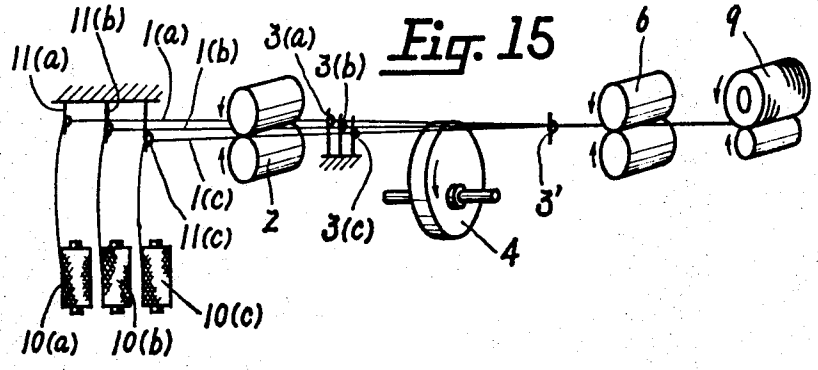


Fig. 15



United States Patent Office

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3,537,251

PRODUCTION OF MECHANICALLY BUNDLED YARNS

Hiroshiro Kimura and Akio Koshimo, Uji-shi, Matafumi Ishibashi, Miyako, Yoshinori Mineda, Uji-shi, and Kentaro Kamamoto, Kyoto-shi, Japan, assignors to Nippon Rayon Kabushiki Kaisha (Nippon Rayon Company Limited), Uji-shi, Japan, a body corporate of Japan

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Claims priority, application Japan, June 6, 1967, 42/36,095, 42/36,096
Int. Cl. D02g 1/02, 3/26
U.S. Cl. 57—140 10 Claims

ABSTRACT OF THE DISCLOSURE

The present invention relates to yarns. More particularly, the present invention relates to mechanically bundled yarns having an improved alternate twist. The yarn is composed of at least two members each of which is entwisted alternatively in the S or Z direction, and which members are entwisted with respect to each other to obtain opposite twisting. The yarn is produced by a novel process wherein parallel groups of filaments are contacted with a friction means to form said bundled yarn.

BACKGROUND OF THE INVENTION

In conventional textile operations, such as winding, knitting and weaving, zero twist yarn or low twist yarn has poor performance due to the loose structure which permits separation and breakage of filaments, fluffs, wraps, etc. To overcome such disadvantages, conventionally, there is imparted to the textile yarn a true twist sometimes further sized. But such a true twisting is time-consuming and expensive, and moreover such a mechanical twisting often deteriorates the physical properties of yarns.

If a yarn having sufficient handling and running properties could be obtained without a true-twisting operation, the advantages thus obtained are apparent. It has therefore been desired to obtain a coherent yarn bundle without true twisting so as to give good running and handling properties.

Several attempts have been suggested for this purpose.

In one such attempt, it has been suggested to intermittently contact a yarn with friction means, so as to impart an alternate twist. The yarn is twisted to S- (or Z-) direction in a section of the yarn, and is twisted to Z- (or S-) direction in the subsequent section. The yarn obtained has successive sections of S-twist and Z-twist. The obtained yarn is, however, unstable in structure and the alternate twist is liable to eliminate under tension. This is because the alternate twist is merely imparted to the yarn as a whole and can only provide poor cohesion properties.

OBJECT OF THE PRESENT INVENTION

An object of the present invention is to provide a mechanically bundled yarn having an improved alternate twist and good cohesion properties.

Another object of the present invention is to provide a process for producing the same.

Other objects of the present invention will be apparent upon reading the undergoing specification and claims.

BRIEF DESCRIPTION OF DRAWINGS

In the drawings, which illustrate the invention:

FIG. 1 shows schematically a side view of an embodiment of the mechanically bundled yarn obtained by the present invention.

FIGS. 2 to 4 illustrate schematically the cross sectional views of another embodiment of the yarn, which is obtained by the present invention.

FIGS. 5 to 7 illustrate schematically the cross-sectional views of the conventional alternate twist yarn.

FIG. 8 represents a contacting state between a yarn and a friction means according to the prior art for producing alternate twist yarn.

FIG. 9 represents a contacting state between a yarn and a friction means according to the present invention.

FIG. 10 and FIG. 12 represent front views of the embodiment of friction means useful according to the present invention.

FIG. 11 and FIG. 13 represent corresponding side views of the above friction means shown in FIG. 10 and FIG. 12, respectively.

FIG. 14 and FIG. 15 illustrate schematically a preferred embodiment of an apparatus for carrying out the process according to the present invention.

DETAILED DESCRIPTION OF THE YARN

According to the present invention, there is provided a mechanically bundled yarn having an improved alternate twist characterized by:

(a) That the yarn is composed of at least 2 members, each of which is composed of one or more filamentary structures,

(b) That at least two of said members, each of which is twisted alternately in the S or Z direction, are entwisted alternately in the S or Z direction, wherein at least two of said members are substantially entwisted in the opposite direction to the twist of each member.

Hereinafter, the term "a filamentary structure" denotes "a continuous filament, a continuous multifilament yarn or a spun yarn."

It is preferable that the filamentary structure is a continuous filament or a continuous multifilament yarn. Also, it is preferable that the yarn is made of man-made fibers such as, e.g., regenerated fibers (e.g., viscose rayon, cellulose acetate, etc.), synthetic fibers (e.g., polyamide fibers, polyester fibers, polyvinyl alcohol fibers, fibers made of copolymers or mixture thereof, etc.), and combinations of the foregoing.

Since the construction of the mechanically bundled yarn according to the present invention is complicated and may vary with various factors, it is advantageous to describe the construction of the yarn with reference to FIG. 1 illustrating schematically a preferred embodiment of the yarn according to the present invention.

The yarn is composed of four filamentary structures F1, F2, F3 and F4, each two of which comprises one member. In the section X(1), filamentary structures F1

and F2, and and filamentary structures F3 and F4 are imparted respectively with the S-twist to form members A(1) and B(1), and said members A(1) and B(1) are entwisted in the Z-direction. In the section Y(1), F1, F2, F3 and F4 are substantially parallel to each other and are in zero-twist. In the section Z(1), filamentary structures F1 and F2, and filamentary structures F3 and F4 are imparted respectively with the Z-twist to form members A(2) and B(2) respectively, and members A(2) and B(2) are entwisted in the S-direction. The construction of the section V(1) is substantially similar to that of the section Y(1), and the construction of the section X(2) is similar to that of section X(1). The yarn has successively repeating units of X(1)–Y(1)–Z(1)–V(1). Better results can be obtained when the yarn is composed of at least 5 members.

The bundled yarn obtained by the process of the present invention has good cohesion properties and can be treated advantageously with ease equal or superior to that of the conventional unidirectionally twisted yarn in various textile operations. Moreover, the bundled yarn produced by the present invention has a beautiful appearance and uniform dyeability.

The feature of the construction of the mechanically bundled yarn obtained by the present invention is further illustrated in FIGS. 2 to 4 showing schematically the cross-sectional views of the adjacent 3 sections of the yarn. In FIG. 2, each member is imparted with the counter-clockwise twist with other members, and each member itself is twisted in the clockwise direction. In FIG. 3, all filamentary structures have substantially zero twist. In FIG. 4, each member is imparted with a clockwise twist with other members, and each member itself is twisted in the counterclockwise direction.

The alternate twist yarn construction obtained by the prior art is illustrated in FIGS. 5 to 7 showing schematically the cross-sectional views of the adjacent 3 sections of yarn. In these figures, the yarn is alternately twisted as a whole.

In comparing FIGS. 2 to 4 with FIGS. 5 to 7, the distinguishing feature of the yarn obtained by the present invention will be apparent.

DETAILED DESCRIPTION OF THE PROCESS

According to the present invention, there is provided a process for producing a mechanically bundled yarn having an improved alternate twist characterized by the steps of:

(a) Running a plurality of members, each of which is composed of one or more filamentary structures, in substantially parallel and slightly spaced relationship with each other under a tension along a path;

(b) Placing said members intermittently into contact with a friction means so as to form the bundled yarn.

In order to impart the members with a torque from the frictional means individually and concurrently, a slight space should be kept between respective members. An excessively spaced member can give rise to the difficulty of obtaining final twist which would be given by leaving the members therefrom.

A conventional contacting state between a yarn and a friction means for producing an alternate twist yarn is shown in FIG. 8. Contacting state between a yarn and a friction means according to the present invention is shown in FIG. 9. In a conventional process shown in FIG. 8, twist torque is given to a yarn as a whole. On the other hand, in the present process shown in FIG. 9, twist torque is given in the same direction to each member of filamentary structure individually. Thus, the twist mechanism of the present invention differs from a conventional process.

As a friction means according to the process of the present invention, a rotatable means such as, e.g., a disc, a tube, an endless belt, etc., can be used. Such friction means can be used in combination with a yarn-traversing means such as a traverse guide, which intermittently contact the yarn with said friction means, whereby good results can be achieved. An eccentric disc, a cam, an annular cam and the like may be used as a friction means so that the yarn is contacted intermittently with the peripheral surface of said friction means without a yarn-traversing means.

The surface of a friction means which contacts the yarn is necessarily composed of a material having a high coefficient of friction with said yarn. For example, natural rubber, polyurethane, polybutadiene, poly-chloroprene and other synthetic rubbers having suitable hardness and antiabrasion property, may be used as a material for frictional surface.

The tension of said members of the filamentary structures should be sufficiently high to place them into contact tightly with the frictional surface, so as to impart to them a sufficient torque.

In the present invention, when said members leave the friction means so as to eliminate a part of the imparted torque therefrom, at least two of said members are entwisted in the opposite direction to that of the twist of said members whereby it is possible to obtain the yarn according to the present invention which has a stable and duplex structure.

A continuous filament or a multifilament yarn can advantageously be treated by this process. Also, a spun yarn can be treated by this process.

According to another feature of the present invention, it is also possible to produce the mechanically bundled yarn having an improved alternate twist by:

(a) Progressing a multifilament yarn along a path,

(b) Separating said multifilament yarn into plural members, each of which is composed of one or more filaments, whereby said members are positioned in substantially parallel and slightly spaced relationship with each other under a tension,

(c) Placing said members intermittently into contact with the friction means so as to form the bundled yarn.

The process according to the present invention can with advantage be carried out by using a multifilament yarn, which has a twist of less than 50 turns per meter including zero.

According to this process, the multifilament yarn can be separated to plural members by means of blowing a fluid jet to the multifilament yarn. As the fluid jet, an inert gas, preferably air, can be used. Also, the multifilament yarn can be separated to plural members by means of a suitable electrostatic method. In this case, numbers of the members depend upon various operational conditions such as, e.g., shape of the nozzle or electrical charging rod, fluid pressure or electrical intensity forward properties of the filaments used, etc., although numbers of the filaments in total are unchanged.

PREFERRED EMBODIMENTS OF THE INVENTION

FIG. 14 shows a preferred embodiment of apparatus for carrying out the process according to the present invention. The multifilament yarn **1** is supplied from a supplying bobbin, and is processed through a pair of feed rollers **2** and a guide **3**. It is separated into plural members which are then contacted with a moving surface of an eccentrically rotatable disc **4** having an axis arranged substantially parallel to the multifilament yarn path determined by the guides **3** and **3'**. The yarn guides **3** and **3'** are provided in such a manner that the multifilament yarn would be contacted with the periphery of its longer radius, while it would not be contacted with the periphery of its shorter radius. A nozzle **5** is provided in such a manner that the fluid jet is blown on to the multifilament yarn before the moving surface. The multifilament yarn is sepa-

rated to plural groups composed of one or more filaments, and is twisted intermittently and concurrently by the disc **4**, and is taken up by the take-up roller **6** through the guide **3'**. The yarn is then heat-set by using a heater **7** under a low tension provided by roller and take-up units **8** and **9**.

FIG. 15 shows another embodiment of an apparatus for carrying out the process of the present invention. In this case, plural yarns are supplied respectively from different bobbins **10**(*a*), **10**(*b*), **10**(*c*), through guides **11**(*a*), **11**(*b*), **11**(*c*), **3**(*a*), **3**(*b*), **3**(*c*) are contacted intermittently and concurrently with a rotating disc **4** so as to be imparted with a twist-torque. The yarn obtained is taken up through a guide **3'** and rollers **6** onto a winder **9**. It is preferable to dispose guides **3**(*a*)–**3**(*c*) as nearly as possible to each other, as far as yarns **1**(*a*)–**1**(*c*) can be individually twisted. Details of the operational condition are shown in Table 3.

In the following examples and tables, the degree of the separation of the yarn obtained is designated at $\overline{d}$ value (a low $\overline{d}$ value means a high cohesion), which is determined in the following manner:

A yarn sample about 2 meters in length was hung by fixing its upper end and by loading at its lower end with a load of 0.2 gram per denier. A hook having a weight of (deniers of monofilament $\times 3/5$) grams was then inserted at its upper end. After the hook moved downwardly and stopped, the distance of the movement of said hook was measured. Similar measurements were repeated several times. From the obtained values, there was yielded an arithmetic means value representing $\overline{d}$ value.

As shown in Table 1A and 1B, several embodiments of the friction means according to the present invention are used in examples.

TABLE 1A

(1)	(2)	(3)	(4)	(5)
A	Eccentric disc *.	10	1	Polyurethane rubber.
B	do.	10	0.5	Do.
C	do.	6	0.5	Do.
D	do.	6	0.2	Do.

*Eccentric disc shown in Fig. 10 and Fig. 11.

NOTE:
(1) Type of friction means used.
(2) Shape.
(3) Diameter of disc (cm.).
(4) Distance between center of disc and center of shaft (cm.).
(5) Materials of friction surface.

TABLE 1B

(1)	(2)	(3)	(4)	(5)	(6)
E	Concentric disc like cam*.	3.0	2.6	45	Polyurethane rubber.
F	do.	3.0	2.6	90	Natural rubber.
G	do.	3.0	2.6	60	Polychloroprene rubber.

*Concentric disc like cam shown in Fig. 12 and Fig. 13.

NOTE:
(1) Type of friction means.
(2) Shape.
(3) Distance D1 in Fig. 12 (cm.).
(4) Distance D2 in Fig. 12 (cm.).
(5) Angle of circumference α in Fig. 12 (°).
(6) Materials of friction surface.

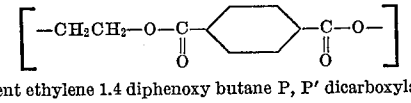
EXAMPLES 1 TO 16

Examples 1 to 16 respectively, were carried out to produce a mechanically bundled parn by using different embodiments of the apparatus according to the present invention, each of which is substantially similar to that shown in FIG. 14. Different embodiments of the friction means according to the present invention as shown in Table 1A and Table 1B were used, and the results obtained are given in Table 2.

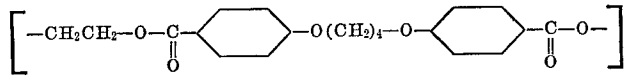
TABLE 2

Example No.	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)
1	Nylon 6 (70/24)	0	A	1,200	500	Air	2.5			8.8
2	do.	0	A	1,200	500	do.	2.5	450	180	8.5
3	do.	0	A	1,200	500	Nitrogen gas	2.5	450	180	8.7
4	do.	0	B	3,000	500	Air	2.0	450	180	6.0
5	do.	0	C	4,500	350	do.	2.0			5.3
6	Nylon 6.6 (70/24)	0	D	4,500	350	do.	2.0			5.5
7	do.	0	E	4,500	350	do.	2.0			5.2
8	do.	0	F	4,000	400	do.	2.0			6.0
9	Cellulose acetate (150/40)	20	G	4,000	400	do.	2.0			5.8
10	PET *1 (75/36)	20	F	4,500	500	do.	2.0			6.3
11	do.	20	F	6,000	500	do.	2.0			4.2
12	PAN *2 (75/38)	20	F	4,500	400	do.	2.0			6.2
13	PEB *3 (70/36)	0	F	4,500	400	do.	2.0			6.5
14	PEE *4 (70/34)	0	F	4,500	400	do.	2.0			6.4
15	PPE *5 (70/24)	20	F	4,500	400	do.	2.0			6.6
16	Viscose rayon (150/40)	40	F	4,500	400	do.	2.0			5.6

NOTE:
(A) Type of yarn (total deniers/filaments):
*1. Polyethylene terephthalate.
*2. Polyacrylonitrile.
*3. Polyethylene oxybenzoate.
*4. Copolyester-ether: Copolymer consisting of two different recurring units composed of 50 mol percent ethylene terephthalate units



and 50 mol percent ethylene 1.4 diphenoxy butane P, P' dicarboxylate units



*5. Polypropylene oxybenzoate.
(B) Yarn twist (turns/meter).
(C) Type of friction means.
(D) Rotating speed of friction means (r.p.m.).
(E) Yarn speed (meter/minute).
(F) Kind of fluid.
(G) Pressure of fluid (atm.).
(H) Length of heater (mm.).
(I) Temperature of heater (° C.).
(J) $\overline{d}$ value (cm.).

EXAMPLE 17

An apparatus similar to that shown in FIG. 11 was used to produce a mechanically bundled yarn except six electrical charging rods made of polyethylene were substituted for the nozzle 5. A zero-twist nylon 6 multifilament yarn, 70 denier/24 filaments, was fed with a speed of 300 meters/minute and rubbed under a tension of about 60 grams/70 denier by means of electrical chargings rods to result in the separation of the fed material. The multifilament yarn was contacted intermittently with disc F (see Table 2) rotating at 4,500 r.p.m., passed through a guide 3', passed through rollers 6 and 8, and was wound onto the winder 9. Heat setting of the yarn was not carried out. The yarn obtained had a $\bar{d}$ value of 6.1 cm.

EXAMPLE 18

A similar apparatus to that described in Example 17 was used to produce a mechanically bundled yarn. A zero-twist nylon 6 multifilament yarn, 70 denier/24 filaments, was fed with a speed of 450 meters/minute and was rubbed under a tension of about 65 grams/70 denier with the charging rods. At the same time, the multifilament yarn was blown by air at a pressure of 2 kg./cm.^{2} through the nozzle 5, and then treated in similar manner to that described in Example 17. The yarn obtained had a $\bar{d}$ value of 5.6 cm.

EXAMPLES 19–21

Examples 19 to 21 were respectively carried out to produce a mechanically bundled yarn by using the apparatus as shown in FIG. 15, wherein the friction means as shown in Table 1A and Table 1B is used. The results are shown in Table 3. Numbers of guide 3 used are shown in Table 3.

TABLE 3

Example No.	A	B	C	D	E	F	G
19	Nylon 6 (30/7)	0	4	A	1,200	500	11.0
20	Nylon 6 (50/12)	0	4	A	1,200	500	15.5
21	PET *1 (30/12)	20	4	A	1,200	500	11.5

NOTE:
(A) Type of yarn (total deneirs/filaments): *1 same as Table 2.
(B) Yarn twist (turns/meter).
(C) Numbers of guide 3.
(D) Type of friction means.
(E) Rotating speed of friction means (r.p.m.).
(F) Yarn speed (meters/minute).
(G) $\bar{d}$ value.

Having described the present invention, that which is sought to be protected is set forth in the following claims.

We claim:

1. A mechanically bundled yarn having improved alternative twist characterized by the following features:
   (a) the yarn is composed of at least two members, each of which is composed of at least two filamentary structures,
   (b) in a first section the filamentary structures are in a S-twist arrangement to form each of said members, and said members are entwisted in the Z-direction,
   (c) in the subsequent section the filaments are substantially parallel and are in zero-twist arrangement,
   (d) in the next section the filamentary structures are in a Z-twist arrangement to form each of said members, and the members are entwisted in the S-direction,
   (e) and in the next section the filaments are again substantially parallel and are in zero-twist arrangement.

2. A mechanically bundled yarn according to claim 1 in which the filamentary structure is a continuous filament or a continuous multifilament yarn.

3. A mechanically bundled yarn according to claim 1, in which the yarn is made of a regenerated fiber.

4. A mechanically bundled yarn according to claim 3, in which the yarn is made of a member of the group consisting of viscose rayon, cellulose acetate and mixture thereof.

5. A mechanically bundled yarn according to claim 1, in which the yarn is made of a thermoplastic fiber.

6. A mechanically bundled yarn according to claim 5, in which the yarn is made of a member selected from the group consisting of polyamide, polyester, polyacrylonitrile, polyolefine, polyvinyl-alcohol, and mixture thereof.

7. A process for producing a mechanically bundled yarn having an improved alternate twist characterized by the steps of:
   (a) progressing a multifilament yarn along a path,
   (b) separating said multifilament yarn into plural members, each of which is composed of one or more filaments, whereby said members are positioned in substantially parallel and slightly spaced relationship with each other under a tension,
   (c) placing said members intermittently into contact with a cam means so as to impart a twist torque in the same direction to each member individually, said twist torque being effective on each member so as to entwist it in the adverse direction whereby the bundled yarn is formed.

8. A process according to claim 7 in which the multifilament yarn is separated into said plural members by jetting a compressed fluid.

9. A process according to claim 7 in which the multifilament yarn is electrostatically separated into said plural members.

10. A process according to claim 7 in which the multifilament yarn has a twist of less than 50 turns/meter.

References Cited

UNITED STATES PATENTS

3,225,533	12/1965	Henshaw	57—34
3,306,023	2/1967	Henshaw et al.	57—156
3,377,792	4/1968	Walls et al.	57—77.3
3,434,275	3/1969	Backer et al.	57—156 XR
3,443,370	5/1969	Walls	57—156 XR

STANLEY N. GILREATH, Primary Examiner

W. H. SCHROEDER, Assistant Examiner

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