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[54] **DRAW TEXTURED YARN AND PROCESS**

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[58] **Field of Search** ..... 57/34 HS, 140 R, 157 TS, 57/157 S

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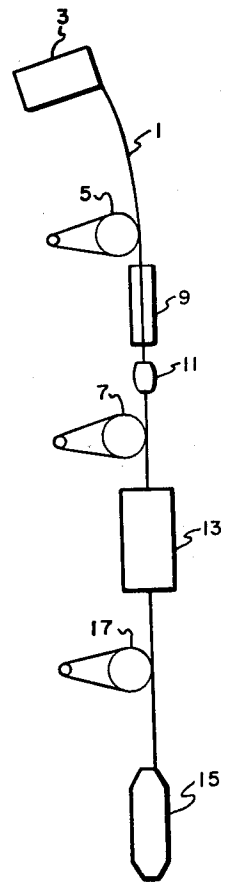
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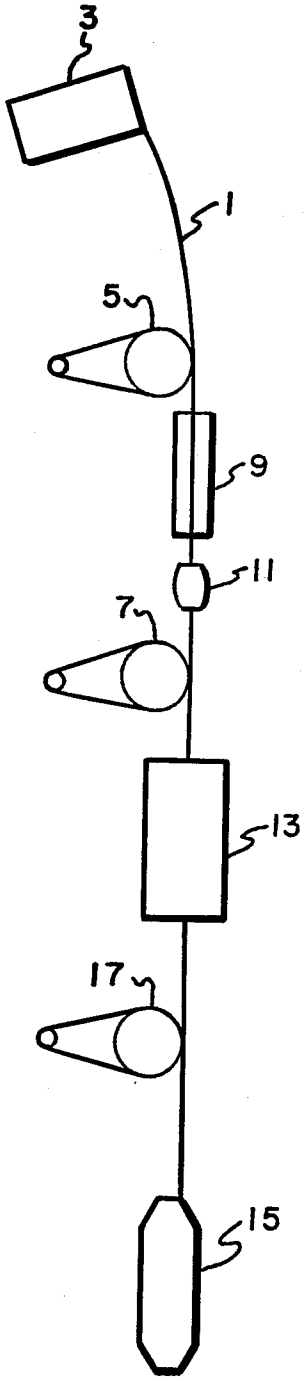
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[57] **ABSTRACT**

Textile denier, multifilament, false twist crimped, heat set stabilized polyester yarn characterized by liveliness and filamentation values and a simultaneous draw-texturing process for the production thereof.

15 Claims, 1 Drawing Figure




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DRAW TEXTURED YARN AND PROCESS

The present invention relates to a novel, draw-textured, stabilized polyester multifilament, textile denier, yarn suitable for fabric constructions, particularly knit and woven goods, requiring superior dimensional stability coupled with excellent yarn processability.

More particularly, the present invention relates to such a yarn of the false twist crimped type having a total denier of at least 30; a tenacity of about 2.5 to 4.0 grams per denier; an elongation of about 20 to 35 percent; about 30 to 85 crimps per extended inch of filament, a linear shrinkage under hot, wet conditions below about 15 percent, a liveliness factor of about 9 to 20 and a filamentation value of about below 0.4.

It has been suggested that the separate process stages involved in the production of false twist textured yarn can be combined into a simultaneous, sequential operation. Conventionally, a fiber producer spins a continuous filament yarn and then in a continuous or lagged operation therewith draws the yarn to a denier and tensile strength suitable for fabric construction. In a separate and distinct operation, the yarn is false twist crimped and then stabilized in continuous fashion by being overfed while subjected to heat or in a separate operation by being wound loosely onto a package which is then steam autoclaved. (See British Patent No. 787,619 and U.S. Pat. No. 3,316,705). In any event, stabilization is achieved by hot shrinkage of the yarn. These conventional texturing operations on the draw yarn are hereinafter referred to as "lagged operations" and the yarn thereby produced as "lagged operation yarn".

Belgian 728,461 discloses a type of simultaneous draw texturing process wherein undrawn yarn of textile denier would be fed into a false twist zone consisting sequentially of a heater, a false twister and a draw roll, the latter operating at a speed sufficient to draw the yarn at the desired draw ratio. The false twist backs up into the heated zone to and through a draw neck point located therein, wherein the twist is set into the yarn. The yarn is then sequentially, and in a continuous manner, overfed through a heated zone and packaged.

Although sound in principle, it was found that the product of the above described simultaneous draw texturing process, when processing conditions were as closely tuned to the lagged process conditions as reasonably feasible, did not perform as well as lagged draw and then textured yarn during fabric construction.

It has now been discovered that a polyester multifilament yarn of a total drawn denier of at least about 30, but generally below 200, and usually 40 to 175, and a denier per filament of about 0.5 to 10, usually 3 to 5.5, can be produced of somewhat lower tenacity where desired than lagged operation yarn but being characterized by superior fabric construction processability coupled with excellent dimensional stability in converted form. This invention relates to this novel product and a process by which it can be produced. Preferred embodiments of the present invention concern a 140 to 160 denier product processed at a defined twist per inch range.

As compared with lagged operation yarn continuously stabilized which has a tenacity of about 4.0 grams per denier (gpd) and above, the yarn of this invention has a tenacity of about 2.5 to 4.0 gpd, usually about 3.2 to 3.8 gpd. Elongation of both yarns is about 20 to 35 percent. Although the precursor yarn of the yarn of the

invention can be conveniently drawn to tenacities above about 4.0 gpd, such tenacities do not appear to be obtainable without the consideration of feed stock modification, detailed process optimization and the like, in the simultaneous draw texturing process. However, quite surprisingly yarn is produceable, utilizing the improved draw texturing process disclosed herein, having a tenacity up to about 4.0 gpd which is superior to lagged operation yarn in knitting and weaving operations, and in final fabric stability—two areas where one could normally expect decreased tensile properties to be a hindrance.

Processability of a false twist textured, stabilized yarn is conveniently gauged by its liveliness factor and filamentation value. If the yarn is too lively it curls and kinks upon itself as it is withdrawn from the package and fed into the fabric construction machinery, resulting in tension fluctuation and ultimately machine stoppage. Likewise, yarn of high filamentation value indicates the presence of ruptured filaments and fluttering filaments which snag, catch and otherwise cause machine stoppage.

The yarn of the invention has a liveliness factor of about 9 to 20 while lagged operation yarn heretofore tested by applicant has a liveliness factor of above about 60.

Liveliness factor (Q) is calculated by experimentally determining in a numerical fashion (1) the tendency of the yarn to twist upon itself in a relaxed state (designated A) and (2) the torque wrap number of the yarn when under a low tension such as applied during knitting and weaving operations (designated B). Liveliness factor is the product of torque wrap number and self-twisting tendency ($Q = AB$).

To determine "A", a 10 inch sample of yarn is attached between two clamps along a scale ruled to hundredths of an inch in a manner so that the yarn does not become free to untwist while being so placed and is under no tension. Then a tension hook applying 6.5×10^{-4} grams per denier (based on the denier of the yarn) stress is placed at a point midway between the two clamps. By releasing one clamp, slack is pulled from the yarn until it is parallel with the ruled edge. The tension hook is adjusted to the midpoint of the yarn's length, if necessary. One clamp is then unlocked and slowly moved toward the stationary clamp until the yarn twists or kinks upon itself. The distance remaining between the clamps is recorded. "A" or self-twisting tendency is equal to the average value over 10 observations. For the yarn of the invention "A" is below 1.5, preferably below 1.3, e.g., 0.90 to 1.30. Lagged operation yarn as heretofore tested has a value of over 2.0 and generally 2.2 to 2.5. Testing is conducted after moisture equilibrium is reached at 65 percent relative humidity at 70°F. in a draft-free enclosure.

To determine "B", or the torque wrap number, a 40 inch length of yarn is doubled and held vertically, secured at both ends, at 65 percent relative humidity at 70°F, but under no tension. A tension weight to apply 0.02 grams per denier to the yarn is then attached to the lower end of the doubled yarn and that end is released. After the yarn reaches equilibrium, the number of twists in the 20 inch sample is counted and the torque wrap number is the number of twists minus any producer twist present. Again, an average of 10 samples is used in the Liveliness Factor equation. For the yarn of the invention "B" is about 10 to 20, preferably

below 18, most preferably about 10 to 15, while lagged operation yarn as heretofore tested has a value of over 30 and usually about 40.

Thus, the Liveliness Factor, which takes into account what are believed to be two of the prime yarn characteristics involved in poor knitting processability due to yarn liveliness, of the yarn of the invention is about 9 to 20, preferably about 10 to 18, most preferably about 10 to 15.

Filamentation during the draw-texturing process is most prone to occur between the spindle and the draw roll. This is because the highest tensions to which the yarn is subjected during drawn texturing occur in that region of the operation wherein drawing tension is compounded by tension imposed by the spindle. In the usual lagged operation sequence, wherein the yarn is not being simultaneously drawn and false twist textured, the yarn is not under drawing tension and for 140 to 160 denier yarn about 50 to 60 turns per inch of false twist are inserted into the yarn. Thus, the yarn has been drawn at its optimised draw ratio, say about 3.65 for polyethylene terephthalate yarn, of birefringence about 5.8×10^{-3} and spun I.V. about 0.63 and then separately false twist textured. However, when these conditions are combined in simultaneous draw texturing, tenacity drops slightly but filamentation of the yarn significantly increases at the conventional lagged operation twist insertion level of about 55 turns per inch for 140 to 160 drawn denier yarn. Filamentation can be eliminated by significant draw ratio reduction i.e. below about 3.2 but with corresponding deterioration in tenacity i.e. often below 2.5 grams per denier. However, it has been quite unexpectedly found that in the simultaneous draw texturing operation, said operation being described in greater detail in the discussion of the Drawing hereinbelow, actual tension, as measured along the yarn longitudinally, decreases with increase in twist level, which results in improved tensile properties, particularly tenacity, by enabling the use of a higher draw ratio and also results in reduced filamentation. In fact, filamentation value without significantly lowering tenacity and elongation, can be decreased from about **10** to 30 at about 55 tpi; to about 0 to 0.4 at the higher twist frequency levels based on 140 to 160 drawn denier yarn.

In fact, yarn filamentation decreases to where it is below that of the lagged operation yarn as determined by "filamentation value," disclosed more fully hereinafter. Although not entirely understood, it is believed that higher twist translates a greater proportion of the total drawing and spindle induced tension into a force vector perpendicular or tangential to the longitudinal axis of the yarn, thereby reducing the tension component which the yarn must bear in the lengthwise direction. Thus, higher draw ratios corresponding to higher filament tensions can be employed, i.e., draw ratios approaching the optimum draw ratio of about 3.60 to 3.70 can be employed, e.g. about 3.20 to 3.40. Heretofore, to avoid excessive filamentation, draw ratios in the simultaneous draw texturing process of the order of below about 3.2 were believed to be about the highest useable in practice and then even producing yarn of marginal convertability as tested by filamentation value.

Having discovered the unexpected advantages of operating the simultaneous draw texturing process at a higher twist insertion level than lagged operators appeared to be employing, a defined range of twist level for 140 to 160 denier drawn yarn (assuming one starts with the usual 400 to 650 denier as spun yarn) has been developed which results in the low filamentation value but of acceptable tensile properties, yarn of the invention. An additional assumption is made, which is that the 140 to 160 drawn denier yarn (as used herein drawn denier means the denier of the yarn after drawing but prior to any relaxation or further stretching to the package or next speed control device) for proper aesthetic characteristics in today's commercial markets should not be processed at a twist level above about 80 and that it is desirable to operate at at least a twist insertion level of about 60 to realize the benefits of the invention. Thus, within the range of about 60 to 80 tpi, for no filamentation (as determined by broken filaments) during processing and low filamentation value yarn, tpi should be greater than about 25 R-**17** wherein R is draw ratio. For example, with a 500 denier as spun yarn, and draw ratio of, 3.4, the simultaneous draw texturing process should be run at at least 68 tpi. By using these operation conditions, one preferably is able to maintain tension above the spindle to about 23.0 to 27.0 grams, e.g. 25 grams for 150 denier drawn yarn, or less. Obviously, it is possible, once a given tpi is desired, to run the process at a range of draw ratios and measure tension between feed roll and spindle. The highest draw ratio between 3.2 to 3.4, within the 60 to 80 tpi range, which reduces tension as described, can be employed.

Filamentation value characterizes the yarn not only in a physical sense but is indicative of its improved performance properties, as will be apparent. This is because the characteristic relates directly to the number of times a fabric construction machine, in this case a knitting machine, will be stopped per unit length of fabric due to yarn filamentation, filamentation in this sense meaning loose filaments and the like as well as broken filaments. In other words, the theoretical and visual improvement by selection of yarn processing conditions translates into improved fabric construction efficiency.

Filamentation Value is based on knot free yarn and is the actual number of machine stops due to filamentation (most usually a loose filament caught underneath adjacent layers of yarn on the feed package) per 30 feeds (30 feed packages) per **10** fabric yards on a Fouquet Interlock Knitter. The knitting machine is set to 15 to 18 rotations per minute with the machine stop mechanism being set at medium sensitivity.

The yarn of the invention has a Filamentation Value below 0.4, usually about 0.1 to 0.3. Yarn produced by draw texturing at the low twist insertion levels with draw ratios which would be used to fully flat draw the same yarn has a significantly higher Filamentation Value, e.g. about 10.0 to 30.0; lagged operation yarn has a Filamentation Value of about 0.4 to 1.0.

Although the yarn of the invention (improved draw textured yarn) in certain instances is not as strong, as measured by tenacity as lagged operation yarn, it performs in a superior fashion in final fabric form as regards maintenance of shape definition. This is believed to be characteristic of the yarn of the invention because of its method of manufacture which apparently imparts a high degree of resiliency or recovery to the yarn as can be measured by the "dynamic cycle stretch yarn" test.

The dynamic cycle stretch test measures the amount of work required to extend an end of relaxed yarn after it has been extended a given number of times at a defined load. A higher value correlates with enhanced fabric stability. The yarn of the invention has a dynamic cycle stretch test value of above about 1.8, preferably above 2.0, but generally below about 2.5. Lagged operation yarn as heretofore tested has a value of about 1.0 to 1.6, which is significantly lower. The dynamic cycle stretch test value is determined as follows:

APPARATUS

A constant-rate-of-extension tester such as the Instron, which will draw a closed-loop extension-recovery curve is required. This should preferably be equipped with an integrator to measure the work of extension. The instrument is adjusted to draw a closed-loop extension-recovery curve. The following settings are used:

Full Scale Load	0.2 gm. per den.
Gauge Length	2.5 in. (63.5 mm)
Head Speed	2 in. per min.* (50.8 mm. per min.)
Chart Speed	5 in. per min. (127.0 mm. per min.)

* It may be desirable to vary the head speed depending on maximum yarn stretch.

PROCEDURE

1. Skein 5 yards (4.57 m) of yarn under low tension. Relax in water at 140° to 158°F. (60° to 70°C.) for 10 minutes and centrifuge. Dry in tensionless state, and condition for one hour in a standard atmosphere at 70°F. (21°C.) — 65 percent RH.

2. Cut 4 samples of yarn approximately 5 in. (127.0 mm.) long when in relaxed state.

3. Attach a weight of coiled copper wire to one end of each sample equivalent to 0.002 gm. per den. of original yarn. Attach the other end of each sample to a rack or horizontal bar so that the yarns can hang freely.

4. Using a clamp weighted (equivalent to 0.1 gm. per den.), subject each yarn in turn to this tension, removing the clamp after 1 or 2 seconds so that the yarn is again hanging freely under 0.002 gm. per den. tension. The purpose of this step is to remove the tangled fibers which result from skeining, scouring, and drying, and which would otherwise interfere with the accuracy of the test.

5. After a minimum of 15 minutes, place sample in the tester so that the 2½ in. (63.5 mm.) gauge length is attained while the yarn is under a tension of 0.002 gm. per den.

6. Operate the tester so that the sample is cycled 5 times between original gauge length and that which creates a force of 0.1 gm. per den. (recorder pen half way across chart). Record integrator readings for each of the extension and recovery cycles. After the third or fourth cycle, the decrease in these readings should be less than 5 percent. For routine testing, only the reading of the fifth extension cycle is needed.

CALCULATIONS

Values of percent stretch and the work stretching of the fifth cycle are calculated from the Instron chart and the integrator reading.

EXAMPLE I

An as spun 510/36 yarn of linear fiber-formable polyethylene terephthalate (having an intrinsic viscosity of about 0.63, a birefringence of about $\sim 5.7 \times 10^{-3}$, polymerized from polyester monomer produced by the direct esterification of terephthalic acid with ethylene glycol, such polymer having a free glycol content of less than about 2.25 mol percent) is draw textured in a continuous operation in accordance with the following process conditions and with reference to the drawing.

The undrawn yarn having a producer twist of about 0 turns per inch, is supplied from supply package **3** to the draw texturing operation. The yarn is pulled off of the supply cheese by positively controlled feed roll **5.** Draw roll **7** is operated at a peripheral speed so that the yarn is drawn 3.45 times, based on feed and draw roll surface linear speeds in the drawing zone between feed roll **5** and draw roll **7.** Hot plate **9,** heated by internal steam generating means and 3.25 feet long, is maintained at about 230°C. False twist spindle **11,** being of the tube type having a centrally-located sapphire pin about which the yarn is wrapped once, is rotated by means not shown at about 370,000 rotations per minute. Yarn speed around the draw roll is about 440 feet per minute, so that about 70 tpi (turns per inch) of twist is put into the yarn upstream of spindle **11** while the same amount of twist is taken out of the yarn downstream of the spindle, in accordance with conventional false twisting principles. The 70 tpi runs back from the spindle, along the yarn as it passes across the heater, gradually decreasing as it reaches the draw point, which is located about 2.5 inches below the top of the heater plate **9,** thus setting the yarn in the twisted configuration. The draw point is precisely located without the use of external means such as a draw pin by the dynamic conditions of the draw texturing process. Because of the change in yarn denier at the draw point, tpi above the draw point is no more than about 15 to 20 and gradually dissipates as it runs back toward the feed roll **5.** Tpi decreases about proportional to increasing denier as it passes through the draw point. From the drawing texturing zone, the yarn, now about 150/36, passes immediately and sequentially into a 25 inch long hot air chamber **13** maintained at about 190°C. at a 16 percent overfeed as measured between draw roll **7** and relax roll **17.** In the relaxation zone, the drawn, crimped, torque lively yarn is stabilized for subsequent use in knit and woven fabric constructions requiring dimensional stability, stitch definition and the like properties. The yarn is then fed to package **15** at about 7 percent underfeed to form a firm package construction suitable as a feed package for knitting and weaving processes. The yarn has the following characteristics:

Tenacity	3.2	gpd
Elongation	22%	
Linear Shrinkage	5%	
Liveliness Factor	32	
Self-twisting Tendency	1.6	
Torque Wrap Number	20	
Filamentation Value	0.2	
Dynamic Cycle Test Stretch Value	2.1	
*Crimp Frequency	34	crimps per extended inch of filament

-Continued

*Five individual filaments are removed from the yarn bundle at points spaced from the outside to the center thereof. Each filament is extended fully, but not stretched, and the number of crimps per extended inch counted. The average of the five values is the crimps per inch of the yarn based on extended filaments which is about 30 to 85 for the yarn of the invention. (30 to 45 for 145 denier and above and where desired 45 to 85 for the lower denier yarns)

Linear shrinkage is measured after 30 minutes in boiling water as linear shrinkage per unit length under a tension of 0.045 grams per denier. Preferably, the yarn of the invention has a linear shrinkage below 10 percent, most preferably below about 5%.

EXAMPLE II

Example I is repeated with the following changes: the polyester yarn is drawn at a draw ratio of 3.2, 65 tpi is put into the yarn and the hot air chamber **13** is 40 inches long. The product of this Example is essentially equivalent to the product of Example I, except that its linear shrinkage is **2.275** percent, its liveliness factor is 15.12, its self-twisting tendency is 1.08 and its torque wrap number is 14.0.

Example I illustrates the general type of draw texturing process and product described herein and disclosed in copending, commonly assigned, application Ser. No. 110,985, filed Jan. 29, 1971 now U.S. Pat. No. 3,708,970.

Example II illustrates the inventive species of process and product disclosed herein.

With reference again to the drawing, the following is a more general disclosure of the process used to produce the improved yarn of the invention.

Heater **9** is maintained at a temperature of about **180**°C. to 240°C, preferably **210°–240**°C., for enhanced dye uniformity. When a heater having a gradual temperature profile along its length is used, the temperature stated is the maximum measurable temperature. The heater may be of any suitable shape and form, as the grooved plate type or of the hot air box convection type. The plate type is preferred because with polyethylene terephthalate yarn, or with many other synthetic polymer yarns, the yarn will melt if heated in undrawn state above the second order transition temperature of the polymer (90°–100°C. with polyethylene terephthalate). Drawn yarn can be subjected to the higher temperatures employed in the simultaneous draw-texturing process, but drawing will not take place unless the yarn is heated above ambient conditions. Thus, the yarn is held off but near the heater plate until draw texturing is taking place and is then placed in direct contact with the heater. Conductive heaters may be heated electrically or by other means such as by steam or hot air flowing through a tube positioned beneath the surface of the heater. The heater will be about 2 to 6 feet long, usually about 3.3 feet long.

The twister will generally be of a conventional spindle type. Preferred for balance purposes is a tubular spindlet having a twist trap pin centrally located across its diameter about which the yarn is wrapped once. The spindle is driven by a motor at speeds of about 300,000 to 600,000 rpm, and above, i.e., 800,000 rpm. Various threadline stabilizers, such as tubes and guides, many of which are well known in the art, can be positioned above and below the twister. With lower denier yarns, approaching the 40 denier area, friction false twisters such as one or more revolving bushes, flanges and cups arranged for sequential and/or simultaneous yarn contact can be employed. Yarn speed is correlated with twister speed to insert the desired number of turns per inch into the yarn. The inserted twist runs back along the yarn, through the draw necking segment of the yarn and on into the as-spun yarn, with the tpi value decreasing about proportional to increasing yarn denier.

A spin finish of the type imparting good, that is low, fiber to twist trap pin friction characteristics to the yarn will be applied to the yarn prior to the draw texturing operation or therewith but prior to the first heater. This is done so that excessive tensions are not imposed on the yarn by the twister, which would contribute to filamentation. Finishes suitable for this purpose are those routinely employed in the art, for example those containing lubricants such as hexadecyl stearate, high viscosity mineral oil, polysilicones, and the like. The drawtexturing process should be operated so that the ratio of tension above the spindle to the tension below the spindle is about 1:1.5 to 1:2.5, preferably about 1:1.7 to 1:2.3. In preferred numerical values, the measureable tension along the strand path above the twister is about 0.118 to 0.180 grams per denier based on the drawn yarn denier and about 0.236 to 0.420 grams per denier below the twister, also based on drawn yarn denier.

The feed and draw roll means are of a non-slipping, positively controlled type, for example a draw roll and spacedapart associated separation roll about which the yarn is wrapped a plurality of times, or of the endless belt "ca sablanca" type.

The second heater is conventionally of the enclosed convection type, although plate type heaters can be employed, and is maintained at about 150°–240°C., preferably about 170°–210°C. The second heater stabilizes the yarn and has a primary influence on the degree of bulk in the yarn on the package, which is relaxed about 10 to 30 percent, preferably about 12 to 20 percent as it passes through the second heater zone. Generally, the higher the first heater temperature and the lower the second heater temperature, the higher the bulk of the yarn on the take-up package. For practical purposes, degree of bulk on the package may be considered to be overfeed minus linear shrinkage, with greater linear shrinkage occuring at higher second heater temperatures. From the heat stabilization step, the yarn is underfed about 5 to 10 percent to the take-up package in order to form a package of sufficient hardness and stability suitable for use to feed yarn into knitting and weaving operations.

Various modifications of the invention will appear obvious to those skilled in the art. For example, although the invention has been exemplified with polyethylene terephthalate, fibers formed of other fiber-formable polyester, as well as fiber-forming polyamides and blends thereof are useable in conjunction with the present invention.

It will be further undersood that, while the Examples describe a unitary operation involving passage through a second heater, the advantageous properties of the yarn of this invention induced by high-twist level simultaneous drawing and texturing may be secured in a lagged operation involving a separate autoclave step, or second heater and autoclaving steps might be usefully combined. For 140 to 160 drawn denier yarn, about 60 to 80, preferably 63 to 72 tpi is inserted into the yarn in accordance with the inventive process. With decreasing denier yarns, twist insertion level can be raised even higher if yarn speed is accordingly sacrificed. For

example, it is believed that to produce a 100 denier multifilament yarn i.e. 100/20 of similar aesthetics, dye uniformity and constructability properties as the 150 denier product described herein, about 75 to 95 twists per inch, preferably about 80 to 90 twists per inch should be inserted into the running threadline. In this manner, the amount of secondary twist, which is believed to contribute to dye uniformity, found in the 150 denier product will be inserted into the 100 denier product. This level of secondary twist is about 25 to 50 turns per inch. With the 100 denier product up to 60 tpi of secondary twist can be inserted.

The general principles outlined herein can be used in the texturing of partially drawn yarn as well as with as-spun yarn.

What is claimed is:

1. A fully drawn polyester multi-filament, false twist crimped, stabilized yarn having a total drawn denier of about 140 to 175, a denier per filament of about 0.5 to 10, a tenacity of about 2.5 to 4.0 grams per denier, an elongation of about 20 to 35 percent, a linear shrinkage below 15 percent, a liveliness factor of up to about but less than 20 and a filamentation value of about below 0.4.

2. The yarn of claim **1** wherein the liveliness factor is above 9.

3. The yarn of claim **1** wherein the polyester is polyethylene terephthalate.

4. The yarn of claim **3** wherein the yarn tenacity is at least 3.0 grams per denier, linear shrinkage is below about 10 percent, the liveliness factor is above **10** and the filamentation value is 0.1 to 0.3.

5. The yarn of claim **4** wherein linear shrinkage is below about 5 percent and the liveliness factor is above 10.

6. The yarn of claim **3** wherein the torque wrap number is 10 to 25 and the self-twisting tendency is below 1.7.

7. The yarn of claim **6** wherein the self-twisting tendency is 0.9 to 1.3 and the torque wrap number is 10 to 20.

8. The yarn of claim **3** wherein the dynamic cycle stretch test value is above 1.8.

9. The yarn of claim **3** wherein the dynamic cycle stretch test value is 2.0 to 2.5.

10. In a process for producing a drawn false twist crimped polyester multifilament yarn having a total denier of about 140 to 175, wherein an undrawn or partially undrawn polyester yarn is fed into a simultaneous drawing and false twist crimping zone consisting of a heater and false twister positioned between a feed means and draw means and wherein the false twist backs upstream into the heated zone wherein the false twist is set into the yarn and wherein the yarn necks at a draw point without the presence of snubbing means with the false twist passing back through the draw necking segment of the yarn on into the undrawn yarn, the level of twist decreasing about proportional to the increasing denier of the yarn, the improvements which comprise inserting about 60 to 80 turns per inch of false twist into the yarn while drawing the yarn about 3.20 up to but less than 3.40 times to produce a yarn having a tenacity of at least **3.0** gpd and an elongation of at least 20 percent, said draw ratio being less than the optimum draw ratio of said yarn.

11. The process of claim **10** wherein the yarn tension on the yarn along the longitudinal axis thereof is about 0.118 to 0.180 grams per denier above the false twister and about 0.236 to 0.420 grams per denier below the false twister.

12. The process of **11** wherein 63 to 72 turns per inch of false twist is inserted into the yarn.

13. The process of claim **11** wherein as spun yarn is processed and at least 25 R-17 turns per inch of false twist is inserted into the yarn, wherein R is the draw ratio being employed in the false twist zone.

14. The process of claim **13** wherein the tension in the yarn above the false twister is below about 27 grams.

15. A knit fabric comprising the yarn of claim **1.**

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