Aug. 12, 1958 J. BILLION 2,846,839

SNAG RESISTANT BULKY MULTI-PLY SUPERPOLYAMIDIC YARN

Original Filed May 18, 1953

Fig. 1

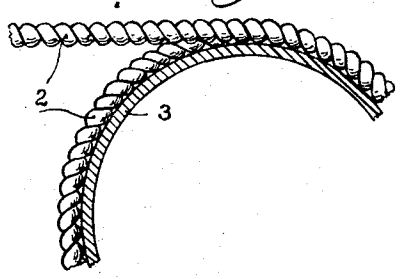


Fig. 2

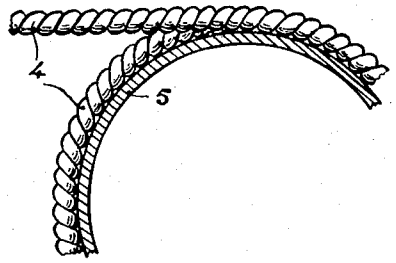


Fig. 5

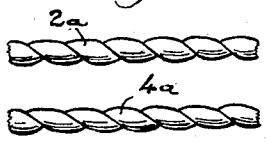


Fig. 6

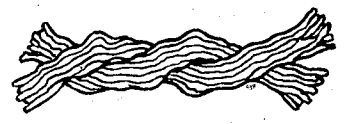


Fig. 3

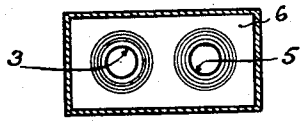
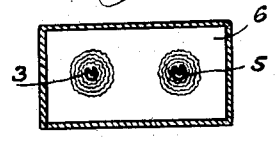


Fig. 4



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2,846,839

SNAG RESISTANT BULKY MULTI-PLY SUPERPOLYAMIDIC YARN

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Original application May 18, 1953, Serial No. 355,712. Divided and this application October 15, 1957, Serial No. 694,469

Claims priority, application France May 20, 1952

6 Claims. (Cl. 57—140)

The present invention relates to methods for producing yarns formed from individually kinked resilient component superpolyamidic filaments.

More particularly, the present invention pertains to a modification of and improvement in the methods and products described and claimed in U. S. Patent No. 2,564,245, issued Aug. 14, 1951.

This application is a division of my prior application, Serial No. 355,712, filed May 18, 1953.

Patent No. 2,564,245 describes generally a method for producing an improved yarn having a superpolyamidic base, which method comprises the steps of highly twisting a yarn consisting of a plurality of superpolyamidic strands or filaments, permitting free shrinkage of the resulting highly twisted thread, setting the deformation resulting from the shrinkage, and then back twisting the thread to a low twist or substantially no twist, followed, if desired, by a relaxation of the filaments by a heat treatment.

According to one embodiment of the invention described in U. S. Patent 2,564,245, two or more threads, each obtained by subjecting a superpolyamidic yarn to a high twist, free shrinkage, setting and untwisting to a low twist or no twist, may be combined into a yarn by a low twist. Specifically, the patent describes a method of making a yarn of great fluffiness and excellent thermal insulating properties which consists in twisting a superpolyamidic yarn to approximately 3500 turns per meter left twist, twisting a second superpolyamidic yarn identical with the first yarn to approximately 3500 turns per meter right twist, permitting both the resulting highly twisted threads to shrink freely, setting the deformations resulting in both threads from the shrinkage, untwisting both threads individually to approximately 125 turns per meter left twist and assembling said two threads to form a yarn by twisting them together at approximately 125 turns per meter right twist.

While yarns made by the methods described and claimed in U. S. Patent 2,564,245 provide optimum properties for the manufacture of a wide variety, particularly of knitted products, there are nevertheless instances where certain additional properties are desired. More specifically, yarns made according to U. S. Patent 2,564,245 with a low final assembling twist of up to about 125 turns per meter are excellently adapted to be knitted into sweaters of a soft, warm and elastic texture, but sheer fabrics such as women's stockings cannot be satisfactorily made from such yarn, nor is it possible to produce fabrics having the high snag and burr resistance and a great resistance to frictional abrasion which is required in certain cases.

It is the principal object of the present invention to produce yarns which combine: (*a*) the desirable characteristics generally inherent in superpolyamidic yarns such as high tensile strength, high stability under dry and humid conditions and indifference to the action of ordinary organic solvents with (*b*) the peculiar advantageous properties obtainable according to U. S. Patent 2,564,245 such as smooth and velvety touch, dull texture with little

metallic sheen, high elasticity and excellent thermal insulating properties, and which furthermore (*c*) are suitable for the manufacture of fabrics displaying high resistance to snagging, burring and frictional abrasion and which may have any desired degree of sheerness.

It has been found that it is not possible to accomplish these results simply by combining two or more threads of low twist or no twist produced by the methods described in U. S. Patent 2,564,245 with a higher assembling twist than envisioned in this patent because the resulting yarns lack many of the desirable properties characteristic of the yarns produced according to the patent. Particularly some of the heat or thermal insulating properties and some of the resiliency seem to be lost when two threads of no twist or low twist are combined by twisting to a final twist of more than about 250 to 300 turns per meter.

According to the present invention the essential advantageous properties of the yarns obtainable according to U. S. Patent 2,564,245 are retained and additional desirable properties are added by a method which comprises subjecting superpolyamidic yarns each consisting of a plurality of filaments individually to a high twisting operation to produce a twist of the order of about 1500 to about 4000 turns per meter, permitting the resulting highly twisted yarns to shrink freely, setting the deformation resulting from the shrinkage of the yarns, back twisting the individual yarns until each of them has reached a final twist in one and the same predetermined direction and of an intermediate magnitude corresponding to about 400 to about 800 turns per meter and finally combining a number of yarns having an identical intermediate twist in said predetermined direction by twisting or plying them together in a direction opposite to said predetermined direction to provide a twist of assembly having a magnitude equal to that of the previous intermediate twist of the individual component yarns. As a result of this plying operation the component yarns of the finished multiply yarn are held assembled by the plying twist of intermediate magnitude, while within each component yarn the filaments are restored to zero twist. The numerous kinks, waves or undulations in each filament are fully preserved, but the position of any particular crimped or kinked individual filament within each component yarn of the plied yarn is so controlled with respect to every other filament within the same component yarn and also within the composite multi-ply yarn that the multi-ply yarn has a smaller volume and a much greater resistance to snagging, burring or frictional abrasion, all new properties which up to the present it has not been possible to obtain with yarns of this type by any known method. The yarns, according to the present invention therefore lend themselves readily to the manufacture of new textile products which cannot be made from yarns produced by the methods described in U. S. Patent 2,564,245.

If, for instance, a number of highly twisted, shrunken and set yarns are back twisted to a twist in one and the same predetermined direction of 500 turns per meter and two or more of such yarns are assembled by twisting them together to 500 turns per meter in the direction opposite to said predetermined direction, yarns are obtained which are suitable for the knitting of sheer women's hosiery having a high snag resistance. If, on the other hand, a number of highly twisted yarns, after shrinking and setting of the deformation resulting from the shrinkage, are back twisted until they have a twist in one and the same predetermined direction of 700 turns per meter and then two or more of such yarns are combined by twisting or plying them together to 700 turns per meter in the direction opposite to said predetermined direction, yarns are obtained which can be woven into tight and elastic fabrics such as gabardines of excellent thermal

insulating properties and high resistance to frictional abrasion suitable, for instance, for the manufacture of ski suits.

According to a preferred embodiment of the present invention a first superpolyamidic yarn consisting of a plurality of filaments is highly twisted in a first direction and a second superpolyamidic yarn similar to said first yarn is highly twisted in a second direction opposite to said first direction, said first and second yarns being given substantially the same amount of twist. Both the resulting highly twisted yarns are then permitted to shrink freely and the shrunken yarns are subjected to a fixing treatment for setting the deformations in the individual filaments of the yarns resulting from the shrinkage. Then the first yarn is partially untwisted to an intermediate value of twist in said first direction and the second yarn is completely untwisted and retwisted to said same intermediate value of twist in said first direction. Finally, the two yarns having the same intermediate twist in the first direction are assembled to form a multi-ply yarn by twisting or plying them together in said second direction to the same value of intermediate twist whereby the crimped filaments in each of the yarns which were originally twisted to a high twist in opposite directions have substantially no twist within each yarn, said filaments being held together by the plying twist or twist of assembly in said second direction.

The fixing or setting of the crimped deformations in the individual filaments of each highly twisted yarn resulting from the shrinkage of the yarn may be effected in known manner by heat treatment or by sizing or the like. According to a preferred embodiment of the invention, the shrinkage and setting are combined in a single operation by subjecting the highly twisted yarns while wound on collapsible supports to a high humidity at an elevated temperature.

One embodiment of the invention is hereinafter described in detail solely by way of illustration with reference to the accompanying drawing, in which:

Fig. 1 shows a yarn of polyhexamethylene adipamide highly twisted to 2500 turns per meter to the left and wound on a tubular support which is radially collapsible under a predetermined pressure.

Fig. 2 is a similar illustration of a yarn twisted to 2500 turns per meter to the right.

Figures 3 and 4 show, on a reduced scale, a collapsible support filled with the yarn twisted to the right and a collapsible support filled with the yarn twisted to the left, disposed in a treatment chamber before and after, respectively, having been subjected to the shrinking and setting treatment.

Figure 5 shows, on an enlarged scale, two yarns twisted at 700 turns per meter to the left, and

Figure 6 shows the same two yarns combined by a twist of 700 turns per meter to the right to form a yarn according to the present invention.

The starting material is a yarn of polyhexamethylene adipamide, 45 deniers, consisting of 13 strands or filaments combined by a twist of 20 turns per meter to the left and delivered by the spinning plant wound on a wooden support (not shown). This yarn is unwound from the support and highly twisted to 2500 turns per meter to the left, and the resulting highly twisted yarn is wound on a support **3** (Fig. 1) formed of plastic material and collapsible to a reduced diameter under a predetermined pressure.

A second yarn, which is identical with the first yarn, is highly twisted to 2500 turns per meter to the right, and the resulting highly twisted yarn **4** is similarly wound on a collapsible support **5** (Fig. 2) identical with that used for the yarn **2** twisted to the left.

The two highly twisted yarns **2** and **4** on their respective collapsible supports **3** and **5** are next placed in a treatment chamber **6** (Fig. 3) where they are subjected to a high humidity treatment at 95% relative humidity and at a temperature of 110° C. for 45 minutes. By this single treatment, the yarns are caused to shrink, thus crushing their collapsible supports, and the component strands or filaments of each yarn are deformed so that they have innumerable kinks, waves or undulations which become fixed or set by the action of the high temperature. After drying in free air, the yarn which was previously twisted to 2500 turns per meter to the left is partially untwisted to a residual intermediate twist of 700 turns per meter to the left and the yarn which was previously twisted to 2500 turns per meter to the right is completely untwisted and retwisted to an intermediate twist of 700 turns per meter to the left.

After this operation, the two yarns **2***a* and **4***a* (Fig. 5) which were originally twisted, one to 2500 turns per meter to the left and the other to 2500 turns per meter to the right, respectively, and which are now both twisted to 700 turns per meter to the left, are assembled or plied together by a twisting of 700 turns to the right to form a yarn according to the present invention.

In the yarn thus obtained, the two component yarns **2***a* and **4***a* of 45 deniers each are combined and held together by a plying twist of 700 turns per meter to the right, whereas within each of the individual yarns, the 13 component crimped or undulatory filaments are not held together by any twist other than the plying twist.

Thus, in the final yarn, in each of the two component yarns, the individual filaments which are apparently parallel, do not turn with respect to one another (see Fig. 6) This parallelism is only apparent, however, because as soon as the tension is relieved, each of the 13 individual filaments is given free play and forms kinks or undulations which cause each filament to separate itself from the remaining 12 strands. On the other hand, the freedom of movement of each individual filament is restricted, because seven times over each centimeter of its length each filament of each component yarn is pressed against the group of 13 filaments of the yarn with which it is plied.

The multi-ply yarns obtainable according to the present invention may be used to provide a warp thread which can be combined on a loom with a woof thread of wool. The fabric thus obtained displays all the advantages of strength, resistance to organic decomposition, and chemical inertness which are characteristic of yarns having a superpolyamidic base. Such a yarn further provides the advantages of softness, elasticity, high thermal insulation, and the flattering appearance which are attributable yarns produced according to the method of Patent 2,564,245.

Finally, due to the use of a plying twist or twist of assembly of 700 turns per meter given to the yarn made up to the two component untwisted yarns, the individual kinked or crimped filaments of the yarns are held together seven times in each centimeter of the length of the plied yarn and therefore do not present free loops or ends which are liable to be damaged by friction.

Thus, a fabric comprising yarns made according to this invention combines the advantages resulting from the use of the superpolyamidic threads with all the desirable characteristics of a fine wool worsted fabric.

What I claim is:

1. A yarn having a superpolyamidic base comprising a plurality of bundles of component superpolyamidic filaments, the fibers within each bundle having kinky undulations formed therein and extending substantially parallel at zero twist relative to each other, said bundles being held together by a twist of assembly of between about 400 and 800 turns per meter.

2. A yarn as claimed in claim 1 in which the bundles of component filaments are held together by a twist of assembly of about 700 turns per meter.

3. A yarn as claimed in claim 1 in which the bundles of component filaments are held together by a twist of assembly of about 500 turns per meter.

4. A bulky multi-ply yarn comprising a plurality of

multi-filament component yarns each containing a plurality of thermoset continuous filaments, each filament being individually permanently crimped throughout its length, the crimped filaments in each component yarn being disposed in a group at substantially zero twist relative to each other and being confined in said group by between substantially more than 8 t./ in. and 20 t./in. twist thereabout of another said component yarn.

5. A yarn as set forth in claim 4, in which the group

of crimped filaments in each yarn are disposed in a generally parallel pattern.

6. A yarn as set forth in claim 4, in which the thermoset continuous filaments are superpolyamidic filaments.

References Cited in the file of this patent

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2,564,245	Billion	Aug. 14, 1951
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