Dec. 26, 1967 H. A. SCHWARTZ ETAL 3,359,934

TUFTED CARPET HAVING SPLITTABLE FILLING YARNS IN THE PRIMARY BACKING

Original Filed March 27, 1964

Fig. 1.

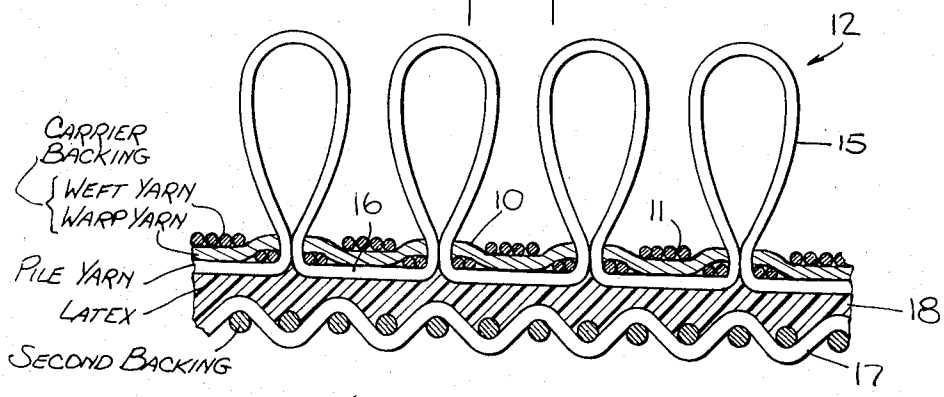


Fig. 2.

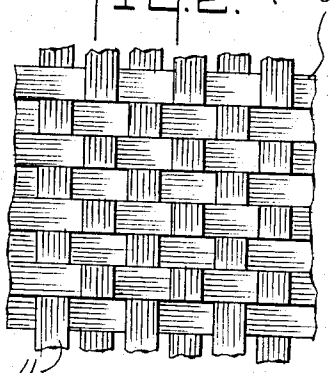
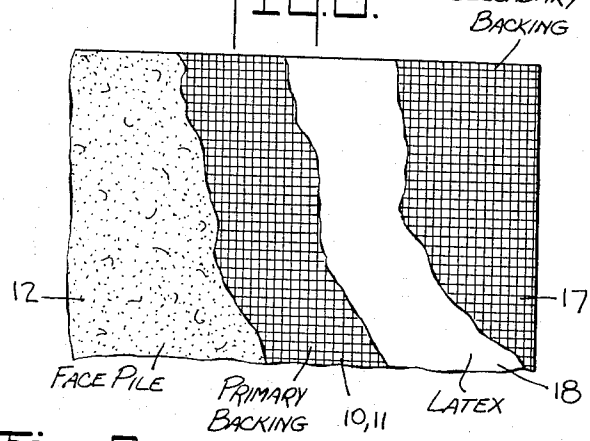


Fig. 8.



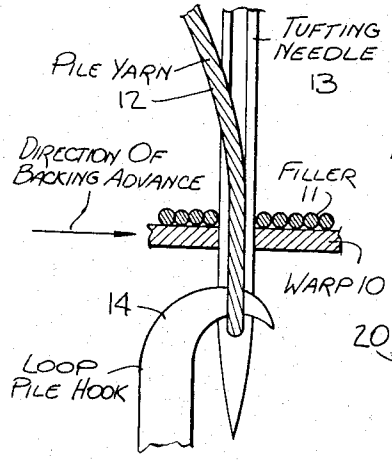
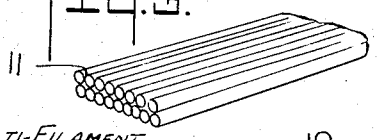
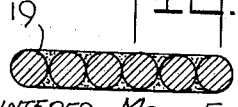


Fig. 3.



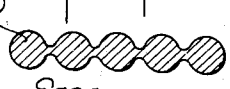
MULTI-FILAMENT TYPE

Fig. 4.



SINTERED MONO-FILAMENT

Fig. 5.



SERRATED MONO-FILAMENT

Fig. 6.

DUMBBELL MONO-FILAMENT

Fig. 7.

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United States Patent Office 3,359,934
Patented Dec. 26, 1967

3,359,934

TUFTED CARPET HAVING SPLITTABLE FILLING YARNS IN THE PRIMARY BACKING

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Filed May 8, 1967, Ser. No. 636,804
7 Claims. (Cl. 112—410)

ABSTRACT OF THE DISCLOSURE

A tufted pile fabric in which the pile yarns are tufted into a primary backing woven of warp and filling yarns to produce pile loops above the backing and connecting loops therebelow, the filling yarns being formed of multi-sectional synthetic plastic yarns having a generally flat cross-sectional shape formed by a cluster of longitudinally extending continuous filaments in parallel abutting relationship, the filaments in the cluster thereof separating when subjected to the action of a tufting needle to permit passage therethrough, whereby rupture of said filling yarns is prevented and the pile yarns are firmly anchored therein.

This application is a continuation of the copending application Ser. No. 355,255, filed Mar. 27, 1964, now abandoned.

This invention pertains generally to tufted fabrics formed by threading pile yarns through a woven backing, and more particularly to improved primary backings which facilitate tufting operations and which provide a carrier of high tensile strength.

In manufacturing tufted fabrics such as carpets, rugs and bedspreads, a woven backing in advanced through a needle tufting machine. The pile yarns are borne by a bank of reciprocating needles which extend transversely across the backing web and pierce the backing material. As the needles are withdrawn, looper members serve to hold the inserted yarns, thereby forming on the moving backing row upon row of pile loops which project above the backing face. In the completed fabric, the crests of the loops remain connected or they are severed, depending on whether a short or a long loop pile or a cut pile fabric is desired.

The quality, appearance, residual tensile strength and dimensional stability of tufted fabrics is in large measure controlled by the tufting characteristics of the woven backing. If the nature of the backing is such as to induce random deflection of the tufting needles, the pile yarn stitches will be uneven and the resultant pile will have an irregular density and poor pattern definition. Thus the pile density will be sparse in certain areas, thereby exposing backing, particularly in low loop constructions, and producing an effect known as "grinning." Heretofore to compensate for this effect, additional face yarn was required, but this of necessity raised the cost of the fabric. Moreover, while the backing may initially have a high tensile strength, if the nature of the backing is such that it is subject to mutilation by the tufting needles, its tensile strength may be seriously impaired.

In an attempt to produce a backing having superior characteristics, backings have heretofore been woven of flat or ribbon-like synthetic plastic yarns, rather than of the conventional round or twisted yarns of jute, cotton and kraftcord. Among the materials used for such synthetic flat yarn have been polypropylene and polyethylene. In order to cause the tufting needles to pierce the flat woven yarns in all instances rather than to pierce some and to push aside others in random fashion, the ribbon-like warp and weft or filling yarns of the backing were

closely woven so that the backing surface was free of interstices.

Though such backings, when formed of flat synthetic yarns, have certain advantages over prior constructions, we have found that the tufting operation gives rise to a significant reduction in the tensile strength thereof. Our tests have indicated that the loss of strength runs as high as fifty percent of the initial tensile value in the filling.

The reason for this drawback is that the tufting needles are of oval to rectangular cross-sectional shape, with the long direction of the needles running parallel to the warp yarns and transversely with respect to the filling. The nature of the tufting operation is such that the bank of needles is deployed across the width of the advancing backing web; hence at any one time the narrow cutting edge of no more than one or two needles will strike an individual warp yarn, whereas the wider edge of a large number of needles may concurrently strike the same weft yarn. Consequently, the weft or filling yarns are subjected to more massive stresses than the warp yarns and ordinarily lose more tensile strength in the course of tufting.

While the purpose heretofore of using a ribbon-like mono-filament yarn in the filling as well as in the warp is to cause the tufting needles to pierce both the filling and the warp, in practice such piercing actually takes place in only a few instances, and in the majority of cases the filling yarn is either fractured or pushed aside. Because such materials as polypropylene are subject to rupture and splintering by an impact, even if the portion of the needle striking the flat yarn cuts only one-half of the yarn, this transmits a shock to the remaining section of the yarn, thus weakening it.

Furthermore, we have found that in weaving a backing of flat mono-filament synthetic plastic yarns, the nature of the weaving operation is such that in many cases there is some folding and twisting of the filling yarns, whereas there is relatively little twist imparted to the ribbon in the warp direction. The tufting needles, whose broad sides lie parallel to the warp, slit the flat ribbons with relative ease in the warp direction with a minimum of rupture and with little or no needle deflection. However, with the twisted flat yarns in the filling, the needle action is unpredictable.

Accordingly, it is the main object of the present invention to provide an improved backing for a tufted fabric which facilitates the tufting operation and which minimizes undesirable needle deflection effects to produce a tufted fabric of superior quality and appearance.

Also an object of the invention is to provide a woven backing for a tufted rug, whose initial tensile strength is high and whose tensile strength is not sharply reduced by the tufting operation, whereby the tufted fabric is strong and dimensionally stable.

More specifically, it is an object of the invention to provide a woven backing having the above noted characteristics, the backing being formed of flat synthetic plastic warp yarns interwoven with multi-sectional or multi-filament filling yarns which are readily penetrable, whereby the impinging needles will either enter between adjacent filling yarns or separate closely adjacent filaments or sections of particular filling yarns and thereby pass through the filling yarns rather than fracture or otherwise mutilate them. A backing in accordance with the invention provides improved tuft bind, since the filling yarns are not fractured or mutilated and the pile yarns are firmly secured to the carrier.

A significant feature of the invention resides in the fact that the tufting needles are subjected to a minimum of deflection by the warp and filling yarns, both of which yield to rather than resist or oppose the needle action, thereby avoiding pattern distortion and maintaining the tensile strength of the backing to a high level.

Also an object of the invention is to provide an improved backing as a carrier for a tufted fabric, which primary backing may be effectively laminated to a secondary backing, such secondary backing serving to impart greater body to the tufted fabric.

Briefly stated, these objects are accomplished in a tufted fabric whose primary backing is composed of flat ribbon-like mono-filament warp yarns interwoven with filling yarns of synthetic plastic material but in multi-section form, such that a needle impinging on the filling yarn will separate the filaments or sections thereof to pass therethrough and not be deflected thereby. By the term "multi-sectional filling yarn" is meant:

(a) a yarn formed by a cluster of fine continuous filaments, preferably with little or no twist;

(b) a yarn formed by a group of closely adjacent mono-filament yarns, preferably with little or no twist; and

(c) a yarn formed by a single mono-filament whose cross-sectional shape is such as to produce a series of inter-connected parallel sections which may easily be separated by a needle.

In the forms (a) and (b), the filaments may be held together as by adhesive or sintering.

For a better understanding of the invention as well as other objects and further features thereof, reference is had to the following detailed description to be read in conjunction with the accompanying drawing, wherein:

FIG. 1 is a sectional view of a double-backed tufted fabric including a primary backing in accordance with the invention;

FIG. 2 is a plan view of said primary backing;

FIG. 3 shows, in perspective, the multi-filament structure of the multi-sectional filling yarn in the primary backing;

FIG. 4 illustrates in transverse section, a modified form of multi-sectional filling yarn;

FIG. 5 shows in section, another preferred modification of the multi-sectional filling yarn;

FIG. 6 is still another embodiment of the multi-sectional filling yarn;

FIG. 7 illustrates, in section, the action of a tufting needle on a primary backing in accordance with the invention; and

FIG. 8 is a plan view of the tufted fabric, the structure being cut away to illustrate the various layers thereof.

Referring now to FIG. 1, a tufted fabric in accordance with the invention includes a preformed primary backing constituted by longitudinally-extending warp yarns **10** and transversely-extending filling yarns **11**, which are interwoven on a loom in any known manner to form the carrier for the tufted fabric. Tufted into the backing is a pile yarn **12** which may be of cotton, wool, or any suitable material, or synthetic fiber, this pile yarn forming the face of the fabric.

In the loop pile machine for making tufted fabrics, each needle **13** in a serial bank thereof, as shown schematically in FIG. 8, inserts the loop of pile yarn **12** through the backing fabric (warp **10** and filler **11**) and carries it down to a point below the hook **14**. A web of backing fabric is fed continuously into the needle bank. The hooks **14** function in timed relationship with the needles **13** and cross the needles just above the needle eye to pick up the loop of pile yarn. The hooks then hold this loop while the needles are being retracted from the backing, meanwhile rocking back and forth from the needle path. When the needles start their next descent, the loops have been released from the hooks and the feed mechanism for the backing has advanced the backing forward one stitch length carrying the loop away from the needle.

Thus, in FIG. 1, each loop **15** represents one in a row of pile loops running across the backing web, there being as many loops in the row as there are needles in the bank. The distance between loops in the chain thereof

running in the direction of web movement is determined by the reciprocating rate of the needle and the speed at which the backing is advanced, this distance constituting the stitch spacing. The pile loops **15** in each chain are linked by connecting loops **16** drawn against the under-surface of the carrier backing. The height of the pile may be made low or high, as desired, or any combination of high and low loops in accordance with known patterning practices. Alternatively, the pile loops may be cut in accordance with known techniques.

In order to porperly anchor the pile yarns and to impart the desired body to the tufted fabric, a relatively heavy secondary backing **17** is provided, which is laminated to the carrier or primary backing **10** and **11** and to the underlying connecting loops **16** by means of an adhesive **18** such as latex. The adhesive is applied in the fluid state and flows freely into the spaces between the warp and filling yarns of both the primary and secondary backings to form a film-like coating. This latex is then cured, or if other known forms of adhesives are employed, the coating is allowed to set and harden.

The present invention is concerned mainly with the physical properties and structure of the primary backing and its tufting characteristics. As pointed out previously, if the structure of the backing is such as to be ruptured or mutilated by the needling operation, its tensile strength will be impaired and the quality of the tufted fabric will be degraded. Also, if the nature of the backing is such as to cause deflection of the needles, so that if instead of a row of uniformly-spaced loops across the backing and uniformly-spaced loop stitches in the direction of backing movement, these spaces are irregular, then grinning may occur and the pattern of the fabric will not be properly defined.

In accordance with the invention, the warp and filling yarns from which the primary backing is woven are made of synthetic plastic material, such as polypropylene, polyamides such as nylon, polyester or polyacrylic yarns, as well as vinyl and polyethylene yarns.

The warp threads **10** are preferably constituted by ribbon-like uniform mono-filament yarns of relatively flat cross-section, highly oriented in the longitudinal direction. This is usually accomplished by so drawing the ribbon or the broad web from which the ribbon-like yarn is slit, as to irreversibly stretch the material, thereby orienting its molecular structure and increasing its tensile strength. When a needle interposed in the path of a ribbon-like warp yarn, as shown in FIG. 8, strikes this yarn, it will pierce the yarn without difficulty, for the broad side of the needle which has an oval or rectangular cross-section, lies in the warp direction and the needle therefore effects a clean slitting action which does not materially impair the tensile strength of the warp.

The filling threads, however, lie transversely with respect to the broad side of the needles, and should ribbon-like yarns be used for this purpose, the needles, as pointed out previously, tend to rupture the filling or to push it aside. The resistance offered by such filling also gives rise to needle deflection. To avoid the drawbacks incident thereto, the filling threads, in accordance with one embodiment of the invention, are of multi-sectional construction, as shown separately in FIG. 3, where it will be seen that the yarn is composed of a cluster of individual fine continuous filaments with little or no twist, each filament being of about 6 to 50 denier.

Hence when the needle strikes the multi-sectional filling yarn, as shown in FIG. 7, the cluster of filaments composing the filling is divided rather than ruptured, and as there is little if any twist, this permits the needle to pass through the yarn. This yielding action of the filaments in the cluster serves to preserve the tensile strength of the yarn. Since few if any filaments are broken, the others which constitute the vast majority remain intact, and the rupture or impact is not transmitted to the other filaments.

The interwoven mono-filament warp yarns and the

multi-sectional filling yarns afford a relatively thin primary backing which is advantageous for it limits the amount of face yarn hidden in the backing. The backing fabric made in accordance with the invention is such as to minimize needle deflection, and a uniform stitching action is obtained which produces a pile of regular density with no distortion of the pattern. Since the primary backing is relatively light-weight, a secondary backing is necessary to impart body to the fabric, where such body is desirable, as in rugs.

In stead of the filling yarns taking the form of a cluster of independent continuous, fine filaments, one may also use a filling yarn composed of a group of closely adjacent mono-filament yarns of relatively large denier in the order of 50 denier and above. The individual filaments in the cluster or group thereof may be of round cross-section or in any other geometric form, such as triangular, elliptical or square. Another suitable form of multi-sectional filling yarns, as shown in FIG. 4, is one in which a group of individual filaments 19 lying in the same plane are weakly joined together longitudinally either by heat-sintering or by the use of an adhesive. The filaments are so interbonded that the junction lines are relatively weak, hence when the needle strikes the yarn it tends to part along a bonding line rather than to rupture.

A similar effect may be obtained by a multi-sectional yarn 20 as shown in FIG. 5, wherein the yarn is so extruded as to have a serrated or corrugated cross-section. In effect, therefore, the yarn is composed of mono-filaments which are joined together by relatively thin and weak junction lines, thereby facilitating penetration of the needles. In lieu of a series of serrations, the filling yarn 21, as shown in FIG. 6, may have a single serration producing a dumbell cross-section, so that the multi-sectional yarn is effectively composed of two filaments which separate and yield when struck by a needle.

When the primary backing is made up entirely of flat yarns and is of a material such as polypropylene, it does not provide a good laminating surface, for conventional adhesives do not bond well to such smooth, non-porous synthetic plastic surfaces. However, by the use of multi-sectional filling yarn in the backing, the surface is then effectively composed of a myriad of fine pores, interstices, or indentations which can be impregnated by the adhesive fluid and thereby afford an improved adhesive action. Thus a primary backing in accordance with the invention is more conducive to lamination.

While there has been shown a preferred embodiment of woven backing for tufted fabrics in accordance with the invention, it will be appreciated that many changes and modifications may be made therein without, however, departing from the essential spirit of the invention as defined in the annexed claims. Thus in lieu of mono-filamentary flat yarns in the warp, multi-sectional yarns of the type disclosed herein may be used.

While there has been shown and described a preferred embodiment of woven backing for tufted fabrics in accordance with the invention, it will be appreciated that many changes and modifications may be made therein without, however, departing from the essential spirit of the invention as defined in the annexed claims.

What is claimed is:

1. A tufted pile fabric comprising a primary backing woven of warp and filling yarns and rows of pile yarn tufted into said backing to produce pile loops above said backing and connecting loops therebelow, said filling yarns being formed of multi-sectional synthetic plastic yarns having a generally flat cross-sectional shape, each filling yarn being constituted by a multiplicity of longitudinally extending continuous filaments, means holding said filaments together in a cluster and permitting said filaments to separate without rupture of said filling yarns when subjected to the action of a tufting needle, the pile yarns being firmly anchored in said primary backing.

2. A tufted pile fabric, as set forth in claim 1, wherein said means by which said filaments in said cluster are held together are constituted by a slight twist in said filling yarn.

3. A fabric as set forth in claim 1, wherein said warp yarns are formed of uniform mono-filament synthetic plastic ribbons of flat cross-section.

4. A fabric as set forth in claim 1, wherein said filling yarns are formed of polypropylene.

5. A fabric as set forth in claim 1, wherein said warp yarns are also formed of said multi-sectional synthetic plastic yarns.

6. A tufted pile fabric comprising a primary backing woven of warp and filling yarns and rows of pile yarns tufted into said backing to produce pile loops above said backing and connecting loops therebelow, said filling yarns being formed of multi-sectional synthetic plastic yarns having a generally flat cross-sectional shape formed by longitudinally extending parallel sections which are joined together by relatively weak junction lines which cause the sections joined thereby to separate when subjected to the action of a tufting needle to permit passage therethrough, whereby rupture of said filling yarns is prevented and the pile yarns are firmly anchored therein.

7. A fabric as set forth in claim 6, wherein said multi-sectional filling yarns are in serrated mono-filament form composed of interconnected parallel sections.

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