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 [21] Appl. No. **786,811**
 [22] Filed **Dec. 5, 1968**
 [45] Patented **Sept. 7, 1971**
 [73] Assignee **Fiber Industries, Inc.**
Continuation-in-part of application Ser. No.
708,621, Feb. 27, 1968, now abandoned.

[50] **Field of Search**.....57/34 B, 36,
 51, 51.6, 77.3, 77.33, 139, 140, 144, 156, 157;
 28/1

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[54] **COHERED YARN FABRICS AND METHOD FOR**
FORMING SAID YARN
8 Claims, 8 Drawing Figs.

[52] U.S. Cl..... 57/140,
 57/157
 [51] Int. Cl..... D02g 1/16,
 D03d 13/00, D04b 1/14

ABSTRACT: A knitted or woven fabric and the process for preparing such fabrics from continuous filament yarns cohered by means of double opposed pneumatic false-twisting jets whereby the yarns have a spreadability factor not greater than about 11.

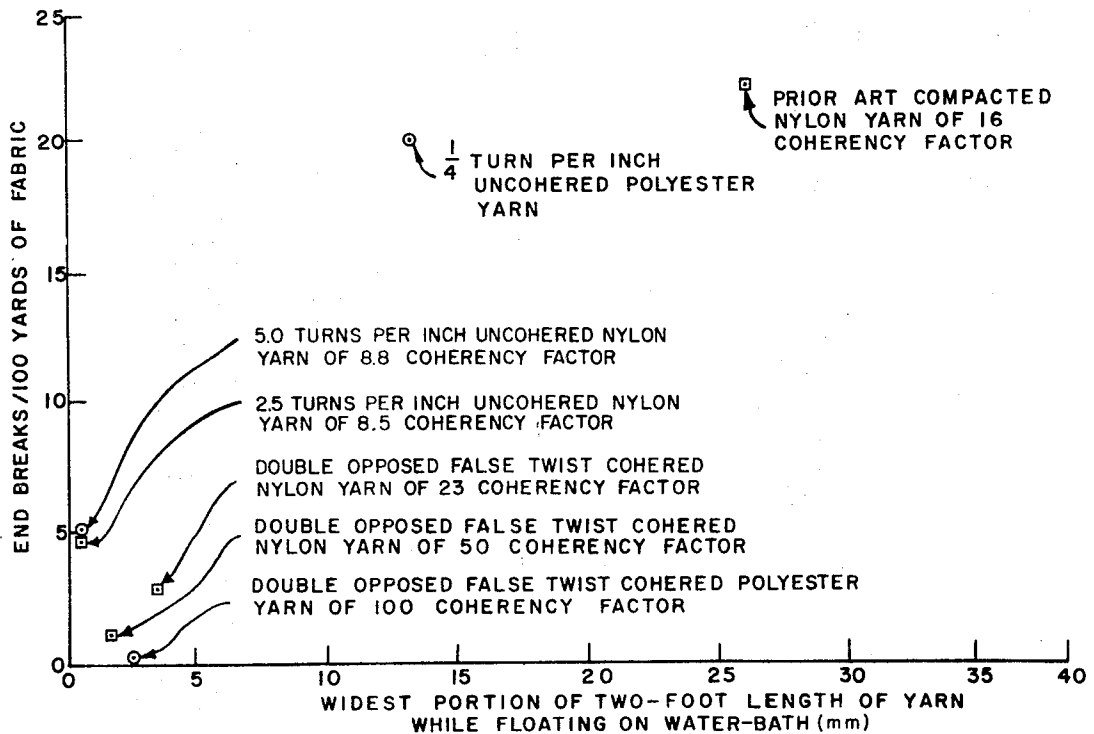


FIG. 1

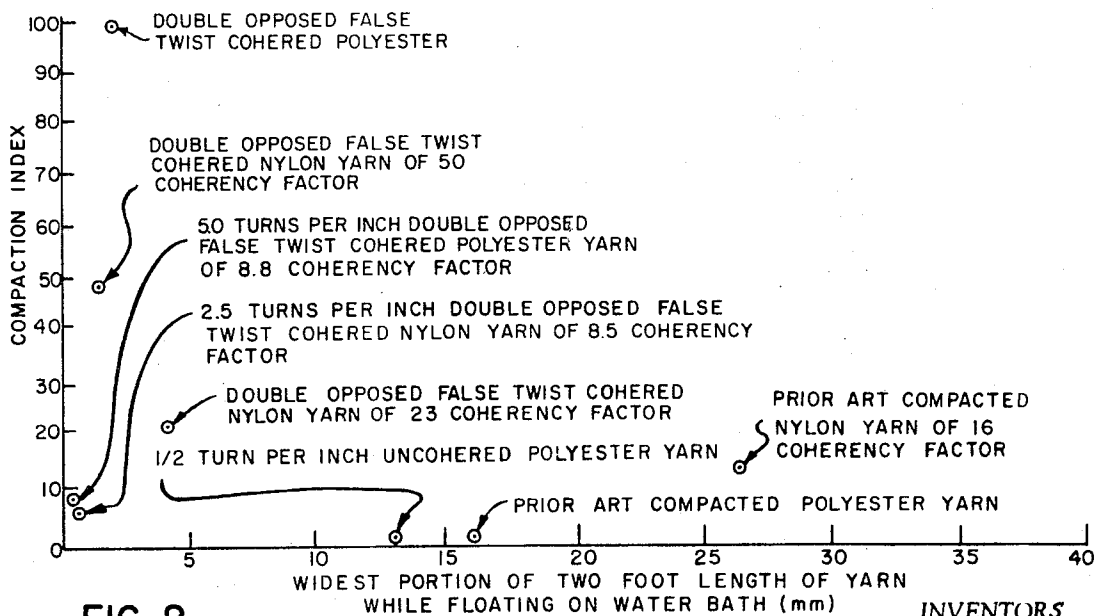


FIG. 2

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PATENTED SEP 7 1971

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SHEET 2 OF 3

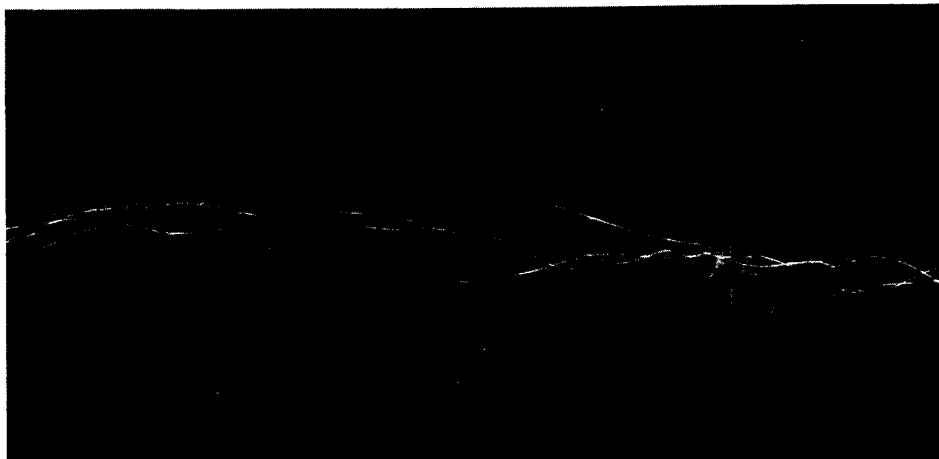


FIG. 3

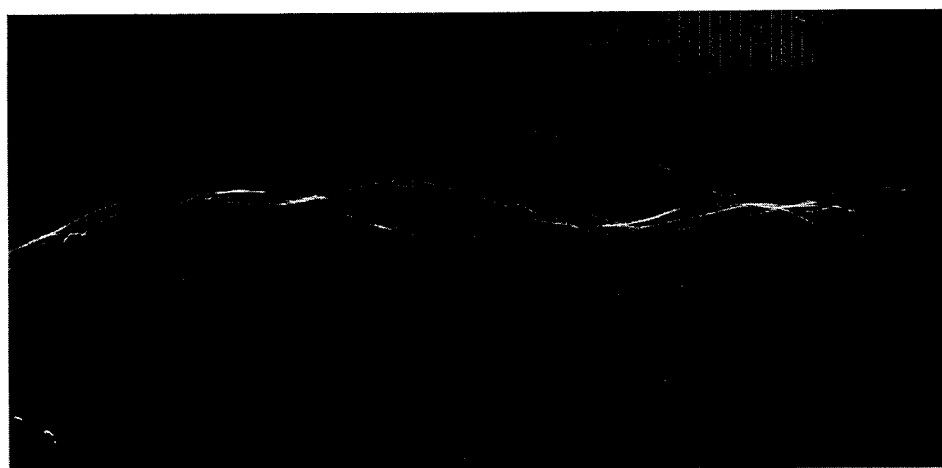


FIG. 4

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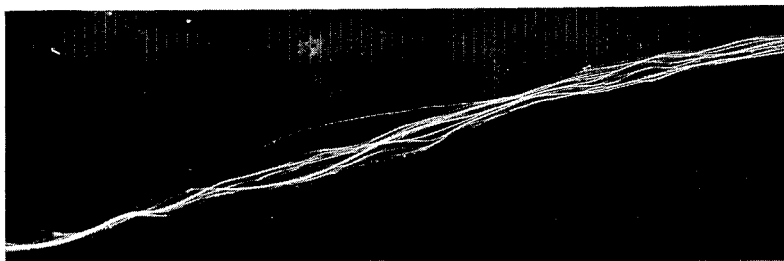


FIG. 5

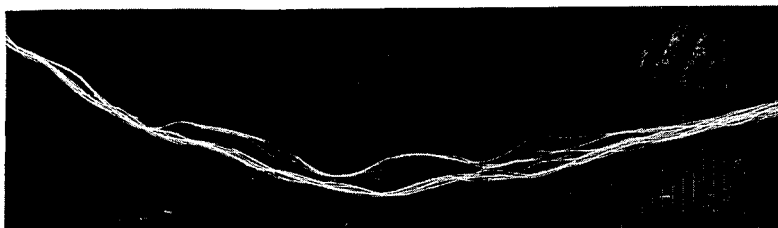


FIG. 6



FIG. 7

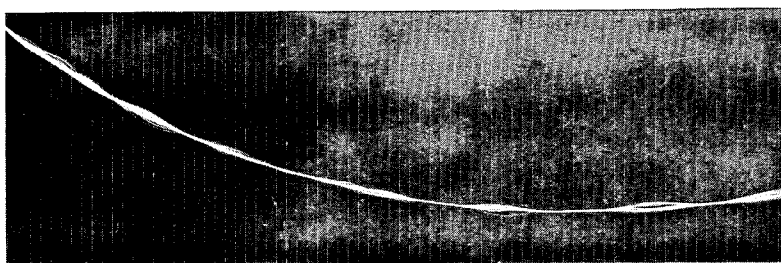


FIG. 8

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COHERED YARN FABRICS AND METHOD FOR FORMING SAID YARN

This invention, which is a continuation-in-part application of copending application, Ser. No. 708,621, filed Feb. 27, 1968, now abandoned relates to compacted yarn fabrics and more specifically, to knitted and woven fabrics prepared from continuous filament compacted yarns having substantially no twist.

It is well known in the textile industry that continuous filament yarn bundles in their "as spun" or zero twist configurations perform poorly in many of the common textile operations such as winding, weaving, knitting, and the like, primarily due to a looseness of structure that permits individual filaments to snag and break, thence forming fluff balls, slubs, wringers, wraps, strip backs or similar defects. Zero-twist yarns also have a tendency to run in the form of a ribbon over guides, rollers and so forth, whereby as a result of increased frictional contact, the yarns are more readily abraded and subject to breakage. As a result of these shortcomings, continuous filament producers usually carry out the additional step of twisting each continuous filament yarn bundle to provide an acceptable starting product. The twisting operation serves to compact and unify the yarn bundle, thus resulting in a more cohesive structure which resists the pulling out of individual filaments. The twisting operation however, is expensive and time consuming and does not lend itself to the continuous operation which characterizes much of the manufacturing sequence in the preparation of the zero-twist continuous filament yarn bundle.

In order to overcome the expense of the twisting operation, and also to employ a twist substitute manufacturing operation, which is adaptable to the continuous manufacturing operation employed in the manufacture of continuous filament yarn bundles, compact interlaced yarns have recently been introduced to the textile industry. Compact interlaced multifilament textile yarns of the type presently under discussion are set forth in U.S. Pat. No. 2,985,995. In brief, the compact interlaced multifilament textile yarns of the prior art are produced by subjecting an "as spun" substantially zero-twist continuous filament yarn bundles to the action of one or more fluid jets, whereby individual filaments are randomly intermingled with adjacent filaments and groups of filaments along the length of the yarn to maintain the unity of the yarn by frictional constraint between the filaments. Yarns of this type have been found to be satisfactory for such textile operations as winding and beaming. The preparation of knitted and woven fabrics from such compact interlaced multifilament textile yarns, has, however, remained impractical in the absence of additional twist being applied to these yarns. While conventional continuous filament yarns which have not been subjected to compacting operations are conventionally given from about one-quarter to one-half turns per inch in order to facilitate winding and beaming operations, these yarns are also unsatisfactory for formulation into woven or knit products without additional twist. For instance, in order to weave a continuous filament nylon yarn, it is usually necessary to have at least $2\frac{1}{2}$ turns per inch of twist, while for polyester at least five turns per inch are necessary.

It is therefore an object of this invention to provide a process for the manufacture of knit fabrics and woven fabrics from substantially zero-twist yarns.

It is another object of this invention to provide a process for the preparation of knitted fabrics and woven fabrics from cohered yarn bundles having substantially zero-twist.

It is still another object of this invention to provide woven fabrics from cohered yarn bundles having substantially zero-twist.

It is a further object of this invention to provide knitted fabrics from cohered yarn bundles having substantially zero-twist.

In accordance with this invention, it has now been discovered that it is possible to prepare knitted and woven fabrics from cohered substantially zero-twist multifilament textile yarns which exhibit a minimal degree of spreadability, preferably the cohered multifilament textile yarns which exhibit the minimal degree of spreadability are yarns which have been cohered by means of a double-opposed false-twist operation.

The cohered yarn is preferably a yarn selected from the group consisting of nylon yarn and polyester yarn having a spreadability factor not greater than about 11 and having substantially zero-twist. More, preferably, the cohered yarn has a spreadability factor not greater than about nine and a coherency factor from 20 to 150. Still more preferably, the cohered yarn has a spreadability factor of about five and a coherency factor of from about 40 to about 100.

The term "spreadability" as employed herein is meant to define a measure of tendency of individual filaments to stray from the main yarn bundle. The measurement is made as follows:

1. Fill a bath having dimensions of 8 by 46 by 4 inches to overflowing with distilled water at ambient temperature $\approx 21^\circ\text{C}$, pH 7.0 ± 0.5 .
2. Wipe surface water from bath with straight edge leaving water level slightly below (one-sixteenth-one-eighth inches) the top edges of the bath walls.
3. Take yarn by hand over the end of a bobbin with minimum tension. Cut off at least 4.5 ft. of yarn.
4. Lay this length of yarn lengthwise on the surface of the water carefully allowing the middle of the threadline to contact the water first, and without tensioning the yarn, lower both ends of the threadline so that they hang loosely over the sides of the bath.
5. After approximately 10 seconds, measure, without disturbing the threadline or the water, the two widest widths of total spread of the yarn recording the two values in millimeters, the measurements being made at least 12 inches apart.
6. Repeat procedures 1 through 5 for 22 lengths of yarn.
7. Discard the two highest and two lowest measurements leaving $N=40$.
8. Average the 40 values.

A better understanding of the invention may be had from a discussion of the drawings wherein:

FIG. 1 is a graph plotting end breaks for warp yarns per 100 yards of fabric vs spreadability, each yarn being legend identified.

FIG. 2 is a legend graph plotting compaction vs spreadability.

FIG. 3 is a photograph of a double-opposed false twist cohered yarn subjected to a water bath test.

FIG. 4 is a photograph of a prior art compacted polyester yarn subjected to a water bath test.

FIG. 5 is a photograph of a flat wound polyester yarn subjected to a water bath test.

FIG. 6 is a photograph of polyester yarn having a quarter turn per inch being subjected to a water bath test.

FIG. 7 is a photograph of a prior art compacted one-quarter turn per inch polyester yarn being subjected to a water bath test.

FIG. 8 is a photograph of a double-opposed false twist cohered polyester quarter turn per inch yarn being subjected to a water bath test.

As can be noted in FIG. 1, those yarns which exhibit fewest end breaks per 100 yards of woven fabric are those yarns which exhibit the smallest spreadability.

Turning to FIG. 2, it may be further noted that the degree of compaction may be correlated to the spreadability; that is to say, those yarns having a higher degree of compaction also have a smaller spreadability.

Distinctions in spreadability existing between double-opposed false twist cohered yarns of this invention and the compacted yarns of the prior art may be seen from table I.

smaller spread between the extreme filaments of the yarn bundle than does the multifilament yarn of the prior art having random intermingling of the filaments. A graphic illustration of these differences may be seen in a comparison of FIGS. 3 and 4 wherein the double-opposed false twist yarn of FIGS. 3 exhibits less spread and less main bundle cohesion than the random intermingling prior art yarn represented by FIG. 4.

TABLE I

Yarn	Average Spreadability, mm.	σ	N	Coherency factor	End breaks per 100 yds. fabric	Yards fabric woven
70 denier/36 filament polyester double opposed false twisted yarn of Example I.....	2.3	.10	40	100	0	600
70 denier/36 filament polyester with $\frac{1}{4}$ turn per inch or twist.....	10.3	1.8	40	2.0	19	300
70 denier/34 filament prior art compacted polyester yarn.....	30.0	3.1	40	13.3	(¹)	-----
70 denier/34 filament nylon yarn double opposed false twisted according to Example II.....	4.3	.32	40	23	3.0	500
70 denier/34 filament nylon yarn double opposed false twisted according to Example III.....	2.0	.71	40	50	1.0	500
70 denier/34 filament prior art compacted nylon yarn.....	65	16	40	16	22.1	77

¹ Excessive breaks.

σ = Average deviation.

N = Number of measurements taken.

The phrase "coherency factor (needle pull)" as employed in table I defines coherency factor as measured by a needle-pull test. The needle-pull test is conducted by inserting a needle into a threadline and pulling the threadline until sufficient tension downstream of the needle builds up to trip a switch, thereby indicating an intersection of filaments. The apparatus employed in conducting the test comprises in the direction of yarn travel, a hysteresis brake tensioner, a tension setting device positioned prior to the testing needle, a pneumatic cylinder for disengaging the testing needle, a switch mechanism placed under tension by the traveling yarn and actuated by a preselected tension and a takeup wheel. The actual testing procedure is carried out as follows:

1. Adjust switch so that a force of 14 g. is required to close the circuit.
2. Adjust hysteresis brake tensioner to provide 3/70 g. per denier tension with one-quarter wrap of yarn.
3. String-up yarn.
4. Insert needle into yarn bundle by actuating pneumatic cylinder which holds needle.
5. Rotate takeup wheel until switch is actuated.
6. Read centimeters of yarn travel from the periphery of the takeup wheel.
7. Repeat procedure 10 times, disregarding the two highest readings and the two lowest readings and add the remaining six readings and divide the total into 600. As can be seen from the table, average spreadability for double-opposed false-twist yarns was about 2.3 while the average spreadability for prior art compacted yarns was about 10.3, all measurements having been made on polyester yarn. When nylon yarns were compared, double-opposed false-twist nylon yarns exhibited spreadability of about 3.1 whereas the prior art compacted yarns exhibited a spreadability of about 65.

The double-opposed false-twist yarns may be described as unique compact cohesive multifilament yarns wherein oppositely located peripheral filaments and groups of filaments overlay the main bundle of filaments in a crisscross manner to provide a netlike effect for the main bundle of filaments and establish a cohesive unity for the multifilament yarn. When these yarns are floated on a water surface, the netlike effect of the multifilament yarn is partially destroyed by the surface tension of the water, releasing the main bundle of filaments, permitting the filaments to spread in the water layer. This effect contrasts qualitatively with the prior art multifilament yarn having random intermingling of the filaments since the product of the invention tends to remain as a unitary bundle and still maintain its cohesiveness when floated on the surface layer of water. When, however, a quantitative measurement is made of the widest width of total spread of the yarn according to the spreadability test as previously described, it is found that the double opposed false-twist yarns exhibit substantially

A better understanding of the invention may be had from the following specific examples. It should be understood, however, that the examples are given for purposes of illustration and should not be considered as limiting the spirit or scope of this invention.

EXAMPLE I

Polyethylene terephthalate is melt spun at a temperature of 300° C. through a spinneret containing 72 round holes. The melt is found to contain 0.25 percent titanium dioxide and has an intrinsic viscosity of 0.61. The spun filaments are separated into two bundles of 36 filaments each, which are wound up at a speed of 4,000 feet per minute.

The yarn is then drawn on a conventional drawtwister. Drawing conditions are set up to give a draw speed of 1,800 feet per minute and a draw ratio of 3.3 with a spindle speed of 5,400 r.p.m. A double-opposed false-twist compacting device is then installed about 5 inches below the draw roll for the purpose of imparting coherency to the threadline. Compressed air is supplied to the double-opposed false-twist compacting device at a pressure of 80 pounds per square inch.

Yarn drawn under the above conditions is found to give a drawn denier of 70. This yarn is then beamed and woven without adding any additional twist above the normal 0.25 turns per inch already imparted to the yarn during drawing. Of 600 yards of woven fabrics, no end breaks are found to occur during weaving.

Another lot of yarn was spun and drawn in exactly the manner described above with the exception that no double-opposed false-twist compacting device was employed. This yarn was beamed and woven with no additional twist being added above the 0.25 turns per inch already imparted to the yarn during drawing. Of 300 yards of woven fabric, 19 end breaks were recorded during weaving.

In order to compare the above two lots of yarn with yarn made by the prior art, a beam of 70/34 polyester compacted by a prior art process was woven in an identical manner as the aforementioned double-opposed false-twisted polyester yarn and the one-fourth turn per inch polyester. The prior art compacted polyester yarn proved to be unweavable.

EXAMPLE II

Polyhexamethylene adipamide is melt spun at a temperature of 290° C. through a spinneret containing 68 round holes. The melt is found to contain 0.30 percent titanium dioxide and have a relative viscosity of 40. The spun filaments are separated into two bundles of 34 filaments each and are wound up at a speed of 3,700 feet per minute.

The above yarn is then drawn on a conventional drawtwister with a double-opposed false-twist compacting device mounted about 5 inches below the draw roll for the purpose of impart-

ing coherency to the threadline. Drawing conditions are set up to give a draw speed of 3,390 feet per minute and a draw ratio of 3.17 with a spindle speed of 10,000 r.p.m. Compressed air is supplied to the double-opposed false-twist compacting device at a pressure of 30 pounds per square inch.

The yarn is drawn and compacted under the above conditions to give a drawn denier of 70. The yarn is then beamed and woven without adding any additional twist above the normal 0.25 turns per inch already imparted to the yarn during drawing. Of 500 yards of woven fabric, three end breaks per 100 yards are found to be recorded during weaving.

EXAMPLE III

Another lot of yarn is spun and drawn in exactly the manner described above with exception of air pressure supplied to the double-opposed false-twist compacting device, which was 60 pounds per square inch. This yarn is beamed and woven with no additional twist being added above the 0.25 turns per inch already imparted during drawing. Of 500 yards of woven fabric, one end break per 100 yards is recorded during weaving.

In order to compare the above two lots of yarn with yarn made by the prior art, a beam of 70/34 semidull nylon compacted by a prior art process was woven in an identical manner as the aforementioned two lots of double-opposed false-twist compacted yarn. Of 77 yards of woven fabric, 22.1 end breaks per 100 yards were recorded during weaving.

As previously mentioned the compacted yarns of the prior art have not been found to be amenable to weaving and knitting operations. The compacted yarns with which this invention are concerned are compacted yarns prepared by continuously feeding a multifilament yarn bundle which is substantially free of bundle twist under a positive tension through a fluid zone having at least two fluid streams. One of the fluid streams directs continuously the peripheral filaments on one side of the yarn bundle to be twisted over the bundle and a second fluid stream substantially reverses continuously the twist of the peripheral filaments. After the twist and untwist, the bundle is withdrawn from the fluid zone under tension means such as direction changing means, snubbing means, confining means, bar, pin or the like to permanently place the filaments in the bundle and thereby produce a cohesive multifilament yarn. This is a surprising result to twist and untwist a

bundle of continuous filaments to produce a compact cohered multifilament yarn. Without wishing to be bound to any theory, it is believed that each twister (jet) twists some peripheral filaments over the yarn bundle, causing these filaments to overlay the yarn bundle from both directions forming a crisscross restraining network. Furthermore, with the tendency of the filaments to remain in the twisted stage, the untwisting step permits several filaments to remain in the twisted stage while the remaining filaments are thrust back providing a disarray of filaments overlaying the bundle to provide a cohesive effect in the bundle.

Having thus disclosed the invention, what is claimed is:

1. A continuous filament yarn containing fabric selected from the group consisting of knitted fabrics and woven fabrics containing at least some continuous filament yarn, said yarn being a cohered multifilament yarn having a spreadability factor not greater than about 11 and having substantially zero-twist.
2. The product of claim 1 wherein said continuous filament yarn is a polyester continuous filament yarn and wherein said spreadability factor is not greater than about 9.
3. The product of claim 1 wherein said continuous filament yarn is nylon continuous filament yarn and wherein said spreadability factor is not greater than about 11.
4. The product of claim 1 wherein said continuous filament yarn has a coherency factor of from 20 to 150.
5. A process for the preparation of continuous filament yarn fabric selected from the group consisting of knitted fabrics and woven fabrics, said yarn being prepared by cohering a substantially zero-twist yarn bundle by continuously feeding the yarn bundle under a positive tension through a fluid zone having at least two fluid streams, one of said fluid streams causing the peripheral filaments on one side of said yarn bundle to be twisted over the bundle and the second of said fluid streams substantially reversing continuously the twist of the previously twisted peripheral filaments so as to produce a cohered yarn having a spreadability of about 5.
6. The process of claim 5 wherein said cohering is conducted so as to produce a coherency factor of from about 40 to about 100.
7. The process of claim 5 wherein said substantially zero-twist yarn bundle is a nylon yarn bundle.
8. The process of claim 5 wherein said substantially zero-twist yarn bundle is a polyester yarn bundle.