May 23, 1961

R. H. BRAUNLICH ET AL

REGENERATED CELLULOSE FILAMENT HAVING LARGE AND SMALL DENIER SECTIONS

2,984,889

Filed March 12, 1957

2 Sheets-Sheet 1

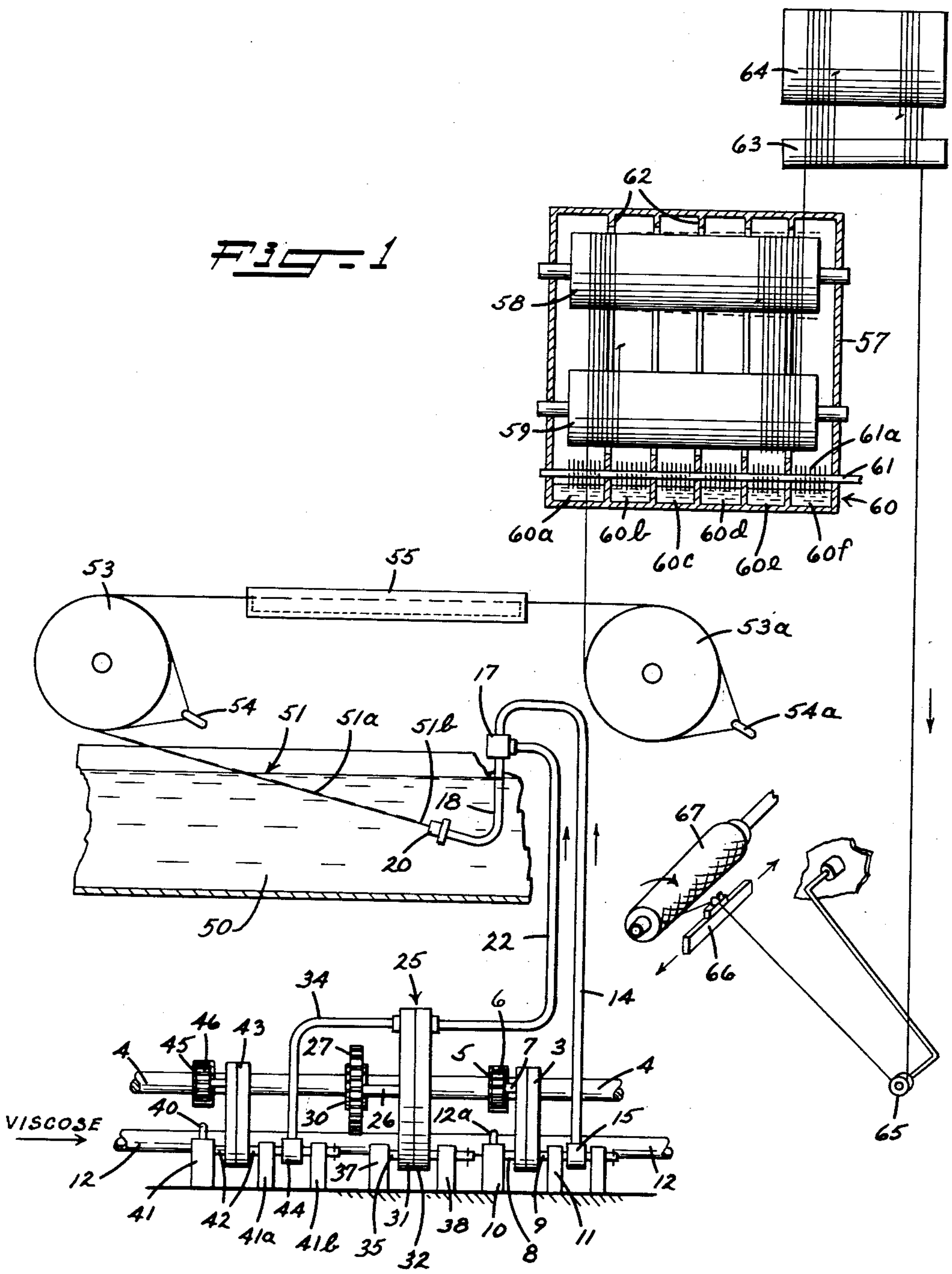

Fig-1

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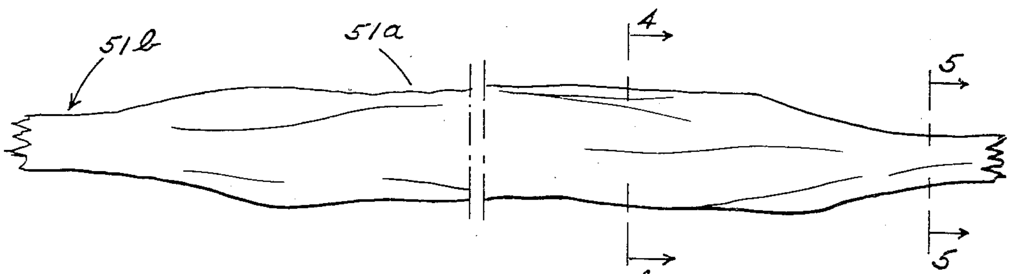

Fig. 2

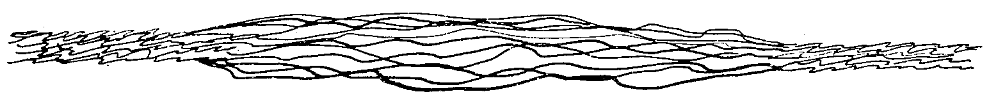

Fig. 3

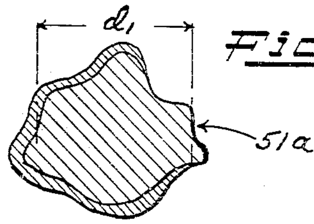

Fig. 4

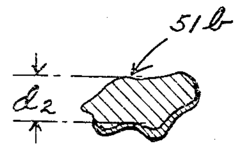

Fig. 5

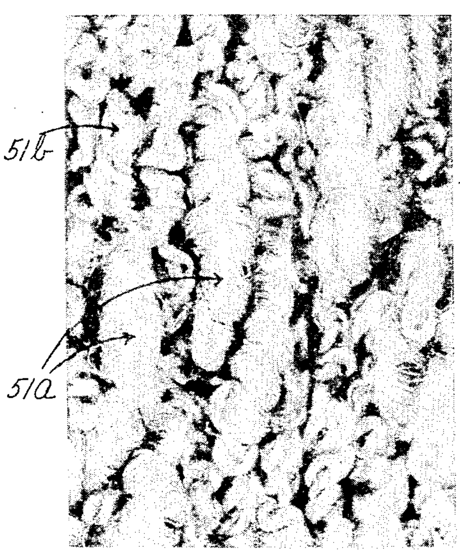

Fig. 6

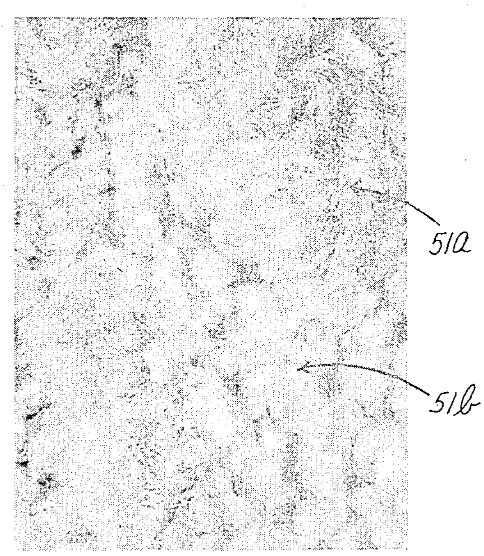

Fig. 7

United States Patent Office 2,984,889
Patented May 23, 1961

2,984,889

REGENERATED CELLULOSE FILAMENT HAVING LARGE AND SMALL DENIER SECTIONS

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Filed Mar. 12, 1957, Ser. No. 645,503

3 Claims. (Cl. 28—82)

The present invention is directed to the preparation of a crimpable continuous "thick-and-thin" rayon filament and to its process of preparation. This case is related to our application Serial No. 592,462, filed June 19, 1956, same assignee, and now abandoned.

The use of viscose rayon staple in the manufacture of pile fabrics, especially carpets, has enjoyed a remarkable growth in the past several years since rayon is considerably cheaper than carpet wool which must be imported from the Middle East. The preparation of carpets from staple however requires a number of operations including cutting the continuous filament into staple, carding and twisting the latter, and then weaving it by means of a loom into a carpet. A further objection to both wool and spun rayon staple in carpets is the fact that the shorter fibers in the tufts are not anchored to the backing and are slowly removed from the tufts during the life of the material, especially during vacuum cleaning. These problems can be overcome by using continuous crimpable rayon filament which a pile manufacturer need only sew through a backing by means of a tufting machine (similar to a sewing machine) to produce a pile rug possessing a latent crimp, that is, the capacity for crimping. This process is even more attractive if the crimp can be brought out simply by immersing the rug in water, or any other aqueous solution, such a yarn being classified as LCW (latent-crimp-water). Such a process is described in copending application Serial No. 592,462, filed June 19, 1956, same assignee.

The present invention is an improvement over the latter application in that it provides an LCW yarn having not only a high latent crimp in water but also the property of a differential crimp at regular or irregular intervals along the length of the fiber. In other words, the filament of the present invention exhibits one type of crimp at certain intervals along its length and a contrasting type of crimp in the intervening intervals of length. The two types of crimp alternate with each other throughout the length of the filament, and are separated by lengths of intermediate crimp where the nubs narrow down to join the base denier.

Accordingly, it is an object of the present invention to provide a process for the preparation of a continuous thick-and-thin filament yarn having the ability to crimp spontaneously upon immersion in water, and crimp according to a regular pattern along its length, one type of crimp alternating with another. A further object is to provide pile fabrics made from the aforesaid yarns.

These objects are achieved according to the present process by employing a continuous filament spinning process which includes a slashing operation and the feature of introducing a supplementary spinning solution into the main spinning solution at intervals upstream from the spinneret. No invention is claimed for the feature of alternate injection of supplementary spinning solution per se, this idea being old in the art. It is essential that the viscose be spun into a high salt bath in the manner described in the Merion-Sisson patent, U.S. 2,517,694, so

as to produce a filament having a thick skin along a portion of the cross-section and a thin skin or no skin along the remainder. This is designated as "an unbalanced cross-section." This filament is drawn from the coagulating bath over a first godet, pulled through a horizontal plasticizing bath and over a second godet with stretching between godets, then passed, with a slight additional stretch to improve "tracking," over a thread-advancing reel whereon the filament is advanced helically from one end of the reel to the other while being treated with a series of solutions which may, for example, further regenerate, wash, desulfide, bleach, wash, and surface finish the filament. The finished filament is next given a further stretch, dried under tension, and collected on a cone, with or without twisting. The coned filament is a thick-and-thin type of continuous filament which is non-uniform in denier, stiffness, and cross-section, and crimp potential. It will crimp not only in a caustic solution but also in cold water, formaldehyde solutions, aqueous dye baths, and aqueous solutions in general. The surprising feature is the fact that the "nubby" segments of the yarn crimp to a lesser degree than the thin sections, so that a length of the yarn will show sections having a pronounced crimp alternating with other sections having a lesser crimp.

Figure 1 illustrates the apparatus for spinning and wet-processing the novel regenerated cellulose filaments of the invention,

Figure 2 is a view of the filament showing the thick and thin portions,

Figure 3 is a view of the yarn after it has been crimped,

Figure 4 is a cross-section of the thick portion or slub taken along cutting plane 4—4 of Figure 2,

Figure 5 is a cross-section of the filament of Figure 2 taken across the narrow portion 5—5,

Figure 6 is a photographic top view of a looped-pile fabric made from the fiber of Figure 3, and

Figure 7 is a photographic top view of a cut-pile fabric made from the fiber of Figure 3.

The means for manufacturing the thick-and-thin LCW yarn of this invention is illustrated in Figure 1 wherein an overrunning gear **5** is mounted on the drive shaft **4** and during spinning is meshed with an inner gear **6** fixedly mounted on pump shaft **7** so as to drive the pump **3**, which is preferably of the positive displacement type, such as a conventional gear pump. Pump **3** may be swivelly mounted on the axis of the suction and discharge conduits **8** and **9** respectively so that gear **6** may be withdrawn from engagement with gear **5** or swung into such engagement, as desired. The conduits **8** and **9** communicate with the suction and discharge ports of the pump **3** and also with suitable supply and discharge passages in the stationary brackets **10** and **11** respectively. The supply passage in bracket **10** is connected with a header **12** for the spinning material by a suitable branch conduit **12***a*. Conduit **9** communicates through bracket **11** with a conduit **14** which is connected into a pivotally mounted elbow **15**. The main spinning solution passes from lines **8**, **9** up through conduit **14**, T-fitting **17**, a "rounder" pipe **18** and through spinneret **20** into spin bath **50**.

The supplementary spinning solution is introduced into the side connection of T-fitting **17** by means of a conduit **22** connected to the discharge port of disk valve **25** keyed to a drive shaft **26** on which there is fixedly mounted a gear **27**. Gear **27** engages a drive gear **30** on drive shaft **4**. Disk valve **25** is preferably of the type described in Serial No. 292,929, now Patent No. 2,780,833, same assignee; it comprises a housing formed of two plates **31** and **32** which enclose a rotating disk. Without going into further illustration of this element it can be explained that a circle of holes in plates 31, 32 register at regular intervals with a circle of holes in the inner rotating disk. In this way viscose from line 34 passes through disk 25 into line 22 at intervals when a hole in the inner rotating disk lines up with a pair of holes in outer disks 31, 32. The spacing of the holes and the timing of the rotor determines the frequency with which a "slub" of supplementary viscose is pumped into line 22. Valve 25 is pivotably mounted on pins 35 which are secured to brackets 37, 38. By this arrangement, the control valve 25 may be swung on the axis of pins 35 to disengage the gears 27 and 30 or engage them at will.

The supply system to line 34 is similar to that of line 14 in that viscose is pumped from supply line 12 through line 40, bracket 41, pipes 42, pump 43, bracket 41*a*, and elbow 44 which opens into line 34. Pump 43 is pivotably mounted on brackets 41, 41*a* so that gear 45 can be swung out of engagement with inner gear 46.

In coagulating and regenerating bath 50 the pulsating viscose streams issuing from the spinneret 20 assume the form of a coagulated thick and thin yarn 51, having segments 51*a* of large diameter alternating with sections 51*b* of smaller diameter (Fig. 2).

From coagulating bath 50 the yarn 51 passes over two or more driven godets 53, 53*a*, with associated guides 54, 54*a* and through an intermediate plasticizing bath 55. The advantage of a horizontal bath 55 over the more conventional vertical cascade is that it lets the fibers flatten out, exposing their entire surface to the liquid. Godet 53*a* turns somewhat faster than 53, the relation between the two being such as to stretch the yarn 51 approximately 45%. The yarn, while still in an incompletely regenerated state is then passed without loss of tension to a thread advancing device comprising a case 57 containing a pair of circular drums or reels 58, 59, a trough 60 in the base of the case, and a rotary brush-like member or flinger 61 mounted in the trough 60. Drum 58 is preferably of the cantilever type, its position being adjustable to permit varying the spacing of the yarn on the two reels. Trough 60 is divided into compartments 60*a, b, c, d, e, f,* by means of partitions 62 which extend along the periphery of the case 57 to the top thereof. Flinger shaft 61 rotates in the same direction as reels 58, 59 with its fingers 61*a* dipping into liquid in the trough 60. The tension in the yarn is maintained as it passes from godet 53*a* to reels 58, 59 and may be increased as it advances from one end of these reels to the other, as explained later.

The processing liquids applied to the reels by flinger 61 are of the conventional type and include a regenerating liquid in compartment 60*a*, an alkaline bleach in 60*b*, a bleach acid in 60*c*, an alkali wash in 60*d*, a water wash in 60*e*, and a soft finish in 60*f*. The regenerating bath 60*a* may be of any type normally used as the second bath of a two-bath spinning process, preferably a weak acid solution of sulfuric, phosphoric, nitric, or hydrochloric acid. The alkali bleach is usually an aqueous solution of sodium hypochlorite or the like. The acid neutralizer applied after the bleach is preferably the same type of acid used in the regeneration spraying, dilute H_2SO_4 or HCl. The finish applied after the water wash is basically a lubricant consisting usually of mineral, vegetable, or animal waxes and oils.

The stretch which is desired between the second godet 53*a* and the right-hand side of the processing drums 58, 59 may be imparted in one of two ways, depending on the design of drum 58. If drum 58 is of uniform diameter throughout its length, as shown in the solid line version of Figure 1, it is impossible to effect progressive stretching of yarn on this drum and hence a stretch must be imparted between godet 53*a* and the left-hand side of drum 58. The alternative situation is where drum 58 tapers toward a progressively larger diameter at the right-hand side as indicated in dotted lines in Figure 1. In this case the yarn is progressively stretched as it advances the length of drum 58, the extent of stretching here being about 4%. This eliminates the necessity for stretching between godet 53*a* and drum 58 and in addition reduces the amount of stretch required between the processing drums 58, 59 and drying drum 64. Stretching between godet 53*a* and drum 58 improves tracking of the yarn across the latter, as previously stated, since otherwise the turns of yarn on the drum tend to alternately drift together and then apart. When this happens and two adjacent turns temporarily crowd together they stick together slightly, so that when they subsequently drift apart they tear their adjoining edges during the separation. Because of this it is important that the tension be maintained, even if not increased, in the yarn between godet 53*a* and drum 58 so that the turns of yarn will be separated and unrelaxed during the regeneration stage wherein the yarn is acid-treated in compartment 60*a*. Tapering the drum 58 in the direction of the advancing yarn to increase the stretch assures good tracking all the way along the drum.

The yarn 51 advances over drums 58, 59 in spaced helical turns toward the right. The fingers 61*a* which are rotated at high speed in the same direction as the yarn storage-advancing device dip a short distance into the liquid in the compartments 60*a, b, c, d, e, f,* and project fine drops of liquid onto the turns of yarn. The drops of liquid being applied to the yarn are moving in substantially the same direction as the turns of yarn are rotating so that they do not damage filaments of the yarn or change the spacing between the turns. Reels 58, 59 rotate at high speed and the excess liquid applied to the yarn is thrown off by centrifugal force shortly after it is applied to the yarn and is returned directly by gravity to the compartment from which it was projected. The partitions 62 form separate and distinct zones along the yarn storage-advancing device, each having a separate liquid applying means, the partitions in the trough-like member preventing the mixing of the liquid from one zone into another. Due to the ends of the brush-like members 61*a* being spaced from the adjacent partitions no liquid is applied to the turns of yarn while passing from one zone into another and the excess liquid applied to the turns of yarn in one zone is thrown off before the yarn enters the next zone. Flinger 61 is described in greater detail in U.S. Patent No. 2,655,429.

The yarn withdrawn from the end of reel 58 proceeds around a pair of thread-advancing drying drums 63, 64 driven at a peripheral speed higher than that of rotors 58, 59 so as to impart a corresponding stretch to the yarn as it passes from processing reel 58 to dryer drum 63. This additional stretch is generally 1–10%, and in one embodiment the stretch imparted at this point raises the total stretch to 52%, based on the speed at godet 53. The greater the stretch applied on the processing drum 58 the less the stretch between this drum and the drying drums. Heat may be supplied to the dryer drums 63, 64 in various ways as by radiation, steam coils and the like or by circulating heated fluid such as steam, hot gases, hot water, etc., through the interior of the rotors. The dry yarn withdrawn from the dryer drums is collected by winding onto cone 67, the spacing hereon being maintained by guides 65, 66.

The yarn collected on cone 67 is made up of a plurality of filaments having the contour shown in Figure 2. The thick slub section 51*a* has a diameter (Fig. 4) appreciably larger than that of the thin section 51*b* (Fig. 5). A typical denier for section 51*b* would be 1800–2700 denier. A pleasing pattern in tufted fabrics results if thin segments 51*b* are 4–6 times as long as slubs 51*a*, the length of slubs 51*a* are 4–6 inches, and the length of the thin segments 51*b* are 20–30 inches.

Yarn 51 in the hands of a textile manufacturer is processed through suitable twisting means and a tufting machine to form a pile fabric. Sewn tufted carpets require a base or backing fabric through which the loops of pile yarn are inserted by the needles of the tufting or sewing machine to form the pile, see U.S. 2,740,430. A hard twisted looped pile fabric made according to this invention may be produced by any of the methods which will produce a looped pile fabric, namely by weaving, knitting, punching with sewing needles through a back, hooking, or by any other method.

It will be seen that when a continuous filament yarn having alternate thick and thin portions is sewn through a backing to form a pile fabric the fabric will form areas of large denier tufts alternating with areas of small denier tufts. This looped pile is now ready to be water-wetted to bring out the crimp. If desired, the loop may be cut prior to wetting. The results in either case are illustrated in Figures 3, 6, and 7. Figure 3 depicts the crimping pattern which results from wetting the thick and thin sections of Figure 2. The striking feature is the sharply contrasting crimp in the two segments. The thin segments **51*b*** are much more curly than the thick or slub portions **51*a***. The ratio is about 2½ to 1 where the ratio of thick-thin denier is 3–4 to 1, the thin yarn having a 75% crimp rating in this case while the thick sections have a 30% crimp rating. "Crimp rating" is the percent shrinkage of a six-inch test length of yarn when immersed in the crimp bath and is calculated by this formula:

$$\text{Percent crimp rating}=100\left(l-\frac{\text{final length}}{\text{initial length}}\right)$$

The difference in crimp rating between the thick and thin portions is presumably explained by the cross sections of Figures 4 and 5. In both the thick section (Fig. 4) and the thin section (Fig. 5) the thick skinned side swells more and shrinks more when wet than the side having little or no skin. Thus when the filament is wetted in relaxed form it draws up into the form of a helix, the thick-skinned side taking the inside or short side of the bends of the crimp. The thin skinned side shrinks less and takes the outside of the bend. The thicker section or slubs (Fig. 4) tend to be more rigid than the thin section (Fig. 5) because of their thicker skin and thus will crimp less in water. This accounts for the differential crimp illustrated in Figure 3.

Figure 6 is an actual photograph of a representative portion of a looped pile fabric prepared from the yarn **51**, which was water-wet and dried. The highly crimped portions **51*b*** show up as numerous small tufts having a very curly appearance, and these alternate with long thick rolls **51*a*** representing the crimped slub sections. Even in this loop form, where each tuft is secured rigidly at both ends, the twist has opened up and distorted on wetting so as to impart a differential crimp to the pile area. The variable loop height makes for interesting patterns and texture.

Figure 7 is a photograph of a crimped cut-pile carpet; it differs from Figure 6 in that the outer ends of the loops were cut before the carpet was wet and then dried. The thin denier areas show up as a plurality of small closely packed curls **51*b*** nested among large bushy clumps **51*a*** representing the slub portions. In this embodiment the variable pile height of the cut pile gives the appearance of a sculptured rug and appears to be a combination of cut and loop pile. Alternatively the high loops **51*a*** (Fig. 6) may be cut but the small loops **51*b*** left uncut, thus forming an even sharper division between the two areas. In both embodiments, Figures 6 and 7, the varying denier of the yarn divides the pile surface into well defined areas of high crimp and low crimp and gives a novel design in which the covering power of the yarn is brought to a maximum. Nothing further has been done to the carpet after the water-immersion and drying; this has brought out all of the inherent crimp in the yarn. The pattern effect can be varied readily by alternating the spacing between loops, the denier of the slubs, and the length of the slubs.

The viscose extruded through the spinneret **20** into coagulating and regenerating bath **50** may fall within a wide range of types but the preferred ranges, in percent by weight of the solution are 35–40% CS_2, 7.0–8.6% cellulose, and 6.0–8.5% sodium hydroxide. A preferred composition is 8.6% cellulose, 6.4% NaOH and 36% CS_2 based on alpha cellulose. The salt test of the viscose may range from 3–10 and the ball fall from 10–150 seconds. It is preferred that the salt test be held within 5.0–5.5 and the ball fall within 30–35 seconds.

The spinning bath **50** must have a regenerating capacity equivalent to that of 7–14% of sulfuric acid, mixed with a small proportion of a zinc salt and a large proportion of sodium sulfate. The zinc salt is preferably zinc sulfate in the range of 0.5–3% by weight of the spin bath. 1.5% $ZnSO_4$ by weight in the spinning bath is desirable for good crimp properties; within the limits of 1.0–2.0% it is insensitive in its effect on crimp. To assure a strong dehydrating action on the filaments a high proportion of salts such as sodium sulfate or potassium sulfate between about 13–25% should be used. As a general rule, the spinning bath should contain about 6.6–7.7% sulfuric acid, about 1–1.5% zinc sulfate and about 16–20% sodium sulfate; it should have a temperature of 50–70° C.

The viscose and spinning bath requirements for the production of a filament of high crimpability are discussed at length in U.S. 2,517,694 and U.S. 2,572,936. In general this requires extruding the viscose into an aqueous acid coagulating and regenerating bath which has, because of a high total salt content, a rapid dehydrating effect upon the extruded xanthate filament and sets up a partially regenerated skin of substantial thickness around a still substantially liquid core. This skin is set up rapidly and has a strong tendency to shrink due to the dehydrating action of the coagulating bath, but this is opposed by the incompressible core. The result is a splitting or longitudinal rupturing of the filaments, thereby causing part of the core to flow through the rupture, in which state the filaments are finally set up. The portion of the resulting filaments which was forced out of the core responds to later stretching (which is necessary to obtain the desired crimpiness) differently than the remainder of the filament, and in this respect, it appears to act as if it had originated from an entirely distinct viscose. As stated above in connection with Figures 3–5, the portion of the filament having the thick skin always takes the inside of the bends of the crimp because of a stronger tendency to shrink.

The invention is illustrated further by the following examples.

EXAMPLE I

In run #1, a viscose solution containing 7.5% cellulose, 6.4% NaOH and 36% CS_2 by weight and having a salt test of 5.0–5.5 was supplied to a spinneret in two streams. One stream was continuous and the other was a pulsating stream. The latter was metered through a rotary disk valve of the type illustrated in U.S. 2,780,833, employing a 12 hole, 3/32 inch hole diameter disk plate rotating at 10.88 r.p.m. A 150 hole spinneret was used. The viscose was injected through the spinneret into a spinning bath containing 7.2% H_2SO_4–1.5% $ZnSO_4$–18% Na_2SO_4, calculated in parts by weight of the total solution, and having a temperature of 60° C. In the spin bath the multiple streams of extruded viscose coagulated into filaments of regularly varying denier due to the intermittent injection of supplementary viscose into the spinneret. The continuous stream of viscose entering the spinneret supplied the base denier or minimum diameter of the filaments while the pulsating supplementary stream supplied the slubs or maximum diameter portions of the filaments. The filaments were drawn through the spin bath for an immersion distance of 36 inches.

The filaments were withdrawn as a multifilament yarn from the spin bath and drawn through a horizontal plasticizing bath between two godets to effect "slashing" or wet-stretching of the yarn. The plasticizing bath composition was 2.5% H_2SO_4–0.3% $ZnSO_4$–5% Na_2SO_4 and was maintained at about 88–90° C. The yarns were stretched 17% between the godets, passed from the second godet to a pair of parallel porcelain process drums, and advanced the length of the latter. The yarn stretch was increased to 23% in passing from the second godet to the top porcelain drum. The latter was tapered sufficiently to increase the stretch to 26% as the yarn advanced the length of the porcelain drums. On these drums the yarn was successively treated with a regenerating solution of similar composition to the spinning bath but more dilute, a weak base washing solution having a pH of about 8.5, a sodium hypochlorite bleach, an acid, another wash with the weak base, and a soft lubricant finish. The yarn was then passed over a pair of drying drums, retaining the 26% stretch, and collected on a cone at a collection speed or "spinning speed" of 40 meters per minute.

The stretch pattern described above is denoted briefly as a 17/23/26/26 percent stretch. This means that the yarn was stretched to the value indicated in each of the four stretch areas of the process. Thus, it was stretched 17% between the first two godets. It was stretched an additional 6% between the second godet and the processing drums, a total of 23% up to this point. It was stretched another 3% on the processing drums, up to a total of 26%. The stretch between the processing drums, and the drier drums was zero so that the stretch was maintained at 26% from there on.

The finished yarn had a slub frequency of 11.65 inches; i.e., this was the linear distance between the end of one slub and the beginning of another. The slub length was 6½ inches. In terms of weight the ratio of the slub weight to the weight of the thin or base sections was 2.88 to 1. In terms of denier based on weight the slub denier was 4822 and the base denier was 1670, thus giving a total denier of 3104. In terms of spinning speed the slub frequency was 130 slubs per minute, using an interrupter disk speed of 10.88 r.p.m. The crimp rating of the slub was 36% and that of the base was 66%, this being measured by immersing a length of each in a water bath at 25° C., and then comparing the shrinkage to the original length by the formula:

$$\text{Percent crimp rating} = 100\left(l - \frac{\text{final length}}{\text{initial length}}\right)$$

EXAMPLE II

Five additional runs, hereafter referred to as run numbers 2, 3, 4, 5, and 6, were made according to the general plan of Example I. In run #2 the yarn was spun under the conditions of Example I but with a slower interrupter disk valve speed. Run #3 was at a still slower disk valve speed and the percent stretch was 17/25/28/28 instead of 17/23/26/26 as in the first two runs. This meant that the stretch was 2% higher between the second godet and the processing drums than in runs #1 and #2, so that the stretch coming on to the processing drums was 25%, and the stretch coming on to the processing drums was 25%, and the stretch in the yarn as it came off the processing drums was an additional 3%, or a total of 26%. In run #4 the disk valve speed was the same as in run #3 but concentration was increased to 9% H_2SO_4–3% $ZnSO_4$–20% Na_2SO_4 and the percent stretch was 17/26/29/30. In runs #5 and #6 the disk valve speed was slowed to 4.35 r.p.m. and the percent stretch was 17/24/27/28.

Table I below compares the yarns from all six runs, run #1 from Example I and run numbers 2, 3, 4, 5, and 6 from Example II.

Table

Run No.	R.P.M. of Disk Valve	Percent Stretch	Slubs/Min.	Slub Frequency, inches	Slub Length, inches	Deniers			Slub-Base Ratio Based on Weight	Percent Crimp Rating	
						Base	Slub	Total		Slub	Base
1	10.88	17/23/26/26	130.6	11.65	6.48	1,670	4,822	3,104	2.88–1	36	66
2	7.27	17/23/26/26	87.3	18.0	7.8	1,880	5,436	2,960	2.89–1	32	64
3	5.44	17/25/28/28	65.2	24.3	9	2,061	5,952	2,990	2.89–1	32	64
4	5.44	17/26/29/30	65.2	24.0	8.2	2,166	5,908	3,066	2.72–1	26	63
5	4.35	17/24/27/28	52.2	30.2	9	2,267	5,727	3,001	2.52–1	34	65
6	4.35	17/24/27/28	52.2	28.0	9.6	2,070	6,607	3,051	3.20–1	32	66

The table illustrates how the slub frequency varies directly with the speed of the interrupter disk in valve **25** (Fig. 1), while the slub length varies inversely with the disk speed. The slower the disk speed the longer are the slubs and the greater the distance between them. This of course was to be expected. The interesting and rather unexpected feature is the crimp ratings of the base denier portions compared to the crimp ratings of the slubs. As shown in the extreme right hand column of the table the average crimp rating of the base denier portions is twice that of the slubs, using a ratio of slub denier/base filament of about 3:1. The effect of this on a pile fabric prepared from this yarn is illustrated in Figures 6 and 7, which demonstrate the contrasting pattern resulting from the crimp rating ratios of the table.

The foregoing specification has been illustrated by drawings and operating examples but these should be considered as simply illustrative of the invention, not limiting. Thus, the slub pattern could be varied as desired depending on the type of interrupter disk, the diameter of the spacer holes therein, the spinning speed, etc. Instead of using a single spinneret as in Example I a multi-end unit could be used to spin a number of yarns at once. The slubs can be spun by any of the methods described in the prior art, e.g., U.S. 2,671,929.

We claim:

1. A rayon filament having alternating large and small denier sections along its length and having a thick skin around part of the periphery of the filament and little or no skin around the remainder of its periphery, the skin being thicker along the large denier sections of the filament than it is along the small denier sections, said filament having a latent crimp which takes effect upon wetting, the crimp being greater in the small denier sections than in the large denier sections.

2. A regenerated cellulose filament having a generally helical crimp and alternate large and small denier sections along its length, percent crimp rating being greater in the small denier sections than in the large denier sections, said filament having a thick skin around a portion of its periphery and a skin of relatively thin to negligible thickness around the remainder of its periphery.

3. A dry substantially straight regenerated cellulose filament having large denier slubs at intervals along the length thereof and having unbalanced internal strains giving rise to different shrinkage characteristics and the potential capacity to crimp upon being treated with water, a cross-section of said filament having a core

within a periphery consisting of two distinct portions of substantial extent, one portion having a thick skin and extending around one side of the core, and the other portion extending around the remainder of the core and having a skin of relatively thin to negligible thickness, the slub sections having a thicker skin than the remainder of the filament and having a reduced capacity to crimp in water as compared to the remainder of the filament.

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