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SYNTHETIC CARPET BACKING

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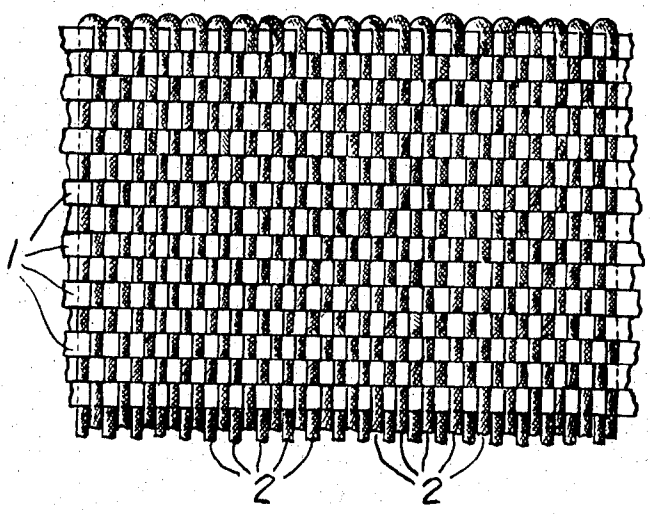

FIG.1

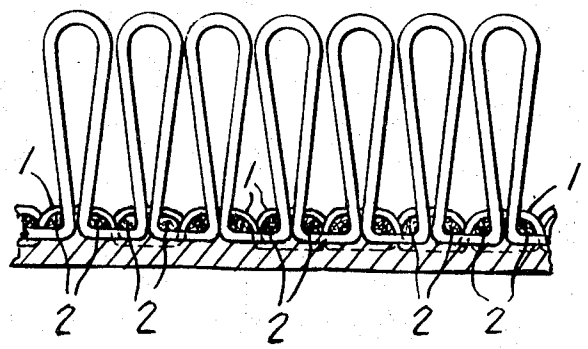

FIG.2

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SYNTHETIC CARPET BACKING

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U.S. Cl. 112—410 7 Claims

ABSTRACT OF THE DISCLOSURE

A backing or a fabric with a backing, which has uniform flat synthetic resin continuous monofilaments as warp ends, and bulky low-twist synthetic resin continuous multifilament crimped yarns, as filling ends. The warp ends are over-filled to eliminate spacing. The filling ends are regularly spaced apart. With this arrangement, the width-wise shrinkage is eliminated and, also the fabric has less tendency to slip or fray.

The present invention relates to a fabric which is particularly suitable as a backing for floor coverings, for example tufted carpets or rugs and to articles having such a backing.

The tufted carpets, etc. to which the invention relates are of the type manufactured by threading pile yarns through a base fabric or primary backing to form pile loops. The backing is then coated with a latex to bind the pile in place. In a typical manufacturing process the primary backing is fed by means of spiked feed rolls through a multiple-needle tufting machine. A row of needles, carrying the pile yarn, pass through the backing by shifting the warp and filling yarns of the backing. As the needles are withdrawn from the backing, looper members serve to hold the inserted yarns, thereby forming pile loops which project beyond the face of the backing. The roll of floor covering so tufted is then transferred to the latexing machine. A commercial lattex is coated on the back of the covering by means of a doctor roll in a continuous process, the coated covering then being carried under tension on a pin tenter through the hot drying oven. The latex is cured and dried in the oven for a certain length of time. When the floor covering emerges from the oven, the selvage is trimmed to produce the finished article.

Carpet patterns are usually designed for a definite wdith of the carpet. When similar carpets are laid side by side, as for instance in a wall-to-wall installation, the repetition and continuity of the pattern is necessary. For this and other reasons of customer acceptance, the finished carpet must be within a close tolerance of its required width, or provision must be made at the tufting stage for the extension or shrinkage that takes place in the width of the carpet during latexing and drying process. With known backings, it is generally difficult to exactly predict these dimensional changes that will occur.

The nature of the primary backing used in the floor covering also has a significant bearing on the wear and handling qualities of the finished carpet and on the efficiency of its manufacturing process.

Yarns of woven synthetic backings, for example the ones woven with a flat ribbon in both warp and weft have a great tendency to slip and fray while being fed in the tufting machine, and when tension is applied by the pin tenter in the drying oven, or when the selvage of the backing or the carpet is being trimmed. Some backings have been found to be easily damaged in transit or punched under the impact of the tufting needles. Needle

deflection and shifting of filling yarns is generally excessive during tufting, which results in confused patterns and pulled out loops.

Carpets made with some synthetic backings shrink in width while the latex is curved in the drying oven, the shrinkage being dependent on the oven temperature and duration of dwell of the carpet in the oven. This shrinkage is particularly serious when the flow of the carpet through the drying oven is stopped for any length of time, which occurs frequently in the manufacturing process.

In the light of what has been said above, the present invention provides an improved primary backing fabric for tufted floor coverings and improved floor coverings made therewith. The applicant's backing has bulk and body, strength and cleanliness, inhibits shrinkage of the carpet width-wise during manufacture, and gives dimensional stability to the finished carpet under varying humidity and room temperature conditions. The applicant's primary backing fabric does not slip nor fray excessively either in the fabric or in the carpet, thus facilitating the manufacturing operations, while giving a durable and stable product having fine handle and appearnce. It is substantially uniform in thickness per unit of area.

More specifically, the applicant's backing is a woven fabric in which the warp is made up of substantially twistless flat synthetic resin monofilament yarns and the filling of low twist continuous synthetic resin multifilament crimped or crimpable (on being relaxed and heated) yarns. The warp and filling yarns may be woven by known textile processes. The applicant's combination of warp and filling yarns produces a backing of high tensile strength, excellent bulk and body and does not freely heat shrink in the width direction during the manufacturing process. The continuous multifilament filling yarns are interlocked with the flat monofilament warp yarns in such a way as to reduce slippage or fraying of the yarn in the backing fabric as well as in the carpet. The filling yarns allow the tufting needles to pass through them without cutting or displacing them. This improves pattern definition and loop anchorage. The tufting process is clean, quiet and efficient. The crimped bulky multifilament yarn (which is usually substantially circular in cross-section) in the filling aso provides support for the pile, from its root to a certain height, against lateral crush.

The invention wil be further described in conjunction with the attached drawings illustrating a preferred floor covering and in which

FIGURE 1 is an exaggerated schematic plan view of a carpet backing according to the invention.

FIGURE 2 is a vertical cross-section through a carpet having a backing constructed according to the invention.

The fabric of FIGURE 1 is made up of monofilament warp threads **1** which are flat strips of polypropylene preferably extruded individually as compared with strips cut from a wider band. The filling yarns **2** are low twist continuous multifilament polypropylene crimped yarns. In the carpet of FIGURE 2, pile loop yarns **4**, are loped through the backing in the normal manner. The conventional latex backing is shown as **3**.

FIGURE 2 represents the ideal case where the needle passes through the filling yarns **2**, splitting them in half, one half on one side of the loope and the other half on the other side of the loop. This provides strong anchorage. It should be explained that the drawings are exaggerated. In practice, it is preferable that the weave be close with little or no spacing between the respective warp ends. The finished carpet is characterized by substantial absence of displacement of the filling yarns, i.e., the filling yarns remain in substantially the position they were

placed in when the backing was woven. The warp monofilaments 1 are displaced in the backing by the bulky filling yarns 2 so that the former are corrugated transversely with the filling yarns engaging in the corrugations to limit their movement warpwise.

The layer 3 is formed of commercial latex of a type which can easily wet the backing and penetrate the interstices of the warp and filling yarns. Normally, latex does not stick to polypropylene. However, it must wet the fabric and penetrate the interstices in order to avoid peeling and flaking. For good loop anchorage, the latex must adhere to the pile yarns. A preferred latex is a styrenebutadiene synthetic rubber extended with a calcium carbonate filler.

In the application of the latex, an oven temperature between 250° F. to 350° F. may be employed. A preferred range of temperature is from 300° F. to 330° F. Keeping in mind the time-temperature relationship for the curing of the latex, the carpet may stay in the oven for different lengths of time depending on the temperature used. The carpet usually stays in the oven for fifteen minutes, although stops in the oven are sometimes as long as one hour and a half, in which case the heat is shut off, so that the oven temperature falls slowly.

The filling yarns are interlocked with the warp yarns because of their crimp and because they are somewhat cylindrical and thus indent the warp yarns to provide, in the warp yarns, bridges over the filling yarns. In other words, there are bridging parts and underpassing parts in both warp and filling yarns. The bulkiness of the filling yarns accentuates these bridges in the warp yarns so as to prevent the filling yarns from moving lengthwise of the warp yarns. On the other hand, the warp yarns, having relatively large bearing surfaces can slip more freely weftwise over the filling yarns. The construction has advantages in the tufting process. The tufting needles can pass through the filling yarns because of their fixed position warpwise and their multifilament construction. Since the warp yarns are overfilled (there are substantially no interstices) their tendency to shift is reduced and the tendency of the needles to pierce them is enhanced.

Preferred warp is made from flat fiber grade polypropylene monofilament without twist and has the following characteristics. The width of the monofilament may be from about 0.010 to about 0.50 of an inch with a preferred range from about 0.030 to about 0.250 of an inch. The thickness of the monofilament may range from about 0.0005 to about 0.010 of an inch. A preferred range is from about 0.001 to about 0.004 of an inch. Sometimes monofilaments are also specified in denier measurements. In this case, the denier would range from about 500 to about 5,000 denier, with a preferred range of about 800 to about 1,500. A typical denier is 1,100. These figures are given merely as illustrative. Individually extruded filaments are desirable as compared with those formed by slitting a film. Filaments cut from a film by slitting usually have rough edges and fibrillation which causes difficulty in the weaving. When the warp ends have to pass through the heddles in the loom, roughness can cause tangling.

The preferred filling yarns are continuous multifilament fiber grade polypropylene yarns, textured either by helical crimping or by other crimping methods or treated so that they will crimp when heated in the form of a floor covering into which they are woven. A typical preferred yarn has a helical crimp ranging from 8 to 30 crimps per inch (preferably 10 to 15 crimps per inch). The crimp should be heat-set at a temperature ranging between 100° C. to 150° C., preferably 130° C. to 140° C. for a period of time ranging from two minutes to one hour. The twist level is desirably below one turn per inch although a higher twist may be used in modified backings. Lower twist level below one turn per inch is preferred so that the tufting needles can easily pass through the filling yarns of the fabric without shifting the yarns. Twist-level depends on the type of fabric desired. Denier range covered is from 500 to 6,000 with a preferred range of 800 to 2,000. Typical denier used is 1,600. The number of picks per inch used in the weaving of a fabric would to some extent depend on the denier of the filling yarn. High denier would require fewer picks and low denier would require more picks to produce a comparable fabric. The filling yarns are lubricated, for one example with about 2% glycerol monostearate as lubricant. Other lubricants may be employed but the lubricant should be non-migratory and should not be prone to soiling.

The preferred synthetic resin for the warp and filling has been given as polypropylene. The applicant prefers to use isotactic polypropylene of commercial fiber grade and of reduced specific viscosity between 1.4 to 5, although ranges from 2.2 to 3.3 are more common and may be used. The approximate melt indices will range from 50 to 1.0 and 10 to 2.5 respectively. The viscosity figure is the reduced specific viscosity of polypropylene resin of 0.1% concentration of decaline at 135° C. Polypropylene mixed with heat stabilizers may be used in natural white colour or be mixed with commercially available pigments to obtain any other desired colour or combination of colours.

While the preferred synthetic resin for the warp or filling or both has been defined as polypropylene, other linear polymers mya be employed for one or both, as for example polyethylene, nylon, polyacetal polyesters, cellulosic resins, vinyl resins or other synthetic resins that have the mechanical characteristics effective for the purposes defined, as will be understood by those skilled in the art.

Carpets or rugs are usually made in 12 feet finished width. Jute-backed carpets are tufted eleven feet, ten inches and extended in the latexing and drying oven to a finished width of twelve feet. Carpets made from known synthetic backings would instead shrink to eleven feet in width. The applicant's polypropylene backing must be tufted twelve feet wide to get a twelve feet wide carpet.

Various fabric constructions may be used. A preferred construction is a simple weave as shown. Various combinations of ends times picks may be employed. Preferred fibers have ten to eighteen ends per inch and eight to fifteen picks per inch. Polypropylene backings shrink in both length and width. But, shrinkage in length is not of concern since it can be counteracted, if desired, by varying the number of stitches per inch at the tufting machine.

Because of the high strength, low density and low cost of polypropylene fibers, the backings produced with them are competitive with conventional materials and have the following advantages over them. Pirning and weaving with continuous multifilament filling yarns is relatiely easier. Backings so produced are lighter in weight and more convenient to handle. A smoother handle is obtained by calendering such backings at a sufficiently high temperature although such a step is not necessary for normal carpet end use. Such backings do not require pre-shrinking nor heat-setting and therefore retain their original strength, form and lustre.

A carpet made in accordance with the invention using polypropylene does not shrink in width after it has been tufted and while it is being latexed and dried. The finished carpet is dimensionally stable under varying humidity and room temperature conditions in storage or in use. The textured multifilament yarn filling does not slip nor fray and allows the tufting needles to pass through easily, giving better pattern definition. The backing has greater bulk, body, strength and cleanliness.

Carpets or rugs produced from such a carpet backing have a high crush resistance and greater dimensional stability. Said carpets or rugs are easier to stretch and install. Carpets or rugs made with such backings can be shampooed without fear of staining or puckering and curling. Any type of loop yarns used in commercial car-

pets may be used in combination with the backings of the invention.

The invention will be exemplified in the following examples, illustrative of a floor covering according to the invention. These examples show, of course, only preferred aspects of the invention and should not be taken in a limiting sense.

EXAMPLE I

Flat polypropylene monofilament yarn 0.0025 of an inch thick by 0.100 of an inch wide and approximately 1,100 denier was produced using stabilized isotactic polypropylene resin of reduced specific viscosity 3.2. Yarn properties were:

Denier	1,100
Tenacity (grams per denier)	4.5
Elongation (percent)	21.0

A continuous multifilament helically crimped yarn was prepared using the same resin as above, 1,600 denier, 75 filaments, crimped by a process described in United States patent application Ser. No. 415,430 filed Dec. 2, 1964, J. D. L. Tessier. A processing lubricant (glycerol monostearate) to the extent of 2% was applied. The yarn properties were:

Denier	1,600
Tenacity (grams per denier)	3.5
Elongation (percent)	15.1

A warp of 2,340 ends was prepared with the monofilament yarn using 15 ends per inch to produce a fabric 156 inches wide. The multifilament yarn was used as filling with ten picks per inch of fabric. Simple open weave was used. Some properties of the fabric were:

Fabric width	inches	152
Weight of fabric	oz./yd.^{2}	4.5

Breaking strength per inch:

Warp	pounds	146
Weft	do	104

Breaking elongation (percent):

Warp		21.0
Weft		84.0
Thickness of fabric	inch	0.040

A twelve feet wide carpet was tufted on the above backing using a standard commercial tufting machine where the needles were spaced five-thirty seconds of an inch apart along the width of the carpet. Properties of the carpet after tufting and before latexing were:

Stitches per inch		8.15
Pile weight	pounds	2.60
Loop pull strength	do	0.83

Breaking strength per inch:

Warp	pounds	109
Weft	do	80
Width of carpet		11′ 11½″

The tufted carpet produced in the above process was then latexed with a latex of styrene-butadiene rubber extended with a calcium carbonate filler. The amount of latex applied was 18 oz. per square yard of carpet. The latexed carpet was stretched out on a pin tenter to twelve feet, four inches and carried two passes through a twenty yard long drying oven. After the carpet came off the pin tenter it was again passed through the oven for the third time, this time under relaxed condition. All this was done in a continuous process so that the carpet had no time to cool between passes. The oven temperature was maintained at 330° F. The carpet travelled at the rate of four yards a minute.

After the carpet came out of the oven, the selvage was trimmed from both sides. A twelve feet wide finished carpet was thus obtained. Some properties of the finished carpet were as follows:

Weight per square yard	pounds	4.1
Loop pull strength	do	10.0
Breaking Strength per inch:		
Warp	do	149
Weft	do	105

A sample of this carpet 36 by 26 inches was drenched with hot water and left to dry. When dried, the carpet had no visible puckering and had shown no change in dimensions.

EXAMPLE II

The flat polypropylene monofilament yarn of Example I was used to make a warp of 2,184 ends, 14 ends per inch.

A continuous multifilament yarn was melt-extruded using the same resin as in Example I. A processing lubricant (glycerol monostearate) in an amount of about 2%, was applied. This yarn was then crimped on a false twist crimping machine to give ten crimps per inch. The crimped yarn was heat-set at about 140° C. for one hour in a relaxed condition. The resulting yarn had the following properties:

Denier	1,500/75
Tenacity (grams/denier)	1.4
Elongation (percent)	23.0
Tenacity at yield (grams/denier)	0.6
Elongation (percent)	23.0
Elastic recovery from 10% elongation (percent)	95
Modulus (grams/denier)	20

This continuous multifilament yarn was used as filling with 13 picks per inch of fabric. A simple weave was used. The fabric had a width of 152 inches, a weight of 5 oz./yd.^{2} and a breaking strength/inch in the warp of 148 pounds and in the weft of 59 pounds. The fabric had complete elastic recovery when stretched only in weft direction by 5% of its original length. A carpet was made using this fabric. It was tufted, latexed and dried in the same manner as described in Example I. The finished carpet showed no shrinkage in width during drying operation, and it had high loop pull strength of 12 pounds. A sample of this carpet 36 inches by 36 inches was drenched with 80° C. hot water and left to dry. When dried, the carpet had no visible puchering and did not change in dimensions. In comparative pile crush tests, the carpet made with crimped filling yarn showed 16% improvement over one of otherwise similar characteristics made with jute backing.

EXAMPLE III

The flat polypropylene monofilament warp of Example II was used. A 3,700/75 denier continuous multifilament yarn was melt-extruded and lubricated as in Example II. This yarn was twisted with 1 t.p.i. Z twist. The twisted yarn was stretched at room temperature by 3.5× stretch ratio at low input stretching speed of 25 feet per minute. The resulting yarn has the capacity of crimping automatically when relaxed as occurs in the weaving process. This crimp can be enhanced, if desired, by subsequently heating as done in the finishing of the carpet. This potentially crimpable yarn had the following properties:

Denier	1,100/75
Tenacity (grams per denier)	3.0
Elongation (percent)	30
Percent shrinkage at 135° C. for 15 minutes	70

The above yarn was used as filling with 11 picks per inch of fabric. Simple weave was used. The fabric had a width of 152 inches, a weight of 4.0 oz./yd.^{2}, a breaking strength/inch in the warp of 145 pounds and in the weft of 85 pounds. The percent shrinkage of the fabric

at 135° C. for 15 minutes (relaxed) was in the warp of 30% and in the weft of 28%.

A carpet was tufted, latexed and dried as in Example I. The finished carpet shrank in the drying oven by 10% in the width direction and 6% in the length direction.

I claim:

1. A tufted pile fabric comprising a woven backing fabric made up of respectively crossing warp ends and filling ends, the warp ends being substantially uniform flat synthetic resin continuous monofilament ribbons, the filling ends being bulky uniform low twist synthetic resin, continuous multifilament crimped yarns having at least 8 crimps per inch, the warp being overfilled to substantially eliminate spacing, the filling ends being substantially regularly spaced apart, the warp ends being deformed transversely to the plane of the backing by displacement by the bulky crossing filling ends to provide in the warp ends arched catching portions engaging adjoining portions of the filling ends thereby to inhibit displacement of the filling ends lengthwise of the warp ends, and a row of pile extending through the backing fabric and piercing the bulky filling ends thereby to provide added support for the pile.

2. The tufted pile fabric of claim 1, wherein said ribbons are composed of a polyolefin resin.

3. A woven backing for a floor covering comprising warp ends and filling ends, the warp ends being flat monofilament ribbons composed of a synthetic resin, the filling ends being bulky crimped multifilament yarns having at least 8 crimps per inch, wherein the warp ends are overfilled to substantially eliminate spacing, and the filling ends are substantially regularly spaced apart, and the warp ends are deformed transversely to the plane of the backing by displacement by the bulky crossing filling ends to provide in the warp ends arched catching portions engaging adjoining portions of the filling ends thereby to inhibit displacement of the filling ends lengthwise of the warp ends.

4. The backing of claim 3, wherein said ribbons are composed of a polyolefin resin.

5. The backing of claim 4, wherein said polyolefin is polypropylene.

6. The backing of claim 4, wherein said multifilament yarns are helically crimped.

7. A tufted pile fabric comprising the backing of claim 3.

References Cited

UNITED STATES PATENTS

2,723,683	11/1955	Fleischer	139—1
3,152,380	10/1964	Martin.	
3,286,322	11/1966	Sneary	139—391 XR
3,359,934	12/1967	Schwartz et al.	112—410
2,715,309	8/1955	Rosenstein et al.	28—72
3,106,507	10/1963	Richmond	139—420 X
3,110,905	11/1963	Rhodes	134—420 X
3,262,257	7/1966	Martin	28—1
3,317,366	5/1967	Dionne	112—410 X

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U.S. Cl. X.R.

139—420; 161—65