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ALTERNATELY CRIMPED STAPLE FIBER

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FIG. 1



FIG. 2



FIG. 3

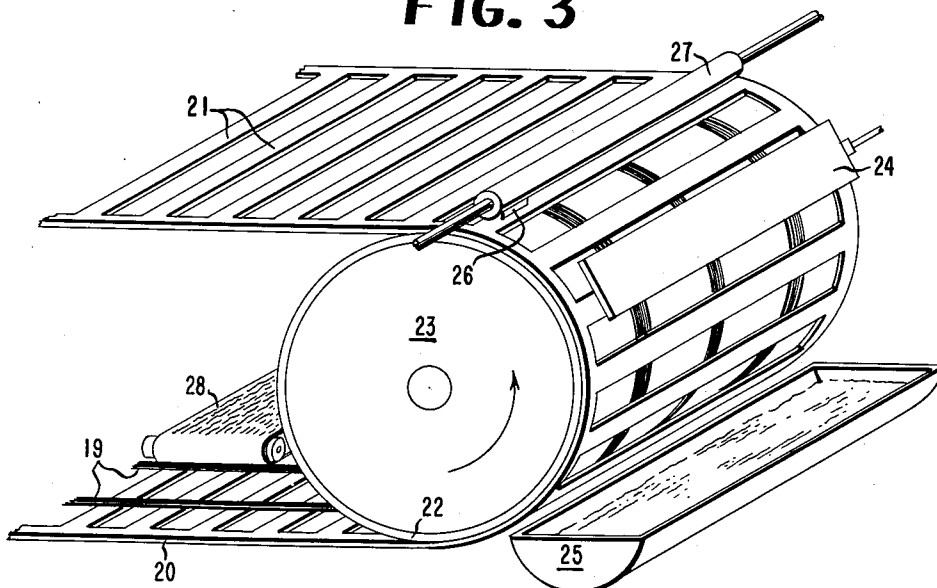
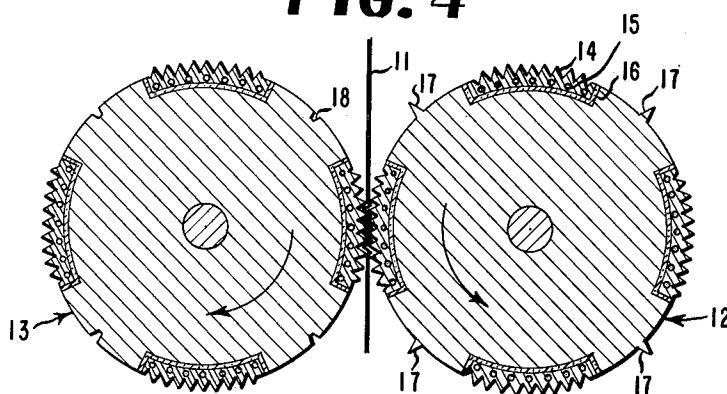


FIG. 4



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ALTERNATELY CRIMPED STAPLE FIBER

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6 Claims. (Cl. 28—82)

This invention relates to textile fibers and more particularly to novel, synthetic, staple-length fibers.

It has been a long-sought goal of the synthetic fibers industry to produce, from synthetic fibers, wearing apparel fabrics which would resemble fabrics made of prestige animal fibers such as wool and cashmere. Such fabrics would be characterized in having the desirable bulk, cover, resiliency, and hand of the animal fibers and, additionally, would possess the desirable properties of synthetic fibers such as decreased shrinkage, resistance to insecticidal damage, ease of care, and increased durability. The approach generally taken toward accomplishing this goal has been to convert synthetic fibers, which are normally produced as straight fibers of indefinitely long length, into short-length staple fibers having a length roughly comparable to the length of the animal fibers, and processing these staple fibers into yarn and fabric, using methods and equipment similar to those used on the animal fibers. The synthetic staple fibers, in the course of their production, are often provided with fairly uniform deformations or crimps throughout the length of the staple fiber so that the staple fibers will be non-straight and thus more closely resemble the animal fibers. The crimp may be temporary or durable. Temporary crimp is useful merely in improving web cohesion during carding operations, thus permitting the synthetic staple to be processed into spun yarns on equipment designed for wool; but this crimp is not retained in the final fabric in its normal use. Durable crimp, in addition to aiding yarn spinning, is retained by the staple fibers in the spun yarn or fabric products, providing bulkier spun yarns, and fabrics having the bulk, cover, and resiliency of wool fabrics. However, it is generally found that the synthetic fabrics lack the hand of wool or cashmere fabrics, and in addition present a pilling problem during the course of fabric use which is not encountered in fabrics of animal fibers. Various fiber or fabric treating methods have been employed in efforts to reduce pilling and to improve fabric hand, but very few of the treatments are effective without deleterious effects, nor do they provide desirable effects which are durable for the life of the fabric.

It is therefore an object of the present invention to provide synthetic staple fibers which can be formed into pill-resistant fabrics having a cashmere-like hand. It is another object of the present invention to provide synthetic staple fibers which can be formed into pill-resistant fabrics resembling cashmere fabrics. It is another object of this invention to provide pill-resistant fabrics made from durably crimped, synthetic staple fibers, which fabrics feel like wool or cashmere and resist shrinking and insecticidal damage. Other objects and advantages will be apparent from the following specification and appended claims.

The objects of the present invention are accomplished by providing a synthetic, intermittently crimped, staple-length filament of 1 to 15 denier having a durably crimped portion and at least one essentially straight terminal portion, said crimped portion comprising between 25% and 75% of the unextended or crimped filament length, said crimped portions having a crimp index between 8% and 35%. The intermittently crimped filaments may be prepared by intermittent exposure of a continuous strand of fibers which are spontaneously crimpable by thermal or chemical means, to the necessary crimp-inducing thermal

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or chemical means, and cutting the strand into staple lengths at points on the uncrimped portions of the strand. Alternatively, the intermittently crimped filaments may be prepared from crimp-settable fibers by intermittent application of mechanical crimp, simultaneously with, or followed by, a setting or stabilizing operation.

Throughout the specification and claims, by "staple fibers" it is meant fibers having an extended, i.e., uncrimped, length from about 0.5 inch to about 5 inches. By "extended length" it is meant the shortest length to which the staple fiber must be elongated by tension to remove all the crimps and produce a temporarily completely straight fiber. Upon release of the tension, the fiber will spring back to its original, crimped configuration.

The crimp index is defined by the formula:

crimp index

$$= \frac{(\text{extended length minus crimped length})}{(\text{extended length})} \times 100$$

and is customarily used to predict the performance of a staple fiber during carding and drafting on cotton, woolen, and worsted systems. The value of the crimp index is dependent upon the frequency and amplitude of the crimp and its general geometric configuration. For the purposes of the present invention the crimp frequency is preferably in the range of 5 to 30 crimps per inch. The "crimp amplitude" is the average amplitude of the peak-to-peak vertical deflection of a planar projection of the crimped portion of the staple fiber, and is preferably in the range of 0.05 mm. to 0.5 mm.

In accordance with the present invention, the durably crimped portion must have a crimp index between about 8% and 35%. When a major portion of the fiber length is crimped, i.e., from about 50% to 75%, the crimp index may be near the lower limit. Conversely, when a minor portion is crimped, i.e., from about 25% to 50%, the higher crimp index values are preferred. If the crimp index falls below about 8%, web cohesion, necessary in carding operations, is lost. If the crimp index goes above about 35%, the fabrics exhibit a tendency toward excessive pilling.

The nature of the invention and its objects and advantages will become more readily apparent from the following description and the drawings related thereto in which:

FIGURE 1 illustrates the embodiment of a crimped staple fiber of the present invention in which both terminal portions are straight;

FIGURE 2 illustrates another embodiment of a crimped staple fiber of the present invention in which one of the terminal portions is straight;

FIGURE 3 is a diagrammatic illustration of suitable apparatus for preparing the staple fiber shown in FIGURE 1; and

FIGURE 4 is a diagrammatic illustration of one form of apparatus for preparing the staple fibers shown in FIGURES 1 and 2.

Referring now to FIGURE 4, a continuous filament tow of heat-crimpable material 11 is passed from a supply source, not shown, between a pair of counter-rotating rolls 12 and 13. Each of the sets of teeth 14 are adapted to be heated by internal electrical resistance heating elements 15. A thermal insulating material 16 prevents heating of the remainder of the surface of the rolls. Teeth 14 are arranged to intermesh at the point at which tow 11 passes between rolls 12 and 13, thereby imparting durable crimp to a portion of tow. As the rolls rotate, knives 17 engage the tow, forcing it against the edge of slots 18 in roll 13, thereby periodically severing it into staple fiber lengths. The staple fiber which has two

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straight terminal portions is collected in a receptacle, not shown.

Alternatively, knives 17 and slots 18 are placed adjacent to the trailing portion of teeth 14. With this arrangement, the tow is severed to provide a staple fiber having one straight and one crimped end.

In FIGURE 3, continuous tow 19 is supported on belt 20 by a plurality of nonporous, flat bars 21. The tow is held firmly against the resilient peripheral surface 22 of drum 23 by the bars. A liquid or gaseous chemical crimping agent is directed by jets, not shown, in chamber 24 onto the exposed sections of tow, any excess agent being collected in tray 25. The tow is periodically severed along the leading edge of bars 21 by means of blade 26 of pneumatic knife 27. The severed staple is forwarded to a receptacle, not shown, by conveyor 28.

The invention will be further illustrated but is not intended to be limited by the following examples.

EXAMPLE I

A continuous 10,000 denier tow of polyacrylonitrile fibers containing 3300 individual filaments, prepared by the dry, contiguous spinning of two different types of polymer as described in the U.S. application of Ryan and Tichenor, Serial No. 793,502, filed February 16, 1959, now Patent No. 2,988,420 is loosely wrapped around a one-foot diameter steel drum and clamped by flat steel bars one and one-quarter inches wide, spaced one inch from one another and extending the length of the drum. The drum is rotated at a rate of one revolution per minute over a steam jet positioned beneath the drum and extending the length of the drum. After contact with the steam, the tow is cut from the drum by a knife at each trailing edge of the bars. The crimped staple-length filaments thus obtained have only one straight end, have a crimped portion extending about 45% of the crimped length of the staple fiber, have an average crimp amplitude of 0.27 mm., and a crimp index of 14%. These fibers are processed into 2/32's worsted count yarns by worsted system processing and are knit into a fabric of 14 stitches/inch construction. The fabric thus obtained is tested for pilling propensity using the apparatus and techniques described in "Textile Research Journal," vol. 26, pages 731-735 (1956); Baird, Legere, and Stanley. In brief, the fabric swatches are tumbled inside a rubber-lined cylinder in the presence of a small amount of cotton lint. The fuzz and pills formed in this process are counted and compared with standards representing known fabric pilling characteristics and having the following designations: (1)=no pilling, (2)=slight but tolerable pilling, (3)=moderate pilling of borderline acceptability, (4)=unacceptable pilling, and (5)=extremely high pilling. The fabric thus tested had a pill rating of 3 at twenty minutes. The fabric has a texture or hand very much resembling cashmere.

As a control test, fibers of the same composition and same over-all staple length are made which have a continuous over-all crimp. Yarn and fabric are made of these thoroughly crimped staple fibers by identical processes as described above and similarly tested. The fabric has a very coarse texture and has an unsatisfactory pill rating of 5.

EXAMPLE II

The continuous tow of Example I is loosely wrapped around a one-foot diameter steel drum and clamped by flat steel bars one and one-half inches wide and spaced one-half inch from one another and extending the length of the drum. The drum is rotated in a trough containing boiling water at a rate of one revolution per fifteen minutes. After drying at 130° C. for twenty minutes, the tow is cut through the middle of each clamped section through a one-sixty fourth inch slit provided in each bar and the bars are released. The staple-length filaments thus obtained have two straight ends and a helically crimped portion in the center of each fiber comprising

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about 25% of the crimped length of the filament. The average crimp frequency is 14 crimps per inch and the crimp index is 35%. These fibers were processed into spun yarns of 5 woolen run count by woolen system processing and woven into a herringbone 2 x 2 twill using 40 ends and 40 picks per inch. The fabric thus obtained has a hand resembling cashmere and a pill rating of 3 units at twenty minutes.

As a control test, fibers of the same composition and same over-all staple length are made having a continuous over-all crimp. Yarn and fabric are made of these thoroughly crimped staple fibers by identical processes as described above and similarly tested. The fabric has a coarse texture and has an unsatisfactory pill rating of 5.

EXAMPLE III

A continuous 900-denier yarn of polyethylene terephthalate filaments, produced according to the process of U.S. Patent 2,604,689, having an individual denier of 3.1, is continuously wrapped onto the rotating drum of the type shown in FIGURE 4, having a one-foot diameter, and clamped by flat steel bars 3/4 inch wide, spaced 13/4 inches from one another, and extending the length of the drum. The unshielded yarn is exposed to dry heat at a temperature of 150° C. provided by closely located electrical heating elements in reflectors, the drum being rotated at a rate so as to permit five seconds of exposure at this temperature. After contact with the dry heat source, the tow is cut from the drum by a knife acting at each trailing edge of the bars. The crimped staple-length filaments thus obtained have only one straight end and have a crimped portion extending about 75% of the crimped length of the staple fiber. The crimped portion has an average crimp frequency of 5 crimps per inch, and a crimp index of 8%. These fibers are processed into 5 woolen run spun yarns by woolen system processing and made into the fabric construction of Example II. The fabric thus obtained has a satisfactory pill rating of 2 and a texture or hand resembling cashmere.

EXAMPLE IV

A flattened, continuous tow of 3 denier per filament nylon (66) filaments is passed through the nip of the intermittently-toothed counter-rotating wheels of FIGURE 4. The temperature of the teeth is maintained at 420° F. and the rate of operation is such as to impart a setting action to the crimps produced. A double-straight-ended staple fiber, 2 1/2 inches long is thus produced having a crimped portion occupying about 25% of the unextended length of the fiber and having a crimp index of 20% with a crimp frequency of about 30 crimps per inch. The staple fibers are converted into the fabric of Example I. The fabric thus obtained has a cashmere-like texture and a pill rating of 3.

The products of this invention may be prepared from all types of continuous filamentary materials which are capable of being given a durable crimp, for example thermoplastic linear synthetic polymers such as polyamides, polyesters, polyacrylics, and polyvinyl compositions. Particularly suitable are the so-called spontaneously crimpable fibers, i.e., crimpable upon the application of heat or a suitable chemical, described in U.S. Patents 2,517,694 and 2,604,689, British Patent 808,213 and Belgian Patent 562,290.

The fibers of this invention may be used in a variety of applications. They may be used alone or blended with other synthetic or natural fibers to provide spun yarns which may be used in various fabric constructions having a pleasing cashmere-like hand while exhibiting an acceptable level of pilling during the life of the garment. The fibers can be of such length that they are suitable for processing into textile yarns on cotton, woolen, or worsted machinery used in the manufacture of cotton or woolen spun yarns.

The staple fibers of the present invention have a crimp

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which is durable to textile manufacturing operations and to conventional textile cleaning procedures carried out during the life of a fabric or, which if pulled out during textile processing, returns during textile finishing. Thus, the advantages of reduced pilling and cashmere-like hand are retained throughout the life of a textile fabric. Other uses for the novel staple fibers of the present invention may be readily found in view of their unusual characteristics. Various chemical coatings may be employed to enhance the cashmere-like effects the compositions described in copending application Serial No. 836,350 being typical.

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

I claim:

1. A synthetic staple fiber having an essentially uniform cross section along its length, a denier from about 1 to about 15, at least one essentially straight terminal portion and a durably crimped portion, said crimped portion having a crimp index between about 8% and about 35%, and a length comprising between about 25% and 75% of the unextended length of said fiber.

2. The staple fiber of claim 1 wherein both terminal portions are straight.

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3. The staple fiber of claim 1 wherein the crimped portion has a crimp frequency between 5 and 30 crimps per inch.

4. The staple fiber of claim 1 wherein the crimped portion has a crimp amplitude between 0.05 and 0.5 mm.

5. A textile yarn comprised of synthetic staple fiber having an essentially uniform cross section along its length, a denier from about 1 to 15, at least one essentially straight end and a durably crimped end, said crimped end comprising from about 25% to about 75% of the unextended length of said fiber and having a crimp index between about 8% and about 35%.

6. A textile fabric having high resistance to pilling and a cashmere-like hand comprising staple fiber having an essentially uniform cross section along its length, at least one essentially straight terminal portion, a durably crimped portion and a denier from about 1 to 15, said crimped portion having a crimp index between about 8% and about 35%, and a length comprising between about 25% and 75% of the unextended length of said fiber.

References Cited in the file of this patent

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	2,669,001	Keen	Feb. 16, 1954