June 21, 1960 J. J. McCANN 2,941,261

DRAFTING APPARATUS AND METHOD

Filed Aug. 2, 1956 2 Sheets-Sheet 1

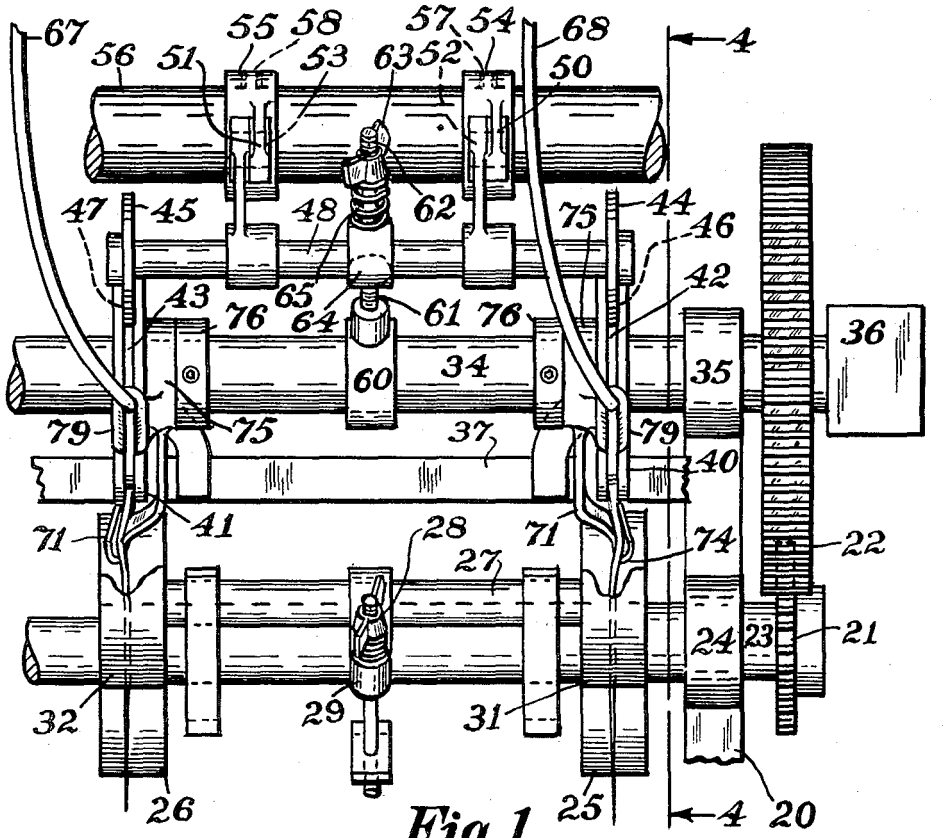

Fig. 1.

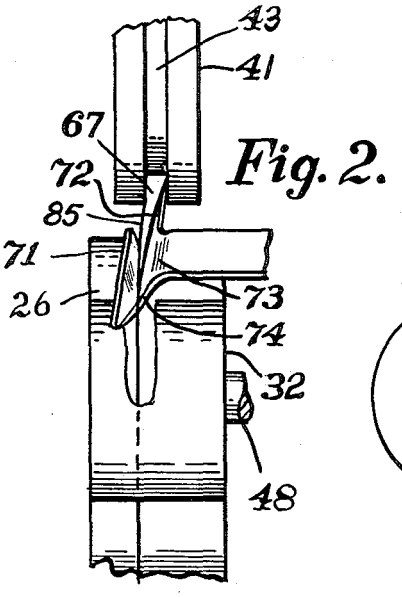

Fig. 2.

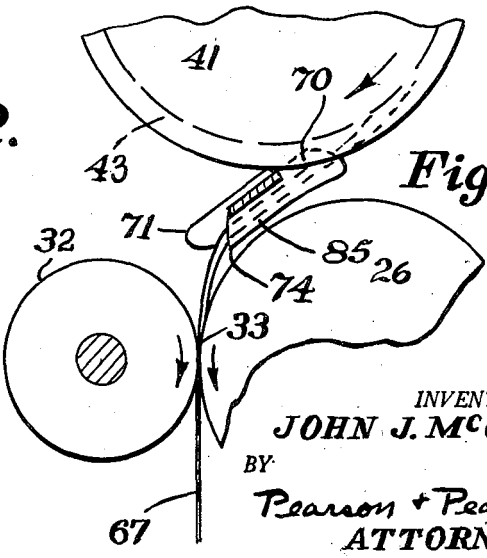

Fig. 3.

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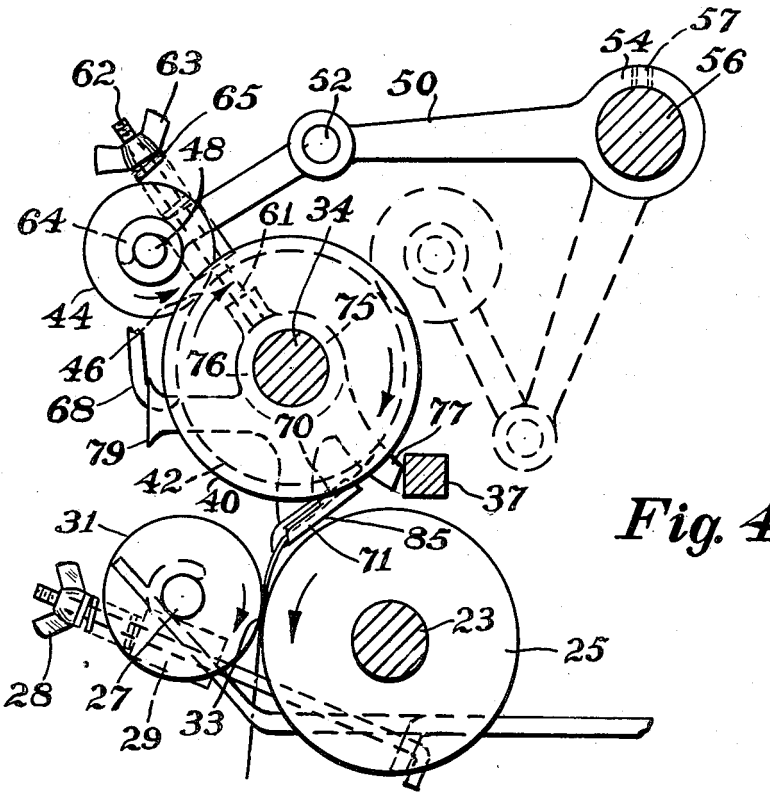

Fig. 4.

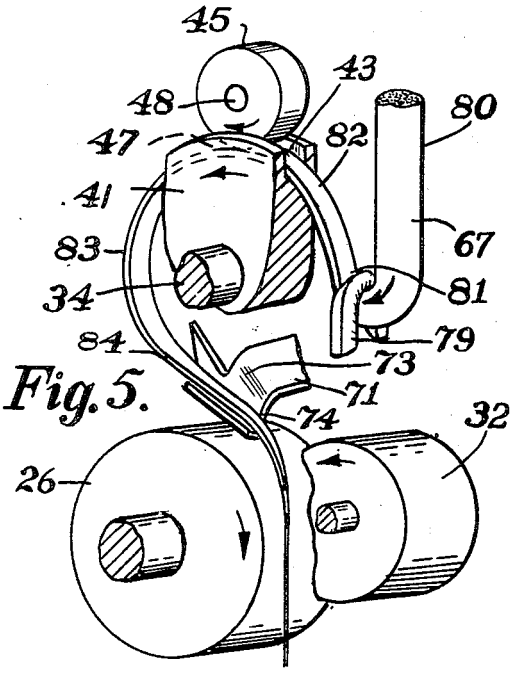

Fig. 5.

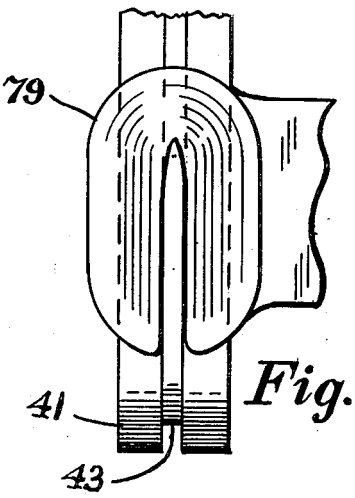

Fig. 6.

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DRAFTING APPARATUS AND METHOD

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17 Claims. (Cl. 19—130)

This invention relates to a process and apparatus for the drafting of a continuous strand of staple fibers.

In the textile art a continuous strand of fibres such as roving, sliver and the like, is drafted between two spaced apart sets of drafting rolls defining a drawfield or drafting system between the nips thereof. The feed rolls of the drafting system rotate at a slower speed than that of the delivery rolls and the ratio of the relative surface speeds of the rolls is termed the draft.

To secure a relatively even strand and continuous delivery there usually is a control apparatus in the drawfield between the two sets of drafting rolls. When a continuous strand of staple fibers enters the drawfield the fibers are first under control of the nip of the feed rolls, then they pass into an intermediate position where they are free to move forward except for a drafting control mechanism, without which the strand would part or separate, and finally the fibers pass into the nip of the delivery rolls which has a relatively faster surface speed which causes the strand to be elongated and reduced in diameter, whereupon twist is inserted to form yarn which is wound into a package.

Such control mechanism has taken the form of additional sets of carrier rolls, porcupine rolls, single apron and rolls, double aprons, condensers or flumes, stationary guides like the quarter turn guides or a combination thereof and all have been intended to control the fibers of the strand in their passage through the drawfield.

In most such devices, the strand has passed through the drawfield in a straight line path and the above mentioned control has been exerted on the strand at certain points only or for short distances only. In such devices as have guided the strand in an indirect, circuitous path through the drawfield the gaps between such control devices have usually been even greater than in the straight line type. Because of the intermittent control, or agitating action, caused by the intermediate mechanism of such devices, it has often been necessary to use low drafts and several additional doubling and drafting operations to get the required size or count of yarn without excessive yarn unevenness, or parting of the continuous strand.

In prior drafting devices the drafted portion of the strand has usually been rolled out to a flattened cross section or ribbon in a horizontal plane whereby it is presented to the nip of the delivery rolls in extended, flattened condition with a minimum of internal frictional resistance of the fibers in the strand. Fibers protruding from the edge of the flattened strand have been engaged by the faster moving delivery rolls at a distance away from the body of the strand and have either been caused to protrude further to form a hairy yarn or have been entirely plucked out of the strand.

I am aware that in U.S. Patent 2,673,376 to Ambler of March 30, 1954, a small grooved roll and follower is provided near the delivery nip with the strand advancing in a straight line path from feed nip to delivery nip.

I am also aware that in U.S. Patent 1,433,529 to Butler

of October 31, 1922, a plurality of grooved, lower intermediate rolls and disc follower upper intermediate rolls are provided in a drafting zone. In the Butler patent the strand is advanced from nip to nip, first in a straight path and then in a brief parti-circular path in the groove of an intermediate lower roll before it crosses an elongated gap to the nip of delivery rolls. However, in my invention the single grooved lower feed roll eliminates the use of various pairs of intermediate rolls as this single grooved lower feed roll occupies nearly all of the drafting zone. In addition, my invention provides a relatively fixed grooved channel member which not only bridges most of the gap between the grooved feed roll and the delivery rolls, but also performs a valuable condensing, compacting or compressing function at this critical area of drafting. All stationary or rolling pressure-applying elements in contact with the strand while it is being conveyed in the groove of the single enlarged, lower feed roll, or supported in the control condenser, have been eliminated in my invention from the feed nip up to the delivery nip. Thus the fibers in the strand are not subject to any localized or arbitrary pressure but are under practically continuous uniform control through the drawfield by the path imposed on the drafted strand.

Desirably, the leading end of the fibers of a drafted strand should be presented to the nip of the delivery rolls in substantial bunched parallelism and in progressive order while the positions of the other fibers as they travel through the drawfield remain relatively the same as when they were fed into the drawfield.

The principal object of the invention is to provide control apparatus within a drafting zone, or drawfield, which presents the fibers in progressive order to the nip of the delivery rolls by imposing a path on the strand through the drawfield adapted to substantially, continuously maintain the relative position of the remaining fibers of the strand in the drawfield until they are gripped in the nip of the delivery rolls.

Another object of the invention is to provide drafting apparatus wherein the drafted strand is substantially continuously supported through the drawfield, by means of snubbing faces in each of the various quadrants around the strand, whereby all protruding fibers are urged inwardly into parallelism with the strand body in their passage through the drawfield.

A further object of the invention is to support and confine a drafted strand through substantially all of a drawfield while continuously snubbing the strand from various directions the snubbing action enabling the shorter fibres to maintain their relative positions in the strand until individually advanced by the nip of the delivery rolls.

Still another object of the invention is to provide an apparatus and method for long drafting of fibrous strands wherein strand twist is not essential or critical and the necessary internal frictional resistance of the fibres in the strand is supplied by the confining action of the curved and circuitous strand path.

A still further object of the invention is to supplement the internal frictional resistance of the fibres in the strand created by the path imposed thereon in the drawfield of this invention, by providing support to the strand through the critical point of drafting just in advance of the delivery rolls. Thus twist in the strand is prevented from running up to the delivery nip zone by a continuous snubbing action of the circuitous path of the drafting apparatus.

Another object of this invention is to provide means to tension and compact the strand before it enters the nip of the feed rolls by passing it through an inverted U shaped guide condenser that positions the strand in the grooved feed roll.

Another object of this invention is to provide means

whereby the distance between the nips of the feed and delivery rolls can be conveniently and rapidly changed to accommodate various maximum lengths of fiber in various strands and various diameters of individual fibers and strands of fibers.

Other objects and advantages of the invention will be apparent from the claims, the description of the drawing and the drawing in which:

Fig. 1 is a fragmentary front view of a portion of a drafting frame showing the control apparatus of the invention and with the top delivery roll broken away.

Fig. 2 is an enlarged front view of the control condenser of the invention.

Fig. 3 is a side view from the right of the drawing of the device shown in Fig. 2.

Fig. 4 is a side view from the right of the drawing, showing the mechanism of Fig. 1.

Fig. 5 is a diagrammatic view, in perspective, showing the control exercised over a strand being drafted by the mechanism of the invention, and

Fig. 6 is an enlarged front view of the feed condenser of the invention.

In the drawing, 20 represents the roll stand portion of a drafting frame of any well known type having suitable means for driving the gears 21 and 22, and suitable means for supporting the supply of strand to be drafted above the roll stand. The particular embodiment of the invention shown is adapted for use with long staple fibers although it will be apparent that the apparatus may be varied to draft strands made up of other lengths of fibers. The draft change drive gear 21 rotates a shaft 23 journalled in a bearing 24 and carrying the usual fluted lower delivery rolls such as 25 and 26. Conventional means such as the shaft 27, spring pressure device 28 and mounting 29 are provided for compressing the usual smooth resilient faced upper delivery rolls such as 31 and 32 to form a nip 33 between the delivery rolls such as 25 and 31.

The gear 22 is much larger than gear 21 and revolves the shaft 34 in bearing 35 at comparatively low speed. Traversing mechanism 36 of a well known type is shown conventionally in Fig. 1 and reciprocates the shaft 34 and gear 22 in bearing 35 in the usual manner. A longitudinally extending frame piece or rod 37 is used in this invention for a purpose to be later described.

Mounted for rotation with shaft 34 are identical lower feed rolls 40 and 41, each provided with a circumferential groove 42 or 43, preferably of rectangular cross-section. A pair of disc follower, upper, feed rolls 44 and 45 are each mounted to enter and fit within one of the grooves 42 or 43 to thereby establish a feed nip such as 46 and 47 with their respective lower rolls. The upper feed rolls 44 and 45 are rotatably and slideably mounted on an axially or longitudinally extending shaft 48. Since a portion of the upper feed rolls is engaged in the groove of the lower feed rolls, the upper feed rolls reciprocate axially along with the lower feed rolls under the influence of traversing mechanism 36. Shaft 48 is supported at the terminal end of each of a pair of arms 50 and 51, which are each hinge pivoted as at 52 and 53 and each supported by collars such as 54 and 55 on an axial rod 56. A set screw such as 57 or 58 is provided on each collar to affix the collars at desired angular positions relative to rod 56. A collar 60 is rotatable around shaft 34 and supports a rod 61 having a threaded end 62 for a wing nut 63, and having a hook 64 slideable therealong. Hook 64 embraces shaft 48 and a coil spring 65 around rod 61 enables the spring pressure of shaft 48 and upper feed rolls 44 and 45 to be adjusted by turning wing nut 63.

It will thus be seen that the hinge pivoted arms 50 and 51 may be adjusted to desired angular locations around rod 56, as illustrated in dotted lines in Fig. 4, to support the upper feed rolls 44 and 45 in desired angular locations around the grooved lower feed rolls 40 and 41. The angular movement of upper feed rolls 44 and 45 changes the location of the feed nip and creates a shorter or longer drawfield or drafting zone as required by the particular length of staple of fibers being drafted.

It should be noted that only one pair of feed rolls is provided in this invention for each single continuous strand such as 67 and 68, or two or more strands if such be used, and consequently only one circumferentially grooved lower feed roll. Each circumferentially grooved lower feed roll such as 40 is of sufficient diameter to occupy the major portion of the drafting zone between the feed nip 46 and the delivery nip 33. The path of a strand such as 68 from the time it is forwardly urged into the drawfield by engagement in the groove 42 is parti-circular around the shaft 34 as an axis and the groove conveys, supports and confines the strand nearly up to the delivery nip 33.

The gap between the point of departure 70 of each strand such as 68 from the circumferential groove 42 to the delivery nip 33 constitutes a minor portion of the drawfield or drafting zone and is nearly bridged by what I call a strand control condenser 71. Control condenser 71 may be V shaped in cross section and is fixed or stationary relative to the rotating feed rolls and delivery rolls, although it is reciprocable axially with the feed rolls. As best shown in Fig. 2, control condenser 71 is provided with an outwardly obliqued entrance edge 72, constituting a plow and arranged to commence the sidewise compacting, compressing or condensing of a flattened strand riding groove 43 while stripping the same from the groove. Condenser 71 is misaligned slightly relative to groove 43 to cause the strand 67 to be pulled or snubbed against a side wall such as 73 of the V shaped channel thereof to continue the sidewise compressing thereof. An exit edge 74 of condenser 71 is inwardly obliqued to further condense and snub the strand 67 as it leaves the condenser to enter the nip 33 of the delivery rolls. Preferably the condenser 71 receives the strand 67 tangentially from groove 43, supports the strand throughout its length and discharges the strand angularly into the plane of the nip 33 as shown in Fig. 3 in order that the fibers are presented to the nip in progressive order and in order that the strand be frictionally snubbed proximate the nip of the delivery rolls.

Each control condenser such as 71 is mounted on a sleeve 75 carried by shaft 34 and is held between a lower feed roll such as 40 and a collar 76 fixed to the shaft. The sleeve 75 thus traverses with the shaft 34 but does not revolve therewith. Any tendency of the sleeve 75 to revolve is prevented by the integral arm 77 of the sleeve which bears against the rod 37.

A strand feed condenser 79 is preferably provided on each sleeve 75 and supported integrally thereby at a fixed angular relationship to condenser 71 around the feed roll such as 40. Feed condenser 79 is inwardly tapered in the manner of a funnel and arranged to condense a cylindrical strand such as 68 slightly while leading the same into the base of the groove 42 in a feed roll 40. Preferably feed condenser 79 is of inverted U shape in cross section in order that a strand may be quickly threaded therein.

In operation, a continuous strand of textile fibers such as 68 is led from a suitable supply such as a spool, bobbin, cheese or the like, suspended in inverted position above roll stand 20 into the feed condenser 79. Feed condenser 79 places the strand under slight tension into the circumferential groove 42 of the lower feed roll 40. The rectangular groove 42 is usually of less width than the diameter of the strand and the condenser 79 tends to reduce the strand diameter to fit the groove. In Fig. 5, the strand 67 is shown to be cylindrical at 80, then slightly condensed at 81 when it passes through condenser 79 and then slightly downwardly compressed at 82 between condenser 79 and the upper feed roll 45 by reason of being pulled around a curved path. The strand 67 then passes under the disc upper feed roll 45 which is spring pressed into groove 43 of roll 41 and the fibres are confined by

both side walls of the groove 43 as well as by the feed nip 47. The inwardly compressed and sidewise confined strand 67 shown at 83 in Fig. 5 is then in the drafting zone and is conveyed through the major portion thereof in a parti-circular path by the groove 43. Meanwhile it is compressed into a comparatively flat cross section and held in the bottom of rectangular groove 43 by the tension exerted on the strand by the delivery rolls which travel at a higher surface speed than the surface speed of the feed rolls. A snubbing action is thus produced on the intermediate fibres, not gripped by either the feed rolls or the delivery rolls, which tends to retain them in the strand in their proper positions so that they are not plucked by the faster moving fibers in the delivery nip to cause uneven yarn. After being conveyed through the major portion of the drafting zone in groove 42, in flattened and snubbed condition as shown at 84 in Fig. 5, the strand 67 reaches the entrance edge of strand control condenser 71. Condenser 71 bridges most of the gap from the feed roll 41 up to the nip 33 of the delivery rolls and continues the snubbing action on the strand.

As indicated at 85 (in Fig. 2) the slight angle of condenser 71 to the vertical path of the strand causes the already flattened strand to be sidewise compressed so that it leaves the exit edge thereof with a substantially symmetrical cross section. While the strand enters condenser 71 tangentially, it leaves with an abrupt change of direction from merely downwardly inclined to substantially vertical which change of direction also has a snubbing effect. The continuous control and support of the strand from the feed nip nearly up to the delivery nip and the circuitous path imposed thereon with its snubbing action tends to prevent twist in the strand from running up to the delivery nip and adversely affecting drafting.

The confining of the strand in the rectangular groove 42 or 43 and the V shaped condenser 71 causes the fibers in the strand to remain parallel, or be urged into parallelism right up to the nip 33 and therefore prevents hairy yarn or the plucking of projecting fibers.

I have produced a 50's worsted yarn with a 38 percent average unevenness with the apparatus of this invention. This compares favorably with a 68 percent average unevenness standard for this count and a draft of 22 was utilized as compared with a conventional draft of 8. I have shown two drafting elements in a unit and it should be understood that there are normally about 25 such units on each side of a frame. All of the units on a side have a common train of gears to drive the rolls with a conventional change gear in the train to vary the draft. The drafting unit can be used with any means of twisting such as a pot, ring, cap or flyer twisting and/or winding element or the drafted strand can be fed into a can. The apparatus is readily threaded up because all of the drafting control mechanism of the invention is open ended except the feed roll nip which is spring pressed. The time and effort of feeding the leading ends through the drafting field is thus greatly reduced.

I claim:

1. Apparatus for controlling a continuous strand of staple fibers as the strand passes through a drafting zone into the nip of a pair of delivery rolls rotating at a predetermined speed, said apparatus comprising a first feed roll having a diameter co-extensive in length with the major portion of the length of said zone and having a circumferential strand groove therearound; a second feed roll forming a pressure nip within the groove of said first feed roll; means for rotating said first feed roll at a predetermined surface speed less than that of said delivery rolls and a strand control condenser substantially co-extensive in length with, and substantially bridging, the remaining minor portion of the length of said zone, said control condenser being mounted to receive said strand tangentially from said groove, deflect said strand angularly in its path and deliver the same into the nip of said delivery rolls, the groove in said first feed roll continuously supporting, confining and conveying said strand in a parti-circular path through the major portion of said drafting zone and said control condenser continuously supporting and confining said strand through substantially the remaining minor portion of said drafting zone, with no other strand engaging elements in said drafting zone.

2. Apparatus as specified in claim 1 wherein said second feed roll is supported by a hinge pivoted arm and is angularly movable thereon around the axis of said first feed roll to pre-selected positions for changing the length of the drafting zone between the nips of said rolls.

3. Apparatus as specified in claim 1 wherein said first and second feed rolls and said control condenser form a unit slideable on shafts extending parallel to the axis of said delivery rolls and means are provided for traversing said unit on said shafts.

4. Apparatus as specified in claim 1 wherein said groove is of rectangular cross section and adapted to support said strand in inward compacted condition and said control condenser is of V shaped cross section and axially misaligned relative to the groove in said first roll to support and sidewise compact a strand passing therethrough.

5. Apparatus as specified in claim 1 plus a strand feed condenser of inverted U shaped cross section mounted in fixed position in advance of said second feed roll and proximate the groove in said first roll for guiding a continuous strand supply into said groove while condensing the strand.

6. Apparatus as specified in claim 5 wherein said strand control condenser and said strand feed condenser are both mounted in fixed angular relationship on a sleeve and said sleeve is slideable with a shaft, extending parallel to the axis of said delivery rolls, with said first feed roll.

7. Apparatus as specified in claim 1 wherein said strand control condenser is of V shaped cross section and includes an upstanding plow element adjacent to one inside face of the groove in said feed roll to deflect said strand therefrom into said condenser.

8. Apparatus as specified in claim 1 wherein said strand control condenser is of V shaped cross section, axially misaligned with the groove in said feed roll and provided with oppositely obliqued exit and entrance end edges for compacting said strand.

9. Apparatus for drafting a continuous strand of textile fibers comprising a pair of delivery drafting rolls rotating at a predetermined speed; a single pair of feed drafting rolls rotating at a lesser predetermined speed than said delivery rolls, one of said feed rolls being grooved and the other roll forming a pressure feed nip within said groove and said grooved roll being of sufficient diameter to occupy the major portion of the space between said pressure feed nip and the nip of said delivery drafting rolls and a strand control condenser bridging substantially all of the remaining minor portion of said space, said control condenser having an exit end positioned to change the direction of, and frictionally snub, said strand proximate the nip of said delivery rolls and an entrance end proximate the groove in said grooved feed roll, the groove in said grooved roll and said control condenser being arranged to support and compact said strand substantially continuously in a circuitous path between the feed nip and the delivery nip of said apparatus with said strand otherwise unconfined and unsupported.

10. Apparatus as specified in claim 9 wherein the groove in said feed roll is rectangular in cross section and said control condenser is axially misaligned relative to said feed roll groove for sidewise compacting said strand.

11. Apparatus as specified in claim 9 wherein said condenser is of V shaped cross section and the entrance and exit end edges thereof are cut at opposite oblique angles for facilitating the bunching of the fibers of said strand as they are presented to the nip of said delivery rolls.

12. A process of drafting a strand of staple fibers, said process comprising the steps of inwardly compressing said strand while forwardly urging the strand at a predetermined initial speed into a drafting zone; continuously supporting and conveying said inwardly compressed strand through the major portion of said zone along a curvilinear path in a plane while maintaining the strand in inwardly compressed condition; continuously confining and supporting said strand through substantially the remaining minor portion of said zone along a rectilinear path angularly deflected out of said plane while sidewise compressing the same and forwardly urging said strand out of said zone at a predetermined speed greater than said initial speed.

13. A process as specified in claim 12 plus the step of reducing relative axial displacement of the shorter fibers in said strand while said strand is confined and supported along said rectilinear path by frictionally retarding and snubbing said strand and abruptly changing the direction thereof at the end of said rectilinear path.

14. Apparatus for long drafting a continuous strand of staple fibers, said apparatus comprising a pair of delivery rolls rotating at a predetermined surface speed, and having a delivery nip; a single pair of rotatable feed rolls having a feed nip, one of said feed rolls being grooved and of sufficient diameter for said groove to form an elongated continuous parti-circular path from said feed nip to proximate said delivery nip, means for rotating said grooved feed roll at a less surface speed than the surface speed of said delivery rolls to cause said strand to be conveyed along said parti-circular path while continuously supported in said groove, and a strand control condenser fixed at an angle to the plane of the nip of said delivery rolls, said condenser being adapted to receive said strand from said groove at a point along said parti-circular path, and angularly change the direction thereof adjacent the delivery nip of said delivery rolls.

15. Apparatus as specified in claim 14 wherein said strand control condenser is fixed in position of misalignment relative to the groove in said grooved feed roll to cause said strand to be compacted against one side thereof.

16. In combination with a pair of delivery draft rolls, a drafting mechanism comprising a circumferentially grooved lower feed roll, an upper feed roll engaging the bottom of the groove of said lower roll, a strand feed condenser adapted to lead a strand into said groove in advance of said upper feed roll, and a strand control condenser adapted to lead a strand tangentially out of said groove at a point angularly removed from said upper feed roll, said strand control condenser being mounted to abruptly and angularly change the direction of said strand just in advance of the nip of said delivery draft rolls.

17. Apparatus for drafting a strand of staple fibers in a drawfield, said apparatus comprising a first grooved feed roll having a diameter coextensive in length with the major portion of said drawfield and having a circumferential strand groove therearound; a second feed roll forming a pressure nip within the groove of said first grooved feed roll; a grooved channel strand guide substantially co-extensive in length with, and substantially bridging, the remaining minor portion of the length of the drawfield; a pair of delivery rolls; means to rotate said delivery rolls at a greater surface speed than that of the feed rolls, the groove in said first feed roll being adapted to continuously confine, support and convey said strand in a parti-circular path through the major portion of the drawfield and said grooved channel strand guide being mounted to receive said strand tangentially from the groove in said first feed roll, confine and support said strand through substantially the remaining minor portion of the drawfield and frictionally snub said strand adjacent the nip of said delivery rolls.

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