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METHOD OF MANUFACTURING A HIGHLY ELASTIC YARN PLY

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The present invention relates to a novel method of manufacturing a highly elastic yarn ply, preferably formed of synthetic or semi-synthetic fibers and mixtures thereof.

It has been attempted for a considerable length of time to manufacture yarn plies from fully synthetic or semi-synthetic yarns which possess, in addition to a certain degree of fluffiness, a high degree of elasticity and are particularly suitable for processing into knitted goods. In accordance with a known process, several endless yarns are twisted together and imparted with a high degree of twist and then subjected to a heat treatment on a rigid or slightly deformable tube in order to fix the imparted twist in spooled condition. The yarn ply is then finally untwisted to a normal twist.

According to another known method in the art, the individual yarns which previously have imparted thereto an initial twist of 200 to 400 turns per meter (t./m.) are given a still higher twist in order to be fixed in a second heat treatment after a first heat treatment and untwisting slightly beyond the zero point.

However, the articles produced in accordance with the known processes are not satisfactory either with respect to their elasticity or stability. It has been found that a high degree of residual or remanent twist which would normally, as such, be advantageous for enhancing elastic properties, commonly causes the manufactured knitted goods to be distorted which, obviously, is extremely undesirable. At all events, the elasticity and liveliness encountered in crimped yarns cannot be obtained by these processes.

The present invention has for one of its objects to provide a novel method of manufacturing a highly elastic yarn ply which obviates the aforementioned disadvantages and results in a substantial improvement in the hereinabove mentioned properties of the resultant yarn ply.

It is another object of the present invention to provide a novel method of forming a yarn ply of superior elastic properties wherein the individual yarn strands of said yarn ply are at least partially formed from endless fibers initially reduced to staple fibers prior to beginning of the twisting operations.

Still a further object of the present invention is the production of a novel article of manufacture, to wit, a highly elastic yarn ply wherein the initial twist imparted to an individual yarn strand of the yarn ply corresponds substantially in magnitude but opposed in direction to the final twist, taken from a zero position, imparted to said yarn ply.

A further object of the present invention is the provision of a novel method of manufacturing a highly elastic yarn ply from synthetic or semi-synthetic fibers.

In accordance with the teachings of the method of the present invention continuous fibers formed of a synthetic or semi-synthetic material are first reduced to staple fibers, at least some of said staple fibers are then spun to form individual yarn strands. The thus formed individual yarn strands possess an initial twist of given magnitude in a first direction, conventionally noted as t./Z, that is to say, turns per unit length in a first direction, such as, a right-hand direction. Next a plurality of such yarn strands are twisted together in said first direction from a zero position. The twist imparted to said yarn strands is then fixed by a suitable fixing operation known

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in the art. Thereafter, the plurality of yarn strands are twisted in a second direction (t./S) opposite to said first direction to return to the zero position, and then, the twisting in said second direction (t./S) is continued through said zero position to an extent approximating or corresponding to the initial twist of given magnitude possessed by a single yarn strand. It is to be appreciated that suitable fixing operations may be employed also subsequent to each twisting step. Additionally, although the continuous fibers and the yarn are preferably formed of synthetic or semi-synthetic materials the method might also be employed with natural fibers.

It is a particular feature of the method according to the present invention that the remanent twist imparted to the yarn ply is practically identical with the twist of an individual yarn strand, which is in the magnitude of several hundred turns per meter. Since the yarn twist and the yarn ply torsion are additionally opposed, they are balanced so that the yarn ply will exhibit no tendency towards subsequent twisting. This results in the further advantage that the remanent torsion in the yarn ply may be maintained comparatively high thus adding to its elasticity.

It is of particular importance in carrying out the method of the present invention that the endless fibers are no longer directly twisted but are previously processed into staple fibers and then spun to form a yarn. After spinning, the yarn is subjected to a wetting treatment either by application of moisture or by steaming.

According to the characteristics of the material employed, the endless fibers may also simultaneously be drawn so as to obtain a high degree of elasticity already in the base material. In the case of fully synthetic fibers, processing into staple fibers may be effectuated by employing a tearing or stretching process in which the fibers are given maximum elongation prior to breakage. In accordance with the high degree of stretching, a high degree of contraction may be obtained in the heat treatment after twisting. The heat treatment of the yarn ply may be performed on rigid or deformable tubes in a known manner, depending on the material and the final use of the yarn ply. Generally, rigid, for example, metallic tubes will be employed for ply yarns exhibiting little or no contraction. On the other hand, a deformable tube, for example, one formed of cardboard, is preferable for materials which have the tendency to substantially contract. Contraction of the fibers in the yarn ply enables a substantial improvement of its properties to be achieved.

Heat treatment may be performed in any of the known installations commonly employing steam and applying a vacuum. Heat treatment after untwisting may also be performed, in the manner known, simultaneously with dyeing in the dyeing bath or liquor. It is particularly advantageous with triacetate and acrylic fibers and imparts to the yarn ply maximum elasticity. It has been found that the method of the present invention enables yarn plies to be manufactured wherein the elasticity, depending on the kind of fiber and titre, is between 200% and 700%.

The following table lists the elasticity values or factors of some yarn ply types:

	Percent
No. 40/2—nylon	400
No. 80/2—nylon	400
No. 100/2—nylon	380
No. 200/2—nylon	605
No. 100/2—rilsan	700
No. 130/2—rilsan/viscoss 70/30	314
No. 100/2—crylor	200
No. 80/2—crylor	230
No. 40/2—nylon/triacetate 50/50	380
No. 40/2—triacetate	300

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In order to provide for a better understanding of the present invention the following examples are given by way of illustration only, since various changes and modifications will be readily apparent to those skilled in the art. It is to understand that the various temperature values and heat treating times are given by way of exemplification only with respect to the specific material processed in each example.

Example 1

Endless bundled nylon fibers of 1.5 denier are processed into staple fibers by means of a tearing process with correspondingly pronounced elongation. The said fibers exhibit a mean length of 120 mm. in a conventional type staple diagram. The fibers thus obtained are spun into a yarn No. 100 with 700 t./Z (turns per unit length in a first direction) in the conventional manner. To fix the torsion or twist the yarn is wetted. Two yarns of this number are twisted with 2500 t./Z in a multi-deck twister, the yarn ply being wound on elastic tubes. The yarn ply on the tube is subjected to steaming at 130° C. for 30 minutes, the process being performed in a vacuum. The yarn ply is then untwisted in the direction S (opposite to said first direction), far enough beyond the zero point that 700 t./S (turns per unit length in a second direction opposite to said first direction) remain. The yarn ply can then be dyed in the liquor. The elastic elongation of the yarn ply so produced amounts to 380%.

Example 2

Endless nylon fibers of 3 denier are reduced to staple fibers in a tearing process and the product mixed with cut staple fibers formed of triacetate of 2.5 denier in the ratio of 1:1. In the staple diagram, the fibers exhibit a mean length of 100 mm. The fiber mixture is spun into yarn No. 40 with 440 t./Z, which is fixed by treatment in a steam bath at 70° C. for 30 minutes. Two yarns of this number are then twisted with 1500 t./Z in a multi-deck twister. The yarn ply so obtained is wound on metallic tubes and subjected to steam treatment at 120° C. during a period of 30 minutes. After fixing, the yarn is untwisted in the direction S beyond the zero point until it has reached 440 t./S. After untwisting, the yarn ply in hanks is subjected to a heat treatment at 100° C. which process may be combined with the dyeing operation. The yarn ply so obtained possesses a remanent elastic elongation of 380%.

Example 3

Staple fibers are cut, possessing a mean staple diagram length of 100 mm., from endless triacetate fibers of 2.5 denier. These fibers are spun into a yarn No. 40 with 440 t./Z. The twist is then fixed in heat treatment at 70° C. for 30 minutes. Two yarns of the same number are twisted together with 1500 t./Z. The yarn ply wound on metallic tubes is subjected to heat treatment at 120° C. during a period of 30 minutes and untwisted in the direction S, after being fixed, far enough beyond the zero point for 440 t./S to be retained. The yarn ply may then be subjected to steam treatment at 100° C. which, however, may be dispensed with when dyeing is effected in the liquor. Subsequent to heat treatment, the yarn ply will possess an elastic elongation of 300%.

Having thus described the present invention what is desired to be secured by United States Letters Patent, is:

1. In a method of forming a highly elastic yarn ply from at least partially synthetic yarns; comprising the steps of reducing continuous fibers to staple fibers then forming individual yarn strands containing at least some of said staple fibers with each of said yarn strands possessing an initial twist of given magnitude in a first direction, thereafter twisting a plurality of the thus formed yarn strands together in said first direction from a zero position, fixing said twist from said zero position, thereafter twisting said plurality of yarn strands in a second direction opposite to said first direction to said zero po-

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sition, and finally continuing said twisting in said second direction through said zero position to an extent approximating said initial twist of given magnitude possessed by a single yarn strand.

2. In a method of forming a highly elastic yarn ply according to claim 1, including the step of fixing said initial twist imparted to said yarn strands in said first direction and said final twist in said second direction.

3. In a method of forming a yarn ply according to claim 1, wherein said continuous fibers are subjected to a drawing operation.

4. In a method of forming a yarn ply according to claim 1, wherein said continuous fibers are completely synthetic and reduced to staple fibers by subjecting the same to a tearing process.

5. In a method of forming a yarn ply according to claim 1, wherein said yarn strands are subjected to a wetting treatment subsequent to formation thereof.

6. In a method of forming a yarn ply according to claim 5, wherein said yarn strands are subjected to a heat treatment subsequent to formation thereof.

7. In a method of forming a yarn ply according to claim 1, wherein said yarn ply is subjected to a stabilizing heat treatment subsequent to the final twisting operation.

8. In a method of forming a yarn ply; comprising the steps of reducing continuous fibers to staple fibers, then forming individual yarn strands containing only said staple fibers with each of said yarn strands possessing an initial twist of given magnitude in a first direction, thereafter twisting a plurality of the thus formed yarn strands together in said first direction from a zero position, then fixing said last mentioned twisting operation, thereafter twisting said plurality of yarn strands in a second direction opposite to said first direction to return to said zero position, then continuing said twisting in said second direction through said zero position to an extent approximating said initial twist of given magnitude possessed by a single yarn strand, thereby forming a yarn ply of superior elasticity.

9. In a method of forming a yarn ply; comprising the steps of reducing continuous fibers to staple fibers, then forming individual yarn strands containing at least some of said staple fibers with each of said yarn strands possessing an initial twist of given magnitude in a first direction, thereafter twisting a plurality of the thus formed yarn strands together in said first direction from a zero position, then fixing said twist of said plurality of yarn strands, thereafter twisting said plurality of yarn strands in a second direction opposite to said first direction to return to said zero position, then continuing said twisting in said second direction through said zero position to an extent approximating said initial twist of given magnitude possessed by a single yarn strand, thereby forming a yarn ply of superior elasticity.

10. A method of forming a yarn ply according to claim 9, including the step of fixing of said twist in said second direction.

11. A method of forming a yarn ply according to claim 10, wherein said respective twist fixing steps are carried out by wetting of said yarn strands.

12. A method of forming a yarn ply according to claim 11, wherein said wetting of said yarn strands is by steam.

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