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STRAND TREATMENT

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Fig. 1.



Fig. 2A.



Fig. 2B.



Fig. 3A.



Fig. 3B.

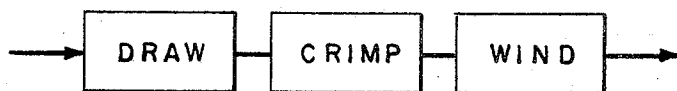


Fig. 4A.

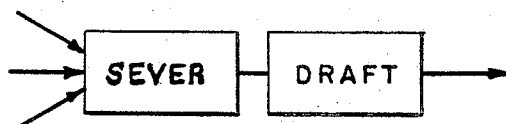


Fig. 4B.

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STRAND TREATMENT

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9 Claims

ABSTRACT OF THE DISCLOSURE

A textile strand composed at least in part of continuous filaments is drawn to increased length and crimped at such increased length; numerous strands similarly treated are combined side by side in parallel juxtaposition to form a composite strand, and the filamentary components are severed while maintaining the composite strand intact, after which the strand is drafted to reduced diameter into the form of top.

The invention relates to treatment of textile strands having filamentary components, especially conversion of continuous filaments to top. The top so formed is converted into yarn by drafting and twisting.

Synthetic continuous filaments are extruded from molten or dissolved polymer and are collected in essential parallelism with one another as a loosely coherent bundle of filaments. Most synthetic organic compositions used for this purpose produce filaments that are drawable to increased length, with accompanying reduction in diameter of the individual filaments; the product thereof being tow from which yarns formed of relatively short or staple-like lengths are formed by either of two methods, one of which is modeled on the spinning of staple yarns and the other of which is a continuous conversion into yarn without formation of staple. The cutting of continuous filaments into short lengths, for treatment as staple fibers are conventionally treated, is a complex and time-consuming process, hence the development of the continuous conversion method. The product of the latter method, however, is subject to undesired variation in denier because of unevenness in the operation.

A primary object of the present invention is conversion of continuous textile filaments into uniform assemblages of discontinuous or staple-like lengths having structural integrity, in untwisted form (i.e., top) and twisted form (i.e., yarn).

Another object is blending of numerous such strands.

A further object is performance of the foregoing conversion in continuous manner.

Other objects of this invention, together with means and methods for obtaining the various objects, will be apparent from the following description and the accompanying diagrams indicating, in block form, performance of various steps in the process of the prior art and the process of the invention.

FIG. 1 illustrates a conventional conversion method for producing staple-like yarn from extruded continuous filaments.

FIG. 2A illustrates a conventional method of producing staple fibers from continuous filaments; and

FIG. 2B illustrates conversion of such staple fibers into an untwisted strand or sliver in a conventional manner.

FIG. 3A illustrates conventional conversion of sliver into a twisted strand or roving; and

FIG. 3B illustrates the conversion of roving into yarn in a conventional manner.

FIG. 4A illustrates conversion of continuous filaments into a drawn bundle or tow; and

FIG. 4B illustrates conversion of tow into top.

In general, the objects of the present invention are

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accomplished by drawing to increased length a strand of continuous filaments, crimping the drawn strand, combining the crimped drawn strand side by side with a plurality of similarly treated crimped drawn strands to form a composite strand, severing the filaments while maintaining the composite strand intact, drafting the resultant strand to reduced diameter, and collecting the top so formed. The foregoing method is performed continuously in one embodiment of the invention, and in another embodiment the crimped drawn strand is wound onto a temporary package from which it is unwound for combination with other similarly treated crimped drawn strands in forming the composite strand subsequently treated as stated above. Yarn is formed from the top so produced by further drafting and twisting and winding.

FIG. 1 illustrates in block form the principal steps of converting a bundle of continuous filaments, such as produced by extrusion, into yarn composed of twisted relatively short discontinuous filamentary lengths similar to staple fibers. The filaments are drawn to increased length and broken to produce a bundle of discontinuous filamentary lengths, whereupon that bundle or strand is drafted to slide the discontinuous lengths longitudinally with regard to one another and thereby reduce the strand diameter, during or after which the strand is twisted and then wound, usually onto a package, in the form of yarn. As indicated above, conventional equipment for accomplishing this sequence of steps has not proved too successful because of imperfect denier adjustment or control.

FIGS. 2A and 2B illustrate in block form the principal steps of converting a bundle of continuous filaments into a sliver of staple fibers by way of complete cutting into staple and reforming into relatively untwisted strand form. Thus, according to FIG. 2A the continuous-filament bundle is drawn, crimped, and cut into staple, which then usually is baled or otherwise stored temporarily. As indicated by the several arrows at the left of FIG. 2B, staple fibers from a number of such operations are blended together into a mass, which is then opened and carded preparatory to collection as sliver.

FIGS. 3A and 3B illustrate in block form conversion of sliver into yarn by way of an at least partially twisted roving. As indicated by the arrows at the left of FIG. 3A, sliver from a number of such operations as were illustrated in the preceding view are combined and gilled or combed into parallel form and then drafted as a unit and twisted into a roving. FIG. 3B illustrates the combination of several rovings and the drafting, twisting, and winding thereof into yarn form.

Yarn produced by the staple route as illustrated in FIGS. 2 and 3 has the advantage of having been formed by way of multiple blending of the component fibers, first in the form of staple and then in the form of sliver, and finally roving. This advantage is not present in the long-draft direct spinning method illustrated in FIG. 1.

The steps illustrated in the following views are advantageously performed according to this invention. Thus, a strand of continuous filaments, which may be relatively freshly extruded or may have been extruded long before and suitably stored in the meantime, is used as a starting material. Totalling some thousands of denier, preferably between 10^4 and 10^5 , such as 25,000 or 30,000 denier, it is subjected to a draw of from several to something over a half dozen times its original length to produce a tow of correspondingly dimensioned denier, such as 5,000 denier. This is on the order of no more than a tenth the size of tow in conventional synthetic strand processing. It is crimped in any suitable manner, preferably compressively as in a stuffer-crimper, of which many examples are known in the art. The crimped tow is wound and for convenience may be wound up onto a temporary package

tube, much as in ball warping, without addition of twist. A multiplicity thereof, up to several hundred, may be creeled for withdrawal simultaneously as illustrated in the next view. Suggested by the arrows at the left, a multiplicity of strands of the drawn crimped tow are combined, as from a creel as suggested, into essentially parallel relationship, as by using a suitable multiple-end guide, and while so arranged the component filaments are severed intermittently along their lengths. Such severing is preferably performed by a rotating helical blade, which nips the filaments against a supporting anvil or similar relatively unyielding structure. Although the continuity of the individual filaments is interrupted, the overall strand continuity is maintained, and the composite strand resulting from combination of the multiplicity of tow bundles is drafted to reduced diameter, the respective discontinuous filament lengths sliding over one another as in the instance of sliver drafting. The resultant strand structure or top having a denier of from about 10^5 to 10^6 , such as several hundred thousand, is composed of essentially parallel lengths of filaments terminating individually at successive locations along the strand and may be wound into suitable package form. With or without such packaging, the top may be drafted, apart from or together with (e.g., 20 strands) additional top to further reduced diameter, and then or thereafter be further drafted and twisted and eventually wound into yarn form, much as in FIG. 3B.

It is entirely practicable to have upwards of a thousand combinations or doublings of strands in the practice of this invention, thereby greatly reducing or even eliminating the effect of marked variations in denier or physical characteristics of the respective blended strands. While for convenience the draw-crimped tow may be creeled temporarily, if sufficient units of drawing and crimping (or draw-crimping) machinery are available, the process preferably is operated continuously without the holdup effected by temporary storage.

The steps illustrated in FIG. 4B may be performed in a Pacific converter or similar apparatus known in the art. The distribution of lengths into which the component filaments are severed is adjusted or controlled as desired by appropriate regulation of the speed of rotation of the severing blade in relation to the speed of travel of the material being severed. Avoidance of non-parallelism of the filamentary components, whether in continuous or discontinuous form, until the intentional introduction of twist thereinto is a feature of this invention, which although described above may be modified by addition, combination, or subdivision of steps or parts, and is defined in the following claims.

The claimed invention:

1. In treatment of textile strands having filamentary components, the steps of drawing a textile strand having a total denier of 10^4 to 10^5 to increased length so that the

drawn strand has a total denier of 10^3 to 10^4 , crimping it, and winding the drawn crimped strand onto a temporary package; performing the foregoing steps upon a plurality of strands separately from one another; unwinding a multiplicity of such strands from the temporary packages, combining them in parallel juxtaposition into a composite strand having a total denier of 10^5 to 10^6 , severing the filamentary components while maintaining the composite strand intact, and drafting the strand to reduced diameter.

2. Strand treatment according to claim 1 wherein the filamentary components in the strands are initially essentially parallel to one another and free of twist and remain essentially free of twist throughout.

3. Strand treatment according to claim 1 wherein the denier of the starting strand is between 25,000 and 30,000.

4. Strand treatment according to claim 1 wherein the denier of the temporarily packaged strand is on the order of 5000.

5. Strand treatment according to claim 1 wherein the denier of the resultant composite strand is several hundred thousand.

6. Process for converting continuous filaments to top by consecutive steps performed in continuous manner comprising drawing to increased length a strand of continuous filaments, crimping the drawn strand, combining the crimped drawn strand side by side with a plurality of similarly treated crimped drawn strands to form a composite strand, severing the filaments while maintaining the composite strand intact, drafting the resulting strand to reduced diameter, and collecting the top so formed.

7. Product of the process of claim 1 in the form of top.

8. Top produced according to the process of claim 6.

9. Process according to claim 6 including the step of drafting together with the resultant strand a quantity of strand similarly treated separately therefrom.

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