April 18, 1961 J. E. BROMLEY ET AL 2,979,882

METHOD AND APPARATUS FOR STRETCHING AND TWISTING CONTINUOUS FILAMENT YARN

Filed July 15, 1959 5 Sheets-Sheet 1

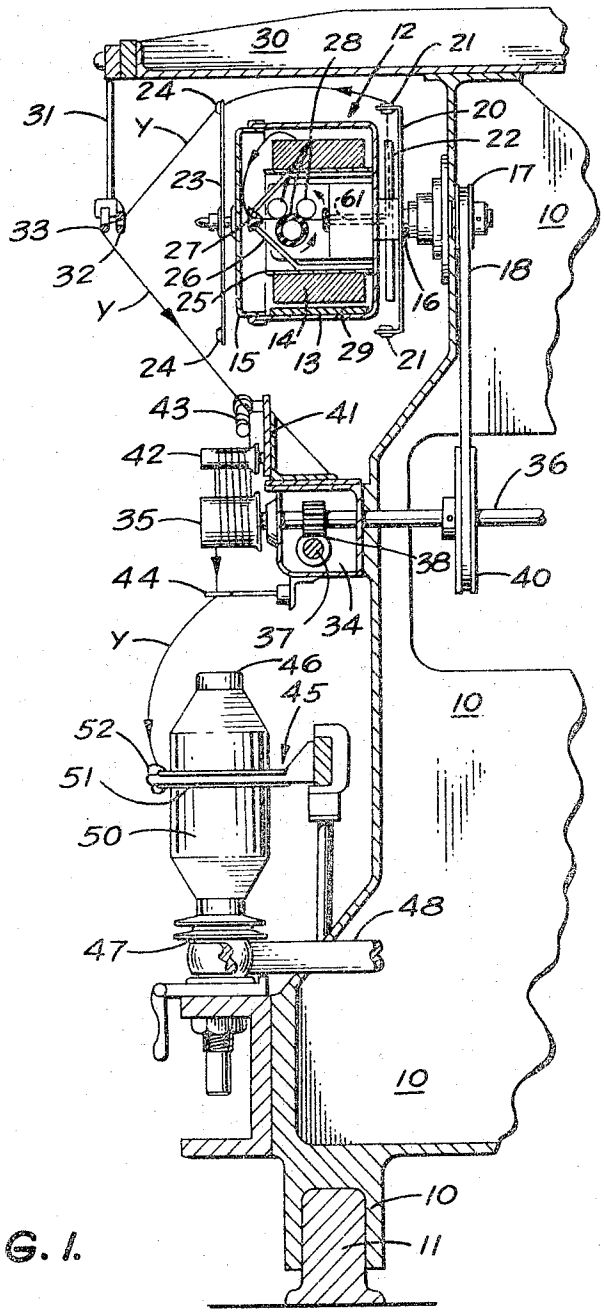

FIG. 1.

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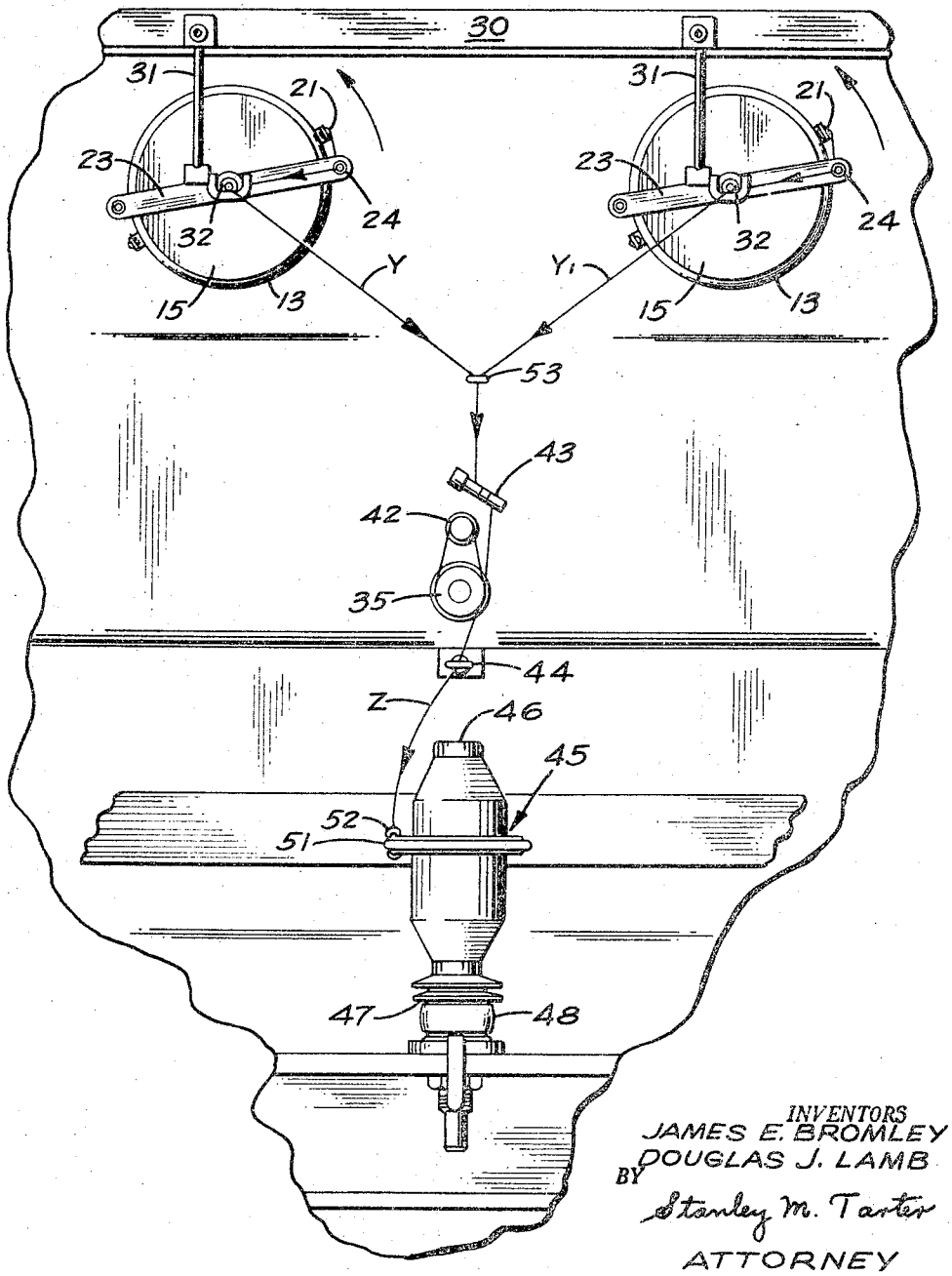
FIG. 2.



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Filed July 15, 1959 5 Sheets-Sheet 3

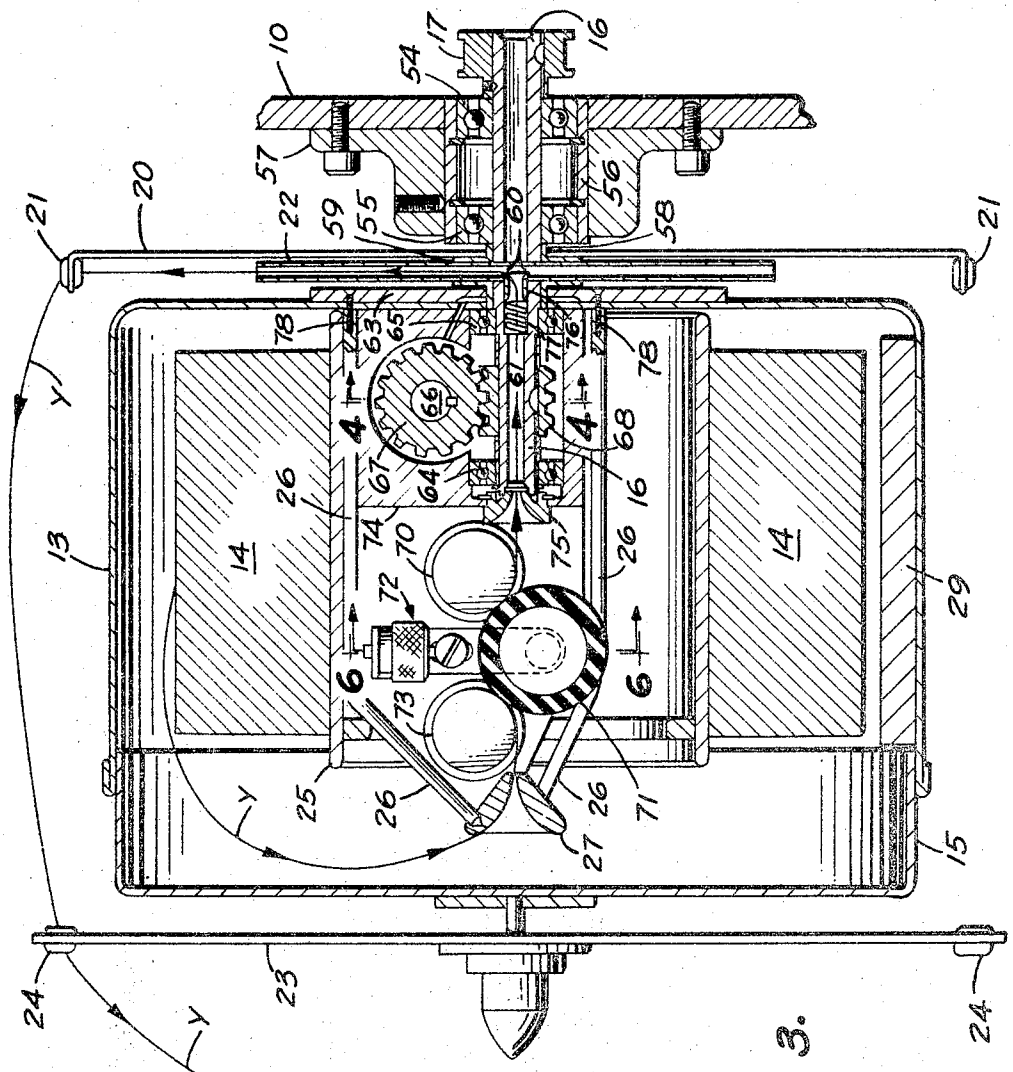

FIG. 3.

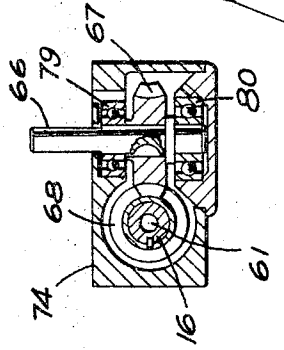

FIG. 4.

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Filed July 15, 1959 5 Sheets-Sheet 4

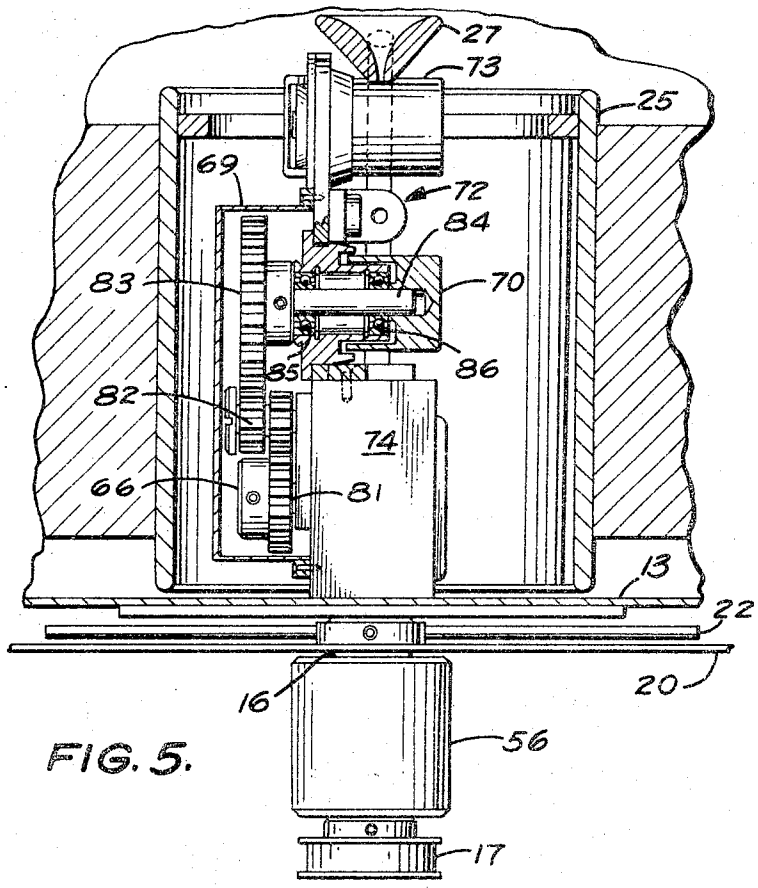

FIG. 5.

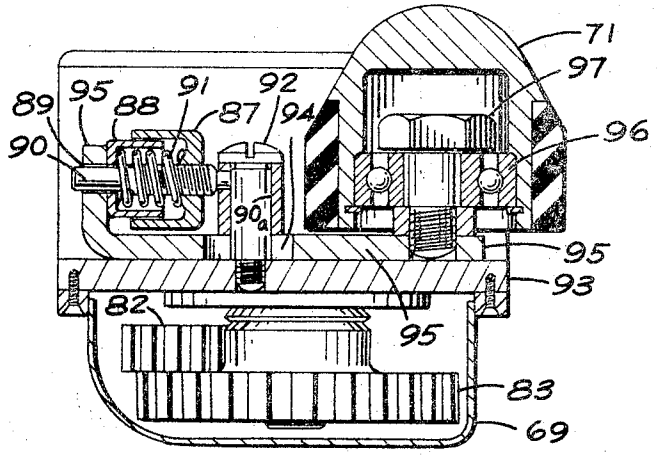

FIG. 6.

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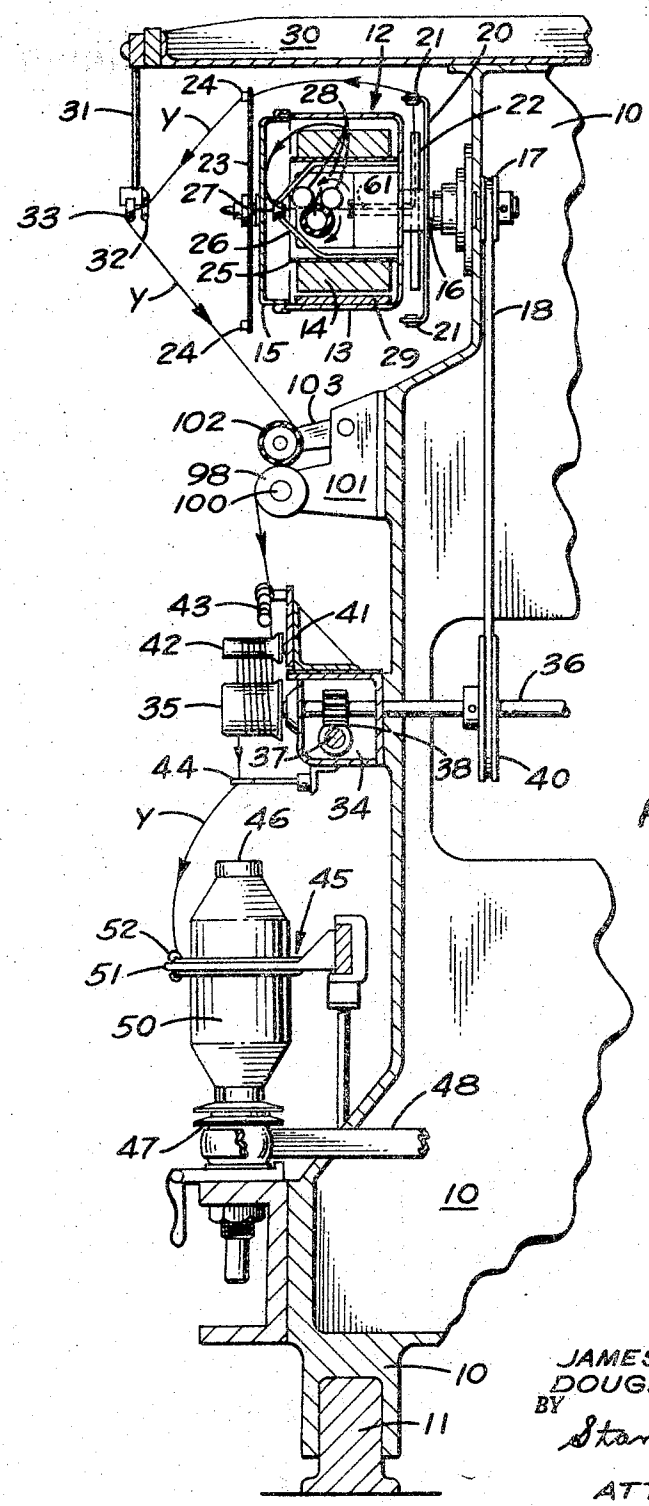

FIG. 7.

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United States Patent Office 2,979,882 Patented Apr. 18, 1961

2,979,882

METHOD AND APPARATUS FOR STRETCHING AND TWISTING CONTINUOUS FILAMENT YARN

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Filed July 15, 1959, Ser. No. 827,275

13 Claims. (Cl. 57—55.5)

This invention relates to the textile art and more particularly relates to that part of the art concerned with continuous stretching and increasing the twist in a moving continuous filament yarn.

Continuous synthetic cold-drawable filaments can be formed from nylon polymers and the like by the wet, dry, or melt spinning processes, the last mentioned process being employed in the commercial production of most, if not all, of the nylon filaments made today. The freshly formed nylon filaments generally are not highly oriented and have relatively low tensile strength as compared to highly oriented nylon filaments in which the molecules are aligned or oriented in the direction of the filament axis. To orient nylon filaments and thereby to increase greatly the strength thereof, they are stretched to a desired extent by longitudinally extending them by means of thread advancing devices such as two godets or two other thread advancing rolls operated at a predetermined peripheral speed differential therebetween, the difference in the speed between the rolls determining the degree of stretch which may be of the order of 4:1 for nylon 66 filaments. In the stretching of continuous filaments of nylon it is known that the extension of the filaments is accomplished advantageously when the point at which stretching occurs is fixed or localized by mechanical means or thermal means. In ordinary practice the orientation of the molecules in nylon filaments by stretching same with a slight twist being imparted thereto after stretching is performed by the filament manufacturer who in turn ships the filaments in an orderly form to other locations for additional processing before same are converted into fabric or the like. An important operation at these various other locations is the additional twisting of the filaments to a significant extent, as well as the plying of two or more ends of the additional twisted filaments into cords and the like, the extra twisting being desired to obtain greater strength, increased uniformity, or to obtain novelty effects. It has been known heretofore to twist and to ply oriented nylon filaments and the like by the use of a so-called two-for-one twister, whereby for each revolution of the spindle of such twister two turns of twist are inserted into the yarn.

From an economical viewpoint it would be highly advantageous to twist and to cause the filaments to be oriented in one operation since obviously by twisting and orienting the filaments in separate operations costly interruptions become necessary for such purposes, as collecting the filaments and transferring the collected filaments from one place to another. Furthermore, this requires the installation and maintenance of expensive equipment and necessitates the employment of numerous workers to handle the filaments in the many steps of operation. Unfortunately, the combining of highly twisting and orienting simultaneously has not been commercially practical for a number of reasons, one of which being the uneconomical and physical speed limitations of existing equipment. One of the greater difficulties in this respect lies in the development of suitable equipment with a high degree of reliability for expeditiously accomplishing the twisting and orienting of the filaments having yarn forwarding and treating elements that operate at economical speeds in the proper relationship to each other. Such difficulties have arisen because of the impossibility with prior art apparatus to maintain synchronized twisting and feeding of the yarn between the yarn feeding means and yarn stretching means.

While it known to impart a false twist to continuous filament yarn during drawing by known means and to set the twisting therein, thereby producing a potentially bulky and crimpy yarn, such process does not increase the effective twist in the yarn. That is to say, in one prior drawing and twisting operation, the net amount of swist imparted to the yarn in the twisting step is zero.

An object of the present invention is to provide apparatus for simultaneously drawing of and imparting a true twist rather than a false twist to continuous filament yarn and collecting it into a package in one continuous operation. Another object of the present invention is to provide apparatus so constructed and arranged that orientable continuous filament yarn can be simultaneously drawn and twisted, additionally drawn, and then twisted before collection thereof. Still another object of the invention is to provide apparatus in which two or more bundles of orientable continuous filament yarn are simultaneously drawn and twisted, each bundle retaining its own identity, and then the twisted bundles are plied into a cord by twisting same together. A further object of the invention is to provide a two-for-one twister for use in performing this simultaneous twisting and drawing expeditiously and adapted to withdraw uniformly yarn from a package at a predetermined rate by means of surface engaging positively driven feed rolls having parallel exes and arranged within the area occupied by the yarn package and to associate this twister with the other elements in the apparatus so that they will operate in the proper relationship to each other. A still further object of the invention is to provide a method for simultaneously orienting and twisting traveling continuous filament yarn. A yet further object of the invention is to provide a method for simultaneously orienting and twisting traveling continuous filament yarn, then additionally orienting the thus-twisted yarn and thereafter twisting same, if desired, in a single operation. Still another object is to provide a method for simultaneously orienting and twisting two or more bundles of orientable continuous filament yarn wherein they are simultaneously cold drawn and positively twisted, each bundle retaining its own identity and then the twisted bundles are plied into a cord by twisting same together. Other objects of the present invention will be apparent hereinafter.

As indicated above the invention generally relates to a method and apparatus for simultaneously increasing the molecular orientation of and the twist in a traveling bundle of filaments. A bundle of orientable continuous filaments, i.e. filaments which have the ability to accept a longitudinal stretch whereby the molecular orientation thereof is increased, is withdrawn from a suitable package, such as by withdrawing the bundle of filaments over one end of a stationary package having an axial passage. Thereupon by the use of suitable guide means the bundle of filaments is directed through said axial passage wherein there is located positively driven means for withdrawing and forwarding the filaments from the package and through said passage. After being passed through the axial passage the filaments are passed radially through a rotating guide or rotor and then are directed in the direction opposite to that taken by the filaments through the axial passage whereby the filaments are caused to revolve around the package. In other words the rotation of the rotor produces a yarn "balloon" around the pack-

age with the path defined by the ballooning yarn completely enclosing the package which in turn encloses the yarn forwarding means. The bundle of filaments is then led to a second yarn forwarding means, such as a driven roller, a pair of rollers, godet, or the like adapted to be operated at an increased peripheral speed relative to the delivery speed of the first yarn forwarding means. Preferably the second yarn forwarding means is power-driven in timed relation with the associated first yarn forwarding means by driving means interconnecting the two yarn forwarding means. As a result the filaments are drawn a desired extent to induce increased molecular orientation therein. Hence, it will be noted that the bundle of filaments running between the two forwarding means is considerably taut since it is subjected to comparably high tensioning during stretching. This arrangement further provides effective control of the balloon in view of the fact that the path of the yarn revolving will not vary to any appreciable extent. It is apparent that the yarn is twisted between the two yarn forwarding means which define a twist-stretch zone. Furthermore, two twists will be imparted in the yarn for each revolution of the rotor as is understood. Then, the bundle of filaments finally is collected in an orderly manner. In accordance with a slightly modified embodiment of this invention two or more bundles of filaments are passed through separate twist-stretch zones and are subjected therein to the same operation as above described and then combined to form a balanced ply construction therefrom such as being wound up together on a doubling spindle or the like. The resulting cord is highly advantageous for use as reinforcing inserts in rubber articles, such as tires, belts, and the like.

The invention accordingly comprises the apparatus possessing the construction, combination of elements, and arrangements of parts which are exemplified in the following detailed disclosure; and the scope of the invention will be indicated in the claims.

For a more complete understanding of the nature and objects of the invention, reference should be had to the following detailed description of the invention, taken in connection with the accompanying drawing wherein:

Figure 1 is a side elevational view, partially in axial section of one point of the improved stretching and twisting apparatus in accordance with the invention;

Figure 2 is a front elevational view of another arrangement of the improved stretching and twisting apparatus, showing two ends of yarn being separately twisted and stretched, and then plied together;

Figure 3 is an enlarged detail view in axial section of one twister assembly of the improved twisting apparatus, together with the yarn forwarding means contained therein, in accordance with the invention;

Figure 4 is a detail sectional view taken generally along line 4—4 of Figure 3;

Figure 5 is a fragmental view partially in section with parts removed for convenience of illustration, showing in detail a gearing arrangement for driving the yarn forwarding means in a definite relationship with the means causing the yarn to balloon around the package to be twisted a predetermined amount per given length of yarn;

Figure 6 is a detail sectional, fragmental view taken generally along line 6—6 of Figure 3 illustrating means for adjusting the firmness with which the yarn is held by the feed rolls in the twister assembly; and

Figure 7 is a side elevational view of a slightly different embodiment of the yarn twisting and stretching apparatus made in accordance with the invention, illustrating a two-stage stretch arrangement.

In these various figures the same reference numerals designate like parts. The apparatus of the present invention is preferably a multiple unit machine. That is to say, it is provided with a plurality of identical yarn processing units along its length and on both sides thereof in back to back relation. Inasmuch as the units are similar, only one will be described herein.

Referring now to the drawing for a better understanding of the invention, there is shown in Figure 1 a supporting means or vertical framework 10 that is secured to a base 11 and is braced suitably to form a rigid structure. The framework 10 is adapted to support rotatably a spindle or shaft of a two-for-one twister assembly designated generally by numeral 12. The assembly 12 which is shown horizontally mounted for ease of illustration comprises a housing or balloon guard bucket 13 adapted to receive a package of yarn 14 having an axial passage such as a freshly spun package of nylon continuous filament yarn and a lid or cover 15 therefor adapted, for example, to engage with said housing for a quick detachable arrangement. Drive shaft or spindle 16 of the assembly 12 is rotatably supported in framework 10 to be positively driven by a convenient source of power. As shown, shaft 16 is driven by pulley 17 keyed thereto and pulley 17 in turn is driven by a belt 18 entrained thereon. Rotor 20 is constructed to be rotated about the axis of shaft 16 by rotary motion of said shaft. At each end of the rotor 20 there are attached yarn ring guides 21 for determining the course taken by the yarn. Tubular yarn guide 22 radially projects from shaft 16 and is adapted to be rotated thereby about the axis of shaft 16 and is used to control properly the yarn or bundle of continuous filament yarn. Mounted for free rotation on cover 15 is a flyer 23 having eyes 24 for determining the figure of revolution enclosing twister assembly 12 and generated by the yarn. The package of yarn 14, as shown, is wound on a bobbin 25 or the like having an axial passage, which is supported by means, such as the tripod support composed of rods 26 fixedly mounted to the bottom of bucket 13. At the opposite end to their place of mounting the rods converge so as to support a guide, such as a trumpet-shaped yarn guide 27. At least one of the three feed rolls 28 inside of tripod rods 26 is driven positively. A typical drive for the rolls is by suitable gear connections with drive shaft 16 so that the rate of feed of the yarn and the twist therein imparted by the rotor 20 are constantly under control in a definite relationship to each other. It is important to the desired operation of the machine that the rolls have surface engagement to grip the yarn with sufficient firmness so as to prevent any slip of the yarn therethrough owing to the considerable tensioning applied to the yarn thereafter and thus to maintain an accurate feeding relationship. It should be pointed out that with this type of arrangement the threading up is facilitated since it is not necessary that the yarn be wrapped entirely around any roll. Only one roll needs to be driven with the other rolls being driven by peripheral contact with the driven roll with which they engage. In order to enable the feed rolls to grip the yarn with the desired degree of firmness, it has been found that the best results can be obtained by making at least one of the rolls of soft rubber, or by providing the roll with a fairly thick cover of rubber. For most purposes two metal rolls running against one rubber covered roll interposed therebetween are entirely satisfactory. In other arrangements, however, better results may be obtained by providing two or three rolls with rubber or other resilient and yielding surfaces to grip the yarn. In either construction the firmness with which the rolls grip the yarn can be varied by adjusting the pressure with which the rolls are held in engagement with each other. A convenient arrangement for providing such an adjustment is shown in Figure 6 and will be discussed in greater detail below.

Bucket 13 is eccentrically weighted at 29 so that, if the twister assembly 12 is disposed at an angle with respect to the vertical the weight 29 will seek the lower position and maintain the bucket 13 and package of yarn 14 therein substantially non-rotating even though the rotor 20 rotates at high speeds. Vertical arm support 30 is mounted to framework 10 and extends therefrom for

a suitable distance over twister assembly 12 to provide suitable means for mounting guide support member 31 which carries at its lower end a suitable guide, preferably axially aligned with twister assembly 12. The guide arrangement shown includes a ring guide 32 and a spaced hook guide 33.

Block 34 is secured to framework 10 or integral therewith to provide suitable mounting for stretching roll 35 whose drive shaft 36 is rotatably journaled therein. Shaft 36 is positively driven by a convenient source of power. As shown shaft 36 is driven by drive axle 37 through gearing 38 by a source of power not shown. Preferably, at one end of shaft 36 and keyed thereto is a pulley 40 arranged so that belt 18 is entrained thereon. Hence, with such arrangement shafts 16 and 36 are interconnected and are driven conveniently in timed relation with each other, as well as with the speed of rolls 28. Mounted on a supporting plate 41 and positioned adjacent to stretching roll 35 is a spacer roller 42 or the like which may or may not be rotatable. The axis of said roller 42 is positioned at a slightly inclined angle with respect to the axis of roll 35 so as to insure proper longitudinal distribution on and advancement along the peripheries of roll 35 and roller 42, thus preventing superpositioning of the wraps thereon. Mounted on supporting plate 41 above roll 35 is a stretch or draw pin 43 where the majority of the stretching of the yarn may be localized, if desired. The pin ordinarily is mounted to be stationary and axially askew with respect to the axis of roll 35 and has a smooth yarn contact surface. The pin may or may not be heated and can be omitted from the apparatus entirely, as is understood.

Vertically below roll 35 a guide 44 is advantageously employed for controlling the delivery of the yarn from said roll to a place where the yarn is taken up in an orderly arrangement in a conventional manner by a suitable form of a package building apparatus. As shown in Figure 1, the yarn Y is taken up by a ring twisting assembly generally denoted by reference number 45 which comprises a bobbin 46 adapted to be driven on spindle 47 which in turn is driven by belt 48 in a conventional manner to collect a supply of yarn indicated by numeral 50. The assembly further comprises a conventional vertically recriprocatable spinning ring 51 carrying a ring traveler 52 adapted to revolve freely around bobbin 46 as the yarn is twisted a desired amount and wound on the bobbin.

The above described apparatus for Figure 1 functions in the following manner. A package of yarn is placed on a support provided by rods 26. The yarn Y is unwound from the periphery of the package and directed axially therethrough. The withdrawing of the yarn is accomplished by driven feed rolls 28 positioned inside said package. The yarn then passes through the spindle passage in shaft 16 that communicates with the axial passages in tubular yarn guide 22. From guide 22 the yarn is directed through guide 21 attached to rotor 20 which in operation rotates at high rotative speeds and then through eye 24 of flyer 23 and guides 31 and 32. As is understood, for each rotation of the rotor 20 two turns of twist are imparted to the yarn. From the guides the yarn is led downwardly and around draw pin 43. After being passed around said pin a desired number of times, the yarn is directed around part of the periphery of roll 35 and then is directed tangentially therefrom and around part of the periphery of spacer roll 42. Thus, the yarn wrapped around rolls 35 and 42 assumes generally the shape of a flattened helix, the convolutions of which are spaced apart. The peripheral speed of roll 35 relative to the peripheral speed of rolls 28 usually (say in the order of 300% to 500% or more for nylon) is greater. The difference in speeds between roll 35 and rolls 28 determines the amount of stretch that is imparted to the yarn being twisted. The yarn is then taken up in a uniform manner.

The operation of the apparatus of Figure 2 is similar to that of the single end twisting and drawing apparatus of Figure 1 except that means are provided for treating two ends of yarn. It will be appreciated that three or more ends may be processed in like manner. The two ends, after passing through the feed rolls 28 inside buckets 13, are led together at guide 53; yarns Y and Y_1 are directed then around the common stretch pin 43 and stretch roll 35 together with the spacer roll 42 associated therewith. As in the case of the single-end twister in Figure 1, two twists will be inserted in the yarns for each rotation of the rotor 20; and the yarns will be stretched a predetermined extent between the internal feed rolls 28 and stretching roll 35. The two ends are then plied together to form a cord Z. Preferably yarns Y and Y_1 are twisted by the twister assembly 12 in one direction and then are intertwisted together in the opposite direction by the ring twisting assembly 45 to produce a balanced cable yarn. Thus, for example yarn Y and Y_1 are twisted to the right several turns per unit length and then the two twisted yarns which have also been drawn are intertwisted to the left for the required number of turns. Balanced cords or cables of other types may be formed, such as three or four ply or various types of ply yarns or the like.

With reference now to Figure 3 where the novel two-for-one twister of the present invention is shown in more detail and in axial section to illustrate more conveniently the structural features of the twister, it is seen that drive shaft 16 is rotably supported in bearings 54 and 55, the outer races of which are mounted in shaft support housing 56 secured to annular collar 57 which is bolted to framework 10. Keyed to one end of shaft 16 is pulley 17 adapted to be belt driven. Further along shaft 16 is support member 58 having extending hollow-cylinders 59 on which rotor 20 is fixedly mounted so that the rotor 20 and guide 21 rotate about and with shaft 16. Radial passages 60 are provided in shaft 16 to permit yarn Y passing through axial passage 61 to proceed radially outwardly from said shaft. Tubular yarn guides 22 are mounted in hollow-cylinders 59 and thus are adapted to rotate about shaft 16 in unison wtih rotor 20. An annular backing plate 63 is attached to cylindrical bucket 13. Additional radial bearings 64 and 65 are provided for that part of shaft 16 extending inside of bucket 13. From shaft 16 the driving shaft 66 is driven through a worm gear 67 and its worm 68, gear 67 being keyed to shaft 66. Through a spur gear arrangement shown in Figure 5 feed roll 70 is driven positively. Cot feed roll 71 carrying a rubber engaging surface is in peripheral engagement with roll 70 and is driven thereby, roll 71 being slidable into and out of engagement with roll 70 by adjusting means identified by numeral 72 described in more detail below and with a third feed roll 73 which is also freely rotatably mounted. Rolls 70, 71, and 73 have parallel axes, with the plane in which the axes of feed rolls 70 and 73 are located being parallel to the axis of twister assembly 12. Mounted to gear housing 74 and axially aligned with shaft 16 is a second trumpet-shaped yarn guide 75. A bushing 76, preferably made of a wear resistant material is inserted in passage 61 adjacent to passages 60 and held in position by spring 77.

A plurality of axially parallel extending rods 26 are bolted to the bottom of bucket 13 at 78 and are adapted to receive and support a package of yarn having an axial opening. The rods 26 at their ends opposite to those at which they are mounted converge to form a support for trumpet-shaped yarn guide 27. As shown a package of yarn 14 is carried on bobbin 25 which is supported by rods 26. Weight 29 is attached to the inner wall of the bucket 13 so that the bucket is eccentrically weighted so that it will be substantially non-rotating even though shaft 16 is rotated.

In Figures 4 and 5 linkage means or drive transmit-

ting means connecting drive shaft 16 with feed roll 70 is shown. Worm gear 67 and shaft 16 have non-intersecting and non-parallel axes with worm 68 on shaft 16 intermeshing with the teeth of gear 67 so that rotary motion of shaft 66 is given by the rotary motion of shaft 16. As shown, shaft 66 is journaled by bearings 79 and 80 and is keyed to spur gear 81 that is operable to transmit power through compound idler gear 82 to spur gear 83 to which shaft 84 is keyed. Shaft 84 is journaled by bearings 85 and 86 and is so constructed to impart rotation to feed roll 70 when it is rotated. Gear cover or casing 69 is provided to house the just described gearing.

With reference now to Figure 6 there is shown cot roll 71 in axial section, together with the associated adjusting means for sliding roll 71 into firm engagement with rolls 70 and 73. The numeral 87 designates a sleeve for receiving cup-shaped member 88 having an axial port 89 for permitting free reciprocation therethrough of cylindrical rod 90. This rod is threaded at one end for reception in the threaded axial bore in sleeve 87. The central portion of rod 90 is surrounded by spring 91 interposed between the opposed bottoms of cup-shaped member 88 and sleeve 87. The threaded end of rod 90 extending through sleeve 87 is fixed in bushing 90*a* surrounding keeper bolt 92 which is in threaded relation with mounting plate 93 and which extends through slot 94 in bracket 95 so that by turning sleeve 87 tension exerted by spring 91 is adjusted, thereby controlling the degree of firmness with which cot roll 71 engages rolls 70 and 73. Roll 71 is mounted for free rotation on bearing 96 mounted on bolt 97 which is in threaded relation with bracket 95.

Figure 7 is a side view of the twisting and stretching apparatus similar to that in Figure 1 but adapted to stretch the yarn in two stages and representing another embodiment of the invention. Interposed in the yarn path between the twister assembly 12 and draw pin 43 is an intermediate feed roll assembly comprised of roller 98 carried for rotation by shaft 100. This shaft is positively driven by a convenient source of power, not shown, and is journaled in bracket 101. Preferably the peripheral speed of roller 98 is greater than the peripheral speed of feed rolls 28. Roll 102, preferably having a rubber yarn engaging surface, is rotatably secured to the free end of arm 103 for movement into engagement with roller 98. As can be seen in this embodiment the yarn Y is unwound from a package as indicated by driven feed rolls 28. The yarn is simultaneously twisted and stretched between rolls 28 and the assembly of rolls 98 and 102. The twisted yarn is stretched again since the peripheral speed of stretching roll 35 is ordinarily greater than that of roller 98, the difference in the speeds determining the amount of stretch. The yarn is taken up in a uniform manner such as by the ring twisting assembly 45 as shown. It will be appreciated that two or more ends can be processed in accordance with this embodiment similarly to the manner shown in Figure 2 with cord being constructed from these ends.

It will be observed that from the above description that the advantages of the invention are many. The method results in the production of yarn having desired strength and twist and is broadly applicable to produce such yarns from a wide range of cold-drawable filaments manufactured from thermoplastic resins. The improved device for processing continuous filaments, for example, of the nylon type including nylon 66, nylon 4, nylon 6, nylon 610, nylon 11, and the various fiber-forming copolymers thereof may be run at high speeds and high efficiency with little operator attention. The construction and arrangement of the device make it possible to modify at moderate expense existing textile processing equipment such as a draw twister for nylon processing into a machine of the type disclosed and claimed herein by the suitable mounting of the twister assembly thereon. The filaments in accordance with the invention are stretched and twisted in one operation, together with the plying thereof into a cord construction. This fact effects an important saving in the operation over the heretofore method of carrying out these steps in separate operations. In addition to these advantages afforded by this arrangement, the invention provides a construction in which the tension on the threads as they are twisted by the two-for-one twister is uniform as they travel between the feed rolls in the twister and the stretching rolls because the tension is positively controlled by two sets of driven rolls, one feeding the bundle of filaments to the twist-stretch zone and the other taking it away from said zone. The use of the machine of the invention is advantageous where high tensioning of the balloon is needed. The internal feed roll assembly is easily threaded up and provides positive feed of the yarn, which controls balloon tension, thereby permitting more revolutions per unit time in the balloon. It may also be pointed out that in such an arrangement as that shown, for example in Figure 1, the rolls inside the twister assembly determine the rate of feed of the filaments, while the speed of stretch roll determines the amount or degree to which the filaments will be stretched. Since both of these sets of rolls are driven positively and in a definite relationship to each other, the degree of stretch is constantly under control. Further, the amount of twist is determined and controlled by the relationship between the feed rolls inside the twister and the speed of the rotor. This relationship can be varied conveniently by a change gear arrangement in the gear train of the twister. Hence, the instant invention provides an exceptionally high degree of uniformity in the tension during drawing and twist formation and also provides means for positively correlating the twist, the stretch, and the feed of the filaments in a highly advantageous manner.

Since certain changes may be made in the above apparatus and method without departing from the scope of the invention herein involved, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense. Hence, it will be understood that the invention may be embodied in additional forms without departing from the spirit or scope thereof.

What is claimed is:

1. Apparatus adapted for processing orientable continuous filament yarn comprising, in combination, a rotatably supported shaft having an axial passage and a radial passage therein for reception of said yarn, support means associated with said shaft and constructed to carry a package of yarn having an axial passage, means within said support means to withdraw the yarn over an end of said package and to feed said yarn axially therethrough, a rotor secured to said shaft for rotation therewith about the axis thereof, guide means associated with said rotor for defining a path of said yarn enclosing said package of yarn, means for rotating said shaft, linkage means connecting said withdrawing means and said shaft so that they are driven in timed relation, means for controlling said package of yarn, support means and withdrawing means against rotation about said shaft when said shaft is rotated, rotatably mounted yarn forwarding means adapted to receive said yarn and to advance same at a predetermined increased rate as compared to the rate at which said yarn is withdrawn from the package whereby the yarn normally advancing between said withdrawal means and said yarn forwarding means is stretched and twisted simultaneously to a predetermined extent thereby to increase the molecular orientation of the yarn while same is being twisted, means for driving and interconnecting said shaft and said yarn forwarding means to rotate same in timed relation, and means for taking up the thus-processed yarn in an orderly manner.

2. Apparatus adapted for processing orientable con-

tinuous filament yarn comprising, in combination, a rotatably supported shaft having an axial passage and a radial passage therein for reception of said yarn, support means associated with said shaft and constructed to carry a package of yarn having an axial passage in which said shaft extends, surface engaging feed rolls within said support means to withdraw the yarn over an end of said package and to feed said yarn axially therethrough, a rotor secured to said shaft for rotation therewith about the axis thereof, guide means associated with said rotor for defining a path for said yarn enclosing said package of yarn, linkage means connecting said feed rolls and said shaft so that they are driven in timed relation, means for controlling said package of yarn, support means and feed rolls against rotation about said shaft when said shaft is rotated, rotatably mounted yarn forwarding means adapted to receive said yarn and to advance same at a predetermined increased rate as compared to the rate at which said yarn is withdrawn from the package, whereby the yarn normally advancing between said feed rolls and said yarn forwarding means is stretched and twisted simultaneously to a predetermined extent thereby to increase the molecular orientation of the yarn while same is being twisted, means for driving and interconnecting said shaft and said yarn forwarding means to rotate same in timed relation, and means for taking up the thus-processed yarn in an orderly manner.

3. Apparatus adapted for processing orientable continuous filament yarn comprising, in combination, a rotatably supported shaft having an axial passage and a radial passage therein for reception of said yarn, support means associated with said shaft and constructed to carry a package of yarn having an axial passage in which said shaft extends, surface engaging feed rolls within said support means to withdraw the yarn over an end of said package and to feed said yarn peripherally in tangential relation to the engaging surfaces axially therethrough, a rotor secured to said shaft for rotation therewith about the axis thereof, guide means associated with said rotor for defining a path for said yarn enclosing said package of yarn, linkage means connecting said feed rolls and said shaft so that they are driven in timed relation, means for controlling said package of yarn, support means, and feed rolls against rotation about said shaft when said shaft is rotated, rotatably mounted yarn forwarding means adapted to receive said yarn and to advance same at a predetermined increased rate as compared to the rate at which said yarn is withdrawn from the package, whereby the yarn normally advancing between said feed rolls and said yarn forwarding means is stretched and twisted simultaneously to a predetermined extent thereby to increase the molecular orientation of the yarn while same is being twisted, means disposed in the yarn path between said guide means and said yarn forwarding means for localizing the stretching of the yarn, means for driving and interconnecting said shaft and said yarn forwarding means to rotate same in timed relation, and means for taking up said yarn.

4. Apparatus adapted for processing orientable continuous filament yarn comprising, in combination, a rotatably supported shaft having an axial passage and a radial passage therein for reception of said yarn, support means associated with said shaft and constructed to carry a package of yarn having an axial passage in which said shaft extends, peripheral surface engaging feed rolls within said support means to withdraw the yarn over an end of said package and to feed said yarn axially therethrough, the axes of said feed rolls being parallel, a rotor secured to said shaft for rotation therewith about the axis thereof, guide means associated with said rotor for defining a path for said yarn enclosing said package of yarn, linkage means connecting said feed rolls and said shaft so that they are driven in timed relation, means for controlling said package of yarn, support means, and feed rolls against rotation about said shaft when said shaft is rotated, a first rotatably mounted yarn forwarding means adapted to receive said yarn and to advance same at a predetermined increased rate as compared to the rate at which said yarn is withdrawn from the package, whereby the yarn normally advancing between said feed rolls and said yarn forwarding means is stretched and twisted simultaneously to a predetermined extent thereby to increase the molecular orientation of the yarn while same is being twisted, a second rotatably mounted yarn forwarding means adapted to receive said yarn from said first forwarding means and to advance same at a predetermined increased rate as compared to the rate at which said yarn is forwarded by said first forwarding means to impart additional stretch in the yarn, a stretch pin disposed in the yarn path around which said yarn normally is wrapped for localizing the stretch between the two yarn forwarding means, means for driving and interconnecting said shaft and said second yarn forwarding means to rotate same in timed relation, and means for taking up said yarn.

5. A two-for-one twister comprising, in combination, a rotatably supported shaft having an axial passage and a radial passage therein for reception of a yarn, support means concentric with said shaft and constructed to carry a package of yarn having an axial passage in which said shaft extends, a housing for containing said package of yarn and the support means, a cover for said housing detachably secured to said housing, three surface engaging feed rolls within said support means to withdraw the yarn over an end of said package and to feed said yarn axially therethrough peripherally in tangential relation to the engaging surfaces of the said feed rolls, one of said rolls being positively driven with the other two being idler rolls, one of said idler rolls being slidably and adjustably mounted in rotating engagement with the driven roll, a rotor secured to said shaft for rotation therewith about the axis thereof, a flyer mounted on said cover for free rotation, guide means at the tips of said rotor and said flyer for defining a path for said yarn enclosing said package of yarn, linkage means connecting said shaft and said driven feed roll so that it is positively driven in timed relation with said shaft, and means for controlling said housing, package of yarn, support means, and feed rolls against rotation about said shaft when said shaft is rotated.

6. Apparatus adapted for processing a plurality of ends of orientable continuous filament yarn into cord comprising, in combination, at least two of the twisters as set forth in claim 5 in side-by-side relation, yarn forwarding means associated with the said twisters to draw the yarns normally advancing therefrom at a speed greater than the speed at which they are withdrawn from the packages in said twisters whereby the yarns are twisted and stretched simultaneously, means for driving and interconnecting said shaft and said yarn forwarding means to rotate same in timed relation, and a take-up twister assembly to combine the yarns and to collect the combined yarn in an orderly manner in the form of a cord.

7. A method for processing a continuous filament yarn comprising the steps of providing a package of molecularly orientable continuous filament yarn having an axial passage, withdrawing said yarn over an end of said package, passing said yarn axially through said passage, then ballooning said yarn about said package to twist same, forwarding said ballooning yarn at an increased speed relative to the withdrawal speed so as to stretch and to increase the molecular orientation of the yarn as same is being twisted, and collecting the thus-treated yarn in an orderly manner.

8. A method for processing a continuous filament yarn comprising the steps of providing a package of molecularly orientable continuous filament yarn having an axial passage, withdrawing said yarn over an end of said package, passing said yarn axially through said passage, then revolving and advancing said yarn about said package

to twist same, forwarding said revolving yarn at an increased speed relative to the withdrawal speed so as to stretch and to increase the molecular orientation of the yarn as same is being twisted, additionally twisting the yarn, and collecting the thus-treated yarn in an orderly manner.

9. A method for processing a continuos filament yarn comprising the steps of providing a package of molecularly orientable continuous filament yarn having an axial passage, withdrawing said yarn over an end, passing said yarn axially through said passage, then revolving and advancing said yarn about said package to twist the same, forwarding said revolving yarn at an increased speed relative to the withdrawal speed so as to stretch and to increase the molecular orientation of the yarn as same is being twisted, imparting additional stretch to the yarn in a second stage, additionally twisting the yarn, and collecting the thus-treated yarn in an orderly manner.

10. A method of forming a cord from at least two bundles of continuous filament yarn comprising the steps of providing a plurality of packages of molecularly orientable continuous filament yarn having an axial passage, withdrawing said bundles over an end of the associated package, passing the bundles axially through the associated package, then revolving and advancing the bundles about the associated package, forwarding said revolving bundles at an increased speed relative to the withdrawal speed so as to stretch and to increase the molecular orientation of the yarn as same is being twisted, twisting said bundles of yarn together to form a cord therefrom, and collecting the cord in an orderly manner.

11. The method of claim 10 wherein the yarn is made from a nylon poylmer.

12. The apparatus of claim 1 wherein the means for taking up the yarn is adapted to impart additional twist to the yarn.

13. The apparatus of claim 2 wherein the yarn takeup means is a ring twister.

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