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

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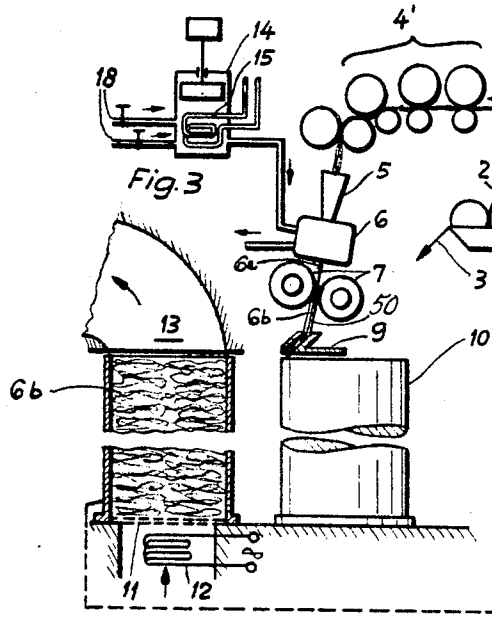

Fig. 3

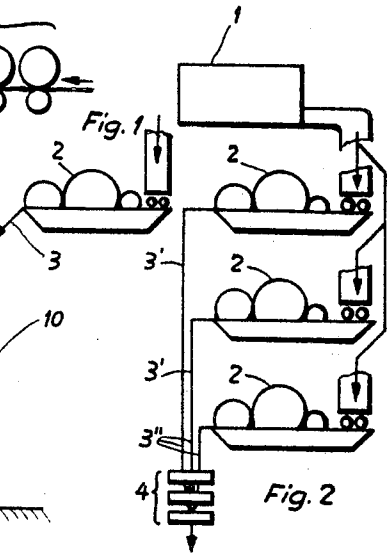

Fig. 1

Fig. 2

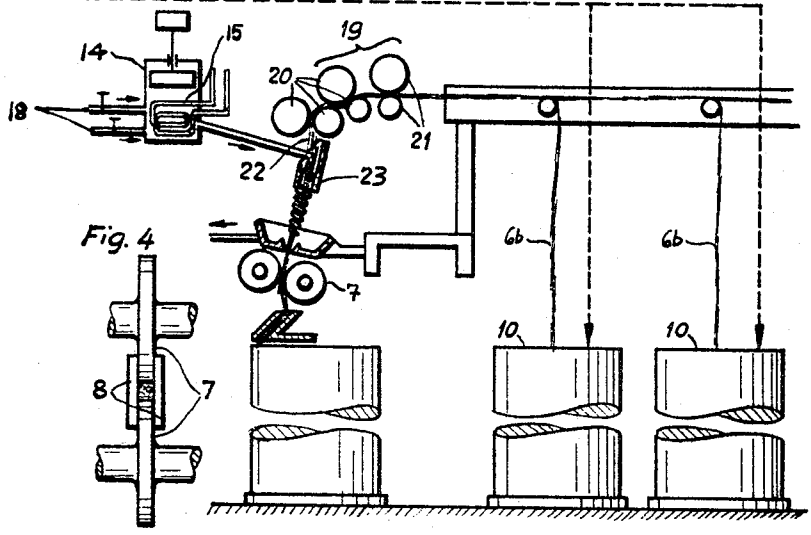

Fig. 4

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

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Int. Cl. D01b 3/04; D01d 5/00; D01f 1/00

ABSTRACT OF THE DISCLOSURE

A process for manufacturing a draftable staple fiber band or sliver of high density and strength. A fiber arrangement formed of a homogeneous, draftable staple fiber band is formed into a staple fiber layer. Then there is initially introduced a dissolved fixing agent into the staple fiber layer, the latter is then consolidated into a sliver of small specific volume and excess fixing agent is withdrawn. The sliver is bonded by the fixing agent by evaporating the solvent of the fixing agent by drying in a drying zone. Then there is formed a doubled fiber arrangement from a plurality of these slivers and subsequently the bond is ruptured by drafting in a drafting zone. The sliver leaving the aforesaid drafting zone is subjected to further soaking with a liquid which is the same as the initially introduced fixing agent or compatible with such fixing agent and capable of dissolving the latter. Then the fiber material of the sliver is consolidated, excess liquid is extracted, and the sliver dried.

The present invention has reference to an improved process for the manufacture of a draftable staple fiber band or sliver of high density and breaking or tearing length from which a twisted yarn can be produced after subsequent drafting.

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 bands and the like for instance.

Accordingly, a primary object of the present invention is directed towards overcoming these disadvantages by providing an improved process for the manufacture of a draftable staple fiber band of high density and breaking length.

These aforementioned disadvantages of the mentioned spinning processes can be overcome with the inventive process for the manufacture of a draftable staple fiber band of high density and great breaking length in that, starting with a homogeneous draftable staple fiber band, the following process steps are undertaken:

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 band or sliver of small volume and the removal of superfluous fixing agent, depositing of the band

and binding of the sliver by evaporating the solvent. After forming a doubled fiber arrangement or strand from a number of such bands and subsequent rupture of this bond by drafting in a drafting zone the thus departing sliver or band 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 depositing of the band.

A further feature of the present invention 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 inventive 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 band or 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 band or 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 bands become considerably more resistant for transportation, and band 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 superfluouos. 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 bands.

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:

FIGURE 1 schematically illustrates a machine installation for delivery of a homogeneous draftable staple fiber band;

FIGURE 2 depicts a variant of the machine installation of FIGURE 1;

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

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

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 manmade 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 (FIGURE 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 stand 3'' (FIGURE 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

FIGURE 3 designated by reference character 4' corresponds to the drafting arrangement 4 of FIGURE 2 and incorporates a preliminary drafting zone and main drafting zone. The web or the staple fiber layer 3 leaving the drafting arrangement 4' (FIGURE 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 throughpassage 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 silver or band which is as homogeneous as possible. The departing band or silver 6*a* is then squeezed through a pressure zone, consisting of a pair of stripping disks 7 provided with lateral guard means 8 (FIGURE 4), consolidated into a compact band or silver 6*b* and deposited in a silver 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 United States patent application Ser. No. 299,550, filed Aug. 2, 1963, now United States Patent 3,191,375, and entitled "Process for the Manufacture of a Twisted Yarn." It is enventually 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 United States Patent, and generally schematically indicated by reference numeral 50 which denotes such a drying zone in FIGURE 3 between the disks 7 and the trumpet wheel 9.

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 an 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 FIGURE 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 FIGURE 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 preserving 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, United States 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," 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 minimum 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 bending 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) Compatability 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 reactivation 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 cornstarch, 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 arangement 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 of Basel, Switzerland. 140 grams "Vitatex 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 approximately 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 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).

The foregoing detailed description has been given for clearness of understanding only, and no unnecessary limitations should be understood therefrom, as modifications will be obvious to those skilled in the art.

What is claimed is:

1. Process for the manufacture of a draftable staple fiber sliver of high density and strength starting from a fiber arrangement formed of a homogeneous, draftable staple fiber band, comprising the steps of:

(a) forming a staple fiber layer,

(b) initially introducing a dissolved fixing agent into said staple fiber layer,

(c) consolidating the staple fiber layer into a sliver of small specific volume and withdrawing excess fixing agent,

(d) bonding such sliver by said fixing agent by evaporating the solvent of the fixing agent by drying in a drying zone,

(e) forming a doubled fiber arrangement from a plurality of these slivers and subsequently rupturing the bond by drafting in a drafting zone,

(f) subjecting the sliver leaving the aforesaid drafting zone to further soaking with a liquid,

(g) consolidating the fiber material of the sliver and extracting excess liquid,

(h) then drying such sliver.

2. Process for the manufacture of a draftable staple fiber sliver according to claim **1** wherein said further soaking with a liquid comprises the steps of introducing a dissolved fixing agent essentially consisting of the same components as the initially introduced dissolved fixing agent, into the drafted staple fiber layer having particles of said initially introduced fixing agent.

3. Process for the manufacture of a draftable staple fiber sliver according to claim **2**, wherein a smaller concentration of said dissolved fixing agent is introduced during step (f) than the concentration of dissolved fixing agent initially introduced during step (b).

4. Process for the manufacture of a draftable staple fiber sliver according to claim **1**, wherein said further soaking with a liquid comprises the step of introducing a liquid which is compatible with respect to said initially introduced fixing agent which is still present in the sliver.

5. Process for the manufacture of a draftable staple fiber sliver according to claim **1**, wherein said further soaking with a liquid comprises the step of introducing a liquid which is capable of dissolving any initially introduced fixing agent still disposed in the sliver.

6. Process for the manufacture of a draftable staple fiber sliver according to claim **1**, wherein said further soaking with a liquid comprises the steps of introducing a liquid which is capable of solvatizing any initially introduced fixing agent still disposed in the sliver.

7. Process for the manufacture of a draftable staple fiber sliver according to claim **1** including the step of conditioning said sliver in the drying zone for bringing the fiber material into a condition suitable for subsequent drafting.

8. Process for the manufacture of a draftable staple fiber sliver according to claim **1**, including the step of

conditioning said sliver after evaporation of the solvent of the fixing agent.

9. Process for the manufacture of a draftable staple fiber sliver according to claim **1**, further including the step of maintaining the bond achieved at the sliver due to introduction and evaporation of the solvent of the fixing agent until withdrawal of the fibers of the sliver by the delivery rollers of said drafting zone.

10. Process for the manufacture of a draftable staple fiber sliver according to claim **1**, including the step of drafting the staple fiber layer prior to the initial introduction of a dissoved fixing agent according to step (b).

11. Process for the manufacture of a draftable staple fiber sliver according to claim **1**, further including the step of simultaneously introducing textile finishing additives when initially introducing the fixing agent.

12. Process for the manufacture of a draftable staple fiber sliver according to claim **11**, wherein said textile finishing additives comprise coloring matter.

13. Process for the manufacture of a draftable staple fiber sliver according to claim **11**, wherein said textile finishing additives comprise bleaching agents.

14. Process for the manufacture of a draftable staple fiber sliver according to claim **11**, wherein said textile finishing additives comprise fungicides.

15. Process for the manufacture of a draftable staple fiber sliver according to claim **11**, wherein said textile finishing additives comprise bactericides.

16. Process for the manufacture of a draftable staple fiber sliver according to claim **1**, including the step of simultaneously introducing textile finishing additives when further soaking with the liquid.

17. Process for the manufacture of a draftable staple fiber sliver according to claim **16**, wherein said textile finishing additives comprise coloring matter.

18. Process for the manufacture of a draftable staple fiber sliver according to claim **16**, wherein said textile finishing additives comprise bleaching agents.

19. Process for the manufacture of a draftable staple fiber sliver according to claim **16**, wherein said textile finishing additives comprise fungicides.

20. Process for the manufacture of a draftable staple fiber sliver according to claim **16**, wherein said textile finishing additives comprise bactericides.

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DORSEY NEWTON, *Primary Examiner.*