

[54] **IN-LINE FRICTION TWISTER AND METHOD OF TWISTING**
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[58] Field of Search57/51-51.6, 77.3-77.45, 57/156, 157; 28/72

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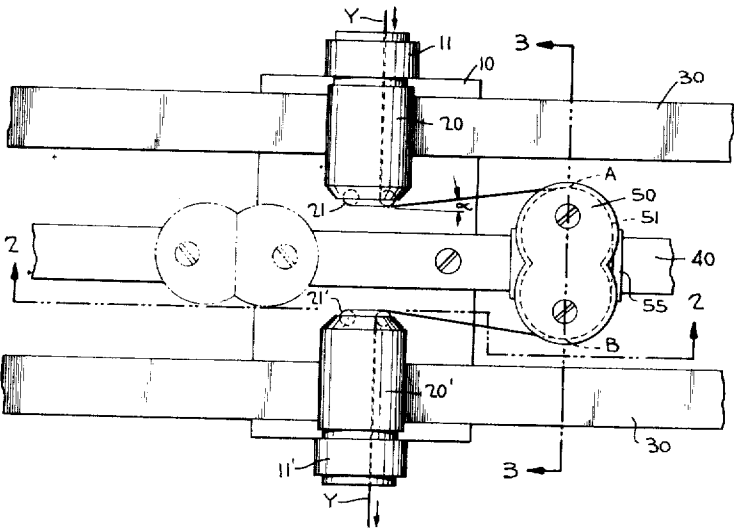
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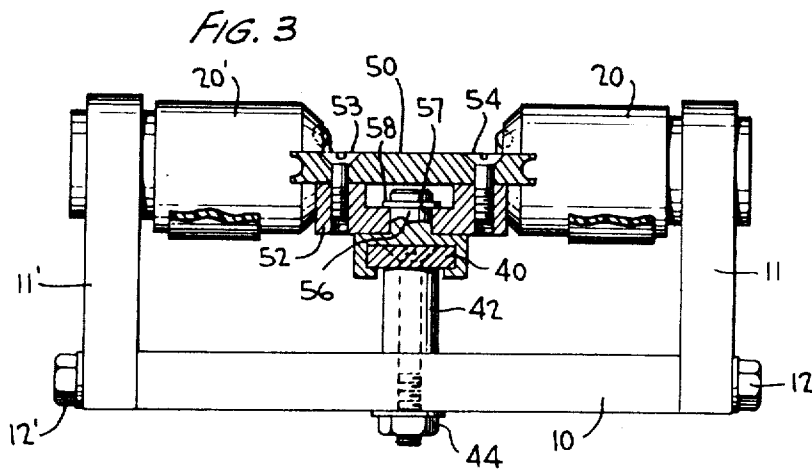
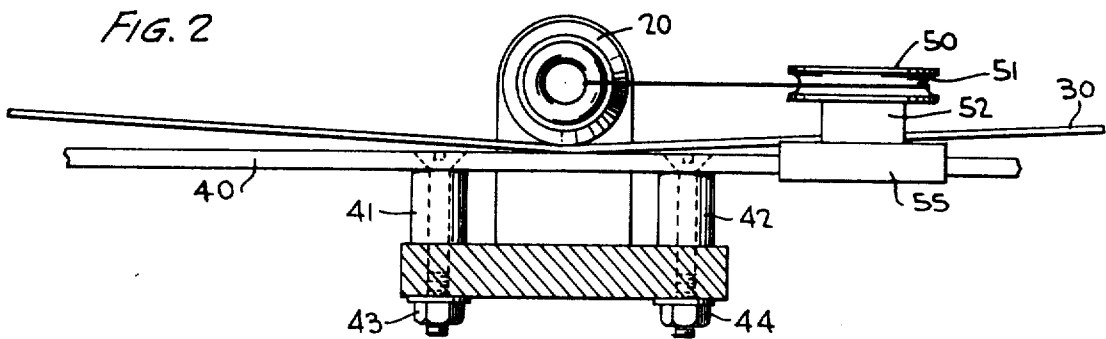
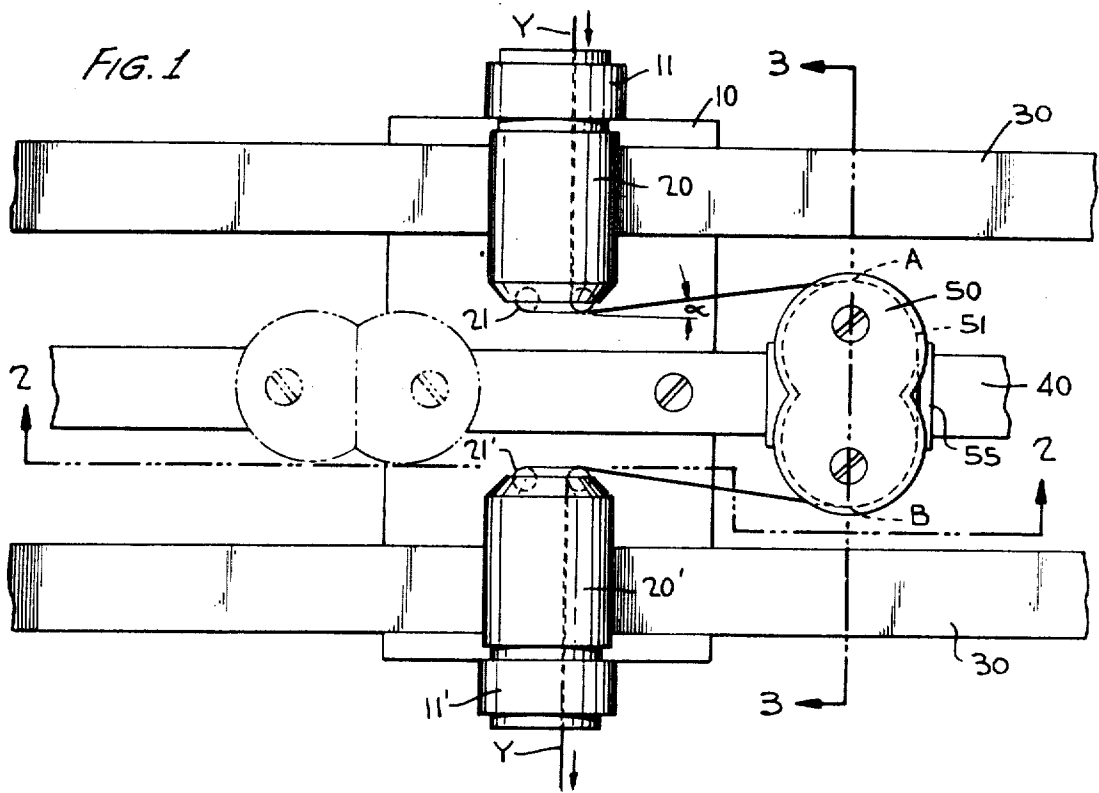
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[57] **ABSTRACT**

A method and apparatus is disclosed for imparting false twist to textile yarn wherein a friction twister is employed to impart a plurality of turns of twist to a strand of yarn for each revolution of the friction twister. The invention is particularly suited to situations wherein the yarn strand is moving rapidly. The disclosed frictional twister comprises two axially aligned hollow spindles containing frictional engagement means therein. The two spindles are driven by moving belts that contact the exterior circumferential surfaces of the spindles. Movable yarn guide means are provided to engage the yarn strand and assure adequate frictional engagement between the yarn strand and the frictional engagement means after the spindles are threaded up. Another embodiment of the friction twister has the capacity to handle a plurality of yarn strands simultaneously.

15 Claims, 5 Drawing Figures





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FIG. 4

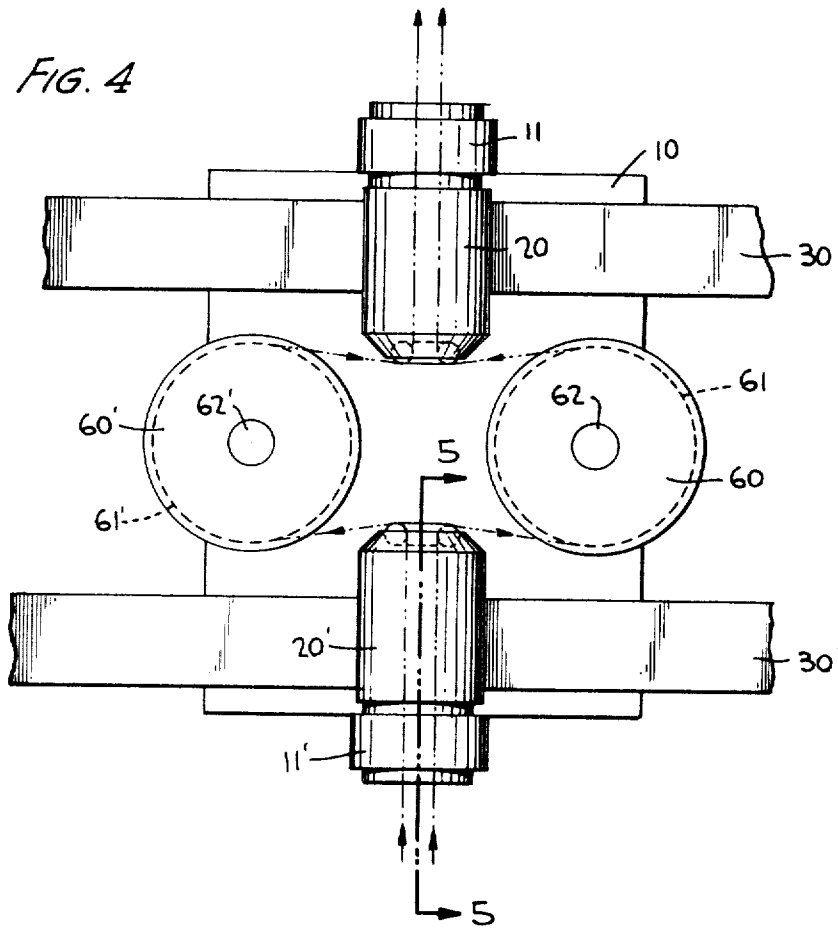
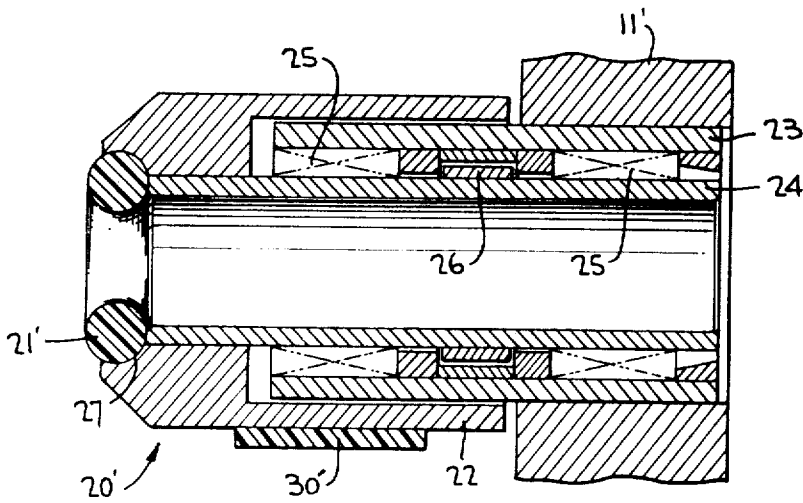


FIG. 5



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IN-LINE FRICTION TWISTER AND METHOD OF TWISTING

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of U.S. Patent Application Ser. No. 25,559, filed Apr. 3, 1970.

BACKGROUND OF THE PRESENT INVENTION

The present invention relates to a yarn twister and the method of utilizing said twister. More particularly, the invention relates to a yarn friction twister for false twisting one or more yarn strands and a method of using said friction twister.

One of the greatest drawbacks of a conventional false twisting blade with a twist trapping pin such as that disclosed in U.S. Pat. No. 3,044,247 to Hilbert is that one revolution of the spindle blade is necessary to impart each revolution or turn of twist to the textile strand of yarn. Since conventional false twist spindles are limited to certain rotational speeds by the strength of conventional materials, there is a definite ceiling on the productivity realized by the use of conventional false twist spindle blades.

In U.S. Pat. No. 2,936,567 to Russell, et al, U.S. Pat. No. 3,936,570 to Arthur, et al, and U.S. Pat. No. 3,029,591 to Scraff, et al, there are disclosed several types of devices or apparatus for false twisting a textile strand wherein one rotation of the false twister imparts numerous rotations to the textile strand. However, the false twist apparatus disclosed in each of these three patents is subject to certain disadvantages. For example, in none of these false twisting devices may more than one yarn strand be processed at a time. Furthermore, none of these devices possess rotatable frictional elements that are readily replaceable. In addition, these prior devices do not contain a simple and economical means for rotating the frictional surfaces that perform the actual twisting. Also, these prior devices may not be threaded-up quickly as would be necessary in certain applications wherein the yarn is moving at great speeds.

SUMMARY OF THE PRESENT INVENTION

The friction twister of the present invention is particularly suited to applications wherein the process of texturing thermoplastic yarns with a false-twist heat set into the yarn is combined with another process such as a spin-drawing of the yarn.

When first obtained from the manufacturer, thermoplastic yarn such as nylon or Dacron is of a given cross-sectional diameter and may require a drawing process to produce a yarn of proper size, strength and related properties.

Generally, yarn is drawn over a series of rotating wheels or feed rolls as it is being heated, in order to draw the yarn into its desired configuration. Because the length of the yarn is constantly increasing, it is necessary for progressive feed rolls to move at greater and greater speeds in order to advance the yarn at a constant rate. The lineal yarn speeds achieved in such processes are high — in the order of 4,000 — 5,000 yards per minute.

With such speeds, it becomes necessary to employ a false-twist imparting means that is capable of quick thread-up, if the drawing process is to be combined with a false-twist texturizing process. The false-twist imparting means of the present invention is capable of meeting these criteria.

The apparatus disclosed herein comprises two hollow spindles substantially coaxially aligned and mounted on a base plate for rotation about their own axes. Because of the axial alignment of the two hollow spindles, a strand or end of yarn may be easily and quickly threaded through the hollow core of both spindles. Such threading may be accomplished by the use of a simple wire hook or, in certain operations, may be accomplished by blowing or sucking the yarn through the spindles with a jet of air or a vacuum.

It is to be emphasized that when the spindles are defined as substantially coaxially aligned, what is meant is that the yarn-engaging friction-twisting surfaces on the spindles are so positioned relative to each other that they define a straight yarn

path between them. Such a straight path allows the just described quick thread-up of a strand of yarn that is moving rapidly. As is apparent, the size of the hole through the spindles would allow slight deviations from absolute coaxial alignment but such deviations are intended to be within the scope of the present invention.

After the end of yarn is threaded through both spindles, a movable yarn guide with a major and minor axis of different lengths is moved through the space between the spindles and then, when offset from the axis of the spindles is pivoted on its mount so that the alignment of its major axis creates a yarn path there-about of a dimension greater than the dimension of the space between the spindles. In this manner the yarn assumes a generally "U" shaped configuration between the spindles but, because of the just described dimensional relationship, will contact a greater surface area of and be in good frictional engagement with the resilient friction twisting means located on the adjacent, facing ends of the two hollow spindles.

In other words, when the guide is offset from the axis of the two spindles, an operative yarn path is created that passes from one twisting member to the guide and then to the second member. Yarn passing through such a path will contact a greater portion of the twisting means. When the twisting means is a torus-shaped element or member and when the yarn is passing through the hole through the torus, the increased contact of the yarn path will be such to constitute an arc of more than 90° of the surface of the torus and the frictional engagement between the twisting member and the yarn will be increased and improved.

As a second embodiment of the present invention, the yarn guide means may comprise one or a plurality of yarn guides each in a position fixed to but offset from the common axis of the two spindles. In such an embodiment, the end of yarn may be easily threaded through both spindles and then, even if moving at a rapid speed, may be manually engaged with a threading tool and routed around the appropriate yarn guide. When a plurality of such yarn guides exist, a plurality of yarn ends may be twisted by this embodiment of the friction twister.

Accordingly, it is an object of the present invention to provide friction twister that is capable of being quickly and easily threaded up with a rapidly moving strand of yarn, yet still assure an adequate twist imparting frictional engagement between the yarn and the frictional engagement means of the friction twister.

It is another object of the friction twister to provide a friction twister that is capable of simultaneously twisting a plurality of textile strands.

It is another object of the present invention to provide a friction twister wherein the rotatable friction twisting surface is readily replaceable.

It is another object of the present invention to provide a friction twister wherein a textile strand at least approaches or departs the frictional engagement means axially of the twister spindle.

It is yet another object of the present invention to provide a friction twister wherein two rotating spindles are combined with a plurality of yarn guides in order to simultaneously false twist a plurality of textile strands, yet, at the same time, maintain the plurality of strands physically separated to avoid entanglement thereof.

It is an additional object of the present invention to provide a friction twister that may be easily and quickly threaded.

It is still a further object of the present invention to provide a friction twister having a simple construction, relative ease of maintenance and economy of operation.

Other objects will appear hereinafter.

DESCRIPTION OF THE DRAWING

FIG. 1 is a top view of an embodiment of the friction twister of the present invention illustrating the axially aligned rela-

tionship of the spindles and showing the yarn guide means in a yarn engaging position in solid lines and a yarn non-engaging position in dotted lines.

FIG. 2 is an end view of a portion of the friction twister taken on the plane line 2—2 of FIG. 1.

FIG. 3 is a side view of the friction twister of the present invention taken on the plane line 3—3 of FIG. 1.

FIG. 4 is a top view of another embodiment of the friction twister of the present invention with a plurality of fixed yarn guides to simultaneously twist a plurality of yarn strands.

FIG. 5 is a sectional view of the friction twister of the present invention.

DESCRIPTION OF A PREFERRED EMBODIMENT

A preferred embodiment of the apparatus of the instant invention may be more easily understood with particular reference to the drawing. Two hollow spindles 20 and 20' are rotatably mounted on base plate 10 by means of spindle brackets 11 and 11'. As is best visible in FIG. 3, spindle bracket 11 is mounted to base plate 10 by means of bracket screw 12.

When a plurality of like elements exist, primes (') will be used to designate like elements. Hollow spindles 20 and 20' are coaxially aligned with each other and each has mounted on one end a resilient O-ring or friction twisting means 21 and 21', respectively. These O-rings are torus-shaped and may be considered peripheral twisting members as the yarn will contact the internal peripheral surface of the rings. The axis of the torus hole corresponds to the rotational axis of the spindle. The ends of spindles 20 and 20' that have friction twisting or engaging means 21 and 21' mounted thereon face each other and are spaced apart so that a given distance exists between friction engaging means 21 and friction engaging means 21'.

The hollow spindles are mounted in spindle brackets 11 and 11' in a manner that will be described in greater detail below but which permits rotation about the axis of the hollow spindles. Spindles 20 and 20' are driven or rotated about their own axes by driving belts 30 and 30', respectively. As is best visible in FIG. 2, driving belt 30 contacts the outer circumferential surface of spindle 20 and, as drive belt 30 moves past spindle 20, the frictional engagement therewith will rotate spindle 20 about its own axis.

With particular reference to FIG. 2, yarn guide slide bar 40 is rigidly mounted to base plate 10 by slide bar support members 41 and 42. These support members are mounted to base plate 10 by slide bar screws and nuts 43 and 44. Yarn guide slide bar 40 is mounted midway between spindle 20 and spindle 20' and is substantially perpendicular to the axis of the spindles.

Double lobe yarn guide 50 is mounted on yarn guide slide bar 40 in a manner that permits a sliding action along the extent of yarn guide slide bar 40. Yarn guide 50 is shown in two positions in FIG. 1. The first position, in phantom lines, is the position the yarn guide assumes prior to its engagement with yarn strand Y. The second position, shown in solid lines, illustrates the position of yarn guide 50 as it is engaging yarn Y. Attention is directed to the fact that yarn guide 50 has a major axis passing through screws 53 and 54 and a minor axis displaced 90° therefrom. In the aforementioned first position, the major axis of yarn guide 50 is aligned with slide bar 40 so that the yarn guide may be moved between spindles 20 and 20'. In the second position, the major axis of guide 50 is offset from and parallel to the axis of the spindles for a purpose to be described below.

With particular reference to FIG. 3, double lobe yarn guide 50 is mounted by means of yarn guide screws 53 and 54 to yarn guide bracket 52. Yarn guide bracket 52 has formed therethrough bracket pivot hole 57. A slide shoe 55 is formed in a manner to fit over and embrace yarn guide slide bar 40 and is complementarily formed so that slide shoe 55 is free to slide along the extent of yarn guide slide bar 40. Slide shoe pin 56 is attached to or integrally formed with slide shoe 55 and

passes through bracket pivot hole 57 in yarn guide bracket 52. A spring fastener 58 is employed to attach yarn guide bracket 52 to slide shoe pin 56 in a manner that permits rotation of yarn guide bracket 52 and its attached double lobe yarn guide 50 about pin 56 of slide shoe 55 yet will maintain yarn guide 50 in a given position. This feature of rotatability of double lobe yarn guide 50 is necessary so that the yarn guide may be passed or slid between the two spindles 20 and 20' yet, after the yarn is engaged around the yarn guide, the guide may be rotated so that its major axis is parallel to the axis of the spindles. As the major axis of guide 50 is greater than the distance between the two spindles, the yarn path will be distorted or pass around the friction means in a manner to increase the frictional engagement between the yarn and the friction engagement means 21 and 21'.

More specifically, and with particular reference to FIG. 1, yarn Y is seen passing through the hollow core of spindle 20, then passes through groove 51 of double lobe yarn guide 50, and then passes through the hollow core of spindle 20'. In applications where yarn Y is moving at very great speeds, as for example in a machine that would combine a false twisting process with a drawing process, yarn Y would first be passed through both spindles 20 and 20' by means that would facilitate a speedy thread up. One example of such a means would be an air jet or an air suction that would blow or draw yarn Y through the hollow cores of both spindles. It is then necessary to pass the yarn over friction engaging means 21 and 21' in a manner such that the rotation of spindles 20 and 20' will impart a false twist to yarn Y passing therethrough.

Double lobe yarn guide 50 is shown in FIG. 1 in phantom lines in a position such that its minor axis is aligned with yarn guide slide bar 40. As yarn guide 50 is slid through the space between spindle 20 and 20', yarn Y is engaged in yarn guide groove 51 and, as the motion of yarn guide 50 continues past spindles 20 and 20', yarn Y is drawn against and in contact with an arc of greater than 90° of the surface of friction engaging means 21 and 21'.

Yarn guide 50 is then rotated about pin 56 of slide shoe 55 such that the distance from point A on yarn guide 50 to point B on yarn guide 50 is greater than the distance between friction engaging means 21 and friction engaging means 21'. Because of this dimensional relationship, yarn Y will be drawn about friction engaging means 21 and 21' at an angle that is illustrated in FIG. 1 and designated α . This angle is measured between the line of the yarn path and a plane passing perpendicular to the axis of the spindle.

The actual angle necessary to insure adequate frictional engagement is a function of, among other parameters, the tension of the yarn, but generally is of the order of 5° to 15°. While angle α is illustrated relative to friction engaging means 21, it is understood that a similar angle exists between the yarn and a plane passing through friction engaging means 21' and perpendicular to the axis of spindle 20'. As the tension of the yarn will vary throughout the friction twister, these two angles are not necessarily the same, though they will be within several degrees of each other. The size of each lobe of yarn guide 50 will determine the corresponding yarn angle.

Spindles 20 and 20' are mounted for rotation in spindle brackets 11 and 11', respectively. With particular reference to FIG. 5, spindle 20' is shown attached to bracket 11' by means of a cylindrical spindle mounting member 23. Member 23 may be press fit into a hole in bracket 11' or may be rigidly mounted in some other conventional manner. Bearings 25 may be needle, ball or other suitable bearings and are positioned between mounting member 23 and hollow spindle core 24. Bearings 25 are separated by bearing spacer 26. Hollow spindle core 24 is attached to or integrally formed with cylindrical spindle body 22.

Belt 30' contacts the outer surface of spindle body 22 and when belt 30' is moved past the spindle, spindle body 22 and hollow spindle core 24 will rotate about the axis of the spindle.

Spindle body 22 has formed in one end a friction member recess 27 that is shaped complementarily to O-ring or friction

twisting means 21'. It is to be noted that the O-ring is firmly seated within recess 27 so that its midline is recessed below the end wall of spindle body 22. By such seating the O-rings are prevented from being pulled out of the spindle during rotation thereof. The natural resilience of the O-ring is sufficient to hold it within recess 27 yet removal for purposes of replacement is easily accomplished. It is noted that as one side of the O-ring is worn from contact with the yarn, the O-ring need only be reversed to present a new face to the yarn.

Another embodiment of the present invention permits the simultaneous twisting of a plurality of yarn strands. With particular reference to FIG. 4, stationary yarn guides 60 and 60' are shown attached to base plate 10 by means of yarn guide mounts 62 and 62'. Both yarn guides are offset from the axis of the two spindles 20 and 20' so that a strand of yarn may be easily and quickly drawn through the hollows of both spindles. A yarn threading tool or hook may then be employed to engage a strand of yarn and route it around the appropriate yarn guide, even while the strand of yarn is rapidly moving.

Each yarn guide has a yarn guide groove 61 formed therein and the dimension of the diameter of the yarn guide, as measured from the bottom of the groove to bottom of the groove, is to exceed the dimension of the distance between the two O-rings on spindles 20 and 20'. This dimensional relationship permits the yarn strand to contact a greater portion of the O-ring surface to thereby increase the frictional engagement therebetween. As mentioned with respect to the embodiment illustrated in FIG. 1, the angle thus formed between the path of the yarn strand and a plane passing through the O-ring and perpendicular to the axis of the spindle may be in the order of 5° to 15°, although these values are not critical. The objective is merely to insure that adequate frictional engagement of the strand with the O-ring is maintained throughout the twisting cycle.

While the embodiment of FIG. 4 is shown with two yarn guides 60 and 60', it is to be understood that a greater number of yarn guides may be positioned in a circle a full 360° about the axis of the two spindles. The practical limitation on the number of yarn guides possible, and hence the number of yarn strands that may be simultaneously processed, is only that sufficient space must be allowed between the strands as they pass through the spindle to avoid entanglement during operation.

Several further factors are to be noted. The internal diameter of O-ring 21 or 21' maybe less than the internal diameter of hollow spindle core 24 so that yarn passing over the O-ring will be held clear of the internal surface of core 24. In this manner, undesirable contact between the yarn and the core will be avoided.

Additionally, although a strand of yarn passes through two separate spindles in each embodiment of the present invention, the twisting action of the O-ring of each spindle is not additive. One O-ring imparts a given number of turns of twist to the strand but then the second O-ring does not add more turns of twist to the strand. Instead, each member cooperates with the other in the impartation of a given number of turns of twist to the yarn strand.

Of further interest is the fact that the increased length of the yarn path as it passes around the yarn guide permits an increased period of time in which the yarn may cool and set the twist that has been imparted thereto. It is a well known phenomenon that a false twisting device imparts a false twist upstream in a yarn moving therethrough but removes the false twist downstream of the device. With particular reference to FIG. 1, yarn Y is passing from spindle 20 to spindle 20'. Twist will be imparted to the yarn upstream of spindle 20 and will be removed downstream of spindle 20'. The yarn will still be twisted as it passes about the yarn 50 and, as no heat is being added to the yarn in this zone, the yarn will have a path of increased length in which to cool. This feature is particularly advantageous when the lineal speed of the yarn is very high. Such speeds would be encountered in, for example, a process combining a drawing operation with a false twist texturizing operation.

The number of twists that may be imparted to an end of yarn with the friction twister of the instant invention may be appreciated by the following example. A friction member with 0.328 inch inside diameter and an 0.702 inch outside diameter (and a circular cross section with a diameter of 0.187 inch) will create a twisting diameter of about one-half an inch. If the spindle friction member has a twisting diameter of one-half an inch and a 15 denier filament with a diameter of approximately 0.001 inch is used, a ratio of 1:500 will exist between the two. With such a ratio, every rotation of the friction spindle member will produce 500 revolutions of the yarn end. Consequently, if the spindle is rotating at 20,000 revolutions per minute, the end of the yarn would have 10,000,000 revolutions per minute imparted thereto. The number of twists imparted per unit length is, of course, a function of the speed at which the yarn is traveling through the twister. Thus, it can be seen that the friction twister of the instant invention is capable of imparting a very large number of twists to an end of yarn running through the device.

OPERATION

In operation, yarn guide 50 is positioned as shown in solid lines in FIG. 1. Friction engaging means 21 and 21' and yarn guide 50 define an operative yarn path for yarn Y.

The strand of yarn is led toward O-ring 21 and is frictionally engaged by the interior surface of the O-ring. The strand contacts somewhat over 90° of the surface of the O-ring (as seen in cross section), the degrees over 90° being a function of the size of angle α . It is only necessary that the contact between the yarn and the O-ring be sufficient to assure a good twist-imparting action.

The yarn strand Y then departs O-ring 21 as the yarn path passes toward point A of yarn guide 50. After passing around the yarn guide the yarn path passes from point B of yarn guide 50 toward O-ring 21'. As is apparent from an inspection of FIG. 1, the yarn path from point B to O-ring 21' is substantially the reverse of the yarn path from O-ring 21 to point A, although angle α and its corresponding angle with O-ring 21' prevents this reversal from being a precise 180° reversal.

Yarn Y then contacts O-ring 21 and is frictionally engaged thereby. After passing over a sufficient surface area to assure a good twist imparting action, the yarn strand Y continues in the yarn path on to the next step in the textile process, such as cooling and take-up.

Throughout the entire false-twisting of the yarn, the tension in the yarn must be controlled and maintained in a manner that will assure a good twist imparting action yet avoid yarn jump and chatter. Too great a tension will cause the yarn to jump on the surface of the O-ring, causing uneven wear of the O-ring and affecting the twist imparting action. Tension may be controlled in a number of well known methods such as positively driven feed rolls before and after the false-twist spindle assembly.

The direction of twist imparted by the in-line friction twister of the present invention may be governed in one of several ways. A simple reversal of the direction of travel of both belts 30 and 30' will rotate both spindles 20 and 20' in a different direction, thereby changing the direction of the twist. In the alternative, if the driving belts move only in one direction, contact with the bottom surface of the spindles will drive them in one direction and contact with the top surface will drive them in the other direction. It is of course understood that other driving apparatus may be used in place of the belts 30 and 30'.

The thread-up of the device is such that the false twister of the present invention may be used with yarn that is moving rapidly. The yarn may be passed from one twisting surface of a twisting member to the other so that the path of the yarn defines a straight line. If each twist member is located in a twisting zone, the straight line passes from one zone to the other.

The yarn may be stationary or may be moving through the two zones but a segment of the yarn is now displaced from its straight yarn path by either moving the guide past the spindles or, if the guide is stationary, engaging the yarn with a threading tool and positioning it about the guide. Thread-up is now complete.

It should be apparent that the present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof, all of which are intended to be encompassed by the appended claims.

I CLAIM:

1. Apparatus for imparting false twist to thermoplastic yarn comprising two separate yarn-engaging friction-twisting means each affixed to a rotatably mounted spindle, said spindles being in substantial coaxial alignment and spaced apart by a given distance, and yarn guide means cooperating with said twisting means to define an operative yarn path passing from one of said twisting means to said guide means and then to the other of said twisting means.

2. Apparatus according to claim 1 wherein each of said yarn-engaging friction-twisting means comprises a torus-shaped resilient member mounted for rotation about the axis of the hole of said torus.

3. Apparatus according to claim 2 wherein said guide means is offset from said torus-shaped resilient members so that the yarn passing through said operative yarn path contacts a portion of said torus-shaped member constituting an arc of more than 90° whereby adequate frictional engagement is assured between said torus-shaped resilient members and yarn passing through said operative yarn path.

4. Apparatus according to claim 3 wherein said yarn guide means is one of a plurality of yarn guide means, each establishing a separate operative yarn path with said torus-shaped resilient members whereby a plurality of yarn strands may be simultaneously false twisted.

5. Apparatus according to claim 2 wherein said guide means is slideably mounted on bracket means for displacement between a thread-up position and an operative position whereby yarn initially passing direct from one of said torus-shaped members to the other of said torus-shaped members may be carried to said operative position by the displacement of said guide means.

6. Apparatus for imparting false twist to thermoplastic yarn comprising a base plate, two hollow spindles rotatably mounted on said base plate in substantial coaxial alignment and spaced apart by a given distance, a torus-shaped friction-twisting member mounted on each of said spindles, guide means cooperating with said twisting members to define an operative yarn path passing from one of said members to said

guide means and then to the other of said members and drive means to rotate each spindle and its associated torus-shaped member to thereby impart false twist to a strand of yarn passing through said path.

7. Apparatus according to claim 6 wherein said torus-shaped members are mounted on the adjacent facing ends of said spindles.

8. Apparatus according to claim 6 wherein said drive means comprise two driving belts, one for each spindle and contacting the outer circumferential surface of said spindle.

9. Apparatus according to claim 6 wherein said base plate has mounted thereon a slide bar and said guide means is slideable along said slide bar.

10. Apparatus according to claim 9 wherein said slide bar extends substantially perpendicular to the axis of said hollow spindles and said guide means has a major axis and a minor axis and is pivotally mounted to a guide bracket, said guide bracket being slideably mounted to said slide bar.

11. Apparatus according to claim 10 wherein said guide means is positioned with said major axis parallel to but offset from the axis of said hollow spindles when yarn is passing through said operative yarn path.

12. Apparatus according to claim 6 wherein said guide means is one of a plurality of yarn guide means, each rigidly attached to said base plate and establishing a separate operative yarn path with said torus-shaped members whereby a plurality of yarn strands may be simultaneously false twisted.

13. In the process for threading-up a false twisting apparatus, the improvement comprising the steps of passing a strand of yarn in a first straight path through a first false twisting zone and a second straight path through a second false twisting zone in a manner that both of said paths are coaxially aligned with each other and said yarn strand defines a straight line between said zones, and subsequently positioning a segment of said strand of yarn around a guide means so that said segment deviates from said straight line.

14. The improved process of Claim 13 wherein said strand of yarn is moving between said zones simultaneously with said step of positioning said segment around said guide means.

15. In a process of threading-up a false twisting apparatus, the improvement comprising the steps of advancing a strand of yarn in a straight path toward said false twisting apparatus, continuing to advance said yarn in said path while passing said strand across the twisting surface of two friction twisting members in said false twisting apparatus, and subsequently engaging said yarn between said surfaces and displacing said yarn about a guide to increase the contact and frictional engagement between said yarn and both of said twisting surfaces.

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