United States Patent

Taylor

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[54] **FLANGE FALSE TWIST TEXTURED NYLON**

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[51] **Int. Cl.** **D02g 3/24**

[58] **Field of Search**...57/34 HS, 36, 55.5, 77.3, 77.4, 57/140 R, 140 BY, 157 R, 157 S, 157 TS

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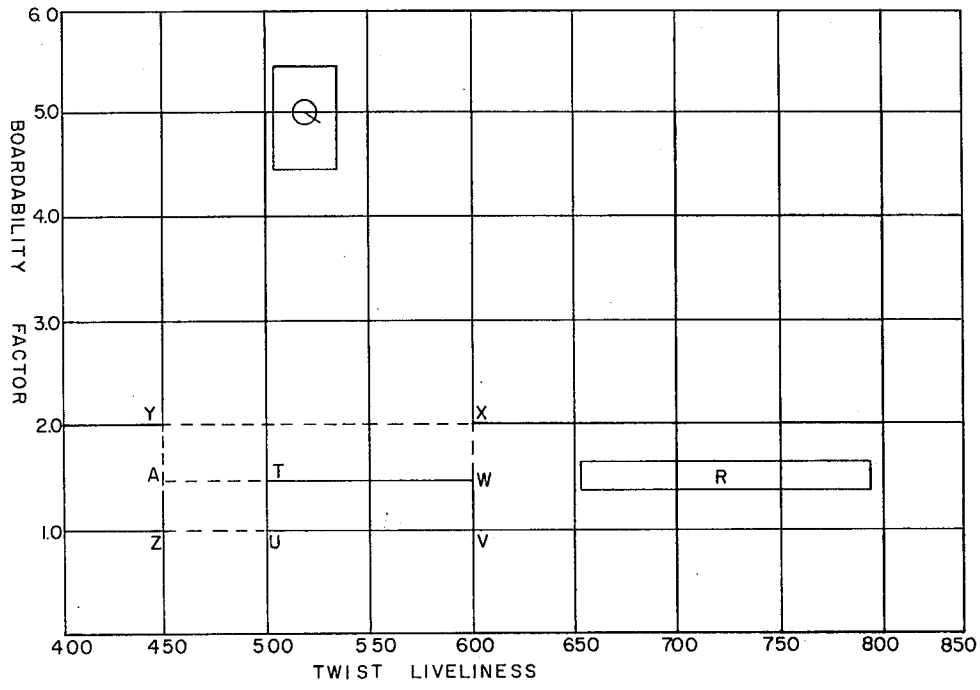
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[57] **ABSTRACT**

A novel monofilament nylon yarn suitable for use in knit constructions, particularly women's hosiery, characterized by its boardability and twist-liveliness values is disclosed. A false twist process, which may be a simultaneous or sequential drawing, false twisting operation utilizing a twist insertion flange, is disclosed as exemplary of methods to produce the yarn.

13 Claims, 2 Drawing Figures



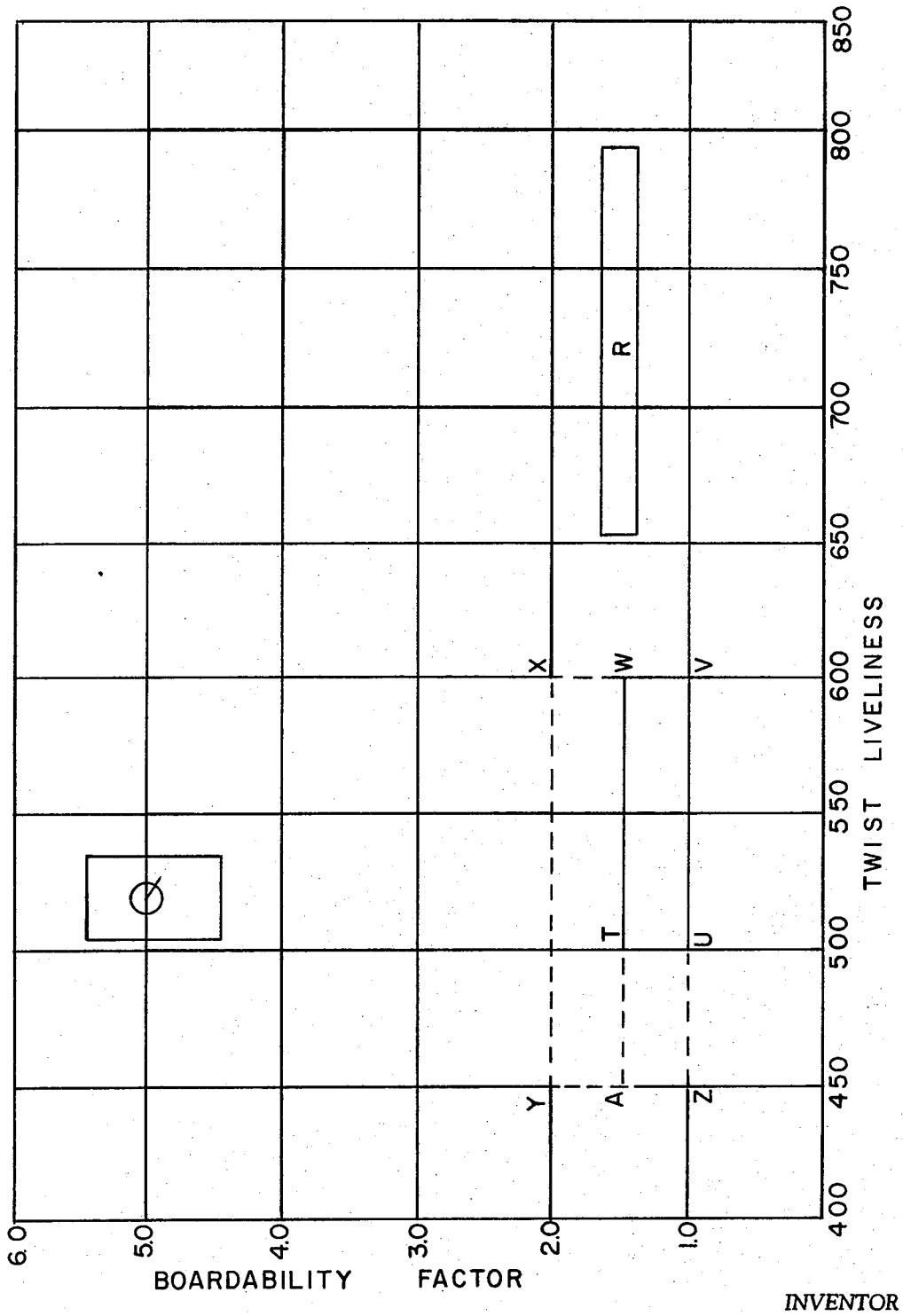


FIG. 1

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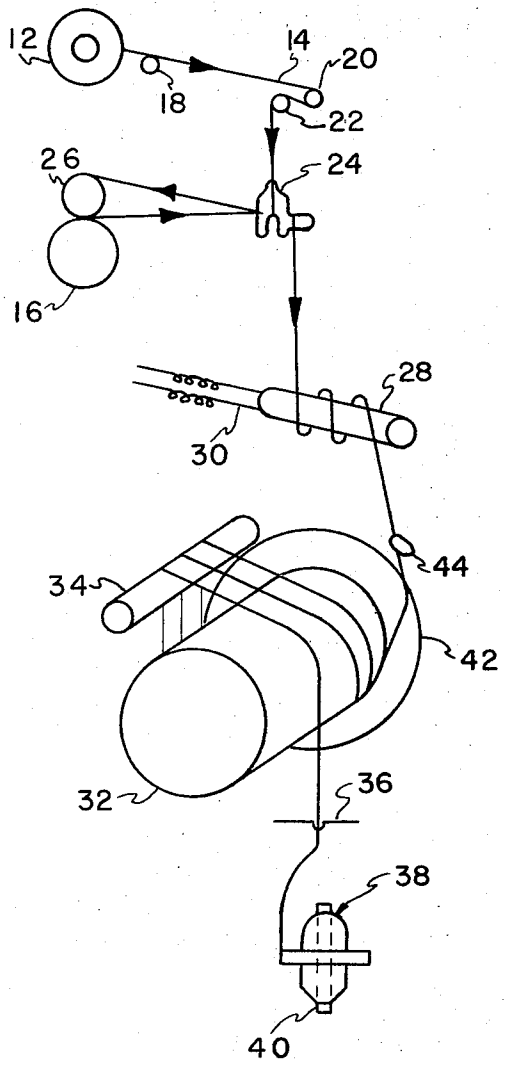


FIG. 2

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FLANGE FALSE TWIST TEXTURED NYLON

BACKGROUND OF THE INVENTION

The present invention relates to a special false-twisted nylon monofilament yarn and a process for its production.

Twist-lively monofilament nylon yarn is widely used in the production of hosiery, particularly women's stretch hose. A number of yarn properties inter-act to affect the ultimate suitability of a particular yarn for this end use. For example, a minimal torque value is required for a yarn to be suitable in a plain knit hose construction, especially where "stretch" hose (a single hose construction which "stretches" to conform to all or a selected range of normal foot sizes) is to be the ultimate product. Although torque is a valuable comparative characteristic between yarns of the same denier, a more exact indicator of potential yarn contraction as translated into product contraction or post-autoclave length in a knit hosiery product, particularly to evaluate yarns of different deniers, is a twist liveliness value obtained as the product of torque and denier. This latter function of "twist-liveliness", as discussed in greater detail in the detailed description of the invention hereinafter, is used as one parameter to gauge the processability, and hence product advantages of the novel yarn of the invention as compared with the yarns of the prior art.

Apart from the consideration of torque, two other characteristics of the yarn, namely post-autoclave length and equivalent steam set temperature (ESST) markedly affect the extent of board conformation of the knit product, and hence the quality of the finished and boarded hose. The critical feature of the boarding process involved with these two yarn properties is the ability of the contracted fabric to fit snugly around the narrow ankle area of the form and conform to the new shape with adequate definition during the steam setting process. Post-autoclave length and ESST are appropriately correlated into an expression of monofilament yarn boardability by a boardability factor as developed in the detailed description of the invention hereinafter. The boardability factor of the yarn operates as the second parameter to establish the improved properties of the novel yarn of the invention as compared with the yarns of the prior art. A graphical representation is utilized, plotting boardability and twist-liveliness yarn values as abscissa and ordinate functions respectively, to pinpoint the yarn of the invention with respect to both of the defining parameters, and as compared with the yarns of the prior art.

Various processes have been used to impart the above-described properties to nylon monofilament yarn and articles made therefrom, such as hosiery, pantyhose and other items of inner and outer apparel. One such technique involves false twist texturing wherein the yarn is fed to a rotating false twist spindle which positively engages it, putting in Z- or S twist upstream of the spindle and taking out precisely the same amount of opposite twist downstream. The yarn, while twisted, is passed through a setting zone so that its bias to remain twisted is locked therein. The yarn is collected, made up into fabric and, upon release, the fabric shortens due to contraction of the yarn which can be compared to an extended coil spring. Stretching force serves again to stretch the fabric to any extent up to the fully uncoiled length of the component yarns.

While this system largely overcomes the disadvantages of earlier systems, when running at high speeds on mono-filament yarns it is found that the products so produced as well as the process require improvement for commercial acceptance.

Therefore, it is an object of the present invention to provide a novel false twist textured nylon monofilament yarn of superior properties for use in hosiery constructions.

It is another object of the invention to provide a monofilament yarn, particularly comprising poly(hexamethylene adipamide), characterized by disclosed twist-liveliness and boardability values.

It is still another object of the invention to provide knit structures, especially hosiery, constructed of the novel yarn.

It is a further object of the invention to provide an improved friction false twist process to produce the novel yarn of the invention.

Other objects of the invention will appear obvious to those skilled in the art from the detailed description of the invention hereinafter.

SUMMARY OF THE INVENTION

It has now been found that nylon monofilament yarn characterized by a boardability factor below 2.0, preferably between 1.0 and 2.0, more preferably about 1.0 to 1.5, and a twist-liveliness value below 600, preferably between about 600 and 450, more preferably between about 600 and 500, can be knit into hosiery constructions, particularly women's stretch hose constructions, having improved boardability, shape definition, aesthetic appearance and the like properties.

It also has been found that the afore-mentioned yarn may be produced by a friction false twisting process, preferably a simultaneous drawing, false twisting process utilizing a rotating flange, wherein the yarn is heated in a heating zone maintained at about 150°–220 °C, preferably 170°–190° C, said heating zone being about 2 to 30 inches, preferably 2 to 10 inches, in length along the yarn path, while travelling between about 1000 to 5000 , preferably 1500-2500 feet per minute, allowed to cool in ambient air for about 5 to 50 milliseconds after leaving said heating means; then friction false twisted under conditions to impart about 20 to 40 turns per inch of false twist in said yarn, said twist running back to said heating zone; and finally taking up said yarn with a ring and traveller mechanism while inserting a real producer twist, i.e. about ⅛ to 1 turn per inch, into said yarn by means of said ring and traveller, in the opposite direction of said false twist.

In preferred embodiments of the invention, the feed yarn is essentially undrawn and is simultaneously drawn about 3.5 to 5 times during the false twist insertion operation.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a plot of Boardability vs. Twist Liveliness showing the area in which the novel products fall in contrast with prior art products: and

FIG. 2 is a schematic perspective view of an apparatus for practicing the present invention.

DETAILED DESCRIPTION OF THE INVENTION

In knitting hosiery from twist-lively or torque stretch yarn, the hose contract spontaneously when released from knitting tensions. The contraction for monofilament hose is typically 50 percent lengthwise, that is along the Wales; and 25 percent widthwise. A further small contraction, about one tenth of the original, occurs during a finishing steam treatment (100° C) when the full torque potential of the yarn is released. The contracted hose, after dyeing, are boarded, i.e. stretched over a forming board, and set to their finished form by a second, higher temperature (118° C) steaming.

Fabric contraction reflects a structural relaxation to a new stitch conformation, where the original flat loops produced in knitting have been turned out of the knitting plane and titled by the fiber torque. Stitch loops in adjacent courses, which are knit from yarns of opposite twist to maintain an overall torque balance in the hose, distort in opposing directions, tilting left or right depending upon whether the yarn has 'S' or 'Z' torque. The interaction between these opposing distortions causing the courses to ride up over one another as the fabric structure relaxes, giving the characteristically large walewise or lengthwise contraction. The lesser contraction around the courses, the widthwise hose contraction, sums the turning distortion in individual loops.

In order to evaluate the boarding performance and final hosiery characteristics of the novel yarn of the invention and the yarns of the prior art, hose are produced in accordance with the following construction to produce a finished size 9½ medium hose.

The Reading two feed Mark III circular knitting machine, manufactured by the Reading Machine Company of Reading, Pa. knits in a plain jersey single knit construction 24 courses per chain link and is set to:

Hose Region	Number of Links	Number of Courses
Welt	17	408
Shadow Welt	2	48
Upper Leg	38	912
Lower Leg (graduator)	24 576	
*Heel	29 (reciprocated)	696
Foot	15	360
Toe	33 (reciprocated)	796
Run-down	2	48

giving	**Cross-Stretch (inhhes) Greige	Finished
Welt	14 ¼	12 ½
Leg	12 ¾	11 ¾
Ankle	'10 ¾	9 ¾
Foot	10 ¾	9 ½

* (patched heel)

** (measure by Stretchette machine manufactured by Corbett Associates of Concord, North Carolina

A tolerance of ± ½ inch is allowed on each cross-section value. Welt and heel yarns are conventional spindle false twist textured 40/13 continuous filament nylon 6,6 yarn. All other yarn used is constructing the hose is the yarn of the invention or prior art yarn as indicated hereinbelow.

After the knitting operation, the knit hose contracts substantially in the lengthwise direction; however, a smaller degree of contraction occurs in the widthwise direction.

A second, small contraction occurs during a finishing steam treatment at about 100° C. The contracted hose, after dyeing, are stretched over a forming board and set to their finished form by a second, higher temperature (118° C) steaming.

It has been found by the present invention that certain definable properties of the yarn markedly affect the boarding performance, and hence final characteristics of the knit product. More particularly, it has been found that the equivalent steam set temperature of the precursor yarn (with reference to nylon 6,6 and the like yarns which are relatively moisture insensitive as compared with nylon 6 and the like yarn - equivalent heat set temperatures or EHST, which directly correlates to ESST, is used with the moisture sensitive yarns) and post-autoclave length of the knit hose can be combined in an empirical relationship to describe the boardability of the precursor yarn.

Widthwise contraction is important, indeed a critical boarding feature, because the fabric must fit snugly around the narrow ankle area of the form in order to be properly set into the new configuration. Because monofilament yarn torque converts inefficiently with widthwise hose contraction, it is conventional to design the fabric so that its pre-boarding length is short enough to require stretching to the final boarded length, thereby generating tension which pulls the ankle region of the fabric into the board. However, torque alone does not translate into a well-defined set in practice. The hose must be heat set to a large degree during the final steaming operation on the board in order to retain the boarded configuration and shrink sufficiently in the widthwise direction around the narrow ankle areas of the form. Thus, the degree to which the yarn is still capable of being set during the final boarding treatment, markedly affects the boardability performance of the hose (hence yarn) and the quality of the finished product.

ESST (and EHST) values of the yarn describe the capability of the yarn to be heat set while simultaneously shrinking during the boarding operation, with lower ESST values correlating with a lower set prior to boarding; therefore, a greater ability to conform to the new shape. Obviously, yarn of lower ESST value is preferred for stretch hose constructions. ESST is defined by the equation

$$ESST = 140 - S/K$$

where S is the percent shrinkage of the yarn measured in steam at 140° C and K is a proportionality constant for the shrinkage-temperature relation, which for nylon 66 is about 0.1%/° C and for nylon 6 is about 0.07%/° C. S is measured by draping **30** centimeter samples of processed yarn (preconditioned in 50°C water for 30 minutes and air dried), free of restraint, across wire racks followed by 6 minutes of prevacuum to about 12 psig, steaming for 6 minutes at 140° C with saturated steam (37.72 psig), after which the steam is bled off under vacuum and the yarn cooled. (For nylon 6 shrinkage is determined as above with the exception of the use of hot air at 190° C. in place of the steam treatment.) Initial and final lengths of the yarn are measured

under 0.06 g/denier tension at 70° C and 65 percent relative humidity. Before measurement, each sample is conditioned in water at 50° C for 30 minutes and air dried. The shrinkage of the novel yarns is quite high, i.e. usually more than 8 percent and sometimes 10 percent, compared with less than 4 percent for conventionally false twist textured yarns. This corresponds to a ESST below 75° C and generally below 60° C, for example 47°C to 55°C, compared to over 100°C for conventionally false twist textured yarns.

On the lower end of the scale, it has been determined that ESST should be at least about 40°C to prevent unacceptable torque decay during hot, humid storage conditions.

The lower the ESST value, the less the yarn has been heat set. The less severe is the set of the yarn, the easier it is for the yarn to take on a new set and retain the new shape. In the case of boarding, a low ESST value, i.e. below about 75° to 60°C, indicates ability in the hose to shrink and conform to the new shape, particularly about the ankle, and retain the new shape following removal from the board. The difference between the boarding temperature and ESST is the denominator in the equation defining the overall boarding performance of the yarn, according to the equation:

$$\text{Boardability factor (B)} = \frac{2 \times \text{post-autoclave length}}{118^\circ\text{ C.} - \text{ESST }^\circ\text{ C.}}$$

As apparent from the above Boardability Factor, the second value to be considered in determing boarding performance is the post-autoclave length of a standard hose, the 9½ medium described above in the present instance. Of course, other standard hose sizes may be used to determine post-autoclave length values with appropriate recalculation of boardability factor values.

The main yarn factor contributing to post-autoclave length is the torque of the yarn. Hose released from the knitting machine contracts spontaneously. A final, lesser, but more rapid, contraction occurs during the first steam finishing treatment. The summation of the two contractions is indicative of the total torque of the yarn. Post-autoclave length is measured after the first steam finishing treatment between the bottom of the welt and the point of the heel from which the knitting needle reciprocates in knitting the half courses for the heel along the wales with the hose hanging by the welt under 5 grams tension. The post-autoclave length determines to what degree the hose will be stretched on the board. The lower the post-autoclave length, the better the boarding performance of the hose and hence yarn. For example, using the hosiery construction described above and a typical board used for 9½ size nylon stretch hose, post-autoclave lengths below about 44 cm produce good quality hose.

The relationship between length and boarding performance has been described hereinbefore. Hose requiring a greater degree of stretch over the board will conform more exactly to the shape of the board.

It becomes apparent that post-autoclave length and ESST, in the proper relationship, define the boarding performance of the hose, and hence the yarn. For proper weight to be given the post-autoclave length value, it is multiplied by a factor of **2** in the numerator of the boardability factor. Because postautoclave length and ESST are both limited as to the lowest possible values, with maximum values determined by the boarding temperature and board length, the lower the boardability factor of the yarn, the better the performance of the hose.

Other factors in addition to torque affect post-autoclave length to a certain degree. For example, there may be mentioned fabric density and the various surface applications such as knitting oils which are applied to the yarn. As long as the tested hose are constructed and processed substantially identically, the measured post-autoclave lengths will be comparable on a relative basis. To derive the post-autoclave lengths utilized herein, the standard hose leg was knit, allowed to contract under tensionless, ambient conditions for 5 days and then is steam treated at 100°C for 20 to 45 minutes. Boarding is at 118° C in steam for 45 seconds in an autoclave under **25.9** pounds per square inch absolute.

Minor variation in post-autoclave length and ESST determinations do not appreciably affect the boardability factor numerical range. The important consideration is the ESST value coupled with the approximate post-autoclave length value, and the boardability factor equation takes into consideration the relative weight and exactitudes of the post-autoclave length and ESST functions.

The second parameter used to characterize the novel yarn of the invention is the twist-liveliness of the yarn. Twist liveliness is yarn torque normalized for denier by the expression:

$$\text{Twist-liveliness} = \text{torque} \times \text{denier}$$

The importance of torque during the knitting operation and boarding has been discussed hereinbefore.

Torque is measured by a skein test as follows:

A 70 warp × 1⅛ meter skein is wound on a denier reel. The skein is mounted on a prepared framework and tensioned with a 54.40 gm load. The tensioned skein is held in two clamps which can be moved together by sliding along a rod. One side of the skein is cut away, leaving **70** ends about 19½ inches long. A symmetrical cross-shaped tension weight (54.50 gms; each of the arms is 4½ inches × ½ inch × ¼ inch aluminum, the ½ inch dimension being in the plane of the cross) is hung by a hook to the middle of the yarn bundle and the clamps are brought together, lowering the cross to 1 inch below the surface of water in a beaker.

The skein, driven by the fiber torque, twists around itself causing the cross to rotate in the water. One complete revolution is allowed for the system to accelerate to a dynamic equilibrium then the time period for the next five revolutions is recorded on a stopwatch to be quoted as the estimate of fiber torque.

Standard lag-time in a controlled environment and standard bobbin stripping procedure are followed to ensure consistent results. Obviously, as true torque increases, the numerical value of twist liveliness decreases. The novel yarn of the invention in 15 denier is generally characterized by a torque of between about 40 and 30, preferably about 33 to 40. These values calculate to a twist liveliness range of about **450** to **600**, preferably about **500** to **600**. These twist liveliness values are desirable for monofilament yarns of any denier, for example, a 20 denier yarn should have a torque below about 30 to be within the inventive con-

cept. The twist liveliness value remains constant although torque and denier of the monofilament yarn may vary.

In accordance with the above discussion, the Boardability Factor of the novel yarn of the invention should generally be below about 2.0, preferably less than about 1.5 and most preferably about 1.0 to 1.5 with twist liveliness ranges as above disclosed.

In FIG. 1 of the Drawing, yarn twist liveliness is plotted against yarn boardability factor. The novel yarn of the invention has a boardability factor below the 2.0 and a twist liveliness below about **600**. Preferably the yarn is characterized by falling within the rectangle formed by the points VXYZ. (Boardability Factor of about 1.0 to 2.0 and twist liveliness of about **450** to **600**); more preferably within the rectangle VWAZ (Boardability Factor of about 1.0 to 1.5 and twist liveliness of about **450** to **600**), and most preferably within the rectangle UVWT (Boardability Factor of about 1.0 to 1.5 and twist liveliness of about **500** to **600**).

Throwster textured yarn conventionally is characterized by the properties within the bounds of rectangle Q. The prior art producer textured nylon monofilament yarns are characterized by rectangle R.

The throwster yarn, although having adequate torque for plain knit hosiery, exhibits inferior widthwise contraction and definition around the narrow ankle area during boarding. The prior art producer textured yarn does not have sufficient twist liveliness to be useable in plain knit hose constructions. Of course, the yarn of the invention is also excellent for unboarded constructions.

Turning now more specifically to the drawing, in FIG. 2 there is shown a yarn package such as a biscuit or a cheese **12** from which yarn **14** is pulled by feed roll **16**, the yarn passing over guide **18** and tension bars **20**, **22**, then over traverse guide **24**, then about the cot roll **26** which is driven by contact with the feed roll **16**. The yarn passes one or more turns about snubbing pin **28** provided with an electrical element **30** for heating, after which the yarn passes toward a drawing mechanism comprising a draw roll **32** operating in conjunction with a separator roll **34**, the yarn making several wraps around both to prevent slippage and then passing to the balloon guide **36** of a ring and traveller take-up **38** by means of which it is collected on a pirn **40**.

The draw roll is provided with a flange **42** which the yarn contacts transversely in its path to the roll surface. The flange **42** is provided with a relatively high friction surface, e.g. neoprene, to minimize yarn slippage thereover, the yarn being caused to twist by contact with the flange. The number of turns of twist inserted is theoretically a function of the relative diameters of the flange and the yarn although there will be some slippage whose amount depends on variables such as the type of spinning finish used.

The rotation of the flange sometimes causes the yarn to be flicked around the periphery and break out. To prevent this it has proven beneficial to position a guide **44** in such a position relative to the flange as to maintain a more positive contact between the yarn and flange and to minimize, if not prevent, such flicking of the yarn. Surprisingly, the guide does not arrest the twist in the yarn inserted by flange **42** and therefore does not prevent the twist from travelling back to heated draw pin **28**.

The invention is especially directed to a nylon monofilament yarn such as a 15 to 25 denier monofilament, although the filament may be as low as 10 denier or even 5 or as high as 50 or 100 or more. Heterofilament yarns in which the nylon portion is one continuous segment of the yarns are also contemplated. The nylon is preferably nylon 66, i.e. polyhexamethylene adipamide, but it may be nylon 6, 10 and the like, as well as polymers of caprolactam, amine-undecanoic acid, butyrolactam, the condensate of bis[para amino cyclohexyl] methane with dodecanedioic acid, and the like, as well as copolymers thereof and aromatic polyamides such a polyhexamethylene terephthalamide. Of course, the ESST or EHST testing procedure will be appropriately modified according to the yarn polymer properties, as is apparent to those skilled in the art.

While described hereinabove as coming from a package, if desired, the yarn may be coming directly from an extruder, never having previously been collected. Possibly, it is extruded continuously with polymerization so that monomeric hexamethylene diammonium adipate goes in at one end and a drawn and textured nylon **66** monofil is collected at the other.

After leaving pin **28**, the yarn cools slightly in ambient air for about 5–50, preferably 20–50 milliseconds. If desired, positive cooling means may be employed to effect further reduction in the temperature of the yarn during the false twisting operation.

Pin temperature is between about 150° to 220°C, preferably 170°–190°C with a pin diameter and number of yarn wraps so that the yarn path through the heating zone is about 2 to 30 inches, preferably 2 to 10 inches when the yarn speed is about 1000 to 5000, preferably 1500 to 2500, feet per minute. The desired degree of set is obtained under these conditions.

As discussed above, when setting is too extensive, the yarn does not conform as well to the new set during boarding. These processing conditions are not suggested by the prior art such as Deeley et al, U. S. Pat. No. 3,094,834, being directed to the production of multifilament crimped yarn.

The rotation of the flange should impart at least about 15 and preferably at least 20 to 40 turns per inch of real twist in the yarn between the flange and the snubbing pin. This can be measured visually by observing the change in angle of surface striation with respect to the longitudinal axis of the yarn and calculating the twist inserted therefrom. A yarn sample snatched from the twist zone is viewed under the scanning electron microscope when in the twisted configuration between the drawing pin and the flange.

While the process has been described as producing a pirn of product, the product may be collected on a horizontally rotating shaft, as a biscuit or cheese similar to **12**.

All take-ups have some upper limit of speed and the running yarn, where simultaneously drawn, has an optimum draw ratio to produce desirable properties and a stable process. Assuming the speed is 100 meters per minute and the draw ratio is 5:1, the maximum feed speed is only 200 meters per minute. If the feed is a filament extruder, this will necessitate running the extruder far below its capacity. It is a feature of the

present invention that with any given system the optimum draw ratio is lower than otherwise because of the percentage of draw effected due to the twisting action, so that for the same take-up speed a higher extrusion speed may be used, thus operating closer to the capacity of the extrusion equipment and of the polymerization equipment if all is in series. A draw ratio of about 3.5 to 5, especially about 4.0 to 4.5 and particularly about 4.2, is preferred.

The invention will now be further described in conjunction with the following illustrative examples.

EXAMPLE I

Using an apparatus as shown in FIG. **1**, undrawn nylon **66** monofil is fed to a ⅞ inch diameter snubbing pin maintained at a temperature of 175°C, passing thereabout two turns. The yarn is pulled from the pin at a draw roll speed of 1980 feet per minute fore a draw ratio of 4.22, the resulting monofil being 15 denier. The yarn in passing to the draw roll contacts the surface of flange **42** which is 5 inches in diameter. The rotational speed of the flange is such that about **30** turns per inch of false twist are inserted. The distance from pin to flange is 13.5 inches so that the yarn is appreciably cooled, and is thus heat set, while in twisted condition for about 22.7 milliseconds. The resulting yarn has a torque of 36.5 seconds, an ESST of 50, a Boardability Factor of 1.17 and a twist liveliness of 527.

Hoselegs knit therefrom in plain stitch constructions are characterized by improved ankle conformity and freedom from fabric distortion encountered using different draw-false twist conditions with the same apparatus.

EXAMPLE II

By contrast, 15 denier nylon 66 monofilament falst twist textured in conventional manner (after having been drawn in a previous operation) using a spindle and a heating element at 210°C has an ESST of 100, a Boardability Factor of 4.44 and a twist liveliness of 525. Because of the substantially high boardability factor, the host knit from such yarn does not adequately shrink widthwise during boarding and is characterized by poor post-boarding definition due to the inability to be adequately heat set during the boarding operation.

EXAMPLE III

Using the apparatus of FIG. **1** of the Drawing using a pin temperature of 120°C, a nylon 6,6 yarn is produced having an ESST of 40, a Boardability Factor of 1.66 and a twist liveliness of **780** (torque of 52 seconds for 15 denier yarn). The yarn is not lively enough for plain stitch knit hose constructions.

EXAMPLE IV

Using the apparatus of FIG. **1** in accordance with the invention, a 20/1 nylon 6,6 yarn is produced having an ESST of 54, a Boardability Factor of 1.25 and a twist liveliness of **600**. The yarn performs well in plain stitch hosiery constructions.

EXAMPLE V

A producer textured nylon **6** yarn is produced having an EHST of 51, a Boardability Factor of 1.49 and a twist liveliness of **660**. The yarn is characterized by insufficient torque for plain stitch hosiery constructions.

EXAMPLE VI

Using the apparatus of FIG. **1** in accordance with the invention, a 15/1 nylon 6,6 yarn is produced having an ESST of 58, a Boardability Factor of 1.33 and a twist liveliness of **555**. The yarn is excellent for use in the production of plain stitch hosiery with superior conformation about the ankle area.

EXAMPLE VII

Another sample of throwster, spindle false twist textured yarn having an ESST of 105, a Boardability Factor of 6.15 and a twist liveliness of 525 is knit into the standard hosiery construction. The hose after boarding exhibits poor configurational definition about the ankle area.

The yarn of the invention has a tenacity (grams/denier) of about 3 to 7, preferably 4 to 6 and an elongation at the break of about 15 to 50 percent, preferably 25 to 35 percent.

The yarn is preferably collected on the pin by means of a ring and traveller inserting a low degree of real twist, ⅛ to one turn per inch in the opposite direction of the false twist in the yarn. This facilitates take-off of the yarn from the pirn during the knitting operation. If the yarn is wound onto the pirn with a low degree of twist insertion in the same direction as the previously inserted false twist, the yarn springs off the package presenting control problems during the knitting operation.

It will be appreciated that the instant specification and examples are set forth by way of illustration and not limitation, and that various modifications and changes may be made without departure from the spirit and scope of the present invention.

What is claimed is:

1. False twist textured nylon continuous monofilament yarn having a Boardability Factor less than about 2.0 and a twist liveliness of about 450 to about 600.

2. The yarn of claim **1** having a Boardability Factor about 1.0 to 2.0.

3. The yarn of claim **2** having a Boardability Factor below about 1.5.

4. The yarn of claim **3** having a twist liveliness of about 500 to 600.

5. The yarn of claim **4** having a Boardability Factor below about 1.3.

6. The yarn of claim **2** having an ESST of less than about 75°C.

7. The yarn of claim **6** having an ESST of about 40 to 60°C.

8. The yarn of claim **2** having a torque of about 30 to 40 seconds.

9. The yarn of claim **2** comprising nylon 6,6.

10. The yarn of claim **2** comprising nylon 6.

11. A knit article comprising the yarn of claim **2**.

12. A knit structure comprising the yarn of claim **9**.

13. A knit structure comprising the yarn of claim **10**.

* * * * *