United States Patent

[11] 3,622,434

[72] Inventor **Nicholas S. Newman**
West Newton, Mass.

[21] Appl. No. **42,924**
[22] Filed **June 3, 1970**
[45] Patented **Nov. 23, 1971**

[73] Assignee **The Kendall Company**
Boston, Mass.

Continuation-in-part of application Ser. No. 655,881, July 25, 1967, now abandoned. This application June 3, 1970, Ser. No. 42,924

[54] **CREPED FIBER-FILM COMBINATION AND PROCESS THEREFOR**
7 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **161/128,** 156/85, 156/183, 161/113, 161/151
[51] **Int. Cl.** **B32b 3/28**
[50] **Field of Search** 161/128, 129, 151, 170, 113, 117; 156/85, 183; 264/282, 342

[56] **References Cited**

FOREIGN PATENTS

727,591	4/1955	Great Britain	156/85
742,295	12/1955	Great Britain	156/85

Primary Examiner—William A. Powell
Attorney—John F. Ryan

ABSTRACT: A lightweight fibrous fleece is prepared, containing a sufficient proportion of heat-retractable fibers to make the fleece potentially capable of shrinking 20 percent or more in area if heated without restraint. The fleece as prepared is bonded to a soft film which does not shrink to any great extent when heated under conditions which would cause the fleece to shrink. The bonding of fleece to film is done under restraint, not allowing shrinkage. Subsequently the fleece-film combination is heated without restraint. The heat-retractable fibers shrink, creating a pebbled or creped texture on both faces of the combination.



FIG 1

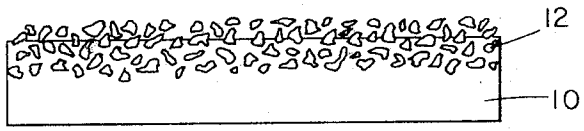
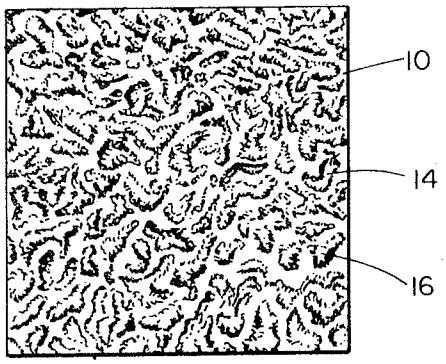


FIG 2



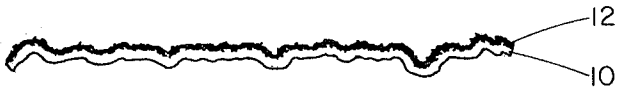


FIG 3

CREPED FIBER-FILM COMBINATION AND PROCESS THEREFOR

This application is a continuation-in-part of my copending application Ser. No. 655,881, filed July 25, 1967, now abandoned.

This invention relates to the preparation of nonwoven fabrics consisting of fleeces of textile-length fibers bonded to soft, deformable films, the combination being treated so as to impart a pebbled or creped texture to both surfaces of the product. More particularly it relates to relatively thin fiber-film bonded combinations of creped surface texture wherein the hills and valleys of the obverse surface are reflected as valleys and hills on the reverse surface.

Bonded nonwoven fabrics, comprising textile-length dry-assembled unspun and woven fibers bonded by polymeric binding materials, are produced by a variety of well-known processes and are a staple article of commerce. Since they are uniform and planar on their surfaces, resembling generally a sheet of paper, they lack surface interest. Attempts have been made to overcome this deficiency by printing on the surface of thin, planar nonwoven fabrics a pattern resembling interwoven yarns, or by embossing the surface under pressure. Either expedient, however, merely creates a perfectly repetitive pattern on the surface of the sheet, which therefore lacks the desired casual, random, nonrepetitive appearance such as that obtained in fabrics woven with slubbed or other types of nonuniform yarns. The present invention is concerned with a novel method for producing a truly randomized and nonrepetitive surface textured effect, resembling a creped or pebbled surface, on both faces of relatively thin and lightweight nonwoven fabrics. The fabrics of this invention have good tensile strength coupled with substantial elongation and recovery therefrom, a combination of properties which renders them suitable for disposable garments, draperies and the like.

Attempts have previously been made to impart surface texture to thick, feltlike nonwoven fabrics by combining layers of heat-retractable fibers with layers of nonretractable fibers needled together and heated, as in U.S. Pat. No. 3,243,861.

It has also been proposed to bond together fibrous webs of differing heat retractabilities by means of spaced-apart areas of binder substance, leaving unbonded areas of free fibers. As described in U.S. Pat No. 3,214,323, heating such an assembly puffs the free fiber segments into ridges, imparting a lofty, bulky appearance to the fabric. Such feltlike products are usually either textured on one face only, or the ridges on one face are matched by ridges on the other face. Various mechanical expedients, such as mechanical creping between differentially moving surfaces, have been employed to crepe nonwoven fabrics, as in U.S. Pat. No. 3,059,313. A mechanically imparted crepe, however, is a transient state, removable or distortable under tension.

It is an object of this invention to provide a relatively thin and sheetlike nonwoven fabric comprising a layer of textile-length fibers bonded to a layer of film, said fabric having a textured surface arranged in a pebbled or creped configuration in which the ridges and valleys of one surface correspond to valleys and ridges on the other surface.

It is a further object of the invention to provide a product as above wherein the fabric has sufficient elasticity to allow it to be elongated to at least 10 percent with substantially complete retention of its surface texture upon recovery from elongation.

Other objects of the invention will be apparent from the following description and drawings, in which:

FIG. 1 is a magnified cross-sectional view of a fiber-film bonded combination before retraction of the fibers and,

FIG. 2 is the product of the invention, being the product of FIG. 1 after heat retraction has been effected.

FIG. 3 is a representative cross section of the product of FIG. 2.

FIGS. 2 and 3 are less highly magnified than FIG. 1.

As a first step in the practice of this invention, a fleece of textile-length fibers is prepared. By textile-length is meant those fibers, usually 0.5 inches in length or longer, which can be processed on dry-assembling equipment met within the textile field, such as cards, garnets, air-lay or cross-lay devices, and the like. At least a portion of the fibers in the fleece are heat-retractable: that is, capable of shrinking at least 10 percent in length when heated to a suitable temperature. Typical heat-shrinkable fibers include the polyolefins such as polyethylene and polypropylene fibers; fibers known as vinyon which are formed from a copolymer of vinyl acetate and vinyl chloride; certain polyester fibers; fibers formed from copolymerized vinyl chloride-vinylidene chloride; and the like. In general, it is preferred that the fibrous fleece contain between 25 and 75 percent of heat-retractable fibers, although with strongly retracting fibers as little as 15 percent may be effective and over 75 percent may be employed for maximum depth of the surface convolutions which are to be formed.

The balance of the fibrous fleece will normally be between 75 and 25 percent of a textile-length fiber which is substantially unaffected by the temperatures which cause the heat-retractable fibers to shrink. Viscose rayon, cotton, cellulose acetate and nylon are representative of such a class.

The thermoretractive fibers and the insensitive fibers are intimately comingled and blended together in order to bring about the fine-grained, pebbled effect desired in this invention. That is, the operative shrinking force is that of a thermoretractive fiber on a film, the fiber being bonded to the film at a multiplicity of points along its length.

The film to which the fibrous fleece is to be bonded must satisfy two criteria: at the temperature of the unrestricted shrinkage step, explained below, it should be limp enough and conformable enough to be readily drawn up into a creped or pebbled configuration by the retraction of the thermosensitive fibers adherent thereto. Second, the film must not melt, and shrink, or lose its integrity at the retraction temperature of the thermosensitive fibers. What is required is a film which is thermally stable and nonshrinking at the fiber retraction temperature, but which is soft and readily deformable at said temperature.

The softness and deformability of the film is related to its stiffness, which preferably does not exceed 0.25 inches when measured by the Cantilever Bending Method, Textile Test Methods, Federal Specification CCC-T-1,916, Method 5,206.2.

Films which are particularly suited to the practice of this invention are certain types of polyurethane films and modified, cross-linkable polyacrylic films. The polyurethane films are those which are cast from polymers prepared by the reaction of an isocyanate with a polyol, and are of the class known as thermoplastic polyurethanes—i.e., they are of the elastomeric, nonfoamable type, processable by milling of calendering. They generally are characterized by an initial softening range of 250°-275° F.

The cross-linkable polyacrylic films belong to a class of films which have a temperature range within which they are tacky and adhesive, but which contain cross-linking reactants so that on heating or curing at elevated temperatures, the film becomes irreversibly thermoset and cannot be reverted to a thermoplastic condition. Such types of film may consist of an acrylic polymer containing in the polymeric chain reactive groups capable of cross-linking, at elevated temperatures, with a reactant such as melamine formaldehyde, which is incorporated in the film substance. Such films are soft and plastic at room temperature, flowing readily under modest heat and pressure. When heated to 300° F., or more, the film cross-links internally and becomes thermostat in nature.

The fibrous fleece described above is bonded to a layer of selected film. In the case of thermoplastic as well as thermoretractive fibers, or for thermoplastic films, the bonding may conveniently be effected by heat and pressure, as by the use of heated press rolls or heated plates. It is important at this stage that no significant shrinkage be allowed to develop in the fibrous fleece.

If desired, the fibers may be bonded to the film by a suitable flexible adhesive which will not interfere with or be adversely

affected by the subsequent heat treatment. Hot calendering, however, is the preferred method of this invention, utilizing pressures of from 700 to 1,500 pounds per inch of nip width and a temperature sufficient to bond a major proportion of the thermoretractive fibers to the base film at a multiplicity of points along their length.

The resulting calendered product is presented in cross section by FIG. **1**, where **10** represents the layer of film and **12** represents a fibrous fleece comprising thermoretractive fibers. The fibrous fleece is adherent to and preferably partially embedded in the film. Embedment should not be so extensive as to completely surround and engulf the fibers, however, since this seems to impede or inhibit the subsequent development of crepe.

The essentially planar product of FIG. **1** is then heated to a temperature at which the thermoretractive fibers in the fleece will decrease in length. This heating step must be carried out under conditions which allow for free and unimpeded shrinkage of the product, as is conveniently effected by passing the product continuously through a heated oven while supporting it on a conveyor belt. FIG. **2** represents the pebbled or creped film surface of the product of FIG. **1** after the heat-retraction step. The formerly planar film surface is found to be drawn up into a decorative array of fine-grained ridges **14** and valleys **16**, lending an air of surface interest not possessed by conventional nonwoven fabrics.

The invention will be illustrated by the following examples.

EXAMPLE 1.

A carded web of blended and intermingled 50 percent denier 1.5-inch polypropylene fibers and 50 percent dull crimped viscose rayon 1.5 denier 1-9/6 inch fibers, weighing 19 grams per square yard, was laminated to a 1 mil cross-linkable acrylic film. The film, being somewhat tacky, was supported on silicone-coated release paper while the film and web were passed through the nip formed by a cotton-filled roll heated to 200° F., and a steel roll heated to 300° F., at a pressure of 1,250 pounds per inch of nip. The essentially planar, unshrunken laminate was then allowed to shrink, without restraint, in an oven at 330° F.

The laminate shrank 20 percent in area while developing a soft, drapeable hand and an interesting pebbled surface texture, wherein the ridges and valleys on one surface corresponds to valley and ridges on the other surface.

The product had a tensile strength per inch wide strip of 14 pounds in the machine and 2 pounds in the cross direction. Elongation at break was 70 percent machine direction, 140 percent cross direction. The pebbled surface texture of the film was substantially completely recoverable after elongations below the ultimate, the film apparently being set in the textured configuration. This may be due to the fact that he film, being an acrylic polymer with cross-linking possibilities, is converted from an adhesive, thermoplastic state to a cross-linked, thermoset state during the curing step, during which it is simultaneously being deformed into a textured configuration by the shrinkage of the polypropylene fibers which are intermittently bonded thereto.

EXAMPLE 2.

Under physical conditions similar to those of example 1, a 75 percent viscose rayon-25 percent polypropylene fibrous web weighing 28 grams per square yard was bonded to 1.5 mil thermoplastic polyurethane film. The product had a tensile strength per inch wide strip of 14.2 pounds in the machine direction, 2.2 pounds in the cross direction. Elongation at break was 51 percent in the machine direction, 15 percent in the cross direction, and the product had a pebbled texture similar to the product of example 1.

Another embodiment of the present invention lies in the production of creped or pebbled laminates with a fibrous surface on each face of a film.

EXAMPLE 3.

Using the same 19 gram card webs and the same film as in example 1, one card web was bonded at light pressure and a temperature of about 200° F. to one side of a layer of cross-linkable acrylic film supported on release paper. The release paper was removed and a second, similar carded web was plied with the fresh side of the film by calendering at 300° E. and 1,250 pounds pressure as in example 1.

Shrinkage at 300° F. in an oven converted the essentially planar product to a highly creped material, resembling a nonwoven seersucker, with a tensile strength of 36 pounds machine direction, 7 pounds cross direction, and an elongation of 90 percent machine direction, 125 percent cross direction.

If increased air and water permeability in the film section of the product is desired, the invention may be practiced employing slit film, or perforated or netlike films such as are described in U.S. Pat. Nos. 3,012,918 and 3,137,746. In this manner, practically any desired degree of porosity and permeability may be built into a surface-textured nonwoven fabric.

Having thus described my invention, I claim:

1. The process of producing a nonwoven fabric with a creped surface which comprises

assembling an unspun and unwoven array of textile-length fibers comprising at least a proportion of thermoretractive fibers capable of shrinking at least 10 percent when heated,

bonding at least one layer of said fibrous array to at least one face of a soft, deformable polymeric film under conditions which allow substantially no shrinkage of said film or said fibrous array,

said film being selected from the class consisting of polyurethane films and modified cross-linkable acrylic films and being characterized by a cantilever bending length of not greater than 0.25 inches,

and heating the laminate thus formed to the retractive temperature of the thermoretractive fibers under conditions which allow substantially uninhibited shrinkage of said laminate,

whereby the laminate is textured to possess a creped surface,

the hills and valleys of one face of the product corresponding to valleys and hills on the opposite surface.

2. The process according to claim **1** in which between 25 percent and 75 percent of the fibers are thermoretractive.

3. The process according to claim **1** in which the laminate is caused to shrink at least 20 percent in area in the uninhibited shrinkage step.

4. The process according to claim **1** in which the thermoretractive fibers are polyolefin fibers.

5. The process according to claim **1** in which a layer of textile-length fibers comprising thermoretractive fibers is bonded to one face of a film.

6. The process according to claim **1** in which a layer of textile-length fibers comprising thermoretractive fibers is bonded to both faces of a film.

7. An elastic, creped, and textured nonwoven laminate comprising a layer of polymeric film and at least one layer of textile-length fibers consisting essentially of thermally retracted fibers,

said polymeric film being selected from the class consisting of polyurethane films and modified acrylic films, and being characterized by a cantilever bending length of not greater than 0.25 inches,

at least one face of said film being bonded to said fibrous layer,

the laminate formed by said fibrous layer and said film being corrugated into a fine-grained pattern of hills and valleys,

the hills and valleys on one face of the laminate corresponding to valleys and hills respectively on the other face

thereof, said laminate being soft and elastic, capable of substantially complete recovery when extended 10 percent and allowed to relax.

* * * * *