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DRAFTABLE NON-TWISTED STAPLE FIBER BAND AND PROCESS FOR THE MANUFACTURE OF A DRAFTABLE STAPLE FIBER BAND OF HIGH DENSITY AND BREAKING LENGTH

Original Filed Aug. 10, 1964

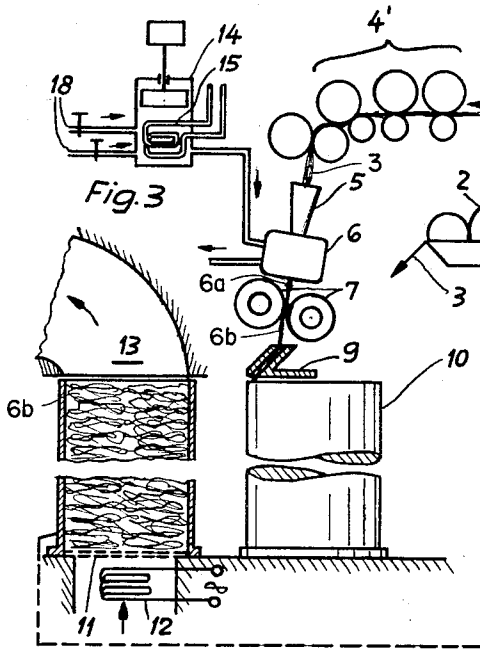


Fig. 3

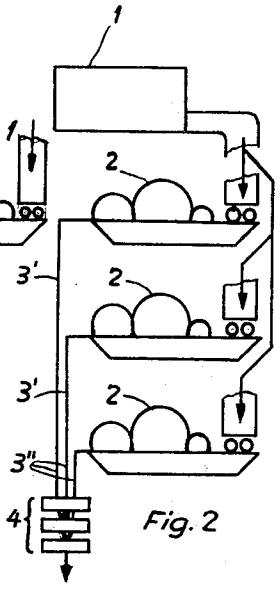


Fig. 1

Fig. 2

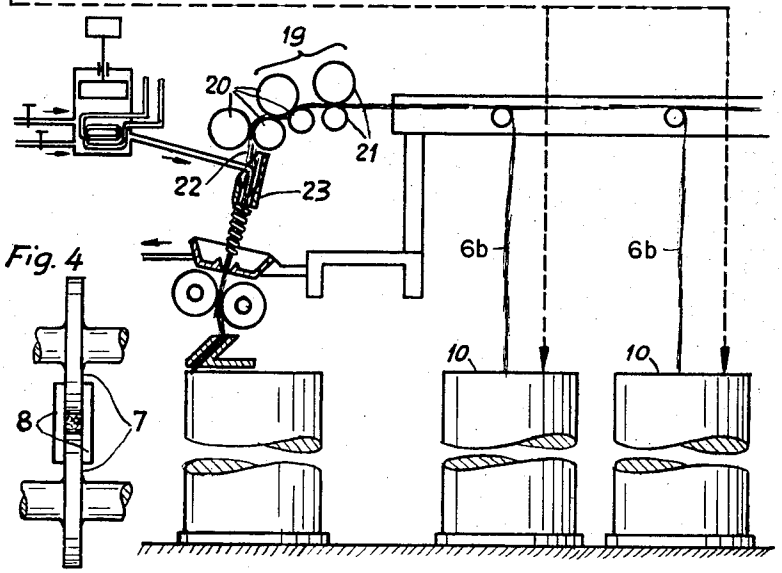


Fig. 4

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DRAFTABLE NON-TWISTED STAPLE FIBER BAND AND PROCESS FOR THE MANUFACTURE OF A DRAFTABLE STAPLE FIBER BAND OF HIGH DENSITY AND BREAKING LENGTH

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Continuation of abandoned application Ser. No. 725,239, Sept. 19, 1967, which is a division of application Ser. No. 388,430, Aug. 10, 1964, now Patent No. 3,432,889. This application Oct. 18, 1971, Ser. No. 189,969
Claims priority, application Switzerland, Aug. 16, 1963, 10,231/63; Germany, Mar. 5, 1964, P 33,758
Int. Cl. D02g 3/00; D04h 11/00
U.S. Cl. 161—176 8 Claims

ABSTRACT OF THE DISCLOSURE

A non-twisted consolidated staple fiber sliver possessing high density and small specific volume which is capable of being drafted. A dried fixing agent surrounds individual fibers of the sliver. The fixing agent binds the fibers to one another so strongly that the breaking length of the sliver considerably exceeds that of a twisted roving formed of the same staple fibers as the sliver, yet not bonded, and possessing the same weight per unit length as the bonded staple fiber sliver.

CROSS-REFERENCE TO RELATED CASE

The instant application is a continuation application of my commonly assigned, copending U.S. application, Ser. No. 725,239, filed Sept. 19, 1967, now abandoned which, in turn, is a divisional application of my commonly assigned U.S. application, Ser. No. 388,430, filed Aug. 10, 1964, now Pat. No. 3,432,889.

BACKGROUND OF THE INVENTION

The present invention has reference to an improved non-twisted staple fiber band or sliver of high density and breaking or tearing length from which a twisted yarn may be produced after subsequent drafting.

In the context of this application the term "staple fiber band or sliver" denotes a non-twisted fiber arrangement, band or sliver consisting of staple fibers.

The heretofore known so-called direct spinning processes encompassed two drawing frame passages following the carding machines delivering a sliver and the formation of a twisted yarn at a ring spinning frame while employing very complicated multiple-zone drafting arrangements provided with a plurality of condensers. Since the fiber masses fed to the drawing frames are, of necessity, quite considerable there can not be employed any means for improving the guiding of the fibers in these drafting arrangements, as such occurs, for example, with the drafting arrangements at flyers and ring spinning frames working with much smaller fiber masses and where the guiding of the fibers is considerably improved by fiber guiding means effective at the main drafting zone in the form of aprons and the like for instance.

SUMMARY OF THE INVENTION

Accordingly, one of the objects of the present invention is directed towards overcoming these disadvantages by providing a non-twisted staple fiber sliver of high density and breaking length.

It is a further object of the present invention to provide a non-twisted staple fiber sliver which can be drafted, i.e. which possesses those characterstics required for drafting in a drafting arrangement.

According to the present invention there is formed a non-twisted staple fiber sliver of high density and great

breaking length, the individual fibers of which are essentially in parallelism. This staple fiber sliver is consolidated or compacted and possesses a small specific volume, a dried fixing agent surrounding the individual fibers, the fixing agent binding the fibers to one another so strongly that the breaking length of the sliver considerably exceeds that of a twisted roving formed of the same fibers, yet not bonded, and possessing the same weight per unit length as the bonded staple fiber sliver.

According to a further feature of the invention the non-twisted staple fiber sliver possesses a cross-sectional configuration having generally no dimension in any direction appreciably greater than in any other direction, such as a generally round or rectangular configuration.

According to a further feature of the invention the non-twisted staple fiber sliver is draftable, i.e. may be subjected to drafting in a drafting zone of a drafting arrangement, the fixing agent binding the fibers to one another such that the bond between the staple fibers will be ruptured during drafting in the drafting zone before destruction of the individual fibers.

A non-twisted staple fiber sliver according to the invention can be manufactured by a process which, starting with a homogeneous draftable staple fiber arrangement, comprises the steps of:

Forming a staple fiber layer and the first application of a dissolved fixing agent, whereafter there occurs a consolidation or compressing of the staple fiber layer into a compact sliver of small specific volume and the removal of excess fixing agent, binding of the sliver by the fixing agent by evaporating the solvent of the fixing agent by drying in a drying zone. After forming a doubled fiber arrangement or strand from a number of such slivers and subsequent rupture of this bond by drafting in a drafting zone the thus departing sliver is once again subjected to an impregnation or soaking by means of the same fixing agent or a liquid compatible therewith, with there taking place subsequent consolidation or grouping together of the fiber material and squeezing out excess fixing agent or liquid as well as drying of the sliver.

A further feature of the process resides in the drafting of the staple fiber layer to produce a greater fiber parallelism prior to the first application of dissolved fixing agent.

The process is further characterized by the feature that the bond attained by introducing and evaporating the solvent is maintained until the fibers are withdrawn through the delivery rollers of a subsequent drafting zone.

The thus obtained sliver possesses the essential requirements which must be demanded for ideal behavior during drafting in a single-zone drafting arrangement at the ring spinning frame should the yarn quality be brought to a stage not previously attainable. In fact, the carded yarns spun from a sliver produced according to the invention possess greater uniformity, less thick and thin locations, smaller neppiness, as well as greater breaking strength, and very closely approach the species of a combed yarn.

Additionally, the slivers become considerably more resistent for transportation and silver rupture as well as faulty drafting due to improper processing are practically impossible. Driven band or sliver lifting-rollers and other supply means to a drafting arrangement are rendered superfluous. Furthermore, the bundles or packages necessary for material transport from machine to machine contain considerably larger quantities of material in consequence of the greater density of the compact slivers.

As a result of the steps of forming the doubled fiber arrangement, subsequent rupture of the bond by drafting in the drafting zone and again subjecting such to an impregnation and consolidating, which follow the step of

binding of the sliver by evaporating the solvent of the fixing agent, the staple fiber not only possesses greater uniformity but advantageously contains a reduced amount of fiber hooks. As known in the art such fiber hooks can be of disadvantage in the subsequent drafting process of the ring spinning frame. For example, the staple fiber sliver resulting from such processing contains an extremely small percentage of fibers having trailing hooks, such as about 1% with respect to the number of fibers of the sliver, i.e. hooked ends of the fibers which would trail into a drafting process. After reversal of such sliver, for example after depositing the sliver in a can, the small percentage of hooked ends can be fed into the drafting process of the ring spinning frame as leading hooks, whereby an improved quality of the yarn manufactured from such sliver results. The extremely small number of fiber hooks which are present in a sliver prepared according to the teachings of this invention, irrespective of the manner in which such sliver may be further subsequently processed, in and of itself contributes to an improved quality of the sliver.

BRIEF DESCRIPTION OF THE DRAWINGS

Other features, objects and advantages of the invention will become apparent by reference to the following detailed description and drawing wherein like reference numerals generally denote the same or analogous elements, and in which:

FIG. 1 schematically illustrates a machine installation for delivery of a homogeneous draftable staple fiber band or sliver;

FIG. 2 depicts a variant of the machine installation of FIG. 1.

FIG. 3 is an installation suitable for carrying out the inventive process; and

FIG. 4 illustrates a detail of the installation of FIG. 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Describing now the drawing, a conventional blowing room installation **1** furnishes a number of carding machines **2** with fiber material which deliver a homogeneous and draftable staple fiber band for the inventive process in the final stage of processing. Such a staple fiber band can, of course, consist of natural or man-made fibers, or mixtures thereof, and can be produced from a given machine which, like the carding engine, is capable of delivering a homogeneous draftable staple fiber band. The staple fiber band produced at a carding engine or machine **2** (FIG. 1) is then, after either forming a staple fiber layer **3** or, however, after grouping together a number of card bands or slivers **3'**, first of all consolidated into a fiber arrangement or strand **3''** (FIG. 2) and this doubled fiber arrangement **3''** drafted in a conventional multi-zone drafting arrangement **4** for achieving a desired fiber parallelism.

It will be appreciated that the drafting arrangement of FIG. 3 designated by reference character **4'** correponds to the drafting arrangement **4** of FIG. 2 and incorporates a preliminary drafting zone and main drafting zone. The web or the staple fiber layer **3** leaving the drafting arrangement **4'** (FIG. 3) after being grouped together through the agency of guide means **5**, such as a condenser, is guided into a fluid or liquid applying apparatus **6**. At this liquid applying apparatus **6**, while maintaining the fiber orientation, the web is soaked during its through passage with a fixing agent, for example a sizing agent dissolved in water, more fully to be considered hereinafter. In carrying out the aforedescribed impregnation or soaking operation, as much fixing agent is introduced as is necessary to obtain distribution of fixing agent in the sliver or band which is as homogeneous as possible. The departing band or sliver **6*a*** is then squeezed through a pressure zone, consisting of a pair of stripping disks **7** provided with lateral guard means **8** (FIG. 4), consolidated into a compact band or sliver **6*b*** and deposited in a sliver can **10** through the intermediary of a depositing apparatus **9**, such as a trumpet wheel of known construction. A so-called sliver machine of the aforementioned type is disclosed in my commonly assigned, copending, U.S. patent application, Ser. No. 299,550, filed Aug. 2, 1963 and entitled "Process for the Manufacture of a Twisted Yarn," now U.S. Pat. No. 3,191,375. It is eventually possible that a surface drying of the sliver **6*b*** can become important prior to deposition, and such can be effected by well-known heating means or by first passing through a specific drying zone, as taught in my aforementioned copending application.

This surface drying of the sliver **6*b*** directly after leaving the pressure zone for the purpose of initiating evaporation of the solvent is thereafter completed by means of a uniform thorough drying. To this end, the sliver can **10** advantageously provided with a perforated floor or base **11**, after having been filled, is placed in an air current heated or conditioned by means of a suitable heater mechanism **12**. This air current then flows through the sliver can **10** and is drawn-off via this can **10** and through a chimney or flue **13**. Here, in addition to drying of the capillary water there is also provided the opportunity of bringing the fiber material into a condition suitable for subsequent drafting (moisture content, temperature, etc.).

The fixing agent itself is delivered under pressure from a reservoir or supply container **14** to the liquid applying apparatus **6**. This container **14** incorporates a heating coil **15** for heating the fixing agent in the event such is desired. The excess fixing agent can again be returned to the container **14** via a pump and a filter (not shown). The two conduits **18** indicate that the fixing agent can contain different constituents which, as the case may be, can be separately introduced, as will be further explained hereinafter.

The entire assembly of apparatus according to the upper portion of FIG. 3 can, as will be recalled, conveniently be termed a compact-sliver machine. The sliver can **10** filled with the fixed band or sliver **6*b*** is then brought to a second, analogously constructed compact-sliver machine, depicted in the lower portion of FIG. 3. After having performed doubling of the bands or slivers **6*b*** removed from the sliver cans **10** there is undertaken drafting in a single-zone drafting arrangement **19**. The four rollers **20** of the second roller group all travel with the same, yet greater circumferential speed, than the roller pair **21**. The previous imparted fixing of the sliver is considerably maintained until having passed the pair of rollers **21** and is first again broken by the drafting of the rollers **20** of the aforesaid single-zone drafting arrangement **19**, whereby a new type of fiber control is performed during the drafting operation by the fibers still bound by the size, and therefore floating fibers do not occur which disturb the drafting operation.

The web **22** leaving the single-zone drafting arrangement **19** is then again consolidated or grouped together while perserving the parallelism of the fibers and while making uniform the distribution of the adhesive or agglutinant introduced during the previous stage, such web then being delivered to a further liquid applying apparatus **23**. The liquid applying apparatuses **6** and **23** are described in detail in my copending, commonly assigned, U.S. patent application, Ser. No. 326,058, filed Nov. 26, 1963 and entitled "Method and Apparatus for the Continuous Introduction of Liquid Into a Staple Fiber Band or the Like," now U.S. Pat. No. 3,323,176, so that further details of the physical structure thereof is not believed warranted.

The water soluble fixing agent introduced during the second stage advantageously possesses a smaller concentration than the fixing agent introduced during the previous work-cycle and, of course, is—although it basically can be of a different nature—compatible with and can dissolve such. In order to prevent a migration of fixing agent at the surface by virtue of the drying operation, it is advantageous to hold the quantity of fixing agent newly introduced during this working cycle to a mini-

mum by pronounced squeezing-out or pressing. The fixing agent introduced during this stage serves, on the one hand, to sufficiently re-activate the homogeneously distributed size particles still disposed in the sliver, that is, permits superficial swelling and partial dissolving, in order to no longer disturb the uniformity achieved by doubling and drafting, and, on the other hand, to guarantee for a renewed, faultless fixing of the sliver after leaving the second compact sliver machine.

In this second compact sliver machine there is thus achieved a uniform or homogeneous distribution as possible throughout cross-section and length of the fixing agent applied in suitable quantity, and as a consequence there results as good as possible fixing of the individual fibers within the staple fiber band.

The particular requirements placed upon the fixing agent with regard to the drafting operation are as follows:

(1) The connection or bond between the fibers should be capable of rupture in the drafting zone of the drafting arrangement without fiber damage, and without the cohesion or bond effected by the fixing agent being prematurely destroyed in consequence of bonding and clamping between the individual rollers during the infeed of the bands; in other words sufficient elasticity should prevail.
(2) Small tendency towards migration.
(3) Compatibility with the simultaneously performed chemical finishing operations.
(4) Soluble in water.

Thus, there generally comes under consideration for the fixing agents the water soluble sizing agents previously employed up to the present in weaving mills or textile manufacturing processes, whereby also an additional sizing with simultaneous re-activation of the already available size particles during the textile manufacturing process, if necessary, does not encounter any difficulty whatsoever. Such type sizing agents which are well-known to the art are corn starch, rice starch and potato starch, which during preparation are dissolved in a concentration of 0.5 to 5% by cooking in water and cooled down to room temperature, or also applied in heated condition. The fixing agents on the basis of pure starch give relatively brittle connections or bonds between the individual fibers resulting in a stiff band or sliver, so that the bond then, during unsuitable conditions of handling, for example with pronounced flexing or too great loading of the draw-in rollers, easily breaks or ruptures already prior to drafting. This disadvantage can be countered by the addition of plasticizing agents. In the event that it appears desirable to have a further increase of the elasticity, it is recommended to employ a polyvinyl alcohol as the fixing or sizing agent which, likewise to achieve a condition of use, is mixed in a concentration of approximately 0.5 to 5% in water.

Depending upon the desired elastic properties of the bands or slivers it is also possible to employ as the fixing or sizing agent a solution containing, in combination, starch and polyvinyl alcohol. Also suitable for use are sodium alginate, casein as well as cellulose xanthogenate. The homogeneous distribution of the solution of fixing agent or sizing blend in the sliver and the good wetting of the individual fibers can be additionally facilitated by the addition of a surfactant or wetting agent.

Furthermore, the addition of substances or additives commonly employed in the textile finishing or sizing department, such as fungicides or bactericides, as for example commercially available "Antimutin SR" or "Antimutin AN," manufactured by the Sandoz Company, Basel, Switzerland, in concentrations of 0.01 to 0.02% in the same working operation with the fixing or sizing agent can already be accomplished, completely considered apart from the possibility of dyeing the fibers by the addition of dyes or coloring matter in the fixing agent, also at a point at which the individual fibers can be still easier contacted at all sides than with a finished twisted yarn. Moreover, the addition of bleaching agents, antistatic agents, or quite generally, textile finishing agents can easily and effectively take place at this point. It will be further appreciated that these aforesaid materials, such as textile finishing agents, coloring matter, etc. can be added during each soaking with fixing agent or compatible solvatizing liquid, and that the second such introduced materials can be the same or different than the first.

Now that the inventive process and the means necessary for the performance of the same have been described in general terms, a concrete example employing cotton will now be given in order to further facilitate understanding of the inventive concepts.

EXAMPLE

A fiber arrangement of 8000 tex. (Ne 0.074) is delivered to the first drafting arrangement **4'** and while employing a preliminary draft with a quadruple overall draft is drafted to a strength of 2000 tex. (Ne 0.3) and thus delivered to the first liquid applying apparatus **6**.

The preparation of the fixing agent is undertaken with "Vibatex S," a commercially available aqueous polyvinyl alcohol with 20% dry content manufactured by Ciba AG or Basel, Switzerland. 140 grams "Vibatex S" are admixed with 860 grams hot water for each kilogram fixing agent. This fixing agent is introduced to the band or sliver via the liquid applying apparatus **6** and by means of the stripping disks **7** pressed-out until attaining a fixing agent content of 40% calculated with respect to the normal weight of the introduced cotton (based upon 65% relative humidity at 20° C.). For each kilogram normally climatized cotton this 40% fixing agent thus corresponds to 400 grams aqueous solution, containing approximately 56 grams "Vibatex S." With the mentioned 20% dry content of "Vibatex S" there accordingly appears in the band an introduced solid content of 11.2 grams per kilogram normally climatized cotton, which results in a solid content of approximately 1.2 percent by weight. After drying the band there appears for the first time a fixed sliver or band exhibiting an adherence length of approximately 1000 meters, such value being of course dependent upon different factors, such as the type of cotton, the available fiber wax and the distribution of the fixing agent in the band or sliver. However, such value is still considerably higher than that of a strongly twisted roving (approximately 300 meters). In the second phase six bands, each 2000 tex., are then doubled into a fiber arrangement of 12,000 tex., and with a fourteenfold drafting in a single-zone drafting arrangement there results at the outlet a sliver of 860 tex. which is then delivered to the liquid applying apparatus **23**. Here, there occurs the second introduction of fixing agent possessing a smaller "Vibatex S" concentration of 120 grams per kilogram fixing agent. After pressing-out to a fixing agent-content of 28% there is attained an increase of the solid content per kilogram normal climatized cotton of aproximately 6.7 grams or 0.67%, corresponding to a total content of 17.9 grams. The staple fiber band produced in this manner possesses a breaking or tearing length in the same order of magnitude as that after completion of the first fixing operation.

In order to produce a twisted yarn the drafting of the in the meantime dried or suitably conditioned bands takes place at a single-zone ring spinning drafting arrangement, for example with 43.5-fold drafting, whereby there results a yarn of 19.6 tex. (Ne 30).

While there is shown and described present preferred embodiments of the invention, it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied and practiced within the scope of the following claims.

Accordingly, what is claimed is:

1. A non-twisted consolidated staple fiber sliver possessing

(a) an untwisted fiber arrangement compressed into a compact untwisted sliver of high density and small specific volume;

(b) said untwisted fiber arrangement resulting from a doubled arrangement of non-twisted consolidated staple fiber slivers drafted before compression of said untwisted fiber arrangement;

(c) said staple fiber sliver comprising said compact sliver possessing a cross-section configuration having generally no dimension in any direction appreciably greater than in any other direction;

(d) the individual fibers of the sliver being essentially in parallelism; and

(e) a dried fixing agent surrounding said individual fibers, said fixing agent binding said fibers to one another so strongly that the breaking length of the sliver considerably exceeds that of a twisted roving formed of the same staple fibers as the sliver, yet not bonded, and possessing the same weight per unit length as the bonded staple fiber sliver.

2. A non-twisted consolidated staple fiber sliver possessing

(a) an untwisted fiber arrangement compressed into a compact untwisted sliver of high density and small specific volume;

(b) said staple fiber sliver comprising said compact sliver further possessing a cross-sectional configuration having generally no dimension in any direction appreciably greater than in any other direction;

(c) the individual fibers of the sliver being essentially in parallelism;

(d) a dried fixing agent surrounding said individual fibers, said fixing agent binding said fibers to one another so strongly that the breaking length of the sliver considerably exceeds that of a twisted roving formed of the same staple fibers as the sliver, yet not bonded, and possessing the same weight per unit length as the bonded staple fiber sliver; and

(e) said staple fiber sliver containing an extremely small percentage of fibers having leading hooks.

3. The non-twisted consolidated staple fiber sliver according to claim 2, wherein said staple fiber sliver possesses a generally round cross-sectional configuration.

4. The non-twisted consolidated staple fiber sliver according to claim 2, wherein said staple fiber sliver possesses a generally rectangular cross-sectional configuration.

5. A draftable, non-twisted consolidated staple fiber sliver, possessing

(a) an untwisted fiber arrangement compressed into a compact sliver of high density and small specific volume, the individual fibers of the sliver being essentially in parallelism;

(b) a dried fixing agent surrounding said individual fibers, said fixing agent binding said fibers to one another so strongly that the breaking length of the sliver considerably exceeds that of a twisted roving

formed of the same staple fibers as the sliver, yet not bonded, and possessing the same weight per unit length as the bonded staple fiber sliver; and

(c) said fixing agent further binding said fibers to one another such that the bond between the staple fibers will rupture during drafting in a drafting zone before destruction of the individual fibers;

(d) said staple fiber sliver containing an extremely small percentage of fibers having leading hooks.

6. A draftable non-twisted consolidated staple fiber sliver possessing

(a) an untwisted fiber arrangement compressed into a compact sliver of high density and small specific volume;

(b) said staple fiber sliver comprising said compact sliver possessing a cross-sectional configuration having generally no dimension in any direction appreciably greater than in any other direction;

(c) the individual fibers of the sliver being essentially in parallelism;

(d) a dried fixing agent surrounding said individual fibers, said fixing agent binding said fibers to one another so strongly that the breaking length of the sliver considerably exceeds that of a twisted roving formed of the same staple fibers as the sliver, yet not bonded, and possessing the same weight per unit length as the bonded staple fiber sliver;

(e) said fixing agent further binding said fibers to one another such that the bond between the staple fibers will rupture during drafting in a drafting zone before destruction of the individual fibers; and

(f) said staple fiber sliver containing an extremely small percentage of fibers having leading hooks.

7. The draftable non-twisted consolidated staple fiber sliver according to claim 6, wherein said staple fiber sliver possesses a generally round cross-sectional configuration.

8. The draftable non-twisted consolidated staple fiber sliver according to claim 6, wherein said staple fiber sliver possesses a generally rectangular cross-sectional configuration.

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