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METHOD OF PREPARING YARN AND STRETCHABLE ARTICLES

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This invention relates to the production of yarn for the making of textile articles, to the preparation of textile articles therefrom, and the article produced thereby.

When synthetic fibers of the polyamide and polyester types, and in general the polymer synthetics which are formed by extruding a liquid through a nozzle, hardening and then stretching the filament, are subjected to setting operations at correlated temperature and time conditions, they thereby attain the capacity of returning toward the shape existent during the setting operation, in event of later mechanical twisting or untwisting, for example. Such yarns can be referred to as comprised of stretched microcrystalline polymers. When it is desired to increase the stretchability of a fabric made from multifil yarn, it has been proposed to set them in twisted form, so that the fabric is thus composed of individual knitted courses, wefts or warps, which have curls or twists in the filaments. In knitted fabrics there is a permissive stretchability in the loops formed in the knitting, and if a monofil or multifil yarn is employed which has a curled or helical form, a further stretching is permitted by the movement of the yarn from helical to straight form under the force applied.

However, such helical yarns are more costly to make than straight filament yarns, and there are difficulties in preparing fabrics from yarns which have been twisted to confer a helical form, due to so-called "liveliness" or "wildness." Snarls may occur during the knitting and defective articles result. Machine attachments and devices are known, in which such lively yarns may be handled by maintaining them in a relatively uniform stretched condition; but even in such cases the machine adjustments are very critical, operation is difficult, and the output per machine is reduced.

It has also been proposed to compensate for the active "liveliness" by plying the wild yarn with a transitory yarn, e.g. silk, which restrains the wild yarn during knitting, with a later removal of the transitory yarn from the knitted fabric by dissolution thereof in a caustic alkali solution. Another proposal has been to ply the wild yarn with another and plain or untwisted yarn which restrains the contraction or snarling of the wild yarn during the knitting; during knitting the plied yarns are formed into the usual loops; and during later treatment of the fabric, the wild yarn causes a partial conformance of the plain yarn, so that a contraction of the fabric occurs, with a greater percentage of stretch available in the contracted fabric than if plain yarn alone had been used.

It has been found that stretchable fabrics can be made from piled yarns in which the components individually have active liveliness but are effective upon one another to counteract the activity so that the fabrication can be accomplished with the plied yarns in non-lively or "dead" condition; and with a later treatment of the fabric whereby the counteraction effect is dissipated and the yarn components act as individuals and each contributes to the contraction of the fabric so that improved stretchability is exhibited by the fabric.

A characteristic of this invention is the production of a composite yarn from two or more components which individually have active liveliness or twist, but which interact upon one another so that such liveliness is not effective in the composite yarn, whereby the composite yarn is essentially "dead" and devoid of liveliness as a composite and thus capable of fabrication without mechanical or other compensation of the composite yarn during knitting, weaving or other fabricating operation.

Another characteristic is the provision of a composite yarn made of multiple components which have opposite twists or liveliness of differing amounts, the components being plied by a plying twist of extent less than the difference of twist effects in the components and effective to establish compensation or counteraction in the composite yarn of the twists in the individual yarns.

A further characteristic is the production of a composite yarn in which one or more components have individual active liveliness and also have individual potential liveliness not apparent in the yarn while being fabricated but capable of release during treatment of the fabric whereby the same is exhibited in the fabric as active liveliness.

A further characteristic is the production of a composite yarn of at least two components which have active liveliness as individuals but compensate one another in the composite form so that the composite yarn is essentially "dead" and without liveliness; and which upon later treatment of the fabric formed therefrom separate from one another and individually reveal their active liveliness whereby the fabric shrinks but is capable of mechanical stretching essentially to the same dimension as the fabric could have been stretched before such later treatment.

When a length of a "dead" or non-lively monofil yarn of pre-set behavior is twisted about its axis, the effect is not visible in a cylindrical filament while it remains under endwise tension; but it can be assumed that the previous longitudinal molecular linkages at the surface, for example, have been distorted into helical forms. When the endwise tension is released with the ends held against untwisting, the length tends to "fetch up" into a helix of one or more lateral loops with twined bifilar stems. When one end is released, it tends to rotate about the longitudinal axis, to release the twist. If the yarn is subjected to a setting operation while held in such twisted condition, its capability of unwinding is reduced. For example, if a righthand twist of 50 turns per inch (20 turns per centimeter) is given such yarn, and setting accomplished in water at, say, 180 degrees F. (81° C.), the yarn will untwist by, say, 13 turns per inch or 5 turns per centimeter (residual 37 turns per inch or 15 turns per centimeter twist) and then acts "dead" or without liveliness although the original condition has not been gained. In general, the required amount of untwisting depends inversely upon the setting temperature, other conditions being the same: for example the "dead" condition may occur at 14 turns per inch or 5.1 turns per centimeter untwisting (36 turns per inch or 14.9 turns per centimeter residual) after treatment at 170 degees F. or 77° C., or at 12 turns per inch or 4.9 turns per centimeter untwisting (38 turns per inch or 15.1 turns per centimeter residual) at 200 degrees F. or 93° C.

The behavior of synthetic yarn is largely determined by its history. Its disposition upon heating above room temperature, when without external stress, is to assume the shape or relative position of the parts existent during the last prior setting operation: and it may develop internal stresses when detailed against free return to such shape or relative position. In general, the effect of a setting operation can only be totally dissipated by a treatment which is more rigorous than the setting itself. For example, a yarn which has been twisted and set at 200 degrees F. or 93° C. in hot water undergoes a change of

shape or relative positioning which is not completely eliminated by a later immersion in water at such temperature; and in practice some of the imposed twist will not be dissipated by treatment at 212 degrees F. or 100° C.

It has been found that a yarn having a pre-set behavior imposed at a relatively high temperature, which is then given a right-hand twist of 50 turns per inch or 20 turns per centimeter and then set at a lower temperature while held in such twisted state, can then be brought to a non-lively or "dead" condition by partial untwisting by, say 13 turns per inch; and, furthermore, when the yarn in this non-lively condition is again subjected to a heat-treatment, it is activated and tends to untwist further by, say, 12 additional turns, thereupon exhibiting a liveliness condition corresponding to a left-hand twist of 12 turns. The amount of re-assumed liveliness can be determined by the conditions of the successive heat treatments.

Due to the importance of history of the yarn, it is preferred to subject the yarn as received to a presetting treatment, prior to twisting, which is more rigorous than any later treatment to be given. This fixes in the material a condition of straightness, in line with what is sometimes called "memory." Thereafter, when a twisted and re-set yarn is again treated in a relaxed condition, it tends to return toward the original relative positioning of parts imposed by the pre-setting.

As an example of pre-setting treatment, a 15 denier nylon monofil, as received, was subjected without tensional constraint and without twisting to a pre-setting at 265 degrees F. under 25 lbs. steam pressure for 20 minutes. A further example for the same monofil yarn, is exposure at 212 degrees F. to saturated steam for a like time without tensional restraint. In general, the time is not determinative of the pre-setting action, as the major effect is produced upon a single 15 denier monofil strand within a very short time, and only a small increase in effect occurs after the first minute; with no significant difference between 10 and 30 minutes treatment. The time of 20 minutes was used for yarn wound loosely upon bobbins having collapsible cores, to assure penetration of the vapor and heat to all parts of the yarn, to attain uniformity. The pre-setting can be accomplished under dry conditions; but it is presently preferred to employ moist atmospheres with steam, as thereby temperature control is facilitated without risk of any part of a yarn being so heated that it becomes thermo-adhesive.

According to the present invention, yarns so prepared can be twisted and then plied together under conditions of reciprocal compensation of liveliness in two or more such plied ends, with production of a composite yarn which is essentially "dead" or non-lively whereby it may be fabricated without employment of auxiliary equipment for preventing the development of snarls due to liveliness.

A preferred practice is to prepare the individual yarns in such fashion that the composite exhibits no liveliness of a character preventing fabrication by usual equipment and wherewith the components of the composite remain without separation and individual snarling therein incidental to or during fabrication; and in which treatment of the fabric causes separation together with development of liveliness in the individual yarns.

It has been found possible to prepare composite yarns in this way, which do not exhibit objectionable liveliness during fabrication, and attain liveliness of component individual yarns during fabric treatment, but with compensation within the composite whereby the fabric does not exhibit biased effects upon treatment. Thus, for example, a single such composite yarn can be employed for forming the entire leg or welt portion of a knitted stocking, without biasing effects of the developed liveliness; as compared with the strong final biasing when a single individual yarn having active or potential liveliness is employed for preparing such an article.

As a primary example of practice, employing 15 denier polyamide (nylon) material, the yarn is pre-set in steam at 265 degrees F. (25 lbs. per square inch), and two individual parts thereof are respectively twisted 25 turns per inch **S**, and 36 turns per inch **Z**. Each yarn is actively lively, and if permitted to untwist, would do so by substantially the respective stated number of reverse twists before losing its active liveliness. The two preset and twisted ends are then laid together, and given 7 turns per inch **S** twist for plying, after which size is applied. The composite is essentially dead, and can be knitted, on a 400 needle circular machine having a cylinder diameter of 4 inches, with usual equipment, to form a flattened tube of fabric about 6 inches wide. Upon placing the fabric in boiling water, it immediately shrinks in (flattened) width to about 2 inches: the dried fabric can later be stretched to 12 inches width, and recovers from the stretching. Upon close inspection, it can be seen that the individual yarns have separated, and individually form twisted right and left distorted helices within the bights and tangents of the knitted loops.

In the following, as customary in the trade, the expression "turns" will mean "turns per inch." Likewise expressions such as 180/180 will be employed to designate a treatment at 180 degrees F. (dry bulb) in an atmosphere having a wet-bulb temperature of 180 degrees F.; that is, when the same wet and dry bulb readings are so employed, the treating atmosphere is saturated; or the treatment may be in water at the stated temperature.

It is also possible to prepare composite yarns which do not exhibit objectionable liveliness during fabrication, though composed of components which separately would exhibit active liveliness; and to have in one or more of the components a potential liveliness which can be released by treatment of the fabric whereby the resultant total active liveliness of one component of the yarn does not compensate the total active liveliness of the other component, for example, so that single-carrier knitting therewith gives a biased fabric if such is desired. Further, by making two such plied composite yarns, each being essentially dead during fabrication but having the reciprocally compensating effects, with one composite having a non-compensated excess of releasable potential **S** twist and the other a like excess of releasable potential **Z** twist, and employing the same for alternate bands of one or more courses during two-carrier knitting for example, or in like successive pairs of bands separated by a band of a third yarn which has no excess of **S** or **Z** twist (for example a third yarn which has no twist effect, or a composite yarn of twisted components and which is self-compensated both during knitting and in the final fabric) in a three-carrier knitting operation, fabrics can be prepared which have high stretching ability without fabric skewing or bias effects.

As a further example, the same 15 denier material was treated by like pre-setting, with one length then twisted 60 turns **Z** and then twist-set at 180/180, and another length twisted 40 turns **S** without a subsequent twist-set. The two yarns were then plied together with three turns **Z** twist: it being noted that the twist-setting of the first yarn left it with active twist equivalent to about 34 turns **Z** in a twisted yarn which has not been twist-set. The composite was essentially dead and was knitted as before, producing a fabric which contracted to 1⅞ inches wide in boiling water. It likewise could be stretched to 12 inches, and recovered.

The self-compensating effect, in the composite yarns at the time of fabrication, may be obtained: (1) by having twists to different amounts in opposite directions, so that the plying twist brings the components to like twist effects though in opposite directions, as in AA; (2) by twisting and twist-setting one component while the other is twisted but not twist-set or is less severely twist-set so that it retains a higher twist, with the plying twist operating to bring the components to essentially equal and

opposite active twists; (3) by twisting the components, then twist-setting one or both components, adding or subtracting active twist in one or both to provide the desired difference in active twisting forces, and finally employing the plying twist to bring the components to reciprocally compensating condition.

For comparison of various combinations of treated yarns, the following Table I gives results where two 15 denier nylon monofil yarns were brought together before knitting, with the yarn treatments identified by the code letters in which:

A—The yarn was pre-set, then twisted;
B—The yarn was pre-set, then twisted, then twist-set;
C—The yarn was pre-set, then twisted, then twist-set, then partially untwisted;
D—The yarn was pre-set, then twisted, then twist-set, then twisted further in the same direction.

The letters **S** and **Z** represent as usual twistings in the opposite directions. The setting treatment was by exposure to moisture-saturated air at the stated temperature: noting that like results are attained by immersion in water at the same temperature. The individual yarns, except for some examples of treatment according to code C had active liveliness at the time they were brought together. The yarns were brought together, with the stated plying twists, sized and rewound on tubes for knitting. The knitting was by single carrier on a 400 needle circular knitting machine as above: no special tension control was found necessary to avoid snarls. The release of the twist-set was accomplished by immersing the fabric in boiling water (212/212), for simplicity; noting that the effect is likewise attained by moisture-saturated air at the same temperature. The "Results" are stated as "Very Good" when the shrinkage was to 1¾ inches width or less; "Good" with shrinkage to 1¾ to 2 inches; "Fair-Good," with shrinkage to 2 to 3 inches; "Fair," with shrinkage to 3–4 inches; and "Low" with shrinkage to 4 to 5 inches. In each case, the dried fabric could be stretched to at least double (12 inches) the knitted width.

With specimen No. 1 (AA), the plying twist gave a composite which was essentially dead. When twists above 40 turns are employed with 15 denier nylon yarn, it is sometimes preferable to employ a twist-setting, as shown by specimen No. 2 (AB), No. 4 (AD), No. 5 (BB), and No. 7 (BD). The plying twist for 15 denier yarn knitted on a 400 needle machine, should not exceed 10 turns, for assuring separation of the individual yarns during the releasing treatment of the fabric: and the active twists in the individual yarns at the time of knitting should be so related that the plying twist is in direction and amount to bring the resulting twist effects into balance so that the composite is essentially dead. When twist-setting is used, preferably the active and potential twists in the individual yarns are so related that the releasing treatment causes them to have essentially the same effective twist in the final fabric, but in opposite directions: when this is the case, the individual yarns compensate for one another, and the fabric is essentially without bias. However, the invention can be practiced under conditions by which the yarns do not compensate but exhibit right or left liveliness: in such cases, two composite yarns can be prepared which will have respectively right and left liveliness in the fabric, and can then be fabricated by alternate use of such composite yarns in a two-carrier or three-carrier system as taught in my copending applications.

In the composite yarn, whether of two or more components, the behavior at the time of fabrication is that the composite as a whole is essentially free of active twist liveliness by reason of the balancing of the active torques of the right-twisted and left-twisted components with inclusion of the effects of the plying twist.

The yarn components or ends need not be of the same size or denier, and more than two components may be present. In Table II, the same coding is employed as in Table I, with "M" denoting no twisting of the pre-set yarn.

Table I

No.	Code	Twist	Twist setting	Add twist	Plying twist	Release	Results
1	AA	25-S 36-Z			7-S	212/212	Good: 2 in.
2	AB	40-S 60-Z	180/180		3-Z	212/212	Good: 1⅞ in.
3	AC	40-Z 40-S	180/180	10-Z	8-S	212/212	Fair-good: 2½ in.
4	AD	40-S 55-Z	180/180	12-S	3-S	212/212	Very good: 1¾ in.
5	BB	40-S 55-Z	180/180 160/160		3-S	212/212	Fair-good: 2¼ in.
6	BC	44-Z 40-S	180/180 180/180	12-S	4-Z	212/212	Low: 4½ in.
7	BD	55-Z 40-S	180/180 180/180	12-S	6-Z	212/212	Good: 1⅞ in.
8	CC	60-S 60-Z	180/180 180/180	6-Z 12-S	3-Z	212/212	Fair: 3¼ in.
9	CD	40-S 44-Z	180/180 180/180	6-S 12-S	7-Z	212/212	Fair: 3⅞ in.
10	DD	40-S 44-Z	180/180 180/180	6-S 12-Z	3-S	212/212	Good: 2 in.

Table II

No.	Code	Denier	Twist	Twist setting	Add twist	Plying twist	Release	Results, inches
11	AA	10 7	28 S 30 Z			5 Z	180/180	1¾
12	AA	15 7	28 S 50 Z			10 Z	180/180	2¾
13	AB	15 7	40 S 50 Z	150/150		5 Z	180/180	3
14	AA	15 10	28 S 30 Z			7 Z	180/180	2¼
15	AAA	15 7 7	28 S 40 Z 40 Z			6 Z	180/180	2⅛

Table II—Continued

No.	Code	Denier	Twist	Twist setting	Add twist	Plying twist	Release	Results, inches
16	AAA	10	28 S					
		7	40 Z					
		7	40 Z			7 S	180/180	2
17	AAAA	7	30 Z					
		7	30 Z					
		7	50 S					
		7	50 S			5 Z	180/180	2
18	AAMM	7	30 Z					
		7	50 S					
		7	None					
		7	None			4 Z	180/180	2¼
19	(AA)(AA)	15	36 Z	Plied	8 S			
		15	36 S					
		15	36 Z	Plied	8 S			
		15	36 S			4 Z	180/180	2¾
20	(AA) (AA)	15	36 S	Plied	8 S			
		15	36 S					
		15	36 Z	Plied	8 S			
		15	36 Z			4 Z	180/180	2¾
21	AAM	15	44 Z					
		15	28 S					
		20/7	None			3 S	180/180	2½
22	AAM	15	44 Z					
		15	28 S					
		10	None			4 S	180/180	2⅝
23	(AA)M	10	28 S	Plied	7 Z			
		10	30 Z					
		10	None			4 S	180/180	2⅜

In No. 21, the M component was a 20 denier 7 filament nylon multifil. Nos. 11 to 14 show effects of two yarn ends of different deniers. Nos. 15 and 16 show effects with one end twisted in one direction, and two ends twisted individually in the opposite direction, followed by plying the three ends. Nos. 17–20 show effects with more than two ends of the same denier: Nos. 19 and 20 showing that more than one end can be twisted together in a preliminary plying before such plied components are themselves twisted together for furnishing the yarn for fabrication. Nos. 21 to 23 show effects of multi-component systems including untwisted components and having twisted components; noting that here the plying twist establishes counteractions of the components with employment of the plying twist in the M yarn.

A result much like that of No. 21 was obtained by plying the twisted yarns together with 8 S turns of plying twist: and then knitting with the composite yarn and a 20 denier 7 filament untwisted yarn being brought to and placed side-by-side in the needles.

In general, for the examples in Table II, it was noted that the width of the relaxed fabric was not entirely comparable to those in Table I, for the reason that with the greater number of yarn ends within the same area as knitted, the greater bulk tended to produce a greater thickening of the fabric and to restrict the contraction and the fabrics would exhibit elastic tensions toward greater contraction than that set out: that is, Nos. 11, and 14–23 can comparably be described as good or very good, and Nos. 12 and 13 as fairly good: all being strikingly superior in stretching properties over fabrics of like final width prepared from the yarn as received from the manufacturer.

Obviously, the individual treatments of the yarns can be varied; for example with different sizes of yarns to parallel Nos. 3 to 10 on Table I; and with more than two yarns present to give composites such as BBB, BDM, (BB) (DM), etc.

The procedure can be used with stretched synthetic yarns inclusive of polyamides and polyesters, and composite yarns including the same, for effecting shrinkage or contraction in the fabric so that superior stretchability is present in the final fabric. Thus for both polyamide and polyester yarns, the pre-setting in steam at 212 to 265 degrees F. has been found effective for preparing the material so that the twisting, twist-setting, plying, and set-releasing operations can be conducted. The size of the filaments is not critical, and includes the sizes now in production, from 7 to 20 denier, for making ladies' stockings; as well as larger and smaller sizes. The number of turns to be employed in the twisting operations has some dependence upon the filament size, with higher twists for small sizes and lesser twists for larger sizes. In general, the twists are preferably in the range of 20 to 100 turns per inch with 15 denier yarns with practice under No. 1 of Table I, and corresponding higher or lower ranges for finer or coarser yarns. Both monofil and multifil yarns can be employed: for example commercial 70 denier, 34 filament, yarn can be treated, and the behavior in the strands thereof shows that correspondingly small monofils can exhibit the behavior.

There is a general relationship between the temperatures for twist-setting and for set-releasing when these steps are employed. Thus with the above pre-settings at 265 and 212 degrees F., the employment of successively higher temperatures for twist-setting gives yarns of differing and successively lesser amounts of active liveliness. When the pre-setting was at 265 degrees F., twisting by 51 turns followed by setting at 200 degrees left 12 turns of active liveliness with 39 turns in the yarn and potentially in major part available for re-establishing a liveliness condition. At a lower setting temperature, there are left say 15 to 30 turns of active liveliness with correspondingly 36 to 21 turns residual and available for re-establishing a liveliness condition. The operator can thus select conditions by which the active turns in the S and Z components can be accurately balanced in the composite yarn, with or without untwisting to pre-established conditions of active liveliness. For example, a pre-set and then Z twisted yarn of 51 turns can be twist-set, and untwisted to 5 active turns, and a corresponding S twisted yarn is twist-set and untwisted beyond the point of active liveliness so that it also has 5 active Z turns: when these are plied with 5 turns S, each yarn individually is essentially "dead" and fabrication can be done. Upon set-releasing treatment of the fabric, the Z twisted yarn becomes activated and exhibits say 25 turns active liveliness in one direction, while the S twisted yarn exhibits 25 turns active liveliness in the other direction: whereby both as knitted and in the final fabric the yarns counteract one another, and there is no skewing or bias tendency in the fabric.

Likewise a control can be exercised by the relative conditions of twist-setting and set-releasing, so that yarns of different history can exhibit properties in the relaxed or set-released fabric which accurately counteract one another or which are different from one another for a

desired effect: noting that when the yarns in the final fabric exhibit widely different properties of liveliness, yet the fabric as a whole may be "balanced" and free from skew, by employment of the two or three carrier systems of knitting, for example, of alternate courses or bands.

Both the twist-setting and set-releasing treatments require little time, as noted for the pre-setting: but without harm resulting when the time schedule provides say 10 to 30 minutes instead of a minute. Hence the treatments can be accomplished as an incident of dyeing or boarding.

The set-releasing effect increases with the temperature. Thus a pre-set yarn of 15 denier, twisted 51 turns, and then twist-set at 200 degrees F., even if then untwisted to "dead" condition, will exhibit upon set-release at 160 degrees F. an active liveliness of 10 turns: with set-release at 180 degrees, the active liveliness was 16 turns: at 212 degrees F., it was 22 turns; at 240 degrees in steam it was 26 turns. Comparably, with twist-setting at 170 degrees F., with set-releasing at 140 degrees F., 13 turns became active; at 180 degrees F., 18 turns became active; and at 212 degrees F., 26 turns. In practice, for temperatures below 212 degrees F., immersion in water at the intended treatment temperature is an accurately controllable away of assuring the temperature and the preferred humidity for the treatment.

The examples are illustrative; and the invention can be practiced in many ways in accordance with this disclosure and within the claims.

What is claimed is:

1. The method of making a stretchable fabric from yarn components of stretched material, which comprises pre-setting a plurality of yarn components, twisting one component in one direction and another component in the other direction to a lesser extent, plying the plural components while restraining snarling of the individual components and with a twisting together in the direction for increasing the active twist liveliness in the said component which has the lesser number of active twist turns at the time of plying and thereby decreasing the active twist liveliness in the said component which has the greater number of active twist turns at the time of plying, to form a composite yarn in plied condition essentially free from active twist liveliness as a whole, fabricating the composite yarn to form a fabric, and effecting differential shrinkage of the yarn components while in the fabric.

2. The method of making a stretchable fabric from yarn components of stretched material, which comprises pre-setting a plurality of yarn components, twisting one component in one direction and another componet in the other direction to a lesser extent, plying the plural components with said one component having a greater number of active twist turns per unit length in said one direction than the said other component has active twist turns in said other direction and while restraining snarling of the individual components and with a twisting together in the direction for increasing the active twist liveliness in the said component which has the lesser number of active twist turns at the time of plying and thereby decreasing the active twist liveliness in the said component which has the greater number of active twist turns at the time of plying to form a composite yarn in plied condition essentially free from active twist liveliness as a whole, fabricating the composite yarn to form a fabric, and effecting differential shrinkage of the yarn components while in the fabric.

3. The method of making a stretchable fabric from yarn components of stretched material, which comprises pre-setting a plurality of the yarn components, twisting one yarn component in one direction by one number of turns per unit length and twisting another yarn component in the other direction by a different number of turns per unit length, plying the yarn components while restraining snarling of the individual components and with a twisting together in the direction for increasing the active twist liveliness in the yarn which has the lesser number of active twist turns at the time of plying and thereby decreasing the active twist liveliness in the component which has the greater number of active twist turns at the time of plying, whereby the composite yarn in plied condition is essentially free from active twist liveliness as a whole, fabricating the composite yarn to form a fabric while restraining independent action of the components, and effecting response of the yarn components while in the fabric whereby each individually contracts in effective length.

4. The method of making a stretchable fabric from yarn of stretched material, which comprises pre-setting two yarns, twisting the yarns in opposite directions and producing therein active liveliness of different numbers of turns per unit of length, plying the yarns with twisting together in the direction for increasing the active twist liveliness in the yarn which has the lesser number of turns when brought to plying and thereby decreasing the active twist liveliness in the yarn which has the greater number of turns when brought to plying, whereby the said yarns each counteract the active liveliness in the other, then fabricating the plied yarns to form a fabric, and effecting separation of the yarns while in the fabric whereby each responds to its own active liveliness and contracts in effective length.

5. The method of making a stretchable fabric from yarn of stretched material, which comprises pre-setting two yarns, twisting the yarns in opposite directions and producing therein active liveliness of different numbers of turns per unit of length, plying the yarns with twisting together in the direction for increasing the active twist liveliness in the yarn which has the lesser number of turns when brought to plying and thereby decreasing the active twist liveliness in the yarn which has the greater number of turns when brought to plying, said plying twist having a number of turns per unit of length less than the difference in active twist turns in said yarns whereby the said yarns each counteract the active liveliness in the other, then fabricating the plied yarns to form a fabric, and effecting separation of the yarns while in the fabric whereby each responds to its own active liveliness and contracts in effective length.

6. The method of making a stretchable fabric which comprises treating a yarn of stretched synthetic material and thereby establishing therein a twist with active liveliness in one direction, treating a second yarn and thereby establishing therein an active twist liveliness in the opposite direction and of a different number of turns per inch than the twist liveliness in the first yarn, plying the yarns with twisting together in the direction for increasing the active twist liveliness in the yarn which has the lesser number of turns when brought to plying and thereby decreasing the active twist liveliness in the yarn which has the greater number of turns when brought to plying, said plying twist having a number of turns per inch less than the difference in active twist turns in said yarns, then fabricating the plied composite yarn to form a fabric, and separating the yarns while in the fabric to permit each yarn to shrink in accordance with its respective liveliness.

7. The method as in claim 6, in which two yarns of the same material and substantially the same cross sectional size are employed, and the plying twist is for a number of turns per unit of length which is substantially one-half the difference in active twist turns per unit of length in said yarns.

8. The method as in claim 6, in which more than one yarn is provided as a multiple yarn with active twist liveliness in said one direction, and the plying twist is of a number of turns per unit of length so that the active torque of twist liveliness of said multiple yarn counteracts the active torque of twist liveliness of the yarn having twist in the opposite direction.

9. The method of making stretchable fabric from yarn

of stretched material, which comprises twisting yarns in opposite directions and producing therein active twist liveliness of different numbers of turns per unit of length, plying the yarns with twisting together in the direction for increasing the active twist liveliness in the yarn which has the lesser number of turns when brought to plying and thereby decreasing the active twist liveliness in the yarn which has the greater number of turns prior to said plying, said plying twist having a number of turns per unit of length less than the difference in active twist turns in said yarns, applying an adhesive to the plied yarns for preventing separation thereof, fabricating the plied composite yarn to form a fabric, and removing the adhesive from the yarns and effecting separation of the yarns while in the fabric whereby each yarn responds to its own active liveliness and contracts in effective length.

10. The method of producing a stretchable fabric from yarn of stretched material, which comprises pre-setting yarn and then individually twisting two yarns in opposite directions and by different numbers of turns per unit of length so that they exhibit active liveliness in opposite directions, plying the yarns together with a plying twist less than the difference in active twists of the individual yarns and in the direction of twist of the yarn having the lesser active twist, fabricating the composite yarn into a fabric, and then heating the fabric in the presence of moisture while permitting contraction.

11. The method of producing a stretchable fabric from yarn of stretched material, which comprises pre-setting the yarn; then individually treating two portions of said yarn by twisting in opposite directions and setting at least one said yarn portion under a less rigorous treatment than that of pre-setting, to give the individual yarn portions active twist liveliness in opposite directions and by different numbers of turns per unit of length; plying the yarn portions together with a plying twist less than the difference in active twists of the individual yarns and in the direction of twist in the yarn portion having the lesser active twist; fabricating the composite yarn into a fabric, and then heating the fabric in the presence of moisture while permitting contraction.

12. The method as in claim 11, in which a twisted and twist-set yarn is again twisted after the twist-setting treatment.

13. The method as in claim 12, in which the additional twisting is in the direction opposite to the earlier twisting of the said individual yarn portion.

14. The method as in claim 12, in which the additional twisting is in the same direction as the earlier twisting of the said individual yarn portion.

15. The method as in claim 12, in which both yarns are again twisted after the twist-setting treatment.

16. The method as in claim 15, in which the additional twistings are each in the opposite direction to the earlier twisting of the respective individual yarn portion.

17. The method as in claim 15, in which the additional twistings are each in the same direction as the earlier twisting of the respective individual yarn portion.

18. The method of producing a stretchable fabric from yarn of stretched material, which comprises pre-setting the yarn; individually treating two yarn components to establish therein active twists in opposite directions to different extents; bringing the yarn components together with a plying twist amounting in turns per unit length and in direction to substantially one-half the difference in absolute value of the respective twists in the yarn components to form a composite yarn essentially free of active torque as a whole with the individual yarns therein having active liveliness; fabricating the composite yarn into a fabric, and then heating the same in the presence of moisture while permitting contraction.

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