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YARN OF REDUCED LIVELINESS AND PILE CARPET THEREOF

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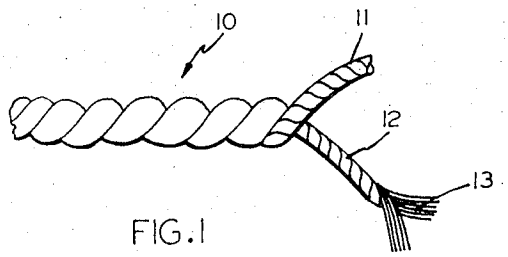



FIG.1

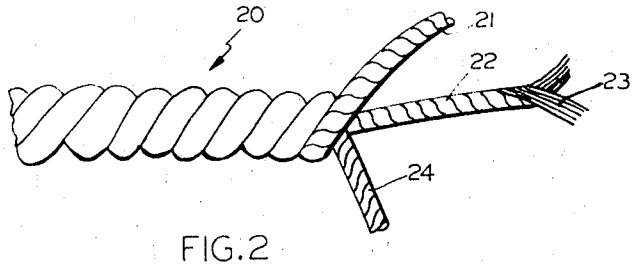



FIG.2

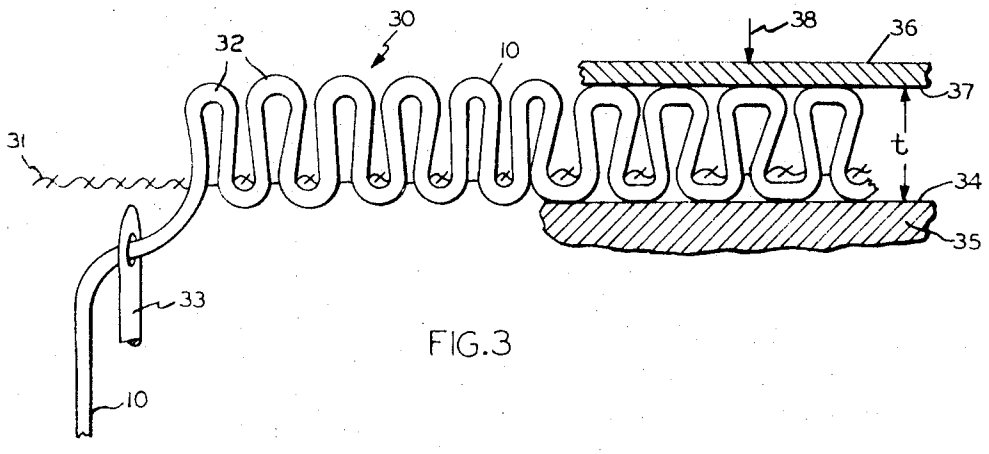



FIG.3

INVENTORS
HARRY E. NEW
DICK R. GREEN

BY Plumley, Tyner & Sandt
ATTORNEYS

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# YARN OF REDUCED LIVELINESS AND PILE CARPET THEREOF

Harry E. New and Dick R. Green, Newport News, Va., assignors to The Dow Chemical Company, Midland, Mich., a corporation of Delaware

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## ABSTRACT OF THE DISCLOSURE

A yarn of reduced liveliness comprising at least a first twisted strand and a second twisted strand wherein the second twisted strand is twisted a different amount in the same direction as the first twisted strand.

A resilient pile carpet comprising a backing material and pile loops of the above described yarn anchored in said backing material, and having portions extending above said backing material.

## DISCLOSURE

This invention relates to yarns of reduced liveliness and to pile carpets incorporating these yarns.

Yarns suitable for the manufacture of woven fabrics, knit goods, and pile fabrics are produced by procedures well-known in the art. By these procedures filaments are twisted into strands, a plurality of which are then twisted into yarns. These two twisting operations impart to the resultant yarn an amount of latent energy which manifests itself in the tendency of the yarn to twist. This tendency is known as yarn liveliness or yarn torque. While this yarn liveliness is acceptable or even desirable in certain applications, it creates a number of difficulties during the subsequent manufacture of textile goods from these yarns, and imparts certain undesirable characteristics to these textile goods. In particular it causes kinking of the yarn during the weaving of woven textiles. This kinking causes an undesirable uneven surface effect. Knit fabrics produced of lively yarns exhibit an undesirable skew.

Particularly troublesome problems occur during the manufacture of pile carpets. The liveliness of the yarn causes difficulty in tufting due to inter-twining of the strands in the creel, the inability to form positive loops, and the tendency for formed loops to curl back into subsequent stitches thus causing sew-through of the loops. Pile carpets produced from these lively yarns exhibit a number of undesirable effects. The liveliness of the yarn causes certain of the loops to twist upon themselves. Since this effect does not occur uniformly the surface of the pile fabric exhibits a streaked appearance. This streaked appearance has been minimized in the past by employing pile loops of slightly different heights in order to mask the streaked effect. Additionally the liveliness of the yarn in the loops causes twisting of the loops which reduces the initial height of the loops. In order to compensate for this reduction in height of the loops it is necessary to employ longer loops requiring a greater amount of yarn with a consequent increase in the cost of the pile fabric. Furthermore pile fabrics employing loops of lively yarns are not resilient in that once stepped upon the loops do not readily return to their original height. This causes undesirable matting of the pile fabric. Furthermore the difference in height of the pile under light foot pressure and full foot pressure is relatively small and does not impart a luxurious feel to these pile fabrics when used as carpets.

It is therefore an object of the present invention to provide a novel method for reducing the liveliness of yarns.



Another object of the present invention isto provide a novel yarn of reduced liveliness.

A further object of the present invention is to provide a pile fabric of increased pile resilience, and especially a pile fabric useful as a carpet.

A still further object of the present invention is to provide a novel pile carpet having pile loops of uniform height and presenting a uniform appearance.

Yet another object of the present invention is to provide a novel pile carpet having a luxurious feel.

Still another object of the present invention is to provide a novel pile carpet employing yarns of reduced liveliness.

Still another object of the present invention is to provide a pile carpet having a greater initial thickness than heretofore possible and having pile loops of the same height.

Additional objects and advantages of the present invention will be apparent by reference to the following detailed description thereof.

The above and other objects are accomplished by providing a yarn of reduced liveliness comprising at least two twisted strands. The first strand is twisted a different amount in the same direction as the second twisted strand. When pile loops of these yarns are anchored in a backing material with portions extending above the backing material the result is a resilient pile carpet possessing the above described and other advantages. Although the present invention is primarily applicable to pile fabrics having continuous loops it is also applicable to pile fabrics having cut loops.

The invention may be better understood by reference to the following detailed description thereof and the accompanying drawings wherein:

FIGURE 1 shows a two ply yarn of the present invention and,

FIGURE 2 shows a three ply yarn of the present invention and,

FIGURE 3 is a warp wise cross section showing (1) a pile fabric of the present invention employing yarns of the present invention, (2) a method of construction of such a pile fabric and (3) a method of testing such a pile fabric.

Referring now to the drawings and in particular to FIGURE 1 thereof, there is shown a yarn **10** of the present invention. The yarn **10** comprises a first twisted strand **11** and a second twitsed strand **12** and is thus a two ply yarn. Both the strand **11** and the strand **12** are constructed of a plurality of filaments **13**. In accordance with the present invention the first strand **11** is provided with five turns per inch of twist in the Z direction and the second strand **12** is provided with three turns per inch in the Z direction. The first strand **11** and the second strand **12** are plied into the yarn **10** with 4.0 turns in the S direction.

Referring now to FIGURE 2 there is shown another yarn **20** of the present invention. This yarn **20** comprises three strands, a first strand **21**, a second strand **22**, comprised of filaments **23** as described above for the yarn **10**, and a third strand **24**. The first strand **21** is provided with three turns per inch Z, the second strand **22** is provided with four turns per inch Z, and the third strand **24** is provided with five turns per inch Z. The three strands **21**, **22** and **24** are plied into the three ply yarn **20** with 2.80 turns per inch S.

Referring now to FIGURE 3, there is shown a pile carpet **30** of the present invention employing the yarn **10** of FIGURE 1. The pile carpet **30** comprises a backing material **31** and a plurality of pile loops **32**. The pile loops **32** are anchored in the backing material **31** and have portions extending above the backing material **31**. The pile carpet **30** can be constructed by passing a needle

33 which has been threaded wtih the yarn **10**, through the backing material **31** as shown.

The thickness of the pile carpet **30** can be measured under varying pressures by placing the pile carpet **30** on the flat upper surface **34** of any convenient support **35**, and then placing a flat plate **36** having a lower surface **37** on the top of the pile loops **32** of the pile carpet **30**. Varying pressures can then be exerted on the plate **36** in the direction of the arrow **38** and the thickness, *t*, measured under these load conditions by determining the distance between the surface **34** and the surface **37**. From these measurements a number of parameters can be calculated.

The pile fabrics of the present invention can have their pile loops sewed to the surface of the backing material or can have the pile loops incorporated into the backing material during the weaving operation. However the pile carpets of the present invention are preferably constructed by pushing the yarn of the present invention through the backing material as described above and is well-known in the art. Suitable methods for constructing the pile fabrics of the present invention are disclosed in U.S. Patents 2,448,928 and 2,810,948.

The yarns of the present invention consist of a plurality of strands and while any convenient number of strands can be employed yarns having two, three or four strands are preferred. While the strands of the yarns can run parallel to one another, they are preferably plied into the yarn in a twist having a direction different than that of the twist of the strands themselves. Thus for example, when the strands have a Z twist they are incorporated into the yarn with an S twist and vice versa.

At least two strands in each yarn must have a different amount of twist i.e. the number of turns per inch in one yarn must be different than that of at least one other yarn. This difference is preferably between 0.5 and 3.0 turns per linear inch. Thus for example when the first strand has a twist of three turns per inch at least one other strand in the yarn will have a twist of from 0 to 2.5 or from 3.5 to 6 turns per linear inch. In a preferred embodiment of the present invention the yarn has three strands all twisted a different amount in the same direction. A particularly preferred embodiment of the present invention is a yarn having two strands the first of which is twisted five turns per inch in the Z direction the second strand of which is twisted three turns per inch in the Z direction, the first and second strands being plied into a yarn with four turns per inch in the S direction.

The yarns of the present invention can be produced on conventional spinning and twisting machines. These machines are generally equipped with a drive motor coupled to twisting apparatus via reduction gears. By the selection of these gears it is possible to give an exact twist per inch to the strands and to the yarn. Selection of appropriate gear ratios and modifications of existing machines to produce the yarns of the present invention is well within the skill of the art.

The filaments which can be employed to construct the strands useful in producing the yarns of the present invention can be any of those previously employed for similar purposes. Thus the filaments can be of naturally occurring fibers or synthetics. Examples of suitable naturally occurring fibers include among others wool, cotton and hemp. Examples of suitable synthetic filaments are those of rayon, nylon, polyethylene terephthalate, and the acrylic fibers such as polymerized acrylonitrile which can be homopolymerized or copolymerized with other vinyl monomers as is well-known in the art. The filaments can be employed in the form of tows of continuous filaments or can be cut into staple and then spun.

The backing materials useful to produce the pile carpets of the present invention can be any backing material previously employed for similar purposes, examples of which include among others the woven and non-woven backing materials of fibers such as jute or hemp. The carpets of the present invention and especially the backing material thereof can be treated with known treating agents such as size, latex, flame retardant agents, anti-slip agents and the like.

The invention may be better understood by reference to the following examples which are illustrative of certain embodiments of the present invention designed to teach those skilled in the art how to practice the invention and to represent the best mode contemplated for carrying out the invention and are not intended to limit the scope of the invention in any manner. Certain control examples are given for purposes of comparison.

## Example 1

This example illustrates the production of certain yarns of the present invention as well as a control yarn.

A standard 1.10 count woolen run strand is produced from a blend of 70 weight percent of 15 denier, 4 inch long staple of polymerized acrylonitrile and 30 weight percent of 16 denier, 4 inch long modacrylic staple, sold by the Eastman Kodak Company under the trade name Verel. The resultant strand has a denier of 2530. These strands are then incorporated into various yarns as follows. Yarn A is produced by giving one of the above strands 4 turns per inch Z and a second of the above strands, 3 turns per inch Z. These two strands are then plied with 3.5 turns S to yield a yarn of the present invention termed Yarn A. Yarn B is produced by giving one of the above strands 5 turns per inch Z, a second of the above strands 4 turns per inch Z and plying these two strands with 4.5 turns per inch S. Yarn C, a yarn of the present invention is produced by giving one of the above strands, 5 turns per inch Z, a second of the above strands, 3 turns per inch Z, and plying these two strands with 4.0 turns per inch S. A control yarn not illustrative of the present invention, termed Yarn D, is produced by giving one of the above described strands 4 turns per inch Z, giving the second of the above described strands 4 turns per inch Z and plying these two yarns with 3.5 turns per inch S.

## Example 2

This example illustrates the construction of a pile carpet of the present invention.

Yarns A, B, C, and D are each separately tufted into a jute backing material on a single needle loop pile tufting machine, adjusted to give 30 ounces per square yard of the yarn on the backing material. These four carpet samples are tested as described below and the results of these tests recorded in Table I.

One square yard of the carpet is weighed and from this weight is subtracted the weight of one square yard of the backing material. The actual amount of yarn per unit carpet area is then recorded in column 2. Each of the carpet samples is placed on a support, similar to the support **35** of FIGURE 3. A plate **36** is then placed on the pile loops **32** of the carpet with a compressive force of 0.1 p.s.i. The distance, $t_a$ between the upper surface **34** of the support **35** and the lower surface **38** of the plate **36** is recorded in column 3*a* of Table I. The pressure on the plate **36** is increased to 1.0 p.s.i. and the corresponding figure $t_b$ recorded in column 3*b* of Table I. The force on the plate **36** is further increased to 2.0 p.s.i. and the dimension $t_c$ is recorded in column 3*c* of Table I. The force on the plate **36** is further increased to 9.0 p.s.i. and the dimension $t_d$ recorded in column 3*d* of Table I. The pressure on the plate **36** is then decreased to 2.0 p.s.i. and the dimension $t_e$ measured and recorded in column 3*e* of Table I. The value in column 3*e* is less than the value in column 3*c*, since the pile loops **32** do not regain all of their original height.

Employing the data recorded in columns 3*a* through 3*e* inclusive, certain other parameters of the pile fabrics of the present invention and the control pile fabric employing Yarn D are calculated. These parameters are re-

corded in columns 4, 5 and 6 of Table I. The height of compression is computed by subtracting $t_d$ from $t_a$. This value is also termed the luxury factor and is proportional to the distance by which one walking on the carpet sinks into the carpet. The greater the height of compression, the more luxurious the feel of the carpet. Pile carpets having a large height of compression give a very luxurious feel and find wide consumer acceptance. As can be seen by reference to column 4 of Table I, the pile carpets of the present invention exhibit a greater height of compression than the control carpet employing control Yarn D.

The percent recovery which is recorded in column 5 of Table I is the percent difference in the measurement of the pile height at 2 p.s.i. load in the compression and recovery curve obtained by compression to 9 p.s.i., which thickness measurements are corected by subtracting the thickness at 9 p.s.i., and is equal to:

$$\frac{100\ (t_e-t_d)}{(t_c-t_d)}$$

The most desirable situation would be to have $t_e$ equal to $t_c$ in which case the percent recovery would be 100, therefore the higher the percent recovery the more springy is the pile carpet. The percent recovery is only one parameter of measuring carpet performance and has been found to be greatly affected by the amount of yarn in the carpet pile as recorded in column 2 of Table I.

The product of the pile height, column 4, and percent recovery, column 5, gives a value called recovery index, recorded in column 6, which has been found to more nearly correlate with the carpet performance during actual wear testing. As can be seen by reference to column 6 the pile carpet employing Yarn B and that employing Yarn D have essentially the same recovery index, whereas the recovery indices of the pile carpets employing Yarns A and C show significant improvement.

The pile carpets employing Yarns A, B and C are uniform and even in appearance whereas that employing Yarn D exhibits undesirable streaks.



## Example 4

This example illustrates the production of yarns of the present invention employing nylon. This example also illustrates the construction of carpets of yarns of the present invention and the difficulties encountered employing control yarns.

This example employs strands of nylon having 204 filaments per strand and a denier of 3700. Yarn G, a control yarn is produced by plying two of the above strands with three turns S. Zero twist is applied to the strands. Yarn H, a yarn of the present invention, is produced by imparting to one strand three turns per inch Z and to the other strand 5 turns per inch Z. These two strands are then plied with 3 turns per inch S. Yarn J is produced by imparting to one strand one turn per inch Z and to the second strand 2 turns per inch Z and plying the two strands with two turns per inch S.

The liveliness of Yarn G was so great that it is necessary to hold the yarn to prevent excessive kinking during the single needle loop pile tufting. The carpet produced from Yarn G exhibited a very uneven pile height, and had a very soft hand, although it did have greater cover than the pile carpets produced from Yarns H and J. Carpets produced from Yarns H and J have a firmer hand than carpets produced from Yarn G, the carpet employing Yarn H being the firmest and having the least cover. The liveliness of Yarns H and J gave no problem in tufting and the pile carpets produced therefrom exhibited a uniform pile height, and showed no streaks.

What is claimed is:

**1.** A yarn of reduced liveliness comprising at least a first twisted strand and a second twisted strand wherein said second twisted strand is twisted a different amount in the same direction as said first twisted strand, and wherein the two strands are plied into the yarn by twist in a direction opposite to the twists of the strands.

**2.** The yarn of claim **1** wherein the difference in twist between said first twisted strand and said second twisted strand is between 0.5 and 3.0 turns per linear inch.

TABLE I

| 1 | 2 | 3 | | | | | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|---|
| | | Thickness under compression | | | | | | | |
| | | a | b | c | d | e | | | |
| Designation of yarn in the carpet | Amount of yarn per unit carpet area (oz./yd.$^2$) | Compression at 0.1 p.s.i. ($t_a$) (inch) | Compression at 1.0 p.s.i. ($t_b$) (inch) | Compression at 2.0 p.s.i. ($t_c$) (inch) | Compression at 9.0 p.s.i. ($t_d$) (inch) | Compression at 2.0 p.s.i. after compression at 9.0 p.s.i. ($t_e$) (inch) | Height of compression ($t_a-t_d$) (inch) | Percent recovery, $100(t_e-t_d)$ $(t_c-t_d)$ | Recovery index (value in column 4 times value in column 5) |
| A | 29.8 | .463 | .370 | .319 | .195 | .238 | .268 | 34.7 | 9.30 |
| B | 30.3 | .435 | .337 | .283 | .180 | .215 | .255 | 34.0 | 8.67 |
| C | 30.4 | .443 | .341 | .288 | .183 | .221 | .260 | 36.2 | 9.41 |
| D | 31.7 | .413 | .343 | .301 | .200 | .242 | .213 | 40.6 | 8.65 |

## Example 3

This example illustrates yarns of the present invention constructed of three strands, and cut pile fabrics of the present invention.

The strands of Example 1 are twisted into yarns as follows. Yarn E is constructed by twisting three strands, the first strand being given 3 turns per inch Z, the second strand being given 4 turns per inch Z, and the third strand being given 5 turns per inch Z. These three strands are then plied into a yarn termed Yarn E with 2.80 turns per inch S. A control yarn termed Yarn F is constructed by twisting three strands each three turns per inch Z and plying them into a yarn with 2.80 turns per inch S.

Yarns E and F are each tufted into a backing material as described in Example 2. A portion of the pile loops on each sample are cut. The pile carpet employing Yarn E exhibits the same improved characteristics as the pile carpets in Example 2 employing Yarns A, B and C. The cut pile carpets employing Yarn E hold the twist in the cut loops better than did the carpet employing Yarn F.

**3.** The yarn of claim **1** further comprising a third strand which is:

(1) twisted in the same direction as said first and second strands,

(2) twisted a different amount than said first strand and

(3) twisted a different amount than said second strand.

**4.** The yarn of claim **1** wherein the first strand is twisted 5 turns per inch Z, the second strand is twisted 3 turns per inch Z, and the first and second strands are plied into a yarn with four turns per inch S.

**5.** A resilient pile carpet comprising a backing material and pile loops of the yarn of claim **1** anchored in said backing material, having portions extending above said backing material.

**6.** The pile carpet of claim **5** wherein said backing material is a woven fabric and wherein said pile loops pass through the backing material and are thereby anchored in the backing material.

**7.** A resilient pile carpet presenting an even appearance, said carpet comprising a backing material and a plurality

of pile loops of the yarn of claim 1, said loops being anchored in said backing material and extending an even distance above said backing material.


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STANLEY N. GILREATH, Primary Examiner

WERNER H. SCHROEDER, Assistant Examiner

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