March 20, 1962 H. M. STRUB, JR., ETAL 3,025,661

COILED TEXTILE STRAND AND METHOD OF PRODUCING SAME

Filed Aug. 18, 1958

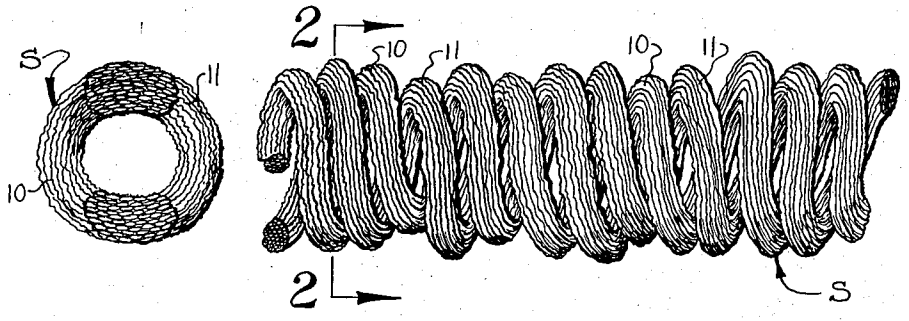


Fig-1

Fig-2

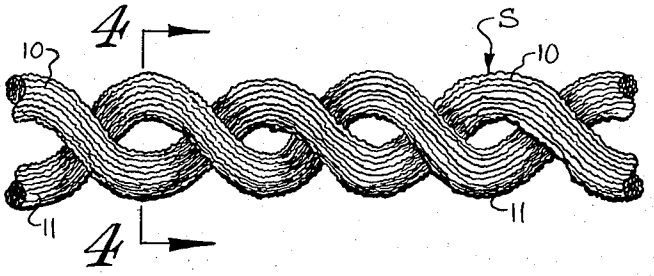


Fig-3

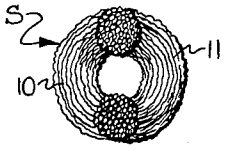


Fig-4

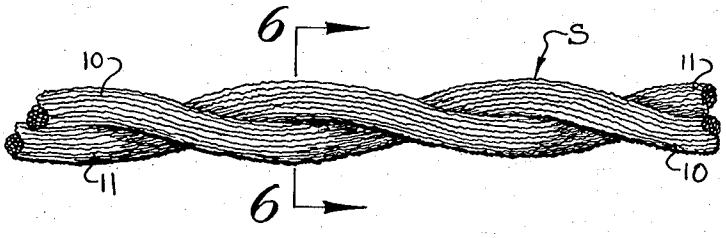


Fig-5

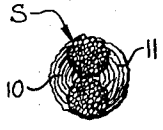


Fig-6

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COILED TEXTILE STRAND AND METHOD OF PRODUCING SAME

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5 Claims. (Cl. 57—157)

This invention relates to a novel method of producing a stretchable yarn and a novel yarn resulting therefrom wherein the yarn is the bulky type stretchable yarn. More particularly, this stretchable yarn is of the coiled type wherein the yarn is formed from a plurality of ends each arranged in a helically coiled manner and plied with each other during the coiling thereof to form a composite helically coiled yarn.

As far as applicants have been able to determine it is completely novel to produce a composite helically coiled yarn formed from a plurality of yarn ends wherein the individual ends are simultaneously coiled while in plied relation. However, it is old in the art to form individual ends of yarn in a helical coil to thus form a stretchable yarn. One method, such as disclosed by Patent No. 2,392,842 teaches forming a helical coiled individual end of yarn by placing the yarn under a predetermined tension while holding one end thereof and then twisting the yarn from the other end thereof and thereafter heat-setting the thus coiled yarn to maintain the desired coiled relation and stretchable characteristics. Another method as disclosed in Patent No. 2,387,320 shows wrapping a yarn around a core which may be a readily dissolvable yarn to be disposed of, if desired, after the helically coiled yarn has been heat-set in coiled relation.

The instant invention primarily concerned with a novel method of forming a multi-end coiled stretchable yarn wherein the method lends itself for utilizing conventional textile machinery. In contrast thereto, the formation of the coiled prior art products mentioned in the aforesaid patents necessitate special textile machinery.

More particularly, the instant invention teaches plying individual ends of yarn to form a composite coiled yarn wherein the ends spiral about each other with the ends serving as cores for each other so that when relaxed each end of the composite yarn will form a helical coil.

Some of the objects of the invention having been stated, other objects will appear as the description proceeds when taken in connection with the accompanying drawings, in which—

FIGURE 1 is a greatly enlarged elevation of the coiled textile strand in completely relaxed condition;

FIGURE 2 is a vertical sectional view through the strand, taken along the line 2—2 in FIGURE 1;

FIGURE 3 is a view similar to FIGURE 1 except showing the coiled textile strand in partially extended condition;

FIGURE 4 is a vertical sectional view through the strand, taken along the line 4—4 in FIGURE 3;

FIGURE 5 is a view similar to FIGURES 1 and 3 except showing the coiled textile strand in completely extended condition;

FIGURE 6 is a vertical sectional view through the strand, taken along the line 6—6 in FIGURE 5.

Referring to the drawings, the coiled textile strand is indicated broadly at S and, in this case, includes individual coiled spring-like yarn ends 10 and 11. In the relaxed strand S (FIGURE 1) each yarn end forms a series of closely spaced helical coils, the diameters of which are at substantially a right angle to the longitudinal axis of the strand. Each yarn end is formed of a heat-settable type yarn which has been individually twisted prior to plying the two ends together, as will be more fully explained hereinafter. While the yarn ends 10 and 11 are shown as being formed of multifilament yarn, it is to be understood that they may be formed of monofilament yarn of any desired type which is capable of being twisted and heat-set.

The coiled stretch textile strand S has been produced in various sizes or diameters and the finished size depends upon the denier of the individual ends and the number of filaments in each end. The yarn ends 10 and 11 may range in size from 15 to 560 denier and the number of filaments in each yarn end may range from a single filament to 68 filaments, or more. Although the size or diameter of the finished coiled textile strand S may be affected by the size or denier of the individual ends comprising the strand S, the process for producing different size coiled strands is substantially the same.

Generally, the process involved to produce a coiled spring-like textile strand includes the steps of individually twisting each yarn end separately and in the same direction, plying or doubling the individual ends together and applying twist in a direction opposite the first twisting direction, setting the twist in the yarn by heat, twisting, heat-setting and untwisting the strand and finally relaxing the strand S by overfeeding or steaming in a muff.

Various size yarns have been treated in accordance with this process to produce bulky and stretchable coiled textile strands and the following examples are illustrative of the procedures used and are not intended to limit the invention thereto:

Example I

One end of 560 denier 32 filament nylon yarn is twisted 10 turns per inch in an S direction on conventional spinning equipment. A second end of 560 denier 32 filamet nylon yarn is twisted 10 turns per inch in an S direction separately from the first end. These two ends are then plied together or doubled while applying five turns per inch in a Z direction to intertwine the two ends.

After the two ends of 560 denier yarn have been combined, this composite yarn is then steamed in a "H-W" conditioner made by The Industrial Dryer Corp. of Stanford, Conn. for 90 minutes at a dry bulb temperature of 170 degrees F. and a wet bulb temperature of 160 degrees F. to steam-set the yarn. The composite yarn is then false twisted on conventional false twisting equipment where the yarn is first twisted in an S direction while it is passed through a radiant-type heater and then untwisted in a Z direction with the false spindle rotating at a speed sufficient to impart 30 turns per inch of false twist to the yarn. The radiant heater is preferably maintained between 650 and 690 degrees F. in order to set the first twist applied in the yarn during this false twisting operation.

Since the yarn has been processed under tension throughout the above-noted steps, at this point its appearance is very similar to the yarn shown in FIGURE 5 and in order for the yarn to assume the spring-like coiled appearance illustrated in FIGURE 1, it must be relaxed. In this case the yarn is relaxed by winding the same into muffs and placing the muffs in a steam conditioning cabinet to relax the same and so that they may shrink and coil. This conditioning is done in an "H-W" conditioning box at a temperature of 185 to 190 degrees F. for a period of two to three minutes. The yarn may also be relaxed by overfeeding the same from the take-up bobbin of the false twisting machine to a pirn or the like. Overfeeding the yarn causes it to be taken off of the take-up bobbin faster than it is wound onto the pirn so that it is wound on the pirn in relaxed condition and will then coil into the shape illustrated in FIGURE 1.

Example II

Four separate ends of 15 denier monofilament nylon yarn are individually twisted 16 turns per inch in an S direction on conventional spinning equipment. These four ends are then plied together or doubled while applying two turns per inch in a Z direction to intertwine the four ends.

After the four ends of 15 denier yarn have been combined, this composite yarn is then twisted on conventional spinning equipment while applying 17 turns per inch in a Z direction. The composite twisted yarn is then steamed in a conditioner of the type referred to in Example I for 90 minutes at a dry bulb temperature of 170 degrees F. and a wet bulb temperature of 160 degrees F. to steam-set the yarn.

This composite yarn is then false twisted on conventional false twisting equipment where the yarn is first twisted in an S direction while it is passed through a radiant-type heater and then untwisted in a Z direction with the false spindle rotating at a speed sufficient to impart 60 turns per inch of false twist to the yarn. The radiant heater is preferably maintained at 500 degrees F. in order to set the first twist applied during this false twisting operation. The yarn is then relaxed by winding the same into muffs and steaming the same in a steam conditioning cabinet so that the yarn may relax and coil.

Example III

Two ends of 15 denier monofilament nylon yarn are plied together with two turns per inch in an S direction to form a first plied end. Two ends of 15 denier monofilament nylon yarn are plied together with two turns per inch in an S direction to form a second plied end. The first and second plied ends are then separately twisted 16 turns per inch in an S direction on conventional spinning equipment. These two ends are then plied together or doubled with two turns per inch in a Z direction to intertwine the two ends.

This composite yarn is then twisted 17 turns per inch in a Z direction on conventional spinning equipment and then steamed in a steam conditioner of the same type as referred to in Example I for 90 minutes at a dry bulb temperature of 170 degrees F. and a wet bulb temperature of 160 degrees F. to steam-set the yarn. The twisted, steam-set composite yarn is then false twisted on conventional false twisting equipment where the yarn is first twisted in an S direction while it is passed through a radiant-type heater and then untwisted in a Z direction with the false spindle rotating at a speed sufficient to impart 60 turns per inch of false twist to the yarn. The radiant heater is maintained at 500 degrees F. in order to set the first twist applied in the yarn during this false twisting operation. The yarn is then wound into muffs and placed in a steam conditioning cabinet to relax the same so that the yarn may coil.

The resulting yarn processed in accordance with Examples II and III is substantially the same, that is, both yarns have the same characteristics of bulkiness and stretchability and it will be noted that in each of these examples the process starts with four ends of 15 denier monofilament nylon yarn. In Example II, the individual ends are separately twisted before plying and in Example III, two ends are plied together before the twisting operation begins. The Examples II and III illustrate that slight variations in the twisting procedure may be made and the resulting yarns will still have substantially the same characteristics.

Of course, the number of turns in the twisting steps may also be varied without departing from the invention. The primary steps of the process include (1) individually applying twist to a plurality of yarn ends, (2) plying the plurality of ends together and applying twist to form a composite twisted strand, (3) twisting, heat-setting and untwisting the composite strand, and (4) relaxing the twisted strand so that it may form into a spring-like coil.

For economic reasons the third step has been carried out in a continuous false twisting process but it should be understood that this third step could be carried out on conventional spinning equipment by heat-setting the yarn between the twisting and untwisting steps.

Other sizes or deniers of yarn may be processed in accordance with the present invention to suit different end use requirements of the bulky stretch yarn and some of the combinations which may be used are listed in the chart below.

Denier of individual yarn ends	30	100	140	200
Number of filaments in each end	10	34	68	68
Number of turns of twist in each end	10–20	10–18	10–18	8–18
Direction of twist	S	S	S	S
Number of turns per inch when plying two ends together	2	2	2	2
Direction of ply	Z	Z	Z	Z
Number of turns per inch applied to plied yarn	15–25	15–20	12–20	10–20
Direction of twist	Z	Z	Z	Z

Steam twisted yarn at 170/160 degrees F. for 90 minutes to set

Turns per inch of false twist applied	60–80	55–60	50–55	45–50
Direction of first twist during false twisting	S	S	S	S
Temperature of false twist heater, degrees	550–620	600–650	630–670	650–690

Relax the false twisted yarn by overfeeding or steaming in muff.

The direction of twist may be reversed in any one of the twisting steps indicated in the above chart if the direction of twist in the other steps is reversed also. In other words, if the initial twist in spinning each single end is applied in a Z direction instead of in an S direction the direction of twist during plying, spinning and false twisting must also be reversed. It should be noted that in the formation of the coiled textile strand from two ends of 560 denier yarn, described in Example I, the second spinning step or the first spinning step after the yarns are plied together has been omitted because a sufficient number of turns is applied during the doubling or plying operation. Of course, the plying and second spinning steps could be combined when processing the other deniers by modifying conventional doubling machines to increase the number of turns placed in yarns as they are plied together.

In the drawing, the filaments in each yarn end appear to be parallel to each other and also parallel to the axis of the yarn end because the size of the yarn has been so greatly enlarged that the slight amount of twist present in each yarn end is not evident. Any twist present in the individual yarn ends will be the result of the difference in the amount of twist applied to the individual ends in one direction and the amount of twist applied to the plied yarn in the opposite direction. In most cases, the twist in each yarn end will be very small, on the order of two or three turns per inch, and since the actual length of yarn represented in FIGURE 5 is less than one-quarter of an inch the slight twist in each end would not be apparent.

In each of the examples given, the plied yarn has been described as being heat-set by steam to set the twist prior to false twisting and this is done to reduce the liveliness of the yarn and facilitate handling during further processing. Since this heat-setting is only performed to make it more convenient to handle during further processing, this heat-setting step may be omitted without departing from the invention.

It will be apparent that the spring-like coiled textile strand of this invention may be utilized in a wide range of end uses since the uniform coils or spring-like spirals of each end of yarn in the strand are straightened with elongation or stretching of the strand and the spirals return to their original position when relaxed. This coiled yarn is also very bulky as is apparent in the drawings which show that the diameter of the relaxed strand S is much greater than the combined diameters of the indi-

vidual yarn ends **10** and **11**. The present yarn is more bulky and has a greater amount of stretchability than has heretofore been obtained by twisting and setting a thermoplastic yarn. The coiled textile strand of this invention may be utilized to knit or weave a fabric and may be used in many other applications where elastic or rubber yarn is now used in the textile industry, such as in the tops of men's and ladies' hosiery.

In the following claims the term "false twist" defines the well known process of treating yarns in a continuous manner by passing the same through a rotating false twisting spindle to first twist the yarn in one direction and then in the opposite direction while heating the running yarn to set the first twist.

In the drawings and specification there have been set forth preferred embodiments of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being defined in the claims.

We claim:

1. A method of producing a highly stretchable composite textile strand which comprises individually twisting at least two ends of thermoplastic yarn in a first direction, plying the twisted individual ends together while applying twist in a second direction to the two ends to form a composite strand, heating to set the twist in the strand, twisting the composite strand in the first direction, heat-setting the strand, untwisting the composite strand in the second direction, and then relaxing the strand to permit the individual yarn ends to form into coils extending helically about the longitudinal axis of the strand.

2. A method of making a coiled textile strand which comprises twisting one end of multifilament thermoplastic yarn within the range of from 8 to 20 turns per inch in a first direction, separately twisting a second end of like yarn in the same manner, plying the individual ends together in a direction opposite the direction of twist initially applied to the separate ends to form a composite strand, twisting the composite strand within the range of from 10 to 25 turns per inch in the same direction as the ends were plied together, heating to set the twist in the strand, false twisting the composite strand to impart a false twist within the range of from 45 to 80 turns per inch with the initial twist being applied in the same direction as the twist applied to the yarns before they are plied together, and then relaxing the false twisted strand to permit each yarn end to form a helical coil.

3. A method of making a coiled textile strand which comprises twisting one end of 560 denier multifilament

thermoplastic yarn 10 turns per inch in an **S** direction, separately twisting a second end of like yarn in the same manner, plying the individual ends together in a **Z** direction while applying 5 turns per inch to form a composite strand, heating to set the twist in the strand, false twisting the composite strand to impart 30 turns of false twist per inch thereto with the initial twist being in an **S** direction, and then relaxing the false twisted strand to permit each yarn end to form a helical coil.

4. A method of making a coiled textile strand which comprises separately twisting four ends of 15 denier monofilament thermoplastic yarn 16 turns per inch in a first direction, plying the individual ends together in a second direction to form a composite strand, twisting the composite strand 17 turns per inch in the second direction, heating to set the twist in the strand, false twisting the composite strand to impart a false twist of 60 turns per inch with the initial twist being applied in the first direction, and then relaxing the false twisted strand to permit each yarn end to form a helical coil.

5. A method of making a coiled textile strand which comprises plying two ends of 15 denier monofilament thermoplastic yarn together to form a first plied end, plying two other ends of 15 denier monofilament thermoplastic yarn together to form a second plied end, separately twisting the first and second plied ends 16 turns per inch in a first direction, plying the first and second ends together to form a composite strand, twisting the composite strand 17 turns per inch in a second direction, heating to set the twist in the strand, false twisting the composite strand 30 turns per inch with the initial twist being applied in the first direction, and then relaxing the false twisted strand to permit each yarn end to form a helical coil.

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CERTIFICATE OF CORRECTION

Patent No. 3,025,661 March 20, 1962

Henry M. Strub, Jr., et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the grant, lines 3 and 4, for "of New York, N. Y., a corporation of New York," read -- of Winston-Salem, North Carolina, a corporation of Delaware, --; in the heading to the printed specification, lines 6 and 7, for "New York, N. Y., a corporation of New York" read -- Winston-Salem, N. C a corporation of Delaware --.

Signed and sealed this 28th day of April 1964.

(SEAL)
Attest:

ERNEST W. SWIDER

Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents