Oct. 3, 1967 R. F. SPICER ETAL 3,344,596

TEXTILE YARN AND PROCESS THEREFOR

Filed April 1, 1965

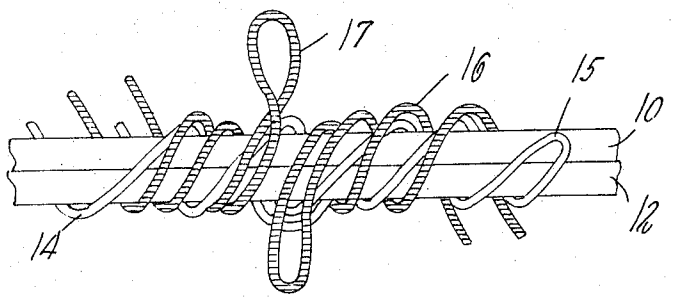

Fig. 1.

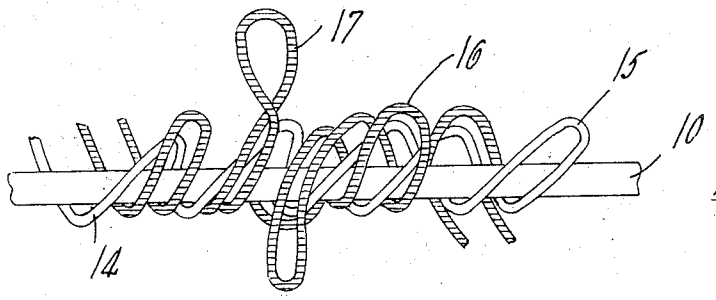

Fig. 2.

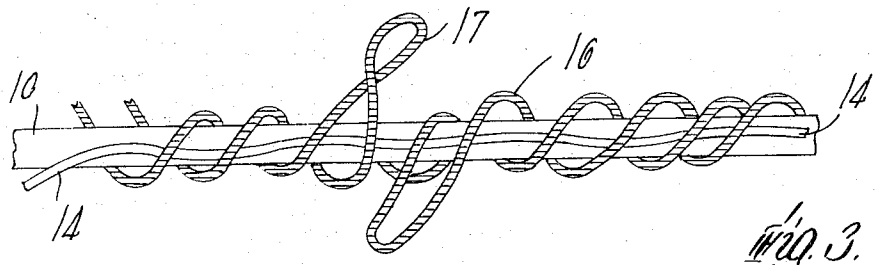

Fig. 3.

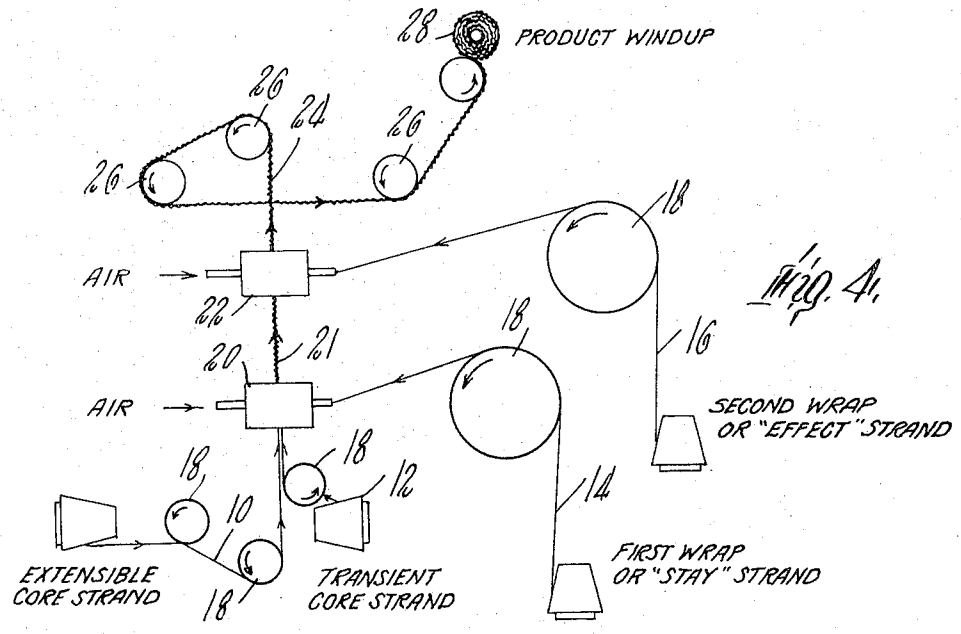

Fig. 4.

United States Patent Office

3,344,596

Patented Oct. 3, 1967

3,344,596

TEXTILE YARN AND PROCESS THEREFOR

Ronald F. Spicer and Preston F. Marshall, Walpole, Mass., assignors to The Kendall Company, Boston, Mass., a corporation of Massachusetts

Filed Apr. 1, 1965, Ser. No. 444,586
10 Claims. (Cl. 57—152)

ABSTRACT OF THE DISCLOSURE

An elastic core strand and an inelastic transient core strand are falsely-wrapped with a first wrapping strand and a second wrapping strand, both wrapping strands being disposed around the core strands in bifilar arrangement, giving no net true twist of wrapping strands around core strands. The amount of second wrapping strand overfeed exceeds the first wrapping strand overfeed. The composite yarn in this form is inelastic and may be converted into fabrics. Removal or rupture of the transient core strand renders the fabric elastic, but the elongation is limited to the elongation of the first wrapping strand, which acts as a stay strand.

This invention relates to the preparation and utilization of wrapped elastic yarns. More particularly, it relates to improvements in the art of making and utilizing wrapped elastic yarns including a transient stretch-limiting member and to fabrics manufactured therefrom.

In the utilization of elastic yarns for the production of stretch fabrics and elastic fabrics, the natural elasticity of such yarns leads to difficulties in the weaving or knitting processes, since the yarn tends to stretch under the processing tensions employed. Since the frictional and mechanical tensions which develop are often of an intermittent and variable nature, it is difficult to arrive at uniformly fabricated textiles when using elastic yarns.

It has therefore been proposed to combine with an elastic core a non-elastic second core, wrapping the multiple core while the elastic member is either unstretched or stretched to any predetermined extent within its elastic limit. The inelastic core member may be of a type that may be subsequently dissolved out, or it may be a member that will withstand the stresses of weaving but is frangible enough to rupture when extra stress is applied after the yarn has been converted into a fabric.

Such an inelastic core member is designated herein as a transient strand, in the sense that it is only a temporary restraint to facilitate a weaving or knitting operation, after which it is rendered ineffective. Potentially elastic yarns which are temporarily restrained by the presence of such a transient member are said to be transiently stabilized.

It has also been proposed to limit the extensibility during weaving of elastic yarns by wrapping an elastic core in the conventional manner and then overwrapping the composite yarn with a transient restraining yarn applied as a spiral outer wrap. Various other expedients have been resorted to in efforts to find a solution to the problem of stabilizing an elastic yarn against elongation during its conversion into a fabric, but none has been entirely satisfactory. When an elastic core in an extended state and an inelastic core are wrapped together by a conventional spiral-wrapping technique, a tight wrap, usually of several layers, must be used, and the machine settings must be adjusted with critical accuracy. Otherwise, the tendency is for the elastic member of the core to contract on leaving the wrapping process, resulting not in an inelastic yarn but in an elastic yarn of limited extensibility. When it is desired to manufacture such elastic yarns under different degrees of extension, the experimentation with machine settings and wrapping tensions is burdensome. The problem becomes even more complex when non-conventional wrapping is employed, of the type described in U.S. Patent 3,078,654 to P. F. Marshall and U.S. Patent 3,011,302 to K. J. Rupprecht.

In copending patent application Ser. No. 285,498, filed June 4, 1963, now U.S. Patent No. 3,158,985, to one of the present inventors, there is described the preparation of a transiently stabilized wrapped yarn by the use of an auxiliary core strand that is retractable: that is, an auxiliary core strand which can be caused to decrease in length by a selected chemical or thermal process. There is also described a process for producing a potentially elastic yarn which is not only transiently stabilized against extension during the process of manipulating it into a fabric, but which is of limited extensibility after the stabilizing member has been rendered ineffective. It is with improvements in this latter category of yarns that the present invention is concerned.

Basically, the sequential steps in the present invention may be summarized as follows:

(1) Passing an extensible core strand, either relaxed or extended, into a wrapping zone or device, together with a substantially inextensible transient core strand.

(2) Wrapping the two core strands with a wrapping strand disposed about the core strands in the form of doubled-back loops, according to the technique set forth in U.S. Patent 3,078,654 to P. F. Marshall.

(3) Wrapping the composite yarn thus formed with at least one more wrapping strand according to U.S. Patent 3,078,654, the second wrapping strand being superimposed upon and around the first wrapping strand.

(4) Manipulating the resultant transiently stabilized yarn into a component part of a textile fabric.

(5) Rendering the transient core strand ineffective, whereby the fabric becomes elastic.

The invention will be better understood with reference to the accompanying drawings, in which:

FIGURE 1 represents a composite wrapped yarn according to the process of this invention.

FIGURE 2 represents the yarn of FIGURE 1 after removal of the transient core strand.

FIGURE 3 represents the yarn of FIGURE 2 under extension.

FIGURE 4 is a schematic flow diagram of a process suitable for the production of the yarn of FIGURE 1.

Referring to FIGURE 4, an extensible core strand **10** and an inextensible transient core strand **12** are fed from conventional sources of supply through conventional tensioning devices **18** to a vortex tube **20**, conveniently a tube such as is described in U.S. Patent 3,082,591, to P. F. Marshall. The extensible core strand may be a natural or synthetic rubber yarn, or a yarn of the segmented polyurethane type known generically as spandex. The transient core strand may be of the frangible type. that is, a conventional textile yarn of such low tensile strength that although it serves to stabilize the composite yarn against breakage under the stresses of fabrication into a textile, the application of tensile stress in excess of the stress of fabrication will readily rupture the transient yarn and render it ineffective.

Also useful as transient core strands are those which can be weakened or dissolved out in finishing procedures after the yarn has been converted itno a fabric, as acetate stay strands may be dissolved out by acetone, wool strands may be dissolved out by the use of alkaline solutions, or alginate strands may be dissolved out in a scouring operation involving soap and soda ash. The principal criterion governing the choice of transient strand and method of rendering it ineffective is that the treatment should

not harm the other constituents of the yarn or of the final fabric.

In its passage into the vortex tubes **20** and **22**, the elastic fore strand **10** may be in a relaxed or unextended condition, or may be stretched by the tensioning wheels **18** and may be delivered to the vortex tubes in an extended state. In the former case, the final fabric will show no significant dimensional change when the transient strand is rendered ineffective, and the fabric will be of the "stretch" type, rather than of the elastic type. That is, it will be a low-modulus fabric, showing easy stretch under slight loading, with modest recovery power or comeback.

In the latter case, with the elastic strand wrapped while extended, there will be a tendency for the strand to retract when the wrapping process is completed. In order to overcome this, one of the wrapping strands, or both conjointly, should be wrapped around the two core strand so tightly that the elastic core strand is prevented from retracting. In this manner the elastic core strand is maintained in extension and may be manipulated into a textile fabric by conventional methods. After the transient strand is rendered ineffective in the fabric, especially if it is dissolved out, there will be a tendency for the fabric to contract, due to the decrease in size of the core element of the yarn and consequent looser contact between the wrapping strands and the core. It has been found that this can to a large extent be overcome by "jamming" the fabric, or weaving it so tightly that shrinkage is substantially inhibited. This is especially effective in cases where the yarn of this invention is employed in the weft of a fabric. An experienced fabric designer can add more warp ends to overcome the tendency to weft-wise contraction, and thus produce an extensible fabric in which the weft yarns are in extension, so that the fabric has a high modulus and high comeback or recovery power.

In the vortex tube **20**, the transient strand **12** and the elastic strand **10** are wrapped with a first wrapping strand **14**, which may be regarded as a "stay" strand. Unlike the transient core strand, this wrapped stay strand plays a permanent part in the character of the yarn and of the eventual fabric, inasmuch as it limits the extent to which the composite yarn can be extended after removal of the transient core strand.

The first wrapping strand **14** is applied to the two core strands, as mentioned above, by the process of U.S. Patent 3,078,654, so that the wrapping strand has no net true twist around the core strands, but is disposed around the core strands in the form of doubled-back loops, the loops being bifilar in configuration, and grasping the core strands rather tightly. The first wrap strand is always fed to the vortex tube at a faster rate than the two core strands are fed, the rate of overfeed being controllable from as low as 25% to as high as 500% or more, a preferred range being 30% to 100%. Since the first wrapping strand, or stay strand, is intended to limit the extension of the elastic yarns in the final product, at which point it becomes a stress-bearing member in the organized fabric, the degree of overfeed of this stay strand is predetermined and controlled to match the desired fabric behavior. For example, if it is desired to produce a fabric in which the stretch is limited to 100%, two yards of the first wrap or stay strand will be fed to the vortex tube **20** for each yard of the combined extensible and transient core strands. Any strand of adequate strength may serve as the first wrapping strand, a multifilament nylon strand being exemplary in its flexibility and tensile strength.

The three-component wrapped yarn **21** then passes into a second vortex tube **22**, where a second wrap strand, or effect strand, is applied to the combination, again according to the procedure set forth in U.S. Patent 3,078,654. Since the external appearance of the finished yarn is governed to a large extent by the nature of this second wrap strand, the particular strand chosen for this purpose is selected for its luster, color or dyeability, resistance to abrasion, etc. The degree of overfeed of this second wrapped strand may be as low as 50% where its chief function is to help to bind the three underlying components together, or it may increase to 1,000% or 1,500% or more where complete coverage is desired.

From the second vortex tube **22** the final wrapped yarn **24** is transmitted by conventional transfer wheels **26** to a windup device **28**.

The nature of the product, as distinguished from the process of this invention, is illustrated by FIGURES 1–3. In FIGURE 1, an elastic core strand **10** and a transient strand **12** are shown as dual core members, wrapped by a wrap stay strand **14**, in doubled-back bifilar loop configuration **15**, these three components being overlaid by a wrap effect strand **16** similarly looped around the composite yarn as at **17**. If the elastic core strand **10** has been wrapped while under substantial extension, so that it tends to retract, the wrapping strands may be arranged more tightly around the two core strands, but always without any true twisting action or true wrapping of an end of either wrap strand around either core strand.

The yarn of FIGURE 1 is stabilized against extension by the presence of the substantially inelastic transient strand **12**. In this condition, the yarn of FIGURE 1 may be converted into a fabric by conventional weaving, knitting, braiding, or other fabricating operations, without recourse to the special precautions that are customarily necessary when dealing with elastic yarns. The yarn of FIGURE 1 may be used throughout a fabric, or it may constitute only the warp, or the filling, or parts of both, depending on the particular functional and esthetic effect which the fabric designer wishes to achieve. Yarns of this transient stabilized nature are particularly useful in the production of warp-stretch fabrics, where the tensions encountered in the drawing of a warp through a loom are especially conducive to elongation of an elastic warp, with consequent puckering and distortion of the resultant fabric.

After the yarn has been formed into a fabric, the transient strand **12** is rendered ineffective by any suitable method, as set forth above. If the transient strand is an alginate yarn, for example, it may be dissolved out of the fabric by a soap-soda ash scouring operation, leaving the yarn in the condition shown in FIGURE 2. In FIGURE 2, the elastic core strand **10** is no longer inhibited from extending, but may respond to any stresses applied to the fabric. The degree of response, however, is limited by the amount of overwrap of the wrap stay strand **14**. In FIGURE 3, the yarn is shown in extension, with the wrap stay strand **14** now assuming a configuration that is substantially parallel with the elastic core strand **10**.

The following example will illustrate one method of practicing the present invention:

Example 1

A 140 denier spandex strand was fed to a first vortex tube at a rate of 303 feet per minute, at an elongation of 4%, together with a 150 denier calcium alginate strand fed at approximately the same rate. In the first vortex tube, the two core strands were wrapped with a 140 denier-68 filament nylon stray strand, fed to the first vortex tube at a rate of approximately 455 feet per minute, an overfeed of 50%. The three-component yarn then passed to a second vortex tube, wherein a second or effect wrap strand was applied, said effect strand being a 75 denier-30 filament viscose yarn fed to the second vortex tube at a rate of 2530 feet per minute, or 740% overfeed.

The resulting transiently stabilized yarn was woven into the filling of a fabric at a rate of 48 picks per inch, across a cotton warp of 2-ply 20's yarns with 38 ends per inch, to form an inelastic fabric. After scouring the fabric with a hot soap-soda ash solution, however, the fabric was found to elongate approximately 50% in the filling direction.

The fabric did not display any appreciable filling shrinkage as a result of the scouring operation.

Having thus described our invention, we claim:

1. A transiently stabilized yarn capable of eventual limited elongation comprising:
a first extensible core strand and
a second, substantially inextensible, transient core strand,
said core strands being disposed in substantially parallel arrangement, together with
a first wrapping strand disposed about both core strands in the form of doubled-back loops in bifilar arrangement,
and a second wrapping strand disposed about the resulting three-component yarn in the form of doubled-back loops in bifilar arrangement,
both wrapping strands possessing no net true twist around said core strands, said first wrapping strand having a lower degree of overfeed than said second wrapping strand.

2. The product of claim 1 in which the extensible core strand is in a substantially relaxed state.

3. The product of claim 1 in which the extensible core strand is in an extended state.

4. The product of claim 1 in which between 130 yards and 200 yards of first wrapping strand are disposed around each 100 yards of extensible core strand and inextensible transient core strand.

5. The product according to claim 4 in which between 150 yards and 1500 yards of second wrapping strand are disposed around each 100 yards of extensible core strand and inextensible transient core strand.

6. The process of making a transiently stabilized yarn capable of eventual limited elongation which comprises:
combining in essentially parallel arrangement an extensible core strand and a substantially inextensible transient core strand,
wrapping both core strands with a first wrapping strand associated with said core strands in the form of doubled-back loops disposed in bifilar ararngement around said core strands,
said first wrapping strand possessing no net true twist around said core strands;
and wrapping the composite three-component yarn with a second wrapping strand,
said second wrapping strand also being associated with said composite yarn in the form of doubled-back loops disposed in bifilar arrangement about said composite yarn and possessing no net true twist around said composite yarn,

said first wrapping strand having a lower degree of overfeed than said second wrapping strand.

7. The process according to claim 6 in which the extensible core strand is in a substantially relaxed condition during both wrapping operations.

8. The process according to claim 6 in which the extensible core strand is in an extended state during both wrapping operations.

9. The process according to claim 6 in which between 130 yards and 200 yards of first wrapping strand are applied around each 100 yards of extensible core strand and inextensible transient core strand.

10. A method of making an extensible textile fabric which comprises:
combining in essentially parallel arrangement an extensible core strand and a substantially inextensible transient core strand,
wrapping both core strands with a first wrapping strand associated with said core strands in the form of doubled-back loops disposed in bifilar arrangement around the core strands,
said first wrapping strand possessing no net true twist around said core strands;
wrapping the composite three-component yarn with a second wrapping strand,
said second wrapping strand also being associated with said composite yarn in the form of doubled-back loops disposed in bifilar arrangement about said composite yarn and possessing no net true twist around said composite yarn,
said first wrapping strand having a lower degree of overfeed than said second wrapping strand;
manipulating the resulting doubly-wrapped yarn to cause said doubly-wrapped yarn to become a constituent part of a textile fabric,
and thereafter rendering said inextensible transient core strand ineffective.

References Cited

UNITED STATES PATENTS

3,041,812	7/1962	Marshall	57—6
3,078,653	2/1963	Marshall	57—152
3,082,591	3/1963	Marshall	57—6
3,158,985	12/1964	Spicer	57—152

FRANK J. COHEN, *Primary Examiner.*

JOHN PETRAKES, *Assistant Examiner.*