Oct. 29, 1963 R. J. CLARKSON 3,108,355

PROCESS AND APPARATUS FOR TREATING STRANDS

Filed April 21, 1960 4 Sheets-Sheet 1

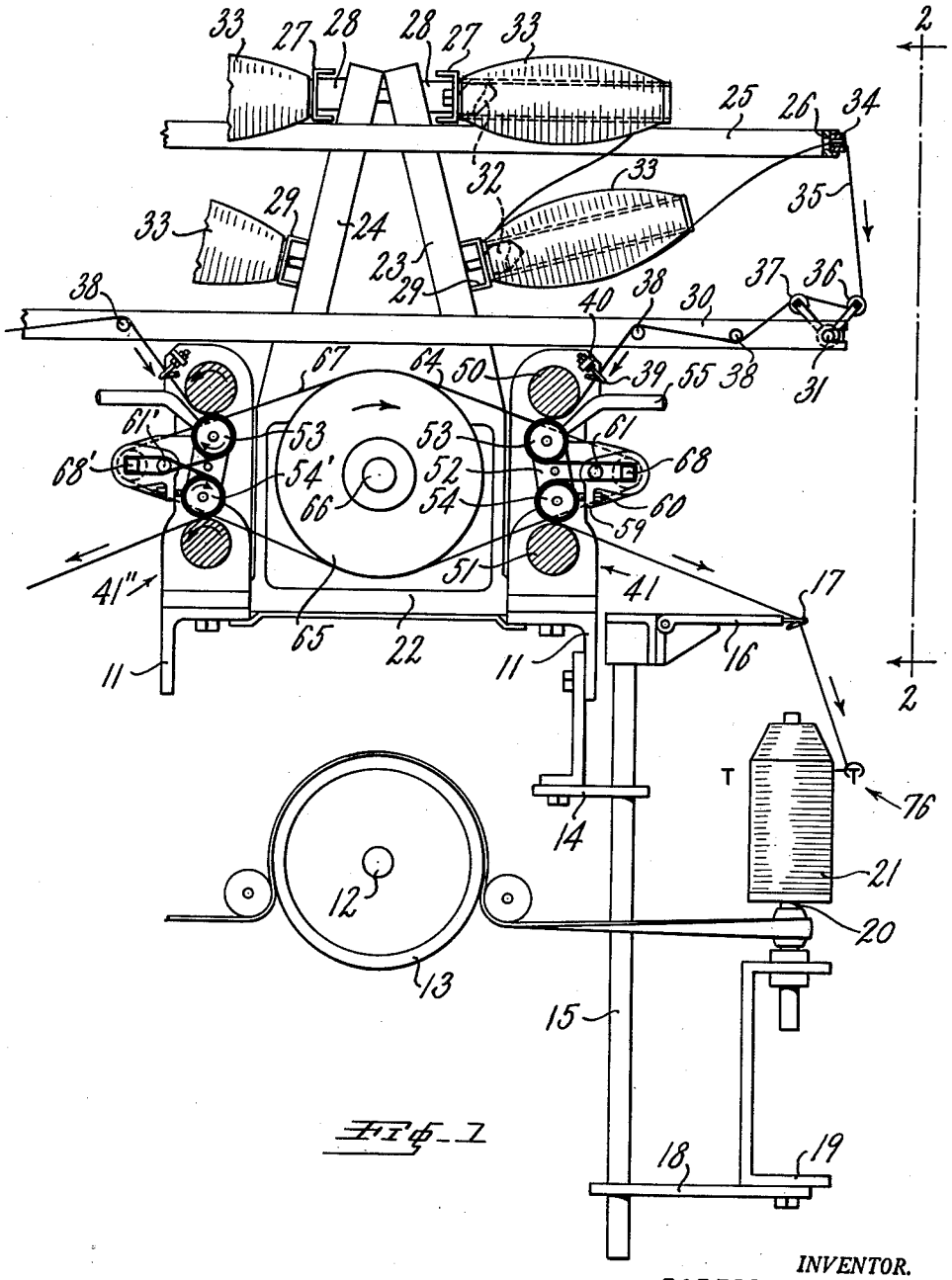


Fig. 1

INVENTOR.
ROBERT J. CLARKSON

By David B. Miller

ATTORNEY

Oct. 29, 1963 R. J. CLARKSON 3,108,355

PROCESS AND APPARATUS FOR TREATING STRANDS

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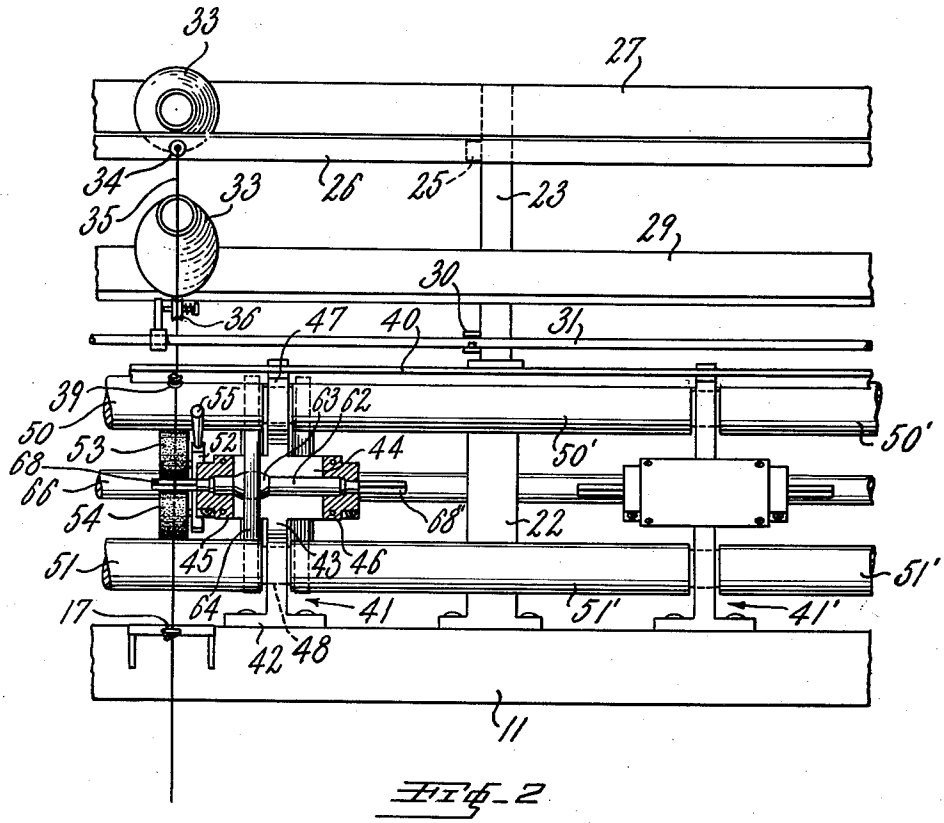


Fig. 2

INVENTOR.
ROBERT J. CLARKSON
BY David B. Miller
ATTORNEY

Oct. 29, 1963 R. J. CLARKSON 3,108,355

PROCESS AND APPARATUS FOR TREATING STRANDS

Filed April 21, 1960 4 Sheets-Sheet 3

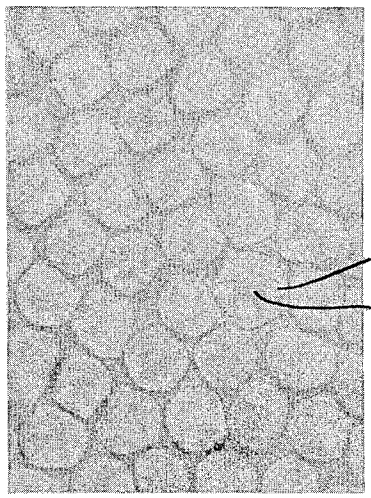


Fig. 5

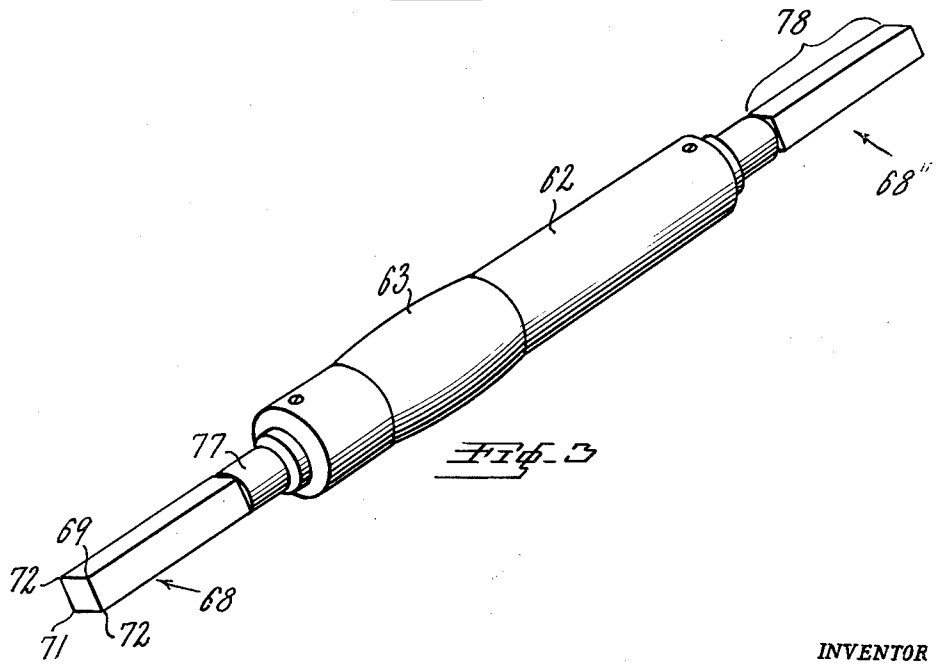


Fig. 3

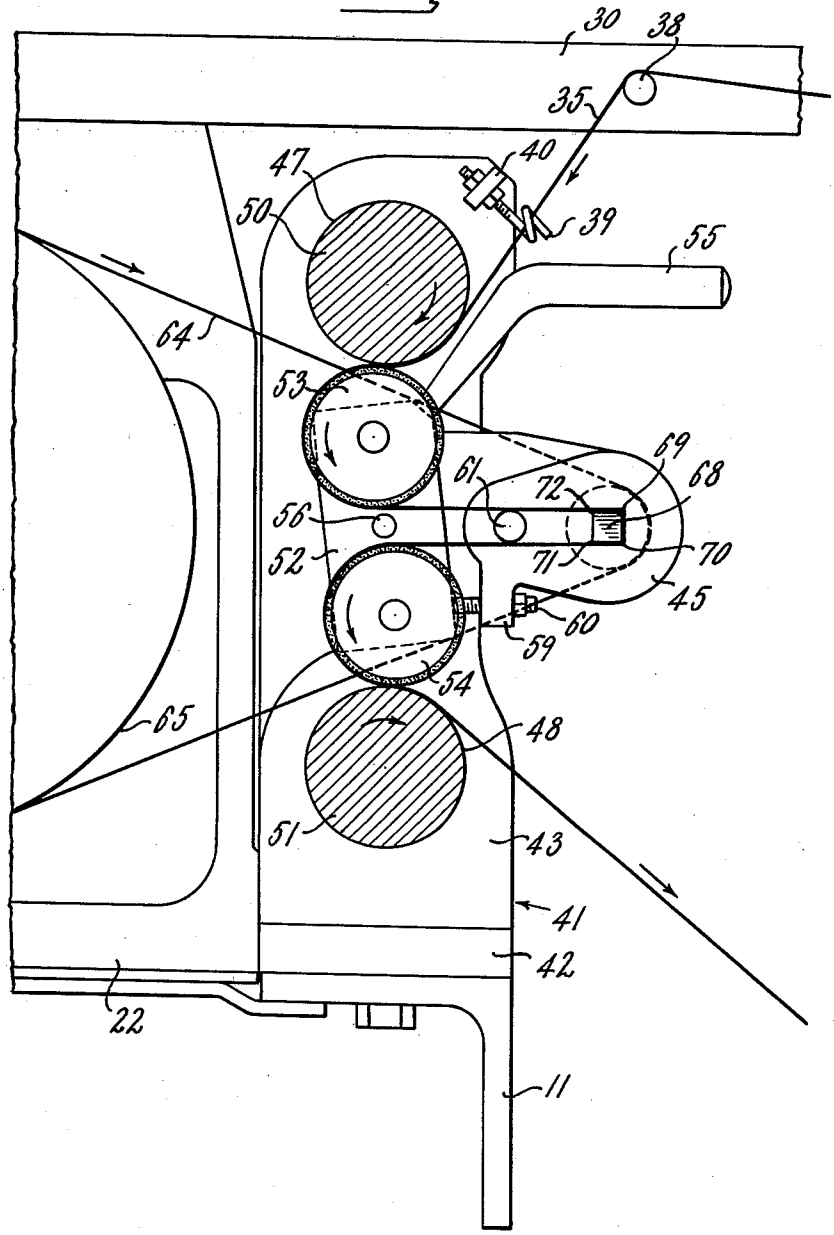
INVENTOR
ROBERT J. CLARKSON
BY David B. Keller
ATTORNEY

Oct. 29, 1963 R. J. CLARKSON 3,108,355

PROCESS AND APPARATUS FOR TREATING STRANDS

Filed April 21, 1960 4 Sheets-Sheet 4

Fig. 4



INVENTOR.
ROBERT J. CLARKSON
BY
ATTORNEY

United States Patent Office 3,108,355 Patented Oct. 29, 1963

3,108,355 PROCESS AND APPARATUS FOR TREATING STRANDS

Robert J. Clarkson, Winnsboro, S.C., assignor to United States Rubber Company, New York, N.Y., a corporation of New Jersey

Filed Apr. 21, 1960, Ser. No. 23,689
23 Claims. (Cl. 28—71.3)

This invention relates to a novel method and apparatus for texturizing continuous textile filaments, and to the texturized filaments.

Today there is great commercial interest in texturing continuous textile filaments, particularly synthetic fiber filaments such as nylon, polyester (e.g., that sold under the trademark Dacron), and the like.

Various methods have been proposed or use to texturize continuous textile filaments, and these methods are well known in the art. For example, multi-filament continuous filament nylon yarns have been twisted, heat relaxed and untwisted; as another example, such yarns have been crimped in a stuffer box, heat relaxed and released from the stuffer box. It has also been proposed to texturize continuous nylon filaments by drawing multi-filament yarns over a right or acutely angular edge as in British Patent 558,297. As a modification of the last mentioned process it has been proposed to draw the filaments over a heated and sharpened razor blade edge disposed at the apex of an acutely angular yarn path as in U.S. Patent 2,919,534.

The method of this invention differs from the foregoing methods, and it is characterized by its extreme simplicity, the ease with which it may be applied to existing yarn manufacturing processes, and its effectiveness to texturize filaments. In accordance with this invention the filament, generally as part of a multi-filament strand such as a yarn, is fed longitudinally of itself, and it is tensioned. A member having a salient corner is maintained with that corner in rapid movement relative to, and in the path of the length of, i.e., longitudinally of, the filament. The filament is wiped through a little distance only along its length by the corner. Throughout a substantial portion of the time during which the filament is being wiped by the corner the filament is pressed strongly toward the corner. The filament is wiped, at each point which is to be texturized, in this way a multiplicity, i.e., generally 5, and preferably 20, or more times.

In the preferred embodiment of apparatus in accordance with this invention a multifilament continuous filament yarn is advanced between two pairs of rolls which positively advance the yarn. The downstream pair advances the yarn faster than the other pair, so the yarn is tensioned and stretched a substantial amount between these two pairs of rolls. Intermediate these two pairs of rolls there is disposed a bar having several salient corners. This bar, in that preferred embodiment, is 2" long and square in cross-section with the square being 7/16" on a side. The bar is arranged so the yarn is wrapped about the bar, e.g., in the form of a U-loop in contact with three sides of the square, or an L-loop in contact with two sides of the square, so tension in the yarn presses it and its filaments against one or more of the four corners of the bar and toward the axis of rotation of the bar. Preferably the yarn advances in the direction of its length at a relatively slow rate of

speed, e.g., 400–2000 inches per minute, between the two pairs of advancing rolls, and the bar rotates about an axis normal to, and through the center of, its cross section square at a relatively high rate of speed, e.g., one of which the corners rotate on a circular path at the rate of at least 4000, and up to 15,000 or more inches per minute, so the corners of the bar wipe short lengths only of the yarn for short periods of time during which the filaments are pressed against the corners by the tension in the yarn, and at each point that is to be texturized along the length of the yarn filaments are so wiped a multiplicity of times.

The filament so treated is inherently capable of developing texture. For example, if maintained at room temperature for a few minutes under no substantial tension, the filament will contract and some texture will develop spontaneously, and it may continue to develop for hours or days. Or the filament will contract and the texture will develop immediately when the yarn is steamed at atmospheric pressure.

As seen in cross-section, and under magnification, the filaments in the yarns treated according to this invention appear to have flattened sides in the sense that the filament shown in FIG. 4 of the aforesaid British patent has a flattened side. However the multi-filament yarns of this invention differ from those treated according to the aforesaid British patent (or treated according to the aforesaid United States patent) in that in yarns according to this invention 75% or more of the filaments will have such flattened sides, whereas the multi-filament yarns treated according to the aforesaid patents will have not more than about 30% of the filaments with flattened sides. The multi-filament yarns of this invention differ also from those treated according to the aforesaid patents in that those filaments which have flattened sides in the yarns treated according to the aforesaid patents will have only one flattened side, whereas in the multi-filament yarns of this invention at any given point in the yarn several filaments will have more than one side flattened at that point, and frequently some filaments will have three, four, or more flattened sides and be substantially polygonal in cross-section.

These an dother characteristics of this invention will be further illustrated and described hereinafter in this specification and in the claims appended hereto. For a better understanding of the nature of this invention, reference should be had to the following detailed description of specific embodiments thereof when read in conjunction with the accompanying drawings forming a part hereof, wherein:

FIG. 1 is a partly schematic side view, which is partly in section, of apparatus suitable for texturing yarn according to this invention;

FIG. 2 is a partial view of the apparatus of FIG. 1 taken along the line 2—2 thereof, slightly enlarged and with a cover removed from part of the apparatus for clarity of illustration of the texturing spindle;

FIG. 3 is an enlarged perspective view of a wiper bar and spindle assembly employed in the apparatus;

FIG. 4 is an enlarged view of a detail of FIG. 1 showing the wiper bar, the feed roll assembly and their supports, and

FIG. 5 is a photographic view of a greatly enlarged cross-section through a segment of yarn textured according to this invention.

In the preferred embodiment of this invention yarn is textured by wrapping it under tension partially about a

rotating bar having a plurality of salient corners, as for example, about a bar of square cross-section in the form of a U-loop in contact with three sides of the square, or an L-loop in contact with two sides of the square, so the tension presses the yarn against one or more of the corners of the bar and toward the axis of rotation of the bar.

Many devices are available in the textile industry which may be used to tension and stretch a yarn, and which therefore may be used in practicing this invention. For example Universal Winding Company's model 10–B twister, with No. 511 attachment known in the trade as a Saaba machine, has two sets of spaced driven yarn advancing rolls in the arrangement shown in that company's United States Patent 2,864,229. This device as shown in that patent consists of the first pair of spaced yarn advancing rolls **31**, **32** and the second pair of spaced yarn advancing rolls **61**, **62**. The speeds of the two pairs of rolls can be adjusted so that the second pair advances the yarn at a greater speed than the first pair.

When the rolls of this device are used, the heater, shown between them in FIG. 1 of the patent, will be removed, and the wiper bar will be inserted in its position. The axis of rotation of the wiper bar will be substantially parallel to the axis of rotation of the larger advancing roll in each set, and the wiper bar's axis will be disposed substantially on the path the yarn would follow in a straight line between the two sets of advancing rolls. In order that the yarn may be wrapped in one or more U-loops or L-loops partially about a wiper bar so situated, a stationary cylindrical chrome plated steel rod having a diameter about the same as the maximum cross sectional dimension of the wiper bar will be positioned with the axis of its cylindrical surface in that plane normal to the straight line yarn path between the two sets of rolls which is the same as the plane in which the longitudinal axis of the wiper bar is positioned. The rod's axis will be parallel to, and spaced a little distance, for example three inches, from the longitudinal axis of the wiper bar. The yarn can be directed from the first set of advancing rolls to the wiper bar and partially thereabout in the form of an L-loop, so the yarn advances about the wiper bar in the same direction as the salient corners are rotated. The yarn may then be advanced to the spaced rod and partially around that rod to be directed to a suitable take-up. Or, if desired, the yarn may be directed about that rod in a U-loop to be directed back to the wiper bar for travel partially about the wiper bar again in an L-loop or in a U-loop. In this way the yarn can be passed back and forth between the wiper bar and the cylindrical rod as often as needed to produce the texturing action desired before proceeding to the second pair of yarn advancing rolls.

The drawings accompanying this specification show the apparatus of the invention used with a modified twister, but those skilled in this art will understand that other devices, for example, spinning frames and winders, may be modified to practice this invention, and that it would be a comparatively simple matter to modify for this practice any of a number of standard twisters, winders and spinning frames available in the textile industry.

The conventional twister whose parts are illustrated in the drawings is that manufactured by the Meadows Manufacturing Company of Atlanta, Georgia and marketed under the name "Meadows Anti-Friction Jumbo Twister." Many of the parts of this twister which are not necessary to an understanding of this invention do not appear in any figure of the drawing, and some of the parts which appear in FIG. 1 do not appear in other figures of the drawings. The twister **10** includes generally the angle iron **11** and the elements arranged beneath these angle irons. Angle irons **11**, main pulley line shaft **12** for the twister's main pulleys, one of which is shown at **13**, and other appurtenant structure of the twister are supported from end frames and intermediate Samsons (not shown). Guide brackets **14** for the traversing rod **15** hang from the angle irons **11**. Traversing rod **15** is transversed vertically in a conventional manner by means (not shown) and carries at its upper end thread boards **16** including the pigtail guide **17**. At its lower end it slides in the bracket **18** fixed to the bottom of the base rail **19**. Base rail **19** supports the spindle **20** which carries the bobbin **21** on which the yarn is wrapped in a conventional way by a ring and traveler array **76**.

The apparatus for texturing yarn according to this invention generally is mounted atop angle irons **11** and disposed above the heretofore described elements of the conventional twister. The apparatus at one texturing station will next be described. This apparatus includes spaced castings **22** bolted atop the angle irons **11**. The castings **22** have shallow sockets in their tops to receive the lower ends of the cylindrical tubes **23**, **24** which are arranged in pairs. One tube in each pair is secured in casting **22** at each side of the frame, and the two tubes in a pair upstand from casting **22** and projecting inwardly toward the center of the frame in the inverted V arrangement shown in FIG. 1.

Castings **22** support the texturizing unit creel on the tubes **23**, **24**. Cross bars **25** are bolted to the tubes **23**, **24** and extend transversely of the frame to a point at each side of the frame which is a little distance beyond the vertical center line of the twister spindles at that side. These bars **25** carry at their outer ends longitudinal bars **26** which extend along the length of the twister frame. Slightly above the cross bars **25** a channel iron **27** extends along the length of each side of the frame and is bolted to the tubes **23**, **24** at that side of the frame. Spacers **28** between the channel irons **27** and the tubes **23**, **24** position the bases of the channel irons **27** in vertical planes. A little distance beneath the cross bars **25** additional channel irons **29** extending along each side and throughout the length of, the frame, are carried by the tubes. Additional cross bars **30** are bolted to the tubes **23**, **24** a little distance beneath channel irons **29** and extend transversely of the frame for substantially the same distance at each side thereof as cross bars **25**. The cross bars **30** are parallel to cross bars **25**, and they have a U-groove at each end thereof which is adapted to receive tubes **31**, one of which extends along the length of the frame at each side thereof.

At each side of the frame the channel irons **27**, **29** each carries one yarn package holder for each texturing station. The yarn package holders **32** illustrated in the drawings are of the type disclosed in United States Letters Patent 2,761,632. Package holders **32** carry the packages **33** of yarn **35** to be textured, and the tail of the yarn on one package at each station may be tied to the head of the yarn of the other package at that station in a continuous creel. The longitudinal bars **26** carry an eyelet **34** for each texturing station, and this eyelet is disposed in substantially the same vertical plane as the axes of the yarn packages **33** and may be nearly aligned with these axes, so the yarn **35** to be textured is pulled off over end from the packages **33** as it is led through the eyelets **34**.

Various types of packages may be used to supply the apparatus, but pirns are illustrated in the drawings. Other types of let-offs, for example off-side let-offs, may also be used, and in that case the yarn package support will be modified as appropriate for the particular let-off selected.

After passing through the eyelet **34** the yarn **35** progresses downwardly to a disc tensioner **36** of well known construction which includes two spring pressed washers adapted to pinch the yarn and exert a retarding force on it as it passes between the washers. The yarn next advances through a second disc tensioner **37** identical to disc tensioner **36**. Two rods **38**, spaced from each other, project longitudinally from their supporting bars **30** through the vertical plane in which eyelet **34** is disposed. After leaving disc tensioner **37**, yarn **35** advances transversely of the frame toward the center thereof to the posi-

tion of the first rod 38 which it passes under; it then advances beyond this first rod 38 and nearer to the center of the frame to the second rod 38 which it passes over. After it leaves the second rod 38, the yarn 35 passes downwardly to the pigtail guide 39 carried in the traversing bar 40.

As appears in FIG. 2 a plurality of castings 41, 41', etc. are spaced from each other on the angle irons 11 along the length of the frame. There is a casting 41 for each pair of texturing stations, and the angle irons 11 at both sides of the frame will carry such castings. These castings carry yarn advancing rolls, the texturing spindle and related apparatus which will be described.

Each casting 41 has a slot in its upper edge adapted to receive the traversing bar 40 which is traversed back and forth along its length a little distance slowly by conventional driving means (not shown). The base 42 of the casting is bolted atop angle irons 11, and a central rib 43 upstands from this base. About half way to the top of this rib (see FIG. 2) a transverse face 44 extends on either side of the rib. Two somewhat triangular shaped ears 45, 46 project outwardly (to the right as seen in FIG. 1) from transverse face 44 with one of these ears disposed near each end of transverse face 44. These ears 45, 46 have holes therethrough which form housings for the bearings of the texturing spindle. The casting 41 has a hole 47 through the central rib above the transverse face 44 near the upper edge of the rib. The casting 41 has a second hole 48 through its central rib beneath the transverse face 44. The hole 47 forms a housing for the upper feed roll bearing and the hole 48 forms a housing for the lower feed roll bearing. The casting 41 also has a pair of ears projecting inwardly (to the left as seen in FIG. 1) from the transverse face 44 opposite each of the ribs containing the bearing housings 45, 46. Each of these inwardly projecting ears has a hole therethrough whose center line is on the line connecting the center lines of the holes forming bearing housings 47, 48 and these holes in the inwardly projecting ears are adapted to receive the pivot shaft for the presser roll bracket to be described.

Upper steel feed rolls 50, 50', etc., and lower steel feed rolls 51, 51', etc. are journaled in bearings in the bearing housings 47, 48 respectively, between adjacent castings 41, and the rolls 50, 50', etc. and 51, 51', etc., in each chain are drivingly interconnected and driven from means (not shown) at the end of the frame. A bracket 52 is pivoted for rotation on a shaft 46 mounted in the hole of the aforementioned inwardly projecting ear. A pair of rubber covered presser rolls 53, 54 are freely rotatable on axles carried by bracket 52, and they are symmetrically disposed about the center of rotation of bracket 52 on shaft 56 with both their centers of rotation on a common line passing through the center of shaft 56.

Bracket 52 is provided with a handle 55 by which it may be rotated (clockwise from the position shown in FIGS. 1 and 4) about shaft 56. The spacing of the rubber covered rolls 53, 54 from each other is such with respect to the spacing between the steel rolls 50, 51 that as bracket 52 is rotated clockwise from the position shown in FIGS. 1 and 4 the rubber covering of the rolls are compressed slightly as rolls 53, 54 approach toward and arrive at the line of minimum spacing distance (i.e., the line where a line connecting their centers is coincident with the line joining the centers of holes 47 and 48) between the rolls 50, 51. The compression on the rubber covers is released as the clockwise rotation proceed beyond this line of minimum spacing. The bearing housing 45 has a depending shoulder 59 with a threaded hole therethrough to receive set screws 60. Set screws 60 are positioned in the path of bracket 52, so set screws 60 act as a stop to the counterclockwise (as viewed in FIGS. 1 and 4) rotation of bracket 52 about shaft 56. By screwing set screw 60 toward or away from the center of the frame, the distance by which rolls 43, 44 are snapped past the line of minimum spacing between rolls 50, 51 before rotation of bracket 52 is stopped by the set screw can be controlled. Consequently the degree of compression on the rubber covers of rolls 57, 58 at this end point can be controlled to vary the nipping pressure on a yarn passing through the nips between rolls 53 and 50 and rolls 54 and 51 respectively. Bearing housing 45 also has a hole therethrough to receive the stationary cylindrical chrome plated steel rod 61 which is positioned on a common center line with the shaft 56 and the wiper bar to be described, and between them, and spaced a little distance from each.

Similar presser rolls and a steel rod are provided at each end of casting 41, so there would be a yarn texturing station at the right hand end of casting 41 (as seen in FIG. 2) in addition to the yarn texturing station at the left hand end. But for ease of illustration the presser rolls and appurtenant structure at that station have been omitted from FIG. 2 of the drawings, as has the presser rolls and appurtenant structure for both treating stations at casting 41'. Similarly there would be treating stations at castings 41'' at the other side of the frame similar to the treating station thus far described, so that a single frame would carry a great many treating stations as is customary in yarn handling frames in the textile industry.

The wiper bar and spindle assembly in the embodiment illustrated comprises an elongated spindle 62 substantially cylindrical in shape and having a hole at each end to receive the cylindrical bases of the two wiper bars 68, 68''. The shank of spindle 62 has a crowned portion 63 on which the nylon tape drive belt 64 runs. Belt 64 is driven from plastic pulley 65 carried by line shaft 66 supported in castings 22; shaft 66 in turn is driven by means (not shown) from the drive for the twister. A second belt 67 from pulley 65 drives the spindle at the opposite side of the frame.

The wiper bar 68 is made of hard metal, for example the machine tool cobalt-chromium alloy sold under the trademark Stellite, and it has a cylindrical base 77. In its operative zone 78 it is a parallelopiped whose cross section normal to its main longitudinal axis forms a square approximately 7/16'' on a side. The operative zone is approximately 2'' long and has four salient corners 69, 70, 71 and 72. Spindle 62 is journaled in bearings in the bearing housings 45, 46 so the salient corners 69 through 72 are rotated about the longitudinal axis of spindle 62 as the spindle is driven by belt 64.

As best appears in FIGS. 1 and 4 a single end of yarn 35 from one of the packages 33 is led through guide eye 26, tensioners 36 and 37, under first rod 38, over second rod 38, through guide 39 on traversing bar 40, through the nip of rolls 50, 53 (which rotate in the direction indicated by the arrows on FIG. 4) then to and partially about wiper bar 68 in a U-loop having its open end facing the center of the frame, then to the nip of rolls 54, 51 (rotating in the direction indicated by the arrows) then to the guide 17 of the twister to be wound on the bobbin of the twister spindle. The wiper bar 68 rotates clockwise as seen in FIG. 1. The wiper bar 68' on the other side of the frame will also be driven clockwise. Therefore the threading of the yarn through the apparatus is varied slightly between the nip rolls on that other side of the frame. From the rubber covered roll 53' the yarn passes downwardly and beneath cylindrical rod 61' thence beneath the wiper bar 68' and in the form of a U-loop open to the inside of the frame. Then it will pass back to rod 61' to pass thereover before advancing to the roll 54'. In this way the yarns on both sides of the frame follow the same U-shaped path, but the yarns on the right hand side as seen in FIG. 1 pass over the wiper bar 68 and then under it, whereas the yarns on the left hand side of the frame as seen in this figure pass under the wiper bar 68' and then over it. On both sides of the frame the wiper bar

is rotating in the same direction the yarn is advancing as the yarn passes the wiper bar. Therefore the rods 61, 61' may function to alter the approach of the yarn to the wiper bar.

In this embodiment the traversing guide 39 is designed to traverse the yarn back and forth one complete cycle along one and one-half inches of the operative zone 38 of wiper bar 68 in 10 to 15 minutes so as to minimize the wear on this bar. Returning to this bar 68, its length may be varied as desired. Should it be desired to treat more than one yarn on a single bar at the same time, its length could be increased if necessary. Further although a bar which is square in cross section in the plane in which the yarn lies as it passes about the bar has been shown and is preferred, a bar having more than four or less than four salient corners in this plane may be used. Generally a triangular bar is not as satisfactory as a square bar because the variations in the tension on the yarn as the bar rotates is substantially increased. Although a two-cornered bar can be made to texture yarn, it is now considered impractical for commercial operations. The number of corners may be increased above four, but the more corners that are used the more difficult it is to obtain a desirable degree of protrusion on the salient corners. Generally an eight-cornered bar is now considered unsatisfactory for commercial operations.

The now preferred dimension of a square bar is 7/16" on a side, for a bar of this dimension has been used with excellent results. But square bars as little as ¼" on a side, and as much as 1" on a side have been used successfully, and it is now believed larger or smaller bars may be used if the operating conditions are suitably varied. Furthermore the sides may be undercut between the salient corners so the yarn is not in contact with the bar at all points in its advance between two adjacent corners. In addition to hard metal bars, bars which have ceramic inserts that form the salient corners have been used successfully. (Aluminum oxide ceramic materials which may be used for the inserts are sold by the American Lava Corporation, subsidiary of Minnesota Mining and Manufacturing Company, under the trademark Alsimag 576, L–5A and Alsimag 614. These are described in that company's Alsimag chart No. 591.)

The lower steel roll 51 advances at a greater peripheral rate of speed than the upper steel roll 50, so the yarn is stretched between these rolls and is under tension as it passes about the wiper bar 68. The tension in the yarn 35 urges it toward the axis of rotation of wiper bar 68 and consequently toward the salient corners 69, 70, 71 and 72 which travel on circular paths during such rotation. In this way the tension in the yarn 35 urges the yarn in contact with each of the salient corners during a substantial portion of the corners' circular path of rotation.

If desired, instead of an arrangement of a single U-loop pass about the wiper bar 68, the rod 61 can be used as a direction reversing axis for the yarn 35, so the yarn could be passed back and forth about rod 61 and wiper bar 68 to make a plurality of U-loop passes about wiper bar 68 if the desired treatment for the yarn is greater than permitted by contact of the yarn with the wiper bar in a single U-loop pass.

It will be apparent that the number of times any given point along the length of the yarn is wiped by a salient corner depends partially upon a number of salient corners on the wiping bar, the speed of the yarn through the apparatus, the rotational speed of the wiping bar and the arrangement of the yarn about the wiping bar. Generally for commercial operations thus far, it is preferred that the yarn is wrapped about the bar 68 in a single U-loop. However it will be obvious to those skilled in the art that each of the aforementioned factors may be varied to produce the desired operating conditions appropriate for any given yarn or textile mill, and various end uses of the yarn may dictate varying the wiping arrangement.

In the now preferred method the bar 68 rotates the corners at a relatively high linear rate of speed while the yarn 35 advances through the apparatus at a relatively lower linear rate of speed. Consequently in this preferred operation each salient corner wipes filaments in the yarn for a little distance along the length of the filaments; in a U-loop path using a 7/16" square bar this distance is equal to $1\frac{5}{16}$" minus the distance in inches advanced by the yarn 35 during the time needed for ¾ of a revolution of the bar 68.

Referring next to FIG. 5 there is shown in cross sectional view a portion of a multifilament yarn that has been treated according to this invention. That yarn pictured there was steamed at atmospheric pressure for a few seconds after being doffed from the treating apparatus. This picture was prepared from a photograph, magnified 250 times with a 20 objective lens, of the cross section through a 4200 denier, 224 filament type HB nylon "6" Allied Chemical yarn photographed under polarized light. This cross sectional view through the yarn shows that at least 75% of the filaments in the photograph have at least one side flattened. It is a simple matter to flatten a side on over 75% of the filaments in a multifilament yarn by means of this invention, and it is characteristic of the now preferred yarn that at least 75% of the filaments in a multifilament yarn will have at least one side flattened at substantially every point, i.e., cross sectional plane, where the yarn is texturized. The filament indicated by the reference character 75 is seen to have several flattened sides, i.e., it is five sided at this point. These filaments in the yarn before the treatment were each substantially circular in cross section. It will also be noted that strains are induced in the filaments as the dark zones, for example the zone 85, indicated in the photograph under polarized light.

It is one of the prime characteristics of this invention that all operations may be carried out at room temperature, i.e., about 70° to 100° F., and using nothing more complicated than pairs of feed rolls and a rotating bar. Experiments indicate that the apparatus will texturize yarn at elevated temperatures; for example, it will texturize yarn if a heater is placed beneath the bar 68 to heat the yarn while on the bar. Similarly experiments indicate the device will texturize yarns at reduced temperatures, for example, it will texturize yarn while CO_2 is blown on the bar 68 and on the yarn in the zone adjacent this bar. Experiments also indicate it will texturize yarns wet with room temperature water. However, as indicated above, the device works excellently at room temperature, and it is contemplated that it would normally be operated under these conditions and would operate on yarns to which no water had been added for purposes of the texturing operation.

The yarn must be under tension while wrapped against the wiper bar and being wiped by the salient corners. Yarns have been processed satisfactorily when under a tension of approximately 1 gram per denier as well as under a higher tension of 3 grams per denier. Lower tensions may be used down to approximately .5 gram per denier. The maximum tension is dictated in part by the radius of curvature of the salient corners on the wiper bar; if the radius of curvature of these corners is small, the tension should be smaller. The tension should not be so great as to cause breakage of an excessive number of filaments in the yarn.

The salient corners of the bar should not be sharp, for otherwise they will cut the filaments and damage the yarn. But if the radius of curvature is too large, it is difficult to obtain satisfactory texturing. Generally it is believed the radius of curvature of the salient corners should be .001" or more and should be less than .005".

It is another characteristic of the preferred apparatus shown that should a filament break in the yarn being treated, the device is essentially self cleaning, for the bar 68 rotates in the same direction as the yarn 35 advances.

However the device will texture yarn if the bar is rotated in a direction reverse to the direction of advance of the yarn.

This invention has been found of special value in texturing carpet yarns of relatively large denier, e.g., 1500 denier and up to 4500 denier. For example, a single 4200 denier nylon yarn may be processed according to this invention and finally given any desired twist. In this condition it may be tufted directly into a pile carpet after which texture is developed when the carpet is heated incident to dyeing. Another carpet yarn is produced by plying one end of 2100 denier type "6, 6" nylon treated hereunder with one end of 2080 denier type "6" nylon treated hereunder. This ply yarn is tufted into a pile carpet, and the texture is developed when the yarn is heated incident to dyeing the carpet. As is well known the two types of nylon take the dye differently, and interesting effects are achieved in the finished carpet.

The following specific examples will further illustrate the yarns according to this invention.

Table A

Sample No.	Yarn producer	Producer's yarn type designation	Generic or brand name of yarn fiber	Chemical name of yarn fiber
1	Allied Chemical	H.B.	Nylon	Polyamide.
2	do	do	do	Do.
3	do	do	do	Do.
4	do	do	do	Do.
5	do	do	do	Do.
6	do	do	do	Do.
7	Chemstrand	S.D.	do	Do.
8	do	do	do	Do.
9	do	do	do	Do.
10	do	H.B.	do	Do.
11	do	do	do	Do.
12	do	do	do	Do.
13	Du Pont	51	Polyester	Polyester.
14	do	do	do	Do.
15	do	do	do	Do.
16	Kurashiki (Japan)		Vinal	Polyvinyl alcohol.
17	do		do	Do.
18	do		do	Do.
19	Industrial Rayon		Alefin	Polypropylene.
20	do		do	Do.
21	do		do	Do.
22	Allied Chemical	H.B.	Nylon	Polyamide.
23	do	do	do	Do.
24	Chemstrand	S.D.	do	Do.
25	Allied Chemical	H.B.	do	Do.
26	Chemstrand	S.D.	do	Do.
27	do	do	do	Do.
28	Allied Chemical	H.B.	do	Do.
29	One end Example 5 and one end of Example 8 thereafter plied together			
30	One end Example 27 and one end of Example 28 thereafter plied together			
31	Two ends of Example 7 thereafter plied together			

Sample No.	Total yarn denier	Number of filaments in yarn	Average denier of filaments in yarn	Yarn fiber type	Yarn twist (per inch)
1	4,200	224	18.75	6	0
2	4,200	224	18.75	6	0
3	4,200	224	18.75	6	0
4	2,100	112	18.75	6	½ Z
5	2,100	112	18.75	6	½ Z
6	2,100	112	18.75	6	½ Z
7	2,080	136	15.3	6,6	½ Z
8	2,080	136	15.3	6,6	½ Z
9	2,080	136	15.3	6,6	½ Z
10	840	140	6.0	6,6	½ Z
11	840	140	6.0	6,6	½ Z
12	840	140	6.0	6,6	½ Z
13	1,100	250	4.4		0
14	1,100	250	4.4		0
15	1,100	250	4.4		0
16	1,200	200	6		
17	1,200	200	6		
18	1,200	200	6		
19	210	70	3		½ Z
20	210	70	3		½ Z
21	210	70	3		½ Z
22	4,200	224	18.75	6	0
23	4,200	224	18.75	6	0
24	2,080	136	15.3	6,6	½ Z
25	4,200	224	18.75	6	0
26	2,080	136	15.3	6,6	½ Z
27	2,080	136	15.3	6,6	½ Z
28	2,100	112	18.75	6	½ Z
29					
30					
31					

Table A—Continued

Sample No.	Shape wiper bar (vertical cross-section)	Wiper bar cross-section size (on a side), inches	Wiper bar speed (r.p.m.)	Yarn feed (inches per minute) at roll 50 or corresponding point
1	Square	7/16	5,400	537
2	do	7/16	5,400	820
3	do	7/16	5,400	1,357
4	do	7/16	5,400	518
5	do	7/16	5,400	659
6	do	7/16	5,400	1,301
7	do	7/16	5,400	490
8	do	7/16	5,400	613
9	do	7/16	5,400	1,206
10	do	7/16	5,400	537
11	do	7/16	5,400	679
12	do	7/16	5,400	1,338
13	do	7/16	5,400	547
14	do	7/16	5,400	679
15	do	7/16	5,400	1,338
16	do	7/16	5,400	537
17	do	7/16	5,400	679
18	do	7/16	5,400	1,367
19	do	7/16	5,400	565
20	do	7/16	5,400	707
21	do	7/16	5,400	1,395
22	do	7/16	1,725	1,696
23	do	7/16	3,622	1,110
24	do	7/16	5,175	1,166
25	do	7/16	3,622	1,728
26	do	7/16	5,175	858
27	do	7/16	5,175	374
28	do	7/16	5,175	433
29				
30				
31				

Sample No.	Yarn feed (inches per minute) at roll 51 or corresponding point	Yarn tension over wiper bar (lbs.)	Yarn tension over wiper bar (grams per denier)	Yarn loops (number and type)
1	584	9.00	.97	1-U
2	867	10.65	1.15	1-U
3	1,432	12.60	1.36	1-U
4	575	5.85	1.26	1-U
5	726	6.25	1.38	1-U
6	1,414	8.25	1.78	1-U
7	574	5.50	1.19	1-U
8	726	5.60	1.22	1-U
9	1,338	7.35	2.31	1-U
10	575	3.65	1.97	1-U
11	726	3.75	2.02	1-U
12	1,414	4.10	2.21	1-U
13	575	4.35	1.79	1-U
14	726	4.35	1.79	1-U
15	1,414	5.00	2.06	1-U
16	575	3.60	1.36	1-U
17	726	3.75	1.42	1-U
18	1,414	4.25	1.60	1-U
19	575	1.40	3.02	1-U
20	726	1.25	2.70	1-U
21	1,414	1.10	2.37	1-U
22	1,791	17.25	1.86	1-U
23	1,150	(1)	(1)	{1-L, 3-U
24	1,357	(1)	(1)	{1-L, 1-U
25	1,791	(1)	(1)	{1-L, 3-U
26	999	(1)	(1)	{1-L, 1-U
27	467	(1)	(1)	1-U
28	467	(1)	(1)	1-U
29				
30				
31				

Sample No.	Yarn twist after processing (turns per inch in yarn on bobbin 21 or corresponding package)	Ply twist (if any) (turns per inch)	Texture	Wipes at each point along length of yarn	Length of Wipes (inches)
1	6.25 Z		A	48.5	1.23
2	4.16 Z		A	32.7	1.19
3	2.50 Z		A	19.8	1.11
4	7.5 Z		B	49.3	1.23
5	6.00 Z		B	39.0	1.21
6	2.9 Z		C	20.0	1.11
7	7.5 Z		B	49.4	1.23
8	6.00 Z		B	39.0	1.21
9	2.9 Z		C	21.2	1.13
10	7.5 Z		C	49.0	1.23
11	6.0 Z		C	39.0	1.21

Table A—Continued

Sample No.	Yarn twist after processing (turns per inch in yarn on bobbin 21 or corresponding package)	Ply twist (if any) (turns per inch)	Texture	Wipes at each point along length of yarn	Length of Wipes (inches)
12	2.9 Z		C	20.0	1.11
13	6.75 Z		A	49.3	1.23
14	5.4 Z		A	39.0	1.21
15	2.6 Z		B	20.0	1.11
16	7 Z		C	49.3	1.23
17	5.6 Z		C	39.0	1.21
18	2.7 Z		C	20.0	1.11
19	6.5 Z		B	49.3	1.23
20	5.2 Z		B	39.0	1.21
21	2.5 Z		B	20.0	1.11
22	2.1 Z		D	5.1	.53
23	3.1 S		B	[2] 11.0	[4] .72
				[3] 16.5	[5] 1.07
24	2.4 S		B	[2] 13.3	[4] .74
				[3] 20.0	[5] 1.11
25	2.1 S		B	[2] 7.0	[4] .63
				[3] 10.5	[5] .94
26	4.1 Z		B	[2] 18.1	[4] .78
				[3] 27.2	[5] 1.17
27	8.9 Z		B	50.7	1.24
28	8.9 Z		B	50.7	1.24
29		2 S			
30		2.9 S			
31		2 S			

[1] Unmeasured.
[2] Wipes in each L-loop pass; add to total wipes in all U-loop passes for total wipes.
[3] Wipes in each U-loop pass; add total wipes in all U-loop passes to wipes in L-loop pass for total wipes.
[4] In L-loop pass.
[5] In U-loop pass.

The yarns in the foregoing table have been classified in the four categories "A," "B," "C" and "D," and the categories may be distinguished from each other as to quality of texture in that order, i.e., "A" category yarns had better texture than "B"; "B" better than "C," and "C" better than "D." Several factors influence the classification of a yarn in one category rather than another. Among these factors, the more important include the percent contraction of the yarn in the textured state (the greater the percent the better the texture); the bulk of the yarn in the textured state (the higher the bulk the better the texture); the fineness of the curls, bends, etc. in the filaments in the textured state (the finer, the better the texture), and the uniformity of the curls, bends, etc., along the length of the filaments and in adjacent filaments at the same point in the yarn (the more uniform, the better the texture). It should be understood that even though less texture is found in category "D" than in category "A" yarns, the former still possessed a pronounced and relatively high texture as distinguished, for example, from cellulose acetate where the texture was only slight, amounting to an increase in volume in the relaxed state of the order of two to three times, after processing.

Examples 2 and 31 after processing and before heating were each processed through a stuffer box crimper of the type disclosed in United States Patent 2,311,174, and were heated while in a loose state after release from the crimper; they were treated according to the process described in copending U.S. Patent application Serial No. 712,912, filed February 3, 1958, now Patent 3,009,233. Each was then tufted into cut pile rugs. Example 29 after processing and before heating was tufted into a loop pile rug, and the texture was developed when the rug was dyed. These examples produced three rugs of good quality.

The number of times each point along the length of the yarn is wiped ("wipes" in the foregoing table) was calculated from the other data in the table as was the normal length of the wipes ("length of wipes" in the foregoing table). For example, Example 28 was processed using one L-loop and one U-loop. This means that in the case of the L-loop the yarn was wrapped around two sides of a square wiper bar, and in the case of the U-loop it was wrapped around three sides of the square wiper bar.

Thus in the L-loop area it had 7/8" exposed to the wiping action of the bar, and in the U-loop area had 1 5/16" exposed to the action of the wiper bar.

The length of time for any point along the length of the yarn to traverse this distance was calculated from the speed at which the yarn is advancing along its own length (which is the same as its speed at feed roll **51**). Similarly the number of corners which wiped past this point as it advanced through this distance was calculated from the rotational speed of the wiper bar, and in this way the number of times that point was wiped was calculated.

The normal length of each wipe was similarly calculated; in the L-loop if a 7/16" inch square wiper bar is rotated at a very much greater rate of speed than the advance of the yarn **35**, this length will be just slightly less than 7/8". Similarly in a U-loop on such a bar under the same conditions, this length will be just slightly less than 1 5/16".

It will be appreciated that although any given point may be wiped a multiplicity of times, the character of all wipes are not identical. For example when the point first reaches the position adjacent corner **69** when that corner is in the position shown in FIG. 1 of the drawing, it will lie near the beginning of one wipe. When it reaches the position shown by corner **70** it will be approaching the middle of another wipe and when it reaches the position shown by corner **72** it will lie near the end of still another wipe. Similarly the wiping force of the corner along the filament will vary along the length of the wipe.

It is necessary that each point be wiped at least five times, and preferably each point is wiped at least twenty times. The length of each wipe extends preferably only for a little distance, i.e. not more than 6", along the length of the filaments. In the now preferred method this distance will generally be from approximately ½ to approximately 3".

Various fibers can be textured by this method. Thus far it has been found that the nylon and polyester yarns heretofore employed give a texture that is currently thought to be most desirable. Polypropylene yarns also are textured well according to this invention. Polyvinyl alcohol yarns can also be textured well. Cellulose acetate has also been textured, but the texture developed under conditions thus far employed is not considered satisfactory for commercial use.

As used throughout this specification and claims the texturing of a filament means the changing of that filament from a generally straight sided cylindrical configuration to one in which the filament is bent along a tortuous path. A filament lying along such a tortuous path has generally been referred to in the past as crimped, crinkled, coiled, whorled, and the like. A yarn is textured when it has one or more filaments that has been textured, and the bulk of the yarn has been increased, generally with a consequent diminution in length. It is known in the textile industry that one yarn user may consider texture of one type desirable and texture of another type undesirable, while another yarn user may consider a texture of the latter type useful and that of the former type undesirable. Therefore although a number of specific embodiments of yarn and texturing techniques have been disclosed, different yarns may be produced and different techniques may be employed within the scope of this invention as defined in the appended claims.

Having thus described my invention, what I claim and desire to protect by Letters Patent is:

1. A method of treating a strand comprising a continuous textile filament, which comprises maintaining relative movement longitudinally of the filament between said filament and a salient corner of a member, wiping the corner a little distance only along the length of said filament, pressing said filament and the corner together throughout a substantial part of the time filament is being so wiped, and at substantially every point that is to be

treated of said strand so wiping a filament a multiplicity of times.

2. A method of treating a strand comprising a continuous textile filament, which comprises tensioning said strand, rotating a member having a plurality of sailent corners to rotate the corners about an axis, advancing said filament past the member while wrapped at least partially thereabout and about the axis of rotation of the corners while said strand is so tensioned, maintaining rapid relative movement longitudinally of the filament between said filament and the corners, each corner wiping a distance along the length of the filament as the corner rotates, and at substantially every point that is to be treated of said strand so wiping a filament a multiplicity of times.

3. A method of treating a strand comprising a continuous textile filament, which comprises tensioning said strand, rotating a member having a plurality of salient corners to rotate the corners relatively rapidly about an axis, advancing said filament relatively slowly past the member while wrapped at least partially thereabout and about the axis of rotation of the corners while said strand is so tensioned, each corner wiping the filament a little distance along the length of the filament as the corner rotates, and at substantially every point that is to be treated of said strand so wiping a filament a multiplicity of times.

4. A method of treating a strand comprising a continuous textile filament, which comprises performing the following steps at substantially room temperature, tensioning said strand, rotating a member having a plurality of sailent corners to rotate the corners relatively rapidly about an axis, advancing said filament relatively slowly past the member while wrapped at least partially thereabout and about the axis of rotation of the corners while said strand is so tensioned, each corner wiping the filament a little distance along the length of the filament as the corner rotates, and at substantially every point that is to be treated of said strand so wiping a filament a multiplicity of times.

5. A method of treating a strand comprising a continuous textile filament which comprises tensioning said strand, rotating a member having a plurality of salient corners to rotate the corners relatively rapidly about an axis, advancing said filament relatively slowly past the member while wrapped at least partially thereabout and about the axis of rotation of the corners while said strand is so tensioned, each corner wiping the filament a little distance along the length of the filament as the corner rotates, at substantially every point that is to be treated of said strand so wiping a filament at least 5 times, and completing the wiping of each said point within a period of time of 30 seconds.

6. A method in accordance with claim 5 in which at substantially every point that is to be treated of said strand a filament is so wiped at least 20 times within a period of 5 seconds.

7. A method in accordance with claim 6 in which the wiping of each point is completed within 2 seconds.

8. A method of treating a strand comprising a continuous textile filament, which comprises tensioning said strand to at least .5 gram per denier, rotating a member having a plurality of salient corners to rotate the corners relatively rapidly about an axis, advancing said filament relatively slowly past the member while wrapped at least partially thereabout and about the axis of rotation of the corners while said strand is tensioned at such level, each corner wiping the filament a little distance along the length of the filament as the corner rotates, and at substantially every point that is to be treated of said strand so wiping a filament at least 5 times.

9. A method according to claim 8 in which the strand is tensioned at least .9 gram per denier.

10. A method of treating a multi-filament yarn having at least 50 continuous filaments each at least 15 denier in size which comprises performing the steps of claim 8 on it while tensioned at least .9 gram per denier.

11. A method in accordance with claim 9 which includes heating the strand after it has been so treated.

12. A method which includes plying two strands together which have been treated in accordance with claim 9 and thereafter heating the plied strand.

13. A method of treating a strand comprising a continuous textile filament, which comprises tensioning said strand, rotating a member having a plurality of salient corners each having a radius of curvature at least .001" and less than .005" to rotate the corners relatively rapidly about an axis, advancing said filament relatively slowly past the member while wrapping at least partially thereabout and about the axis of rotation of the corners while said strand is so tensioned, each corner wiping the filament a little distance along the length of the filament as the corner rotates, and at substantially every point that is to be treated of said strand so wiping a filament at least 10 times.

14. A method in accordance with claim 13 wherein the rotating member has four corners with a corner disposed at each corner of a square between .25" and 1.0" on a side, and wherein said filament is wrapped about at least two sides of said square.

15. A method which includes plying together two strands which have been treated in accordance with claim 14.

16. Apparatus for treating a strand comprising a continuous textile filament, comprising a bar having a plurality of salient corners, means for rotating said bar to rotate said corners about an axis, means for wrapping said strand at least partially about said bar and said axis so said filament may be wiped by said corners as said bar rotates, means for tensioning said strand to urge said filament towards said corners and said axis with force sufficiently low to prevent excessive breakage of said filament, and means for longitudinally advancing said strand past said bar at a speed that substantially every point that is to be treated of said strand is wiped a multiplicity of times by said bar.

17. Apparatus for treating a strand comprising a continuous textile filament, comprising means for advancing said strand in the direction of its length, a bar rotatable about an axis and having a plurality of salient corners, said strand after it leaves said advancing means being wrapped about said bar and said axis so said filament may be wiped by said corners as said bar rotates, further strand advancing means for advancing said strand from said bar, said further advancing means advancing said strand at a greater speed than said first mentioned advancing means, whereby said filament is tensioned and stretched between the two said advancing means and while it is wiped by said rotating bar, said further advancing means advancing said strand at a speed sufficiently low to prevent excessive breakage of said filament between the two strand advancing means, means for rotating said bar to rotate said corners about an axis at a speed that substantially every point that is to be treated of said strand is wiped a multiplicity of times by said bar.

18. Apparatus in accordance with claim 17 in which said corners are rotated at a relatively high rate of speed and said strand is advanced at a relatively low rate of speed.

19. Apparatus in accordance with claim 18 in which the corners have a radius of curvature at least .001" and less than .005".

20. Apparatus for treating a strand comprising a continuous textile filament, comprising means for advancing said strand in the direction of its length at a relatively low rate of speed, and an elongated bar having four corners with a radius of curvature at least .001" and less than .005", one of said corners being disposed at each corner of a square between .25" and 1.0" in-

clusive on a side, means for rotating said bar to rotate said corners at a relatively high rate of speed about an axis, said strand after it leaves said advancing means being wrapped about said bar and said axis with the filament disposed along at least two sides of the square so said filament may be wiped by said corners as said bar rotates, further strand advancing means for advancing said strand from said bar, said further advancing means advancing said strand at a greater speed than said first mentioned advancing means, whereby said filament is tensioned and stretched between the two said advancing means and while it is wiped by said rotating bar, said bar rotating means rotating said bar at a speed that substantially every point that is to be treated of said strand is wiped a multiplicity of times by said bar.

21. Apparatus in accordance with claim 20 in which the relative speed of the bar and strand and the wraps of the strand about the bar are such that each point along the length of the strand is wiped at least 10 times in its passage about the bar.

22. Apparatus in accordance with claim 21 in which the relative speed of the bar and strand and the wraps of the strand about the bar are such that each point along the length of the strand is wiped at least 20 times and the treatment is completed within 5 seconds.

23. Apparatus for treating a strand comprising a continuous textile filament, comprising a plurality of salient corners, means for advancing said strand past said corners so said filament may be wiped by each said corner a little distance along its length, means for tensioning said strand to urge said filament toward said corners with force sufficiently low to prevent excessive breakage of said filament, and means including said salient corners for wiping a filament at least 20 times at substantially every point that is to be treated of said strand.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,108,355 October 29, 1963

Robert J. Clarkson

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 12, line 74, after "time" insert -- the --; column 13, lines 5 and 31, for "sailent", each occurrence, read -- salient --; column 14, line 14, for "wrapping" read -- wrapped --.

Signed and sealed this 28th day of April 1964.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents