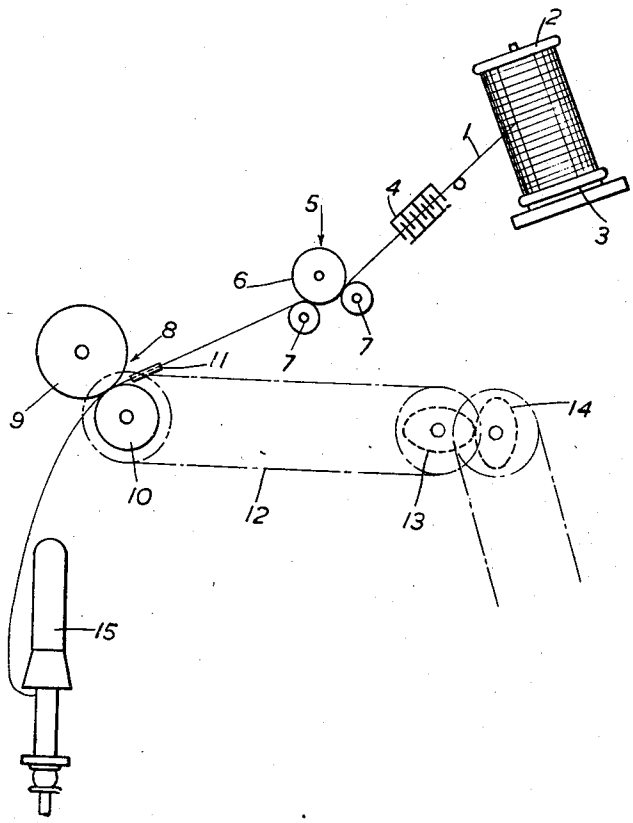
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CONVERSION OF CONTINUOUS FILAMENTS INTO STAPLE FIBER YARN AND LIKE PRODUCTS

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CONVERSION OF CONTINUOUS FILAMENTS INTO STAPLE FIBER YARNS AND LIKE PRODUCTS

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This invention relates to the direct conversion of continuous filaments into staple fiber yarns and like products, especially by the application of a breaking tension to a bundle of continuous filaments.

The invention is especially concerned with the production of staple fiber threads of fine character, and especially threads closely simulating fine threads of natural origin, e. g. linen, worsted, and cotton threads and having the characteristic of varying thickness that for many purposes is an attractive feature of natural threads. The invention is not, however, confined to the production of fine threads only, nor to threads having thickness variations only within the range encountered in natural threads, the operations for carrying out the invention being capable of adjustment to give a range of products varying substantially as regards thickness, and as regards the amounts by which the thickness varies.

According to the invention a bundle of continuous filaments is passed through successive sets of drafting rollers, the second set of rollers encountered by the bundle being driven with a peripheral speed substantially in excess of that of the first set so as to exert a draft of at least 5 times, or preferably 10 times or much higher, e. g. 15, 20, 30, 40, 50 or more times, on the filaments, the speed of the second pair or set of rollers being, however, varied at regular or irregular intervals so as to produce a corresponding variation in the draft applied to the bundle of filaments. The filaments are thus stretched to breaking tension and thereby converted into staple fiber, and at the same time the bundle is considerably reduced in size, and given a variation in thickness simulating, or even accentuating, the variation frequently exhibited by natural fibrous yarns. Filaments having a varying denier may be employed, the variations either occurring at the same point in the length of the bundle under treatment or, if desired, being somewhat distributed throughout the length of the bundle, for example, in the latter case the bundle to be treated may be built up of several smaller bundles, the thicker portions of which do not coincide.

It is important to start with a bundle of large size, the bulk being reduced by the large draft applied, which draft is, as indicated by the figures given above, considerably higher than is normally used in single-stage drafting of ordinary textile fibers. In this way, a satisfactory product is obtained in one operation, counts equivalent to 45 denier being possible in the single drafting.

Very good results are obtained by using artificial filaments of cellulose ester basis that have been stretched so as to have a high strength, e. g. about 4.5 grams per denier or upwards, or upwards, or stretched and saponified so as to be still stronger, e. g. about 6 grams per denier or upwards. The filaments may also be shrunk after the stretching. Examples of cellulose esters of which the filaments may be formed are cellulose acetate, cellulose formate, cellulose propionate and cellulose butyrate, cellulose acetate-propionate and cellulose acetate-butyrate. Strong yarns having initially a cellulosic basis may also be used, as for example regenerated cellulose yarns; such yarns may be subjected to stretching after coagulation or during a late stage of coagulation in the spinning process in which they are formed. The invention is also applicable to the treatment of stretched polyamide filaments.

The invention is, however, applicable to the conversion into staple fiber threads of artificial filaments of normal character, i. e., of normal strength, e. g. ordinary cellulose acetate or other cellulose ester and ether filaments or viscose or cuprammonium filaments, these materials working very well under the conditions already mentioned of starting with a large bulk and reducing this by very substantial draft.

The initial filaments may be lustrous ("bright") or delustred, in accordance with the requirements of the final yarn, especially if the desire is to simulate natural yarns having brightness or dullness as a characteristic. Pigments, which can be incorporated in various proportions, are particularly useful in controlling the degree of dullness.

The bundle may be passed in wet condition through the pairs of rollers, as for example by being carried into a trough disposed immediately in advance of the first pair of rollers, one or more rods or rollers keeping the bundle below the liquid. The wetting may be carried out simply by means of water, which may be cold, but with advantage is heated to, say, 90–95° C. It is sometimes found that this wetting facilitates the breaking and drafting operation. Possibly some softening of the material of the filaments is obtained and in addition a lubrication of the material that facilitates the sliding resulting from the substantial drafting. It has also been found of advantage to include in the

wetting liquid soaps or other salts of compounds having a long aliphatic chain, preferably with more than 12 carbon atoms; salts of higher fatty acids, sulphonated oils, e. g. Turkey red oil, and salts of sulphates of higher fatty alcohols. Such additions probably assist the wetting out of the material as well as aiding the lubrication.

The drafting rollers may be similar to those of the wet line machine used in the spinning of flax. Thus the first pair of rollers encountered may be of brass about 1½" in diameter and having about 28 longitudinal corrugations to the inch; the next pair of rollers may be similarly corrugated, the lower roller being of brass about 2½" in diameter and the upper one of wood, say, 3½–4½" in diameter. The size of the rollers may be varied in accordance with the reach employed. The use of a metal such as brass guards against rusting in the case where the material is treated wet. The rollers are suitably loaded so that the filaments are firmly gripped by the intermeshing corrugations. Preferably the greater part of the load should be applied to the first pair of rollers to maintain good control over the bulky bundle during the drafting. The drafted product may be twisted by a flyer spindle.

The operation may, however, be carried out dry, in which case a somewhat different roller-system may be used. The first pair of rollers (which may be of steel) are about 1½" in diamters with about 8 corrugations or flutes to the inch. Advantageously, however, the rollers may be leather faced. It is also useful to reverse the direction of rotation of these rollers so that by carrying the bundle from a traverse bar above the rollers round the back of the rear roller, up through the nip, and over the front roller, a greater surface of contact is obtained to retain full control over the bundle. The other rollers are plain, the front one being of steel about 3½–4" in diameter and the rear one of wood about 5–6" in diameter. Suitable loading is applied as in the case of the wet operation.

For simulation of a linen thread the reach between the two pairs of rollers may be 1¾" upwards. This spacing may be fixed or any particular apparatus may be provided with a roller adjustment, so that reaches of say 2½", 5" or 10", or intermediately, may be readily obtained.

In the dry operation a reach of 14" upwards, say 16", 18", or 20", is very convenient, but lower reaches of say 6", 8", 10" or 12" may be used.

The invention lends itself to the production of a wide range of linen-like threads. Thus for the production of a coarse thread a bundle of 8,000, 12,000 or 15,000 denier may be subjected to 6–10 times draft to produce a staple fiber thread of about 800 to 2000 denier, the staple length being, say 2½ or 5". A twist of, say 3 or 4½ turns per inch may be inserted, for example, by ring spinning or flyer spinning the product delivered from the breaking rollers.

A finer thread may be produced by subjecting an initial bundle of 1,000 to 2,000 denier to a draft of 6–10 times. In this way a final thread of about 180 denier with 6–8 turns or other number per inch may be formed in the one operation, and, by higher drafting, finer still down to 45 denier.

The use of longer reaches, e. g. the 14" mentioned above for the dry operation, enables longer staple to be formed in the final product.

The operation may also be carried out on spinning machines of the type used for worsted or natural silk with varying reaches of from say 5" up to 20". Normal cellulose acetate filaments can be transformed on machines of this type into yarn having wool-like characteristics. In such a machine, the bundle passes from a traverse guide to the first set of rollers, comprising a spring-loaded smooth steel presser roller resting on a pair of fine-fluted steel rollers, and then to a second set comprising a leather-, rubber-, or cork-faced roller spring-loaded on to a steel roller. A draft of 40 or 50 times may be applied. Thus, a 6000-denier bundle may be reduced in one stage to 150 denier. Two-stage operation may, however, be employed. Thus, a 6000-denier bundle may be first reduced to an intermediate denier yarn or roving, in which say 1 turn per inch of twist may be inserted, and this may then be reduced to 50–55 denier in a second operation, the final thread being collected by cap- or flyer-spinning. The two operations have a joint draft of about 120 times.

The starting material may be wound on long bobbins for free rotation about vertical, inclined, or horizontal axes in a creel from which the material is guided to the drafting rollers, or in the case of wet treatment, to the trough containing the wetting liquid. Cheeses may likewise be used.

If the initial filaments have been produced by a stretching operation considerable variation may be made in the filament denier. Thus, for example, by stretching a cellulose acetate filament of 15 denier 10 times and then saponifying the stretched product a final filament denier of one may be obtained. By stretching filaments initially of finer denier and/or applying greater degrees of stretch finer filament deniers, e. g. 0.4 or less, say 0.1, may be employed. Likewise filament deniers in excess of one may be used if desired, the choice available permitting substantial variation in the final staple fiber product.

Generally, however, higher filament deniers such as 3, 3½, 4, or 4½ draft satisfactorily and yield good yarns, and in such cases non-stretched yarns, bright or dull, may conveniently be used.

The accompanying drawing shows diagrammatically one way of carrying out the invention on a machine of the type used for spinning worsted or natural silk.

A continuous filament bundle 1 is led from a bobbin 2 braked by a felt washer 3 through a gate-tension 4 to a set of feed rollers 5 comprising an upper smooth steel presser roller 6 spring-loaded on to a pair of fine-fluted steel rollers 7. The material proceeds to a second set of rollers 8, comprising an upper roller 9, which may be leather-, rubber-, or cork-faced, spring-loaded on to a steel roller 10. A conductor 11 leads the material into the nip of the rollers 9, 10.

The roller 10 is driven by a chain 12 driven from a pair of elliptical gears 13, 14 the average peripheral speed of the roller being substantially in excess of that of the rollers 7, so as to impart a draft of 10 times, or advantageously 15 times or upwards, to the continuous filaments. The filaments are thus successively broken into staple fiber, and at the same time the bundle is reduced considerably in size because of the applied draft.

The drive from the elliptical gears 13, 14 causes the draft to vary periodically, the rollers 7 not being subject to speed variation, and a corre-

sponding periodic variation is imparted to the thickness of the staple fiber product delivered to the cap-spindle 15. In this way, a close simulation to the thickness variation found in many natural staple fiber products is obtained. The frequency and the amount of the variations may be varied by the use of more elaborate speed-varying devices than the elliptical gears shown.

Having described our invention, what we desire to secure by Letters Patent is:

1. Process for the conversion of continuous filaments into staple fiber yarns and like products, comprising passing a bundle of continuous filaments through two sets of drafting rollers of which the first set of rollers is more heavily loaded than the second and the second is driven at a speed at least 5 times greater than the first, so as to break and draft at least some of the filaments, varying the speed of the second set at intervals during the breaking and drafting to produce varying thicknesses in the yarn simultaneously with said breaking.

2. Process for the conversion of continuous filaments into staple fiber yarns and like products, comprising passing a bundle of continuous filaments through two sets of drafting rollers of which the first set of rollers is more heavily loaded than the second and the second is driven at a speed at least 10 times greater than the first, so as to break and draft at least some of the filaments, varying the speed of the second set at intervals during the breaking and drafting to produce varying thicknesses in the yarn simultaneously with said breaking.

3. Process for the conversion of continuous filaments into staple fiber yarns and like products, comprising passing a bundle of continuous filaments of an organic derivative of cellulose through two sets of drafting rollers of which the second is driven at a speed at least 5 times greater than the first, so as to break and draft at least some of the filaments, varying the speed of the second set at intervals during the breaking and drafting to produce varying thicknesses in the yarn simultaneously with said breaking.

4. Process for the conversion of continuous filaments into staple fiber yarns and like products, comprising passing a bundle of continuous filaments of an organic derivative of cellulose that have been stretched so as to have a high strength through two sets of drafting rollers of which the second is driven at a speed at least 5 times greater than the first, so as to break and draft at least some of the filaments, varying the speed of the second set at intervals during the breaking and drafting to produce varying thicknesses in the yarn simultaneously with said breaking.

5. Process for the conversion of continuous filaments into staple fiber yarns and like products, comprising passing a bundle of continuous filaments of cellulose acetate that have been stretched and then saponified so as to have a high strength through two sets of drafting rollers of which the second is driven at a speed at least 5 times greater than the first, so as to break and draft at least some of the filaments, varying the speed of the second set at intervals during the breaking and drafting to produce varying thicknesses in the yarn simultaneously with said breaking.

6. Process for the conversion of continuous filaments into staple fiber yarns and like products, comprising wetting a bundle of continuous filaments, and passing said filaments in a wet condition through two sets of drafting rollers of which the second is driven at a speed at least 5 times greater than the first, so as to break and draft at least some of the filaments, varying the speed of the second set at intervals during the breaking and drafting to produce varying thicknesses in the yarn simultaneously with said breaking.

7. Process for the conversion of continuous filaments into staple fiber yarns and like products, comprising passing a bundle of pigmented continuous filaments through two sets of drafting rollers of which the first set of rollers is more heavily loaded than the second and the second is driven at a speed at least 10 times greater than the first, so as to break and draft at least some of the filaments, varying the speed of the second set at intervals during the breaking and drafting to produce varying thicknesses in the yarn simultaneously with said breaking.

8. Process for the conversion of continuous filaments into staple fiber yarns and like products, comprising wetting a bundle of pigmented continuous filaments of cellulose acetate that have been stretched so as to have a high strength and passing said filaments in a wet condition through two sets of drafting rollers of which the second is driven at a speed at least 5 times greater than the first, so as to break and draft at least some of the filaments, varying the speed of the second set at intervals during the breaking and drafting to produce varying thicknesses in the yarn simultaneously with said breaking.

9. Process for the conversion of continuous filaments into staple fiber yarns and like products, comprising wetting a bundle of pigmented continuous filaments of cellulose acetate that have been stretched and then saponified so as to have a high strength, and passing said filaments in a wet condition through two sets of drafting rollers of which the second is driven at a speed at least 5 times greater than the first, so as to break and draft at least some of the filments, varying the speed of the second set at intervals during the breaking and drafting to produce varying thicknesses in the yarn simultaneously with said breaking.

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