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PROCESS AND APPARATUS FOR PRODUCING STRETCHABLE
HIGH BULKY YARNS
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HIGH BULKY YARNS

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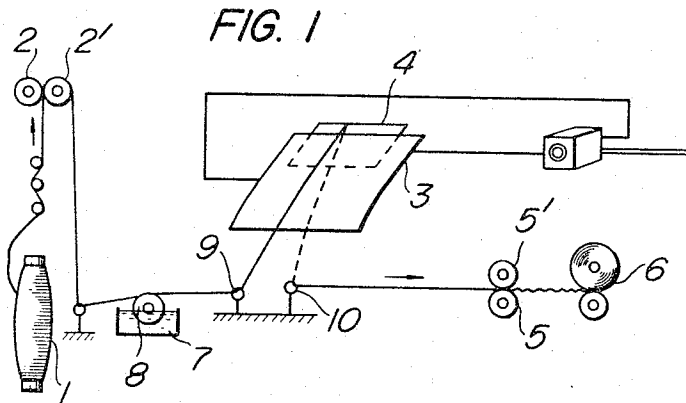
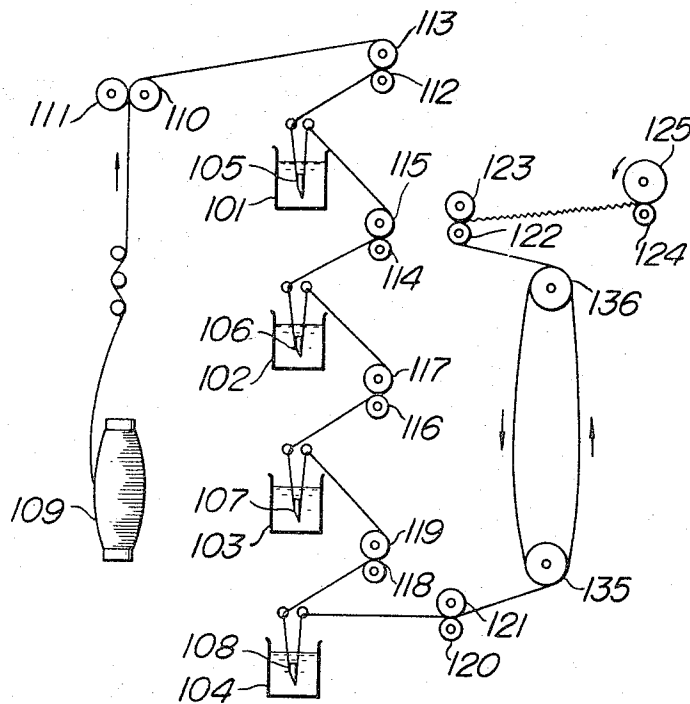


FIG. 2



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FIG. 3

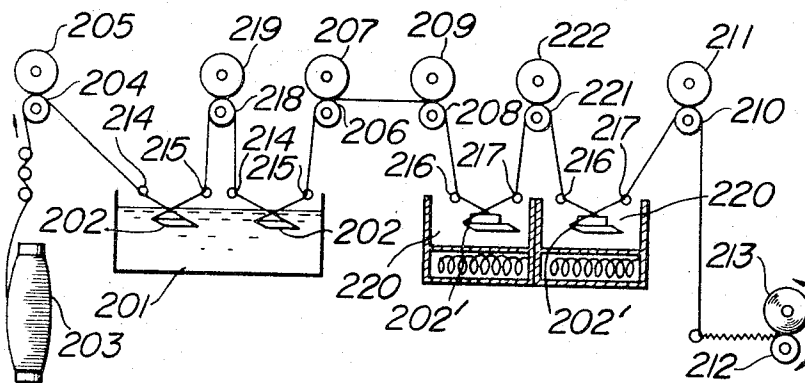


FIG. 4

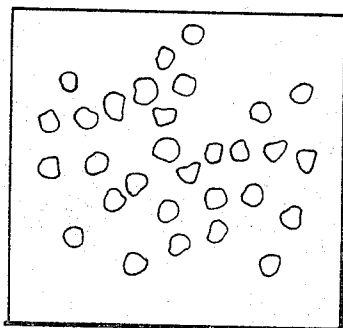


FIG. 5

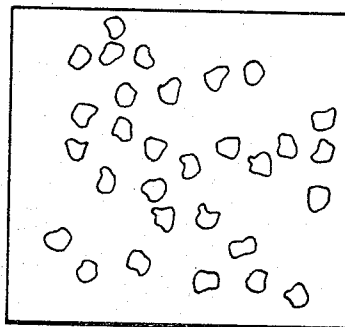
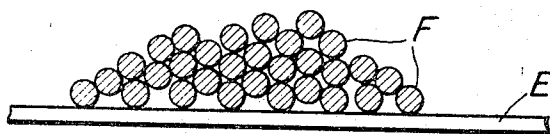


FIG. 6



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PROCESS AND APPARATUS FOR PRODUCING STRETCHABLE HIGH BULKY YARNS

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11 Claims. (Cl. 28—1)

ABSTRACT OF THE DISCLOSURE

An improved process and apparatus for producing edge crimped thermoplastic multifilament yarns, in which the yarns pass over at least one edge of blade placed in water to which acid, alkali, or salt is preferably added. The yarns make a V-shaped turn over the edge of a blade, whereby uniform stretchable bulky yarns are produced which are easily processed.

Drawings

FIGURE 1 diagrammatically illustrates a known method of crimping yarn;

FIGURE 2 diagrammatically illustrates the crimping of yarn in accordance with one embodiment of the invention;

FIGURE 3 diagrammatically illustrates the crimping of yarn in accordance with another embodiment of the invention;

FIGURE 4 illustrates yarns which have been edge crimped with one technique;

FIGURE 5 illustrates yarns which have been edge crimped with another technique; and

FIGURE 6 illustrates a plurality of filaments passing over an edge.

Detailed description

This invention relates to a process and an apparatus for producing stretchable bulky yarns made of thermoplastic synthetic resins. More particularly, this invention relates to a process and an apparatus for producing processed yarns possessing a uniformity and stretchability that no conventional process has ever attained. This invention further relates to a process and an apparatus capable of providing multifilament yarns possessing a number of twists, convenient for processing and handling, with an excellent crimp.

It has been known to produce spiral curls on fiber filaments by passing the same over the edge of a blade in such a way that a V-shaped path of travel is formed. Hereinafter such a process will be referred to as edge crimping. Attempts were made to carry out the edge crimping process while heating thermoplastic yarns so as to bring them easily into a plasticized state. Among the most fundamental processes is the one developed by the Deering Milliken Research Corp. and known as "Agilon." The details of this process are disclosed in Japanese Patents 1,700/1963 and 6,676/1963. Beside these, processes which use a thin linear body having a circular cross-section or a revolving polygonal spindle instead of the edge of a blade have also been proposed. These methods are all characterized by the heating of thermoplastic fiber filaments so as to bring them easily into plasticized state, hanging them over an edge crimping means (such as a blade or linear body) and drawing the filaments out with an appropriate tension, thereby changing the crystalline arrangement, or fiber structure between the surface deformed by contact with the edge and the other surface, thereby providing the filaments with spiral crimps. The

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causes for controlling the crimping properties of the thusly processed yarns are considered to lie in the following four items.

(1) Sharpness of the edge of the blade: As long as it does not cut the yarns, the sharper the edge is (i.e. the smaller the radius of curvature) the better. It is preferred that the radius of such curvature of edges be in the range of $\frac{1}{1000}$ to $\frac{1}{10000}$ millimeter.

(2) Heating temperature of filaments for the purpose of increasing edge crimping efficiency: Preferably, the temperature of a preheater used with the filaments immediately before the latter enter the edge crimping stage should be approximately at the melting point of the filaments. Temperatures lower than 100° C. are ineffective at least for nylon.

(3) Tension of filaments after passing the edge crimping.

(4) Angle between in-coming and out-going filaments at the edge crimping blade: The smaller the angle between the blade and filaments, the better the effectiveness. It is particularly preferably that the out-going angle be smaller.

FIGURE 1 schematically illustrates apparatus for an edge crimping process similar to that disclosed in the above-mentioned Japanese patents. In FIGURE 1, object 1 is a pirn of filaments, and elements 2 and 2' are rolls by which a filament yarn is drawing from pirn 1. Elements 5 and 5' are rolls located before a cheese or winder 6. By controlling the speeds of two sets of the rolls 2-2' and 5-5', an appropriate tension is given to the yarn. During the passage between rolls 2-2' and 5-5', the yarn is heated by contact with a preheater 3 and edge-crimped by a blade 4 while changing its direction of travel at the edge of the blade and forming an acute angle. Tests were conducted on a 6-nylon, 110 d. filament yarn (30 filaments) having a base twist of 15 turns per meter. A preheater was employed and the blade was placed in air so that the above-mentioned four factors was controlling on the edge crimping effect with a normal water content of the yarn. In one test, a safety razor blade was used having a radius of curvature of $\frac{1}{1000}$ mm. and the tension at edge crimping was 0.25 g. per denier. The surface temperature of the preheater was 200° C., the angle between the in-coming and out-going filament at the blade was 5°, and the speed of processing filaments was 10 m./min. The 110 d., 6-nylon filament yarn consisting of 30 filaments and having a base twist of 15 turns per meter was edge crimped while passing over the blade once, and it was found that 18 of the 30 filaments were deformed as shown in FIGURE 4 by one edge crimping. The percentage of deformation of cross-section

$$\left\{ \frac{\text{number of deformed filaments}}{\text{number of total filaments}} \times 100 \right\}$$

was 59 percent, and the percentage elongation of crimp was 32 percent (percentage elongation is the value

$$b-a/a$$

wherein a is the length measured after applying an initial load of 1 mg./d. to a sample of 50 cm. length and b is the length when a load of 100 mg./d. is applied for 30 seconds). However, the resultant yarn was unsatisfactory as a commercial product.

The resultant edge-crimped yarn was further passed through the apparatus of FIGURE 1 a second time with approximately the same conditions, but 5 to 25 percent of the processed yarn was broken and the twice processed yarn also had no commercial value.

When a 840 d. nylon filament yarn having 136 filaments and twists of 15 turns per meter was processed as above-mentioned, the percentage of filaments capable of taking positions directly contacting the edge of blade was

small because of the large number of monofilaments. By edge crimping once, the percentage deformation of cross-section and percentage elongation of crimp obtained were only 18 percent and about 12 percent, respectively. When the yarn was subjected to the edge crimping four times under the same conditions as above-mentioned, the percentage deformation of cross-section and percentage elongation of crimp increased to 35 percent and 19 percent, respectively, but both crimping and bulkiness were not satisfactory. Each time edge crimping was repeated, monofilaments were broken and yielded fuzz yarns resulted. When the above-mentioned edge crimping was repeated more than four times, the cross-section of monofilaments became polygonal as shown in FIGURE 5 because more than one part of the circumference of the cross-sections was rubbed and spiral crimps once formed were elongated, resulting in the reduction of percentage elongation of crimp. Thus, edge crimping repeated more than described is not desirable.

In contrast to the foregoing process, improving results are possible with the addition of a step as shown in FIG. 1. This additional step causes the filaments to contain about 20 percent water which results from passing them around a revolving roller which is immersed in a water vessel 7, and carrying out edge crimping once. When subjected to this improved process, a 840 d. 6-nylon yarn having 136 monofilaments and a twist of 15 turns per meter yields a percentage deformation of cross-section of 33 percent, and a percentage elongation of crimp of 26 percent. When the same processing is repeated four times, the percentage deformation of cross-section, and the percentage elongation were increased to 65 percent and 35 percent, respectively, and no breakage of monofilaments was detected. The stretchable bulky yarns thus obtained were commercially satisfactory.

The difference of crimping effects between yarns having normal water content and those holding about 20 percent of water seems to be due to the plasticizable state of the yarns when passed over the edge. In the case of nylon, filaments are brought into a readily plasticizable state by swelling with water. Moreover, whether the filaments are edge-crimped by a blade placed in air immediately after the preheater or by a directly heated blade, an improvement in crimping effect can be achieved by varying the water content of the filaments. It is also believed that the presence of the water enables the monofilaments to slip readily on the other monofilaments or on the blade and facilitates that the monofilaments make contact directly with the blade thereby increasing the edge crimping effect. The effect of water is shown by the following example in which an 840 d. nylon filament yarn having 136 monofilaments and no twist, subjected to edge crimping, produces a high percentage deformation of cross-section with one contact.

	Percentage deformation of cross-section	Percentage elongation of crimp
Filaments containing 20% water-----	82	73
Filaments containing 5% water-----	61	46

Edge crimping in the twistless state is seen to be easier but the difference of percentage deformation of cross-section and percentage elongation brought about by the difference of water content (i.e., 20 percent and 5 percent) is particularly note-worthy.

When filaments having base twists are processed, the original twists are detained by a rubbing action on the blade until the number of twists of yarn increases to a certain value. Thereafter, edge crimping proceeds with the filament revolving nearly the same number of times as the number of turns of the base twist. The detaining of the original twist in case of 840 d. nylon filament (136

filaments, original twist of 15 turns per meter) amounts to 130 turns per meter at 5 percent water content and to 60 turns per meter at 20 percent water content. Thus, a 20 percent water content gives smoother edge crimping effect than the 5 percent as indicated in the difference of percentage deformation of cross-section and percentage elongation of crimp in the above table.

Furthermore, it appears that the addition of a fiber swelling agent or lubricant into water may be advantageous to increase the edge crimping effects.

From the foregoing, it now appears that following three items are also important factors for controlling the crimping properties of processed filaments in addition to the four above-mentioned items.

(a) Content of water in filaments at the time of edge crimping: Water adhering to the outside of the filaments or that retained within must be at least 8 percent. From 20 to 40 percent water is found to be preferable in order to obtain good processed yarns.

(b) Number of monofilaments included in yarns to be edge crimped: The smaller the number of monofilaments included in the yarn, the easier the edge-crimping, i.e., the easier it is to increase the crimping property of the yarn.

(c) Number of base twists in the original yarns: The smaller the number of base twists, the easier the edge crimping and the easier the increase of the crimping properties of the yarn.

Though spirally crimped yarns, whose cross-sections are deformed by edge crimping, possess relatively large bulkiness, the crimp elongation is smaller than those obtained by the false twist method. Hence, edge-crimped yarns are not suitable for goods using thin denier yarns possessing smaller numbers of monofilaments. It is believed that edge-crimped yarns are used most effectively in goods using thick denier yarns. Thus, the last two factors become less important.

The advantage of edge crimping in water is that (1) the thermoplasticization can be effected at a low temperature; (2) uneven temperature distribution can be eliminated at the edge crimping; and (3) mutual slippage of multifilaments on the edge in water is improved by the presence of water, whereby uniform edge crimping can be effected. FIG. 6 illustrates advantage (3) and shows the filaments F on a crimping edge E. The filaments slip on one another and consequently most of filaments are edge crimped. Repeated edge crimping makes the processed yarns even more uniform. The filaments on the edge when immersed in water become slippery, and the slippage insures the more uniform processing.

The preferred method of the present invention comprises effecting edge crimping with the edge of a blade placed in heated water and wholly immersed therein. According to this invention, the temperature of the blade is maintained exactly the same as that of the heated water, this improving the edge crimping effect. This invention provides thick denier synthetic filament yarns composed of a large number of monofilaments with uniform crimping properties and bulkiness. Because of the combined effect of uniform heating with hot water possessing high specific heat and the swelling property of water, the filament yarns become readily plasticizable and because of the lubricant effect of water, smooth travel of each monofilament against the other monofilaments and the edge of blade is improved and the edge crimping effect is thereby increased. If necessary, the processing water in which the edge is immersed may contain inorganic acid, alkali, inorganic-, organic-salt, esters, alcohols or common lubricants for fibers, or other processing agents for fibers.

FIG. 2 schematically shows one type of apparatus for producing stretchable bulky yarns of the present invention. A filament yarn, taken from a pirn 109 through feed rollers 110 and 111, is edge-crimped with blades 105, 106, 107 and 108 in such a way that the in-coming and out-going paths of the yarn at the edges of blades form V-shaped acute angles while controlling the periph-

eral speeds of rollers 112, 113, 114, 115, 116, 117, 118, 119, and 120, 121 which guide the yarn from each blade in order to provide the yarn with an appropriate tension. The edge crimped yarn is then wound on two shafts 135 and 136 for appropriate times, dried by hot air until its water content drops to less than 10 percent, and taken up on a cheese 125 on a revolving body 124. With the use of all four blades of this apparatus, and under the conditions that the radius of curvature of each blade is $\frac{3}{100}$ mm., the tension of yarn drawn out after edge crimping is about 200 g., the velocities of the yarns are 10 m./min. and 20 m./min. and the temperatures of the hot water are 55°, 65°, 75°, 85° and 95° C., a 840 d. 6 nylon yarn (with 136 filaments and a base twist of 15 turns/meter) can, for example, be processed, relaxed in 60° C. hot water and dried. Results of measurement of percentage deformation of cross-section and percentage elongation of crimp are as follows:

Velocities of processing yarn	Temperature of hot water, ° C.	Percentage deformation of cross-section	Percentage elongation of crimp
10 m./min.-----	55	30	22
10 m./min.-----	65	61	50
10 m./min.-----	75	70	65
10 m./min.-----	85	87	75
10 m./min.-----	95	82	74
20 m./min.-----	55	41	18
20 m./min.-----	65	53	24
20 m./min.-----	75	62	48
20 m./min.-----	85	72	68
20 m./min.-----	95	70	70

It is surprising that crimps are produced even at a relatively low temperature of 55° C. and this crimping lasts even after treatment with hot water at a temperature of about 100° C. which is generally used in dyeing. In the practical use of knitted goods made of these crimped yarns, it is confirmed that the durability of crimp is as good as those made of general textured yarns. If a temperature between about 80° C. and 90° C. is used, it is possible to increase crimping properties further while maintaining an economical processing speed for the yarn. It is advantageous that temperatures higher than 100° C. are not necessary in contrast to the temperature of 220° F. of the known techniques under which only extremely small crimping property is imparted.

Since both yarns and blades used in the edge crimping of the present invention are heated in hot water to the same temperature as the hot water and in such a way that the temperatures of all parts of the yarn are entirely uniform, there is no danger of unevenness of dye absorption which frequently occurs in the case of placing blades in air having low specific heat and causing uneven heating of the yarns. Since there is no influence of any outside air on the water, the control of temperature is easy. Edge crimping at a temperature lower than 100° C. is very effective for increasing operational efficiency particularly in commercial production. No breaks in the yarn and no sticking of broken yarns, fuzzy filaments, unpolymerized matter, and so forth to the heated blade is experienced.

The drying of edge-crimped yarns as shown at 135 and 136 in FIG. 2 can be omitted in some cases. Particularly so in the processing of yarns composed of a number of thin denier monofilaments. When yarns, just after being edge-crimped in hot water and containing 30 to 40 percent water, are wound up in the form of cheeses or corn, the yarns are readily collected into bundles having large sizes. On the other hand, when the yarns are dried too much and the water content is reduced to less than 5 percent, the monofilaments are disjointed and expensive extreme difficulty in winding-up.

In FIG. 3, there is shown schematically an edge crimping apparatus in which the yarns are edge-crimped first in hot water, then secondly by the use of a heated blade in air while simultaneously evaporating excessive water. The drying apparatus is omitted.

In this figure, a yarn 203 is delivered at a constant speed by a delivering means constituted by a shaft 204 and a roller 205, passes a wet type edge crimping apparatus placed in heated water and having a blade shaped body, both the ends of which forms blades, and drawn out by an intermediate yarn delivering means constituted by a shaft 218 and a roller 219 and a drawing means constituted by a shaft 206 and a roller 207. Tension of the yarn is controlled by controlling the rotational speed of shafts 204, 218 and 206. The velocity of drawing out the processed yarns is reduced. The yarn delivered from a yarn delivering means, constituted by a shaft 208 and a roller 209, is sent to a dry type edge crimping apparatus installed in air.

The dry type processed yarn is drawn out by an intermediate yarn delivering means including, a shaft 221 and a roller 222 and a yarn draw out means including a shaft 210 and a roller 211. The tension of the yarn is controlled by controlling the speed of rotation of shafts 208, 221 and 210. The drawn out yarn, the velocity of which is properly reduced, is wound up on a yarn take-up cheese 213 rotating while being pressed with a shaft 212. In the meantime, the angle of the incoming and outgoing paths of the yarn at the end of each blade is properly regulated by a guide 214 before the wet type edge-crimping blade 202 and another guide 215 after the blade 202, and a strong edge crimping effect is obtained by winding the yarn once around the blade shaped body having edges on both sides. Also at the dry type edge crimping apparatus, the angle of the yarn path is properly regulated by a guide 216 and another guide 217 before and after the blade, and the yarn is wound once around the blade shaped body having edges on both sides so as to secure the edge crimping and drying effect. Element 220 is an electric heating means which directly heats the blade.

In short, the yarn is, at first, subjected to the wet edge crimping in hot water (if necessary, inorganic acids, alkalis, inorganic- and/or organic-salts, esters, alcohols, common lubricants for fibers or other treating agents for fibers are incorporated therein) and provided with the greater part of its crimping property. The yarn is then introduced into the dry edge crimping means installed in air with the condition that the moisture content is about 5 to 50 percent (though it varies slightly according to the kind of fiber) and a relatively small further crimping effect is provided while simultaneously evaporating moisture. As in the foregoing example (the same effect of hot water, that is, a uniform, stretchable, bulky processed yarn) can also be obtained by the apparatus of instant example. In the case of the instant apparatus, it is also preferable that the yarn during the course of dry crimping contains 3 to 7 percent of water.

The present invention may be more fully understood from the following examples which are shown only by way of illustration and not by way of limitation.

Example 1

A 840 d. (136 filaments) 6-nylon yarn having a base twist of 18 turns per meter was processed by an edge crimping apparatus as shown in FIG. 2, in which the radius of curvature of the blade edge was $\frac{2.5}{100}$ mm., the temperature of hot water was 92° C., the tension of yarn at the edge of 100 g., the velocity of the yarn was 15 m./min. and edge crimping was carried out four times. The resultant yarn was dried, subjected to steam setting in the form of strands in relaxed condition at a temperature of 100° C. for 20 minutes and further relaxed whereby the following yarn characteristics were obtained:

70	Percent elongation of crimp -----	Percent
	Percent recovery of crimp -----	71
		87

Example 2

A 70 d. (24 filaments) 6-nylon yarn possessing a base 75 twist of 20 turns per meter was processed with the use

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of a crimping apparatus as shown in FIG. 3, in which the curvature of the blade edge was $\frac{3}{100}$ mm., 1 percent sulfuric acid aqueous solution having a temperature of 80° C. was used, the tension of the yarn was 20 g., the processing velocity was 25 m./min. and relaxation was carried out after drying as in Example 1. The following results were obtained:

	Percent
Percentage elongation of crimp	73
Percentage recovery of crimp	86

Example 3

A 180 d. (30 filaments) polypropylene yarn having no base twist was processed with an edge crimping apparatus as shown in FIG. 2, in which the radius of curvature of the blade edge was $\frac{3}{100}$ mm. The edge was placed in a 2 percent aqueous dispersion of Soluol K-124 (non-ionic oiling agent supplied by Kao Sekken K.K., Japan). The temperature of solution was 80° C. The tension of edge-crimping was 40 g. and the velocity of the yarn was 30 m./min. Thereafter, the yarn was wound up into a pirn-form while providing a twist of 50 turns per meter. The pirn was rewound on a cone and knitting was carried out with the use of a circular knitting machine. The knitted goods were lightly crumpled in water at 60° C., dehydrated and dried. Yarn taken from these knitted goods was tested and the following results were obtained:

	Percent
Percentage elongation of crimp	48
Percentage recovery of crimp	76

Example 4

A 180 d. (30 filaments) polypropylene yarn which had been stretched 3.5 times the original length with the use of a draw-twister after melt-spinning was edge crimped just before being wound up on a bobbin with the use of an edge crimper as shown in FIG. 3, in which a blade edge having a radius of curvature of $\frac{3}{100}$ mm. was installed in a 10 percent aqueous dispersion of Soluol K-124 (non-ionic oiling agent supplied by Kao Sekken K.K., Japan) which was maintained at a temperature of 85° C. The tension on the yarn was 40 g. and the velocity of the yarn was 90 m./min. Thereafter, the yarn was taken up on bobbin while imparting a twist of 30 turns per meter. The resultant yarn was knitted with a circular knitting machine, subjected to light crumpling, dehydrated and dried. Yarn was taken out and its crimping properties were tested and the following result was obtained:

	Percent
Percentage elongation of crimp	38
Percentage recovery of crimp	76

Example 5

A 75 denier (30 filaments) polyester yarn having a base twist of 20 turns per meter was processed with the use of an edge-crimping apparatus as shown in FIG. 2, in which the radius of curvature of the blade edge was $\frac{3}{100}$ mm. A 2 percent sodium hydroxide solution maintained at a temperature of 90° C. was used. The tension on the yarn was 20 g. and the velocity of the processing yarn was 20 m./min. Thereafter, the yarn was relaxed after drying as in Example 1. The following properties were obtained:

	Percent
Percentage elongation of crimp	54
Percentage recovery of crimp	83

Example 6

A 110 d. (30 filaments) 6-nylon yarn having a base twist of 15 turns per meter was processed by an edge crimping apparatus as shown in FIGURE 2 in which the radius of curvature of the blade edge was $\frac{1}{100}$ mm. A 4% sodium sulfate solution was used while the temperature was kept at 65° C. The tension of the yarn at the

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edge was 30 g. and velocity of processing of the yarn was 25 m./min. After being washed with water, the yarn was dried and relaxed as in Example 1. The resultant yarn showed the following crimping properties:

	Percent
Percentage elongation of crimp	72
Percentage recovery of crimp	88

Example 7

Example 6 was repeated except a 1.5% sodium formate was used in place of the sodium sulfate solution. The resultant yarn showed

	Percent
Percentage elongation of crimp	70
Percentage recovery of crimp	90

Example 8

A 210 d. (24 filaments) 6-nylon yarn having a base twist of 15 turns per meter was processed by the use of an edge crimping apparatus as shown in FIGURE 2 in which the radius of curvature of the blade edge was $\frac{7}{1000}$ mm. A 1% benzoic acid solution was used. The temperature of the solution was kept at 88° C. The tension of the yarn at the edge was 45 g. and the velocity of processing of the yarn was 35 m./min. After being dried and relaxed as in Example 1, the yarn showed

	Percent
Percentage elongation of crimp	78
Percentage recovery of crimp	89

Example 9

Example 8 was repeated except a 2% methyl benzoate solution was used in place of the benzoic acid. The resultant yarn showed

	Percent
Percentage elongation of crimp	75
Percentage recovery of crimp	90

Example 10

A 75 d. (30 filaments) "Tetron" (polyester fibers) having a base twist of 20 turns per meter was processed by means of an edge crimping apparatus as shown in FIGURE 2 in which the radius of curvature of the blade edge was $\frac{1}{100}$ mm. A 0.8% glycerin solution was used keeping the temperature at 90° C. The tension of the yarn at the edge was 20 g. and the velocity of processing of the yarn was 15 m./min. The resultant yarn, after being dried and relaxed as in Example 1, showed

	Percent
Percentage elongation of crimp	58
Percentage recovery of crimp	90

What is claimed is:

1. A method for producing stretchable bulky yarns comprising subjecting thermoplastic filamentary articles to edge crimping with use of at least one edge of a body placed in water at a temperature higher than 50° C. under tension while making said filamentary articles contact said edge in such way that said filamentary articles make a V-shaped turn where contact is made with the edge.
2. A method according to claim 1, wherein the edge is the edge of a blade.
3. A method according to claim 1, wherein the edge is the edge of a thin linear body.
4. A method for producing stretchable bulky yarns comprising subjecting thermoplastic filamentary articles to edge crimping with use of at least one edge of a body placed in water containing at least one of the group consisting of inorganic acid, alkali, a salt thereof, a salt of carboxylic acid, ester, an alcohol fiber-oiling agent and a fiber-treating agent, at a temperature higher than 50° C. under tension while making said filamentary articles contact said edge in such a way that said filamentary articles make a V-shaped turn around said edge.

5. A method according to claim 4, wherein the edge is the edge of a blade.

6. A method according to claim 4, wherein the edge is a thin linear body.

7. An apparatus for producing stretchable bulky yarns by edge crimping, said apparatus comprising a blade-edge-like part, means to immerse the part in water, and an inlet guide means and an outlet guide means causing the yarns to make a V-shaped turn around and in contact with the blade-edge-like part.

8. A method for producing stretchable bulky yarns which comprises subjecting thermoplastic filamentary articles to edge crimping, firstly, with use of at least one edge placed in a liquid selected from the group consisting of water, an aqueous solution of fiber finishing agent and an aqueous dispersion of fiber finishing agent, at a temperature higher than 50° C. under tension while making said filamentary articles contact said edge and make a V-shaped turn around and in contact with said edge and, secondly, with use of at least one edge placed in air, while likewise making said filamentary articles under tension make a V-shaped turn at said edge.

9. A method according to claim 8, wherein the edge is the edge of a blade.

10. A method according to claim 8, wherein the edge is a thin linear body.

11. An apparatus for producing stretchable bulky yarns by edge crimping, said apparatus comprising means having at least one edge, means to immerse said edge in water, and inlet guide means and an outlet guide means causing the yarns to make a V-shaped turn around and in contact with the edge, means having at least one other edge located in air, an inlet guide means and an outlet guide means which cause the yarns to make a V-shaped turn around and in contact with the latter said edge, and means to move the yarns in sequence across both said edges.

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