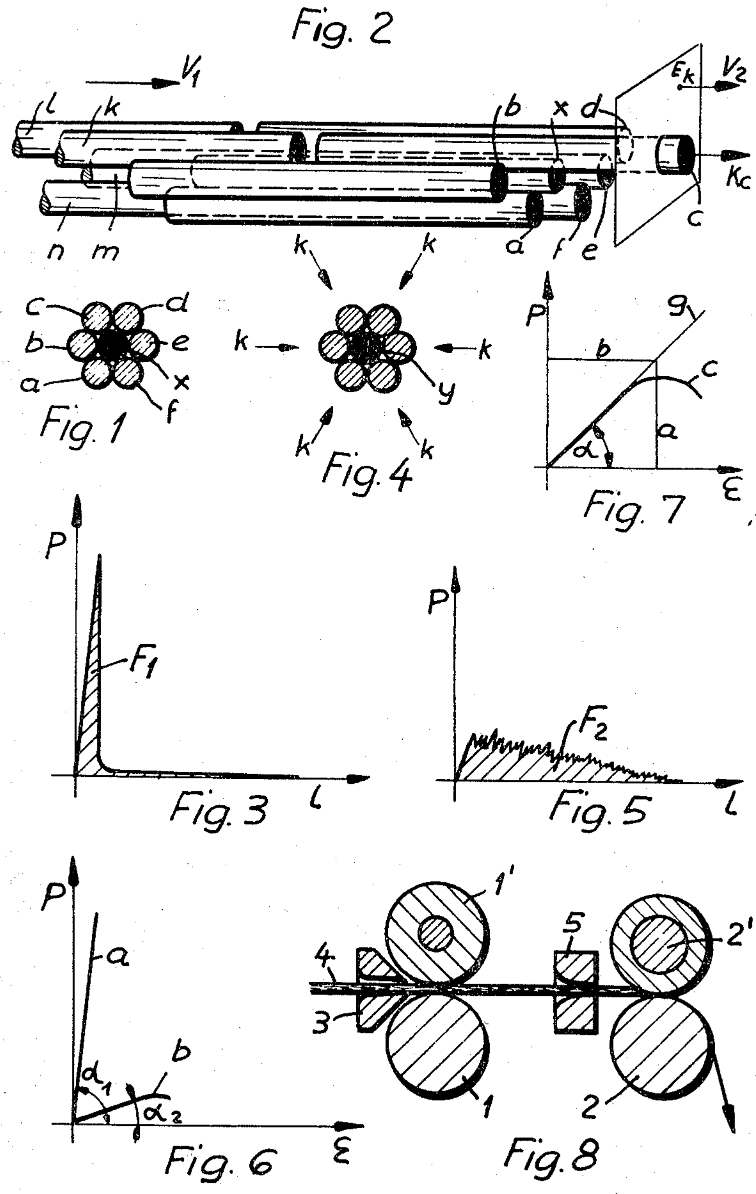
Dec. 22, 1970 W. NAEGELI 3,548,460

PROCESS FOR DRAFTING STAPLE FIBERS

Original Filed Feb. 4, 1965

2 Sheets-Sheet 1



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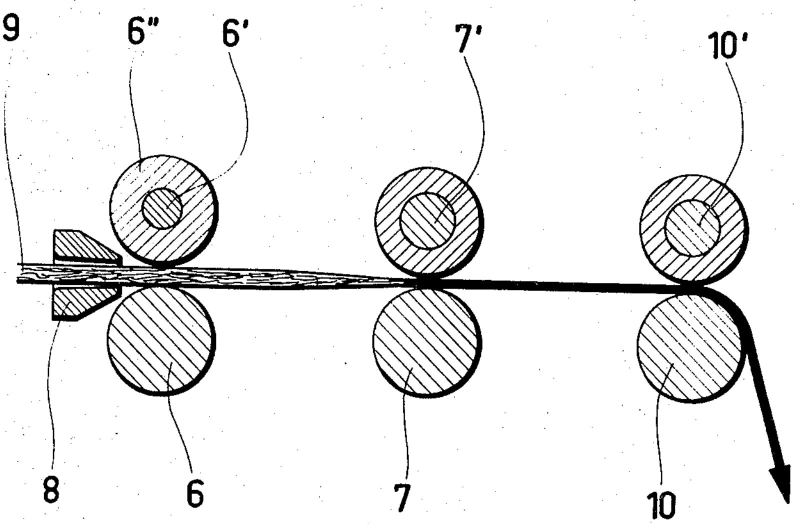

Fig. 9

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PROCESS FOR DRAFTING STAPLE FIBERS

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Continuation of application Ser. No. 430,320, Feb. 4, 1965. This application June 3, 1968, Ser. No. 734,150
Claims priority, application Switzerland, Feb. 15, 1964, 1,881/64
Int. Cl. D01h 5/74
U.S. Cl. 19—66 11 Claims

ABSTRACT OF THE DISCLOSURE

A process for drafting staple fibers wherein a stable band comprising individual fibers mutually adhesively bound by a setting adhesive agent is drawn through a pair of feed rollers and then through a pair of delivery rollers. The individual staple fibers of the stable band are seized, resulting in a rapidly increasing drafting force, which destroys the mutual adhesive bond between the individual staple fibers. Upon rupture of the adhesive bond there results a rapidly decreasing drafting force, so that the tensile load upon these staple fibers is only of very short duration during the drafting operation in comparison with the total drafting time of the relevant fiber. Then, the individual broken-out staple fibers are withdrawn from the stable band practically without force.

The invention also pertains to a draftable web comprising staple fibers which prior to drafting have been adhesively bonded together and which during drafting have been subjected to a high tensile load.

BACKGROUND OF THE INVENTION

The present application is a continuation application of my commonly assigned, copending United States application, Ser. No. 430,320, filed Feb. 4, 1965, now abandoned and entitled "Process for Drafting Staple Fibers and Improved Web Produced According to Such Process."

The present invention relates to an improved process for drafting natural or synthetic staple fibers, or mixtures thereof, and, in particular, to draft such staple fibers between two pairs of rolls or rollers, as well as to an improved web produced in accordance with the inventive process.

First of all, there will be defined the terminology employed herein for the different structures formed of staple fibers:

Thus, the term "spinning-band" denotes a conventional, non-twisted sliver or band, as such for example is produced by a carding engine, drawing frame, etc.

A stable band, as such term is employed in the description of the present invention, denotes a non-twisted band or silver consisting of individual fibers mutually adhesively interconnected by a setting adhesive.

Under the term "web" there is to be understood a fiber arrangement as such appears at the delivery side of a drafting arrangement.

According to the present most widespread process twisted rovings are delivered to a ring spinning-drafting arrangement which initially drafts the rovings in a preliminary drafting zone and thereafter in a primary or main drafting zone a total of 20- to 60-fold, then delivers such to the spinning spindle in order to impart twist. The draft in the preliminary drafting zone lies in the range of approximately between 1.1- to 2-fold, whereby in the main drafting zone drafts of approximately 15- to 30-fold still result. In order to better control the fibers in the main drafting zone and, in fact, to even render such drafting possible at all, mechanical fiber guide means are provided, for example in the form of slip rollers, small belts, and so forth. Notwithstanding such fiber guide means it is, however, not possible to further considerably increase drafting in the interest of a sufficient yarn quality. Additionally, such drafting arrangements are complicated, cause a great number of malfunctions, so that they are no longer adequate for higher requirements.

According to another known process relatively coarse, non-twisted spinning bands are supplied to the ring spinning-drafting arrangements. These bands are then attenuated in a plurality of zones with the help of condensers and small belt units. Such drafting arrangements are expensive, exceptionally complicated in construction, nonetheless enable only relatively small drafts (up to 30-fold) to be performed in the main drafting zone. Additionally, they become very quickly contaminated by fly, and even after the shortest operating time bring about disturbances of all types. These so-called band or sliver spinning processes have not been successful for these reasons.

In comparison with these known drafting processes, according to the invention there is proposed in the higher drafting range an improved drafting process which is based upon a new drafting theory and new drafting technique and which permits controlled drafting in the range of approximately 30- to 150-fold without resorting to the aid of mechanical fiber guide means between two pairs of rollers.

SUMMARY OF THE INVENTION

Thus, a primary object of the present invention has reference to an improved process for drafting staple fibers with relatively high drafts, specifically in a range of approximately 30- to 150-fold, without requiring the use of mechanical fiber guide means.

A further important object of this invention relates to the production of an improved web composed of staple fibers which during drafting are subjected to a high tensile load.

Another noteworthy object of the present invention concerns itself with an improved process for imparting high draft to staple fibers by means of two pairs of rollers devoid of mechanical fiber guide means therebetween.

Still a further considerable object of this invention is directed to an improved process for drafting staple fibers resulting in higher drafts, simplication of the drafting arrangements, increased productivity and improved yarn quality.

In order to implement these and still further objects of the invention the inventive process for drafting staple fibers takes places between a pair of feed or draw-in rollers and a pair of delivery rollers by means of the following process steps:

(a) Drawing-in a non-twisted stable band through a pair of feed rollers, the individual fibers being mutually adhesively bound by a setting adhesive agent;
(b) Grasping or seizing individual staple fibers by means of a pair of delivery rollers;
(c) Subjecting the thus grasped or seized individual staple fibers to a rapidly increasing drafting force;
(d) Destroying or rupturing the mutual adhesive bonds between the individual staple fibers by means of the increasing drafting force applied to such staple fibers;
(e) Subjecting the individual staple fibers to a rapidly decreasing drafting force upon destruction or rupture of the mutual adhesive bonds between the individual staple fibers; and
(f) Withdrawal of individual broken-out staple fibers from the stable band practically without the use of force by means of the pair of delivery rollers.

It will be appreciated that according to the invention drafting takes place freely between the respective pairs of feed rollers and delivery rollers, with drafts in excess of 30, that is, while dispensing with conventional mechanical fiber guide means. In the drafting zone the individual fibers are subjected to a high tensile load, partially brought up to a value corresponding to the strength of the substance of the fibers. While it is obviously not possible to exactly define the term "high tensile load" by means of a specific numerical range or value since such varies from material to material, what is meant is that the tensile load to which the individual fibers are subjected approaches or lies very near the tensile strength of the fibers, in other words, the strength of the substance of the fibers. The inventive process is further characterized by the feature that, the drafting force applied to the individual fibers quickly increases during a small fraction of the total drafting time, and during the much longer remaining drafting time (corresponding to the withdrawal time) the fibers are withdrawn practically without force.

In order to compensate for the danger of spreading of the stable band in front of the drafting arrangement brought about by the squeezing effect, etc., the individual stable band or a doubled fiber arrangement or strand of such stable bands, is preferably guided up to the nip line of the pair of feed rollers. Starting with a doubled arrangement of staple bands the resulting web can be exposed to further drafting directly after the pair of delivery rollers such as in preliminary stages, whereby between the pair of feed rollers and pair of delivery rollers there is undertaken a larger draft than with the subsequent further drafting mentioned above. The web produced according to the inventive process contains staple fibers which have been subjected to a high tensile load or stress during drafting.

According to the invention, drafting is performed between the nip locations of pairs of feed rollers and delivery rollers at a spacing exceeding the length of the drafted staple fibers, that is, short and long staple fibers can be drafted under favorable conditions with uniform length of the drafting zone.

The new and improved inventive drafting theory places a series of previously unknown requirements upon the stable band to be drafted which can be attained by means of a special preparatory process. This preparatory process is described in detail in my co-pending United States patent application, Ser. No. 430,255 filed Feb. 4, 1965, and entitled "Process for the Preparation of a Fiber Arrangement or Strand Composed of Staple Fibers for Undergoing a Subsequent High Draft and a Stable Band Produced According to the Aforesaid Process." It will be understood the present inventive drafting process makes particular reference to this preparatory process.

BRIEF DESCRIPTION OF THE DRAWINGS

Other features, objects and advantages of the present invention will become apparent by reference to the following detailed description and drawings, wherein:

FIG. 1 illustrates in cross-section a theoretical ideal model of a staple fiber band useful for explaining details of the inventive drafting process;

FIG. 2 is a perspective view of the staple fiber band depicted in FIG. 1;

FIG. 3 is a force-displacement diagram for explaining the process of breaking-out of a straightened and parallely disposed individual fiber from a stable band;

FIG. 4 illustrates in cross-sectional view a theoretical ideal model of a spinning band useful for clearly pointing out the differences in drafting between a spinning band and the inventive stable band;

FIG. 5 is a force-displacement diagram serving to explain breaking-out or withdrawal of an individual fiber from a spinning band;

FIGS. 6 and 7 are respective force-elongation diagrams;

FIG. 8 schematically illustrates in cross-sectional view a single zone-drafting arrangement employed for drafting a stable band according to the teachings of the present invention; and

FIG. 9 schematically illustrates a drafting arrangement of a preliminary stage wherein a further pair of drafting rollers are arranged after a single-zone drafting arrangement as such is employed for carrying out the inventive drafting technique upon, for instance, a doubled fiber arrangement in a preliminary stage.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In accordance with the above-mentioned preparatory process the individual staple fibers, after setting of the introduced adhesive material or agent, must be mutually adhesively bonded into a stabilized sliver or band. Due to this mutual adhesive bonding there is obtained, an exceptionally effective fiber control during drafting, which in the extreme case extends to the control of each individual fiber. The mechanics of such will be more fully explained with reference to the illustrated ideal model of a staple fiber band depicted in FIGS. 1 and 2. Also, the marked differences in comparison with normal drafting techniques will be clearly pointed out, particularly with reference to the conventional spinning band depicted in FIGS. 4 and 5.

Directing attention now to FIG. 1, it will be seen that a fiber x is surrounded by six further fibers a, b, c, d, e and f of the same length. They are uniformly adhesively bonded with one another at the line of contact of the fiber surface. The start of these fibers is not disposed in a single plane, rather are staggered in lengthwise direction, as best shown in FIG. 2, according to the law of random distribution. The specifically considered fiber x is shown dotted in the spacial illustration. Thus, the model forms a section of a stable band which is assumed to move to the right of the drawing with a velocity V_1. It is further assumed that the individual fibers x, a, b, c, d, e and f upon passing through the nip or clamping plane E_K, corresponding to drafting, are accelerated from the velocity V_1 to the velocity V_2. There is now posed the question as to how the fiber x behaves during the course of the described drafting operation.

In FIG. 2 the fiber c has just passed through the nip plane E_K, thereby having been accelerated to the velocity V_2. The contacting fibers x, b, d, however, still move with the velocity V_1. Consequently, the fiber c is subjected to a quickly increasing draft force K_c for such length of time until the adhesive bond with the fibers x, b and d ruptures; as a result it moves away with practically no force, since no further forces act upon it. During this procedure the fiber x still remains at the velocity V_1 since it is still adhesively bonded with the neighboring fibers a, b, d, e and f. With further advance of the bundle of fibers the fibers d and e and then f, one after the other, now pass through the nip plane E_K and, thus, arrive for withdrawal. The more closely considered fiber x still remains connected or bonded with the fibers a and b and with the fibers k, l, m and n following the fibers c, d, e and f. The floating fiber x can thus—as explained—never be accidently accelerated by the fibers c, d, e and f withdrawn one after the other with the velocity V_2, rather it maintains its velocity V_1 until it also passes through the nip plane E_K. A fiber is considered to be "floating" if it is neither clamped rearwardly at the feed rollers nor forwardly at the delivery rollers.

A prerequisite for the fiber x to be entrained in uncontrolled manner is that more than half of the fibers a, b, c, d, e, f surrounding the fiber x pass through the nip or clamping plane E_K at exactly the same moment. The probability that this phenomena occurs with a random arrangement of the fibers in the lengthwise direction, that is, that the beginning of the fibers of four of the six fibers surrounding the fiber x are exactly disposed in one plane is, however, extremely small.

During the theoretical consideration of drafting processes, in addition to the forward nip plane E_K in relation to the staple length, as a general rule, there is also further defined a rear nip plane or nip line. This has been intentionally omitted in the foregoing. The described mehanics also take place if all fibers x, a, b, c, d, e, f, k, l, m and n are assumed to be so-called floating fibers.

The physical process of breaking-out a straightened and parallely disposed individual fiber from a stable band can be observed in the form of the force-displacement diagram depicted in FIG. 3. In so doing, it is characteristic that the force P with small displacement L increases quickly and to a high value, and at the moment of rupture of the bond falls back practically to zero, since apart from the pulling or tension force no further external forces act upon the considered fiber. The tensile load upon a fiber is, therefore, only of very short duration during the drafting operation in comparison with the total drafting time of the relevant fiber. However, such is sufficient in accordance with the strength of the set bond in order to elongate the individual fibers such that it is possible to obtain a more or less strong permanent lengthwise orientation of the micelles or the molecular chains along with an increase of the strength of the fiber. This improved property can later prove to be very desirable. Withdrawal from the stable band occurs practically without force after rupture of the bond. The drafting work undertaken during drafting of the fiber is defined by the area F_1.

During conventional drafting undertaken with a non-twisted spinning band and a double apron-drafting arrangement the relationships are basically different.

After passing the preliminary drafting zone, not further to be considered, the spinning band arrives at the main drafting zone equipped with small belts or the like. Here, other boundary conditions prevail. First of all, the fibers are not bonded with one another and, furthermore, transmitted external forces K act upon a model as depicted in FIG. 4. These forces are generated because of tensioning the spinning band due to the form of the belt cradle or bridge and due to the belts themselves. The withdrawal of an individual or single fiber from such a band in principle results in a force-displacement diagram as illustrated in FIG. 5. Initially, the force P increases under the influence of the external forces K until overcoming the static friction, then again gradually falls-off in accordance with the sliding friction and the displacement path L. The trace of the curve also confirms the continuous change of the static and sliding friction of the withdrawn individual fiber depending upon the contact relationship with the surroundings. The drafting work undertaken during withdrawal of the fiber is expressed by the surface or area designated by reference character F_2.

Now, if this behavior of the force-displacement diagram is correlated to the fibers depicted in the arrangement of FIG. 4, then it should be evident that during drafting the fiber y can be readily entrained in an uncontrolled manner if more than half, for instance four of the six surrounding fibers, move with the velocity V_2 (FIG. 2). It is more probable, however, that four of the fibers surrounding the fiber y move with the velocity V_2 at a given moment than that four of the fibers surrounding the fiber x are simultaneously accelerated.

This new drafting theory and the inventive drafting process based thereupon, in spite of dispensing with every mechanical fiber guide means, are thus considerably better with respect to fiber control than all previously known systems. This result is obtained through:

(1) the most extensive degree possible of fiber control inclusive of every single fiber;

(2) the replacement of the static friction of the fibers among themselves brought about by the material, by a controllable, setting bond;

(3) free drafting of the fiber arrangement or strand between two pairs of rollers, that is, dispensing with mechanical fiber guide means, and thereby,

(4) practically forceless withdrawal of the individual fibers after successful rupture of their adhesive bonds; and

(5) a force-like reduction of drafting to a purely tensile load by incorporation of the fiber control in the stable band during the preparatory stage.

A further requirement is that during the tensile load appearing at the drafting arrangement the prepared stable band should elongate as little as possible by the average drafting force. This is for the following reasons:

It is known that the drafting force applied to a spinning band located in a drafting zone is not constant, rather varies because of inhomogeneities. Thus, during drafting the spinning band accordingly elongates in the lengthwise direction to a more or less extent, thereby causes drafting disturbances which always become greater because of the force-displacement relationship. As a result, there appear the known and feared drafting waves.

A stable band prepared by a setting bond exhibits a characteristic force-elongation relationship as such is shown in FIG. 6 by the curve a'', for example depicted for a cotton material. A readily apparent proportionality exists between the force P and the elongation ϵ from the time of application of load till rupture of the band, that is, the stable band approximately ideally follows Hook's Law. Now, of particular interest is the slope of the ascent of the curve a'', since such slope represents a measure for the required lengthwise stabilization of the stable band. The greater the slope of the ascent the better the lengthwise stabilization, in other words, that much less does the stable band elongate by virtue of the average drafting force and that much smaller is the danger of there appearing drafting waves. Thus, a stable band can be considered to possess lengthwise or longitudinal stability if there appears minimum elongation of such band upon being subjected to a drafting force.

In comparison, a spinning band embodying a drawing sliver formed of the same cotton exhibits a force-elongation relationship as such is shown in FIG. 6 by the curve b'' wherein a substantial portion of this curve b'' is linear. Hence, in the case of the curves a'' and b'' of FIG. 6 for a stable band and a spinning band, respectively, formed of the same cotton, it is readily possible to ascertain a value which is characteristic for the slope of such curves, since in both instances at least a substantial portion of each curve is linear. However, in reality the force-elongation curve of a material does not generally conform to a straight-line nor does it have a substantial portion of its curve linear. Thus, if for a given material a considerable portion of its force-elongation curve is not linear, especially from the point of intersection of the axes so that it is not readily possible to ascertain a value of tangent α characteristic for the slope of such curve, then it is necessary to replace such curve by a straight line which approximates the aforesaid curve. In order to further explain such, let it be assumed that a given material possesses a force-elongation curve typical of curve c' of FIG. 7. It will be appreciated that in the case of this more complicated form of curve c' it is not possible to obtain a characteristic value of the slope of such curve since such slope continuously varies along the surface of the curve. Now when this happens, then it is necessary to replace the curve c' by a straight line g which approximates the curve c', so that from such straight linge g it is possible to define tangent α. Hence, in FIG. 7, the slope of curve c' is represented by the slope of the straight line g replacing curve c', that is, $\tan\alpha = a'/b'$.

Consistent with what has been explained above and in order to be able to judge the lengthwise stabilization of different bands tangent α is thus used as comparison value. With the selected scale between force P and elongation ϵ, as shown in FIG. 6, tan α_1 of curve a'' approximately assumes a value of 115. It is furthermore remarkable that elongation at breakage of bonded stable bands, which naturally is dependent upon the type of fibers as well as the type of adhesive, is exceedingly small. for example, with cotton, depending upon band thickness and so forth, it amounts to only approximately about 1.5% to 1.8%.

A normal non-twisted spinning band, as such is used with band spinning processes, behaves completely different. It will be recalled that in FIG. 6 curve b'' represents the force-elongation relationship of a sliver coming from a drawing frame of the same cotton used in the stable band of curve a''. The ascent of the curve is considerably flatter, that is, with a given average drafting force the elongation compared with the stable band a'' is multiplied a number of times. Since $\tan\alpha_2$ of the curve b'' with the same scale amounts to only a maximum of 0.8, there results a slope relationship between both compared bands $R = \tan\alpha_1/\tan\alpha_2$ amounting to 144. This means that the spinning band b'' with a given force P elongates 144 times more than the stable band a'' of the same material. Thus, also in this relationship there can be recognized a great difference during drafting between a stable band and a normal spinning band.

The areas F_1 and F_2 of FIGS. 3 and 5, respectively, represent the drafting work performed during withdrawal of a single fiber from a stable band (FIG. 3) and during withdrawal of a single fiber by means of a small belt unit and a conventional spinning band (FIG. 5). Comparison measurements performed by means of a tensile tester manufactured by Instron Ltd., of High Wycombe, Bucks, England showed that the drafting work necessary during the indicated conditions on the average is smaller for bonded fibers (area F_1) than for non-bonded fibers (area F_2). Consequently, the average drafting force during free drafting of a stable band remains relatively small. This together with the high value of tangent α explains why a stable band permits drafting without drafting waves even with considerably increased length of the drafting zone.

In accordance with the inventive drafting process it is, therefore, possible to draft short as well as also long staple fibers and mixtures thereof under favorable conditions with a uniform length of the drafting zone and without resorting to mechanical fiber guide means.

The transverse stability is a further requirement which is placed upon the stable band prepared by a setting bond. If the stable band is stressed by pulling-out or withdrawing individual fibers, then the local appearing tensile forces must not be propagated directly backwards, rather these forces must be taken over as qiuckly as possible by the entire band and influence such as a unit. Furthermore, the cross-sectional configuration of the stable band forwardly of the drafting arrangement must also be maintained in the high draft zone in order to ensure for homogeneous drafting conditions. These effects are achieved by a pronounced transverse bonding of the individual fibers and by the therewith associated cross-sectional stabilization of the stable band prepared for drafting. Thus, the stable band is considered to possess "transverse stability" if the band is stressed and the local appearing tensile forces are taken up as quickly as possible by the entire band and influence such as a unit. Under the term "cross-sectional stability" it is to be understood that the stable band retains its cross-sectional configuration up to the time it enters the drafting arrangement.

In implementing the inventive drafting process it has proven to be of advantage, and as best shown in FIG. 8, to provide an infeed or feed condenser **3** which extends almost up to the nip line of the pair of rollers **1**, **1'** of the two pairs of drafting rollers **1**, **1'** and **2**, **2'** required for carrying out the inventive drafting process. This infeed condenser **3** which is provided with a bore **3***a* accommodated to the surface of the stable band **4** prevents the latter from being pressed flat by the squeezing effects of the pair of rollers **1**, **1'** and which would thus otherwise prematurely destroy its previously explained transverse stability, that is, prior to reaching the actual drafting zone.

Moreover, a so-called limiting device **5** can be arranged in the high draft zone in order to further mitigate the influence of this squeezing effect, to compensate for electrostatic charges, and so forth. The bore **5***a* of this limiting device **5** advantageously essentially corresponds to the cross-section of the stable band **4**. In order to reduce the squeezing action of the pair of rollers **1**, **1'** it is advantageous to equip the roller **1'** with a thick and relatively soft rubber covering and it is also advantageous to maintain the flutings of the drafting roller **2** as fine as possible on account of the increased drafting force for the individual fibers as shown in FIG. 3.

The high density or weight per unit volume of the stable band is of importance for drafting insofar as it permits delivering to the drafting arrangement as large as possible fiber mass with the smallest cross-section. As a result, greater drafts are possible without preventing the marginal fibers from becoming twisted.

Instead of the considered force-elongation relationship of the prepared stable band, in many instances it is sufficient for practical reasons to indicate the lengthwise stability of the stable band by means of its breaking length (breaking of yarn or bands by its own weight). This value is very easy to determine by simple measurements, without taking resort to complicated and expensive equipment.

The high flexural stiffness simultaneously attained with a stable band is of importance insofar as it enables the automatic infeed and through passage of the stable band through the drafting arrangement. The following example serves to elucidate the discussion to follow:

A carded cotton of American origin with a 1$\frac{1}{16}$" staple after suitable preparation and after 12.5-fold drafting, is imbued with a surplus of a suitable liquid adhesive solution and then compacted. After setting of the adhesive, this occurring through conventional drying at room temperature, such stable band of 1140 tex. which has now been prepared for high drafting possesses a measured breaking length of 3494 meters. The tangent α determined from the force-elongation diagram—as a comparison value for the elastic behavior—with the same scale as chosen in FIG. 6, amounts of 129. The density is 0.3 gram/cm.^{3} for a cross-sectional area of 1.9 times 2.0 millimeters. The stable band is of smooth, faultless appearance, also possesses a considerable transverse strength and transverse stability.

The stable band is delivered to the pair of feed rollers of a single zone-drafting arrangement via an infeed condenser possessing a bore of 1.8 millimeters. Then it is freely drafted to an extremely high draft of 115-fold by the pair of delivery rollers without using any kind of mechanical fiber guide means. After imparting twist to the drafted web there appears a yarn of 9.9 tex. The length of the drafting zone between the pair of inlet or infeed rollers and the pair of delivery rollers amounted to 45 millimeters.

The use of a relatively narrow inlet condenser prevents premature rupture of the adhesive bond between the fibers, so that the cross-section of the stable band before and after the pair of feed rollers essentially corresponds to one another. In order to more clearly express the previously explained feature of a favorable lengthwise stability and transverse stability it is pointed out that the stable band travels through the drafting zone in the manner of a rigid rod. For example, with the exception of the small feed movements no jerks in the lengthwise direction and spreading out in the drafting zone could be observed by eye. For this reason, the arrangement of an enclosing or encircling limiting device in the drafting zone is not necessary in this instance. Of importance is that the length of the drafting zone of 45 millimeters exceeds the length of the longest fibers by 7 millimeters. Such length also exceeds the 2% staple diagram length of the fiber number diagram by 12 millimeters and the mean staple diagram length of the fiber number diagram by 27 millimeters. With such high drafting without special fiber guide means this repesents a specific novelty of the new and improved drafting technique of the present invention, particularly the lengthwise stabilization. Thus, there have been given the conditions rendering it possible to draft under acceptable conditions and without drafting waves short and long staple fibers, as well as mixtures thereof, with one and the same drafting arrangement incorporating two pairs of rollers.

In spite of the fact that the previously valid minimum acceptable number of fibers per yarn cross-section is already exceeded for the species here selected and notwithstanding the extremely high draft of 115-fold, the spun yarn of 9.9 tex. attains a linear irregularity of up to 12.4%, this representing an astonishing peak value. Such values can only be achieved with extremely pronounced bonding of the stable band and exactly operating members of the drafting arrangement.

With the extreme bond chosen in this example the tensile load for breaking-out longer individual fibers from the stable band during drafting in part already exceeds the strength of the substance of the fibers whereby a certain staple damage occurs. Consequently, it is necessary to control the bond in consideration of the fiber material, so that there results total optimum yarn values (linear irregularity, breaking strength, elongation and so forth).

It has proven to be advantageous to employ the new drafting procedure described for high drafts also with preliminary stages of a spinning process, in order to further improve the yarn in compatability with the already considered terminal stage.

In the preliminary stages there exists the need to compensate irregularities associated with the fiber bands by doubling, without carrying out an extreme attenuation. Depending upon the number of doublings the conventional drafts vary between approximately 4- and 15-fold.

In order to also improve the preparatory drafting procedure with these low drafting ranges a doubled, compact and uniform fiber arrangement or strand is formed from a number of stable bands and delivered to a drafting arrangement. Naturally, the degree of doubling and drafting is dependent upon the planned spinning operation.

Since considered percentually a relatively large fiber mass is withdrawn through the pair of delivery rollers of the drafting arrangement during low drafts, the average drafting force and thus the strength of the bond must not be too high. Notwithstanding a certain reduction of the strength of the bond of the individual stable bands, again capable of being expressed in terms of tangent α of the force-elongation diagram, by the breaking length, by the density, and by the cross-sectional stability, the physical effects described with respect to high drafting should be retained analogous to these values. In this regard reference is made to high drafting previously described.

After drafting such a fiber arrangement or strand there appears a conspicuously homogeneous, highly-parallelized web which also manifests itself by being able to be separated extremely well without the formation of any fiber bunches or concentrations. It should be self-evident that this result is also dependent upon the type of drafting arrangement, its physical structure and its adjustment in addition to an appropriate bonding of the individual stable bands.

In many situations, a simple single zone-drafting arrangement is sufficient for working in preliminary stages, as such in principal is depicted in FIG. 8, whereby the infeed or inlet condenser **3** and, if desired, the limiting device **5** naturally have to be accommodated to the doubled band arrangement.

With certain materials and appropriate bonding of the individual stable bands, it can be advantageous to provide after a single zone-drafting arrangement a further pair of drafting rollers, as such has been depicted in FIG. 9. In this instance, both of the pairs of drafting rollers **6** and **6'** and **7** and **7'** which are required for carrying out the inventive process in the preparatory stage, have an infeed condenser **8** arranged in front of and extending up to the nip line of the pair of feed rollers **6** and **6'**, analogous to the arrangement of FIG. 8. This infeed condenser **8** should be accommodated to the doubled stable fiber arrangement **9** which is to be drawn in. Furthermore, this infeed condenser **8** prevents the doubled stable fiber arrangement from being spread wide by the squeezing effect of the pair of infeed rollers **6** and **6'**, which otherwise might especially result in the destruction of the transverse stability of the individual stable bands before reaching the actual drafting zone. In order to reduce the squeezing effect of the pair of feed rollers **6** and **6'**, it is again advantageous to provide this roller **6'** with a thick and relatively soft rubber coating **6''**, in the manner depicted in FIG. 9. The pair of rollers **7** and **7'** have a further pair of rollers **10** and **10'** arranged thereafter, as shown, whereby the relatively small total draft of the preparatory stage in the present case is again divided. In this manner, it is oftentimes possible to further improve the separation and homogeneity of the web. In two zone-drafting arrangements which were previously provided in the preparatory stages it was conventional to carryout the preparatory drafting operation in such a manner that drafting in the first drafting zone was maintained considerably smaller than in the second drafting zone. However, in contrast thereto the new and improved drafting technique of the present invention has found it to be advantageous to maintain the drafting in the first zone greater than in the subsequent second drafting zone. Since the drafting errors in a non-adhesively bonded band increase in relation to the magnitude or degree of drafting, maintaining of the drafting in the second drafting zone small is particularly advantageous.

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.

What is claimed is:

1. Process for drafting staple fibers between a pair of feed rollers and a pair of delivery rollers, comprising the steps of:

(a) drawing-in a non-twisted stable band through the pair of feed rollers, the individual fibers of which are mutually adhesively bonded by a setting adhesive agent;
(b) seizing individual staple fibers of said staple band by means of the pair of delivery rollers;
(c) subjecting the thus seized individual staple fibers to a rapidly increasing drafting force;
(d) destroying the mutual adhesive bonds between the individual staple fibers by means of the increasing drafting forces applied to said staple fibers;
(e) subjecting the individual staple fibers to a rapidly decreasing drafting force upon destruction of the mutual adhesive bonds between the individual staple fibers; and
(f) withdrawing individual broken-out staple fibers from the stable band practically without force by means of the pair of delivery rollers.

2. Process as defined in claim 1, wherein a plurality of stable bands are drawn-in through the pair of feed rollers.

3. Process as defined in claim 2 including the step of guiding said plurality of stable bands substantially up to the nip line of said pair of feed rollers.

4. Process as defined in claim 1, wherein the step of increasing the drafting forces applied to said staple fibers acting upon the individual fibers includes bringing the drafting forces up to a value substantially corresponding to the strength of the substance of the fibers.

5. Process as defined in claim 1, wherein the drafting force acting upon the individual fibers includes the steps of allowing such drafting force to quickly climb during a small fraction of the total drafting time and during the much longer remaining withdrawal time the individual fibers are withdrawn practically without force from the stable band.

6. Process as defined in claim 1, including the step of guiding said stable band substantially up to the nip line of said pair of feed rollers.

7. Process as defined in claim 1, including the step of freely drafting the stable band between said pair of feed rollers and said pair of delivery rollers with drafts greater than approximately30-fold.

8. Process for drafting staple fibers between a pair of feed rollers and a pair of delivery rollers, comprising the steps of:

(a) Drawing-in a plurality of non-twisted stable bands through the pair of feed rollers, the individual fibers of which are mutually adhesively bonded by a setting adhesive agent;
(b) seizing individual staple fibers of said stable bands by means of the pair of delivery rollers;
(c) subjecting the thus seized individual staple fibers to a rapidly increasing drafting force;

(d) destroying the mutual adhesive bonds between the individual staple fibers by means of the increasing drafting forces applied to said staple fibers;
(e) subjecting the individual staple fibers to a rapidly decreasing drafting force upon destruction of the mutual adhesive bonds between the individual staple fibers;
(f) withdrawing individual broken-out staple fibers from the stable bands practically without force by means of the pair of delivery rollers;
(g) subjecting the web of staple fibers withdrawn through said pair of delivery rollers to a further drafting step; and
(h) wherein greater drafts are undertaken between said pair of feed rollers and said pair of delivery rollers than for said further drafting step.

9. Process for drafting staple fibers of a stable band between a pair of feed rollers and a pair of delivery rollers comprising subjecting the individual fibers to a high tensile load in the drafting zone sufficient to cause a permanent lengthwise orientation of the micelles of the fibers.

10. Process for drafting staple fibers of a stable band between a pair of feed rollers and a pair of delivery rollers comprising subjecting the individual fibers to a high tensile load in the drafting zone sufficient to cause a permanent lengthwise orientation of the molecular chains of the fibers.

11. A process for drafting staple fibers comprising the steps of: drawing in through a pair of feed rollers of non-twisted stable band, the individual fibers of which are mutually adhesively bonded by a setting adhesive agent, gripping in turn one or more of the individual staple fibers by a pair of delivery rollers to apply to each such fiber in turn a load which gradually increases up to failure of the bond between each gripped fiber and the fibers bonded thereto and which is distributed to all the remaining fibers of the band, subjecting the band to a negligibly small elongation so that no drafting waves are produced.

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