Aug. 14, 1951 L. A. BILLION 2,564,245

METHOD FOR TREATING SUPERPOLYAMIDE THREADS

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Fig. 1

Fig. 2

Fig. 3

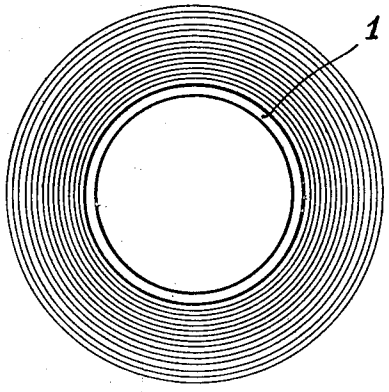


Fig. 4

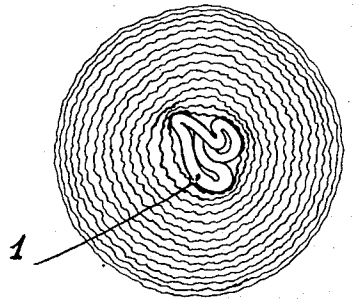
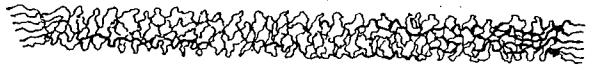


Fig. 5



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METHOD FOR TREATING SUPERPOLYAMIDE THREADS

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6 Claims. (Cl. 57—157)

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It is a well known fact that multi-strand threads made out of substances having superpolyamides as a base show a system of remarkable properties both as concerns their strength in the dry and moist state, their elasticity, resistance to abrasion and inertia with reference to the usual solvents; however the appearance and feel of such threads and of the textile material obtained therewith should advantageously in most cases of application show more yieldingness, softness in order to approximate the grade of natural threads and fibres of animal origin, such as silk and wool; super-polyamidic threads show moreover a heat insulating capacity that is less than that shown by threads of a natural origin even when they include a large number of very fine filaments.

It could be foreseen that it was possible to reduce such imperfect properties and that superpolyamidic threads might equal natural products, from the latter standpoint also by suitably modifying the relative positioning of the filaments in the multi-strand threads and in the fabrics.

In particular, it is necessary that the filaments instead of being perfectly parallel to one another and pressed against one another should play freely in accordance with the possible location of the kinks, crimps and curls imparted previously thereto in a permanent manner.

The threads thus obtained and the textile articles produced therewith would show thereby an improved appearance with a lesser metallic gloss together with a softer and more velvety feel which provides all the advantages and pleasant feeling inherent to the wearing of fabric made with animal fibres. But the most important advantage would reside in a substantial increase in the heat insulating capacity by reason of the importance of the air cushion that might be enclosed between the filaments of the threads or of the fabric or knitted ware made therewith.

It has been attempted to achieve these results through the application of different mechanical or chemical methods but heretofore the results obtained have never been satisfactory.

Furthermore the textile articles obtained with such threads did not show sufficiently permanent properties chiefly as concerns the usual washing, cleaning and the like treatments and their elasticity was far from satisfactory.

The method according to my invention consists chiefly in submitting the superpolyamidic threads to an excess twist and possibly allowing them to shrink freely so as to be stabilized after which an untwisting of the threads produces

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further deformations that may be released through thermic action.

According to a preferred form of execution of the invention, I submit the superpolyamidic threads to an excess twist and then they are allowed to shrink freely on deformable supports through a treatment which produces through the action of crimping and kinking a first series of deformations that are then set. The threads are then untwisted so as to produce a second series of deformations through fluffing, which deformations may be released through a thermic treatment executed on the textile articles produced with the threads.

The superpolyamidic threads that are used are originally continuous and show a small twist generally at the most equal to 200 convolutions per meter for threads of ordinary grade. These threads are first submitted to a higher torsion capable of generating subsequently through heat treatment crimping and kinking of a suitable nature and magnitude. The importance of this twist cannot be defined accurately as it depends on numerous factors, chiefly the nature of the component superpolyamide, the grade of the thread, the fineness of its filaments, the intensity of the heat treatment, the type of fabric to be obtained, the effect sought for.

To make things clearer, I may mention that this torsion may range between 400 and 5,000 convolutions per meter and that good results have been obtained as a general rule with torsions ranging between 1500 and 4,000 convolutions per meter.

During this extra torsion operation the threads are preferably wound over deformable supports adapted to be geometrically modified under the action of the shrinking force developed by the threads; I may use for instance as supports to this purpose cardboard or rubber tubes or slotted or perforated elastic sleeves that when crushed change their curvature under the pressure of the shrinking threads. I may also use skeins of threads, provided means are foreseen, such as retractable reels or the like, adapted to prevent the threads from assuming undesired deformations during the subsequent heat treatment.

The shrinking movement of the over-twisted threads is then produced in any manner whatever so as to produce the crimping and kinking. The treatment may be executed in any suitable manner but it is executed to advantage in a liquid phase for instance through mere immersion in water. The intensity of this treatment, that is, in the preferred case, the temperature of the

water and the duration of immersion, is submitted to no rigid rule as it depends also obviously on various and numerous factors. For usual cases however, it may be stated that satisfactory results are obtained with water in the vicinity of 40° C., the duration of soaking being of about 1 hour.

The deformations that have just been imparted to the threads are then made permanent and to this end the threads are submitted to a heat treatment the intensity of which is greater than that of the thermic treatments to which it may have been previously submitted. Many means are open to choice for obtaining this result, but it is of advantage to adopt the method consisting in bringing the threads to a high temperature in a dry or preferably moist medium; for instance it is possible to heat the crimped and overtwisted thread in boiling water or in steam at about 120 to 130° C. The duration of treatment depends on the temperature adopted, but generally a duration of 10 to 15 minutes is sufficient. The overtwisted crimped threads the deformations of which have become permanent are then allowed to untwist i. e. the threads are brought to a torsion that is less than that precedingly given thereto, said torsion being such that it may allow further deformations through a fluffing or looping of the component filaments; the said threads may then be transformed into various textile articles such as fabric, knitted or plaited articles, and the like. In other words the threads receive the torsion required when in use. The degree of reduction in twist depends on various conditions and in the first place on the applications contemplated for the textile articles considered. It is however often sufficient to adopt a very small torsion provided either in the same direction or in a direction opposed to the preceding torsion.

It is then possible to proceed starting from the untwisted thread with the execution of the textile articles contemplated, said execution being made in conformity with the usual methods, preferably after said threads have been suitably sized and after they have been drawn in the stretched state through unwinding. The size is removed in the usual manner through immersion in boiling water for a few minutes in order to obtain textile articles the threads of which show extremely marked deformation.

All the operations required for executing the said method may be executed with usual machines or apparatuses well known in the art and any person conversant with textile art will easily provide for such operations.

The threads to which the method according to my invention is applicable may be constituted by filaments of the same nature and they may also include compound threads, that is threads obtained through the assembly of superpolyamidic threads and threads or fibres of a different origin whether natural, artificial or synthetic. They may also include filaments of a mineral or metallic nature or rubber threads. They may also be constituted by assembled threads, chiefly when it is desired to produce textile articles. They may lastly before, during or after the execution of the present method be submitted to any suitable auxiliary operation, such as for instance, sizing, plasticizing, dyeing superficially or throughout, printing, bleaching, draining and/or drying, in particular if they have been submitted to treatments in moist media.

In all cases, the threads obtained in accordance with the present method are capable of being cut, spun, carded and the like, so as to form threads of discontinuous fibres as known per se in the art.

Among the superpolyamides forming the thread to which the present invention is applicable, I should mention in the first place those obtained through the poly-condensation or co-polymerization of $\alpha\omega$ dicarboxylic acids and $\alpha\omega$ diamines, and also those obtained through the self-polycondensation or polymerization of ω aminated carboxylic acids or of their derivatives such as in particular the ω lactanes. Particularly satisfactory results have been obtained with threads made of polyhexamethylene adipamide.

The final product is constituted by threads providing textile articles of an entirely novel and unexpected type, inherent in the first place to the nature of the threads and to the method of producing the latter.

These fabrics or the like products are chiefly characterized by a very soft feel, a pleasant appearance, a high heat insulating capacity and also an elasticity, that is remarkably high and stable; it could not be foreseen that it might be possible to obtain with artificial threads showing no twist or only a very low twist textile articles provided with such a high elasticity, resisting wear and the different treatments generally applied; it is hardly necessary to point out to the considerable importance in practice of such fabrics, the applications of which are numerous and varied.

It has already been proposed to submit continuous rayon threads to a series of operations consisting chiefly in over-twisting them, providing for the permanence of said twist and possibly untwisting them for holding them permanently again in their untwisted condition. This bestows on the filaments considered a wooly character.

It has also been proposed to treat in a similar manner continuous rayon threads which are positioned on yielding supports for the retraction of the overtwist.

Lastly it is known per se that superpolyamidic filaments may be held permanently under predetermined conditions through a suitable thermic treatment.

But by reason of the intense power of reaction of super-polyamidic filaments, it was not possible to foresee that the sequence of operations applied according to my invention might communicate to them irregularities in shape that are as marked as those obtained in practice through said method. Probability was that the high original elongation of these threads might be detrimental to the permanence of the novel properties assumed by said articles. Lastly it might have been supposed that the execution of the method disclosed might produce perhaps threads and articles showing extremely remarkable properties as concerns their elasticity, yieldingness, appearance, softness and warmth. Even if the modifications of these properties might have been expected, it is at any rate an unexpected fact that such advantageous properties appear to such an extent.

The following example may illustrate a form of execution of my invention:

Example: I start from a nylon (polyhexamethylene adipamide) thread that has been sized and shrunk, weighing 75 deniers, made of 23 strands, twisted at 200 convolutions toward the left. It is submitted to a further twist to 3,500 convolutions towards the left as it is wound

over yielding cardboard tubes of 40 mm. diameter.

The same operation is executed with a similar thread with the difference that it is submitted to an excess twist to 3,500 convolutions towards the right.

The two threads are then immersed with their supports in water at a temperature of 40° C. for one hour. The threads are then allowed to shrink freely while showing a marked crimping and a regular kink.

The threads are then allowed to dry on their supports by staying for 3 hours inside a dry kiln at 50° C.

The deformations given to the threads are then made permanent by leaving them during 10 minutes inside a moist kiln at 125° C.

The threads are then allowed to dry again as before and then each is untwisted to 125 convolutions per meter towards the left.

The two untwisted threads thus obtained are then assembled with a twist of 125 convolutions per meter towards the right, said threads being the thread originally twisted towards the left and that which has been originally twisted towards the right.

The assembled threads obtained are then sized while unwinding over a wetting roller and they are subsequently used for the execution of the so called Gros de Tours fabric with two threads, twenty seven threads being assembled per centimeter for the warp and as many for the weft.

The fabric thus obtained is dipped into water at 80° C., incorporating a little soda, for 30 minutes after which the fabric is rinsed and allowed to dry in the usual manner without said fabric being submitted to any binding.

The final product is an extremely yielding and thick fabric having a high elasticity and a high thermic insulation capacity and that remains perfectly stable under the action of the usual domestic treatments.

Appended drawings illustrate by way of example a manner of executing my invention. In said drawings

Fig. 1 shows a thread constituted by six parallel strands or elements that have not yet been assembled through twisting.

Fig. 2 shows a thread constituted by said six threads after they have been twisted together, both Figures 1 and 2 being of course on a greatly enlarged scale.

Fig. 3 shows the thread of Fig. 2 wound over a cardboard tube 1.

Fig. 4 shows the same arrangement after the cardboard tube has been crushed through the pressure exerted on it by the shrinking of the thread as a consequence of the treatment it has been submitted to.

Fig. 5 shows the thread constituted by six strands as it appears in its unstretched state after it has been wound off the reel shown in Fig. 4, set and back-twist. As a matter of fact, said thread assumes this extremely fluffy appearance as soon as it is no longer held under tensional conditions.

What I claim is:

1. A method for producing superpolyamidic yarn having permanent crimping and fluffing properties which consists in highly twisting a superpolyamidic yarn, allowing the yarn to shrink freely, setting the yarn, back twisting the yarn to a low twist, releasing the filaments of said yarn and plying the thread obtained with a similar thread which has been back twisted to a low twist after having initially been highly twisted in an opposite way.

2. A method for producing superpolyamidic yarn having permanent crimping and fluffing properties which consists in highly twisting a superpolyamidic yarn, laying said highly twisted yarn on a deformable support, obtaining crimping and kinking effects in the thread through shrinking by immersing the yarn in tepid water, setting the yarn by steaming, back twisting the yarn to a low twist, sizing the thread obtained, and relaxing the filaments of said yarn by immersion in a heated aqueous medium.

3. A method for producing superpolyamidic yarn having permanent crimping and fluffing properties which consists in highly twisting a superpolyamidic yarn up to between 3000 to 4000 turns per meter, laying the said highly twisted yarn on a deformable support, submitting it to immersion in tepid water to produce crimping and kinking effects by a shrinking of the thread, setting the yarn by treatment with steam at a temperature ranging from approximately 120° to 130° centigrade, back twisting the yarn to substantially no twist, stretching and sizing the thread obtained, and subsequently releasing the tension of said yarn by immersion in a heated aqueous medium.

4. A method according to claim 3 wherein before the final step of releasing the tension, the thread is assembled with a thread similarly treated, but initially highly twisted in an opposite direction.

5. A method of producing superpolyamidic yarn having permanent crimping and fluffing properties which consists in twisting a superpolyamidic yarn having approximately 200 turns left twist, to approximately 3500 turns left twist, immersing said twisted yarn on a deformable support in tepid water for approximately one hour to shrink same, drying said yarn on said support at approximately 50° centigrade for approximately three hours, setting the yarn by placing same for approximately 10 minutes in a moist kiln at approximately 125° centigrade, drying the yarn, untwisting said yarn to approximately 125 turns left twist and sizing the yarn.

6. A method according to claim 4, in which a second superpolyamidic yarn having approximately 200 turns left twist is twisted to approximately 3,500 turns right twist, then immersed on a deformable support in tepid water for approximately one hour to shrink ½, then dried on said support at approximately 50° C. for approximately three hours, then set by placing it for approximately ten minutes in a moist kiln at approximately 125° C., then dried and untwisted to approximately 125 turns left twist and sized, whereupon said second yarn is assembled with said first yarn by twisting them approximately 125 turns right.

LOUIS ANTOINE BILLION.

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