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ARTIFICIAL WOOL

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This invention relates to artificial fibers and fabrics and more particularly to a new synthetic wool.

It has been proposed to crimp, curl, or crinkle various straight natural and artificial fibers in order to obtain a product similar to natural wool. The wool-like products produced by application of crinkling processes to the fibers heretofore selected for this purpose, however, are not very satisfactory wool substitutes inasmuch as these known artificial wools lack to a serious degree valuable inherent properties of wool such as resiliency, a high degree of elasticity, and good crimp retentivity, particularly when wet. Thus, although numerous types of artificial fibers have been prepared which can be used to advantage as substitutes for cotton and silk, attempts to prepare a satisfactory substitute for wool have thus far been unsuccessful.

This invention has as an object the manufacture of new and useful synthetic wool. A further object is the preparation of artificial wool-like fibers, yarns, fabrics, and the like, which possess to a high degree the properties most desired in natural wool, and which at the same time possess valuable properties not found in natural wool. A still further object is the production of wool-like fibers and fabrics having good strength, retentivity of crimp both wet and dry, heat stability, and heat insulating properties. Other objects will appear hereinafter.

These objects are accomplished by converting filaments formed from synthetic linear condensation polymers, particularly polyamides, into wool-like fibers as will be more fully described hereinafter.

I have discovered that the application of fiber-crinkling methods to artificial filaments formed from superpolymers, that is, linear condensation polymers capable of yielding useful and pliable fibers, produces a wool-like product differing markedly from that made from other straight fibers in that the synthetic wool of this invention not only possesses to a higher degree the desired properties of wool but possesses in addition new properties which enhance its value. The preparation of these straight fibers from which my improved artificial wool is made is fully described in Patents 2,071,251 and 2,071,253. Of the fiber-forming polymers described in these applications the linear condensation polyamides have been found most valuable in attaining the objects of the present invention. This invention will therefore be described with particular reference to the polyamides.

The fiber-forming synthetic linear condensation polyamides (superpolyamides) are of two types, those derived from polymerizable mono-aminomonocarboxylic acids or their amide-forming derivatives, and those derived from suitable diaminedibasic acid mixtures or their equivalents. A valuable property of the superpolyamides is that they can be spun from melt, i. e., by extruding a molten polymer through suitable orifices and cold drawing the filaments thus prepared. The cold drawing refers to the property of the superpolyamide filaments which permits them after extrusion or spinning to be further elongated under tension at ordinary or moderately elevated temperatures with the simultaneous appearance of fiber orientation and marked changes in physical properties, such as increased pliability. The term "filament" as used herein refers to both oriented and unoriented filaments or threads which are drawn from the superpolymers regardless of whether the filaments or threads are long (continuous) or short (staple), while the term "fiber" refers more specifically to the oriented filaments which are useful in the manufacture of yarn and fabric as are natural textile fibers. The term "crimped" filament or fiber is used to indicate that the filament or fiber contains a crimp, crinkle, curl, spiral, indentation, or serration regardless of whether the crimp or deformation is in one plane or in more than one plane as it would be in the case of a curl or spiral.

A useful method for making my new wool-like product comprises twisting into a thread a plurality of filaments before completion of the above mentioned cold drawing step. After the undrawn or partially drawn filaments are twisted into a thread and several threads are plied together the resultant yarn is cold drawn, an additional twist is applied to the yarn followed by a setting treatment. The yarn is next separated into the initial threads which are then twisted in the direction opposite to the original twist. These operations may be done by hand but are preferably effected by machine. This treatment gives a wool-like yarn composed of fibers having a spiral or helical crimp. The twisting both before and after cold drawing, which differs from any process previously described for making crimped products, gives a more wool-like product than could be obtained by applying all the twisting to the completely drawn fibers. In general at least four crimps per inch are required in the thread before untwisting in order to obtain a truly valuable wool substitute. A novel effect may be obtained

by beginning with a mixture of filaments some of which have been cold drawn to a greater extent than others. When this is done, some of the fibers tend to break in the subsequent drawing operation, thus producing loose ends which add to the woolly character of the final product.

The following is an example of the above mentioned method of producing the crimped or crinkled fibers:

EXAMPLE I

Thirty undrawn filaments, having a denier of approximately 20 each and prepared by spinning polyhexamethylene adipamide of intrinsic viscosity 0.88 from melt, were formed into a thread by applying about one turn per inch twist. Five of such threads were then plied into a larger thread or yarn. This yarn was then twisted to about 20 turns per inch resulting in an evenly knotted yarn with about 50% contraction in length. This yarn was then cold drawn 170% and then given an additional eight turns to the inch twist. The yarn was wrapped on a spool and treated with boiling water for several minutes. The yarn was then removed, untwisted, and the five elementary threads separated. These threads were next given about four turns twist per inch in the opposite direction to the initial twist. This gave a wool-like product in which the fiber had a spiral-like crimp.

If, in place of using undrawn filaments as described above, drawn filaments are used and the yarn is not subsequently cold drawn, the crimps resulting tend to straighten out at the same time when the yarn is under tension. By stretching or drawing the twisted yarn as described in Example I, however, the resulting crimps are sufficiently irregular so that the final yarn has crimped filaments which are not straightened out at the same elongation.

An unusual yarn was made by including in each of the elementary threads about 30% of drawn fibers. These previously drawn fibers were broken when the yarn was subsequently stretched, resulting in some fiber ends protruding from the yarn, and a degree of fuzziness. The number of places in which the individual fibers break is of course dependent upon the manner in which the thread is cold drawn. To obtain a thread having many loose ends the thread should be cold drawn so that only a small section or length thereof is drawn at one time. This is conveniently done by effecting the drawing between two closely spaced revolving drums or bobbins having different peripheral speeds so that only a short piece of thread is under tension at one time. This method is different from any method previously described for making a wool-like product. If desired, other types of fibers can be mixed with the superpolyamide fiber in this process.

Although the above example describes a preferred process for carrying out my invention it is to be understood that my new product may be made by applying various other crimping or crinkling methods to the superpolyamide filaments. These methods also yield an artificial wool which in strength, pliability, softness, crimp or curliness, and in retention of crimp is superior to wool-like products made from other straight fibers by like methods. Fibers having 10 to 50 crimps per inch can readily be prepared and useful wool substitutes may be made with as low as four crimps per inch. A convenient mechanical method is that of gear crimping which consists in pressing the superpolyamide fibers be-

tween intermeshing serrated racks and heating them in this position with steam, preferably saturated steam at 100-150° C. The operation can be made continuous by passing the fibers through slowly moving intermeshing gears in a saturated steam atmosphere, or by pressing wet fibers through heated intermeshing gears. The function of the steam is to make the crimp more permanent. The number of crimps per inch (wave length) and their depth (amplitude) will depend upon the size and number of indentions in the gears. The crimp introduced in this manner is largely in one plane.

Still another mechanical method for introducing a crimp consists in winding the superpolyamide fibers or yarns around a suitable wire or mandrel, preferably one having a diameter less than 0.2 inch, and subjecting the fibers in this position to heat-treatment, preferably in the presence of a setting medium like steam. A similar effect is obtained by winding fibers, which have been treated with water or other suitable setting medium, around a wire and heating the fibers in this position. On removing the fibers they retain the spiral crimped form imparted by the setting treatment on the wire or mandrel.

The advantage of the superpolyamide artificial wool products of this invention over the wool substitutes made by application of the same crinkling means to other straight fibers is shown by the comparison which may be made from the following table:

TABLE I

Crimp retentivity of various types of fibers

Type of fiber	Method of crimping	Setting treatment	Crimp retentivity in percent
Natural wool.....			100
Casein wool ("Lanital").....			19
Superpolyamide.....	Gear.....	Boiling water—10 min.....	70
Natural silk.....			10
Viscose rayon.....			0
Superpolyamide.....		Boiling water—90 min.....	90
Do.....	Twist.....	Boiling water—20 min.....	100

As shown by the last two items in the table the product of the present invention approaches and may even equal the crimp retentivity of natural wool. The products of this invention preferably have a crimp retentivity of at least 40%. As far as I have been able to determine none of the prior artificial wools approach this value.

The above figures representing the crimp retentivity of the fibers were determined as follows: A weight of 0.03 g. per denier was applied to the crimped filament and the filament immersed in water at 60° C. After 30 seconds' immersion in the water the filament was removed, the load removed, and the filament dried. From measurements of the original crimped length, straight length, and crimped length after stretching and drying, the crimp retentivity in percent is calculated by multiplying by 100 the quotient obtained by dividing the difference between initial straight length and recovered crimped length by the difference between the initial straight length and initial crimped length. It is to be understood that "crimp retentivity" as used throughout the specification and claims of this application is determined and defined in this empirical manner.

The following are further examples of the different methods which may be used in obtaining my improved wool-like product:

EXAMPLE II

The fibers used as starting material in this example were prepared by melt spinning polyhexamethylene adipamide of intrinsic viscosity 0.92 obtained from the condensation polymerization of hexamethylenediamine and adipic acid (in form of the diamine-dibasic acid salt) in the presence of a small amount of hexamethylene diammonium acetate which functioned as a viscosity stabilizing agent. A yarn composed of 14 of these fibers, each of which had been cold drawn 315% and had a denier of about 6 and a tenacity of 4.7 g. per denier based on the denier at break, was thoroughly soaked with water and then passed slowly through two intermeshing brass gears (32-pitch and 6-inch diameter) heated to 100° C. The crimps or serrations produced in the fibers in this way were rendered fairly permanent by the action of the heat and water. The product had approximately 10 crimps per inch and a retentivity of 44%. Additional treatment with steam at 120° C. was found to improve the retentivity. Woven or knitted fabrics made from this yarn closely resembled fabrics similarly prepared from natural wool.

EXAMPLE III

The yarn used as starting material in this example was prepared by melt spinning and cold drawing polydecamethylene adipamide of intrinsic viscosity 0.74. The individual fibers had a denier of 1.7. This yarn was moistened with water and wound around a No. 14 copper wire. The whole was then immersed in water for 90 minutes, removed, and heated in an oven at 100° C. for one hour. The wool-like product obtained in this way had about seven crimps per inch.

EXAMPLE IV

A 40-filament yarn composed of 6.5 denier fibers, prepared by dry spinning a formic acid solution of polyhexamethylene adipamide of intrinsic viscosity 1.35 containing 5% of finely divided titanium dioxide as delusterant, was crimped in the manner described in Example III, but was soaked in a 3.7% solution of phenol in water prior to heating at 100° C. for one hour. This gave a wool-like yarn having more than seven crimps per inch and a retentivity of 60%. The product was substantially free of luster.

EXAMPLE V

The fibers used in this example were prepared by dry spinning of a 29% solution of polyhexamethylene adipamide (intrinsic viscosity 1.35) in formic acid under conditions such that some formic acid was retained in the fibers. The fibers, which had been cold drawn 145%, had a denier of 1.5 and a tenacity of 2.5 g. per denier. They were wound around a small copper wire and heated in boiling water while in this position for 20 minutes. This gave a product having about 20 crimps per inch and a retentivity of 100%. Wool-like fibers of equally good properties were obtained by twisting the fibers after the manner described in Example I and using boiling water as the setting medium.

EXAMPLE VI

This example will describe the preparation of wool-like polyamide filaments by electrostatic spinning, i. e., forming the filaments in a strong electrical field. The device used for this purpose may consist simply of a spinneret which serves as one electrode and a receiver placed a suitable

distance below the spinneret which serves as the other electrode. The distance between the spinneret and receiver will usually be in the neighborhood of two to ten feet depending on the strength of the field. A strong electrostatic or direct current field, preferably in the neighborhood of 5,000 to 100,000 volts, is then applied between the spinneret and receiver. The polyamide is next extruded from the spinneret, e. g., as a solution in formic acid, and enters the electrical field. Under the influence of this field, the extruded filaments disrupt yielding very fine filaments which give a wool-like effect when combined into a thread or yarn. If desired an air or steam jet may be impinged on the extruded mass directly below or near the spinneret.

By a suitable modification of the above process, filaments can be prepared which do not disrupt in the electrical field but which are nevertheless quite wool-like. This modification consists in spinning the polyamides, preferably from melt, and collecting the filaments on a suitable revolving drum placed below the spinneret. The optimum distance between the spinneret and drum will depend upon the strength of the electrical field; thus, when the field is 20,000 volts the distance will be in the neighborhood of four to five inches. A strong unidirectional electrical field is set up between the spinneret and an electrode placed near or connected to the collecting drum. The strength of the electrical field and the speed of the drum are so adjusted that the filaments are laid down on the drum faster than the peripheral speed of the drum. As a result the filaments are laid down on the drum in a fine zigzag or crimped fashion. The crimp introduced in this fashion is surprisingly permanent. It persists even after the filaments are cold-drawn, although the number of crimps per inch is obviously reduced in this manner and the amplitude of the individual crimp is increased. It is not difficult, however, to obtain cold-drawn fibers having more than four crimps per inch by this process. The crimp retentivity of the fibers is increased by treatment with steam. Some measure of success can also be attained in preparing crimped filaments by laying down the filaments in a zigzag fashion without the use of an electrical field. This is accomplished by spinning the filaments at a faster rate than they are wound on the collecting drum.

Although this invention has been described with particular reference to polyamides, it is applicable broadly to synthetic fiber-forming linear condensation polymers. As examples of such polymers might be mentioned the polyesters, polyacetals, polyethers, and polyanhydrides described in above mentioned Patent 2,071,251. The invention is also applicable to interpolymers or copolymers, e. g., polyester-polyamides. As already stated the most useful wool-like fibers are obtained from the synthetic linear condensation polyamides.

The mechanical processes for introducing crimp described above can be applied to all types of superpolymer filaments and fibers, including those prepared by the wet and dry (evaporative) processes of spinning as well as those prepared by melt spinning. While fibers of widely different sizes can be crimped by these processes, fibers having deniers ranging from 0.5 to 20 are generally most useful in making wool-like products. The processes may be applied to single fibers or to threads and yarns containing a plurality of fibers. Fibers containing residual sol-

vent, e. g. formic acid or phenol, can also be crimped by the processes of this invention. In this case it is desirable to apply the crimp at a sufficiently high temperature to bring about evaporation of the retained solvent. This automatically sets the crimp in the fibers. Fibers containing plasticizers can also be employed.

To be useful as a wool substitute the superpolymer fibers and fabrics must retain their crimp under conditions encountered in service. This means that they must have good crimp retentivity both wet and dry. Steam treatment of crimped superpolymer products, particularly the superpolyamides, has been found to improve very markedly their crimp retention. Products prepared by removing retained solvent or a mixture of solvent and non-solvent from crimped fibers also have good crimp retentivity.

In the examples the "intrinsic viscosity" of the superpolyamides used is given. This term is defined as

$$\frac{\log_{\eta_{sp}}}{C}$$

in which η_{sp} is the viscosity of a dilute m-cresol solution of the polymer divided by the viscosity of m-cresol in the same units and at the same temperature, and C is the concentration in grams of polymer per 100 cc. of solution. Superpolyamides having intrinsic viscosities ranging from 0.5 to 2.0 are in general most useful in making the wool-like products of this invention. "Viscosity stabilizing agents" mentioned in the examples refers to agents which are added to the monomeric reactants used to prepare the superpolyamide in order to stop the polymerization when a certain molecular weight (intrinsic viscosity) is reached, the point at which polymerization ceases depending upon the quantity of stabilizer added.

It will be apparent that various modifications of the above methods can be applied. In these various methods undrawn filaments, partially drawn filaments or completely drawn filaments may be used. In some instances, e. g. twist crimping, it is desirable to apply the crimping treatment to undrawn or partially drawn fibers, complete the cold drawing, and then apply additional crimping. Furthermore, it is possible to apply cold drawing during the formation of the crimp by the gear, twist, or other processes of this invention.

Superpolyamides other than those specifically mentioned in the examples can be converted into wool-like fibers in a similar manner. A valuable class of superpolyamides for the preparation of wool-like fibers are those derived from diamines of formula $\text{NH}_2\text{CH}_2\text{RCH}_2\text{NH}_2$ and dicarboxylic acids of formula $\text{HOOCCH}_2\text{R}'\text{CH}_2\text{COOH}$ or their amide-forming derivatives, in which R and R' are divalent hydrocarbon radicals free from olefinic and acetylenic unsaturation and in which R has a chain length of at least two carbon atoms. An especially valuable group of superpolyamides within this broad class are those in which R is $(\text{CH}_2)_x$ and R' is $(\text{CH}_2)_y$, wherein x and y are integers and x is at least two. As examples of superpolyamides which fall with one or both of these groups might be mentioned polytetramethylene adipamide, polytetramethylene sebacamide, polypentamethylene sebacamide, polyhexamethylene adipamide, polyhexamethylene sebacamide, polyoctamethylene adipamide, polydecamethylene adipamide, polydecamethylene p-phenylene diacetamide, and

poly-p-xylylene sebacamide. This invention is not limited, however, to the use of superpolyamides of the diamine-dibasic acid type; it is also applicable to fibers prepared from polymerizable monoaminomonocarboxylic acids (or their amide-forming derivatives) of which 6-amino caproic acid, 7-aminoheptic acid, 9-aminononanoic acid, and 11-aminoundecanoic acid may be mentioned as examples. Thus, application of the method described in Example III to a 4-filament yarn prepared from polymerized 6-amino caproic acid of intrinsic viscosity 0.72 gave a wool-like product of good crimp retentivity containing about 18 crimps per inch and having a tenacity of 2.9 g. per denier based on the denier at break. It is within the scope of this invention to prepare wool-like fibers from mixtures of preformed superpolyamides as well as from interpolymers derived from a mixture of polyamide-forming reactants, e. g., a mixture of two diamines with one or more dicarboxylic acids, or a mixture of a polymerizable amino acid with a diamine and a dicarboxylic acid.

As is indicated in Example III the superpolymer used in the preparation of the wool-like fiber may contain a delusterant. The delusterant may be inorganic or organic. It is also possible to carry out the process of this invention using superpolymers containing other types of materials, such as plasticizers, e. g. o-hydroxydiphenyl, resins, oils, cellulose derivatives, etc.

While heat setting with steam is the preferred method, it is within the scope of this invention to set the crimp in the fibers by other methods, e. g. dry heating at 100-150° C. or heating in the presence of various liquids, such as aqueous phenol, aqueous formic acid, 5% hydrochloric acid, 5% aqueous solution of ethylene glycol, 10% aqueous solution of acetamide, and 5% aqueous solution of sodium chloride. The term "setting" as used herein, signifies heating in the presence of a medium, for example water, which improves the crimp retentivity.

The wool-like fibers obtained in accordance with the process herein described are continuous. Yarns and fabrics can be readily formed from these fibers. If desired, the wool-like continuous fibers can be cut up into short lengths, e. g. one to six inches, or short lengths of straight superpolyamide fibers can be crimped by the methods herein described, and these staple fibers can then be formed into yarns and fabrics. Fabrics prepared in this way have a more fuzzy appearance and "feel" than those prepared from the continuous fibers.

It is within the scope of this invention to use the superpolyamide wool fibers or yarns in admixture with other types of fibers or yarns in the preparation of "mixed fabrics". As examples of other types of fibers and yarns which may be used in conjunction with my new artificial wool might be mentioned viscose rayon, spun or staple viscose rayon, acetate rayon, spun acetate rayon, silk, silk waste, natural wool, linen, and cotton. Straight superpolymer fibers may also be used. In these combinations the superpolyamide wool may be used as continuous filaments or in the form of staple fibers. The mixed fabrics may be prepared by using different types of yarns, e. g., a superpolyamide wool yarn and a spun viscose rayon yarn, or by using yarns made up of mixtures of different types of fibers. When the latter method is employed the mixed yarns can be prepared by incorporating the superpoly-

amide fibers with the other fibers at any stage in the preparation of the yarn. For this purpose twisting or doubling methods may also be employed. These mixed yarns may then be used in the preparation of woven or knitted fabrics or be used in conjunction with other yarns. As already indicated, it is also possible to prepare mixed fabrics by using superpolyamide yarns with other types of yarns. Thus, in the preparation of woven fabrics the superpolyamide yarn may be used as either the warp or the filling. Novel effects are obtained by using superpolyamide yarn and other types of yarns intermittently in either the warp, filling, or both. Likewise in the preparation of knitted fabrics the different yarns may be fed into the knitting machine. In this way a wide variety of effects can be produced. The superpolyamide fibers and yarns of this invention impart strength, wooliness, and other valuable properties to these mixed fabrics.

The wool-like superpolyamide fibers are somewhat less lustrous than the uncrimped fibers and their luster can be modified or destroyed, as is often desirable in artificial wool products by the addition of suitable luster-modifying agents such as titanium oxide and other pigments. Thus a delusterant may be added to the superpolyamide before or after it is converted into wool-like fibers. Preferably, it is incorporated with the superpolyamide before the latter is formed into fibers. A convenient method for incorporating the delusterant, e. g., a pigment-like material, is to add it in finely divided form to the monomeric ingredients used in the preparation of the superpolyamide.

As previously indicated the crimp retentivity of the new wool substitute which I prepare from fiber-forming synthetic linear condensation polyamides is far superior to that of known synthetic wools and approaches that of wool itself. The present product also furnishes a satisfactory wool substitute in that it has good insulating properties and good dyeing characteristics. The products claimed herein show fiber orientation when examined by X-rays, have high wet and dry strengths, generally in the neighborhood of 3 to 7 g. per denier based on the denier at break, have excellent elastic properties, and have a resiliency equal to natural wool. They possess not only the properties most desired in wool substitutes but valuable additional properties such as great strength, good resistance to solvents and chemical reagents, little tendency to lose strength on aging and immunity from attack by moths. Owing to the great strength of my new synthetic wool, fine warps and fillings can be made therefrom. This makes it possible to prepare fabrics of very fine thread counts (sheers) from my synthetic wool which is not possible in the case of natural wool. The dyeings are frequently more fast than in the case of natural wool. Moreover, dyes which are used in an alkaline medium, e. g. those of the "Sulfanthrene" type, can also be used with the superpolyamides whereas they cannot be used with natural wool because of its sensitivity to alkali. On heating with strong mineral acid, the wool-like fibers disintegrate yielding the monomeric ingredients from which they were derived. Thus, if wool-like fiber derived from polyhexamethylene adipamide is heated with hydrochloric acid, it is hydrolyzed yielding adipic acid and hexamethylenediamine (as the hydrochloride). The fibers are resistant to attack by strong caustic

alkalies, but these agencies also will finally hydrolyze them.

It will be apparent from the foregoing description that the present invention provides a convenient and economical method for the preparation of artificial wool-like fibers. The nature of the invention is such that the character of the fibers, e. g. the number and nature of the crimp, can be varied within wide limits. The artificial wool-like fibers, yarns and fabrics derived from superpolyamides, approach natural wool in crimp retentivity, heat insulating properties, and are superior to wool in strength, heat stability and dyeing characteristics. These artificial wool-like products are thermally stable at 150° C., whereas natural wool decomposes quite rapidly at this temperature with liberation of ammonia, hydrogen sulfide, and carbon bisulfide. The process by which the artificial fibers of this invention are made is of such a character that modifying agents, for example, delusterants and plasticizers, can be readily incorporated therewith. The fibers of this invention can be easily formed into yarns of the worsted type. These yarns can be knitted or woven into fabrics. They can also be formed into felt-like materials. In contrast to other known synthetic wools, the products of this invention retain their crimp when wet. A bundle of crimped superpolyamide fibers when wet and squeezed will spring back instead of remaining packed as will crinkled or crimped cotton, viscose rayon, cellulose acetate rayon, or any other known wool substitute. This also holds for the corresponding fabrics.

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that I do not limit myself to the specific embodiments thereof except as defined in the appended claims.

I claim:

1. An artificial wool-like product comprising crimped fibers of synthetic linear polymer having a crimp retentivity of at least 40%, said fibers exhibiting by characteristic X-ray patterns orientation along the fiber axis.
2. A synthetic linear polyamide in the form of a crimped filament having a crimp retentivity of at least 40%.
3. A synthetic linear polyamide in the form of a crimped staple fiber having a crimp retentivity of at least 40%.
4. An artificial wool comprising crimped polyamide fibers having at least four crimps per inch and having a crimp retentivity of at least 40%, said polyamide being derived from a diamine of the formula $\text{NH}_2\text{CH}_2\text{RCH}_2\text{NH}_2$ and a compound of the class consisting of dicarboxylic acids of the formula $\text{HOOCCH}_2\text{R}'\text{CH}_2\text{COOH}$ and amide-forming derivatives thereof, in which R and R' are divalent hydrocarbon radicals and in which R has a chain length of at least two carbon atoms.
5. An artificial crimped filament which has a crimp retentivity of at least 40% and which yields on hydrolysis with mineral acid a diamine and a dibasic carboxylic acid.
6. A fabric comprising crimped synthetic linear polyamide fibers having a crimp retentivity of at least 40%.
7. A mixed fabric comprising crimped synthetic linear polyamide fibers having a crimp retentivity of at least 40%.
8. A yarn comprising crimped filaments which do not straighten out at the same elongation and

which have a crimp retentivity of at least 40%, said filaments consisting of synthetic linear polyamide.

5 9. A process for making a permanently crimped wool-like fiber which comprises cold-drawing a polyamide filament, then forming it into a

crimped shape, and then contacting the crimped filament with a substance of the class consisting of steam and hot water and continuing the treatment with said substance until the crimp retentivity of the filament is at least 40%.

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