Nov. 22, 1960 R. R. MATTHEWS 2,960,750

PILE FABRICS AND METHOD OF MAKING SAME

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Fig. 1

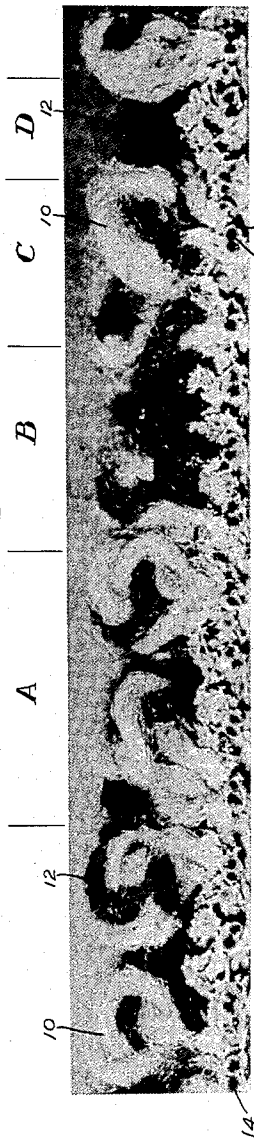


Fig. 2

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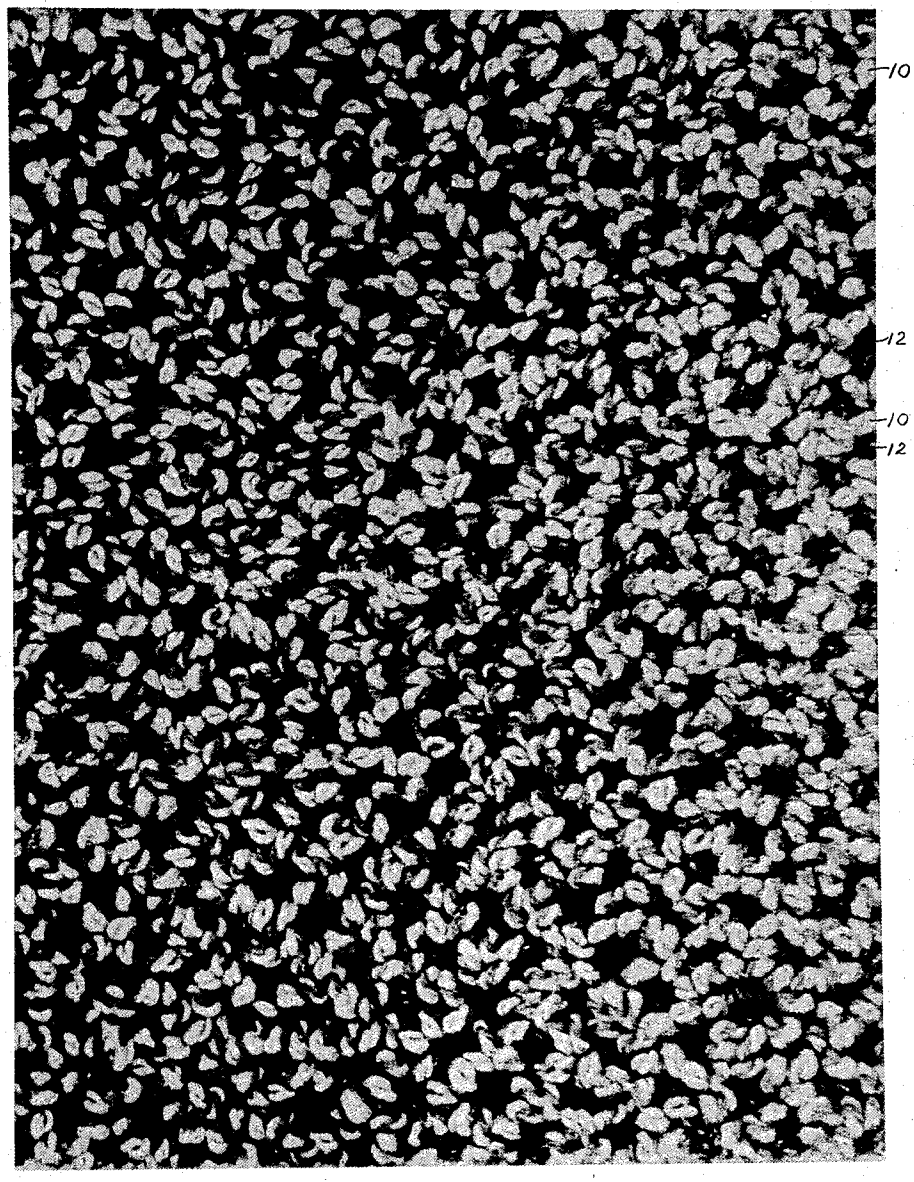


Fig. 3

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United States Patent Office

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PILE FABRICS AND METHOD OF MAKING SAME

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4 Claims. (Cl. 28—72)

This invention relates to pile fabrics and more particularly to those having pile loops, although it is not necessarily restricted thereto.

This invention is applicable to pile fabrics of woven, hooked, tufted, knitted or non-woven construction, and it may be adapted to any manner in which a pile can be incorporated as a wearing surface of a fabric.

In accordance with this invention, a staple fiber or fibers of one character are combined with a fiber or fibers of another character to provide the pile facing of the fabric. The pile surface may be in such form that some of the tufts are wholly of one kind of fiber or filament, while in another case the pile surface may have tufts of a combination of filaments or fibers of different characters in appropriate percentage ratios to achieve different effects as will be hereinafter set forth.

Russell R. Matthews Patent 2,699,593, granted January 18, 1955, discloses a composite form of pile surface material for a pile fabric that would shrink under heat and thereby, when properly distributed, would provide a textured or patterned surface. However, in some cases one of the drawbacks of the cut pile composite yarn described in this patent was that the base portion of the heat shrinkable or thermoplastic fibers lying beneath a plating of relatively non-heat shrinkable fibers not only gave a harsh appearance but also a hard hand to those parts of the fabric which contained the shrunken material.

Therefore, it is the primary object of this invention to provide a fabric having a pile surface in which a given number of pile yarns consist in part at least of heat shrinkable fibers which will shrink the yarn a predetermined amount without resulting in a surface of such shrunken yarn having a harsh feeling, thus providing a "soft hand."

It is another object of this invention to provide a pile fabric that is made with pile loops or pile tufts of identical height, but wherein some at least of these tufts or pile loops are constructed from different yarns, some having more and some having less shrinkable fibers, so that in the finishing process, during which heat is applied, those loops or tufts containing percentages of or being composed totally of heat shrinkable staple or filament fibers will shrink and obviously form pile loops of greater density than the non-shrinkable pile loops.

A further object of the invention is to provide a pile surface carpet having an embossed or carved effect produced by heat shrinkage of selected pile loops.

Another object is to provide a frieze type upholstery fabric having an embossed or carved surface effect.

A specific object is to provide knitted fabrics on the loop or cut pile principle that have a carved or embossed effect.

Still another object is to make so-called tufted fabrics wherein a particular distribution of such shrinkable pile material is used to create a high and low effect.

These and other objects will be more fully understood when taken in conjunction with the accompanying drawings illustrating a preferred embodiment of the invention, and in which:

Fig. 1 is a photolithograph showing in side elevation a fabric of warp knitted construction having pile loops of contrasting color;

Fig. 2 is also a photolithograph showing a similar side elevation of the fabric of Fig. 1 after heat treatment; and

Fig. 3 is a photolithograph top plan view of the fabric after shrinkage of some pile loops.

The fabric construction of Fig. 1 corresponds to that of Fig. 1 of G. E. Herrnstadt Patent 2,718,132, which comprises a knitted pile fabric having chain stitch warps, base wefts extending individually back and forth across at least three warps, and pile face yarns interengaged with the warps and extending rightwise for a plurality of courses, reversing, and extending leftwise for a plurality of courses. The pile yarn may take the form of loops.

In my prior invention as set forth in Patent 2,699,593, the lack of dimensional stability characteristic of vinyl resin when subjected to heat treatment was employed to advantage. The disclosure of said patent deals primarily with "Vinyon," a thermoplastic copolymer of vinyl chloride and vinyl acetate having from 70% to 95% by weight of vinyl chloride, with the vinyl acetate comprising the remainder. This material has a critical temperature range from 65° to 150° C., is permanently water resistant and, as explained therein, is neither inflammable nor susceptible to bacteria or fungi damage.

The essential feature of the new fabric development disclosed herein is not centered in the manufacturing process of the fabric, or its construction, but in the form in which the pile yarn for such fabric is made and utilized.

New artificial fibers, such as nylon, "Dacron," "Orlon," "Acrilan," and many others developed in the past decades may be widely used in pile fabrics. But the special object of this invention is to improve the manufacture of floor coverings, and it is to this end that efforts have been made to achieve the manufacture of new pile fabrics as will now be described.

Hitherto the staple of a bulk yarn could usually be manufactured by stretching the filament so that the denier of the staple made from the filament will be of a finer denier count than the denier of the prestretched filament, for instance: a 15 denier fiber may be made into bulk yarn of approximately 12 denier. Therefore, if staple fibers of that sort (and filaments for that matter) are stock dyed, yarn dyed, or piece dyed, or in any other form exposed to such conditions, the raw material will be caused to contract to its original denier.

The present invention exploits this shrinkability of fibers after the fabric has actually been made in its woven, knitted, or any other form used for the process of manufacturing. As previously indicated, there are many instances that do not permit varying of the pile height during the manufacture because of the mechanical obstacles inherent in the manufacturing process. In other words, it is necessary to use shrinkable yarns and to postpone the shrinkage producing operation until the fabric has been woven, knit, tufted, or otherwise provided with a pile surface, and, as a last step, to utilize a finishing operation.

Since the yarns specified do shrink during the dyeing process, the best course is to blend them with other dyed fibers. By taking into consideration the natural color of each, the blending will achieve the desired color result. The percentage of synthetic elongated staple to be blended with non-elongated or non-shrinkable materials during the spinning process depends on the amount of shrinkage desired in the finishing process. Naturally, a yarn hav-

ing 100% elongated material will shrink more than a yarn which contains only 50% of elongated staple and 50% of non-shrinkable fibers. This variation, however, allows the fabric designer and those preparing the product to be manufactured to have a final fabric of not only one group of high and one group of low pile ends or loops, but in addition, or alternatively, pile ends having three or four dimensional extension, depending on the amount of shrinkable yarn used in the blending of the fibers for the several yarns used.

In Fig. 1 there are shown to enlarged scale groups of pile loops A, B, C, and D, comprising relatively light in color pile loops **10** and relatively dark in color pile loops **12**, all of which are similar in pile height. The pile loops **10** and **12** are also substantially different in character.

Fig. 2 shows to similarly enlarged scale pile loops **10** and **12** after the finishing process.

Fig. 3 shows a plan view to full scale of the finished pile fabric carpet.

At the outset it should be explained that the white part at the bottom of Fig. 1 indicates warp yarns, whereas the horizontal white zone at the bottom of Fig. 2 shows not only warp yarns but also shows addition of black sizing which acts as a backing and also as locking material for the pile loop tufts. The pile loop tufts **10** and **12** previously described are anchored in the knitted carpet foundation or backing **14** by a compounded rubber back sizing **16**.

The groups of pile loops **10** and **12** in both Figs. 1 and 2 consist of light and dark yarns. As may be observed in Fig. 2, the dark yarns have interacted with and pulled the light yarns into a certain twist but have not reduced the pile height very much from that of Fig. 1. The groups of pile loops **12**, which are dark in both Figs. 1 and 2, all have a content of shrinkable yarn. Fig. 2 shows very clearly a group of dark pile loops **12** shrunk below the normal level of pile height illustrated in Fig. 1. The same holds true for the group D pile loops, and it can readily be noticed that considerable shrinkage of the dark loop tufts in group D has taken place, whereas only a small amount of twist has been imparted to the yarn in group C.

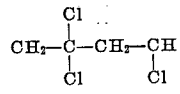
This then is a typical example of the variation of pile loop height achieved through selective shrinkage by virtue of distribution of yarns comprising shrinkable fibers with yarns solely of non-shrinkable fibers.

Whereas heat shrinkable "Vinyon" yarns leave a layer of the relatively unshrinkable fibers at the top of the shrunken material, as well as a certain amount of harshness on the surface of the shrunken pile, high bulk yarns, such as nylon, "Dacron," "Orlon," and others of the same character have been found to produce a different result. No harshness of any noticeable degree is present. The different high bulk yarns mentioned will retain their softness and, even after being shrunk, will have neither a harshness on the bottom nor a plating layer on the surface.

It is well known that most man-made fibers are manufactured by being fed through a spinnerette. The fibers used to practice this invention are intentionally elongated in order to perform the function of shrinking when used in the product as described in the example to be given. It has been found that not only the fiber described in said Matthews Patent 2,669,593 is satisfactory for the purpose of making embossed effects in the pile fabric by the usage of "Vinyon," but that it is preferable in certain cases to use fibers generally known as nylon; acrylic fibers, such as are marketed under the trade names of "Orlon," "Acrilan," and "Dynel"; polyester fibers such as are marketed under the names of "Dacron," or "Terylene," for instance; and vinyl derivatives such as are known as "Vinyon H. H." or "Saran."

For the purposes of this invention the heat shrinkable fibers are preferably of vinyl derivative type and, more particularly, of a copolymer of 85% vinylidene chloride

and 15% vinyl chloride (by weight) having the structural formula:



Wool fibers are preferred for use as the fibers not subject to shrinkage upon heat treatment, and in combination with the vinyl derivative type fibers referred to above. Other natural products such as cotton fibers may also be used in the place of the heat unshrinkable wool fibers.

Other man-made fibers, which are elongated upon leaving a spinnerette, are subject to loss of elongation when subsequently heated, and are exemplified by acrylic, polyester, and nylon fibers have also been found suitable for the intended purposes.

The process of making the yarn for that part of the surface of the pile fabric that when finished, becomes the embossed part, will be described in the following example.

A given number of weight units of dyed fiber of the non-shrinkable type, such as wool, cotton, or the like, are mixed together in a color batch with a predetermined percentage of shrinkable and previously elongated fibers of nylon, acrylic, polyesters, and vinyl derivatives, or substantially similar types. The yarn is then spun by any one of the generally known spinning methods used in the yarn spinning industry. By reason of having the undyed elongated staple fibers mixed in equal proportion with the dyed fibers, that is, 50% heat-shrinkable fibers and 50% non-heat-shrinkable fibers in a successive picking and carding process, the non-dyed fibers do not show up white or in their natural color but are well intermingled with the dyed fibers of the non-elongated material. Thereafter, the yarn may be twisted and put into such form as may be desired for the purpose of manufacturing a pile fabric. During this whole process great care is taken that neither humidity control, operations, steam, or any other incidental assistance of heat during the process exceed a temperature above regular room temperature in normal climates, because as soon as the temperature reaches a point which is critical to the elongation of the fiber, namely, 65° C. in the case of "Vinyon," the fiber will shrink.

It is the controlled retraction of the non-dyed fiber in the finished pile fabric that is an important factor in creating effects which have been difficult to obtain by prior methods of production.

Due to the strength required by the retracting fiber to pull down with it within a pile fabric other fibers, not only a two-dimensional but also a multidimensional fabric may be obtained by this process. This may be done in numerous ways. To exemplify one way: The highest portion of the finished pile fabric contains no shrinkable or retracting fibers; the next pile height of the fabric contains fibers containing a given percentage of non-dyed acrylic fibers, said percentage predetermining the amount of pile height; and the next group of fibers in this example may be fibers of the vinyl derivative type and shrink as much as 50% in length.

Assuming that any of the specially prepared composite yarns described in the above example has been set into a given design for a pile fabric by either weaving, knitting, tufting, hooking, or any other method, the result before application of heat will not be a pile fabric with embossed design but it will show merely a fabric of even surface with equal height loops and/or tufts. But this primary manufacturing operation is then followed by the finishing operation which serves a dual purpose, especially in the case of the manufacture of floor coverings. One of the purposes is to size the backing of the carpet with material such as starch or rubber latex, or the like. Since considerable heat is used for that purpose, the shrinkable fibers will retract responsively and in conjunction with the fibers entwined by them and with them,

so that a carved or embossed effect is produced. While the door of those fibers entwined with the fibers of the retractible type are being pulled down, the pile color will not undergo an appreciable change.

When vinyl derivative type fibers are used as the retractible staple the color is known to vary slightly at times from the color of the non-retractible dyed fibers. This is due to the fact that those vinyl derivatives tend to produce a hard base portion having a plating of non-retractible fibers, as mentioned previously. The color will not change materially when nylon, acrylic or polyester type fibers are used in the retractible yarn. Nevertheless, if a very large amount of the last-mentioned type of retractible fibers are entwined with a lesser percentage of non-retractible staple fibers, it may be advisable to use dope-dyed staple fibers instead of natural color retractible fibers so as to attain balanced color in the retracted pile yarn.

It has been noted that the heat shrinkable fibers of the composite pile yarns shrink during their dyeing process, and this factor may be used to advantage in applying the required heat treatment to the novel pile fabric disclosed herein by piece dyeing said fabric with a cross dye solution heated to a temperature appropriate for producing shrinkage of such heat shrinkable fibers.

The scope of this invention is demonstrated by the fact that it has been used successfully in producing pile fabrics displaying useful design effects on Axminster looms, Velvet looms, Wilton looms, Raschel type knitting machines, and tufting machines.

There has now been described a preferred embodiment of this invention together with several modifications, which serve to demonstrate that other modifications and variations can be made without departing from the principles thereof and the scope of the appended claims.

Having thus described my invention, what I claim as novel and desire to secure by Letters Patent of the United States is:

1. A method of producing an embossed pattern effect in a warp knitted pile fabric, which comprises forming the fabric with pile loops thereon, some of said pile loops being of yarn relatively unshrinkable by heat, the remainder of the pile loops having at least 50% heat-shrinkable yarn, and heating the pile loops so as to shrink the heat-shrinkable yarn loops thereby causing said shrunk loops to become twisted and shortened, thereby being drawn down below the level of the non-shrinkable pile loops.

2. A warp knitted pile fabric having a loop pile face comprising pile loops of yarn relatively unshrinkable by heat, and heat shrunk pile yarn loops interspersed between the unshrinkable pile loops, the pile loops of unshrinkable yarn forming an upper pile loop formation, and the heat shrunk pile loops which are twisted and shortened due to shrinkage providing a lower pile loop formation which is more dense than the upper pile loop formation.

3. The invention as set forth in claim 2 wherein the heat shrunk pile yarn loops comprise at least 50% heat-shrinkable fibers.

4. The invention as set forth in claim 2 and wherein the heat shrunk pile yarn loops consist of 100% heat-shrinkable fibers.

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