July 12, 1960 C. S. LAWRENCE ET AL 2,944,383

COMPOSITE YARN AND METHOD OF PRODUCING SAME

Filed Oct. 1, 1958

Fig-1

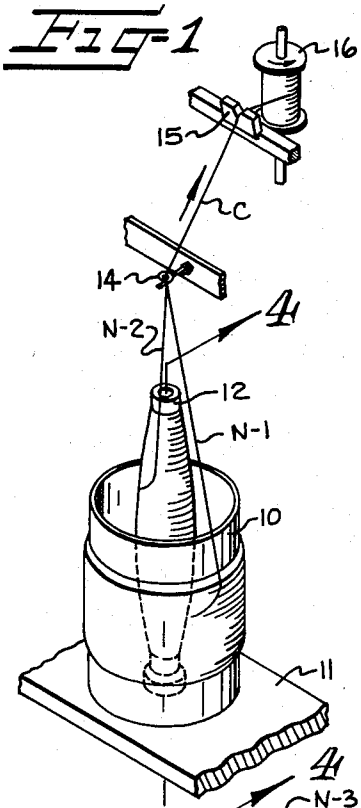


Fig-2

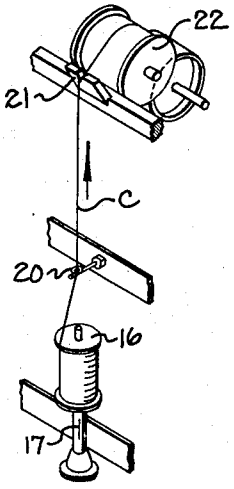
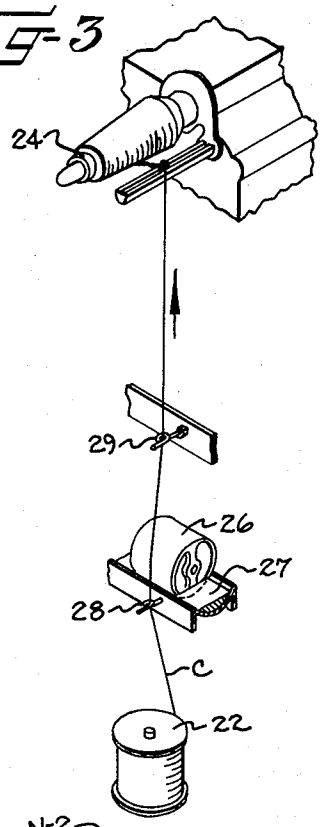


Fig-3



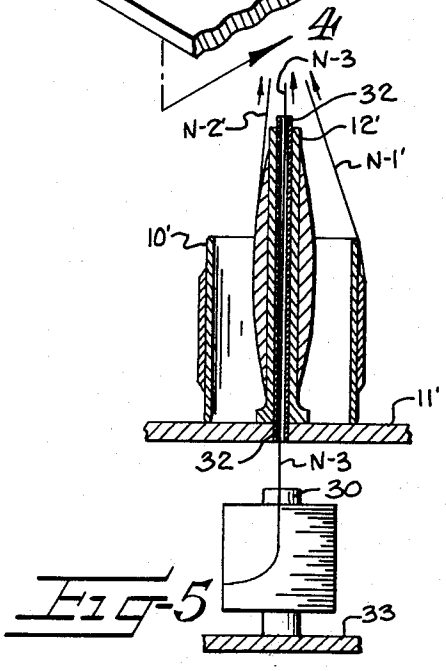


Fig-5

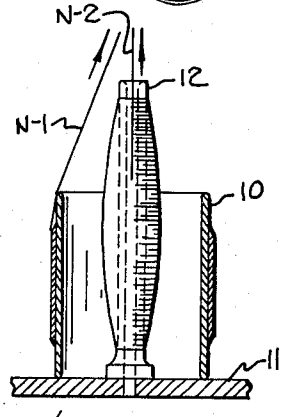


Fig-4

INVENTORS:
CHARLES S. LAWRENCE
and HENRY M. STRUB, JR.
BY Eaton, Bell, Hunt & Seltzer
ATTORNEYS

United States Patent Office 2,944,383 Patented July 12, 1960

2,944,383

COMPOSITE YARN AND METHOD OF PRODUCING SAME

Charles S. Lawrence and Henry M. Strub, Jr., Winston-Salem, N.C., assignors to The Duplan Corporation, New York, N.Y., a corporation of New York

Filed Oct. 1, 1958, Ser. No. 764,549

4 Claims. (Cl. 57—140)

This invention relates to a composite yarn comprised of a plurality of yarn ends and to a novel method of plying the individual yarn ends to form the composite yarn.

The "piling up" or "backing up" of individual ends of a composite yarn is an extremely perplexing problem. The yarn will pile up at yarn guides, yarn tension devices and the like unless the length of each individual end is the same in any given length of the composite yarn. In a plied composite yarn, if one end is wrapped about the other its length will be longer than the other end and when the composite yarn passes through yarn tension devices, and the like, the longer yarn end will be moved along the other yarn end and accumulate thereon. This accumulation will either cause the yarn to break or pass through the tension device or the like and remain on the yarn. Where the composite yarn is being fed to the needles of a knitting machine, the accumulation of yarn will form a defect in the fabric.

It is the primary object of this invention to provide an improved composite yarn and method of forming the same wherein the individual ends are plied or twisted together in a novel manner so that equal lengths of each yarn end are present in any given length of the composite yarn. This plying together whereby an equal length of each yarn is utilized is in contrast to the usual plying practice wherein the length of each yarn end is not positively controlled and one yarn may be wrapped about the other.

It is another object of this invention to provide a composite yarn formed of a plurality of individual ends plied together so that equal lengths of each yarn end are present in any given length of the composite yarn whereby the yarn may be successfully used in various textile processes, such as knitting, to prevent "piling up" of one end of the yarn as it passes through various tension devices and the yarn feeding fingers of a knitting machine.

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 an isometric view schematically showing the preferred manner of plying two strands to form a composite yarn strand;

Figure 2 is another schematic isometric view showing an apparatus for imparting additional turns of twist to the composite yarn strand;

Figure 3 is another schematic isometric view showing the twisted composite strand being rewound onto cones suitable for knitting while applying a suitable lubricant to the strand;

Figure 4 is a vertical sectional view taken substantially along the line 4—4 in Figure 1;

Figure 5 is a view similar to Figure 4 except showing the preferred manner of plying three strands of yarn to form a composite yarn strand.

The present invention is primarily concerned with a composite yarn strand and method of forming the same

which is formed of a plurality of strands of monofilament nylon yarn and wherein each strand has different shrinkage characteristics. This type of composite yarn is in particular demand for use in knitting fine gauge fabric such as ladies' hosiery. Multiple strand fine gauge ladies' hosiery has a greater resistance to runs than hosiery knit of a single strand because when the individual stitch loops are knitted of several strands, should one of the strands break, the remaining strands will hold the stitch loop and prevent runs and the like thus insuring longer life for the hosiery. In order to insure that all of the strands in the stitch loops are not broken at the same time, it is desirable that the individual strands be separated slightly in each stitch loop.

The use of multiple strands having different shrinkage characteristics to form a knit fabric is known in the art, for example see U.S. Patent No. 2,636,369 to Samuel Tait, Jr., and No. 2,715,762 to William Schumann. Both of these patents teach feeding each strand of yarn to the yarn feeding means of a knitting machine separately without previously plying or otherwise combining the same. Since each strand is fed separately, it is almost impossible to maintain equal tension on each strand and therefore equal lengths of each strand are not present in each stitch loop so that when the fabric is finished to shrink the yarn, the strands in each stitch loop may not separate properly.

In the present invention, the composite strand is formed of monofilament nylon strands which have different shrinking characteristics and which are plied together, prior to knitting, in a novel manner to insure that the length of each strand in a given length of the composite strand will be equal. The composite strand may then be fed from a single yarn source, such as a yarn supply cone and the tension regulated on the strand. Extreme care must be taken when plying the two yarns in order to insure that the same length of yarn of each type is present in any given length of the composite yarn because if the yarns are not of the same length, when the composite yarn is fed to the knitting machine, any slackness or greater length in one yarn will result in the yarn piling up or backing up to form a knot or slub in the yarn at yarn tension devices or the yarn feeding finger. When this slub builds up to a considerable size, it will either break the yarn or pass through the device causing the slub to form and pass into the knitted fabric where it will be noted and is objectionable.

The following examples are illustrative of different yarn sizes and treatments which have been used successfully to form a composite strand suitable for knitting multiple strand fine gauge ladies' hosiery but it is not intended to limit the invention thereto.

Example I

One end of 10 denier monofilament nylon, as received from the manufacturer, is wound onto a size tube formed of aluminum and indicated at **10** in Figure 1. The yarn on the size tube **10** is then steamed in a steam cabinet at a dry bulb temperature of 180 degrees F. and a wet bulb temperature of 170 degrees F. for 90 minutes to shrink the yarn. During this operation the yarn is shrunk approximately eight percent or about 75 percent of the total amount it may be shrunk. This partially shrunk 10 denier nylon on the size tube, indicated at N–1 in Figure 1, is then placed on a creel board **11** of a winding frame. A pirn **12** of seven denier monofilament unshrunk nylon N–2, as received from the manufacturer, is placed inside of the size tube **10** with the bottom of the pirn **12** supported on the creel board **11** as indicated in Figure 1. The end of the seven denier unshrunk nylon N–2 and the end of 10 denier partially preshrunk nylon indicated at N–1 are both drawn upwardly from the respective pirn **12** and size tube

10 through a yarn guide pigtail 14, over a vertically movable yarn traversing guide 15 and wound onto a bobbin 16.

Because of the difference in diameters of the pirn 12 and size tube 10, the preshrunk nylon N–1 is wrapped around the unshrunk nylon N–2 approximately one turn in 18 inches of length as they pass through the yarn guide 14 to form the composite yarn strand indicated at C. It is to be noted in Figure 1 that no tension devices are used on either strand as they are plied and wound onto the bobbin 16 and the tension therefore remains in a very low range of from one to one and one-half grams.

The bobbin 16 is then placed on the driven spindle 17 of an uptwister, guided upwardly through a pigtail yarn guide 20, over a horizontally movable traversing yarn guide 21 and wound onto a take-up bobbin 22. The take-up bobbin 22 and the supply bobbin 16 are driven in a conventional manner and at sufficient speeds to impart two turns of twist per inch in the composite yarn strand C.

In order to facilitate feeding the yarn on a knitting machine, the composite yarn C is then wound from the take-up bobbin 22 onto a suitable cone 24 on a conventional winding machine. During this winding operation, a thin coating of oil of a relatively light weight, say 125 viscosity rating, is applied to the yarn strand by a roller 26 which is rotated in a trough of oil indicated at 27. The yarn strand C is guided to contact the roller 26 by pigtail yarn guides 28 and 29. During this winding operation, no additional turns of twist are placed in the yarn and the oil is applied thereto only to facilitate knitting so that the yarn will be lubricated to pass through the yarn feeding finger and the hooks of the knitting needles more easily.

The composite yarn C can then be knitted on a flat bed knitting machine or circular independent needle knitting machine in a single feed manner and since the individual ends N–1 and N–2 of the composite yarn C have been plied together so that they each contain the same length in any given length of the composite yarn, the yarn will feed through any tension device and to the needles without piling up. After the fabric or hose is knit, it is subjected to the usual finishing process, such as "boarding" or the like to shrink the nylon and set the fabric. During this boarding operation, the unshrunk strand will shrink or shorten in length to a greater degree than the partially shrunk strand thus causing the strands to separate in each stitch loop. Since one yarn strand is wrapped around the other only one turn in approximately 2 inches, the yarns are not twisted together enough to prevent their separation in the stitch loops as would be the case when the yarns are highly twisted together.

The operations shown in Figures 2 and 3 are conventional and the success of the composite multiple strand yarn lies in the combination of these conventional operations with the novel operation shown in Figure 1. With the individual yarn strands plied in accordance with the present disclosure, the ends will not separate while they are being fed to the needles of a knitting machine and equal lengths of each end are fed to the fabric and form stitch loops which contain equal lengths of each strand.

In some instances, it is desirable to combine more than two yarn ends in a composite yarn for forming sheer ladies' hosiery and the like. The following example illustrates a specific manner in which three yarn ends may be plied in accordance with the present invention.

Example II

In order to keep the total size or diameter of the composite yarn small, it is desirable that each end of the composite strand be of a relatively small diameter or denier and in this case three ends of seven denier monofilament nylon are used. It is preferred that one end of the composite yarn, indicated at N–1′ in Figure 5, be shrunk a greater amount or percentage than the other two ends indicated at N–2′ and N–3. The end N–2′ is preferably raw or unshrunk and the end N–3 (Figure 5) is preferably shrunk a smaller percentage than the end N–1′.

In the present instance, the end N–1′ is wound onto an aluminum size tube indicated at 10′ and placed in a steam cabinet for 90 minutes at a dry bulb temperature of 180 degrees F. and a wet bulb temperature of 170 degrees F. to shrink the same approximately 75 percent of its shrinking potential, or about eight percent of its original or unshrunk length. The end N–2′ is raw or unshrunk as received from the manufacturer and is unwound from the pirn 12′ as it is purchased from the manufacturer. The end N–3 is wound onto a suitable paper tube indicated at 30 in Figure 5 and placed in a steam cabinet for 45 minutes at a dry bulb temperature of 160 degrees F. and a wet bulb temperature of 150 degrees F. so that the yarn is shrunk approximately 50 percent of its shrinking potential or about five percent of its original or unshrunk length.

The three yarn ends N–1′, N–2′ and N–3 are next combined or plied on an aparatus similar to that shown in Figure 1. In this instance, the size tube 10′ and pirn 12′ are mounted on a creel board 11′ which is provided with an opening for the reception of a guide tube 32, the lower end of which is fixed in the board 11′. It will be noted in Figure 5 that the pirn 12′ surrounds the tube 32 and the yarn end N–3 passes upwardly through the tube 32 and the pirn 12′ from the paper tube 30. The paper tube 30 is supported on an auxiliary or lower creel board 33 spaced in parallel relationship below the creel board 11′. The three yarns from the size tube 10′, the pirn 12′ and the paper tube 30 are passed upwardly and through a yarn pigtail similar to that shown in Figure 1 and wound onto a bobbin similar to the bobbin indicated at 16 in Figure 1. As the yarn ends N–1′, N–2′ andl N–3 are pulled from their respective packages, the yarns N–1′ and N–2′ will be intertwined or plied with the yarn N–3 under very little tension so that in any given length of the composite strand formed there will be equal lengths of each individual yarn.

The composite yarn thus formed from the three ends of nylon monofilament is then subjected to additional twist of two turns per inch in the same manner as the double or two-ply yarn C, shown in Figure 2. The composite three-ply yarn is then oiled and coned in the same manner as the two-ply yarn C shown in Figure 3. When the three-ply yarn is knitted into a fabric and the fabric is subjected to the normal finishing operation where it is shrunk and set, the raw yarn end N–2′ will shrink approximately 10 percent, the yarn end N–3 will shrink aproximately five per cent, and the yarn end N–1′ will shrink only two per cent. This uneven shrinkage of the yarns during finishing will cause the three yarn ends to separate from each other in each knit stitch loop.

While the specific examples used recite the use of nylon yarn which has been shrunk to different degrees for forming the composite yarn, it is to be understood that other types of yarn might be used to form the composite yarn so long as each end of the yarn has different shrinking characteristics. For example, it might be possible to use one end of unshrunk nylon with one end of rayon which is normally non-shrinkable under heat and when the finished article is sized or shrunk, only the nylon yarn would shrink to separate from the rayon yarn. There may also be other types of synthetic yarn which do not shrink or have different shrinking characteristics and which might be combined to form a composite yarn in the maner cited in the above examples.

The above examples set forth basic means for combining or plying a plurality of yarn ends to form a composite strand in which each individual end of yarn is the same length as the other yarn ends of the composite yarn to facilitate the knitting of the yarn and prevent accumulations, loops, and piling up of the yarn as it is fed to the needles of a knitting machine. The reason each yarn end is the same length lies in the fact that equal tension is applied to each yarn end as it is freely unwound from their respective packages and the manner in which the

yarn packages are arranged relative to each other so that the yarns are wrapped about each other.

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 three-ply composite yarn comprising a first strand of yarn which has been preshrunk a given percentage, a second strand of yarn which has been preshrunk a greater percentage than said first strand, a third strand of yarn which is unshrunk, said three strands being plied together under equal tension whereby equal lengths of each strand are present in any given length of the composite yarn.

2. A three-ply composite yarn comprising a first strand of monofilament nylon yarn which has been preshrunk a given percentage, a second strand of monofilament nylon yarn which has been preshrunk a greater percentage than said first strand, a third strand of monofilament nylon yarn which is unshrunk, said three strands being plied together under equal tension whereby equal lengths of each strand are present in any given length of the composite yarn.

3. A three-ply composite yarn comprising a first strand of seven denier monofilament nylon yarn which has been preshrunk five percent, a second strand of seven denier monofilament nylon yarn which has been preshrunk eight percent and a third strand of seven denier monofilament nylon yarn which is unshrunk, said three strands being plied together under equal tension whereby equal lengths of each strand are present in any given length of the composite yarn.

4. A method of forming a three-ply composite yarn of shrinkable individual yarn strands which comprises the steps of winding a first yarn to form a first yarn package having a passageway therethrough, winding a second yarn to form a second yarn package having a hollow center of larger diameter than the outside diameter of the first yarn package, winding a third yarn to form a third yarn package, placing the second package to surround the first package, positioning the third package in alinement with the passageway in the first package, passing the yarn from the third package through the hollow center of the first package, gathering together the yarns from each package, and simultaneously withdrawing the yarns from the packages whereby the yarns will intertwine.

References Cited in the file of this patent

UNITED STATES PATENTS

1,995,533	Bochmann et al.	Mar. 26, 1935
2,174,878	Hardy	Oct. 3, 1939
2,199,429	Finlayson et al.	May 7, 1940
2,203,721	Dingley et al.	June 11, 1940
2,353,432	Arrington	July 11, 1944
2,811,012	Klein	Oct. 29, 1957

FOREIGN PATENTS

573,276	Germany	Apr. 2, 1932

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,944,383 July 12, 1960

Charles S. Lawrence 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, line 3, 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 5 and 6, 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