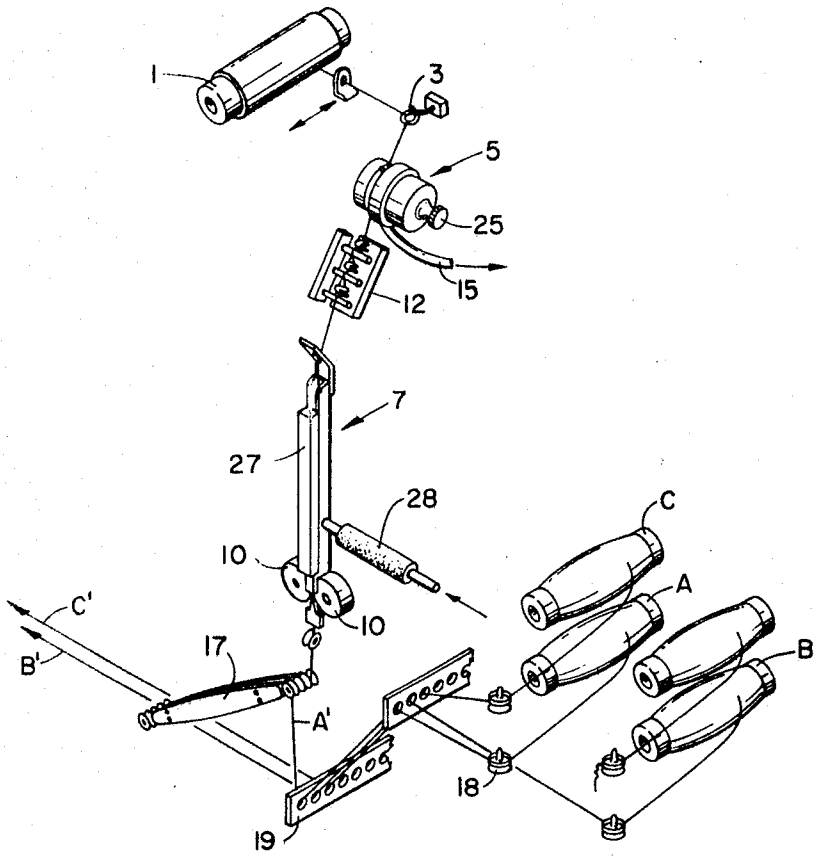
Aug. 19, 1969 B. B. ESKRIDGE ET AL 3,461,521

PROCESS FOR MANUFACTURE OF YARNS

Filed Nov. 24, 1967 3 Sheets-Sheet 1

FIG. 1



INVENTORS

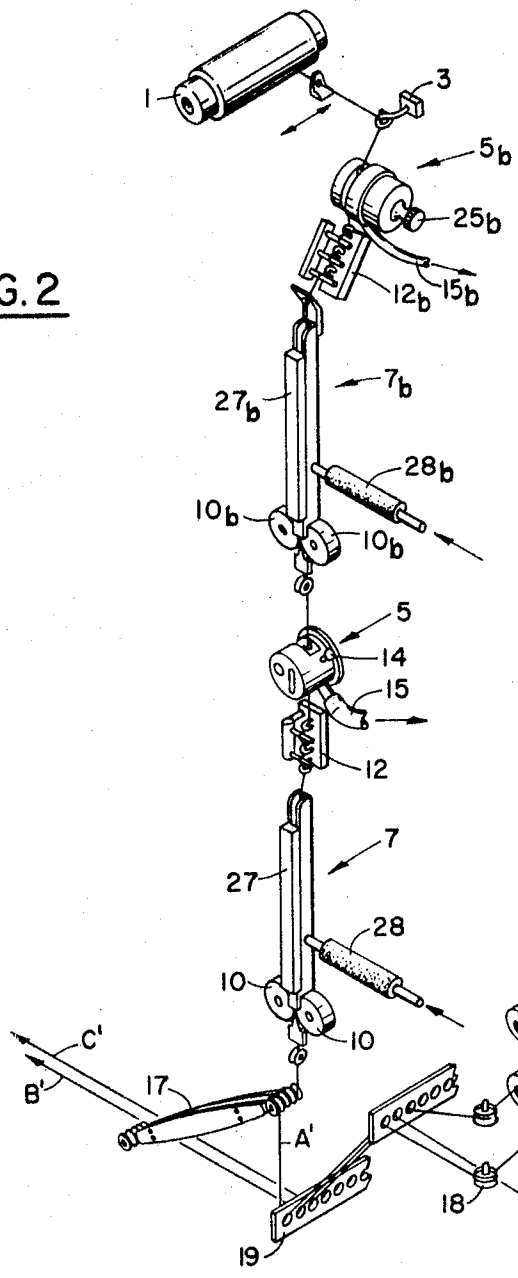
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PROCESS FOR MANUFACTURE OF YARNS

Filed Nov. 24, 1967 3 Sheets-Sheet 2

FIG. 2



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PROCESS FOR MANUFACTURE OF YARNS

Filed Nov. 24, 1967 3 Sheets-Sheet 3

FIG. 3

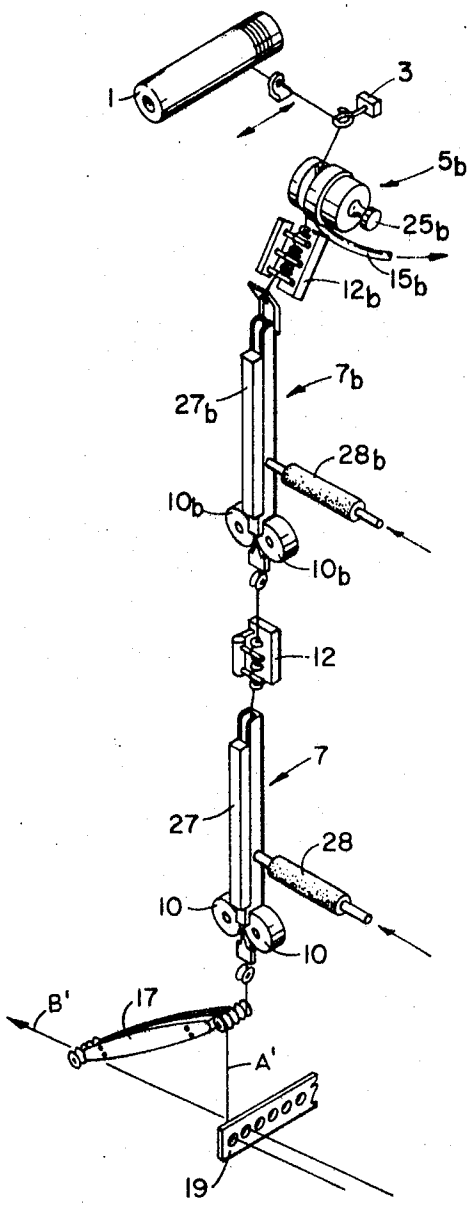
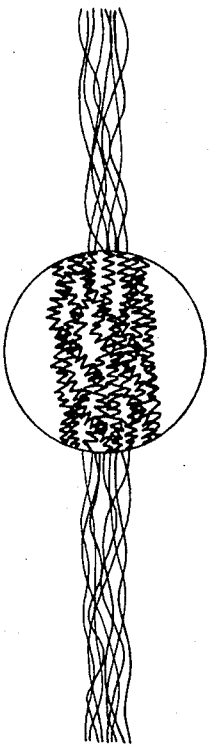


FIG. 4



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3,461,521

PROCESS FOR MANUFACTURE OF YARNS

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Int. Cl. D04h 3/00
U.S. Cl. 28—72.11 6 Claims

ABSTRACT OF THE DISCLOSURE

A textured yarn or strand having exceptional properties can be obtained by deforming thermoplastic filaments, heat setting the filaments while deformed, and thereafter annealing the deformed and heat set filaments with moist heat while under sufficient tension to prevent significant contraction and to remove internal stress imparted by the deforming operation.

This invention relates to a continuous multiple and diverse treatment of filaments, fibers, yarns, or larger bundles of filaments, such as tow and the like, and the product obtained therefrom. More particularly, the invention relates to a process of producing bulky, voluminous yarn having an improved degree of uniformity and of crimp contraction in both linear and amplitude dimensions, which in turn exhibits an improved degree of bulk, bulk stability, even dyeing characteristics, and soft, pleasing "hand" or feel and covering power when made into textile fabrics, floor coverings, industrial textile materials, and the like. Running lengths of initial or source filaments, strands, yarns or tow textured by the process of this invention have an improved permanency of crimp and, accordingly, will have an accompanying high degree of bulk retention and bulk stability when knitted, tufted or woven into fabrics, floor coverings, etc. Permanency of crimp and attendant high degree of bulk retention are also significant in improving pattern definition characteristics when the yarn is woven, knitted or tufted into fabrics, floor coverings and the like and subjected to harsh finishing operations.

In the ensuing specification and claims, the term "yarn" is intended to connote any thermoplastic strand, filament, multifilament or tow of nylon; polyester; acrylonitrile; polyolefins, i.e., polypropylene, etc.; polyvinyl chloride; polyphenylene oxides; or copolymers of the various synthetics regardless of denier, length, structure or composition. It is preferred for the purposes of this invention that plural continuous filaments be used which consist entirely of a synthetic organic polymeric material such as nylon, polyester and the like. Composite filaments of, for example, nylon and polyester are also visualized.

Bulky or voluminous yarn composed of a plurality of continuous individually crimped filaments can be made in a variety of ways. For the most part, known methods comprise: (1) forwarding initially straight twisted or zero twist feeder or source yarn to a stuffer box wherein the yarn overlaps and becomes folded upon compression; (2) subjecting the source yarn to the action of fluids or gases under pressure as in an air jet wherein yarn products are obtained with individual filaments having loops, convolutions, curls, whorls, or the like; (3) mechanically false twisting utilizing high speed spindles or the like; (4) gear crimping per se; and/or (5) a combination of these.

The well-known stuffer box crimping procedure utilizes construction such that relatively straight source yarn is forced into an enclosed chamber by a pair of rolls and accumulates therein by pressure developed by its passage through the chamber. The source yarn accordingly overlaps or "wads" in the box and a repeating serrated, zigzag, or sawtooth-like crimp is imparted to individual filaments thereof by the accumulation. The crimp usually recurs in a somewhat regular fashion. To obtain improved warmth-giving bulk, heated fluids also are often utilized to soften, moisten, and/or heat set the yarn while in a relaxed condition in the box.

In producing yarns of increased bulk pneumatically, i.e., wherein processes and apparatus are utilized that subject an initially straight twisted or untwisted (zero twist) source yarn to the action of a turbulent fluid, the individual filaments of the yarn are looped, curled or convoluted. The individual strands are in effect entangled to form a bulky, wool-like yarn product wherein each of a multiplicity of filaments, when in a relaxed condition, has a plurality of convolutions along a selected length. The convolutions are usually offset and out of phase with each other.

Another yarn of improved bulk is commercially prepared by the steps of twisting, heat setting, and back twisting using a false twisting apparatus.

In U.S. Patent No. 3,099,064, a method is also suggested for producing a "rug" yarn having an improved bulk by continuously passing a plurality of synthetic yarn ends through a fluid jet and, subsequently, stuffer box crimping.

It should therefore be readily apparent that attempts toward development of yarn having an increased warmth-giving bulk, covering effectiveness and, in general, qualities that are more like wool, embrace numerous methods and apparatus. And while most, if not all, lead in some manner to an improved product in regard to such qualities, they still suffer from serious drawbacks and are not completely satisfactory to the industry for all applications where textured yarns conceivably could be utilized.

One significant problem long associated with textured synthetic yarns produced using stuffer box crimpers that has continually plagued the textile industry is their uneven or irregular dyeing characteristics. It has been observed that the affinity of such yarns for various dyes is very sensitive to change, changes not only embracing certain variations of conditions in polymer formation and spinning, but also changes in conditions which impart a different crimped or bulked configuration, or, for that matter, a mere difference in the degree of crimp to the yarn. This sensitivity varies markedly with even the slightest variation in the processing conditions of either the polymer or the yarn and directly causes visible off-color sections, such as deeper or lighter dyed streaks, to occur throughout a fabric product. Since such fabrics are generally unacceptable on a commercial basis, yarn producers are faced with costly claims of the textile fabric manufacturers for all such irregularities believed caused by the yarns.

Manufacturers of textured yarns have made various attempts, including greater control of the source yarn production systems, i.e., control of polymer molecular weight, exact control of temperatures used during spinning and drawing, tensions used during drawing and winding, etc., in an effort to solve the uneven dyeing characteristics and yet obtain yarns that are evenly crimped or bulked and which retain a measure of bulk retention when in fabric form. In this direction, attention has been focused on manufacture and subsequent utilization of filaments having a plurality of different cross sections in texturizing operations. This second procedure serves, in effect, to "hide" dyeing inconsistencies when the yarn is woven into fabric.

While the necessity of bulk stability and bulk retention has not been frequently voiced as a problem in the literature, it remains an important aesthetic quality long sought by producers of synthetic yarns in order to provide a sala-

ble product more favorably comparable to wool when in fabric form. A definite need therefore exists for a synthetic yarn which retains a level of bulk and height of pile along with acceptable dye-evenness characteristics when manufactured into floor coverings, knit goods, or fabrics and subjected to numerous batch or continuous hot and/or aqueous aftertreatments such as dyeing, steaming, washing, backing and the like. Heretofore, no one texturing procedure has been found totally satisfactory.

It is therefore an important object of this invention to provide a process and apparatus for manufacturing stuffer box textured synthetic yarns which have uniform qualities.

Another object is to provide synthetic yarns of acceptable bulk, wool-like appearance and hand when in fabric form.

It is another object of the invention to provide a process for producing textured yarns which have improved crimp and a dimensional stability thereof associated with a distinct uniformity of bulk, bulk retention, color, shade or tone when dyed and in fabric form.

Still another object of this invention is to provide a process and a combination of apparatus for producing stuffer box crimped yarns wherein the degree of permanence and dimensional stability of crimp is appreciably improved over those yarns produced heretofore.

The present invention satisfies the above objectives and efficiently provides a textured yarn product having a remarkable crimp diversity and stability along its length and amplitude (deviation from the horizontal) which, surprisingly, exhibits an improved fabric uniformity in regard to bulk retention and stretch-free appearance when dyed. In addition, the stuffer box crimped yarns of the invention retain almost entirely the degree of crimp imparted along with their original filament properties in regard to modulus, tenacity, etc., when constructed into fabric, floor coverings, etc., and thereafter subjected to hot aqueous aftertreatments such as dyeing, seaming, washing, and the like.

In brief, a process is visualized for texturizing thermoplastic filaments, strands or yarn comprising crimping, heat setting the crimp and thereafter annealing with moist heat, under sufficient tension to prevent shrinkage and to remove internal stress or strain imparted by the crimping or bulking operation.

As a more detailed elucidation, the process of the application contemplates a plural diverse yarn treating procedure in which yarn, preferably containing a plurality of relatively straight continuous filaments, is first advanced from a suitable supply (such as a single package, or plural packages placed on a supporting creel or the like), is preheated and thereafter advanced to a first treating zone which consists of a modified version of a yarn crimping apparatus of the general type shown in U.S. Patent No. 3,027,619. The apparatus of the instant invention essentially comprises an elongated yarn-confining chamber of the stuffer box type wherein a pair of rolls is used to forcibly introduce yarn to the chamber to cause bending and folding thereof when subjected to momentary compression while advancing through the box. In one embodiment, an added compression imparting means such as a compression key, ratchet wheel, weighted exit door or the like is utilized to constitute an obstruction in or on the chamber in order to apply back pressure to the yarn during its passage through this first zone. If desired, the added obstruction can be eliminated, as shown in U.S. Patents No. 3,070,869 and No. 3,108,352. The yarn thus can be compacted or subjected to compression in a crimping area (located immediately within the chamber) merely by the combined action of the two cooperating feed rolls forcing the yarn into frictional engagement with the inner walls of the box. Preferably, the yarn is heat set by treatment with a heated fluid such as air or steam after it emerges from a compression zone but while still within the box. The yarn is not under compression when steamed; it is merely loosely folded upon itself. When the yarn leaves the crimping box, it is, and as a critical aspect of the invention, annealed with a heated fluid such as moist steam while under sufficient tension to prevent subsequent plural dimensional shrinkage or contraction.

With an object toward increasing a degree of permanency in regard to amplitude and frequency of the crimp imparted, the yarn thus textured is not only subjected to moist, crimp setting steam while in the confining passage in the manner described above, it is further subjected to the separate and distinct annealing treatment utilizing moist steam at a temperature of at least 100° C. while under sufficient tension to prevent linear and amplitude contraction (plural dimensional shrinkage) of the yarn. Tension in excess of that required to prevent yarn contraction should not be used since the previously imparted crimp conceivably could be removed should it be too great. While not wishing to be bound by any particular theory, it is believed that this subsequent annealing sequence of the invention serves to remove residual stresses and strains imparted to the yarns when they are stuffer box crimped. Filaments, strands or yarn textured according to the invention thus can be further characterized by having substantially reduced residual internal stress and strain, associated with a reduced degree of bulk contraction and an undiminished degree of crimp amplitude, frequency and individual filament or yarn properties.

A voluminous textured yarn is produced composed of a plurality of substantially continuous individual filaments permanently fixed by their internal molecular structure in a persistent serrated or sawtooth-like configuration and individual curvilinear bends at random intervals along a selected length thereof. Therefore, the term "textured" is used for the purpose of this invention to indicate the fact that lengths of yarn selected at random include filaments having, in combination, a serrated or sawtooth-configuration and curvilinear bends which are offset and out of phase with each other. It is observed that the flow of the moist steam in the annealing procedure utilized after crimping not only enables the amplitude and frequency of the serrated or sawtooth crimp to be retained in the yarn, but it also induces and preserves numerous evenly distributed curvilinear bends which occur throughout a selected length thereof.

Therefore, in using the process of this invention, it is possible to produce textured yarns having a variety and an increased number of crimps in order to give users specific crimp characteristics for subsequent operations. As set forth in British Patent 759,070, the yarn can be passed to a second crimping means, for example, a second stuffer box crimper consisting of an elongated yarn confining stuffing box or chamber for the purpose of increasing the number of crimps along a selected length.

For some intended applications, it also may be preferred that the yarn be cooled by passage through a cooling chamber or the like preliminary to additional texturing procedures.

It is also preferred that the yarns be preheated before being fed to the first crimp imparting means. The filaments can be preheated using an electrically heated plate or tube, infrared lamps, or, conceivably, the yarn can be passed through a heated liquid bath, a steaming chamber, or the like.

During the annealing procedure, the temperature of the steam and tension applied to the yarn must be carefully controlled in order to obtain a product with uniform properties. The temperature of the moist steam applied will, in some degree, depend on the speed of the yarn through the steam treating apparatus.

The complete nature of the invention will be better understood from the following description, taken in conjunction with the accompanying drawings wherein:

FIGURE 1 is a perspective view of a preferred embodiment of the apparatus for manufacturing the textured yarn according to this invention;

FIGURE 2 is a perspective view of an alternate embodiment of the apparatus;

FIGURE 3 is a perspective view of another embodiment; and

FIGURE 4 is an enlarged side view of the yarn produced according to the invention.

Referring to FIGURE 1, the pretwisted continuous filament source or feeder yarn A' to be treated is supplied from yarn package A supported on an appropriate creel. Although producers pretwisted source yarn is utilized in the embodiments of this invention as illustrated, it is to be understood that untwisted yarns also can be used. It should also be understood that an intermediate packaging step can be dispensed with, if desired. In other words, the yarn can be supplied directly from the spinneret to a drawing (stretching) apparatus and then to apparatus utilized by the process of this invention. Yarn A' passes through a suitable tension member **18** and guide members **19**. Each guide has a plurality of corresponding apertures, and serves to guide the yarn to a separate stage consisting of apparatus according to the invention. Plural units can be arranged one after the other for purposes of commercial production. Beyond the perforated guides, the source yarn passes over a single ceramic guide and thence to the electrically heated plate **17**. The yarn is conveniently preheated by one or more passes across the plate. As mentioned previously, it is also contemplated that the source yarn can be adequately preheated using a variety of other means, for example, a heated tube, heated bath, or possibly infrared lamps, and the like.

In referring to crimper or stuffing box **7**, FIGURE 1, feed rolls **10** and their mounts along with their continuous parts are fully described in U.S. Patent No. 3,027,619. The construction of the rolls can be the same as those identified in the patent or they can be of serrated construction, as illustrated in U.S. Patent application Serial No. 427,828 filed January 25, 1965, now U.S. Patent No. 3,353,239, granted Nov. 21, 1967.

It should be understood that the invention is in the manner in which the apparatus is utilized, not in the particular construction of individual crimpers or the steam annealing apparatus. However, for the purpose of stating preferred construction, it is to be noted that boxes **7** are formed by an elongated metal or plastic trough or U-shaped member faced with a clear plastic plate **27**, thus forming an elongated channel-like box. Steam is admitted under a predetermined pressure to the box at **28**. The steam being fed into the stuffing box is taken up for the most part by the yarn in or passing through the box. A serrated or sawtooth crimp is imparted to the yarn by force feeding it between the two rolls into a compacting zone while the yarn is progressively folded; steam is admitted to a relaxing zone in the box.

The yarn leaving box **7** is well crimped due to preheating, steam softening, and the pressure exerted thereon by frictional engagement with the inner walls of the box. In the box, the yarn is folded back and forth (on itself) in a restricted space (compacting zone) until sufficient pressure is built up to force it through the exit end immediately preceding tension gate guide means **12**. It is to be understood that additional compression means, such as a weighted clapper door or ratchet wheel (in the compression exerting retarding pressure on the yarn zone of the box) is preferred. Compression means of various other constructions can also be used in lieu of the one set forth above, if desired.

Textured yarn emerging from crimper **7** passes through the finger tension gate **12** to steam annealing apparatus **5** through which tensioned yarn travels. The apparatus comprises a substantially closed chamber for the treatment fluid having an inlet and outlet for the textured yarn under tension. The yarn to be treated is passed continuously through the chamber while at the same time a fluid, such as wet steam, is being fed thereto. The apparatus may be of a construction as shown in U.S. Patent No. 3,167,843, or that of U.S. application Serial No. 571,949 filed August 11, 1966, now U.S. Patent No. 3,394,440, granted July 30, 1968. Steam under applied pressure enters conduit **14** (shown in FIGURE 2 only) and passes through a jet device in the chamber (not shown). Excess steam is removed from the apparatus through conduit **15** (also through 15_b, FIGURES 2 and 3). The yarn to be treated passes through suitable eyelets and across the orifice of the jet in the chamber, through which the moist steam is discharged. Conceivably, the steam can be passed through the chamber in the same direction as the direction of yarn travel as shown in U.S. Patent No. 2,982,000. The fluid jet is supplied with steam at approximately 15 pounds per square inch. It should be understood, however, that steam may be supplied to the jet at lower or slightly higher pressures, if desired. The pressure and the input and output speeds of the yarn are controlled so as to provide substantial tension (supplemented by tension applied by gate **12**) to prevent complete looping or convoluting the yarn in the steaming apparatus. When the temperature and pressure conditions are sufficient to raise the yarn to a temperature of about 100° C. to 125° C., an applied tension ranging from approximately 0.02 to 0.03 gram per denier is preferred in the annealing apparatus.

The apparatus as shown (elements **5** and 5_b, FIGURES 2 and 3) comprises the type wherein the yarn crosses perpendicular to the exit orifice of the jet through which steam is discharged to a combined treatment chamber. In one side of the chamber, and directly opposite the orifice, there is located a resonance chamber of construction shown in the above-mentioned pending application. Although some turbulence is caused in the chamber by the steam issuing from the jet into the resonance device, it is usually not sufficient to entangle or, in general, convolute the yarn.

Yarn A' is fed into the annealing apparatus by suitable guides positioned in the cover therefor. A suitable cover is shown on annealing jet **5**, having handle **25**.

Before the yarn is fed to the annealing apparatus, a suitable finger tension gate may be provided at **12**.

In the embodiment as shown in FIGURE 2, a yarn issuing from the annealing jet **5** is then fed to additional crimper 7_b which is essentially the same construction as that of preceding crimper **7**. If preferred, and for the most part depending on the use for which the textured yarn is intended, a cooling medium such as air, can be employed in jet **5**. Other possibilities include cooling utilizing a chamber circulating a heat transfer liquid such as water and the like, in which case jet 5_b, immediately after second box 7_b, serves as the annealing apparatus.

In this specific embodiment, a pair of feed rolls is also used to introduce yarn to the chamber and to cause bending and folding thereof under the combined action of the rolls and frictional engagement of the yarn with the inner walls of the box. It is preferred that additional means, such as a key insert, ratchet wheel, weighted exit door, or their equivalent, be utilized to apply back pressure in this second box. Should a yieldable key or ratchet wheel be used, it is preferred that they be located almost immediately after the box entrance and preferably should be constructed in a manner not to interfere with drawing away of the yarn from the box. When the yarn emerges from this second compression—and consequently, crimping area—it is preferred that the crimp be set utilizing a fluid such as heated air or moist steam and thereafter annealed.

In FIGURE 3 the source yarn is first crimped by the two stuffer boxes in tandem and then passed to the annealing apparatus wherein the yarn is treated with hot moist steam while under sufficient tension to prevent shrinkage or linear contraction. Although not shown, it is also contemplated that the yarn can be first textured in a stuffer box crimper, cooled by suitable cooling means such as air, non-reactive gas, water, again stuffer

box crimped and annealed before being collected in package form.

FIGURE 4 illustrates the yarn produced according to this invention. The textured and annealed yarn obtained is serrated (of sawtooth configuration) and rather arch-like, in the nature of deep waves in contradistinction to having serrations combined with complete ring-like loops. From the figure it will be seen that the individual filaments, although closely adjacent to each other, each will have serrations and curvilinear bends randomly distributed along its length, thus having the three-dimensional, permanently retainable and extensible crimp according to this invention. The filaments have been found to retain their texture (crimp and bulk), covering power, and pattern definition when knitted, tufted or woven into fabrics. The yarn, fabrics, etc., are smooth, soft and pliable. Moreover, the fabrics are more appealing and warm to the touch than those which utilize textured yarns produced by conventional processes. Textile fabrics including floor coverings, such as rugs and carpets, closely resemble both in appearance and feel the finest of wool. This improved appearance and voluminosity are retained through long periods of use.

The following examples are given to further illustrate the process and product of the invention. In addition to these examples, it is apparent that other variations and modifications thereof can be adapted to obtain similar results.

EXAMPLE I

A 68 filament, 1040 denier (drawn) tow of poly(epsilon-caprolactam), nylon 6, is fed into a stuffer box crimper of conventional construction comprising a pair of feed rolls and a yielding ratchet wheel constituting a compression imparting obstruction within the box. The tow is preheated to about 125° C. utilizing a heated plate immediately before passing the tow to the feed rolls. The stuffer box is operated in a manner to impart approximately 15 crimps per inch to the tow. The tow is then treated with moist steam in a relatively relaxed condition but while still in the box in order to set the crimp.

Proceeding from the crimper, the tow is collected in package form.

EXAMPLE II

The same yarn (a 68 filament, 1040 denier drawn tow) is textured by the process of Example I and is further subjected to the annealing procedure according to the invention.

Selected physical properties of a number of representative yarn sample skeins crimped by the above procedures set forth in Examples I and II are presented in Table II. Table I presents the combined crimping, steam setting and annealing conditions of yarns produced by Examples I and II. The samples are identified in the tables.

TABLE I.—COMBINED CRIMPING AND ANNEALING CONDITIONS

	Crimping Conditions						Annealing Conditions				
Sample	Tow speed (Avg. y.p.m.)	Denier (uncrimped)	Ratchet wheel pressure (ounces)	Steam pressure (p.s.i.g.)	Steam Temp., °C.	Time in crimper (Sec.)	Steam pressure (p.s.i.g.)	Steam Temp., °C.	Time in annealer (sec.)	Tension, g./d.	Bulked Denier
Ia	600	1,040	6	8	100	5					1,175
Ib [1]	600	1,040	6	8	100	5					1,193
IIa	600	1,040	6	8	100	5	15	105.0	.006	0.025	1,173
IIa [4]	600	1,040	6	8	100	5	15	105.0	.006	0.025	1,197
IIb [3]	600	1,040	6	8	100	5	15	105.0	.006	0.025	1,189

[1] Stuffer box crimped twice. [2] Stuffer box crimped once, annealed twice.

TABLE II.—PROPERTIES

Sample [1]	Percent net wet bulk contraction [2]	Crimps per inch	Bulked denier	Tenacity (g.p.d.)	Elongation (at break), percent	Dyeability	Pattern definition in Carpets
Ia	26.3	15	1,175	3.05	48	Poor	Poor.
Ib [3]	23.3	14	1,193	2.96	49.2	Fair	Fair.
IIa	20.0	14	1,173	3.03	48.3	do	Good.
IIa [4]	17.6	15	1,197	2.93	51.0	Streak-free (excellent).	Excellent.
IIb [3]	18.3	16	1,189	2.94	49.0	do	Do.

[1] The yarn samples employed are representative of that produced in Examples I and II under the conditions tabulated in Table I, samples Ia and Ib being only crimped and thus not annealed following the procedures of the invention.

[2] Net wet bulk contraction in percent is calculated by first selecting representative 30 cm. lengths at random throughout the package, securing the ends of the sample together and measuring the loop length thereof when a weight of about 0.0027 g.p.d. is attached thereto. After exposure of the loop to hot water (70° C.) for 0.5 min., the loop length was again measured and the percent contraction was calculated. The measurement is indicative of the amount of pile height loss which can be expected after subsequent harsh aqueous treatments when in carpet or other pile fabric form.

[3] Stuffer box crimped twice. (Run through the same or similar box twice or boxes in tandem.)

[4] Stuffer box crimped once, annealed twice.

The primary advantage of the process of the invention is that it offers simplicity and economy. The process produces exceptionally bulky yarns having a low percent of contraction and can be made into fabrics having good dyeability, covering power, a wool-like appearance and hand, notwithstanding their excellent stability under conditions of extreme compression and tensile stress. Moreover, an excellent degree of bulk can be achieved in fabric which avoids uncertainties in regard to the amount of shrinkage to be expected during subsequent harsh after-treatments. The yarn is sufficiently strong and uniform to be handled easily by all textile machinery including weaving, knitting and tufting machines without sacrifice of bulk characteristics and fabric pattern definition.

The bulky yarns produced by the process of the invention can be generally characterized by their desirable tendency to retain a flavorable frequency and amplitude of crimp even after being subjected to harsh mechanical treatments usually characterized by conditions of imposed stress followed by finishing treatments utilizing high heat and/or moisture. Such treatments are common in the formation of pile fabrics, such as tufted carpet and the like.

In a tufting operation utilized, for example, in manufacture of carpets, high tensions are applied to yarns forming the pile as tufting needles force the yarn through a fabric backing material. Yarns produced according to the invention withstand such momentarily high tensional forces and immediately resume a well-set crimp, bulky appearance and attendant covering power when relaxed.

What is claimed is:

1. A process for producing textured yarn which comprises, in one continuous operational sequence, feeding continuous synthetic filament yarn through a texturing zone, deforming said yarn while in said zone, heat setting and thereafter annealing the thus deformed yarn in a

separate and distinct moist heat zone while under sufficient tension so as to remove internal stress or strain imparted to the yarn and to prevent excess plural dimensional contraction.

2. A process of claim 1 wherein the yarn is deformed by stuffer box crimping and annealed utilizing moist steam at a temperature of at least 100° C. and at a tension ranging from 0.02 to 0.03 gram per denier.

3. A process for producing a plural dimensionally textured synthetic yarn or tow comprising feeding a plurality of filaments of continuous yarn through a plurality of texturing zones, deforming each of said filaments while in said zone, heat setting the deformed filaments in said zones, and thereafter annealing the filaments in a separate and distinct moist heat zone while under sufficient tension so as to remove internal stresses or strain imparted in the deformation zones and to prevent excess plural dimensional contraction thereof.

4. A process of claim 3 wherein the filaments are deformed by stuffer box crimping and annealed by moist steam at a temperature of at least 100° C. and at a tension ranging from 0.02 to 0.03 gram per denier.

5. A process for producing textured yarn which comprises feeding a plurality of filaments of continuous synthetic yarn through a texturing zone, deforming each of said filaments while in said zone, heat setting the deformed filaments, thereafter annealing the filaments in a separate and distinct moist heat zone while under sufficient tension so as to remove internal stress or strain imparted to the filaments and to prevent excess plural dimensional contraction, and again deforming each of said filaments.

6. A process of claim 5 wherein the filaments are deformed by stuffer box crimping and annealed utilizing moist steam at a temperature of at least 100° C. and at a tension ranging from 0.02 to 0.03 gram per denier.

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LOUIS K. RIMRODT, Primary Examiner

U.S. Cl. X.R.

28—1.3, 1.6, 72.14