Aug. 9, 1960 I. SCHWARTZ 2,948,133

STRAND PROCESSING

Filed Jan. 9, 1957

Fig. 1

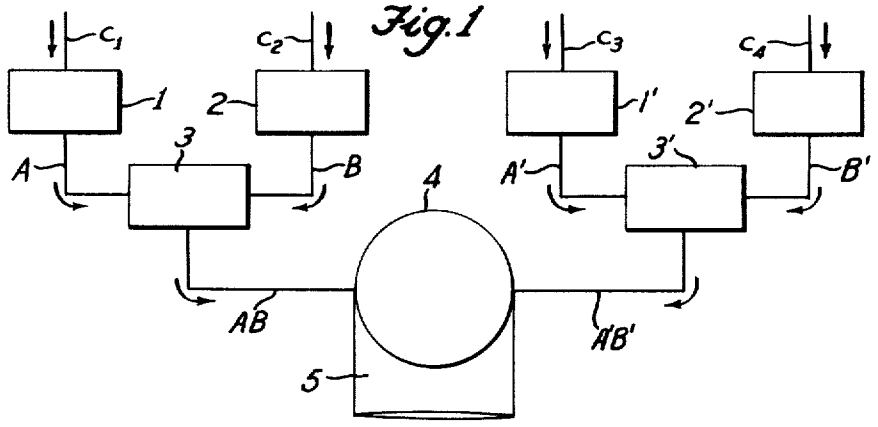


Fig. 2



Fig. 3

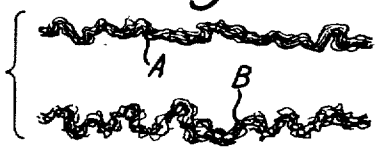


Fig. 4

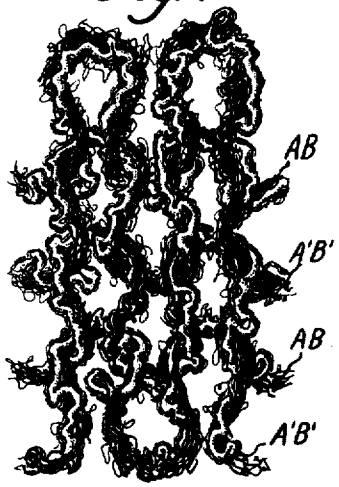
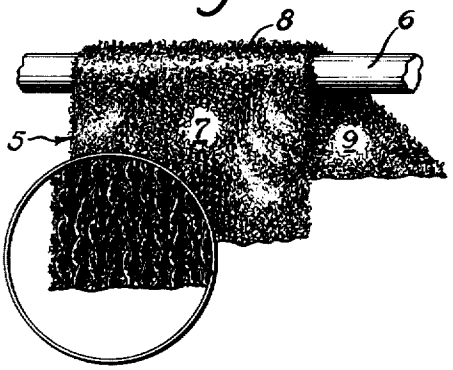


Fig. 5



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United States Patent Office 2,948,133 Patented Aug. 9, 1960

2,948,133

STRAND PROCESSING

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Filed Jan. 9, 1957, Ser. No. 633,303

5 Claims. (Cl. 66—201)

This invention relates to modification of continuous filaments into strands and yarns of increased bulk and to production of fabric therefrom having somewhat boucle-like surface characteristics.

Continuous-filament strands and yarns often are crimped for the purpose of counteracting or eliminating their customary "as-produced" translucency, slickness, and rectilinearity—which are undesirable characteristics in many apparel fabrics, for example. One well-known crimp configuration is helical, being producible, for example, by a twisting of the filamentary article, usually accomplished by heating and followed by elimination of the twist. A strand so treated is characterized by residual helical liveliness or torque directed about its longitudinal axis, and fabric made of it is satisfactorily bulky, crisp, opaque, and similarly staple-like, although care ordinarily is taken to balance out the helical liveliness in adjacent strands (e.g., by plying strands of equal but opposite crimp) to prevent undesirable distortion of the fabric or resulting garment.

A primary object of the present invention is novel combination of helically crimped mulitfilament strands into unbalanced yarns and into balanced fabrics characterized by micro-unbalance evident as boucle-like surface characteristics. Other objects of this invention, together with means and methods for attaining the various objects, will be apparent from the following description and the accompanying diagrams.

Fig. 1 is a schematic representation of practice of the present invention; Fig. 2 is a side elevation of a continuous multifilament strand exemplifying the starting strands of Fig. 1; Fig. 3 is a side elevation of a pair of crimped strands illustrative of modified strands of Fig. 1; Fig. 4 is a plan of knit fabric (magnified) as produced according to Fig. 1; and Fig. 5 is a perspective of such fabric formed according to this invention.

In general, the objects of the present invention are accomplished by helically crimping four substantially like continuous-filament strands separately, one pair of the strands being crimped unequally to one another and the other pair of strands being crimped unequally to one another, each of the strands of the second pair being crimped equally but oppositely to a corresponding strand of the first pair, then combining with one another the two strands of each pair into respective unbalanced yarns, and knitting the respective yarns together into a balanced boucle-like fabric. The invention contemplates, in particular, formation of knit fabric having alternate courses composed respectively of two different continuous-filament yarns, each characterized by net helical liveliness equal in magnitude to that of the other yarn but oppositely directed and each comprising a plurality of strands characterized individually by crimp-induced helical liveliness unequal to the net helical liveliness of the yarn so comprised. The helical crimp or liveliness present according to this invention normally is manifest as displacement or torque of the filament or parts thereof about the longitudinal filamentary axis so that, left free from external restraint, a helically crimped strand can be expected to assume a bulky configuration of unevenly contorted outline; a useful production technique therefor involves a twisting of the component filaments or strands as is known to those skilled in the art and further referred to below.

Fig. 1 shows schematically the practice of this invention upon four continuous-filament strands: c_1, c_2, c_3, and c_4 fed from an external source, such as a creel (not shown); each of them proceeds into a crimping zone, represented in simple block form, as indicated. In crimping zone 1, strand c_1 is crimped helically, leaving the zone as crimped strand A, while strand c_2 is crimped helically in zone 2 to a different extent and emerges therefrom as crimped strand B. Too, strand c_3 is crimped helically in zone 1' to the same extent as the first strand (in zone 1) but in the opposite direction, i.e., as between clockwise and counterclockwise about the axis, to become crimped strand A'; similarly, strand c_4 is crimped helically in zone 2' equally but oppositely to the second strand and emerges therefrom as crimped strand B'.

In combining zone 3, crimped strands A and B are brought together; similarly, in combining zone 3', crimped strands A' and B' are brought together. Being denoted as AB and A'B', respectively, the products of the combining zones then enter fabricating zone 4 from which fabric 5 (also shown schematically in Fig. 1) emerges as a further product of this invention. The surface details of a typical fabric so produced are illustrated to some extent in subsequent views, as are those of the various individual strands.

Fig. 2 shows continuous-filament strand c, which is representative of each of starting strands c_1 to c_4, as viewed from the side; it is made up of a plurality of filaments (substantially alike), and the drawing merely suggests the multifilament nature of the strand, which in the aggregate is a substantially cylindrical filamentary bundle.

Fig. 3 shows, in like view, strands A and B free from external restraint and spaced transversely from one another; strand B, having been crimped more highly (than strand A), has assumed an even bulkier or fluffier and more contorted configuration (in the assumed absence of sufficient axial tension or other external restraint to regularize the outline). On the other hand, the more consolidated component filaments of strand A are not individually so apparent in the drawing. Furthermore, this planar representation of the crimped strands is incapable of distinguishing strands of equal but opposite helical crimp; thus, the showings of Fig. 3 are for all practical purposes also representative of strands A' and B', respectively.

Fig. 4 shows in plan a single-thickness portion of plain knit fabric, exemplifying fabric 5 of Fig. 1, in extended or as-produced form. The strands in each pair are intertwined somewhat, and the two individual yarns so composed (i.e., each pair of strands being considered as one yarn) alternate with one another in the fabric construction. Upon elimination of the tension imposed during the knitting operation, this relatively open fabric configuration changes considerably, as shown in the next view.

Fig. 5 shows in perspective a length of the same fabric draped in open width at relatively slight tension over supporting rod 6. This view shows face 7 and back 9 of fabric 5 essentially in plan, presenting also an edge view or elevation of the fabric at the top just before it passes out of sight over the edge of the rod. Unlike the extended condition of the as-knit fabric in the preceding view, this more relaxed state of the fabric enables it to assume a bulky, opaque appearance, with the helical

liveliness of the component filaments evident in formation of small convolutions or similar contortions (often closed or tight, sometimes relatively open in loop form) throughout the fabric. These characteristic small knotty loops or bunches appear perhaps most clearly at edge 8, where the fabric is presented essentially in elevation, although they are visible also in the magnified portion of the fabric face. For convenience, fabric composed or produced according to this invention is termed here "boucle-like" by virtue of its possession of this characteristic, which is dependent also in part upon loopiness that may be considered fragmentary or inchoate, being invisible or only difficultly visible though contributing importantly to handle and other recognizable attributes of this textile. The fabric has a distinctive bulky and textured appearance and lofty handle that are readily recognizable, though defying adequate verbal description, differing recognizably from conventional boucle fabrics.

Although the unbalance of the individual yarns (each made up of a plurality of strands) gives rise to the characteristic boucle-like appearance described above and illustrated in the drawings (albeit inadequately, as compared with the immediate recognizability of it to sight or touch in the fabric itself), the fabric itself is well balanced as a whole, showing no tendency to skew or run off toward one edge or side or to twist about. In the illustrated fabric this balance is accomplished, as discussed above, by making up alternate courses from the two oppositely unbalanced strand combinations, as may be done simply by feeding them separately to alternate feeds of a knitting machine. Of course, a circular machine produces a tubing, which is cut apart to give a single-thickness piece that can be opened into wide flat form.

If a quadruple-feed machine should be employed according to this invention, identical fabric could be produced by feeding yarn AB (in two separate lengths) to the first and third feeds and feeding yarn A'B' in like manner to the second and fourth feeds, for example. Production of a similar balanced fabric according to the present invention may be accomplished also on such a machine by feeding one of these yarns to two adjacent feeds and the other to the other two feeds, in which instance pairs of like courses would alternate throughout the fabric, thus: AB, AB, A'B', A'B', etc.; in this latter instance also, the unbalance of the individual filaments, strands, and yarns shows up only on a desirably small or "micro" scale as visible or tangible boucle-like loops and the like, both open and closed. Further extension of such multiple-feeding variation in accordance with the principles of this invention will be apparent.

As is well known, twist-crimping apparatus and techniques for imparting helical crimp are disclosed in many U.S. patents, including (inter alia) the following: 2,089,198, 2,089,199, 2,089,200, and 2,111,211 to D. Finlayson et al.; 2,089,239 to W. Whitehead; 2,111,209 and 2,216,810 to H. Dreyfus; 2,463,619 to A. Kunzle; and 2,463,620 and 2,655,781 to G. Heberlein. This art has undergone considerable recent expansion, products thereof having achieved wide commercial acceptance, especially in garments such as socks and sweaters. Thus, the requirements of the crimping zones of the present invention will be immediately apparent to those skilled in the art. Whether the helical crimp is imparted as usual by twisting and heating the strand and then eliminating the twist (which occurs as a matter of course if the twisting is a false twisting) is immaterial to the present invention, inasmuch as strands helically crimped in any manner are adapted to combination and use as unbalanced pairs or similar groups of strands with like effect. Chemical (e.g., polymerizing) agents or other physical setting means or methods may be employed, as one familiar with the art will recognize.

The helical liveliness of the respective strands going to make up a yarn for the purposes of this invention need not be dissimilarly (or, for that matter, similarly) directed about the axis, although for a given algebraic difference in the including twists the maximum desirable effect perhaps accompanies dissimilar direction, at least where each yarn is made up of only a pair of strands. Thus, the strands of the first yarn may be crimped at +46 and −28 twist, respectively, and those of the second at −46 and +28, for example. Of course, three or more strands, either all crimped unequally or at least two of them having been crimped unequally, may be combined into a single yarn for use according to this invention; in that event also, each strand in each yarn will be helically crimped equally but oppositely to its counterpart in the other yarn. The degrees of amenability of filaments having different chemical compositions to such crimping are generally known; most textile filaments can be so crimped, regardless of composition, which is of only secondary importance in the practice of this invention, although of course the composition influences or determines other of the chemical or physical attributes that affect their characteristics and utility. Of perhaps greatest importance for this purpose are filaments of thermoplastic nature, among those composed of synthetic organic polymers.

Actual combination of the strands, which may be accomplished most conveniently by plying them with one another, is a self-explanatory conventional type of step performable on a ring-twister or the like. The strands do not require a great deal of twist to hold them together as a plied yarn, several turns (or less) per inch usually proving adequate. Other methods of combination may be employed, if desired; e.g., the strands may be run side by side and held in that relationship by sizing or the like, which may be removed in subsequent finishing operations; alternatively, the strands may be plaited together at the knitting machine in well-known manner. When plying is employed, the respective unbalanced yarns may be twisted oppositely to ensure balance of the resulting fabric; however, at low plying twist levels this more often than not will prove unnecessary.

The fabric of this invention is suited, as may be expected from the above description of its characteristics, to many apparel uses, including sweaters, skirts, and underclothing. Its bulkiness and excellent covering power help keep the wearer warm, and its textured surface is also pleasing to the eye. The full advantages and benefits of the present invention will become most apparent to those undertaking to practice it in all its aspects.

The claimed invention:

1. Process comprising imparting a twist to a first continuous-filament strand, heating the twisted strand and thereby inducing therein a helical crimp, and eliminating the imparted twist from this first crimped strand; imparting a different twist to a second like continuous-filament strand, heating the twisted strand and thereby inducing therein a helical crimp different from that induced in the first strand, and eliminating the imparted twist from this second crimped strand; imparting to a third like continuous-filament strand a twist equal in magnitude but opposite in direction to that imparted to the first strand, heating the twisted strand and thereby inducing therein a helical crimp equal in magnitude but opposite in direction to that induced in the first strand, and eliminating the imparted twist from this third crimped strand; imparting to a fourth like continuous-filament strand a twist equal in magnitude but opposite in direction to that imparted to the second strand, heating the twisted strand and thereby inducing therein a helical crimp equal in magnitude but opposite in direction to that induced in the second strand, and eliminating the imparted twist from this fourth crimped strand; combining the first and second strands together, combining the third and fourth strands together and knitting the combined first and second strands and the combined third and fourth strands into alternate courses, whereby a kit fabric having boucle-like surface characteristics is formed.

2. A process of forming a balanced boucle-like product, comprising taking two pairs of substantially alike continuous-filament strands, helically crimping the strands of each pair unequally to each other and in such a manner that one strand of each pair is helically crimped equally but oppositely to a strand in the other pair, combining the strands of each pair into a first and second composite strand, and knitting the first and second composite strands together in alternate courses to form a balanced boucle-like fabric.

3. The process defined in claim 2, wherein the crimping of the strands is accomplished by false-twisting them.

4. The process defined in claim 2, including helically crimping the component strands of each of said composite strands in opposite directions during the crimping step.

5. A balanced boucle-like fabric formed of alternate knitted courses of two composite strands with each composite strand being formed of a pair of strands which are helically crimped unequally to each other, with one strand of each composite strand being crimped equally and oppositely to a strand in the other composite strand.

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CERTIFICATE OF CORRECTION

Patent No. 2,948,133

August 9, 1960

Ira Schwartz

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

Column 4, line 3, for "including" read -- inducing --; line 74, for "kit" read -- knit --.

Signed and sealed this 17th day of January 1961.

(SEAL)

Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents