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TUFTED CARPET AND A METHOD FOR PRODUCING SAID CARPET

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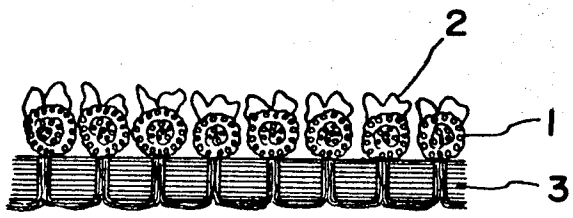


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# TUFTED CARPET AND A METHOD FOR PRODUCING SAID CARPET

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## ABSTRACT OF THE DISCLOSURE

A tufted carpet having a double surfaced structure and a unique appearance, the pile of which is composed of multifilament consisting of a composite filament composed of two thermoplastic synthetic linear polymers and having a latent crimpability and one-component filament composed of a thermoplastic synthetic linear polymer, said composite filament being adhered tightly and distributed uniformly on the surface of a base cloth for the carpet in crimped state and said one-component filament forming loop on the surface of the pile. The method for producing said tufted carpet comprising tufting substantially not crimped multifilament consisting of the composite filament and the one-component filament on the base cloth for the carpet to form carpet pile and then subjecting the resulting carpet to a heat or swelling treatment to develop fully crimps of the composite filament, said composite filament being produced by melting two thermoplastic synthetic linear polymers having different shrinkabilities separately and extruding said melted polymers through a common orifice to form unitary filament, in which said two polymers are bonded eccentrically in side-by-side or sheath and core relation along the total length of said unitary filament and taking up on a bobbin into a bundle.

The present invention relates to a tufted carpet having a unique structure in which a multifilament composed of composite filaments having latent crimpability which consists of two different components and conventional one-component filaments is subjected to tufting and then to after-treatment with heat, water, solvent, etc., and a method for producing said carpet.

As non-crimpable filament has a poor covering property, it is not suitable for raw yarn for carpet, so that spun yarn or crimped yarn having a high covering property hitherto has been generally used. However, crimped yarn is liable to form uneven pile shape, because tension is uneven in tufting step, and it is difficult to obtain a carpet having a uniform surface state. Therefore, the above mentioned drawbacks have been solved by subjecting composite filament having latent crimpability to tufting and then to after-treatment such as swelling and shrinking to develop crimpability.

In this case, the covering property is proportional to the curliness, and the greater the curliness of yarn, the higher its covering property. However, the tendency for forming felt increases extremely, and the surface of carpet is not always satisfactory. On the other hand, yarn having



a poor curliness forms a surface having loops on the surface of pile, but is insufficient in the covering property.

The object of the present invention is to solve the above mentioned drawbacks and to provide a particular tufted carpet having a unique surface and an improved covering property based on the difference of crimpabilities of filaments constituting the carpet.

The above mentioned object can be attained by tufting a non-twisted or lowly twisted multifilament which consists of composite filaments having latent crimpability, which consist of two thermoplastic synthetic linear polymers and one-component filaments, and in which the ratio of the composite filaments in the multifilament given by the following Formula A is 30 to 90% to a base cloth to form piles of carpet, then subjecting the resulting carpet to a heat treatment or swelling treatment to develop the latent crimpability of said two-component composite filament fully.

$$\frac{md_1}{md_1+nd_2}\times 100 \qquad (A)$$

In the above formula,

$m$: Number of composite filaments
$n$: Number of one-component filaments
$d_1$: Denier of the individual composite filament
$d_2$: Denier of the individual one-component filament.

In the present invention, it is preferable to use non-twisted multifilament or lowly twisted multifilament of less than 100 t.p.m., preferably less than 50 t.p.m., which is composed of two-component composite filaments having latent crimpability and usual one-component filaments. When the number of twists is larger, not only crimp developability is disturbed, but also loops of the non-crimpable filament are not formed, so that it is not suitable for the present invention.

The two-component composite filament having latent crimpability which constitutes the above mentioned multifilament can be obtained by melting separately two thermoplastic synthetic linear polymers having different crimpabilities when heat treated or treated with swelling agents and extruding them through a common orifice simultaneously to form a unitary filament in which said two polymers are bonded and extended eccentrically in side-by-side or in sheath and core relation along the axis of the filament. The thermoplastic synthetic linear polymers to form these filaments can be selected suitably from publicly known fibre forming polymers, such as polyamides, polyesters, polyacrylonitriles, polyolefins, polyvinyl halides and polyvinylidene halides depending upon the object.

The multifilament to be used in the present invention can be produced by doubling the two-component composite filaments having latent crimpability with ordinary one-component filaments or spinning these filaments simultaneously through a special spinneret, and taking up on a bobbin the resulting filaments into a bundle. Furthermore, tufted carpets having variously different elegancies and characteristics can be obtained depending upon the desire by varying the mixing ratio of the composite filament to the one-component filaments or varying the constitution of denier of both filaments suitably, but the ratio

of the composite filaments in the multifilaments given in the Formula A should be 30 to 90%, preferably 40 to 80%. When the value of the Formula A is less than 30%, the composite filaments are governed by the one-component filaments, so that the composite filaments can not exhibit crimp developability and satisfactory covering property can not be obtained. On the other hand, when the value of the Formula A is too large, a sufficiently high covering property can be obtained, but a tendency for forming felt is increased, and moreover the effect of loops formed on the surface of pile by the one-component filaments is decreased, so that the characteristic of the present invention is lost.

It is necessary that the two-component composite filaments to be used in the present invention have latent crimpability, but said filaments need not necessarily maintain a completely uncrimped state, but a part of the latent crimpability may be developed to form few crimps. On the final product of carpet, all of the latent crimpability must be developed, but before tufting 3 to 50%, preferably 5 to 30% of the latent crimpability may also be developed. However, as above mentioned, in a highly crimped filament it is difficult to effect tufting, so that crimp development before tufting must be preliminary and the amount of crimps to be developed must be less than 50%. Such preliminary development of crimp gives such advantages that the main development of crimp, after tufting can be easily made and an excess solidification of the obtained carpet can be prevented.

That is, filaments shrink strongly in the main development of crimps, so that the obtained carpet is liable to become hard, while if the filaments are crimped preliminarily, the shrinkage is low, so that the obtained carpet is very bulky and elastic.

The percentage of crimp of two-component composite filament can be obtained in the following way. The two-component composite filament of 3,000 deniers in which crimp has not yet been developed is treated with hot water at 100° C. for 10 minutes under no load and dried in air. Thereafter, the length of the crimped filament ($L_0$) is measured under no load and then the crimped filament is subjected to a load of 1 kg. and after 1 minute the length of the filament ($L_1$) is determined.

The percentage of saturated crimp is determined by the following formula.

$$[(L_1-L_0)/L_1]\times 100 \text{ (percent)} \qquad \text{(B)}$$

The percentage of the preliminarily crimped two component filament is determined in the same manner as described above, provided that the treatment by hot water is not effected and then the value of said percentage is divided by the above percentage of saturated crimp and multiplied a hundredfold to obtain the percentage of crimp development due to the preliminary crimp.

The preliminary crimp can be developed by feeding non-crimped composite filament or multifilament composed of composite filament and one-component filament to heating zone at a constant speed to develop crimps partially on the filaments by dry heat, steam heat or wet heat, delivering the partially crimped filaments at a velocity less than the feed velocity and then taking up on a bobbin.

The heating temperature is set by the kinds of polymer constituting the filament, travelling velocity of the filament, heating time, etc. The over feed ratio is set suitably depending upon the percentage of preliminary crimp.

The step for forming pile by tufting multifilament on base cloth is carried out in a conventional method by using a previously known machine. When the tufted carpet thus obtained is treated with heat, water and swelling agent until the main development of crimp of the two-component composite filament in the pile is fully made, a carpet having a luxurious appearance in which the one-component filaments appear in a loop shape on the surface of carpet can be obtained.



For a better understanding of the invention, reference is taken to the accompanying drawing, wherein;

The figure is a cross-sectional view of the tufted carpet according to the present invention.

Referring to the figure, **1** shows composite filament having latent crimpability, **2** shows a one-component non-crimpable filament, and **3** shows a base cloth for tufting. In the articles according to the invention, the non-crimpable filament **2** appears in a loop shape on the surface of the pile to provide remarkably luxurious appearance and touch which have not been obtained in conventional carpets, while the filament **1** having latent crimpability is crimped with aftertreatment to provide a high covering property.

If the filament having latent crimpability to be used in the tufted carpet according to the invention has a particularly high crimpability, the amount of pile can be decreased, as the covering property increases, so that the manufacturing cost can be reduced.

The following examples are given for illustration of the present invention. The part in the examples means by weight.

## EXAMPLE 1

Nylon-6 having an average polymerization degree of 162 was referred to as polymer A. A copolymer consisting of 90 parts of nylon-6 and 10 parts of polyhexamethylene isophthalamide and having an average polymerization degree of 194 was referred to as polymer B. The polymers A and B were melted separately and fed to a common spinneret for conjugate spinning at the same weight and velocity through separate gear pumps. They were jointed and conjugated just before an orifice of the spinneret, and then extruded through the orifice having Y-shape opening in cross section to obtain a so-called tri-lobal filament, in which the polymer A occupies two lobes of the cross section and the polymer B occupies the other lobe and major part of the centre. Then the extruded filament was cooled, taken up on a bobbin while oiling, and further drawn to 2.9 times its original length at room temperature by a drawing and taking up machine to obtain a non-twisted multifilament C having a high latent crimpability and a total denier of 1,500 deniers and consisting of 100 filaments. The percentage of saturated crimp of the filament was 60.7%. On the other hand, a drawn tri-lobal filament yarn of 1,500 deniers/100 filaments consisting only of nylon-6 was referred to as filament D. Each one of filament C and filament D were doubled while applying 30 t.p.m. of twist to obtain filament E, with which a tufted carpet was produced. In this case, the tufting was effected in gauge number (course) of 6/inch, stitch number of 7/inch and a pile length of 18 mm., and then the resulting carpet was dipped inot hot water at 60° C., without cutting loops, and then the temperature was raised gradually to 100° C. in 30 minutes, and said temperature was maintained for 30 minutes to develop crimps fully. Then the carpet was cooled and dipped in a dyeing bath at 30° C., and the temperature was raised gradually to 70° C. in 60 minutes, after which the carpet was washed, dried and subjected to lining to obtain a carpet product F, which had a very complicated surface. That is, the crimped two-component filament was adhered tightly to the bottom and distributed, and the non-crimped one-component filament rose and fell in a loop state, so that the surface had a double structure and a luxurious appearance.

## EXAMPLE 2

Filament C obtained in Example 1 was passed through a metal tube heated at 180° C. and having a length of 80 cm. and an inner diameter of 4 mm., at a feed velocity of 60 m./min. and a delivery velocity of 40 m./min.

to obtain a preliminarily crimped filament G. Filament G was taken up on a hank reel and the hank was left to stand for 24 hours under no load in a chamber having a humidity of 65% R.H. at 25° C., after which the percentage of crimp was determined to be 5.4%. Therefore, among the latent crimp, the percentage of preliminary development of crimp was as follows:

$$(5.4/63)\times 100=8.57\%$$

The filament G and the filament D as described in Example 1 were doubled to obtain multifilament having the same constitution and number of twist as those in Example 1. Then, the obtaining multifilament was subjected to tufting, crimp development, dyeing, drying and lining under the same condition as described above to obtain a carpet product H. The obtained product H had a very soft touch and a high elasticity, and moreover the crimped two-component filament was adhered tightly and distributed over all the carpet, and was low in lustre due to its crimp. However, the one-component filament rose and fell in a loop state on the surface of carpet having no crimp and gave an excellent lustre. Therefore the carpet had a unique, complicated and luxurious appearance.

## EXAMPLE 3

Two-component composite filaments consisting of polymer A and polymer B as described in Example 1, and one-component filaments consisting only of polymer A were extruded through a common spinneret simultaneously, and taken up on a bobbin into a bundle.

All of the orifices had Y-shape cross section, the obtained undrawn filaments were drawn to 2.6 times their original length by a drawing and taking up machine and then taken up on the machine without twisting to obtain a substantially non-twisted multifilament J consisting of 120 of two-component filaments of 15 deniers and 80 of one-component filaments of 15 deniers. The filament J was subjected to a preliminarily crimp developing treatment in the same manner as described in Example 2. In this case, the feed velocity was 50 m./min. and the delivery velocity was 35 m./min. The two-component filament was taken out from the obtained multifilament and the percentage of preliminary development of the latent crimpability was determined to be 14.5%. Said multifilament and the multifilament applied a twist of 50 t.p.m. were treated in the same manner as described in Example 1 to obtain two carpet products K and L respectively. The product K was similar to the product obtained in Example 2, and the product L was similar to the product obtained in Example 1, and both of them had an improved elasticity and a complicated and luxurious appearance.

What we claim is:

1. A tufted carpet having a double surface structure, the pile of which is formed uniformly with a multi-filament consisting of

(a) a composite filament composed of two thermoplastic synthetic linear polymers; and

(b) a one-component filament,

said composite filament being adhered tightly and distributed on the surface of a base cloth for the carpet in crimped loop shape and said one-component filament rising and falling on the surface of the pile in loop shape.

2. A tufted carpet as claimed in claim 1, wherein said composite filament is contained in said multifilament in a ratio of 30 to 90% calculated by the following formula

$$\frac{md_1}{md_1+nd_2}\times 100 \text{ (percent)}$$

wherein $m$ is number of the composite glaments, $n$ is number of the one-component filaments, $d_1$ is denier of the individual composite filament, and $d_2$ is denier of the individual one-component filament.



3. A tufted carpet as claimed in claim 1, wherein said composite filament is contained in said multifilament in a ratio of 40 to 80% calculated by the following formula

$$\frac{md_1}{md_1+nd_2}\times 100 \text{ (percent)}$$

wherein $m$ is number of the composite filaments, $n$ is number of the one-component filaments, $d_1$ is denier of the individual composite filament, and $d_2$ is denier of the individual one-component filament.

4. A tufted carpet as claimed in claim 1, wherein said composite filament and said one-component filament are composed of fibre-forming thermoplastic synthetic linear polymers selected from the group consisting of polyamides, polyesters, polyacrylonitriles, polyolefins, polyvinyl halides and polyvinylidene halides.

5. A tufted carpet as claimed in claim 1, wherein said said composite filament and said one-component filament are composed of polyamides.

6. A tufted carpet as claimed in claim 1, wherein at least one of said composite filament and said one-component filament are tri-lobal filaments.

7. A method of producing a tufted carpet having a double surfaced structure, which comprises tufting substantially non-twisted multi-filament consisting of a composite filament having a latent crimpability and composed of two thermoplastic synthetic linear polymers and a one-component filament on a base cloth for the carpet to form carpet pile, and then subjecting the resulting carpet to a treatment for developing the latent crimpability to develop fully crimps of said composite filament to obtain a product wherein crimped loops of said composite filament are adhered to and distributed on the surface of said base cloth and loops of said one-component filament are disposed generally on top of the loops of said composite filament.

8. A method as claimed in claim 7, wherein said treatment for developing the latent crimpability is a heat treatment.

9. A method as claimed in claim 7, wherein said treatment for developing the latent crimpability is a swelling treatment.

10. A method as claimed in claim 7, wherein said composite filament is contained in said multifilament in a ratio of 30 to 90% calculated by the following formula

$$\frac{md_1}{md_1+nd_2}\times 100 \text{ (percent)}$$

wherein $m$ is number of the composite filaments, $n$ is number of the one-component filaments, $d_1$ is denier of the individual composite filament, and $d_2$ is denier of the individual one-component filament.

11. A method as claimed in claim 7, wherein said composite filament is contained in said multifilament in a ratio of 40 to 80% calculated by the following formula

$$\frac{md_1}{md_1+nd_2}\times 100 \text{ (percent)}$$

wherein $m$ is number of the composite filaments, $n$ is number of the one-component filaments, $d_1$ is denier of the individual composite filament, and $d_2$ is denier of the individual one-component filament.

12. A method as claimed in claim 7, wherein 3 to 50% of the latent crimpability of composite filament, are developed preliminarily prior to tufting.

13. A method as claimed in claim 7, wherein 5 to 30% of the latent crimpability of composite filament, are developed preliminarily prior to tufting.

14. A method as claimed in claim 7, wherein the number of twist of the multifilament is 0 to 100 t.p.m.

15. A method as claimed in claim 7, wherein the number of twist of the multifilament is 0 to 50 t.p.m.

16. A method as claimed in claim 7, wherein said mul-

tifilament is produced by spinning a composite filament composed of two thermoplastic synthetic linear polymers and having a latent crimpability and a one-component filament simultaneously through a common orifice, and then taking up on a bobbin into a bundle.

**17.** A method as claimed in claim **7**, wherein said composite filament and said one-component filament are composed of fibre-forming thermoplastic synthetic linear polymers selected from the group consisting of polyamides, polyesters, polyacrylonitriles, polyolefins, polyvinyl halides and polyvinylidene halides.

**18.** A method as claimed in claim **7**, wherein said composite filament and said one-component filament are composed of polyamides.

**19.** A method as claimed in claim **7**, wherein at least one of said composite filament and said one-component filament are tri-lobal filaments.



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