United States Patent

Dawbarn

[15] **3,654,884**

[45] **Apr. 11, 1972**

[54] TUFTED PILE FABRIC

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[21] Appl. No.: **884,083**

Related U.S. Application Data

[63] Continuation-in-part of Ser. Nos. 487,402, Sept. 15, 1965, abandoned, and Ser. No. 840,594, June 30, 1969, abandoned, said Ser. No. 840,594 is a Continuation of said Ser. No. 487,402.

[52] **U.S. Cl.** .....**112/410,** 139/420 R, 161/65

[51] **Int. Cl.**.....**D05c 17/02**

[58] **Field of Search** 112/410, 266, 79; 161/62, 65, 161/66, 67; 139/420, 391, 399

[56] **References Cited**

UNITED STATES PATENTS

3,317,366	5/1967	Dionne	112/410 X
3,359,934	12/1967	Schwartz et al.	112/266 X
3,377,973	4/1968	Whitesel et al.	112/266
3,443,541	5/1969	Chopra	161/65 X

Primary Examiner—James R. Boler

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[57] **ABSTRACT**

A primary backing adapted to be used in making tufted pile fabrics and woven from polyolefin yarns, the warp yarns being closely spaced flat ribbon monofilaments of substantially rectangular cross-section and the weft yarns being widely spaced relatively round multifilament or monofilament yarns. The warp yarns are crowded together to give a spacing index of 1.3 to 1.6. The weft or filling yarns are preferably untwisted multifilament yarns with a spacing index of 0.15 to 0.45. The tufted backing is also claimed.

6 Claims, 5 Drawing Figures

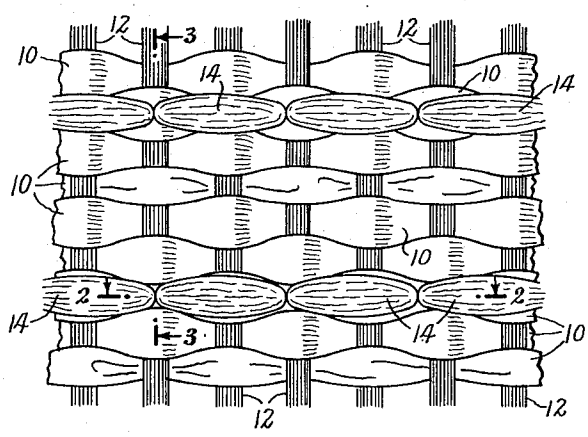

Fig 1

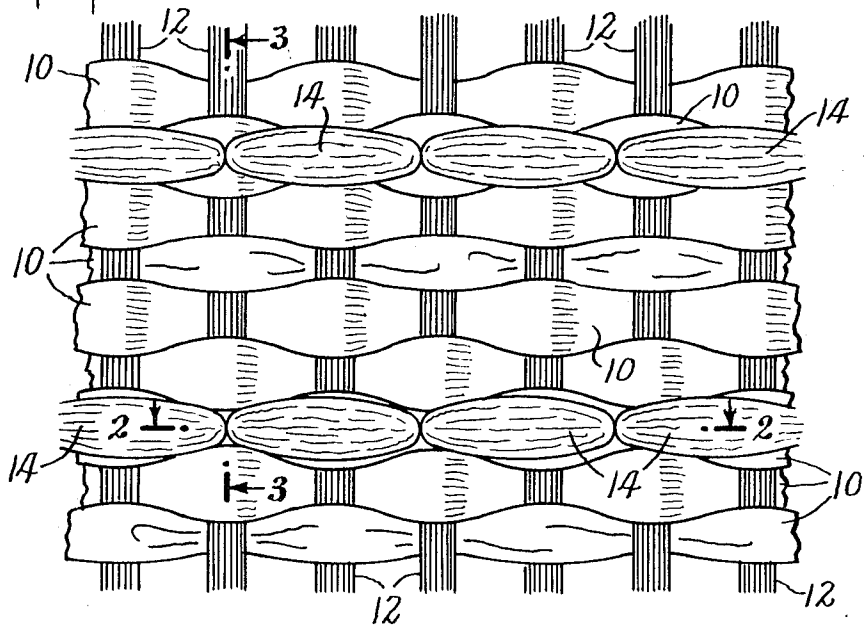

Fig 2

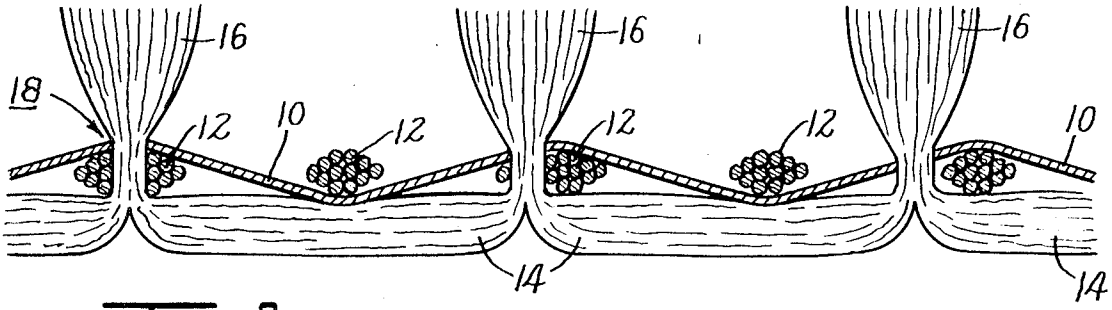

Fig 3

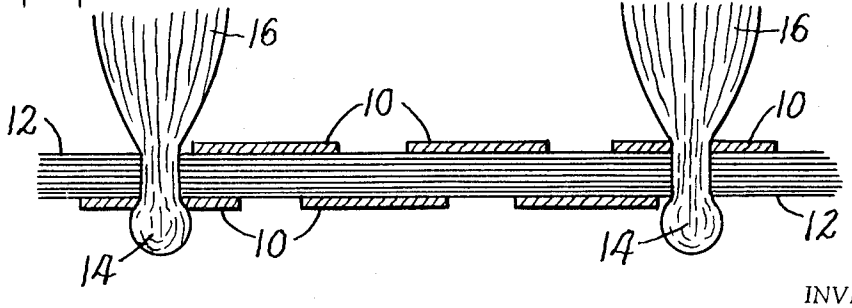

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Fig 4

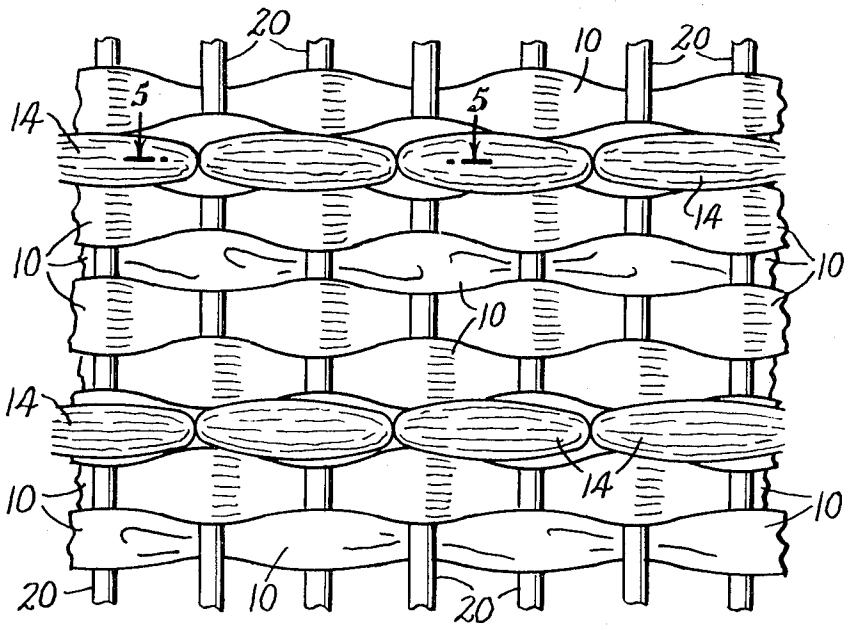
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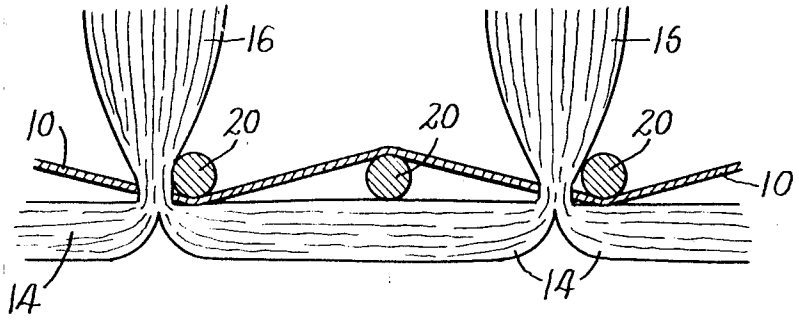
Fig 5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TUFTED PILE FABRIC

This application is a continuation-in-part of parent application Ser. No. 487,402 filed Sept. 15, 1965, now abandoned and application Serial No. 840,594 filed June 30, 1969, now abandoned which is a continuation of application Ser. No. 487,402 filed Sept. 15, 1965, now abandoned.

This invention relates to primary backings for tufted pile fabrics, e.g., tufted carpets, and to improved pile fabrics comprising such primary backings. Tufted pile fabrics such as carpets are commonly made by feeding a woven backing warpwise through a needle tufting machine having a bank or row of needles extending transversely across the backing and carrying the tufting yarn. The needles are reciprocated to penetrate the backing and carry the yarn therethrough, and as the needles are withdrawn, loopers retain the inserted yarns, thereby forming on the moving backing a series of rows of relatively closely spaced loops. The tops of the loops may or may not be cut, depending upon whether a cut pile or loop pile fabric is desired.

In the manufacture of tufted carpets it has been the practice to employ a loosely woven burlap-type backing material having yarns composed of jute, sisal or sometimes paper. A serious disadvantage of this backing resides in the fact that the backing fabric is not of uniform thickness nor density. This characteristic is due in part to the actual interstices between the individual yarns and in part to the wide variation in thickness between individual yarns and varying thickness in the same yarn. As a result, the tufting needles sometimes meet no resistance whatsoever. At the other extreme, the needles encounter maximum resistance due to the necessity for penetrating a thick yarn or double yarns. In still other instances the needles push aside the yarns with little or no penetration of the yarn itself. As a result, the rows of pile yarn stitches jump back and forth between the same yarns in the backing, thus causing gaps between adjacent rows of stitches which include as few as one and sometimes as many as three yarns of the backing material. This causes grinning and uneven rows of pile. When using the conventional jute backing it has been found necessary to overcome this disadvantage by producing tufted pile fabrics with sufficient pile length so that these irregularities are substantially concealed. These irregularities occur both longitudinally and transversely of the fabric since a relatively thick transverse yarn in the backing causes a lateral gap or irregularity in the stitch spacing which cannot be controlled by adjustment of the tufting machine.

As indicated above, the conventional jute backing is quite loosely woven and most of the tufting needles pass through the interstices in the backing. In those cases where the tufting needles engage the jute yarn, there is a tendency, because of the nature of the jute yarn, for the needles to be deflected. Thus deflection of and damage to the tufting needles is a problem when using a woven jute backing.

Since the pile projections in a cut pile tufted fabric naturally tend to spread to a greater extent than in the case of an uncut pile fabric, it is feasible to tuft a lower cut pile fabric and obtain adequate coverage than is the case with an uncut or loop pile tufted fabric. The present invention permits the production of a pile fabric having relatively low pile projections, particularly in a loop pile construction.

In view of the above causes of unevenness in a tufted pile fabric, particularly in the case of loop pile or low pile height, it might be assumed that the use of a continuous sheet of material rather than a woven backing would overcome these disadvantages. Efforts to obtain satisfactory results using a continuous sheet backing material have also proved fruitless because in this case it appears that there is insufficient friction to bind the yarns to permit uniform control of pile height, particularly after disengagement of the loopers. The precise reasons for unsatisfactory results with sheet material are not yet completely understood. It is believed that in the case of sheet material the tufting needles merely punch holes which do not have a sufficient tendency to re-close and grip the yarn to provide adequate or at least uniform engagement as the needles are removed.

One proposal for overcoming the problems outlined above is disclosed in Rhodes U.S. Pat. No. 3,110,905. In accordance with the Rhodes disclosure a backing is tightly woven of synthetic plastic yarns made of, e.g., polyolefins, which yarns are ribbons of rectangular cross-section. By using ribbon yarns for both warp and weft and a tight weave without interstices, Rhodes obtains a backing of a substantially uniform thickness twice the thickness of the ribbon yarns used. When using such a backing nearly all of the tufting needles penetrate both the warp and filling yarns.

Theoretically one might expect this type of backing to overcome the disadvantages outlined above. By using polyolefin yarns, deflection of and damage to the tufting needles is largely eliminated. Moreover, since a high proportion of the tufting needles penetrate two plies of yarn, one might expect the tuft-holding ability of the backing to be substantially greater than that of a jute backing. However, it has been found as a practical matter that the Rhodes type backing, especially when the backing is woven from polypropylene ribbons, is subject to the disadvantage that the tufting needles do considerable damage to the filling yarns.

This damage appears to be due to at least two factors. The tufting needles are of eccentric cross-section with the longer dimension of the section parallel to the warp. Because of this eccentric configuration, the needles can penetrate the warp ribbons without spreading them to such an extent as to weaken them substantially, whereas the longer dimension of the needles piercing the filling yarns seriously weakens and in some cases breaks the filling yarns. Moreover, the tufting needles are arranged in a row perpendicular to the warp ribbons. Hence in any given row of tufting, no more than one needle will penetrate each warp ribbon at one time, whereas a substantial number of needles may penetrate the same filling ribbon simultaneously. The mass impact of the row of needles on a single filling ribbon tends to rupture and shatter the filling yarn. As a result, the tufted carpet is substantially weakened in the fill direction and at the points where the filling ribbons are broken, tufting stitches pull through to give a product having an unsightly and unsatisfactory appearance.

One effort to overcome the deficiencies of the Rhodes proposal as outlined above is shown in Schwartz et al. U.S. Pat. No. 3,359,934. In accordance with the Schwartz et al. disclosure a relatively tightly woven ribbon-ribbon backing is used wherein the filling yarns are composed of separate filaments that are bonded together to form the filling yarn ribbons. While the use of such bonded filament ribbons in the filling facilitates penetration by the tufting needles to some extent, considerable damage to the filling yarns still occurs and strength retention after tufting is not as high as is desirable. Moreover, the preparation of the bonded filament ribbons gives rise to a separate set of problems and tends to increase the cost of making the filling yarns.

A somewhat different approach from that disclosed in the Rhodes patent is shown in Dionne U.S. Pat. No. 3,317,366. The Dionne disclosure is particularly directed to improving the stability to heat and moisture and dyeability of the backing and to eliminating the problem of needle deflection and damage to the needles encountered when using a jute backing. Dionne retains the loose weave and consequent low yarn penetration by tufting needles characteristic of the jute backings, and proposes to solve the needle damage problem by using smooth, slippery, polyester ribbon monofilaments in conjunction with a high-twist polyester multifilament weft. Because of the loose weave and slipperiness of the polyester ribbon warp yarns, they shift easily when engaged by a tufting needle, thus reducing damage to the needles. The Dionne backing does not, of course, have the tuft-holding ability of the Rhodes backing, since in the former backing few, if any, of the tufts are embedded in the backing yarns. Also the pattern definition of the tufted fabric taught by Dionne is inferior.

It is an object of the present invention to provide a woven backing which can be used to produce a tufted fabric which is superior to both the long-known jute-backed tufted fabrics, as well as the more recently proposed but prior tufted fabrics

that have been suggested to overcome certain of the disadvantages of the jute-backed fabrics.

It is another object of the invention to provide a lightweight woven synthetic plastic backing which when tufted exhibits an improved combination of backing strength retention and tuft-holding ability, as well as improved fabric width retention after tufting.

Other objects of the invention will be in part obvious and in part pointed out hereafter.

The present invention is predicated on the discovery that a backing having a tuft-holding ability comparable to that of the closely woven ribbon-ribbon backing such as that disclosed in the above-identified Rhodes patent can be achieved by using closely spaced flat-ribbon yarns in either the warp or weft direction and relatively round, substantially spaced yarns in the other direction. Since damage to the filling yarns during tufting is a principal disadvantage of the closely woven ribbon-ribbon backing, the desired combination of strength and tuft-holding ability is achieved by using closely spaced flat ribbon yarns of substantially rectangular cross-section in the warp direction and relatively round, substantially spaced yarns in the weft direction. While the yarns may be made of any of various polyolefins, polypropylene yarns are preferred for both the warp and weft.

It has been further found that while the round yarns used in the filling may be either monofilament or multifilament yarns, the latter type of yarn is preferable. When untwisted, unbonded multifilament yarns are used in the filling, tufting needles engaging the yarns tend to penetrate the yarns rather than deflecting them, thus preserving the pattern definition of the tufted fabric.

The many objects and advantages of the present invention can best be understood and appreciated by reference to the accompanying drawings which illustrate diagrammatically tufted backings incorporating a preferred embodiment and a modification of the invention and wherein:

FIG. 1 is a bottom plan view of a backing having relatively round multifilament yarns and showing a section of the backing with two rows of tufting yarns inserted therein;

FIG. 2 is an enlarged section through the backing taken on the line 2—2 of FIG. 1, i.e., parallel to the warp yarns;

FIG. 3 is an enlarged section taken on the line 3—3 of FIG. 1, i.e., perpendicular to the warp yarns;

FIG. 4 is a bottom plan view of a backing similar to that of FIG. 1 but having relatively round monofilament filling yarns; and

FIG. 5 is an enlarged section taken on the line 5—5 of FIG. 4, i.e., parallel to the warp yarns.

Referring to FIG. 1, in general, the backing comprises the warp yarns 10 and interwoven filling yarns 12. The backing is pierced at regularly spaced intervals by loops of the tufting yarns 14 to form the tufts 16 shown in FIGS. 2 and 3. As best shown in FIG. 2, the filling yarns are multifilament yarns of relatively round cross-section, and as best shown in FIG. 3, the warp ribbons are of relatively flat, rectangular cross-section.

Referring to FIG. 3, it will be noted that adjacent warp ribbons overlap as they pass over the filling yarns. The spacing of the warp ribbons is such that they are crowded together as illustrated in FIG. 1. The degree of crowding may be conveniently evaluated in terms of what may be called a "spacing index." As used in the present specification and claims, the spacing index is the product of the width of the yarn times the number of yarns per inch. If, for example, the warp ribbons measure 50 mils by 2 mils and 20 ends are used per inch, the spacing index would be 1.0, whereas if the ribbons measure 100 mils by 2 to 2.5 mils in section and 15 ends are used, the spacing index would be 1.5. The backings of the present invention preferably have a warp spacing index of the order of 1.3 to 1.6.

It is evident that when the spacing index exceeds 1.0 and the warp ribbons are crowded together, some disorientation of the ribbons will occur during weaving. It has been found that when using spacing indices greater than 1.0, several types of disorientation may occur at various points along the lengths of the ribbons, namely, (a) tilting of the ribbons, (b) a certain amount of lateral overlap, (c) a certain amount of edge crumpling of the ribbons and (d) an occasional twist of the ribbons.

The warp yarns may vary in width from say 20 to 110 mils (0.020 inch to 0.110 inch) and may vary in thickness from say 2 to 6 or 8 mils. Their denier may vary from about 350 to about 1200. Good results have been obtained with ribbons measuring 50 mils by 2 mils in section and having a denier of about 500.

Still referring to FIGS. 2 and 3, the filling yarns 12 there illustrated are multifilament yarns composed of a substantially untwisted bundle of individual unconnected filaments, so that a tufting needle which happens to engage a filling yarn will readily penetrate the yarn and the tendency of the tufting needles to break the yarn or component filaments thereof is minimized. As indicated at 18 in FIG. 2, upon withdrawal of the tufting needle from such a yarn the filaments engage both sides of the tuft and thus increase the over-all tuft-holding ability of the backing.

The multifilament yarns preferably comprise from seven to 16 filaments and may have a denier from about 600 to about 1200. Typical yarns that may be used are 800/16 (16 filaments of 50 denier each), 800/12, 1050/7, 1120/16 and the like. As pointed out above and indicated in the drawing, the filling yarns are substantially spaced apart. An 800/12 polypropylene yarn, which is typical of those useful in making the present backings has, prior to weaving, a substantially round cross-section of about 16 mils diameter. If 13 ends of such a filling yarn are used per inch, the weft spacing index would be 0.21, assuming no deformation of the filling yarn during weaving. Actually as shown in FIG. 2, the yarn is somewhat flattened during weaving so that the weft spacing index in the woven backing is greater than 0.21. It is desirable in order to avoid excessive damage to the filling yarns during tufting that the weft spacing index in the woven backing be less than 0.5. In other words, the space between adjacent filling yarns should be greater than the maximum width of the yarns. Preferably, when using relatively round yarns, the weft spacing should be within the range 0.15 to 0.45 for multifilament and 0.15 to 0.25 for monofilament yarns.

Referring now to FIGS. 4 and 5, the tufted backing there illustrated is similar to that of FIGS. 1 to 3, except that the multifilament yarns 12 are replaced by a monofilament yarn 20. The monofilament yarns used may vary in denier from say about 600 to about 1200 and preferably from about 750 to about 900. Since they retain their circular cross-section during weaving, the weft spacing index when using monofilament yarns tends to be somewhat less than when multifilament yarns are used. For example, if 13 ends of an 800 denier monofilament filling yarn is used, the weft spacind index is about 0.2. It will be noted that the monofilament yarns 20 are positioned with their axes in substantially the same plane, that is to say, they are linearly arranged across the backing.

The polypropylene yarns used for both warp and filling, whether the filling is multifilament or monofilament, should desirably be of the oriented type, i.e., they should be linearly stretched during manufacture to impart increased strength. The usual orientation involves stretching from about 4 to about 10 times, e.g., about 6 times the length as originally extruded. Since it is desirable that the backing be of relatively light weight and thus low cost, the yarns employed should ordinarily be of no more than 1200 denier and preferably in the range 350 to 1200 denier.

In preparing the tufted fabrics disclosed herein, it is desirable that the yarns or backing be lubricated as disclosed in Kennedy application Ser. No. 453,478 filed May 5, 1965. As disclosed in said application, improved strength retention after tufting can be achieved by applying to the yarns prior to weaving or to the backing prior to tufting from 0.2 to 12 percent by weight of a suitable lubricant. Suitable lubricants include mineral oil, polyethylene glycol esters such as the stearate,

laurate and oleate, high molecular weight polyglycols and various low molecular weight waxes.

Backings incorporating the present invention may be tufted on conventional tufting machines. In typical tufting procedures, from 5 to 13 tufts are provided per inch of fill and approximately the same number of rows of tufts are provided per inch of warp.

From the foregoing description it should be apparent that the present invention provides a backing capable of being tufted to provide a tufted fabric which overcomes the disadvantages of the prior tufted fabrics as outlined at the beginning of the present specification. By using a ribbon warp with a high spacing index a high degree of penetration of the warp yarns by the tufting needles is obtained and hence good tuft-holding ability is achieved. By using relatively round filling yarns with a low spacing index, the proportion of filling yarns engaged by the tufting needles is decreased and the probability of damage to the filling yarns is consequently diminished. By using multifilament filling yarns in which the filaments are substantially untwisted and freely movable with respect to one another, the probability of damage to the filling yarns is further diminished since in the relatively few cases where a tufting needle directly engages a filling yarn it is able to penetrate the bundle of filaments with a reduced probability of breaking the filaments. As compared with the ribbon-ribbon backings such as those disclosed in, for example, the Rhodes patent referred to above, the present backings have better strength retention after tufting and hence, for a given degree of strength after tufting, permit the use of a backing having a lower weight per unit area. Also they produce a tufted fabric with fewer tufting defects and have better width retention after tufting.

It is, of course, to be understood that the foregoing description is intended to be illustrative only and it will be apparent to those skilled in the art that various changes and modifications can be made without departing from the spirit of the invention as defined in the appended claims.

I claim:

1. A tufted pile fabric comprising a primary backing woven of polyolefin warp and fill yarns, said warp yarns being flat ribbon monofilaments of substantially rectangular cross-section and having a spacing index in the range 1.3 to 1.6, said fill yarns being of relatively round cross-section and having a spacing index in the range 0.15 to 0.45, and rows of tufts engaged through said primary backing, said warp yarns being penetrated by a relatively large proportion of said tufts and said fill yarns being penetrated by a relatively small proportion of said tufts.

2. A tufted fabric according to claim 1 wherein both said warp and fill yarns are made of polypropylene.

3. A tufted pile fabric comprising a primary backing woven of polyolefin warp and fill yarns, said warp yarns being flat ribbon monofilaments of substantially rectangular cross-section and having a spacing index in the range 1.3 to 1.6, said fill yarns being relatively round, substantially untwisted bundles of individual unconnected filaments to facilitate penetration of said fill yarns by tufting needles and axial movement of individual filaments, said fill yarns having a spacing index within the range 0.15 to 0.45, and rows of tufts engaged through said primary backing, said warp yarns being penetrated by a relatively large proportion of said tufts and said fill yarns being penetrated by a relatively small proportion of said tufts.

4. A tufted pile fabric comprising a primary backing woven of polypropylene warp and fill yarns, the warp yarns of said backing being flat ribbon monofilaments of substantially rectangular cross-section and having a spacing index in the range 1.3 to 1.6 and a denier of 350 to 1200, the fill yarns of said backing being relatively round, substantially untwisted bundles of seven to 16 individual unconnected filaments, said filament bundles being of 600 to 1200 denier and said fill yarns having a spacing index within the range 0.15 to 0.45, and rows of tufts engaged through said primary backing, said warp yarns being penetrated by a relatively large proportion of said tufts and said fill yarns being penetrated by a relatively small proportion of said tufts.

5. A tufted pile fabric comprising a primary backing woven of polyolefin warp and fill yarns, said warp yarns being flat ribbon monofilaments of substantially rectangular cross-section and being closely spaced and said fill yarns being monofilament yarns of relatively round cross-section and being substantially spaced apart, said warp yarns having a spacing index within the range 1.3 to 1.6 and said fill yarns having a spacing index in the range 0.15 to 0.25, and rows of tufts engaged through said primary backing said warp yarns being penetrated by a relatively large proportion of said tufts and said fill yarns being penetrated by a relatively small proportion of said tufts.

6. A tufted pile fabric comprising a primary backing woven of polypropylene warp and fill yarns, said warp yarns being of substantially rectangular cross-section and having a spacing index within the range 1.3 to 1.6 and a denier of 350 to 1200, the fill yarns of said backing being of relatively round cross-section and having a spacing index within the range 0.15 to 0.45 and a denier of 600 to 1200 and rows of tufts engaged through said primary backing, said warp yarns being penetrated by a relatively large proportion of said tufts and said fill yarns being penetrated by a relatively small proportion of said tufts.

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