TUFTED CARPET AND NON-WOVEN BACKING FABRIC THEREFOR

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ABSTRACT OF THE DISCLOSURE

A tufted pile carpet in which a non-woven backing fabric supports the pile elements which are formed by yarns extending through the backing fabric at closely spaced intervals with portions thereof extending from one face of the non-woven backing fabric. The non-woven backing fabric being in the form of a needled sheet-like web of fibers which are intermixed vertically relative to the thickness of the web with the majority of the intermixed fibers being of a synthetic thermoplastic material, preferably a polypropylene or other polyolefin, which are bonded or fused together on at least one surface of the web with the fibers on the interior of the web being unbounded and movable relative to each other. Said web having incorporated therein threads which increase the resistance of the web to tensile stresses exerted thereon. Said threads preferably being adjacent the surface of the web on which the fibers are bonded or fused and being engaged by the bonded or fused fibers.

The present invention relates to improvements in the backing fabric for tufted carpet or the like and the method of producing such fabric.

This application is a continuation-in-part of our co-pending application Ser. No. 320,276 filed Oct. 31, 1963, now abandoned.

An object of the present invention is to provide a tufted carpet having a backing fabric comprised principally of intermixed fibers which imparts superior qualities to the carpet in a number of respects including the cost, weight, strength, dimensional stability, handle, availability of materials and the like, particularly in comparison to conventional tufted carpet which uses a loosely woven burlap or similar material as the backing fabric.

Another object of the present invention is to provide a backing fabric for tufted carpet which can be produced at a relatively high rate of productivity from inexpensive materials which are readily available in most countries, including the United States. This eliminates problems of long delays and uncertainties of delivery which are frequently encountered in obtaining the commonly used loosely woven burlaps which are usually manufactured from jute in countries such as India.

In addition a backing fabric in accordance with the present invention has a consistent uniformity in composition which practically eliminates irregularities or imperfections in the appearance of the pile face of the tufted carpet due to needle deflection which can occur when a tufting needle strikes a woven strand of jute or similar material. The intermixed fibers of the subject backing fabric also provide for better closure on the pile forming yarns after tufting than do the strands of loosely woven materials such as burlap. The subject backing fabric also has a greater ability to pick up the adhesive back coating which holds the pile forming yarns in place without objectionable penetration of the back coating onto the face of the fabric.

In addition, tufted carpet embodying the present invention is lighter in weight than tufted carpet having comparable tufts or pile which use burlap as the backing fabric, with the result that shipping costs are reduced and larger rolls of carpet can be handled. Various other objects and advantages of the present invention will become apparent and will be better understood from the following description and the accompanying drawings in which:

FIG. 1 is a side elevational view in vertical section in a warpside direction diagrammatically illustrating a piece of tufted carpet embodying the present invention;

FIG. 2 is a side elevational view in vertical section in a warpside direction diagrammatically illustrating the backing fabric of the tufted carpet shown in FIG. 1 but on an enlarged scale and in the form of a needle bar prior to surface treatment thereof;

FIG. 3 is a plan view diagrammatically illustrating the backing fabric shown in FIG. 2;

FIG. 4 is a side elevational view in vertical section in a warpside direction diagrammatically illustrating the backing fabrics shown in FIG. 2 after surface treatment;

FIG. 5 is a side elevational view in vertical section in a warpside direction diagrammatically illustrating the backing fabric shown in FIG. 4 with yarns forming pile elements tufted thereon;

FIG. 6 is a fragmentary view of the tufted carpet shown in FIG. 1, but on an enlarged scale;

FIG. 7 is a side elevational view in vertical section in a warpside direction diagrammatically illustrating a modification of the backing fabric shown in FIGS. 2–6;

FIG. 8 is a side elevational view in vertical section in a warpside direction diagrammatically illustrating a piece of tufted pile carpet with the modified form of backing fabric shown in FIG. 7;

FIG. 9 is a plan view diagrammatically illustrating the apparatus and procedure employed for producing the backing fabric shown in FIG. 4;

FIG. 10 is a side elevation of the apparatus and procedure illustrated in FIG. 9.

It will be understood that the accompanying drawings are merely diagrammatic illustrations and that reference should be made to the following description for a more detailed explanation of the structures involved. Also, it will be understood that the backing fabric will be comprised principally of non-woven fibers and hence, may be referred to as a non-woven fabric. When used as the support element in tufted carpet, the thickness of the backing fabric will be of the same relative order as a woven burlap and may be readily substituted therefor.

Generally speaking, a tufted pile fabric such as carpet made in accordance with the present invention employs a novel backing fabric comprised principally of fibers of a thermoplastic material such as polypropylene which have been subjected to needling and with the fibers on at least one surface of the backing fabric being bonded together as the element on which yarns forming the pile elements are tufted and supported. Prior to tufting the backing fabric is in the form of a sheet-like web in which the majority of the fibers are of synthetic thermoplastic material of high strength, particularly polypropylene and the fibers employed may be those termed "waste" fibers in the trade. The backing fabric may be formed by distributing the fibers at random by means of garnets in one or more superimposed layers on a carrier such as a low-count cotton cheesecloth. The cheesecloth with the
3,394,043 fibers deposited thereon is then moved to a needling machine where the web is subjected to a needling operation which causes the fibers to be intimately intertwined and interengaged with each other throughout the thickness of the web, particularly at the points of needling. After needling, fibers of one or both exterior surfaces of the batting are brought together to a flattened and hardened condition with the interior fibers remaining unbound. This may be done by heating the surface fibers to their melting temperature so as to fuse the surface fibers without fusing the fibers on the interior of the web. The bonding of the fibers on exterior surfaces of the web tends to increase the tensile strength of the web and the bonded or fused surface can pass beneath the needles of tufting machines during the tufting operation without excessive interference or objectionable drag.

The usual tufting machines are employed in forming the pile elements and the tufting needles which carry the tufting yarns penetrate the backing fabric from the rear face thereof so as to form loops of the yarns having a desired length or height which extend from the opposite or front face of the backing fabric. The needles are then withdrawn from the backing fabric with the yarn loops held in place while the backing fabric which has been tufted is advanced for the tufting of the next row of pile elements thereon.

It should be noted here that passage of the yarn-carrying needles through the backing fabric which takes place in the tufting has the effect of compacting the filaments or fibers of the non-woven fabric in the area surrounding the pile yarns and this tends to increase the tensile strength of the backing fabric even though the tufting needles penetrate or puncture the fabric at closely spaced intervals.

As shown in FIGS. 1-6, the needled web of fibers includes a piece of low-count cheesecloth of cotton or other suitable material extending therethrough. As shown in FIGS. 9 and 10, the fibers are deposited on a moving web of the cheesecloth and the fibers carried by the cheesecloth are then subjected to a needling operation. When the procedure illustrated is followed, the cheesecloth is incorporated in the needled web at a point adjacent its lower surface.

If desired, other means, such as a continuous moving belt or slats or the like may be employed to support and transport layers of fibers to needling operation. In such case, the cheesecloth may then be eliminated. A modified form of the backing or support fabric without the cheesecloth is shown in FIG. 7 and the same reference numerals have been applied to corresponding elements. This form of backing fabric after tufting and backing coating is also shown in FIG. 8.

It will be noted that in a tufted fabric, such as tufted carpet, double thicknesses of the pile-forming yarns extend through the backing fabric at closely spaced intervals both across and lengthwise of the fabric and the double portions of the pile forming yarns exert lateral forces on the fabric. Although such forces are of a low order, the cumulative effect of such forces, particularly in a twelve to fifteen foot width of the tufted carpet, will cause the tufted fabric to grow or expand in both its width and length when the backing fabric is formed from fibers having elastic properties, such as polypropylene.

Such growth takes place gradually and may not be uniform, particularly in instances of carpet where different pile yarns are used. Hence, the growth is likely to give rise to difficulties in subsequent manufacturing operations. However, this problem is overcome to a large extent by incorporation of the cheesecloth in the backing fabric as shown in FIGS. 9 and 10 as the threads of the cheesecloth will resist such forces.

When the fibers are deposited on the cheesecloth as shown in FIGS. 9 and 10 with the cheesecloth being adjacent the lower face of the web, the ends of some fibers are forced through the open mesh of the cheesecloth. This is called the beard side of the fabric. Thereafter, when the surface fibers on the beard side of the fabric are fused or bonded together, they also engage with and grip the threads of the cheesecloth and thus, prevent slippage or the beard from coming loose to the web of needled fibers. Under these conditions the fused fibers and the threads of the cheesecloth combine to resist and overcome the forces exerted on the backing fabric as a result of tufting and permit the desired dimensions to be maintained. When the fabric is tufted, it is preferable that the cheesecloth or the like be adjacent the upper or pile face of the carpet as shown in FIGS. 1 and 6.

The backing or support fabric may be made entirely from polypropylene fibers or from mixtures of polypropylene fibers with fibers of other materials such as nylon, rayon, acrylic, polyester or mixtures thereof. Polypropylene fibers have been found to have especially suitable characteristics particularly for use in conjunction with tufted carpet and are readily available in good supply and at low cost in most countries, including the United States. A satisfactory backing or support fabric for tufted carpet may be made from polypropylene fibers of 5 to 15 denier which are commonly produced commercially. If desired, fibers of different denier may be mixed.

In addition, fibers of other materials may be included in the mixture and the following is an example of a suitable mixture of fibers which may be employed in a backing fabric for tufted carpet:

<table>
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<tr>
<th>Percent</th>
<th>Polypropylene fibers (4½ in. staple)</th>
<th>90</th>
</tr>
</thead>
<tbody>
<tr>
<td>75%</td>
<td>Rayon fibers (3 in. staple)</td>
<td>25%</td>
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The rayon fibers in this mixture serve primarily as dye sites in the backing fabric so that its color will approximate the color of the pile yarns after dyeing. The content of rayon fibers may be increased to some extent, but it should not be increased to a point where substantial weakening of the backing fabric takes place.

In the above mixture of 3 and 6 denier polypropylene fibers, the 3 denier fibers will fill any voids or spaces between the larger 6 denier fibers and changes in these proportions can be made as desired.

As is customary, the polypropylene fibers are crimped and the crimp imparted by usual procedure employed in the United States; i.e., by overfeeding the filament as they are fed into a heated stuffing box, is satisfactory.

The bonding or fusing of the surface fibers also flattens upstanding fibers and provides a somewhat harder and smoother surface which will pass more readily beneath the needles of the tufting machine.

In the case of polypropylene fibers, the polypropylene fibers on the surface of the web may be bonded together by heating these fibers to a temperature slightly above their melting point for a short period of time so as to fuse the surface fibers without affecting the interior or remaining fibers of the web.

As noted above, the tufting needles penetrate the backing fabric repeatedly at closely spaced intervals in the tufting operation and in effect, form punctures or openings therein through which double thicknesses of the pile yarns extend. With a conventional backing fabric, such as burlap, needle punctures which occur in the tufting tend to weaken the fabric. This is particularly true with woven fabrics such as burlap where strands of the backing fabric may be severed by the needles if proper care is not exercised. However, the tensile strength of a backing fabric embodying the subject invention is not appreciably reduced or diminished by the tufting and an increase in the overall tensile strength of the tufted pile fabric may result due to the compacting of the unbounded or unfused fibers in the interior center of the backing fabric in areas adjacent the points where the needles penetrate the fabric.

Tensile strength tests made of samples of non-woven backing fabrics of several weights (8 oz., 6 oz., and 4 oz. fabrics) indicate that this is the case. In addition, the unbounded or unfused fibers which are compacted in areas surrounding the needle penetrations retain their resilient characteristics and thus, have a tendency to close on the portions of the pile forming yarns which extend through the backing fabric and to hold the pile yarns in place more effectively in the drawing of the loops than is the case with loosely woven backing fabrics such as burlap. Further, the backing fabric made in accordance with the subject invention will not fray.

A very distinct advantage of the backing fabric described herein over woven backings such as burlap is that no skewing of filling strands can take place and distortion in alignment of pile elements resulting therefrom is eliminated.

As in the pile forming yarns have been tufted on the backing or support fabric, a suitable adhesive compound forming the back-coating 14 is employed at the rear face of the tufted backing fabric. The back-coating penetrates the backing fabric to some extent and it anchors the pile elements in place. A suitable back-coating compound for this purpose is a high solids synthetic latex base adhesive compound, such as is commonly used for tufted carpet.

In this connection, it should be noted that the backing or support fabric remains porous and the unbounded or unfused fibers on the interior thereof permit a considerable amount of the back-coating compound to be absorbed without having the compound penetrate to the pile face of the backing fabric. Thus, the hand of the tufted pile fabric can be varied by adjusting the amount of the adhesive compound applied thereto. Scrub or other suitable finish or covering materials may be applied, if desired, to the rear face of the tufted carpet in the usual manner.

One way in which the backing or support fabric embodying the subject invention may be produced is illustrated schematically in FIGS. 9 and 10. Briefly, polypropylene fibers (or mixtures containing polypropylene fibers) are fed from feed boxes 30 onto guide frame 32 which combine the fibers into layers which pass onto run-out chutes 32. The run-out chutes traverse back and forth over a traveling conveyor or supporting element 33, which, as mentioned above, may be the low-count cheesecloth 15 and deposit the fiber layers thereon.

It is generally desirable to deposit more than one layer of the fibers on the conveyor element or cheesecloth so as to obtain a more even and uniform distribution of the fibers.

The conveyor element or cheesecloth is fed from a roll 34 through a J-box 35 from which it moves forward as a continuous web beneath the ends of the traversing run-out chutes to receive the fibers and thence, to a needling machine 36 carrying the layers of fibers deposited thereon with it. After leaving the needling machine, the needled web of fibers with the cheesecloth incorporated therein passes into another J-box 37 and then to a pair of heated rolls 38 and 39 which contact with the exterior surfaces of the needled web or bat.

In order to fuse fibers of polypropylene having a melting point between 310° to 320° F., the surface fibers should be heated briefly to a temperature between 325° and 350° F. by contact with the rolls. When heated in this manner, the fibers in the center or interior of the web do not reach their melting temperature and will remain unbounded or unfused. When the fused fibers on the exterior surfaces of the web have been permitted to cool, the backing fabric may be then wound into a roll 40.

The web may be run through a disc cutter to cut it to the desired width either before or after the surface treatment. Also, a suitable binder or solvent, such as an acrylic resin or a water resistant curable type latex may be sprayed on the surfaces of the web in liquid form and then dried to bind the surface fibers together in place of fusing them by heat.

The various pieces of apparatus mentioned above are conventional and hence need not be described in detail here.

It will be understood that various changes and modifications may be made by those skilled in the art in the particular embodiments of the tufted pile fabric and the method of producing the same which have been described above for illustrative purposes without departing from the scope of the invention as defined by the following claims.

We claim:

1. In a tufted carpet, the combination which comprises: (a) a backing fabric comprised primarily of intermingled fibers with the majority of said fibers being of polypropylene; (b) said fibers being randomly distributed in one or more layers and being interminged in a vertical direction relative to the thickness of said layers into the form of a sheet-like web; (c) the exposed fibers on at least one exterior surface of said sheet-like web being bonded together with the remaining fibers of the web being unbonded; (d) yarns forming a plurality of individual pile elements extending through and projecting from one face of said backing fabric; (e) each of the pile elements having doubled portions extending through the backing fabric and portions extending along another face of the backing fabric and connecting said doubled portions to adjacent pile elements with the doubled portions being resi-
In a tufted carpet, the combination as defined in claim 1 which includes:
(a) means incorporated in the backing fabric for resisting growth of the backing fabric after tufting.

3. In a tufted carpet, the combination as defined in claim 1 which includes:
(a) means incorporated in the backing fabric for resisting growth thereof after tufting;
(b) said means including a low-count cheesecloth having threads extending lengthwise of the fabric.

4. In a tufted carpet, the combination as defined in claim 1 which includes:
(a) means incorporated in the backing fabric for resisting growth thereof after tufting;
(b) said means including a low-count cheesecloth having threads extending lengthwise of the fabric with the fibers on said one exterior surface of the backing fabric being bonded to said threads.

5. In a tufted carpet, the combination as defined in claim 1 wherein:
(a) the polypropylene fibers on the said one exterior surface of the fabric are fused together.
(b) said fabric also including a web of open-mesh low-count cheesecloth having warp and filling threads adjacent one surface thereof.
(c) the exposed fibers of polypropylene on said surface of the backing fabric being fused into engagement with each other and with the threads of the cheesecloth, with the remaining fibers of the backing fabric being unbonded; and
(d) yarn forming rows of individual pile elements extending through and projecting from one face of the backing fabric.

6. In a tufted carpet, the combination as defined in claim 5 which includes:
(a) a backing fabric comprised of randomly distributed and intermixed fibers with a major proportion of said fibers being of polypropylene;
(b) said fabric also including a web of open-mesh low-count cheesecloth having warp and filling threads adjacent one surface thereof.
(c) the exposed fibers of polypropylene on said surface of the backing fabric being fused into engagement with each other and with the threads of the cheesecloth, with the remaining fibers of the backing fabric being unbonded; and
(d) yarn forming rows of individual pile elements extending through and projecting from one face of the backing fabric.

7. In a tufted carpet, the combination as defined in claim 7 wherein:
(a) the proportion of polypropylene fibers in the backing fabric is at least 80 percent.
(b) said adhesive coating penetrating the backing fabric from said rear face thereof and anchoring the pile yarns to the backing fabric.

8. In a tufted carpet, the combination as defined in claim 7 wherein:
(a) the backing fabric comprises a mixture of fibers in which about ninety percent (90%) of the fibers are polypropylene fibers ranging in size from about 3 to 6 denier, and ten percent (10%) of the fibers are rayon fibers;
(b) said rayon fibers acting as dye sites.

9. In a tufted carpet, the combination as defined in claim 8 wherein:
(a) about twenty-five percent (25%) of the polypropylene fibers are of 3 denier and seventy-five percent (75%) are of 6 denier.

10. In a non-woven fabric, the improvement which comprises:
(a) a needled sheet-like web of intermixed fibers in which the majority of said fibers are of a synthetic thermoplastic material;
(b) said web having exterior surfaces and being needed throughout its thickness at a multiplicity of closely spaced points extending over its surface area with fibers at different levels of the web having portions which are displaced vertically relative to the thickness of the web at said points of needing;
(c) a layer of textile threads incorporated in said needled web adjacent one of the exterior surfaces thereof;
(d) said layer of textile threads having a tensile strength less than that of the needled web of fibers and extending in a plane substantially parallel to said one exterior surface of the web with displaced portions of fibers forming the web projecting through said layer of threads at the points of needing;
(e) the displaced portions of the fibers projecting through the layer of threads being bonded into engagement with each other and with the layer of threads;
(f) said needled web also including fibers located between the exterior surfaces thereof which are not bonded together and are mobile relative to each other.

11. In a non-woven fabric, the improvement as defined in claim 10 wherein:
(a) the synthetic thermoplastic fibers of the needled sheet-like web are of a polyolefin material.

12. In a non-woven fabric, the improvement as defined in claim 11 wherein:
(a) portions of the thermoplastic fibers located at the other exterior surfaces of the web are fused into engagement with each other.

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