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CONVERTING CRIMPED FILAMENTARY MATERIAL TO CONTINUOUS ELONGATED BODY

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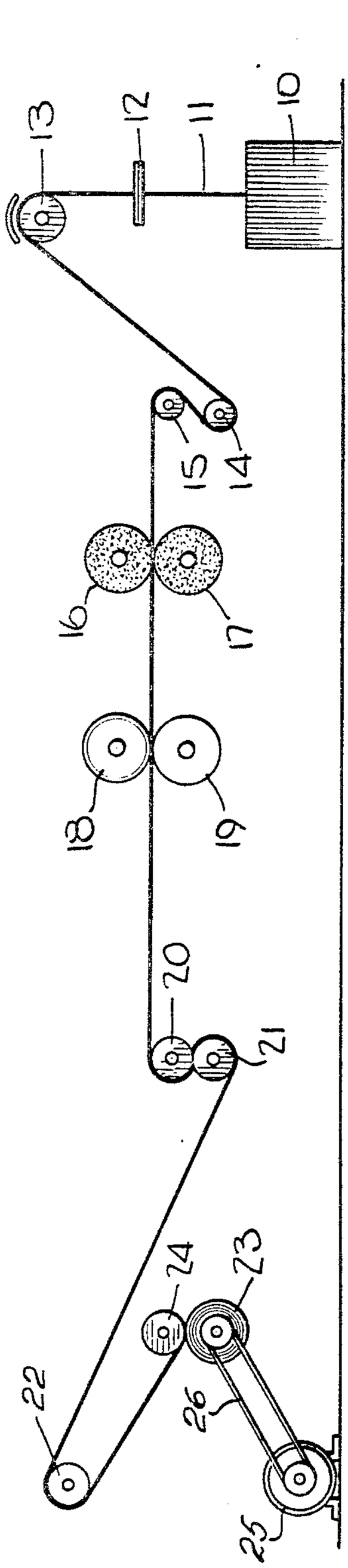

Fig. 1.

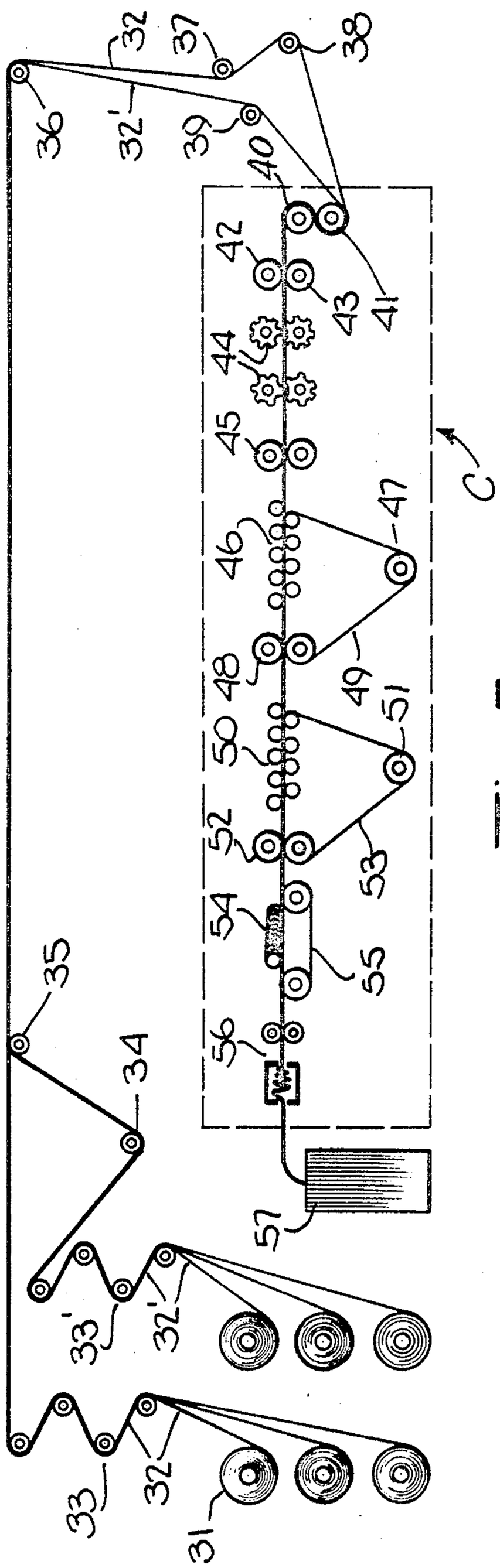

Fig. 2.

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CONVERTING CRIMPED FILAMENTARY MATERIAL
TO CONTINUOUS ELONGATED BODY

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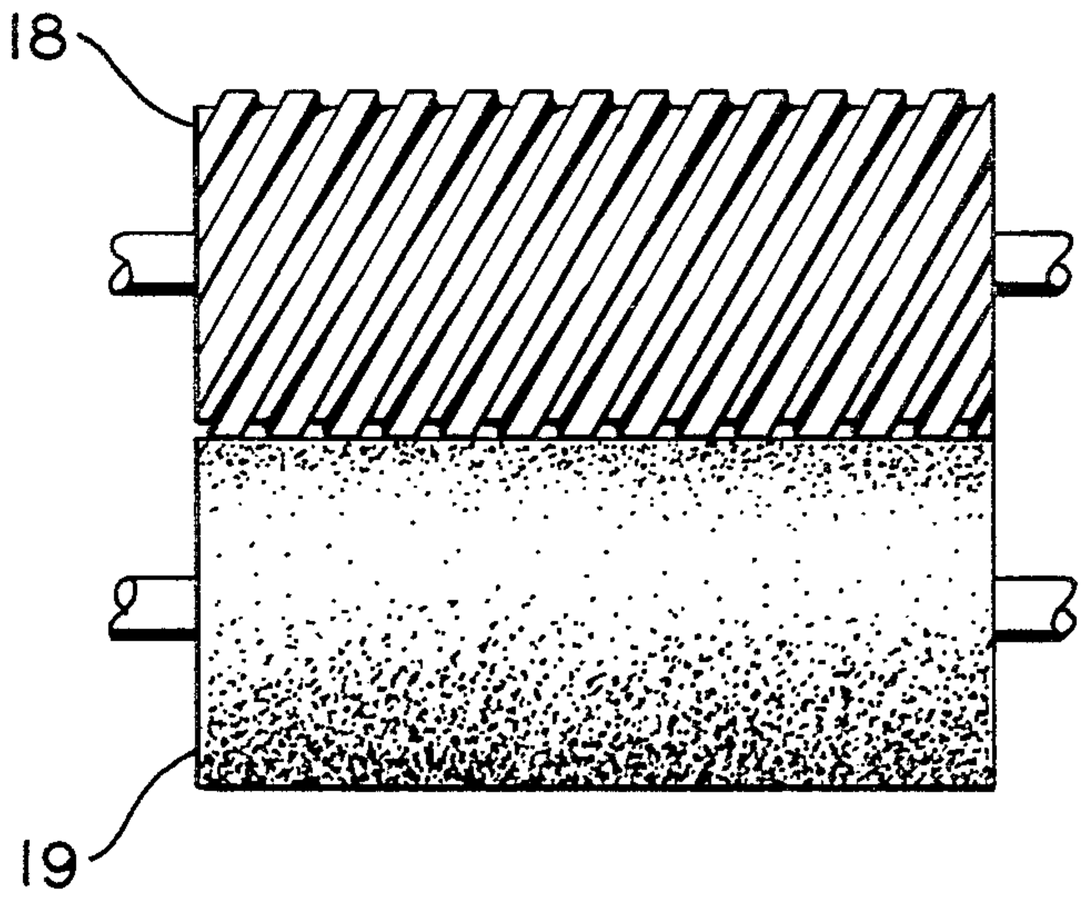
FIG. 3



GEORGE A. WATSON
JAMES A. WILLIAMS
JOSEPH R. GODWIN

INVENTOR

BY Andrew F. Sayko Jr.

ATTORNEY

United States Patent Office

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CONVERTING CRIMPED FILAMENTARY MATERIAL TO CONTINUOUS ELONGATED BODY

George A. Watson, James A. Williams, and Joseph R. Godwin, Charlotte, N.C., assignors to Celanese Corporation of America, New York, N.Y., a corporation of Delaware

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U.S. Cl. 57—2 17 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus and method for the conversion of continuous filaments into a continuous elongated body comprising staple, by opening a tow of continuous crimped filaments, reducing the opened tow to staple and forming the staple into a continuous elongated body.

This invention relates to the conversion of bundles of generally parallel continuous filaments (which hereinafter for convenience will sometimes be referred to simply as "bundles") to fibers in a form suitable for spinning into yarn by conventional processes, to tows which more readily may be so converted and spun, and to the packaging of said tows. The term "tow" refers to a class of said bundles of generally parallel continuous filaments which comprises at least about 500 filaments having a total denier of at least about 1,000.

Their warmth, high covering power, and esthetic appeal has created a huge market for spun yarns. With the advent of synthetic filaments, which are conventionally produced in tow form and sometimes as a smaller bundle, techniques for converting said tows or smaller bundles to staple (i.e., fiber) form were called for in order that spun synthetic yarn could be made. Accordingly, two broad classes of methods for converting a tow directly into a continuous elongated body comprising staple were developed: (1) for converting said bundles, especially those smaller than tows directly into spun yarns; and (2) for converting said bundles, especially tows, into sliver which subsequently could be spun by methods conventional for natural fibers such as cotton and wool. The latter of these two categories of methods is now in ascendacy as it has proved economically superior and technically more flexible than the former category; the former, nevertheless, is also commercially significant.

Synthetic filament bundles, especially tow, oftentimes are maintained as coherent units to aid in handling and processing of the bundles during their manufacture, during subsequent conversion of the bundles to fibers and during manufacture of spun yarn from said fibers; this generally is accomplished by crimping the bundle during manufacture thereof. However, said crimping compresses adjacent filaments of the bundle into the same configuration and causes many of said adjacent filaments mutually to adhere; the filaments so adhered are referred to as being "married" and each area of the bundle where such condition exists is referred to as a "shiner." Often, shiners will interfere in the processes of converting the bundles to staple and spun yarn and result in poor sliver and spun yarn, which persist in spite of efforts to eliminate them during the processes of converting the bundles to sliver and spun yarn. Furthermore, during stages of the sliver making and spinning operations, the adjacent filaments and fibers cut or broken therefrom are placed under compression which creates further marriages.

New packages of said bundles, especially tows, and methods of making and processing said tows have now been found, which tows are improved with respect to conversion to sliver and spun yarn without formation or with

minimum formation or with controlled formation of marriages.

In accordance with one aspect of the present invention, there are provided packages of said bundles, especially tow, which may be processed with said improved results by the two primary classes of methods of converting said bundles to a continuous elongated body comprising staple, namely: stretch-breaking methods and cutting methods of making sliver from said bundles, especially tow, which sliver may subsequently be spun into yarn; and the method of making spun yarn from said bundles, especially said smaller ones, by one unitary, continuous operation. The stretch-breaking methods of converting said bundles to sliver are commonly referred to as the Perlok process and are exemplified by the operation of the commercially well known Turbo Stapler. The cutting methods of converting said bundles to sliver are exemplified by the operation of the commercially well known Pacific Converter. The methods of making spun yarn from said bundles directly are exemplified by the operation of the commercially utilized Direct Spinner.

The principle of stretch-breaking is well known; if a fiber (or fibers) is drawn between the nips of two pairs of rollers running at different speeds (the faster pair being at the delivery end), and the fiber length is greater than the ratch length, then the fiber will first be stretched and then, depending upon the speed of the rollers and the elongation potential of the fibers, will be broken. The break takes place at the weakest point of the fiber which may be anywhere along its length. This breaking principle applies equally to tow where individual filaments may be considered as infinitely long fibers.

The cutting method involves feeding to a cutter said bundle flattened as a sheet or band and suitably tensioned to a cutter. The cutter shears the sheet or band at an acute angle without disturbing the parallel arrangements of the constituent filaments, followed by a redistribution of fiber ends to give a stable, continuous product in the form of a sliver.

The direct tow-to-yarn method involves breaking or cutting the bundle and twisting the resultant fibers into a yarn all in a unitary, continuous operation.

The invention will be more fully described by reference to the drawings in which:

FIG. 1 is a schematic illustrating an apparatus and process for opening crimped continuous filament tow and converting the opened tow to a ball warp in accordance with the present invention;

FIG. 2 is a schematic illustrating the combining of a plurality of ball warps made in accordance with FIG. 1 and converting the continuous filament ball warps into staple and forming a sliver therefrom; and

FIG. 3 is a view of the helically grooved profile roll forming a nip with a nonprofiled roll.

The process of deregistering the crimp in crimped bundles is commonly referred to as "opening." It has now been found that bundles which have been opened by the use of apparatus employing profiled or patterned ("profiled" and "patterned" being intended as synonyms) rolls as described for example in U.S. Patent Nos. 3,032,829 and 3,103,220 and Canadian Patent No. 674,101 (corresponding to a copending U.S. patent application Ser. No. 151,900, filed Nov. 13, 1961, in the names of P. T. Dunlap and R. E. St. Pierre) may be collected in the form of packages which subsequently will serve as a convenient supply for the aforesaid bundle-to-sliver and bundle-to-yarn processes, especially when said bundle is tow; said tow will subsequently be referred to as "profiled roll opened tow." The preferred form of package is a ball warp but other packages such as cans in which the tow is laid in helical configuration, and the like may also be used; also, if a twist is put into the tow (e.g., 2 turns/

foot), it is found that the tow may be baled and thereafter smoothly withdrawn from the bale. It has now been found that profiled roll opened tow, even when untwisted, may readily be withdrawn from a ball warp. This is surprising when one considers that the tow when opened is no longer in a coherent state; accordingly, one would expect that there would be such entanglement of the ball warped tow as to render smooth withdrawal of the tow impossible.

It is believed that profiled or patterned roll tow opening apparatus operates by the following mechanism: the tow is longitudinally passed from a driven feed means into the nip formed by a profiled or patterned roll and another roll (which may or may not also be profiled or patterned); at any given instant, a number of gripping points exist along the nip where a raised portion of the profiled or patterned roll is in juxtaposition to the surface of the other roll or the raised portions of said other roll if also profiled or patterned; a number of the filaments of the tow are gripped at these gripping points while the other filaments of the tow pass, ungripped, through the nip at the indented portions of the rolls; the rolls rotate at a greater linear speed, and thereby longitudinally advance the gripped filament at said greater linear speed, then the linear speed at which the feed means longitudinally feed the tow; thereby the gripped filaments are longitudinally displaced relative to the ungripped filaments and thereby the filaments are deregistered. A more detailed description of the dynamics of operation of profiled or patterned roll tow opening systems is found in a patent application Ser. No. 382,261, entitled "Improved Fiber Debonding During Conversion" by Joseph R. Godwin, filed July 13, 1964, commonly assigned to the assignee of the present invention.

The large majority of filaments in the opened tow do not intersect the paths of other filaments in the tow and those which do intersect generally intersect only with the paths of the one or two immediately adjacent filaments. In other words, "crossovers," i.e., places in the tow where segments of different filaments intersect, are few, being merely incidental. This high degree of parallelization between the filaments renders the tow especially processable because a high degree of parallelization in the staple from which yarn is spun generally is an important objective. When there is uncontrolled lack of parallelization in the tow, sliver produced therefrom tends to have neps or entanglements which must be combed out or the spun yarn tends to be uncontrollably slubby.

It is known to ball warp tow which has been subjected to an opening operation comprising temporary tensioning between retarded rolls and tension rolls; this is described in Examples 1 to 3 of U.S. Patent No. 2,926,392. However, the "opened" tow thereby produced in fact is only partly opened and yields a sliver containing a substantial number of neps and shiners, though less than if the tow were completely unopened. This contrasts with the ball warped tow of the present invention, which is completely or substantially completely opened and yields a completely or substantially completely nep- and shiner-free sliver. Furthermore, it is found that when a higher tension is applied to the tow than is called for by the examples of said patent in order to achieve more opening, a substantial amount of the crimp in the filaments is permanently pulled out and a number of the filaments break to yield a substantial number of broken ends in the tow. This large amount of filament breakage is demonstrated, for example, by the fact that a cellulose acetate tow of 100,000 total denier, 5 denier/filament, and 12 crimps/inch when opened on the tension system at a tension roll: retarded roll speed ratio of 1.4:1 will support not even 30 ft. of its own length when suspended in a caternary configuration whereas a profiled roll opened tow opened in the same manner as described for a different tow in Example I, below, will support about 60 feet of its own length when suspended in said configuration.

A further improvement with respect to tow-to-sliver and direct tow-to-yarn processability is observed when the tow is processed during its manufacture in a special manner which renders it more uniformly profiled roll openable. Such specially manufactured tow when collected as a ball warp, as in the case of the conventionally manufactured tow, is also surprisingly found to be smoothly withdrawable from the ball warp even when profiled roll opened after said special preprocessing and before being collected as said ball warp.

Another advantage of ball warps is that they can be made to hold a greater weight of tow per unit volume (i.e., tow density) thus facilitating shipping and handling. Bales of tow generally have a density of about 15 to 20 lbs./ft.^{3}. On the other hand, the ball warps can be made to carry a tow density of 35 lbs./ft.^{3} and even up to about 50 lbs./ft.^{3} or more. In order to minimize loss of crimp from the tow due to high tension and compression of the tow in the ball warp, while still having a practically compact, high tow pardage package, it is preferred that the tow density be from about 15 to 30 lbs./ft.^{3} and most preferred that the tow density be about 20 to 25 lb./ft.^{3}.

A specific example of profiled roll opening a tow and ball warping the opened tow will now be given, in conjunction with which example FIG. 1 will be described in detail:

EXAMPLE I

Tow **11**, 128,000 total denier, 2.7 denier per filament polyethylene terephthalate, having a crimp frequency of 10 crimps/inch and a degree of crimp of 30% ("degree of crimp" being the percentage, based on the lineal length of the crimped filaments, by which the lineal length of the filaments if uncrimped would exceed said lineal length of the crimped filaments) is withdrawn from bale **11**, passed through ring guide **12** and over cylindrical banding jet **10** (which is shown in detail in FIGS. 1 to 4 of copending application Ser. No. 307,389, filed Sept. 9, 1963) to which air is supplied at the rate of 20 s.c.f.m. and at a pressure of 2.5 p.s.i.g. (lb./sq. inch, gauge) which spreads the tow into a band, which is passed under and against tension guide **14** and over and against tension guide **15**, then between the nip of rubber surfaced rolls **16** and **17** which are driven through roll **17** at a surface speed of 91 feet/min., then between the nip of profiled roll **18** (which is stainless steel 15" wide, 6⅝" in diameter and has a surface in the configuration of a modified American National Thread of 14 threads/inch) and rubber surfaced roll **19** which is driven and drives profiled roll **18** at 146 ft./min., then over and against rubber surfaced roll **20** and rubber surface roll **21**, over and against guide bar **22**, and finally wound in the form of ball warp **23**, which is driven by conventional ball warp driven **24** which is operatively connected to motor **25** by endless belt **26**, drive **24** rotating at a surface speed of 124 ft./min. The ball warp has a tow density of 34 lbs./ft.^{3}.

In a method for making the conventional tows suitable for use in making staple fibers, a number of subtows, each containing only a fraction of the filaments desired in the main tow, are first fed side-by-side to a draw frame where they are stretched, in a manner well known to the art (as discussed for example in Man-Made Textile Encyclopedia, edited by J. J. Press and published in 1959 by Textile Book Publishers, Inc., pp. 75, 76), to develop the desired physical properties (e.g., high tenacity and stiffness); the resultant drawn tow is then fed to a crimping device, preferably a stuffer crimper, after which the crimp is set, as by feeding the band of crimped tow, in an untensioned state, onto a belt which transports it continuously through an oven maintained at a temperature sufficiently high to set the crimp permanently but not high enough to damage or melt the filaments. The product of such process is the tow hereinbefore referred to.

The "specially manufactured tow" preliminarily referred to above is manufactured by feeding a plurality of undrawn sub-tows to a drawing zone and, while in the form of a band in said zone and under the drawing tension, passing them over a deflecting surface inclined to the direct draw path of said band so that the deflection from said direct draw path varies along the width of said band. The use of this process makes it possible to produce novel tows in which there is a controlled "degree of intermingling of the filaments" (i.e., number of cross-overs) and is relatively uniform across the width of the tow, (i.e., the crossovers occur with a substantially uniform frequency across the width of the tow). As with conventionally manufactured tow, ball warps having the above described specifications may be made of the specially manufactured tow. Thus, there can be produced tows with a controlled, limited degree of intermingling which perform well in tow-to-sliver and direct tow-to-yarn processing.

According to another aspect of the present invention, there are provided: controlled partially opened tow; packages of the varieties described above and especially ball warps thereof; and methods for producing staple having a controlled magnitude of shiners and neps and, consequently, spun yarn of controlled slubbiness. This may be accomplished with either the conventionally or specially manufactured tows.

As explained above, married filaments or shiners occur in imperfectly opened tow and such imperfect tow yields slubby yarn. In the past, such slubbiness had been considered an uncontrollable accident, because it was not considered to attempt to or was not possible to partially open tow at a controlled level. It has now been found that the profiled roll system of opening tow may be operated in such a manner as to achieve partial opening to various controlled extents. This controlled partially opened tow when tow-to-sliver processed and the sliver subsequently spun or when direct tow-to-yarn processed yields a spun yarn having a controlled degree of slubbiness; in other words, the results are reproducible.

Operating conditions for a given profiled roll tow opening system by which various degrees of partial opening of the tow may be accomplished can readily be determined by routine experimentation. A preferred embodiment of the profiled roll tow opening system employs two sets of rolls, each set consisting of a lower driven roll covered with rubber and a helically grooved steel surfaced roll above. The tow passes between the nip of each of the two sets of rolls. The set of rolls through the nip of which the tow first passes is termed "feed rolls" and the second set of rolls is termed "ratio rolls." The ratio rolls are operated at a higher speed than the feed rolls. The ratio of the speed of the ratio rolls to the speed of the feed rolls determines the degree to which the tow is opened. Generally a high degree of opening occurs at a ratio of from about 1.1:1 to about 2.0:1 and maximum opening occurs at a ratio of from about 1.2:1 to 1.8:1, depending on the nature of the tow; the higher the ratio the greater the extent of opening until a ratio is reached which provides substantially complete crimp deregistration and further increase in ratio does not result in additional opening.

Another method, according to the present invention, by which there is obtained staple which yields slubby yarn when spun will now be described. Specifically, a plurality of tows at least one of which is unopened is fed to the tow-to-sliver converter or direct spinner. The married filaments or shiners in the unopened tow cause the staple made therefrom to be neppy and the neps in the staple cause the yarn spun from the staple to be slubby. Partially opened, rather than completely unopened, tow may also be used. Everything else being equal, substitution of a partially opened tow for an unopened tow will result in fewer neps and unopened clumps in the staple and less slubby yarn spun therefrom.

The tows of "synthetic" filaments in accordance with

the present invention may comprise organic derivatives of cellulose such as the esters or ethers thereof, for example cellulose organic acid esters such as cellulose acetate, cellulose propionate, cellulose butyrate, cellulose benzoate, cellulose acetate formate, cellulose acetate propionate, cellulose acetate butyrate, and the like, ethers such as ethyl cellulose, etc. The esters may be ripened and acetone-soluble, such as conventional cellulose acetate, or may be substantially fully esterified, i.e., contain fewer than 0.29 free hydroxy groups per anhydroglucose unit, e.g., cellulose triacetate. The tows of "synthetic" filaments according to the present invention also include regenerated cellulose, such as viscose rayon or cuprammonium rayon, and chemically modified or cross-linked regenerated cellulose.

The tows of synthetic filaments according to the present invention further include thermoplastic or solvent-soluble or dispersible polymeric materials such as super-polyamides, e.g., nylon, super-polyesters such as polyethylene terephthalate, polyglycolic acid and copolymers thereof, acrylonitrile polymers and copolymers, polymers and copolymers of olefins and vinyl esters such as ethylene, propylene, vinyl chloride, vinyl acetate, vinylidene chloride, vinylidene cyanide, and the like.

The four major methods of spinning yarn from staple are the cotton system, the American system, the worsted system, and the woolen system. The cotton system can spin sliver having a staple length as low as about ½ or ¾ inch but not more than about 2¾ inches. The worsted system cannot spin sliver having a staple length of less than about 3 inches. In the past, it has not been possible to produce an acceptable sliver having a staple length of less than about 3 inches using the conventional cutting tow-to-sliver conversion processes which are performed by such machinery as the Pacific Converter, and, thus, the sliver from these processes could not be fed to a cotton system for spinning; since there is a great deal of cotton system spinning machinery in existence, this clearly has been a significant shortcoming of the tow-to-sliver conversion processes.

The present invention remedies this shortcoming. It has been found that profiled roll opened tow will yield acceptable sliver of a staple length as low as about 1½ inches suitable for cotton system spinning when the converter is set for minimum staple length by the conventional adjustments for the particular converter.

Especially preferred for profiled roll opening prior to tow-to-sliver or direct tow-to-yarn processing are cellulose triacetate and polyethylene terephthalate tows, since these especially tend to yield a neppy staple in the absence of threaded roll opening prior to processing into staple.

The tow for tow-to-sliver processing preferably comprises about 500 to 750,000 filaments having a total denier of about 1,000 to 1,000,000, and most preferably, about 2,000 to 600,000 filaments having a total denier of about 10,000 to 500,000. The filaments preferably have about 3 to 27 crimps per inch and most preferably about 6 to 16 crimps per inch; since the crimp frequency of the tow as it exists on a ball warp is temporarily reduced by the tension in the ball warp by no more than about one-quarter at the preferred density range of about 15 to 30 lb./ft.^{3}, the preferred and most preferred crimp frequency limits of the filaments of the ball warped tow are about 2 to 20 and about 4 to 12 crimps/inch, respectively.

Generally, tow-to-sliver processing machines which operate by cutting, such as the Pacific Converter, successfully process tow having a total denier as high as 1.5 to 2 million or more while tow-to-sliver processing machines which operate by breaking, such as the Turbo Stapler, though usually not processing tow of higher than 300,000 to 500,000 total denier, may successfully process tow having a total denier as high as 1.5 million and perhaps higher.

By making threaded rolls of very large width, e.g., 10 feet, it would be possible to successfully open tow having

a total denier of 1½ million, 2 million and even higher. However, it is often found desirable, in order to economize on consumption of plant space or to enable a threaded roll tow opening system to be fitted into the space available among existing machinery, to employ threaded rolls of a substantially smaller width. For example, a threaded roll system employing a 30" wide threaded roll as described in Example I is found quite convenient. Such a system has a tow capacity of about 300,000 total denier. Thus, in order to use tow-to-sliver processing machinery to capacity, it is necessary to feed simultaneously the output of a plurality of threaded roll systems into the tow-to-sliver machinery or to feed simultaneously to said machinery the same number of ball warps of tow each of which has been obtained by such process as described in Example I. The following example illustrates the simultaneous processing of tow from a number of ball warps each of which was obtained by the process described in Example I; in conjunction with the following example, FIG. 2 will be described in detail:

EXAMPLE II

Twelve ball warps of tow **31** are on a creel (six of them appear in FIG. 2 and the other six are axial to the six that appear). The tow on each ball warp is 2.7 denier per filament (d.p.f.), 128,000 total denier polyethylene terephthalate; the ball warps were made as described in Example I. The ball warps are creeled in two sets of six ball warps. The tows from each of these sets are brought together to form a 768,000 denier band; the tow from one set of ball warps is brought together at a set of four tension bars **33** to form 768.000 denier band **32** and the tow from the other set of ball warps is brought together at a set of four tension bars **33'** to form 768,000 denier band **32'**; the former band is passed directly over tension bar **35** where it is brought together with the latter band which is passed under tension bar **34** and then over tension bar **35**. The recombined band is passed to tension bar **36** where it is divided again into 768,000 denier bands **32** and **32'**, the former of which is passed against tension bars **37** and **38** and the latter of which is passed against tension bar **39**; from said tension bars, the two bands are passed to conventional Pacific Converter C, which is a single assembly as indicated by the broken line box; all of the parts of the Pacific Converter are conventional and therefor will be designated by name and not described in detail. The two bands are recombined at feed rolls **40** and **41** about which they are snubbed. The tow is passed between cutter roller 42 and anvil roller **43** which are adjusted to produce an average staple length of 3½" and withdrawn by roll set **45**. Between **42, 43** and **45** the staple passes between debonding rolls **44**. From roll set **45** the staple passes to two draft roller and shuffling sections: one of said draft roller and shuffling sections comprising shuffing rollers **46**, draw rolls **48**, apron drive roll **47** and apron **49** which passes about roll **47** and between rollers **46** and the rolls of roll set **48**; and the other of said sections comprising shuffing rollers **50**, draw rolls **52**, apron guide roll **51** and apron **53** which passes about roll **51** and between rollers **50** and the rolls of roll set **52**. From said two sections, the staple passes to diagonal roller **54** which coacts with apron and apron drive rolls assembly **55** to helically roll the stapple together. Said rolled staple is fed to stuffing box crimper **56** comprising a pair of feed rolls and a stuffing box, and the crimped product which issues therefrom ("top" or "intermediate sliver") is deposited in can **57** for storage. The top or intermediate sliver is subjected to a sequence of two conventional pin drafting operations whereby the final sliver is formed. Said sliver is uniform, free of neps and shiners and is spun by the worsted system to yield a uniform yarn of a worsted counts of 1/36.

EXAMPLE III

The cutter and anvil rolls are adjusted to give a staple length of 1½" instead of 3½". The sliver is uniform, free of neps and shiners. Said sliver is spun by the cotton system to yield a uniform yarn of a cotton counts of 24/1.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In combination with a method of converting a crimped bundle of generally parallel continuous filaments to a continuous elongated body comprising staple, the improvement which comprises feeding a crimped bundle of continuous filaments of a first tow to a tow opening means, subject said first tow in said tow opening means to a displacing action whereby some of said filaments are longitudinally displaced with respect to adjacent filaments thereby opening said tow, combining said first tow with a second unopened crimped tow, reducing said combined tow to staple and forming said staple into a continuous elongated body.

2. The method of claim **1**, wherein said means for converting the bundle is direct spinning means and said continuous elongated body is spun yarn.

3. The method of claim **1** wherein said combined tow is cut into staple.

4. The method of claim **1** wherein said combined tow is broken into staple.

5. The method of claim **1** wherein the elongated body is sliver.

6. The process of claim **5** wherein the sliver is spun into yarn.

7. The method of claim **6**, wherein the staple has a length of not more than about 2¾ inches and the spinning is performed according to the cotton system.

8. In combination with means for converting a crimped bundle of generally parallel continuous filaments to a continuous elongated body comprising staple, the improvement which comprises: tow opening and deregistering means comprising a rotatable profiled roll; a second rotatable roll in juxtaposition to said profiled roll whereby said profiled roll and said second roll form a nip; means for feeding a first tow through said nip; and means for delivering said withdrawn tow to means for converting said tow to staple; means for feeding with said first tow a second crimped tow unopened, through said means for converting, and take up means for said staple.

9. The apparatus of claim **8**, wherein said profiled roll has a helically grooved surface.

10. The apparatus of claim **8** wherein said means for reducing said tow to staple is a tow to sliver converter comprising means for reducing tow into staple and means for drafting said staple into a sliver.

11. The apparatus of claim **8** wherein said means for reducing said tow to staple is a direct spinner comprising means for stretching and breaking fiber into staple, means for drafting said staple into roving and means for twisting said roving into yarn.

12. The apparatus of claim **10** wherein said means for reducing tow to staple comprises means for cutting tow into staple and means for drafting said staple into a sliver.

13. The apparatus of claim **10** wherein said means for reducing tow to sliver comprises means for breaking the tow into staple and means for drafting said staple into a sliver.

14. In combination with the apparatus of claim **10**, the additional apparatus which comprises means for spinning the sliver into yarn comprising means for drafting a sliver into roving and means for twisting said roving into yarn.

15. A method of making a slubby spun yarn comprising: profiled roll opening and deregistering a first crimped tow; combining said first tow with a second unopened crimped tow, and drafting said combined tows into a continuous elongated body comprising staple; and spinning said continuous elongated body whereby there is produced said slubby spun yarn.

16. A method of making a slubby spun yarn comprising partially opening and deregistering a first crimped tow by means comprising a profiled roll; combining said first tow with a second unopened crimped tow; reducing said combined crimped tow to staple and rolling said staple into a continuous elongated body whereby there is produced said slubby spun yarn.

17. Apparatus for making slubby spun yarn from crimped tow comprising: tow opening means comprising a rotatable profiled roll; a second rotatable roll in juxtaposition to said profiled roll whereby said profiled roll and said second roll form a nip; means for feeding a first tow through said nip thereby to open and deregister said tow; means for converting said tow to a continuous elongated body comprising staple; means for feeding said opened tow through said means for converting; means for feeding with said opened tow a second crimped tow, unopened, through said means for converting, whereby said tows are converted into a continuous elongated body comprising staple; and means for spinning said continuous elongated body, whereby there is produced from said body a slubby spun yarn.

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DONALD E. WATKINS, Primary Examiner

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