Dec. 3, 1963 N. J. STODDARD ETAL 3,112,600

METHOD AND APPARATUS FOR PROCESSING YARNS

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FIG. 1

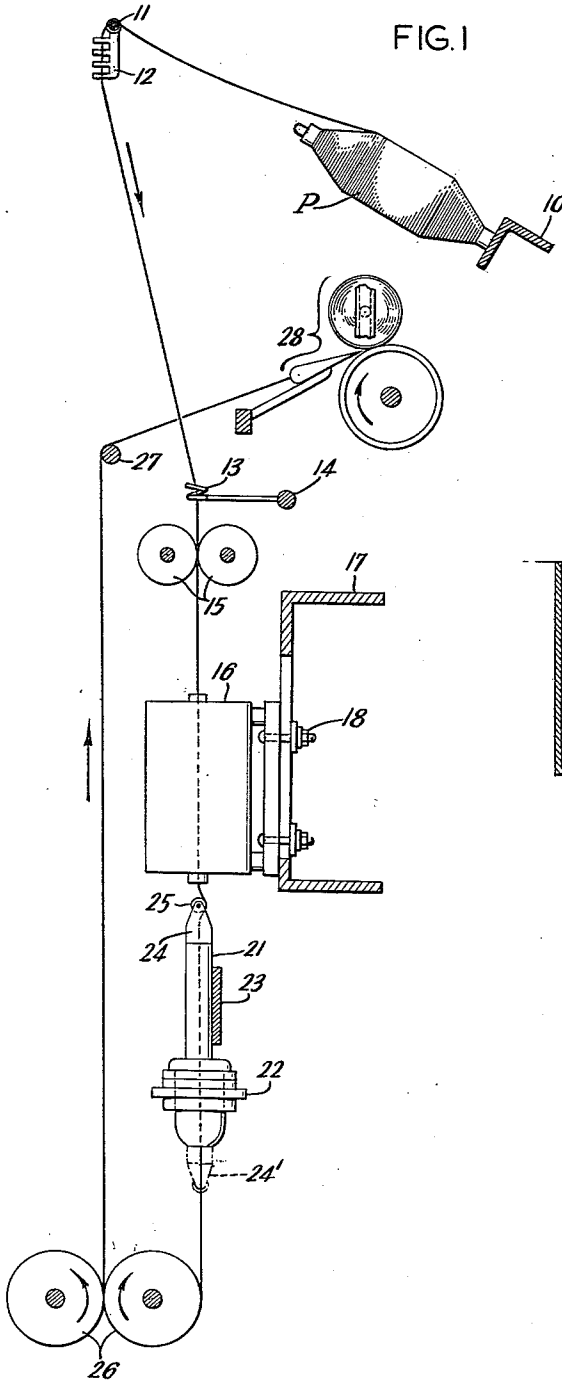


FIG. 1a

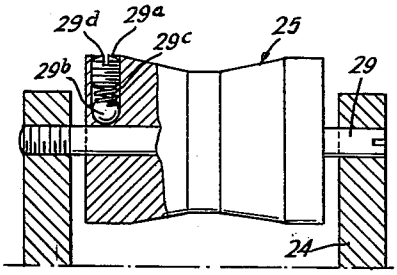
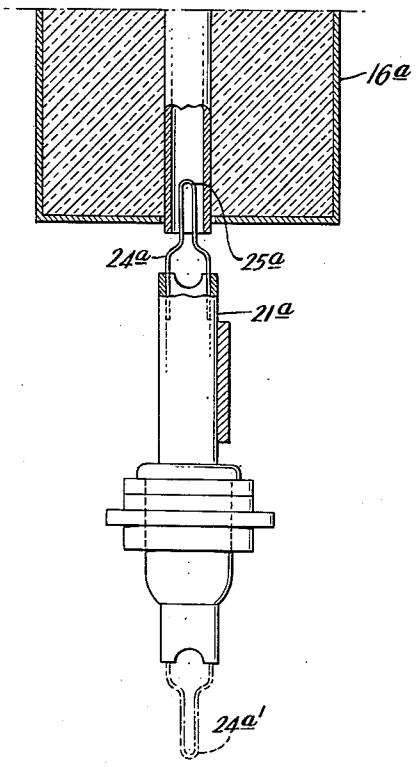


FIG. 2



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FIG. 3.

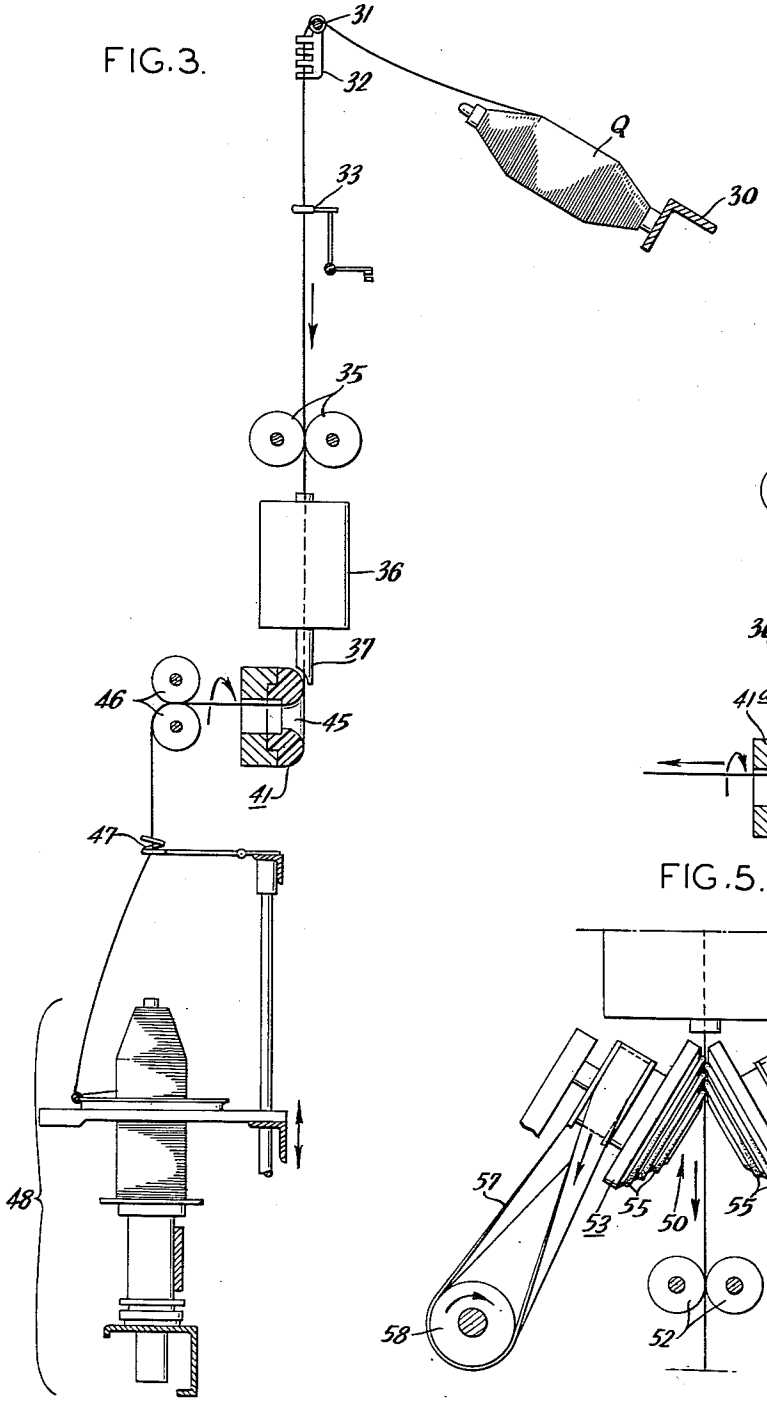


FIG. 4.

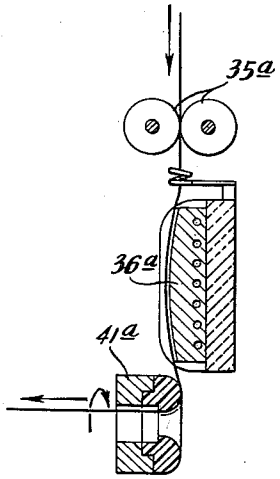


FIG. 5.

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FIG. 6.

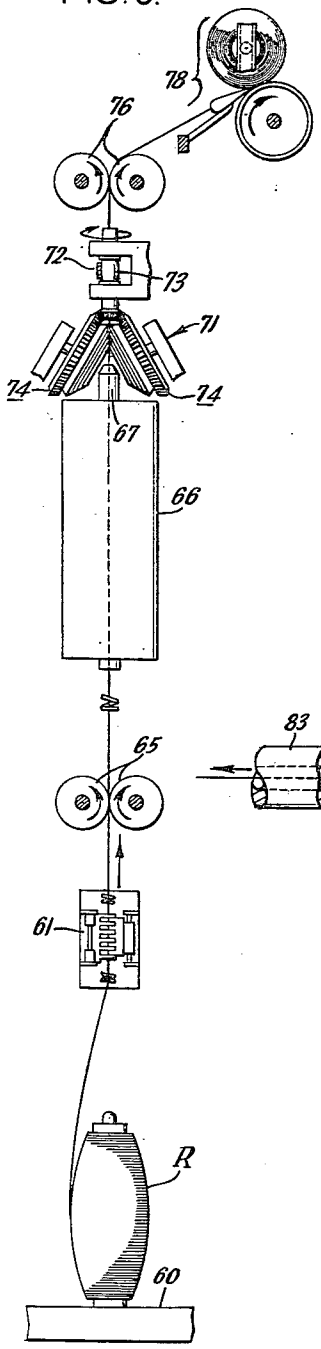


FIG. 7.

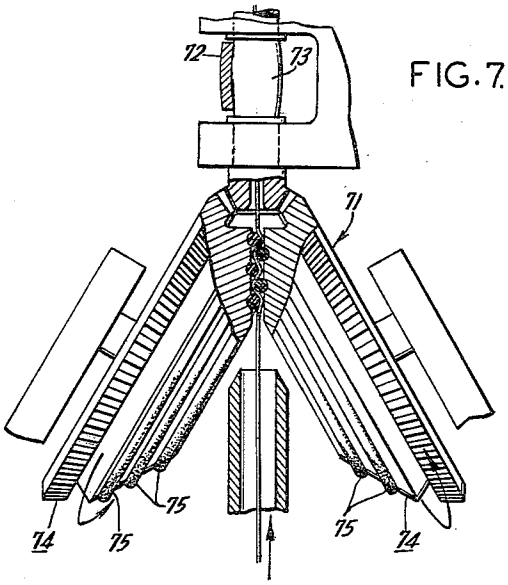


FIG. 8

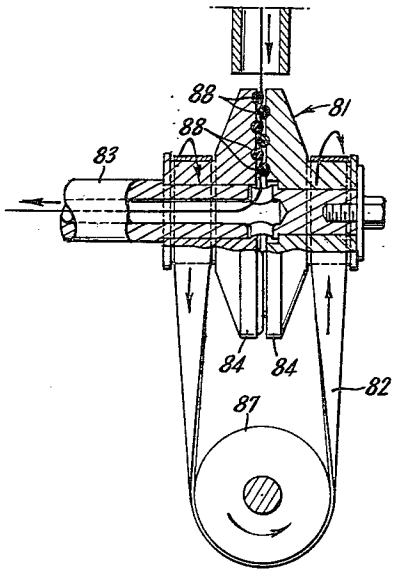
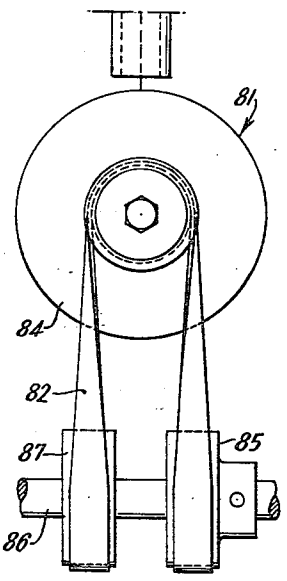


FIG. 9



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United States Patent Office 3,112,600 Patented Dec. 3, 1963

3,112,600
METHOD AND APPARATUS FOR PROCESSING YARNS

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Filed Nov. 2, 1961, Ser. No. 149,660
9 Claims. (Cl. 57—34)

The present invention relates to processing yarns having thermoplastic qualities, including monofilament and continuous and discontinuous multifilament yarns. The invention is directed particularly to yarns which are known as "textured yarns," and which are subject to a change in character upon the application of heat and tension. The invention has particular application to post-treating monofilament or multifilament "torque stretch yarns" which have been produced by twisting, setting the twist, and reverse twisting. The present application is a continuation-in-part of our application, Serial Number 653,953, filed April 19, 1957.

As disclosed in the aforesaid application, it has been found that by post-treating the yarn by the application of heat and correlated tension to torque stretch yarns, it is possible to change the active and latent characteristics of the yarn including the tendency or ability to change in shape, lustre, cross-sectional area, torque, resilience, residual shrinkage, texture, elasticity, stretch, recovery from stretch, and dimensional stability. The The characteristics of the reprocessed torque stretch yarns are controlled by subjecting the yarn to controlled degrees of tensile stress and heat. The process disclosed in the aforesaid application for effecting this control includes the passage of the torque stretch yarn after its initial production through additional heating and tensioning devices. The additional devices may be incorporated into the apparatus for intially producing the torque stretch yarn, or may be embodied in other apparatus for performing additional operations on the torque stretch yarn, such as plying, doubling, redrawing, etc.

In accordance with the present invention, it is possible to produce a post-treated torque stretch yarn simultaneously with the initial processing of the yarn without the requirement for added devices. The initial processing of the yarn involves the passing of the yarn through a heater under controlled tension to thereby condition the yarn to receive the torque stretch characteristics which are imparted thereto by a false-twisting device, the twist deformation applied by the false-twisting device being yarn set in the yarn while it is heated and tensioned prior to or simultaneously with its being reverse-twisted. Whereas the conventional processing involves cooling of the yarn before it is reverse-twisted by the false-twisting device, the present invention post-treats torque stretch yarn by utilizing the residual heat in the yarn and the tension normally present in the yarn and controlling the same simultaneously with or following the reverse-twisting of the yarn by the false-twisting device.

More specifically, the present invention enables the use of the residual heat in the yarn by controlling the degree of heat loss or cooling of the yarn in its travel from the heating device to the false-twisting device.

All of the objects of the invention are more fully set forth hereinafter with reference to the accompanying drawings which illustrate one section of exemplary forms of multisection apparatus for carrying out the present invention, and wherein

FIG. 1 is a fragmentary side view of a section of a modified uptwister embodying the present invention;

FIG. 1*a* is an enlarged fragmentary sectional view through the top of the false twister of FIG. 1 showing a

means for adjusting the drag imposed on the yarn by the false twister;

FIG. 2 is a fragmentary enlarged sectional view showing a modification of the false-twister of the apparatus shown in FIG. 1;

FIG. 3 is a view similar to FIG. 1 showing a modified down-twister made in accordance with the present invention;

FIG. 4 is a fragmentary view illustrating a modified form of heater in the apparatus of FIG. 3;

FIG. 5 is a fragmentary view showing a modified form of false-twister;

FIG. 6 is a view similar to FIG. 1 showing a further apparatus made in accordance with the present invention;

FIG. 7 is an enlarged fragmentary view illustrating the construction of the false-twisting device shown in FIG. 6;

FIG. 8 is a fragmentary sectional view of a further false-twister which may be embodied in the present invention; and

FIG. 9 is an end elevation of the apparatus shown in FIG. 8.

Referring now to the drawings, the apparatus illustrated in FIG. 1 is a modified uptwister. A package P of raw yarn is mounted on a creel 10 to be drawn off over a thread guide rod 11 and through a suitable pre-tension device 12. From the pre-tension device 12, the yarn passes through a guide eye 13 which is oscillated transversely to the yarn by a rod 14. From the eye 13, the yarn passes through tension-controlling feed rolls 15 which are driven so as to control the tension in the yarn as it advances from the package P into a thermally isolated restricted heating zone within a heater 16. The oscillation of the guide eye 13 by the rod 14 prevents wearing of a groove in the rolls 15. As shown in FIG. 1, the heater 16 is adjustably mounted for vertical displacement on the frame 17 of the apparatus and is suitably heated, for example by control apparatus such as shown in our U.S. Letters Patent No. 2,830,105, compensatively with the rate of travel of the yarn therethrough and the rate of heat transfer to the yarn to maintain the yarn at a predetermined treatment temperature regardless of the ambient temperature. From the heater, the yarn travels to a false twist spindle 21 which is journalled on a swing arm of the frame as indicated at 22 and driven rotationally, for example by a belt 23. The spindle 21 includes a twist-trapping head 24 having a suitable twist-trapping device, in the present instance revolving twist-trapping roller 25 about which the yarn is wrapped. After passing around the roller 25, the yarn travels through the spindle 21 to the tension-controlling feed rolls 26, and from the feed rolls 26, over a guide rod 27 to a traverse take-up 28. The tension-controlling rolls 15 and 26 are individually controlled in correlation to exert a predetermined amount of tension on the yarn between the rolls.

The tension on the yarn during its travel through the heater 16 and false-twist spindle 21 is thereby accurately controlled and may be correlated with the effective treatment temperature imparted by the heater to yarn set the twist in the yarn which is inserted by the false twist spindle 21. The tension in the yarn in the heated zone is also affected by the drag on the yarn imparted by the twist-trapping roller 25. Thus, with a freely revolving roller, the tension in the yarn in advance of the roller is only slightly less than the tension in the yarn beyond the roller. If the roller 25 is braked or otherwise retarded in its rotation about its transverse axis, the tension differential before and after the roller is increased so that a substantially greater tension may be imparted to the yarn in that portion of its travel through the false-twist spindle than is imparted to the yarn during its travel

through the heated zone in the heater 16. For example, as shown in FIG. 1*a*, the roller 25 may be mounted for rotation on a pin 29 secured in the head 24, the roller including a brake 29*a* consisting in the present instance of a ball 29*b* biased by a spring 29*c* and set screw 29*d* against the pin 29. By the same token, if means is provided to positively drive the roller 25, the tension on the yarn between the roller 25 and the tensioning rolls 26 may be reduced below the tension on the yarn in the heated zone within the heater 16, depending on the peripheral speed relationship between the roller 25 and the rolls 26 and 15 respectively.

Thus, by regulating the drag imparted to the yarn by the twist-trapping roller 25 and by regulating the speed of the rolls 15 and 26 in correlation, the tension on the yarn in advance of the twist-trapping roller and following the twist-trapping roller may be selectively controlled. As stated above, the effective treatment temperature of the yarn in the heated zone is likewise controlled by regulation of the heater 16, preferably by automatic control apparatus. Thus, the yarn advancing through the heater may be accurately processed to provide a torque stretch yarn.

In order to post-treat the yarn following its initial processing, the tension and temperature are controlled to provide the desired characteristics set forth above. The tension is controlled by the correlation between the twist-trapping roller 25 and the rolls 26 and 15 and the temperature or heating effect on the yarn is regulated in correlation with the tension. The regulation of the temperature of the yarn during the reverse-twisting operation effected by the false-twisting spindle 21, is dependent upon the heat transfer characteristics of the yarn relative to the twist-trapping roller. In accordance with the invention, the roller is of non-heat conductive material so as to minimize the heat loss by conduction from the yarn to the roller. In addition to this conductive heat loss, there is radiant heat loss from the yarn to the surrounding atmosphere between the restricted isolated heating zone of the heater 16 and the false-twist spindle 21, as well as heat loss to the surrounding atmosphere within the false-twist spindle. The adjutable mounting 18 of the heater 16 affords vertical displacement of the heater relative to the false-twist spindle 21. By adjusting the distance between the heater 16 and the twist-trapper 25 in correlation to the linear speed of travel of the yarn, the effective post-treating temperature may be controlled. If it is found that the residual temperature in the yarn following the twist-trapping roller 25 is greater than desired when the heater 16 is at its upper limit position, the twist-trapping head of the spindle may be removed from the upper end of the spindle 21 and mounted at the lower end, as indicated in broken lines at 24'. This change in the position of the twist-trapping device 25 will thereby increase the distance of travel of the yarn between the heating device and the twist-trapper by the length of the spindle and thereby afford an even greater heat loss from the yarn prior to its untwisting operation subsequent to the twist-trapping head. In addition, the heat loss may be reduced or increased by increasing or reducing the linear speed of the yarn. The residual heat for post-treating may therefore be controlled over a wide range by the alternative positioning of the twist-trapper 25 in conjunction with the selective positioning of the heater 16 and selection of the proper linear speed of travel of the yarn.

Thus, the apparatus shown in FIG. 1 enables control of the tension and heat applied to the yarn during and subsequent to its untwisting operation so as to enable effective post-treating of the yarn concurrently with its initial production, utilizing the same elements for applying heat and tension which were used for the initial processing of the yarn to produce the torque stretch yarn. As is apparent from FIG. 1, the application of heat to the yarn enables the post-treating of the yarn at any effective temperature up to a temperature slightly less than the effective treatment temperature of the original processing.

By utilizing a modified twist-trapper, such as shown in FIG. 2, it is possible to post-treat the yarn at an even higher effective post-treatment temperature. To this end, the false-twist spindle 21 is replaced by a modified spindle 21*a* having a twist-trapping head 24*a* in the form of a hair pin wire which projects into the yarn passage within the heater 16*a*. In the operation of this modification, the yarn is passed downwardly through the heater and wrapped around the bight 25*a* of the wire one or more times and thereafter passes downwardly through the spindle. By forming the wire of non-heat conductive material and by positioning the same within the heater tube, heat loss from the yarn is minimized so as to enable an effective post-treating temperature substantially equal to the initial processing temperature. In other respects, the apparatus of FIG. 2 is substantially similar to the apparatus of FIG. 1 including the ability to transpose the twist-trapping head 24*a* from the upper end of the spindle to the lower end of the spindle as indicated at 24*a*'.

It has been found that by the use of the apparatus of FIGS. 1 and 2, it is possible to quite closely duplicate the end results obtained with all of the embodiments of the invention described in our copending application, Serial No. 653,953, by controlling the rate of travel, the degree of twist, the tension, and the heat applied to the yarn in the different portions of its travel through the apparatus.

Another embodiment of the apparatus for carrying out the invention is shown in FIG. 3. In this figure, a modified downtwister is shown which includes a creel 30 for mounting a supply package Q of raw yarn to be processed. The yarn from the package Q is led over a guide rod 31 and through a pretension device 32 to a drop eye 33 which operates in a conventional manner to interrupt the advance of the yarn in the associated section of a machine in the event of breakage or runout of the yarn from the package Q. The yarn is drawn from the package Q by tension-controlling feed rolls 35 which advance the yarn through a heater 36, which is similar to the heater 16 both as to its mounting and as to its heater controls. The yarn tube 37 of the heater 36 is extended downwardly beyond the heater into close proximity to a friction false-twisting device 41 which is mounted for rotation on the frame and is provided with a yarn engaging annulus 45 which operates to false-twist the yarn passing in engagement therewith. From the false-twister 41, the yarn passes through tension-controlling feed rolls 46 which cooperate with the feed rolls 35 to impart a predetermined tension to the yarn therebetween. From the feed rolls 46, the yarn passes through a centering eye 47 to a ring-twister takeup 48 which operates in the conventional manner to impart twist to the yarn in accordance with the rate of travel of the yarn thereto from the feed rolls 46 and the rotary speed of the spindle. The twist-trapping annulus 45 frictionally engages the yarn, and is preferably formed of a non-heat conductive material such as rubber in order to minimize the heat conduction from the yarn to the twist-trapper. The tension in front of and behind the twist-trapping annulus 45 is determined by the relative peripheral speeds of the feed rolls 35 and 46 and the frictional drag imposed on the yarn by passage in engagement with the twist-trapping annulus. The tension in the yarn may be regulated by controlling the frictional characteristics of the annulus as well as the peripheral speeds of the feed rolls 35 and 46, and the residual heat in the yarn in that portion of its travel after it engages the twist-trapping annulus 45 is controlled by varying the spacing between the lower end of the heater tube 37 and the twist-trapper 45. In the operation of this apparatus, the raw yarn from the package Q is given torque stretch characteristics in advance of the false-twister 41, is post-treated subsequent to its passage from the heater 36 and

is thereafter twisted by the twister takeup 48 whereby a post-treated and twisted torque stretch yarn is obtained. If desired, yarns from adjacent sections of the machine may be threaded through the centering eye 47 and onto the twister takeup so as to form a plied yarn having a number of plies corresponding to the number of yarns threaded onto the takeup package.

The heater 36 is a radiant type heater, but the invention may be practiced equally well with a contact heater. Such a heater is shown in FIG. 4 wherein the yarns from the first feed rolls 35*a* which correspond to the feed rolls 35 is passed over a heated contact plate 36*a* which provides a thermally isolated heated zone and which is regulated similarly to the radiant heater 36 so as to compensate for changes in ambient temperature and speed of yarn travel thereover to maintain the yarn uniformly at the desired treatment temperature. From the heater 36*a*, the yarn is passed through a false-twister 41*a* which is identical to the false-twister 41 described in connection with FIG. 3.

A further form of false-twister is shown in FIG. 5 which may be used in place of the false-twister 41 or the false-twister 21. The false-twister illustrated in FIG. 5 comprises a straight-through friction twister which may receive yarn from a heater 51 and twist and untwist the same prior to its passage through the lower feed rolls 52. The false-twister 50 comprises a pair of confronting counter-rotating friction discs 53 and 54 having conical faces provided with grooves therein. Within each groove is a yarn-engaging annulus 55 which upon rotation of the discs 53 and 54, trap the twist in the yarn and cause it to twist back through the heater 51 and to untwist after passage beyond the last annulus 55. The frictional drag on the yarn imparted by the twister 50 is adjustable by adjusting the spacing between the discs 53 and 54, and in the present instance, each disc is separately driven by a belt 57 and drive pulley 58, as indicated by the arrows in FIG. 5. The operation of the false-twister 50 is more positive than the operation of the false-twister 41, but less positive than the operation of the false-twister 21.

The invention may also be carried out on a machine having a constant-speed takeup, which has been modified such as shown in FIG. 6. In this apparatus, the yarn supply package R is mounted on a bottom creel 60 and the yarn therefrom is passed upwardly through a pretensioner 61 to the first set of feed rolls 65 and a radiant heater 66 which is mounted for adjustment on the frame similarly to the heater 16 and which in like manner is energized to maintain a predetermined effective treatment temperature. The tube 67 of the heater 66 is extended upwardly into close proximity with a false-twister 71, through which the yarn passes on its way to the feed rolls 76 and takeup 78.

As shown in FIGS. 6 and 7, the false-twister 71 comprises a pair of frictional discs 74 having a series of concentric grooves, each having a non-heat conductive yarn-engaging annulus 75 therein. The friction discs 74 are geared to a geared spindle 73 which is driven by a traveling drive belt 72. In this way, the discs 74 are driven counter-directionally to false-twist the yarn in a manner similar to the friction discs 53 and 54. The heater and feed rolls are regulated to correlate the treatment temperature and the tension in the thermally isolated heated zone to produce the desired stretch characteristics in the yarn during the first stage of the production. The residual heat in the yarn as it passes through the false-twister 71 is also regulated by controlling the heat loss from the initially processed yarn. The residual heat is correlated to the tension in the yarn following the false-twister and to the heat and tension applied in the first stage to thereby produce post-treated yarn as desired.

FIGS. 8 and 9 show a modified form of false-twister 81 which may be used in any of the aforedescribed apparatus in place of the false-twister shown. The false-twister 81 comprises a pair of friction discs 84 mounted in confronting relation on a hollow spindle 83. In the present instance, the spindle 83 is stationary, and each of the friction discs 84 is mounted for coaxial rotation on the spindle. Each disc is formed with a drive surface upon which a traveling belt 82 is engaged. The belt 82 is driven from a fixed pulley 85 on a drive shaft 86 and is trained over a loose pulley 87 on the same shaft, as clearly shown in FIG. 9. Thus, the discs 84 are driven counter-directionally.

The friction discs 84 have grooves in their confronting face, and in each groove, a non-heat conductive yarn-engaging annulus 88 is mounted to insert into the yarn the desired twist. The twister 81 operates similarly to the twisters 50 and 71 to false twist the yarn, while imparting a predetermined drag thereto which enables the application of separate tensions in the initial production stage of the process and in the post-treating stage of the process.

In the operation of the apparatus, with thermoplastic mono-filament or multifilament yarn, the effective treatment temperature in the thermally isolated zone is preferably within 20 degrees F. of the melting point or softening point of the yarn, but not less than 40 percent below the melting or softening point. The tension on the yarn is correlated to the heat applied, and the twist applied to the yarn by the false-twister is present in the yarn within the zone to thereby impart to the yarn torque stretch characteristics. The heat loss from the yarn after it leaves the thermally isolated heated zone is controlled to prevent excessive cooling of the yarn while it is reverse-twisted at the desired speed of travel of the yarn. The amount of cooling in correlation with the tension determines the degree of stretch and/or bulk in the post-treated yarn wound on the takeup packages in accordance with the desired purpose end use for which the yarn is produced.

For example, to produce a yarn suitable for use in carpets, and other heavy fabrics, a package containing a single end of 1040 denier trilobal nylon is mounted on the creel of the apparatus of FIG. 1. The rotary speed of the spindle 21 is set at 30,000 r.p.m. and the takeup by the feed rollers 26 is regulated to insert 24 turns per inch. The effective treatment temperature within the heated zone of the heater 16 is maintained constant at 450 degrees F. and the tension on the yarn in the heated zone is adjusted to a constant 70 grams by correlating the speed of the feed rolls 15 to the speed of the rolls 26. The clearance between the heater 16 and the twist-trapper 25 is reduced to a minimum and the twist-trapper roller 25 is permitted to rotate freely to impart minimum drag to the yarn whereby the tension within the false-twister spindle 21 is only slightly more than the tension within the heated zone. The yarn is collected by the takeup mechanism 28 and may be plied with similar or dissimilar textile strands to produce a yarn suitable for the desired end use in the finished fabrics.

In order to produce a suitable upholstery yarn, the supply package of FIG. 1 may consist of 780 denier 51 filament trilobal nylon. In lieu of the spindle 21, the spindle 21*a* is inserted in the heat as shown at 16*a* in FIG. 2. The spindle speed is set at 30,000 r.p.m. and the linear speed of the yarn is adjusted to insert 26 turns per inch in the yarn within the heated zone. The effective treatment temperature within the heated zone is maintained constant at 445 degrees F. and the tension is likewise maintained constant at 60 grams. The heater is adjusted to position the twist-trapper 25 within the heated zone so that the yarn is reverse-twisted by the spindle at substantially the 445 degree treatment temperature. The yarn is then collected and thereafter plied with a similar yarn on a down-twister set for two turns per inch of ply twist.

To produce drapery or light upholstery yarn, the apparatus of FIG. 1, as shown or as modified by the spindle of FIG. 2 is set up with 840 denier, 136 filament nylon type 6. The spindle speed is set at 30,000 r.p.m. and the take-up is adjusted to provide a twist of 22 turns per inch. The heated zone is regulated to maintain a constant tem-

perature of 360 degrees F. and the feed rollers 15 and 26 are adjusted to maintain the tension within the heated zone at 70 grams. The twist trapper of the spindle is positioned closely adjacent the heater in order to prevent substantial cooling of the yarn to room temperature before the twist is removed and the yarns produced on the apparatus is susceptible of use as singles without further processing, or may be plied to produce a heavier yarn.

A yarn suitable for either knitting or weaving may be a 70 denier, 34 filament nylon yarn which is processed on the apparatus of FIG. 3. To this end, the raw yarn is mounted on the creel 30 in the package Q, and the effective treatment temperature in the heated zone is maintained constant at substantially 440 degrees F. The speed of the friction-twisting discs are set to produce an effective twist of 95 turns per inch at the desired rate of travel of the yarn and the tension in the heated zone is adjusted to a constant 8 grams by regulating the speed of the feed rollers 46 and 35. The linear speed of the yarn traveling through the heating and twisting zones is regulated to greater than 40 yards per mintue to prevent cooling of the yarn to ambient temperature before the yarn is untwisted beyond the friction twister. Multiple yarns may be combined prior to passage through the feed rollers 46 to provide a plied yarn on the ring take-up 48.

The preceding examples serve to illustrate but few of the many applications within the scope of the present invention. The examples given in connection with FIG. 1 may also be carried out on the apparatus of FIG. 6. While in all of the apparatus illustrated in the drawings, we use two sets of feed rollers to tension the yarn, other tensioning devices may be substituted to feed and tension the yarn in its travel through the apparatus. Other changes and modifications may be made in and to the illustrated embodiments of the invention within the scope of the following claims.

We claim:

1. A method of processing yarn to produce a post-treated torque stretch yarn comprising the steps of continually advancing said yarn at a predetermined speed of travel through a false-twister to thereby twist the yarn in advance of said false-twister and reverse-twist the yarn subsequent to said false-twister, controlling the tension of said yarn during said twisting and reverse-twisting, heating said yarn while it is twisted to a predetermined treatment temperature correlated with the tension in said yarn and said predetermined speed of travel, and controlling the heat loss from said yarn subsequent to said heating to permit cooling of the yarn to a temperature below said predetermined temperature, but to prevent cooling of said yarn to ambient temperature as it is reverse-twisted, whereby said yarn contains sufficient residual heat to be correlated with the tension therein to effect a post-treatment of said yarn continuously with its initial production.

2. A method according to claim 1 wherein said yarn is heated by passage through a thermally isolated heated zone, and the heat loss of said yarn is controlled by regulating the distance between the false-twister and the restricted thermally isolated heated zone in correlation with the said predetermined speed of travel of said yarn therebetween.

3. A method according to claim 1 wherein the yarn is heated by passage through a thermally isolated heated zone, and the heat loss from said yarn is controlled by positioning said false-twister within said thermally isolated heated zone adjacent the exit end thereof to effect said reverse-twisting within said zone.

4. A method according to claim 1 wherein the control of the tension during said twisting and reverse-twisting is effected by regulating the speeds of travel of the yarn into said false-twister and away from said false-twister in correlation with the drag imposed on said yarn by said false-twister.

5. Apparatus for processing yarn having thermoplastic qualities comprising means for mounting a supply package of yarn, means to advance the yarn from said package and to apply predetermined tension thereto in one portion of its travel, a false-twister including twist-trapping means engaging the yarn within said portion of its travel to twist the yarn in advance of said twist-trapping means and to reverse-twist said yarn subsequent to said twist-trapping means, means providing a restricted thermally-isolated heated zone in advance of said twist-trapping means within said portion of the yarn travel to heat the yarn to a constant predetermined treatment temperature, selectively adjustable means affording relative displacement of the twist-trapping means and said restricted thermally isolated heated zone to dispose said twist-trapping means at a selected point between a point adjacent the trailing end of said restricted thermally isolated heating zone and a point spaced therefrom, and to thereby control the heat loss in said yarn to maintain the yarn in heated condition below the predetermined treatment temperature during the reverse-twisting thereof, and take-up means to receive the yarn from said one portion of its travel and wind the same on a package.

6. Apparatus according to claim 5 wherein said heater means comprises a radiant heater having a tube through which the yarn passes, and wherein said false-twister includes a hollow spindle having a twist-trapping means at one end in registry with said tube and projecting into said tube to trap the twist within said zone adjacent the trailing end thereof.

7. Apparatus according to claim 5 wherein said predetermined tension applying means includes means to adjust the drag imposed on the yarn by said twist-trapping means whereby the yarn tension in advance of said twist-trapping means may be adjusted relative to the yarn tension subsequent to said twist-trapping means.

8. Apparatus according to claim 7 wherein said false-twister comprises a rotary hollow spindle having a rotatable twist-trapping roller therein, the freedom of rotation thereof determining the drag imposed on the yarn by said roller.

9. Apparatus according to claim 7 wherein said false-twister comprises a pair of counter-rotating friction discs disposed in confronting relation, said discs mounting a plurality of generally concentric twist-trapping annuluses frictionally engaging the yarn, the annuluses of the respective discs meshing with one another to deflect the yarn into a tortuous path, the drag imposed on said yarn by said twist-trapping annuluses being determined by the degree of mesh thereof.

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