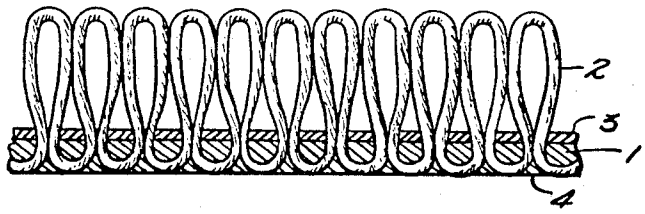
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METHOD OF MAKING A TUFTED FABRIC

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METHOD OF MAKING A TUFTED FABRIC

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The present invention relates to certain improvements in the preparation of tufted products, e.g. carpets or the like, which include a backing partially or wholly comprised of nonwoven fabric.

This application is a division of my copending application, Ser. No. 301,782, now Patent No. 3,348,992, filed Aug. 13, 1963.

Carpeting or other forms of tufted products are frequently provided with nonwoven backings comprising one or more materials such as jute, cotton, rayon, nylon and polyester fibers or the like. Usually, these fibers are bound together by means of a thermoplastic binder, e.g. acrylic resin, although in those cases where the fibers themselves are thermoplastic, the desired binding effect may be obtained by simply softening the fibers at elevated temperature.

Usually tufted products of the type referred to above are prepared by sewing or passing appropriate tufting yarn, e.g. nylon, rayon, acrylic, wool and/or cotton yarn, systematically back and forth through the backing fabric with the formation of a pile or yarn loop on the top face of the backing. These loops may or may not be cut, as desired. Rubber or some thermoplastic resinous material is also generally applied to the bottom or back side of the backing fabric as a so-called "backsize" for the purpose of improving hand or body, retaining or locking the tufted yarn in position and improving dimensional stability of the tufted product. This backsizing material may be the same as the fabric binder or different therefrom and the material may completely or only partially impregnate the nonwoven backing.

Tufted products of the above-described type have several disadvantages. For one thing, it is conventional practice to piece dye these products, with the thermoplastic backsize thereon, using fairly long lengths of time and dyebath temperatures of the order of 180° to 212° F., i.e. temperatures at which the usual thermoplastic components are soft. Moreover, when the thus dyed tufted product is subsequently dried, it often encounters drying temperatures as high as about 250° F. The force applied to pull the goods through the dyebath and the post-dyeing drier is transmitted through the product with the result that at these elevated temperatures where the thermoplastic components of the product are in a softened state, permanent stretching and weakening of the product occur with a resultant loss in quality, tensile strength and other desired characteristics.

It has also been difficult, if not impossible, in the past to fabricate tufted products having tuft or loop heights substantially less than about 0.1 inch using prior tufting and processing conditions. This is due to the fact that tufts or loops having a height shorter than 0.1 inch tend to be pulled out during tufting and/or when the backing fabric becomes wet.

It will be seen from the foregoing that there is considerable room for improvement in the art of preparing tufted products using nonwoven backing fabrics. Accordingly, the principal object of the present invention is to provide an improved carpet or like tufted product which is free from the abovementioned disadvantages. Another object of the present invention is the provision of a tufted

product having a backing partially or wholly comprised of nonwoven fabric and characterized by its outstanding tensile strength and freedom from stretch even at elevated processing temperatures. A further object of the invention is the provision of a tufted fabric that may be advantageously dyed by means of conventional formula dyeing procedures with resultant savings in labor, time and material costs. Still another object is the provision of a commercially acceptable tufted fabric having an attainable loop height substantially less than is now efficiently provided using conventional prior practices. Another object is to provide a unique process for preparing the improved product of the invention. Other objects and advantages will be apparent from the following detailed description of the invention.

Broadly stated, the foregoing and other objects are realized by the provision of a tufted or pile fabric comprising a nonwoven layer of backing fabric, with tufting yarn passing back and forth through the backing fabric, the latter having a thermosetting resinous backsize applied thereto. Advantageously, a layer of paper, preferably high wet strength paper, and/or polymer film comprising polyethylene or polypropylene according to U.S. Patent 3,075,865 may be superimposed upon the backing fabric to prevent strikethrough of the backsize.

The nonwoven backing fabric may comprise any one or more conventional fibrous materials, e.g. jute, cotton, wool, acrylic, rayon, nylon and polyester (e.g. Dacron) fibers or mixtures of two or more of these. Where the backing fabric includes a thermoplastic fibrous material, it may not be necessary to use a separate thermoplastic binder for the nonwoven fabric. However, generally speaking, the fabric is bound together by means of conventional binders, e.g. acrylics, although in some cases, it may be possible to omit the thermoplastic binder and rely only on the thermosetting backsize to function also as the fabric binder.

When wet strength paper or a polymer sheet is superimposed on the backing fabric, as aforesaid, the fabric is generally about 5 to 25 times as thick as the superposed layer although this relationship can be varied.

According to the invention, the nonwoven backing fabric is backsized with the thermosetting resinous material prior to dyeing but either before or after tufting, preferably after. One or more conventional hardeners or catalysts for curing the thermosetting resin may also be used and, depending on the activity of the catalyst at the temperatures involved, the catalyst may be added with the resinous material or separately therefrom.

Any thermosetting resin may be conveniently employed herein, for instance, alkyds; allyls; epoxides such as the reaction products of epichlorohydrin and bisphenol or the condensation products of phenol acetone and epichlorohydrin; melamine-formaldehyde resins; phenol-formaldehyde resins; urea-formaldehyde resins; polyesters; etc., and particularly those which are flexible when cured and give a product having good hand and freedom from boardiness. The resin may be applied to the nonwoven backing fabric in any convenient fashion, e.g. in liquid, organic solvent solution, water emulsion, powder, pellet or film form. Appropriate curing agents or catalyst are also available in these various forms but the physical form of the catalyst as used need not be the same as that of the thermosetting resinous material. The choice of the curing agent will depend, of course, on the thermosetting resinous material used. Thus, for example, strong bases such as sodium hydroxide are used with phenol-formaldehyde resins while polyfunctional amines such as ethylene diamine, ethylene triamine, diethylene triamine, tetraethylene pentamine; anhydrides or polybasic acids may be utilized with the epoxy resins. In any case, however,

the curing agent will usually be used in amounts varying from about 0.01 to 0.50% by weight, based on the weight of thermosetting resin solids.

When cured, the thermosetting resins are strong and tough and can vary from brittle to supple depending on the physical properties of the resin. The strength and toughness of the thermosetting resinous material substantially enhances the dimensional stability and loop lock in the tufted fabric and prevents the backing from stretching and weakening during finishing processes where the temperature may be as high as 375° F.

The thermosetting resinous material, when cured, is substantially hydrophobic and hence there is little or no dissolution or abrasion loss in the dyebath. Further, because the thermosetting resinous material thoroughly seals off or coats the backing fabric, the latter accepts substantially no dye during the dyeing operation. Thus, when a superposed layer is employed, e.g. polyethylene or polypropylene, this layer also accepts substantially no dye and only the pile yarn is available as a dye acceptor. Formula dyeing is thus most conveniently carried out. This represents an especially important advantage in the case of products where the backing fabric contains jute since heretofore there has been a tendency for such backing fabric to accept varying amounts of dye necessitating an adjustment of the concentration of the dye in the bath to produce uniform color results in any given piece of tufted product. However, in accordance with this invention, since only the pile yarn is available for dyeing when using the superposed paper or polymer layer, a given quantity of a dye will produce a uniform color without the necessity for continuous adjustment of the dye concentration in the bath.

The application of a thermosetting resinous material to the nonwoven backing fabric makes it possible to dye at the usual elevated temperatures and even higher without the prior art disadvantage of stretching and weakening of the tufted product. As an added advantage, the invention permits the fabrication of a product possessing a tuft or pile yarn height substantially less than about 0.1" which limitation heretofore was imposed because of the tendency of the pile or tuft to be pulled apart from the backing fabric when the latter became wet during the dyeing process. For instance, loops as low as 0.05 inch are possible with the present invention thereby facilitating high-low constructions heretofore only available in certain woven techniques.

The thermosetting resinous material may be applied to the backing fabric in any convenient manner as by knife, dip or roll coating, dusting, spraying, in sheet form, etc. Generally, when the thermosetting material is coated on, the coating composition has a viscosity between about 100 to 2000 centipoises and a concentration between about 10 to 60% by weight of solids. The catalyst or hardener, if used, may be provided in amounts sufficient to cure or set the backsize within a convenient processing period and the exact amount of catalyst to be used in any particular situation can be readily determined from a consideration of other operating conditions.

As stated, there is advantageously employed a superposed or intermediate layer of paper, polyethylene or polypropylene which can be of the crystalline or conventional type. These layers may include minor amounts of other polymers, e.g. 5–50% of polyisobutylene. Usually, for purposes herein, the layer thickness may vary from about 0.002 inch to 0.02 inch although other sizes may also be used. When paper is used, this may comprise high wet strength paper, e.g. 20, 40, 50, 60 or 90 pounds wet strength natural kraft paper. Reinforced wet strength paper such as that known as "Scrimtex" (Mosinee Paper Co.) with rayon, fiberglass or the like as reinforcing filaments may also be used herein. Typical resin treated papers useful with the invention are those treated with, for example, melamine resin and/or neoprene obtainable from St. Regis Paper Co. Usually this paper layer will vary from about 0.002 to 0.02 inch although other sizes may also be used.

The tufting yarn may be of any of those normally used for this purpose. Thus, for example, cotton, rayon, wool, acrylic or nylon yarns or mixtures thereof may be used. Mixtures of different types of yarns, e.g. wool and nylon blends, or yarns of different sizes may be utilized to give pattern effects as may be desired.

The amount of thermosetting resinous backsize applied to the nonwoven backing will vary, depending on the physical properties of the nonwoven fabric and the form of the resin as applied. However, an amount of resin (resin solids) in the range of 0.1 to 5 ounces per square yard of the nonwoven fabric may be used. This is usually sufficient to not only coat the back of the fabric but also completely impregnate the backing. Complete impregnation of the backing fabric with the thermosetting backsize is particularly advantageous although there may be instances where only partial impregnation is desired.

Curing of the backsize may be effected separately or in conjunction with some other operation. Temperatures of the order of 200 to 375° F. for a period of 4 to 25 minutes are usually sufficient for curing although this will vary depending on the thermosetting material and catalyst which are used.

The invention and its advantages are illustrated by the following example:

Example

A film of conventional polyethylene 0.006 inch thick was superposed upon a 2 ounce per square yard, nonwoven rayon/nylon (50%–50%) backing fabric bound with acrylic resin (i.e. Rohm and Haas Rhoplex E–32) provided in amounts of about ¼ ounce per square yard of fabric. The bottom side of the backing fabric was dusted wih a powdered epoxy resin and a curing agent (namely a filled β-stage epoxy comprising the reaction product of epichlorohydrin and bisphenol and ethylene diamine, respectively).

The thermosetting resin-containing laminate was fed into a conventional tufting machine (i.e. the so-called "Super-Tufter") and tufted with the polymer film representing the upper laminate surface having viscose rayon tufting yarn. Thereafter, the tufted product was cured by holding the same dimensionally stable on a tenter frame with the back of the fabric given ten minutes contact with a "Teflon" coated roll heated to a surface temperature of 275° F. The thus cured product was then dyed at about 210° F. and dried in a hot air oven at a temperature of about 250° F. The product was characterized by excellent strength, freedom from stretch during processing, high tensile strength and outstanding loop lock and hand or feel. The height of the lowest loop was approximately 0.05 inch, unusually low for a product obtained on a conventional tufting machine without using a special construction to insure adequate loop lock.

In addition to the advantages noted above, the present products may be spot cleaned with household solvents or commercially dry cleaned, as well as laundered, without any noticeable undesired effect. This is an important advantage because the conventional cleaning solvents cannot be used on conventional rubber-backed tufted products since the rubber is dissolved by these solvents.

The tufted product of the invention, in one embodiment, is illustrated by the vertical sectional view set forth in the accompanying drawing. As shown, the numerals **1**, **2** and **3** represent, respectively, the nonwoven backing fabric, tufted yarn and intermediate or superposed layer or sheet of polyethylene, polypropylene or high wet strength paper. Acording to the invention, the bottom surface **4** of the backing fabric **1** is backsized with thermosetting resin which extends throughout the fabric so as to completely impregnate all of the fibrous material, in-

cluding the tufting yarn, located below the layer of polyethylene, polypropylene or paper.

Obviously, various modifications may be made in the tufted fabric and method described herein, and the foregoing description is not intended to limit the invention, the scope of which is defined in the attached claims wherein, I claim:

1. In a method of making a tufted fabric wherein a backing fabric is tufted by passing tufting yarn back and forth through the fabric to form a tufted surface and the tufted fabric is thereafter finished under high temperature conditions, the improvement which comprises applying a thermosetting resinous material, which would not soften at said finishing temperature, to the backing fabric at any stage prior to finishing and curing the thus applied resinous material.

2. The method of claim 1 wherein the thermosetting resinous material is applied to the backing fabric prior to tufting and said material is cured after tufting.

3. The method of claim 2 wherein a curing agent is applied to the fabric prior to tufting along with the thermosetting resinous material.

4. The method of claim 2 wherein a curing agent is applied to the fabric after tufting and the resinous material is then cured.

5. The method of claim 1 wherein the thermosetting resinous material is applied to the backing fabric in the form of a film.

6. The method of claim 1 wherein the thermosetting resinous material is applied to the backing fabric in the form of a powder.

7. The method of claim 1 which includes the step of incorporating a barrier layer on the tufted surface side of the backing fabric.

8. The method of claim 1 which comprises providing a nonwoven backing fabric, positioning a barrier layer on the top of said backing fabric, positioning a thermosetting resinous film on the opposite side of said fabric, passing tufting yarn back and forth through the resulting laminate to form a tufted surface thereon and then heating the resulting product to cure said thermosetting resin.

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