

[54] **STEAM-ETCHED SOLVENT EMBOSSED
TUFTED CARPET**

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[51] Int. Cl. **D03c 19/00**

[58] Field of Search 161/65, 63, 62, 66, 67;
8/130.1; 156/83, 305, 277

References Cited

UNITED STATES PATENTS

3,053,609 9/1962 Miller 8/130.1

3,236,586	2/1966	Humphreys.....	8/130.1
3,236,587	2/1966	Genereux.....	8/130.1
3,505,000	4/1970	Shinmura.....	8/130.1
3,567,548	3/1971	Miller	156/277

Primary Examiner—Marion E. McCamish

[57]

ABSTRACT

A tufted carpet material is printed with a decorative pattern. The ink formulation used for printing contains a solvent for the fiber of the carpet. After printing, the carpet is steamed. This causes the fibers to shrink and/or partially dissolve to produce an embossed effect. The carpet is then washed and dried. There is produced a carpet having an embossed design with a natural fibrous appearance.

2 Claims, 2 Drawing Figures

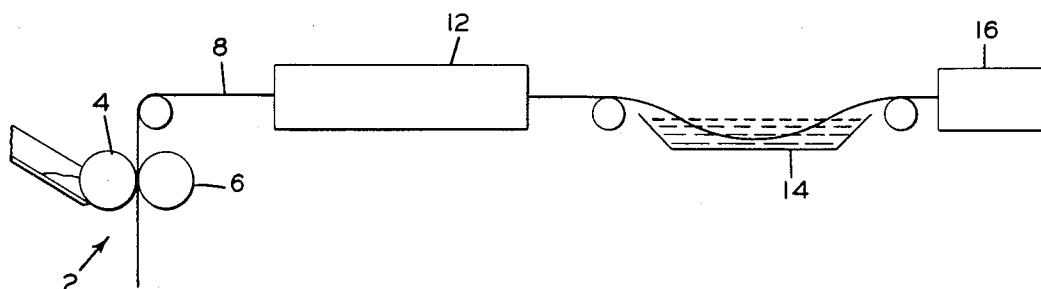


Fig. I

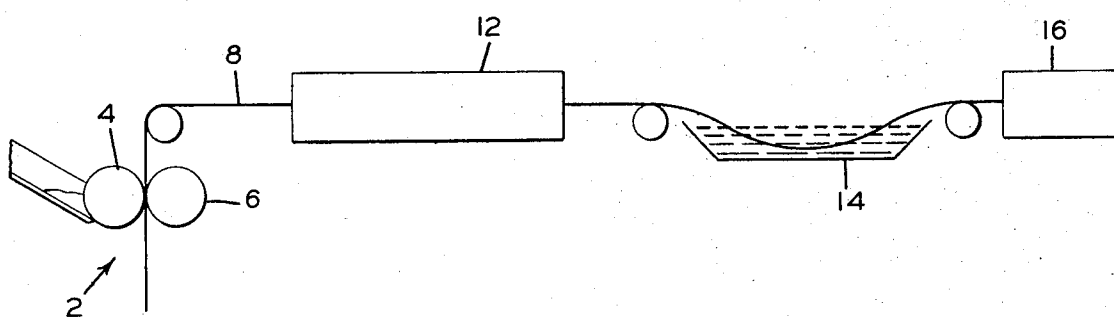


Fig. II



STEAM-ETCHED SOLVENT EMBOSSED TUFTED CARPET

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of copending application Ser. No. 51,210, filed June 30, 1970, in the name of Walter J. Bohrn and entitled "Steam-Etched Solvent Embossed Carpet."

DESCRIPTION OF THE PRIOR ART

The present process for embossing a tufted pile fabric involves the use of a solvent. When a solvent is used, the process broadly comprises the steps of (1) directly depositing in a predetermined pattern a solution containing a solvent for at least one of the major constituent fibers of the pile; (2) dry heating the pile fabric to concentrate the fiber solvent; (3) compacting the pile; and (4) relofting the pile elements. This process is basically covered in U. S. Pat. No. 3,567,548. It is possible to add an adhesive to the solvent solution and obtain the combined effects of a solvent etching and adhesive effect. The presence of the solution in the predetermined pattern area results in a dissolving in part of the fibers so that they in turn act as adhesive materials. The compacting step is necessary to depress the pile to secure an embossed effect.

In the process herein, the hot air impingement type drying utilized in the above process along with the compression or compacting operation is eliminated. Elimination of the compaction also eliminates the need for relofting. Herein, steam is used and the combination of steam and solvent produces a synergistic effect. The fibers of the tufted strand shrink and/or partially dissolve to produce an embossed effect. The dry heat operation is ineffective without compression to provide the above effect. Elimination of the compressing of the carpet helps permit the use of certain pile constructions which would be deleteriously affected by a compression operation which would tend to crush the pile and leave it with a crushed appearance regardless of a relofting operation. The process herein produces an embossed product with a natural fibrous appearance. This is particularly advantageous over the prior art process which has a distinct fused look, resulting in loss of fiber identity in the embossed areas. Also with the elimination of the compression or relofting operation, the process herein will generally provide more loft in the product than is obtained with the prior art process.

U. S. Pat. No. 2,110,866 discloses a pile fabric which is subjected to a solvent action to shrink the loops of the pile fabric.

U. S. Pat. Nos. 3,053,609 and 3,236,587 disclose other embossed pattern effects on fiber materials wherein there is printed on the surface thereof in certain areas a chemical swelling or shrinking agent for the fiber which shrinks it in the printed areas.

All three last above-mentioned patents which deal with solvents to shrink fibers are specifically directed to the use of a shrinking agent or swelling agent which shrinks the fibers and produces an embossed effect. There is nothing in the processes of the above references which indicates that the chemical agents which shrink the fibers also dissolve partially the fibers. In the invention herein, there must be some partial dissolving of the fibers, so that the individual fibers of a strand of

material forming a loop will become tacky and adhere to each other. However, the dissolving is not such as to cause the individual fibers to lose their fibrous appearance within the strand.

SUMMARY OF THE INVENTION

The process herein involves a printing step which may utilize any of a various number of different printing techniques. This could involve either the rotogravure, intaglio, flexographic, flat or rotary screen printing techniques. The ink formulation used in the printing operation generally contains a solvent for the fiber of the carpet. The printing technique is immediately followed by a steaming step. Here there is a combination of fiber shrinkage and dissolving to produce an embossed effect. This operation is then followed by a washing operation which will remove from the carpet chemicals such as solvents or unfixed dyes, etc. Finally, the carpet material is dried in the usual manner to remove the wash water. There is now provided a tufted pile carpet with an embossed area retaining its natural fibrous appearance and having the individual fibers forming the strand which is tufted in such a condition that the individual fibers are partially adhered to each other and tend to maintain the loop configuration of the tufts.

BRIEF DESCRIPTION OF THE DRAWING

FIG. I of the drawing is a representation of the process utilized herein; and

FIG. II is a showing of a fiber strand which has been removed from a carpet made by the process disclosed herein.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. I, the process herein involves the printing of a carpet or any type pile fabric with a water-based ink containing a dye for the fibers and including a solvent or swelling agent for the fibers. Conventional printing apparatus 2 is used to print the carpet. This would involve any type of conventional printing technique such as rotogravure, intaglio, flat or rotary screen printing. In FIG. I, there is shown a printing operation in which pattern roll 4 applies the ink to the face of the carpet 8. A back-up roll 6 is used on the back side of the carpet 8.

With a carpet being made up of an acrylic material, the solvent or swelling agent may be ethylene carbonate. The following is a formulation of a typical ink for use on a 1/8 inch gauge, 1/4 inch pile, 42 oz./sq.yd. acrylic carpet:

Components	Parts by Weight
Dyes	0.78
Acetic Acid (56%) — dye solvent	3.57
Water	64.35
Ethylene Carbonate	30.00
Hydroxyethyl Cellulose — thickener for viscosity control	0.80
2-ethylhexanol — antifoam agent for ink	0
	100.00

The particular solvent, ethylene carbonate, used in this case is present in a much larger quantity than one would normally find in conventional carpet printing inks containing dyes. The optimum viscosity will de-

pend upon a number of factors, e.g., print application technique, design printed, weight and type of fabric being printed, etc. The thickener amount is varied to control viscosity.

After the printing operation, the carpet passes to a steaming chamber 12 which applies steam in the temperature range of 212° to 220° F. The steaming normally takes place 5 minutes after the printing operation. Under the effects of the steam, the dye will be developed on the fiber. In addition, and of particular importance, is that under the effects of the steam, the fibers in the area treated with the solvent will shrink and to a degree dissolve to produce an embossed effect in the printed area. The fibers within the embossed area still generally retain their fibrous appearance, but the individual fibers within a strand now are partially bonded together due to the partial dissolving of the surface of the fibers by the solvent. The carpet then passes to a conventional wash tank 14 through which the carpet passes to remove any thickeners from the printing ink or any other residual chemicals which may remain in the carpet. The carpet then passes onto a conventional drying structure 16 which evaporates the wash water from the carpet in the usual manner. The carpet coming out of the dryer has a good hand, and the appearance obtained in the embossed areas is that of a fibrous material. The loft of the carpet is maintained, and the embossed areas are particularly pleasing in appearance.

The amount of solvent used will vary from one carpet construction to a different carpet construction. Therefore, to get the proper fibrous appearance in the embossed area, there must be a balancing of the quantity of ink applied, and the solvent concentration in the ink formulation versus the construction of the carpet. Obviously, too much solvent dissolves the fiber too much and gives an embossed, but non-fibrous appearance.

The process herein is carried out by the use of dyes and eliminates the need for pigments and a pigment binder which may be undesirable for a flooring product due to the potential soiling problems associated with the use of pigments and pigment binders. If the solvent is applied and a substantial delay exists before steaming, the solvent will completely dissolve the fibers. Therefore, steaming should take place as soon as possible after printing to get an embossed area with a fibrous appearance. Certainly, the use of a high concentration of solvent or a stronger solvent can give the same results. Conversely, it is possible to use a weak solvent or a lower concentration of the same solvent, with a delay in steaming and get comparable and acceptable results. Under some circumstances, a pigment with a fiber solvent could be used in lieu of a dye.

With the above process, it is possible to print solvent with plural pattern rolls and even coordinate conventional ink printing with the solvent printing. This can be done by a single pass through an appropriate printing apparatus with multiple heads.

The above process was also performed on a nylon material which was in the form of a tufted carpet with a 5/64 inch gauge, 3/16 inch pile, and 18 ounces per square yard. The solvent used was resorcinol at a concentration of 20 parts by weight with an appropriate thickener. The solvent and nylon were used in the above process with steam, and an embossed product was formed with fiber identity in the embossed areas.

The steaming operation was carried out approximately 5 minutes after the printing with the solvent. The strand which was used as the tufting material was composed of a number of individual fibers, approximately 85 in number, which had previously been consolidated into a strand for tufting.

A carpet made of polyester fibers was also treated by the above process. The carpet was 5/64 inch gauge, 1/8 inch pile and had a fiber weight of 28 ounces per square yard. It was printed with a solution of 80 parts by weight of phenol and 20 parts by weight of water with some thickener. A steam treatment was used 5 minutes after printing and a pronounced embossed effect was obtained with little or no loss of fiber identity in the embossed areas.

Finally, a carpet was made of wool fibers. The carpet was 5/64 inch gauge, 1/8 inch pile and had a fiber weight of 13.5 ounces per square yard. It was printed with a solution of 1 part by weight of sodium hydroxide and 97 1/2 percent parts by weight of water. An appropriate thickener (1 1/2 parts) was added to facilitate printing. A steaming was used approximately 5 minutes after printing and a pronounced embossed effect was obtained with little or no loss of fiber identity in the embossed areas.

In all of the above examples, a pile loop was formed from a strand which in turn was composed of a number of individual fibers. The solvent treatment was such that the outer surface of the individual fibers forming the strand became tacky and would tend to stick to each other. However, the solvent concentration was not sufficient to dissolve the fibers so that the fibrous-looking strand took on the appearance of being simply a single fiber strand. The action of the solvent was such as to cause the fiber strand which formed the loop to shrink in size and at the same time for the individual fibers within the strands to stick together.

Now if the strand were pulled out from a conventional carpet after tufting, the fiber strand would take on the appearance of FIG. II. A conventional strand which had been untreated by a solvent or one of the prior art strands which had only been shrunk, when pulled from the carpet, would be a straight line strand. The bump effect 18 of the strand in FIG. II has proved to be of particular value in the carpets herein in that it makes the carpet highly resistant to tuft pullout. With tufted carpets, it is often possible for the claws of animals, women's shoes, or other objects to hook onto an individual tuft or loop and apply a force thereto. Since the tufts are formed from one continuous strand, it is possible by pulling on one tuft to pull out a large number of adjacent tufts. It is not possible to then re-establish the tufts within the carpet. Normally, the material pulled out is cut off and you are left with a section of the carpet in which a series of tufts are missing and this is a very noticeable defect in the carpet.

Due to the fact that the individual fibers of a loop within the carpet of this invention tend to stick together, the removal of a strand from the carpet by pulling is extremely difficult to carry out. The loop configuration will not readily move into a flat, straight line configuration. The bump effect is maintained within the individual strand and this bump effect is very difficult to pull through the backing of the carpet. Consequently, the force applied to an individual loop of a carpet made according to this invention will provide a substantial resistance to pullout.

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What is claimed is:

- 1. A process for embossing a fabric consisting of the steps of: printing a specific pattern on the fabric with a material containing a solvent for at least one of the fiber members constituting the fabric, said fabric being a tufted material with loops in which the strands forming the tufts are composed of a number of individual fiber members, applying steam to the fabric to shrink the fibers within the tufted loop where they are affected by the solvent and at the same time to soften the outer surfaces of the individual fibers so that they become tacky and adhere to each other at the top portions of the individual tufted loops without the loss of their fiber identity, washing the fabric, and drying the fabric to remove the wash water.
- 2. A carpet structure having a surface layer which is formed of loops of tufted carpet material which are formed from a continuous strand of material, said con-

tinuous strand of material being formed from a plurality of individual fibers, said strand of material being adaptable for tufting through a carpet backing structure, said individual loops being subjected to a solvent treatment operation which applies solvent to fibers of the individual tufts, said fiber also being subjected to a subsequent steaming operation, said solvent and steaming operation forming the top portions of the individual tufts into a fibrous-appearing mass which has the individual fibers within the mass adhered to each other so that the strand of fabric when stretched out in a generally straight line configuration will have a series of bumps thereon which are formed by the masses of solvent-treated fibers of the loops adhered to each other and being incapable of assuming a straight line configuration.

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