United States Patent Office 3,137,991 Patented June 23, 1964

3,137,991

MANUFACTURE OF BULKED YARNS

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No Drawing. Filed Aug. 5, 1963, Ser. No. 300,042
Claims priority, application Great Britain Aug. 14, 1962
14 Claims. (Cl. 57—160)

This invention is concerned with improvements in or relating to processes for the manufacture of bulked yarns.

It has long been the intent of those skilled in the textile art to devise processes for imparting to the so called man-made fibres and filaments, hereinafter referred as yarns, some of the more desirable properties of the naturally occurring fibers such as wool. Particular attention has been paid to the manufacture of man-made yarns having the covering power, handle and insulation properties of wool. In recent years processes for achieving this end have been primarily intended for application to the wholly synthetic yarns such as those based on the polyamide, polyester or acrylic classes of polymers, and have been the subject of numerous patent applications.

The majority of the aforementioned processes have been concerned with the crimping of continuous filament yarns in order to increase their bulk and thus display the desired qualities while retaining the more desirable properties of the synthetic yarn, for example high strength (tenacity) and excellent abrasion resistance.

Staplised wholly synthetic yarns also have some of the desired qualities but have only a relatively low tenacity. In order to retain the properties of the staple yarns but obtain an improved tenacity, staple fibers have been wound as a sheath around a core of a continuous filament yarn so that the continuous filament yarn is the load bearing component of the combined sheath and core yarn.

It is with processes for obtaining bulked yarns of this latter type that the present invention is particularly concerned.

The plying or twisting together of two or more continuous filament yarns which have been drawn to different amounts, so that on redrawing one end breaks to give a yarn composed of a continuous filament core with a staple fibre sheath, in which the loose ends of the staple fibers stand out from the yarn, is well known in the art. However this process suffers from the disadvantages that any crimp in either of these yarns is largely removed during the redrawing operation so that the combined yarn has only a low bulk, also considerable lapping of the broken ends around the draw-roll occurs. We have now found that the expensive process of twisting the two components of different orientations before drawing can be replaced by false-twisting two components of different spun orientation together at drawing. Thus when two polyhexamethylene adipamide yarns of different spun orientation are heated and then have false-twist inserted between the snubber pin and draw roll, the yarn is crimped at drawing, and simultaneously the yarn having the highest spun orientaiton breaks into staple fibres, having a minimum length of about 8 inches, in the highly twisted drawing zone which traps the broken filament ends. In the subsequent untwisting zone the crimp in the yarn from the twisting and heat setting process makes the broken ends curl into the yarn, entangling with the continuous filaments, to form a stretch type bulked yarn with a sheath of long crimped staple fibers surrounding a continuous filament core. We have also discovered that the process for producing this type of sheath and core yarn need not be limited to the use of yarns having differing orientations, but may be achieved by the use of two or more yarns having differing physical characteristics

which result in the said yarns having different drawing performances i.e. different extensions to break. Extension to break is defined as being the amount by which a yarn may be elongated before it breaks.

Thus considering two polyamide yarns which are to be subjected to the process of false twisting at drawing as described hereinbefore, although this invention is not to be taken as being, in any way limited to polyamide yarns, the physical properties and therefore the drawing performance of one of these yarns may be arranged to differ from the other in, for example, one of the following ways. An additive e.g. alkathene may be included in the polymer prior to spinning to yield a relatively weak yarn of poor drawing performance, the yarn may be spun under conditions which result in the filaments having denier variations or different spun orientations or it may be subjected to random quenching after spinning, e.g. by spraying water onto the yarn while in the conditioner tube, so that a highly spherulitic yarn is obtained, or again random fusion of the filaments, may be induced at spinning. In these latter instances the yarns would all have relatively poor drawing performances. Alternatively the yarn may be abraded or otherwise physically or chemically damaged at spinning or in some subsequent operation.

It is not necessary that the yarns to be used in this process be of the same type, for example one may be a polyester and the other a polyamide or a polyhydrocarbon and a polyamide, or again a polyester and a polyhydrocarbon, provided that they have different drawing performances. Also one yarn may be non-drawable and the other drawable, for example rayon and a polyamide, or fully drawn and undrawn polyamides.

According to one aspect therefore, the present invention provides a process for the manufacture of a bulked yarn comprising a crimped continuous filament core surrounded by a sheath of staple fibres, wherein two or more yarns, at least one of which is thermoplastic, having different extensions to break are heated and the combined yarns simultaneously false-twisted and drawn, the amount of drawing being sufficient to cause the yarn having the lowest extension to break to break into staple length fibres, which fibres form a sheath around the remaining unbroken crimped yarn or yarns which thereby form a crimped continuous filament core, the ends of the said staple fibers becoming entangled with the filaments of the core.

The term yarn includes bundles of filamentary materials, threads and other plied structures.

We have further found that a tension-stable bulked yarn can be obtained by further processing of the sheath and core yarn described above. In this context a tension stable yarn is defined as a bulked yarn containing a continuous filament core which does not suffer a loss in bulkiness when subjected to a lengthwise tension.

By passing the drawn yarn obtained by the process as previously described herein through a second heated zone under controlled tension, the crimp in the continuous filament core is removed while the crimp in the stable fibre sheath is further developed, to give a tension-stable yarn having an uncrimped continuous filament core and a sheath of crimped staple fibres.

From another aspect therefore this invention further provides a process for the manufacture of a tension-stable yarn comprising a substantially crimp free continuous filament core surrounded by a sheath of crimped staple fibres, wherein a yarn obtained according to the process described hereinbefore is subsequently heated under controlled tension to remove substantially all of the crimp from the continuous filament core and further develop the crimp in the staple fibre sheath.

The invention includes the bulked and tension stable yarns produced as described above and textile articles woven or knitted therefrom.

A particularly suitable method for inserting false-twist in a yarn which may be employed in the process of this invention is that known as the flange false-twist process and described in the specification for Letters Patent No. 890,053. In the use of this method in the process of this invention yarns having different spun-orientations are fed from feed rolls around a heated snubbing pin to a draw roll provided with a flange, the combined yarn is caused to rub against the said flange, which rapidly rotates the said yarn and imparts a false-twist thereto, so that the yarn is drawn while in an intensely false-twisted condition. The broken filament ends, resulting from the yarn having the lowest extension to break breaking during drawing, are locked in the yarn and thus prevented from lapping around the draw roll, a condition frequently encountered when ends break at drawing.

The processes of this invention will now be more fully described in the following examples which are intended to be merely illustrative and not limitative of the invention.

In these examples the method for inserting false-twist while drawing is that previously described herein in which a 3.820 inch diameter drawroll is fitted with a 5.75 inch diameter flange of Shore Hardness 80°. The snubber pin, offset 1.5 inches from the flange, is electrically heated and has an acid-etched chromium plated surface maintained at 185° C. to heat-set the false-twist at drawing.

Example 1

Undrawn yarns of polyhexamethylene adipamide are employed in this example as follows:

(*a*) High spun-orientation component—20 filament yarn having a denier of 181 and a spun birefringence of 0.021.

(*b*) Low spun-orientation component—25 filament yarn having a denier of 404 and a spun birefringence of 0.0075.

The above yarns are drawn together over the flange at a speed of 500 f.p.m. to a drawn ratio of 3.65 to give a combined 45 filament yarn of total denier 160 in which the yarn having the higher spun-orientation is broken into long lenth staple fibers. The combined yarn therefore comprises a core of crimped 25 filament 4 denier continuous filament yarn surrounded by a sheath of crimped 3 denier per filament staple yarn having a staple length of several feet.

A weft knitted fabric made from this yarn had a pleasing appearance and a warm soft handle.

Woven fabrics containing the bulked yarn of this invention as a weft across a 60 denier polyhexamethylene adipamide warp in a plain weave count 100 x 69 or a four end sateen weave 100 x 90 have many small loops and filament ends protruding from the surface, and possess an attractive dry handle.

Example 2

A 20 filament polyhexamethylene adipamide yarn in which ten of the filaments have a different spun orientation from the remainder is obtained in the following manner. The molten polyamide is extruded into filaments through 20 orifices contained in a single spinneret plate and solidified by a transverse blast of air in the conventional manner. Ten of the filaments thus obtained are taken and caused to pass around two spaced ceramic pins such that the filaments make two turns through 90° and then recombined with the remaining filaments. The combined filaments are next passed through a steam conditioning tube and wound up onto a package in the usual manner. The effect of passing ten of the filaments around ceramic pins is to increase the tension in those filaments and hence cause them to be drawn to a greater extent and thus have a higher spun orientation than the remaining filaments.

This yarn is processed in the manner described for the combined yarns in Example 1 to give a bulked yarn comprising a core of 10 crimped continuous filaments surrounded by a sheath of long length staple fibres.

Example 3

Undrawn polyhexamethylene adipamide yarns used in this example are:

(*a*) High spun-orientation component—13 filament yarn having a denier of 119 and a spun birefringence of 0.019.

(*b*) Low spun-orientation component—13 filament yarn having a denier of 152 and a spun birefringence of 0.011.

These yarns are drawn together over the flange at a speed of 450 f.p.m. to a draw ratio of 3.66 to give a bulked core and sheath yarn having a total denier of 80. After leaving the draw roll the yarn is wrapped 1½ times around a 1 inch diameter metal pin maintained at 205° C. before being wound up. The tension in the yarn between the pin and the wind up is maintained substantially constant at 0.15 gm./denier. The resultant bulked yarn is tension stable with small loops of crimped fibres surrounding a substantially uncrimped continuous filament core.

A fabric in which the tension stable yarn of Example 3 is woven as weft across a 60 denier polyhexamethylene yarn as warp in a plain weave count 100 x 80 has a drier handle and less lustrous appearance than either a fabric woven with a corresponding continuous filament unbulked weft, or a continuous filament bulked weft containing no broken filaments produced by drawing together two undrawn yarns of the same spun orientation, under the conditions detailed in this example for the production of the tension stable yarn.

The presence of broken filaments in this tension stable yarn results in a marked increase in the specific volume (gm./cc.) of the yarn compared with a continuous filament 80 denier 26 filament unbulked yarn or a continuous filament 80 denier 26 filament bulk yarn produced under the same conditions as the tension stable yarn but without broken ends i.e. by drawing together two yarns of the same spun orientation, as shown in the table below:

Yarn:	Specific volume, g./cc.
Tension stable yarn of Example 3	2.0
Similar yarn without broken filaments	1.55
Continuous filament unbulked yarn	1.19

It can be seen that breaking some of the filaments into long staple lengths increases the specific volume of the yarn, making a greater contribution to the total than false-twisting at drawing.

The specific volume of the yarn is measured by winding onto a container of volume 10.30 cc. at a tension of 7 g., the weight of yarn required to fill this volume is a measure of the specific volume of the yarn which is expressed in g./cc.

Although the above examples have been described with particular reference to polyhexamethylene adipamide yarns, it is to be understood that the invention may be effectively applied to all polyamide and other thermoplastic yarns such as those based on polyesters or polyhydrocarbons.

What I claim is:

1. A process for the manufacture of a bulked yarn comprising a core of crimped continuous filaments surrounded by a sheath of staple length fibres, wherein two or more yarns, at least one of which is thermoplastic, having different extensions to break are combined, and are false twisted and drawn while in a heated condition to cause the yarn having the lowest extension to break to break into crimped staple length fibres, which fibres

form a sheath around the remaining unbroken crimped filaments which thereby form a core of crimped continuous filaments, the ends of the staple fibres entangling with the continuous filament core.

2. A process according to claim 1 wherein the yarns are initially formed from the same starting materials but have different orientations.

3. A process according to claim 2 wherein the yarns are initially formed from the same starting materials but have different spun orientations.

4. A process according to claim 3 wherein the yarns are formed as a single yarn from polyhexamethylene adipamide which is formed into filaments by melt extrusion through a spinneret and a proportion of the filaments so formed is subjected to a greater tension than the remaining filaments before winding up to impart thereto a higher spun orientation.

5. A process acording to claim 4 wherein the tension is applied to the filaments by causing them to pass over two or more ceramic pins after solidification and before passage through a steam conditioning tube.

6. A process according to claim 1 wherein one yarn is treated by a chemical or physical process to weaken it with respect to the remaining yarns.

7. A process according to claim 6 wherein the yarn is formed by melt spinning and is weakened by random quenching of the melt spun filaments.

8. A process according to claim 2 wherein one yarn is a fully drawn high molecular weight synthetic polymer yarn.

9. A process according to claim 8 wherein the polymer is polyhexamethylene adipamide.

10. A process according to claim 1 wherein the staple fibres formed by the process have a minimum length of 8 inches.

11. A process for the manufacture of a tension staple bulked yarn comprising a substantially crimp free continuous filament core surrounded by a sheath of crimped staple fibres wherein the yarn of claim 1 is heated under a controlled tension to remove substantially all of the crimp from the continuous filament core and further develop the crimp in the staple fibre sheath.

12. A process according to claim 11 wherein the fibres in the crimped staple fibre sheath have an uncrimped length of at least 8 inches.

13. A process according to claim 11 wherein the yarns are composed of polyamides.

14. A process according to claim 13 wherein the yarns are polyhexamethylene adipamide yarns.

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