Jan. 21, 1969 E. J. BERGER, JR., ETAL 3,422,613

YARN ASSEMBLY APPARATUS FOR FALSE TWISTING YARN

Filed May 8, 1967 Sheet 1 of 4

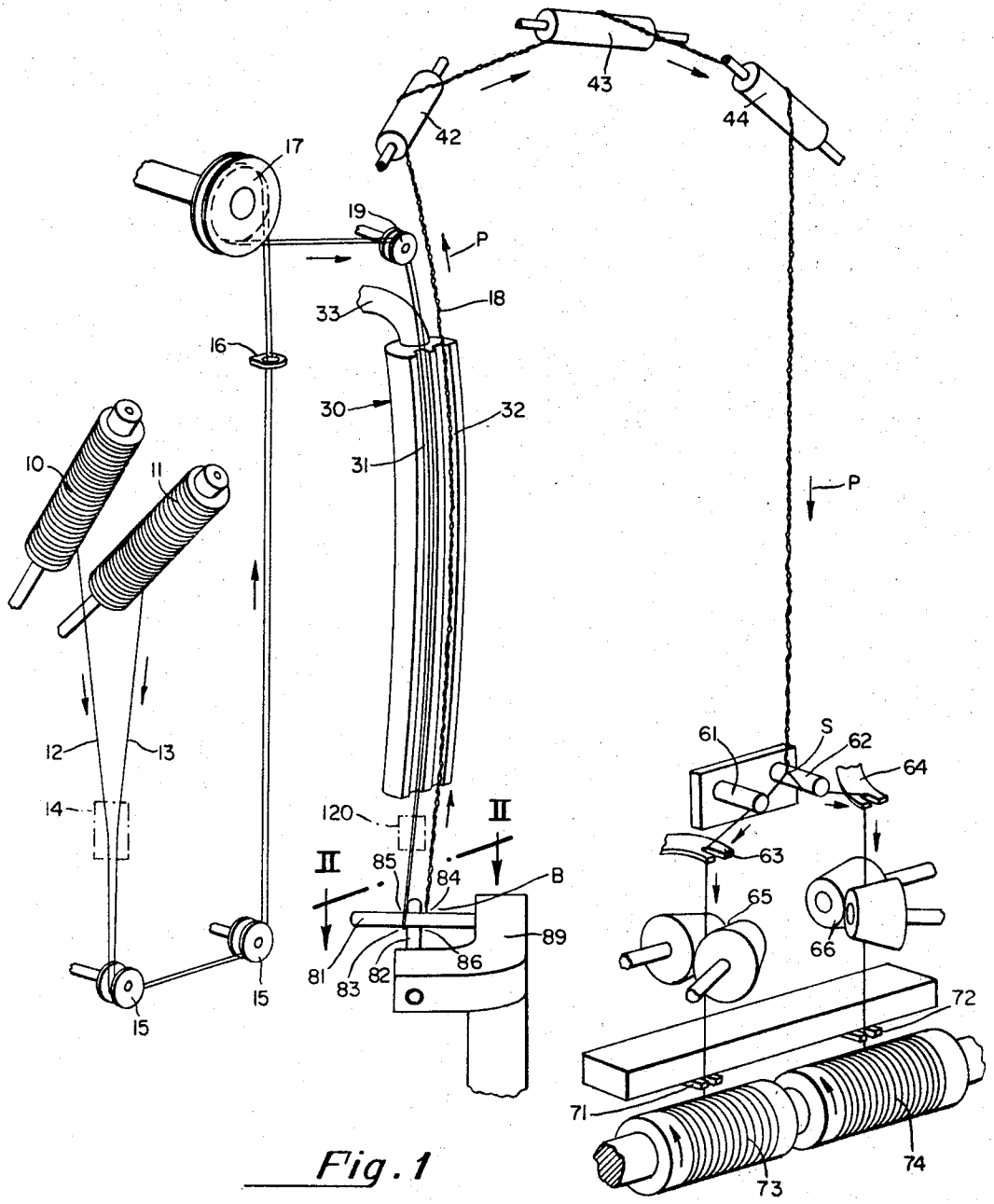


Fig. 1

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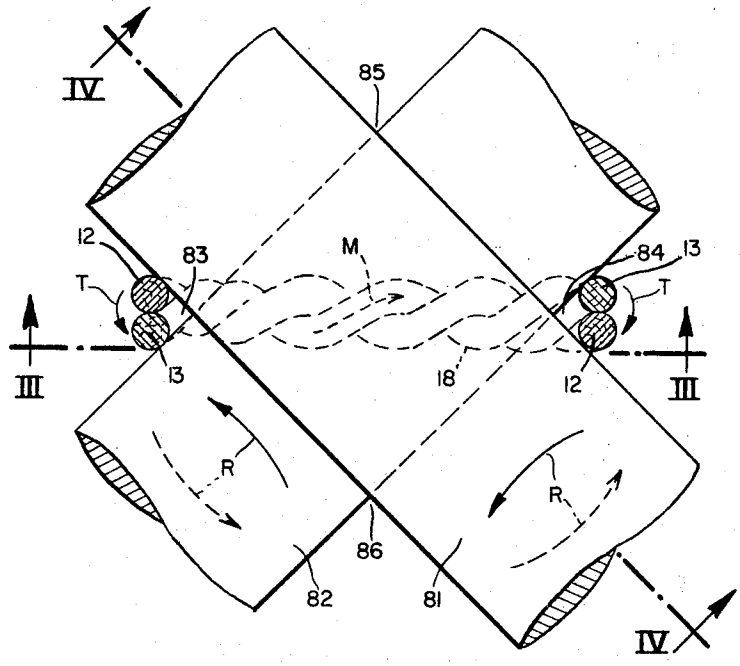


Fig. 2

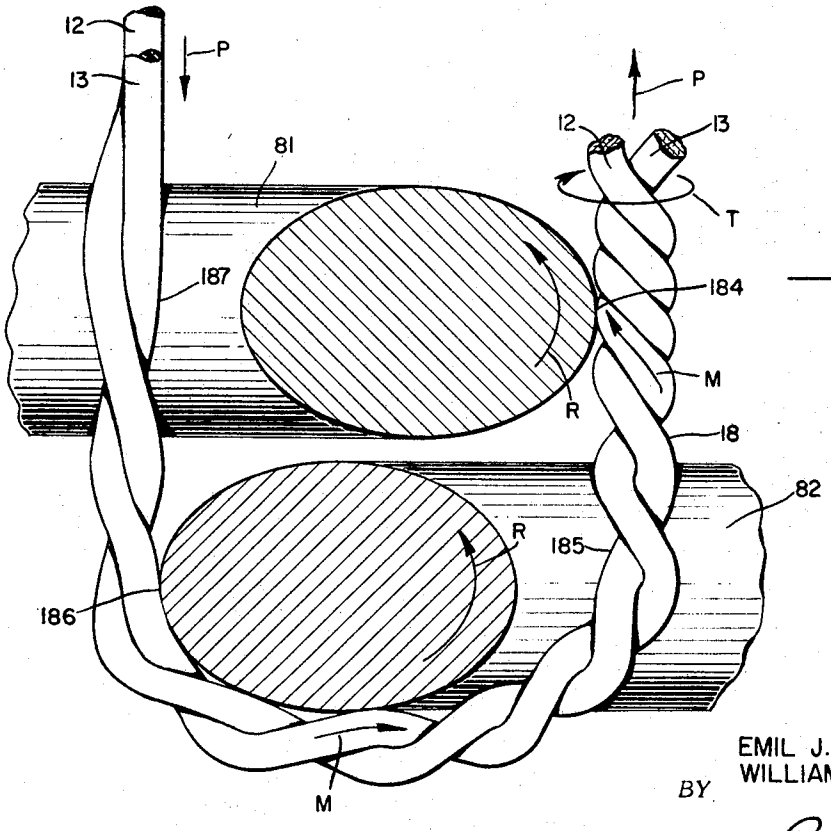


Fig. 3

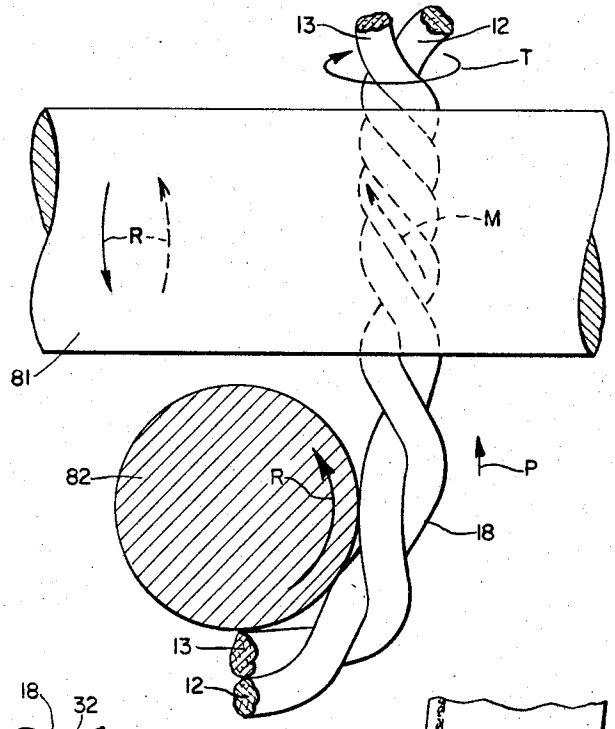
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YARN ASSEMBLY APPARATUS FOR FALSE TWISTING YARN

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Fig. 4



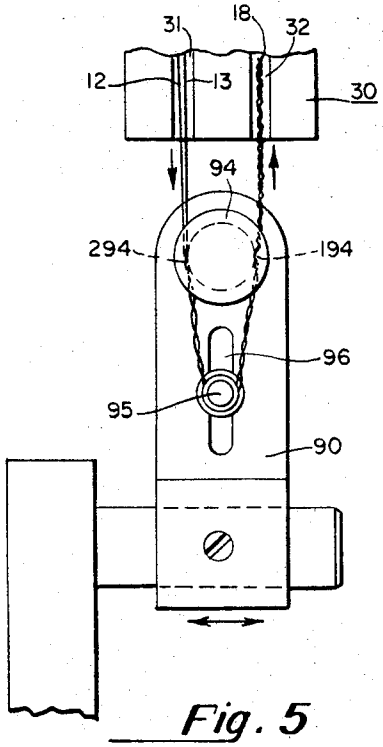


Fig. 5

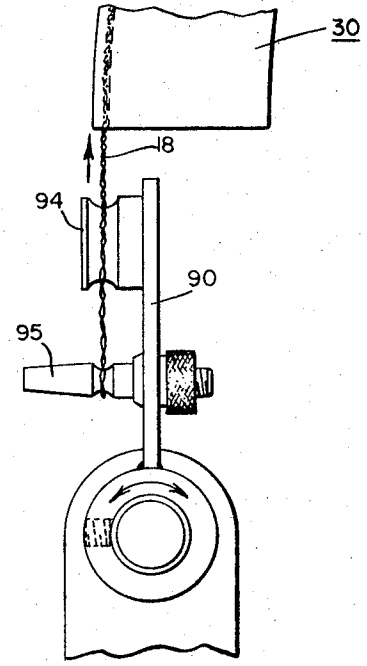


Fig. 6

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YARN ASSEMBLY APPARATUS FOR FALSE TWISTING YARN

Filed May 8, 1967 Sheet 4 of 4

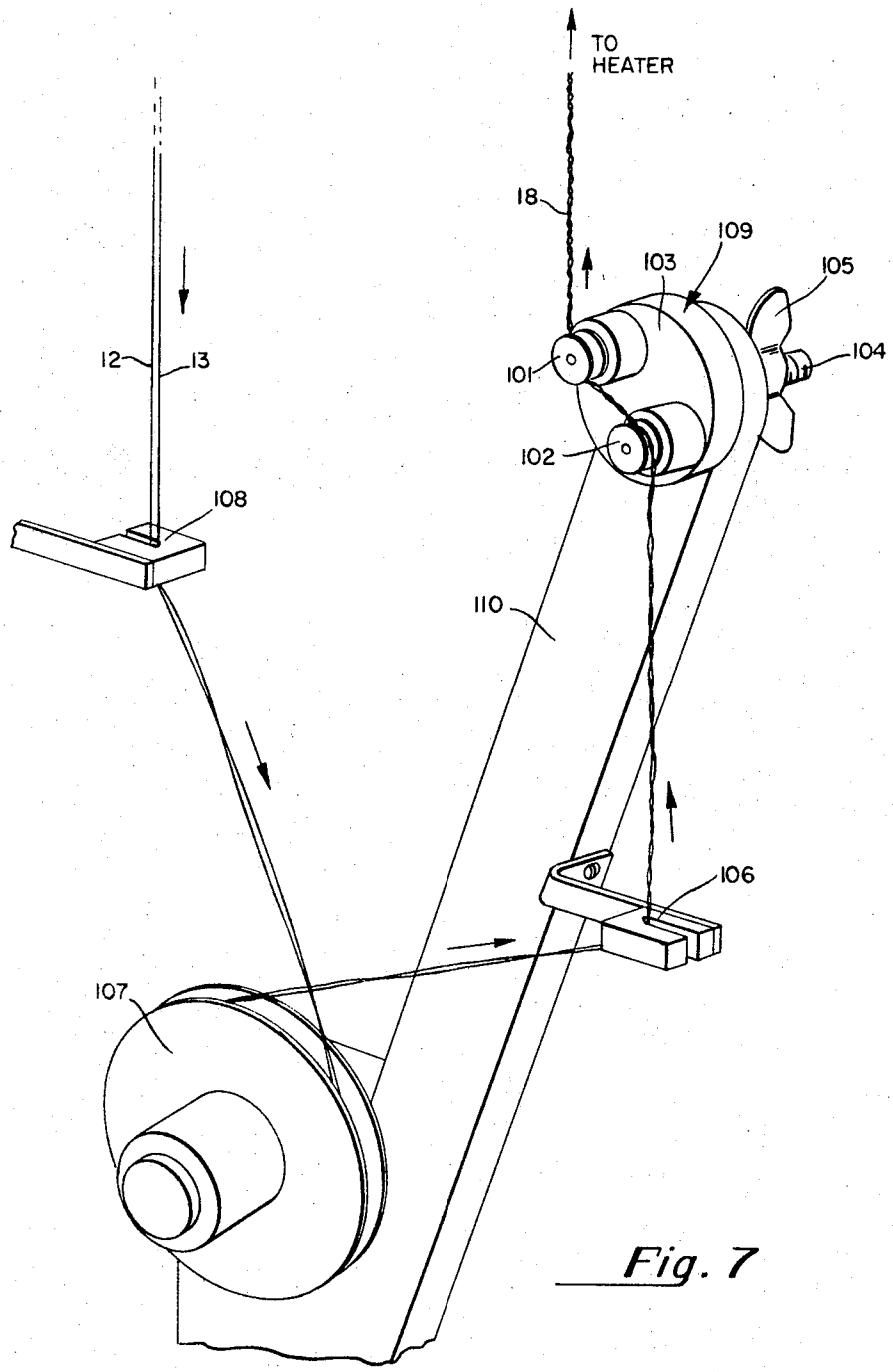


Fig. 7

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United States Patent Office 3,422,613 Patented Jan. 21, 1969

3,422,613

YARN ASSEMBLY APPARATUS FOR FALSE TWISTING YARN

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Filed May 8, 1967, Ser. No. 636,976
U.S. Cl. 57—34 12 Claims
Int. Cl. D01h 13/26; D02g 3/02

ABSTRACT OF THE DISCLOSURE

A texturing method and apparatus is disclosed in which two ends of untwisted multi-filament heat-settable yarns are false-twisted together, heat-set, cooled and separated to provide two ends of textured yarn. The method and apparatus disclosed achieves the transition of two ends of untwisted multi-filament yarn into a two-ply helically twisted yarn smoothly and progressively in a series of stages. A very small degree of twist is introduced at the first stage. Thus, the angle of first departure of the untwisted filaments from the substantially linear path is small. The number of turns of twist per inch introduced at the second and succeeding stages is progressively greater until the full transition from the untwisted to the twisted condition is attained. In the preferred method and apparatus, the untwisted single ends of yarn are preheated prior to twisting.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to texturing heat-settable multi-filament yarns by false-twisting techniques.

Description of the prior art

Prior art patents include British Patent 901,922 and U.S. Patents 2,807,130, 2,987,869, 3,154,906, 3,091,908, 3,192,697, 3,237,391, and 3,237,392.

Summary of the invention

The present invention is characterized by the smooth progressive manner in which two ends of untwisted multi-filament yarns are twisted together into a two-ply twisted yarn. The transition from untwisted substantially parallel filaments to the two-ply twisted condition is accomplished in a plurality of stages or steps. The assembly device is such that but a few turns of twist per inch are introduced at the first stage, a somewhat greater number of turns of twist per inch are introduced at the second stage, and so on until the final stage at which the full number of turns of twist per inch are introduced. Due to the gradual transition from untwisted to fully twisted condition, the initial angle of departure of the filaments from the linear direction of the yarn path is small, and this has the advantage of avoiding the entanglements, snags and other irregularities which are produced when the yarn filaments are transformed too rapidly from untwisted to twisted condition.

The assembly of untwisted multi-filament yarns into the two-ply fully-twisted form is accomplished by a device which inhibits or restrains the twist from running back upstream. This device may be viewed, looking downstream from the untwisted yarn source, as an assembly device, or, it may be viewed, looking upstream from the yarn-end separation device, as a twist-barrier or inhibitor. When the device is viewed as a barrier or inhibitor looking upstream, the yarn in the first stage of the twist inhibitor will have less turns of twist per inch than the yarn downstream therefrom. And, in the next succeeding upstream stages of the twist-inhibitor device, the number

of turns of twist per inch will become less and less until at the upstream end of the twist-barrier device the yarn ends are substantially free of twist.

By using twist-barrier or restraint devices of the multi-stage type described herein, the texturing apparatus may be run at considerably higher speeds since the untwisted single ends of yarn are assembled and twisted smoothly and progressively, and without abrupt change in direction, thereby avoiding the entanglements which tend to develop when the transition from untwisted to twisted condition is made too suddenly.

The present application discloses several different forms of multi-stage assembly or twist-barrier devices. Each is effective to restrain, in a plurality of stages, the passage of the twist upstream, whereby, as viewed looking downstream, the transition of the filaments from untwisted parallel condition to the twisted two-ply condition is made smoothly and progressively.

Brief description of the drawing

FIG. 1 is a diagrammatic illustration of a texturizing system incorporating one form of multi-stage twist-barrier device in accordance with the present invention;

FIG. 2 is an enlarged fragmentary plan view of the crossed rollers of the twist-barrier device, looking down along the line II—II of FIG. 1;

FIG. 3 is a fragmentary view, in front elevation, looking along the line III—III of FIG. 2. It should be noted that the rollers are actually circular in cross section, and that the oval cross sections appearing in FIG. 3 are due to the fact that the line of view III—III is not perpendicular to the axis of either of the rollers.

FIG. 4 is a fragmentary view, in side elevation, looking along the line IV—IV of FIG. 2;

FIG. 5 is a front view of an alternate form of multi-stage twist-barrier device;

FIG. 6 is a side view of the device of FIG. 5;

FIG. 7 is a diagrammatic perspective illustration of yet another form of multi-stage twist-barrier device.

Description of the preferred embodiments

In FIG. 1, two ends **12** and **13** of multi-filament untwisted heat-settable yarns are pulled through the texturizing or false-twist apparatus by two pairs of delivery rolls **65** and **66** and delivered through reciprocating traversing means **71** and **72** to the take-up rolls **73** and **74**.

In FIG. 1, the path of the two ends of yarn **12** and **13** may be traced from the supply packages **10** and **11** down through the pretwister device **14**, under and around the guide rollers **15**, up through the guide eye **16**, around the tension-adjusting device **17**, over the guide roller **19**, down through the left groove **31** of the arcuate heater **30**, through the multi-stage twist-barrier or restraining device B, up (as a two-ply twisted yarn **18**) through the right groove **32** of the heater **30**, over and about the cornering and guide rollers **42**, **43** and **44**, down to the separation device S, and then (as the separate ends **12** and **13** of textured yarn) to the delivery rolls **65** and **66**, and to the take-up rolls **73** and **74**.

In the region between the supply packages **10** and **11** and the upstream side of the twist-barrier device B, the yarn ends **12** and **13** are untwisted and the filaments thereof lie substantially flat and parallel. It is in this form that the yarn ends **12** and **13** first pass through the arcuate contact heater **30**. The concept of so doing and the non-obvious advantages to be derived therefrom are described in the copending application Ser. No. 636,814, filed May 8, 1967, of Emil J. Berger, Jr., entitled "Preheating in Yarn Texturing," filed concurrently with the present application and assigned to the same assignee.

Between the downstream side of the twist-barrier device B and the separation device S, the two ends of yarn **12**

and **13** are twisted together forming the two-ply yarn which has been designated **18**. At the separation device S, the two plies are separated and passed separately to the take-up rolls **73** and **74**.

As has already been indicated, the novelty of the present invention is directed primarily to the manner in which the untwisted filaments of the two ends of yarn are smoothly and progressively transformed into tightly twisted condition. This end result is attained by a multi-stage twist-barrier or inhibitor device B which progressively inhibits run back of the twist. Several forms of device B are disclosed in the present application. One form is that of a pair of crossed rollers, this form being shown in FIGS. 1, 2, 3 and 4. An alternate form of multi-stage twist-barrier device is shown in FIGS. 5 and 6, and yet another form is shown in FIG. 7.

Each of the several forms of multi-stage twist-barrier device shown and described in the present application achieves a smooth and progressive transition from untwisted to tightly twisted condition, as viewed looking downstream. Because of the smooth and progressive manner in which the untwisted parallel filaments are transformed into a tight helical twist having an angle of say 45°, the entanglements or snags that tend to develop when yarns are twisted together abruptly are avoided. As a result, the stresses that tend to cause yarn breakage are eliminated. The resultant two-ply twisted yarn which passes through the texturizing zone is tightly bundled, comprising closely adherent filaments with substantially few, if any, stray filaments. As a result, the texturizing apparatus can be operated at higher speeds without encountering the yarn stresses and resultant breakages which would otherwise tend to occur. Thus, a superior textured yarn is produced.

As has already been indicated, the device B may be viewed in two aspects. It may be viewed as a twist-barrier device which inhibits or restrains the running back upstream of the twist of the two-ply twisted yarn which extends from the separation point S to the device B. It may also be viewed as a yarn filament assembly device in which the untwisted parallel filaments of the two yarn ends **12** and **13**, which approach the device B in the downstream direction, are assembled into the two-ply tightly twisted yarn **18**.

It will be convenient to consider first the aspect of the device B as a twist-barrier device which operates to inhibit the passage of the twist of the two-ply yarn **18** into the region which lies upstream from the device B.

In FIGS. 1–4, the device B comprises a pair of laterally-disposed vertically-separated crossed rollers **81** and **82** each mounted for free rotation in bracket **89**. The angle at which the rollers cross is not critical. In the illustration they are shown 90° apart. The yarn ends **12** and **13** are pulled downwardly through crotch **83** of the crossed rollers and upwardly through the opposite crotch **84**, the crotches restraining lateral movement of the yarn along the rollers. Due to the frictional engagement of the rollers by the yarn ends **12** and **13** as they are pulled through the crotches **83**, **84** in the direction indicated by the arrows P, the upper roller **81** and the lower roller **82** are rotated in the directions indicated in FIGS. 2–4 by the arrows R.

It will be understood that as a result of the rotational forces imparted to the yarns when the two ends **12** and **13** are pulled apart at the separation device S, the two-ply twisted yarn **18** rotates about its linear yarn path as the twist runs back upstream from the separation device S. In the illustration, the two-ply yarn **18** is assumed to have an S twist, and the direction of rotation of the two-ply yarn is indicated by the arrows T.

Considering the crossed rollers **81** and **82** of FIGS. 1–4 as a device for restraining the passage of twist upstream, and looking upstream at the device, it will be noted that the point of first contact of the twist is at a point **184** on the downstream side of the upper roller **81**. At this point **184**, a component of the helical movement M of the yarn filaments is parallel to the axis of rotation of the roller **81**, and, as a result thereof, the surface of the roller **81** imparts a resistive component of force to the yarn which tends to inhibit the helical rotation thereof. As a result, the number of turns of twist per inch upstream from the point **184** is less. This is indicated in FIGS. 3 and 4. At a point **185** on the downstream side of the lower roller **82**, the two-ply yarn **18** of lessened twist makes a further contact with the rollers, and this contact is maintained until the yarn leaves the lower roller **82** at point **186** on the upstream side thereof. Here again, a component of the helical movement of the yarn filaments is parallel to the axis of rotation of the roller **82** and a component of resistive force is imparted to the yarn by the roller surface which tends to inhibit the helical rotation of the yarn. As a consequence, a progressive lessening occurs in the number of turns of twist per inch in the region between points **185** and **186**. As the now substantially lessened twist tries to run upstream, it encounters the upstream side of the upper roller **81** at point **187**, and here again a component of the helical movement of the yarn is axial to the upper roller **81**. As a result, further resistance is introduced by the roller surface to the helical movement of the yarn, and, as a consequence, there is substantially zero twist upstream of point **187**.

In summary then the crossed rollers **81**, **82**, inhibit or restrain the twist of the two-ply twisted yarn **18** from running back upstream. The restraint is imposed in steps, establishing stages of lessened twist. A first stage extends from point **184** at the downstream side of the upper roller **81** to point **185** at the downstream side of the lower roller **82**. A second stage extends from point **185** to point **186** on the upstream side of the lower roller **82**. A third stage extends from point **186** to point **187** on the upstream side of the upper roller **81**.

Viewing the crossed rollers **81–82** downstream as an assembly device, it will be seen that the untwisted substantially parallel filaments of the yarn ends **12** and **13** are gradually and progressively transformed into a two-ply tight twist having an angle on the downstream side of the device of the order of 45°. But the angle of first departure of the untwisted filaments from the direction of the linear path is small, and is thereafter gradually and progressively increased. This technique produces a two-ply twisted yarn in which each ply comprises tightly bundled closely adherent filaments with few, if any, stray filaments. The filaments of one ply do not become entangled or intermeshed with filaments of the other ply, and when the two plies are separated at the separation device S, the separation is clean and without cross stresses. The tension on the two plies remains substantially equal, and the separation point remains relatively fixed. Thus, at least in some installations, it will no longer be necessary to provide guide means **63** and **64** which, while remaining at fixed spacing relative to each other, move laterally back and forth in response to changes in tension of one ply relative to the other, to change the positions of the separated plies relative to the pairs of conical rollers **65** and **66**. A separation device of the type just referred to is shown and described in the patent application of William Kirk Wyatt, entitled "Yarn Separating Means," filed June 17, 1965, Ser. No. 464,797, assigned to the assignee of the present application. While guide means which move in response to changes in tension may no longer be required, the employment of pairs of conical rolls, such as **65** and **66**, may still be desirable in that by adjustment of the spacing between the guide means **63** and **64** the speed at which the yarn is pulled through the apparatus is adjustable. But where such adjustment is not deemed to be necessary, it is contemplated that the multi-stage twist-barrier means described herein will make it possible, at least in certain installations, to employ cylindrical rather than conical delivery rolls.

In FIGS. 1–4, the two-ply twisted yarn **18** is illustrated

as having a right hand or S twist. When the yarn to be texturized is to be given a left hand or Z twist, the crossed-roller device is rotated 90° (in either direction) from that shown in FIGS. 1–4 and the yarn is pulled through the opposing crotches **85** and **86** of the crossed rollers **81–82**. This 90° shift in the positions of the crossed rollers **81** and **82** is necessary in order that a component of Z helical movement of the yarn filaments be parallel to the axis of the under roller **82**, and not circumferential thereto as would be the case if the 90° shift were not made. When yarn is pulled about a rotatable roller in such manner that the helical path is circumferential relative to the surface of the roller, no resistance is imposed upon the yarn to restrain the helical rotation of the twist, and the twist is permitted to pass rather than to be inhibited.

An alternate form of multi-stage twist-barrier device is shown in FIGS. 5 and 6. In FIGS. 5 and 6, a large diameter pin **94** and a smaller diameter pin **95** are mounted on an adjustable bracket **90** below the lower end of heater **30** in such positions that the pins **94** and **95** are in alignment with the axis of the heater **30**. Pin **94** has an annular groove of such diameter that opposite sides of the groove, identified as **194** and **294**, are in alignment with the grooves **31** and **32** of the heater **30**. The smaller pin **95**, located below pin **94** is mounted in a slot **96** and its position is vertically adjustable, thereby to adjust the angle of the yarn path between point **194** and the pin **95**, and also the angle between point **294** and the pin **95**.

The yarn is threaded in the manner shown in FIG. 5. The untwisted substantially flat parallel multi-filament ends **12** and **13** from heater groove **31** contact the groove of pin **94** at point **294** at the upstream side, then pass under and around the pin **95**, then contact the groove of pin **95** at point **194** on the downstream side, and then pass up and into the heater groove **32**.

In operation, viewing the device of FIGS. 5–6 from the downstream side, as the twist of the rolling two-ply twisted yarn **18** tries to move upstream, resistance to its helical rotation is first encountered at point **194**, and as a result the number of turns of twist per inch in the region below point **194** is lessened. An additional component of resistance is imparted to the helically twisting yarn by the pin **95** and, accordingly, in the region between the under surface of the pin **95** and the point **294** on the upstream side of pin **94** a further decrease occurs in the number of turns of twist per inch. A still further point of resistance is at point **294**. At this point, the final bit of twist is removed, and upstream of pin **94** the two yarn ends **12** and **13** are untwisted and the filaments lie substantially flat and parallel in the heater groove **31**.

FIGURE 7 illustrates yet another form of multi-stage twist-barrier device. In FIGURE 7, when the twist of the two-ply twisted yarn **18** tries to run back upstream, it encounters first the pin **101**, then the pin **102**, then the guide **106**, then the tension adjusting device **107**, and finally the guide **108**. Pins **101** and **102** are mounted on the enlarged head **103** of a stud **109** having a threaded stem **104** which carries a wing nut **105**. The pins **101** and **102** are equi-distant from the axial center of the stud **109** so that rotation of stud **109** adjusts the positions of the pins **101–102** relative to the yarn path. In the drawing, adjustment of stud **109** counterclockwise will increase the angle of departure of the two-ply yarn **18** from the linear path of the yarn downstream from pin **101**. The greater the angle at pin **101**, the greater the resistance offered to the passage of the twist as it tries to run upstream, and the larger the decrease in the number of turns per inch of the yarn in the region between the pins **101** and **102**. Pin **102** introduces further resistance to the twist, so that upstream of the pin **102**, the yarn twist is further reduced. At the guide means **106** still further resistance to passage of twist is encountered. The resistance at **106** is considerable, due to the angle of bend of the yarn path at this point, and due to the fact that guide **106** is not a rolling surface. Thus, the twist upstream from the guide **106** is very much reduced. A further reduction in the number of turns per inch occurs as the yarn passes over the tension wheel **107**, and at the final guide pin **108** substantially all of the twist is eliminated so that the ends **12** and **13** thereabove are substantially without twist.

If the twist-barrier or twist-restraining device illustrated in FIG. 7, be now considered as a yarn assembly device, it will be seen that the two ends **12** and **13** of untwisted multi-filament substantially parallel incoming yarns are first given a very slight degree of twist between the guide **108** and the tensioning device **107**, then a very slight increase in twist between the tensioning device **107** and the guide **106**, then a substantial increase in the degree of twist between the guide **106** and the pin **102**, a further increase in twist between the pin **102** and the pin **101**, and a final degree of twist downstream from the pin **101**.

It will be seen that the present invention provides means for assembling two ends of multi-filament yarn into a two-ply yarn in a way that avoids entanglement or intermeshing of the filaments of one ply with those of the other. The assembly devices take the yarns parallel to each other and then gradually permit the filaments to twist while under tension. As a result, each ply is a tightly bundled unit with substantially no stray filaments. The initial slight degree of twist is then increased in steps until the final degree of twist is attained.

While the multi-stage assembly technique may be employed without preheating the untwisted parallel filaments, the use of a preheater for the untwisted filaments in combination with the multi-stage assembly technique herein described allows the texturing apparatus to be run at speeds very considerably higher than has been permissible theretofore using prior art apparatus and methods. The use of the preheater is particularly advantageous where the yarn denier is relatively large, for example, 70 denier for each end. In such cases, a fifty per cent increase has been realized in the speed at which the yarn ends are through the texturing apparatus.

In some cases, it may be desirable to insert a known form of tension control device in the path of the untwisted yarn ends between the heater groove **31** and the assembly device B. Such a device is indicated in the drawing by the dot-and-dash rectangle **120**. By means of the tension-control device **120**, the tension on the untwisted heated filaments in groove **31** may be made relatively low, while keeping a considerable amount of tension on the twisted yarns downstream thereof.

While the preferred embodiments of this invention have been described in some detail, it will be obvious to one skilled in the art that various modifications may be made without departing from the invention as hereinafter claimed.

What is claimed is:

1. In a texturing machine

(a) a source of two ends of multi-filament yarn, the ends being pretwisted at start-up to form a two-ply yarn having a preselected number of turns of twist per inch,

(b) delivery means for pulling said yarn ends,

(c) separation means upstream from said delivery means for separating the two-ply yarn into single ends,

(d) multi-stage twist-restraining means upstream from said separating means for applying to said two-ply yarn at spaced intervals twist-restraining resistance to decrease in steps in the upstream direction the degree of twist from a full twist to substantially zero twist,

(e) the magnitude of the resistance applied at the several points being such that only a slight degree of twist remains in the first stage downstream from the substantially zero twist region.

2. Apparatus according to claim **1** characterized in that the twist-restraining means comprises freely rotatable first

and second crossed rollers mounted on skewed axes forming oppositely disposed crotches, and in that the yarn is pulled through one crotch, then about the second roller, and then through the opposing crotch, and in that said resistance is applied at the downstream side of said first roller, at said second roller, and at the upstream side of said first roller.

3. Apparatus according to claim 1 characterized in that the twist-restraining means comprises a pair of crossed rollers mounted for free rotation one above the other and angularly disposed relative to each other forming opposing crotches, and in that the yarn is pulled down through one crotch, then under the lower roller, and then up through the other crotch, and in that said resistance is applied at the downstream side of the upper roller, at the under side of said lower roller, and at the upstream side of said upper roller.

4. Apparatus according to claim 1 characterized in that the twist-restraining means comprises a larger diameter pin and a smaller diameter pin mounted in alignment, and in that the yarn is pulled along one side of said larger pin, about the smaller pin, and then along the opposite side of the larger pin, and in that said resistance is applied at the downstream side of said larger pin, at the smaller pin, and at the upstream side of the larger pin.

5. Apparatus according to claim 1 characterized in that the twist-restraining means comprises in order in the upstream direction, a pair of adjustable pins disposed at an adjustable angle relative to the yarn path and between which the two-ply twisted yarn is pulled, guide means upstream thereof, and a yarn-tension device, said guide means being so disposed between said yarn-tension device and said pair of adjustable pins that the yarn changes direction substantially as it is pulled through said guide means.

6. In a method of texturing yarn,

(a) providing two ends of multi-filament yarn, the ends of which are pretwisted at start-up to form a two-ply yarn having a selected number of turns of twist per inch,

(b) pulling the yarn,

(c) at a point upstream from the pulling point separating the two-ply yarn into single ends,

(d) at a point upstream from said separating point taking the two ends of untwisted substantially flat parallel multi-filament yarns and applying a slight degree of twist thereto to form a lightly twisted two-ply yarn and then at succeeding downstream points increasing progressively the degree of twist until the final degree of twist is obtained.

7. Apparatus according to claim 1 characterized in that heater means are provided upstream from said twist-restraining means for heating the substantially zero twist yarns.

8. Apparatus according to claim 7 characterized in that heater means are also provided downstream from said twist-restraining means.

9. The method according to claim 6 characterized in that the two ends of untwisted yarns are heated prior to applying the slight degree of twist.

10. The method according to claim 9 characterized in that the yarn having the final degree of twist is also heated.

11. In a yarn texturing method in which a two-ply multi-filament twisted yarn is separated and the twist tends to run upstream, the improvement which comprises the steps of imposing, at a first point on the yarn upstream from the separation point, a resistance opposing helical rotation of the twist to impose a partial restraint to the upstream movement of the twist, thereby to lessen the degree of twist upstream from said first point, and then at one or more additional points upstream from said first point imposing further resistance to impose further restraint to further lessen the degree of twist to substantially zero.

12. The method according to claim 9 characterized in that the two ends of untwisted yarns which are heated prior to the application of the slight degree of twist are under relatively low tension and in that the tension is increased before twisting begins.

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U.S. Cl. X.R.

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