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Triplett

[11] **3,772,131**

[45] **Nov. 13, 1973**

[54] **FLOCKED SPUNLACED BLANKET**

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[52] **U.S. Cl.** **161/64,** 117/33, 156/72, 156/279, 161/67, 161/156

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[58] **Field of Search** 117/33, 140; 161/64, 161/67, 69, 143, 150, 153, 156; 156/279, 72

[56] **References Cited**

UNITED STATES PATENTS

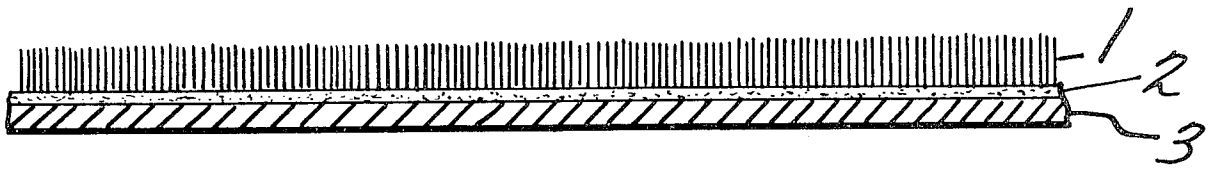
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[57] **ABSTRACT**

A process for producing a durable textile fabric, for use as a bed blanket and the like, from a nonwoven spunlaced material by application of a fibrous substance to at least one side of the spunlaced material by flocking techniques is disclosed. The spunlaced nonwoven which is utilized comprises a nonwoven fabric having a fiber entanglement completeness of at least 0.5, and being preferably formed from polyester fibers having average fiber lengths of between ¼ inch and 5 inches with an average fiber denier of about 0.50 to 20. An adhesive material is first applied to the spunlaced substrate, then the flocking fibers, having a denier of about 0.5 to 10 and a length or mixture of lengths ranging from 0.5 to 8 mm, are applied using conventional techniques. The resulting product, functionally sound and lightweight, is also described.

17 Claims, 2 Drawing Figures



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Fig. 1.

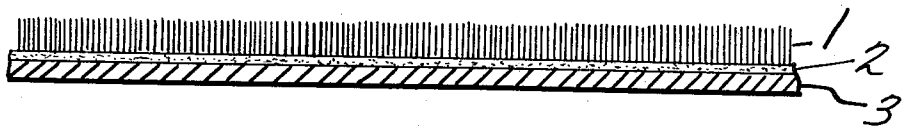
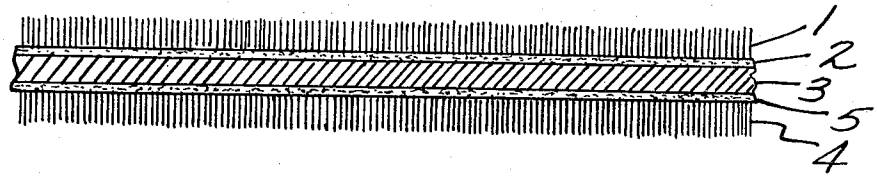


Fig. 2.



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FLOCKED SPUNLACED BLANKET

BACKGROUND OF THE INVENTION

The deposition of relatively short fibers on a fabric substrate, generally known as flocking, and apparatus therefor have been known in the textile art for some time. Quality and commercial acceptability of the products so produced have increased in recent years due in large measure to the electrodeposition machines and advanced adhesive materials used. Most recently the technique has been used to produce relatively inexpensive imitation velvets, suedes and carpets. In this known process flocking fibers are generally applied to an adhesive coated substrate by dispensing them from a receptacle or hopper above or below the moving substrate and passing the fibers through an electrical field to separate the fibers and thereby assist in causing them to assume an upright position substantially perpendicular to the substrate material as they approach the adhesive coating. Machines that set up vibrations in the substrate are also used to this end. A flock-applying apparatus as hereinbefore described is disclosed in U. S. Pat. No. 3,379,175 to Spencer and, to the extent that this patent assists in the understanding of the present invention, it is hereby incorporated by reference. Similar apparatus has been developed whereby flock is drawn upwards electrostatically toward the adhesive-coated substrate.

The application of flock fibers to both sides of a substrate to produce a blanket-type textile is also known; however, depending on the substrate employed for the flocking material, prior to the present invention the blanket-type product has lacked the desired properties found in a woven blanket. For instance, U. S. Pat. No. 3,528,874 to Spencer applies flocking fibers to both sides of a foam laminate substrate to produce a lamellar material but inherent problems with the foam laminate substrate, even when the more flexible closed-cell polyurethane foams are used, cause the resulting product to be unduly bulky and poorly drapeable thus lacking in body conformity. Moreover, the substrate material itself is unduly costly from a commercial standpoint. Woven substrates, when coated on both sides with an appropriate adhesive coating used to adhere the flocking fibers to the substrate, become too stiff to be aesthetically acceptable for the manufacture of flocked blankets. Knit structures, while initially appearing more desirable than woven structures, have proven to be unsuccessful as substrates owing to poor dimensional stability, poor adhesion and surface non-uniformity. Of the conventional nonwoven fabrics used in the art and held together by fiber fusion or resin bonding, unsuccessful results due to poor fiber mobility in the composite producing a relatively stiff flocked blanket have been observed.

I have now found a nonwoven composite spunlaced textile fabric to be the most suitable substrate both as to aesthetics and economics for the manufacture of a flocked blanket. The fibers therein have mobility in the sense of a limited degree of freedom of movement, and when resin coated and flocked on both surfaces of the substrate, the resultant product has the desirable aesthetics including softness, drapeability, and warmth of a lightweight blanket. Thus I have been able to produce an aesthetically pleasing and functionally sound blanket material or durable textile fabric suitable for use as a lightweight decorative bed cover and the like by applying known flocking techniques to an improved, nonwoven spunlaced structure.

Durable fabrics which are made in accordance with this invention have physical characteristics and aesthetic characteristics which make them useful as bedspreads, draperies, curtains, mattress pads, shoe substrates or blankets. Additionally, with added processing, it is possible to produce decorative products, such as wall coverings, furniture coverings and other products having useful and decorative surface appearances.

The present invention provides for a novel process and product using a specific form of nonwoven fabric. As used herein the word "spunlaced" refers to a textile fabric consisting of fibers entangled in a predetermined, repeating pattern to form a strong unbonded structure having a tensile strength greater than one pound per inch per ounce per square yard.

DETAILED DESCRIPTION OF THE INVENTION

This invention makes use of a specific nonwoven material, or fabric, which is known in the art and which will be described hereinafter as a spunlaced nonwoven material or fabric. Spunlaced nonwovens are described in U. S. Pat. Nos. 3,434,188; 3,485,706; 3,485,708; 3,485,709; 3,486,168; 3,493,462; 3,494,821; 3,498,874; and 3,508,308, the disclosures of which are hereby incorporated by reference to the extent necessary to understand the definitions and characteristics of these unwoven products and the processes for their manufacture. Spunlaced (sometimes referred to also as tanglelaced) nonwoven products have interesting properties due to the absence of chemical binders or fusions of fibers.

Certain of the patents identified above suggest that properties of spunlaced nonwovens may be similar to properties needed for blankets (for example, see U.S. Pat. No. 3,485,706 at column 29, line 48). Also, surface treatments and certain laminations of spunlaced nonwovens are suggested (see, for example, U.S. Pat. No. 3,485,708, column 10, lines 39–44).

Spunlaced nonwoven material comprises a relatively compact and coherent fabric formed in accordance with the processes and apparatus described in the U. S. patents listed above. Preferably the spunlaced nonwoven material is made from polyester fibers, for example, polyethylene terephthalate fibers, which have an average fiber length of between one-fourth inch and five inches and which have a fiber entanglement completeness of at least 0.5, as determined in the absence of a binder. Additionally, it is preferred that the spunlaced nonwoven material have a fiber interlock value, due to fiber entanglement, of at least seven, this value also being determined in the absence of a binder. It is also preferred that the fiber entanglement frequency of the spunlaced nonwoven fabric be at least 20 per inch, and that the nonwoven material web be characterized by an internal-bond value of at least 0.2 foot-pound. Methods for testing spunlaced nonwoven fabrics to determine the aforesaid values are described in U. S. Pat. No. 3,485,706, at column 74, line 17 to column 77, line 18. This patent, already referred to above, for its disclosure of spunlaced nonwoven fabrics, is also incorporated herein by reference to the extent necessary to understand the aforesaid physical properties and to conduct tests to determine same.

As identified in the aforesaid patents disclosing the spunlaced nonwoven materials used in this invention,

the fibers may be of any type of fibrous material whether naturally or synthetically produced, including fibrils, paper fibers, textile staple fibers, and continuous filaments. Preferably, the spunlaced nonwoven fabrics are produced from textile staple fibers, especially polyester fibers and more preferably polyethylene terephthalate fibers. For instance, the fibers sold commercially under the trade name Dacron Type 54, Dacron Type 106, or the like, may be utilized in the spunlaced nonwoven materials used for the present invention. The fibers may be of widely varying diameter and length, with lengths up to continuous filaments. Preferably, however, the average fiber lengths will vary between one-fourth inch and five inches, more preferably between one-half inch and two inches. The individual fiber denier may vary widely, e.g., 0.50 to 20.0 denier per filament (hereinafter sometimes d/f) or even higher, but preferably about 1.0 to about 3.0 d/f and most preferably about 1.25 d/f. The fabric weight may also vary widely, up to 5 ounces per square yard or even higher, but fabric will generally be of a weight of at least 0.5 ounce per square yard. Preferably, the fabric weight varies between 0.8 and 3.0 ounces per square yard, and most preferably about 1.0 to about 2.5 ounces per square yard.

The flock fibers applied to the above-described nonwoven spunlaced substrate are derived from several sources and are generally short substantially straight textile fibers of any desired material having two ends. Viscose rayon and nylon, two fibers characterized as straight, untwisted, uniform in cross-sectional diameter, and controlled as to length, denier size and diameter, are preferred. Cotton and wool fibers may also be used. The flock stock, prior to application to the adhesive coated substrate, may be treated with water repellants, dyes, flame retardants and the like. For example, cellulosic-based flock stock is in practice commonly treated with water repellant materials such as the commercial product Zepel of the DuPont Company. Flock fibers employed are preferably about 0.5 to 8 mm in length, more preferably about 1 to 6 mm in length, and have a preferred average denier of from 0.5 to 10.0, more preferably from 1 to about 6. As is known in the art, all of the individual flock fibers need not be of the same length. Although uniformity in fiber length is possible and commercial products are available, due to cost factors in some applications it is economically attractive to use flock fibers of two or more lengths.

The flock fibers as described are then applied to the spunlaced substrate. Numerous techniques of applying flock stock to an adhesive coated substrate are well documented in the art and are suitable for the process of the present invention. The spray method may be employed wherein the flock fibers are sprayed through a gun of relatively large diameter a short distance from the adhesive coated substrate to which they are applied, to insure that a majority of the flock spears or ends are driven onto the adhesive in an upright position. Another method which may be used employs the use of vibration to erect the fibers. In this method the flock fibers are distributed onto the adhesive coated substrate in a random pattern. Before the adhesive has had an opportunity to set, the substrate is directed over a plurality of vibrating areas, as for example, rotating beater bars, which bars cause the coated substrate bearing the flocking fibers to vibrate thereby standing the flocked fibers on end. However, this method is somewhat ineffective for producing a high number of vertically oriented fibers in the finished product. After the substrate has been vibrated, the adhesive on the flock material is allowed to set.

The preferred method of applying the flocking material to the substrate is the electrostatic method as disclosed in U. S. Pat. No. 3,379,175, the disclosure of which is hereby incorporated by reference. This particular technique of applying an object in oriented direction to a substrate has been known for several years and employs the use of an electrical charge on the falling fibers; in this instance an electrostatic field is created between the container for the flock fibers and the substrate. Generally the flock is given a positive charge causing the individual fibers to repel each other and align themselves in parallel position to the lines of force. The coated substrate is given a negative charge in order to attract the positively charged fiber particles to its surface. The charged fibers are readily accepted and held in place by adhesive coated substrate. The resulting textile material gives a commercially acceptable product wherein the flock fibers are substantially perpendicular to the substrate to which they are secured.

Thus in the preferred process of the present invention flock fibers are introduced into a charged hopper and urged through openings therein by rotating brushes. The fibers being charged fall from the hoppers in a substantially vertical direction onto a moving adhesive coated substrate passing thereunder, the substrate being grounded. The thus deposited fibers are introduced to a drying area where the adhesive sets and fixes the fibers onto the substrate. Of course it is also possible to draw the fibers upwardly, as previously mentioned, and this is another embodiment of the present invention.

Flock fibers are applied to either one or both surfaces of the nonwoven spunlaced substrate.

FIG. 1 is a cross-sectional view showing flocking fibers 1 secured by adhesive 2 to the upper surface of non-woven spunlaced substrate 3.

FIG. 2 shows flocking fibers 1 and 4 applied to both sides of non-woven spunlaced substrate 3 secured by adhesive layers 2 and 5.

As will be appreciated, several different decorative effects may be achieved by varying the type, quantity and length of the flocking fibers on the respective sides of the spunlaced nonwoven substrate. For instance pigments included in the adhesive, colored flock or both may be used to produce a product having one color on one side of the material and a different color on the other.

Flock fibers of two or more different lengths are also used and, when the major portion of the fibers are of the shorter length and closely spaced together, the resulting product resembles the nap of a conventional napped woven blanket.

As the adhesive there may be used any suitable adhesive material that secures the flocked fibers to the spunwoven substrate but does not objectionably affect the hand of the resulting flocked textile fabric. Acrylic latex emulsion adhesive formulations have been used in flocking other substrates and are also particularly suited for the adhesive coating of the present invention. Acrylic latex emulsion adhesives, after application of the substrate, are flexible, durable, washfast and substantially free from undesirable odor or stiffening with age. Formulations resulting in these properties vary

widely as to the type of acrylic latex resin employed and various modifying agents and additives to be incorporated with the resin emulsion. Examples of these materials are viscosity stabilizers, catalysts, antifoaming agents, thermosetting resins, plasticizers, humectants and pigments, among others. As the acrylic latex resin emulsion the preferred type is self-crosslinking, as for example the various emulsions commercially available from Rohm and Haas under the trade name "Rhoplex" with numerical designations. One such acrylic latex resin is Rhoplex K-14 which is characterized by the manufacturer as having the following properties: Milky white liquid, 46 percent solids content, nonionic emulsifier, pH 3.0, density 8.6 lb/gal at 25° C, T_{300} (temperature where torsional modulus of an air-dried film is 300 Kg/cm²: thus a relative measurement of film stiffness) −47° C, Brookfield viscosity (No. 1 spindle, 12 rpm) 200 cps at 25° C. Other commercially available acrylic flocking adhesives may be based on Rhoplex E-32, E-269, E-358, K-87 and HA-8, all commercially available from Rohm & Haas. For a detailed discussion of Rhoplexes as flocking adhesives see U.S. Pat. No. 3,528,874, columns 7 and 8.

Viscosity control of the adhesive formulation is important in maintaining the adhesive on the substrate surface to cement the flock without excessive penetration of the adhesive into the fabric and subsequent strike-through. Desirable, but by no manner limiting adhesive formulations are in the range of from about 50,000 to 100,000 centipoises Brookfield viscosity for knife-over-roll and engraved-roll applications, although roller applied adhesive formulations may be as low as about 5,000 to 20,000 centipoises. Selected acrylic latex emulsions are supplied as low viscosity liquids and the addition of a thickening agent, as for example methyl-cellulose is usually required. Carboxylated acrylic latex emulsion resins, as Acrysols ASE-60 and ASE-95, marketed by Rohm & Haas swell, clarify and become viscous when neutralized with a suitable alkali. Crosslinking agents such as oxalic acid or diammonium hydrogen phosphate are used to assist in attaining the desired wash fastness and dryclean fastness. Several suggested formulations are reported in Resin Review, Vol. 20, No. 3, pages 3–8 and Textile Industries, November 1969, pages 137–141, the disclosure of which is hereby incorporated by reference to the extent necessary to further describe known flocking adhesive formulations and techniques. It is to be understood that the particular adhesive system used is relevant only to the extent that the desirable properties of durability, hand flexibility, wash fastness and freedom from stiffness with age are achieved in the ultimate textile product.

The use of a nonwoven spunlaced substrate avoids potential problems with adhesive-substrate interaction, such as the discoloration when exposed to ultraviolet light and instability upon heating experienced with acrylic latex adhesives applied to a layer of open or closed-cell foam. Also a wider range of adhesive formulations can be used, even those containing metallic salt complex catalysts.

The adhesive coating is applied to the spunlaced substrate in a manner generally known in the art and in either a continuous or discontinuous manner, as for example knife-over-roll, engraved-roll, rotary screen, transfer roll and spray. When desired special effects are obtained using the engraved-roll or rotary screen. For use with the spunlaced nonwoven substrate of the present invention a knife-over-roll applicator is preferred. The amount of adhesive applied to a given surface area of substrate varies widely and depends, in part, upon the particular adhesive formulation used, the relative viscosity thereof, the nature of the flocking used and the characteristics of the surface of the nonwoven spunlaced substrate. Workable amounts are within the range of about 0.015 to 0.255 inch in thickness wet (before the adhesive has set) and within the range of 0.9 to 1.5 ounces per square yard. It is emphasized that the above ranges are merely exemplary of the area in which acceptable and desirable results are obtained.

The adhesive formulation may also be applied in a discontinuous manner to the substrate to produce decorative or ornamental effects. Similarly pigments may be incorporated into the adhesive material, or the nonwoven spunlaced substrate, before adhesive and flocking are applied, may be printed with a decorative design or configuration. The printed area or areas will become somewhat muted after the flocking material is applied. Other interesting patterns and effects are produced by flocking with fibers of different lengths as for instance a relatively short fiber and a relatively longer fiber.

Following application of the acrylic latex-type adhesive to the nonwoven spunlaced substrate and the flocking operation, as previously described, the wet, flocked material is dried at a suitable temperature then cured at a somewhat elevated temperature. Both time and temperature may vary widely in the drying and curing steps depending upon the specific formulation of acrylic latex adhesive used. Other factors including ambient temperature, humidity and the extent of penetration of adhesive into the substrate must be taken into account.

The resulting product is resilient, soft to the touch, flexible, readily drapeable and body-conforming, dimensionally stable, substantially non-shedding and readily launderable. The economies realized in the use of the non-woven spunlaced material, as contrasted with other more costly substrates, are appreciable, not to mention the savings in labor to manufacture a similar type product using conventional weaving techniques.

EXAMPLES

Various woven and nonwoven substrates were electrostatically flocked under similar conditions using the same acrylic latex-based adhesive formulation in order to compare the quality and aesthetic characteristics of blanket-type material so produced. The following acrylic latex-based formulation in parts by volume was applied to each of the selected substrates:

	Parts
Rhoplex K-14	500
Nopco DF-160L	1.5
Water	1.5
Nonylphenoxypoly(ethyleneoxy)-ethanol	5.0
Acrysol ASE-60	15.0
Water	15.0
NH_4Cl (25%)	10.0
NH_4OH (28%)	1.5

The resulting formulation had a pH of 7.5, an LVF Brookfield viscosity of 90,000 centipoises (spindle number 4, 6 rpm) and was applied to one side of the selected substrate with a Gardner knife set at 0.003 inches. Natural nylon flock 5 denier and 0.080 inches long was then applied to the adhesive-coated substrate

electrostatically at 60,000 volts and the flocked material was dried at 230°F. for 3 minutes. The adhesive formulation was then applied to the other side of the substrate with the Gardner knife set at 0.003 inches followed by the electrostatic deposition of the nylon flock under the same conditions. This flocked adhesive layer was also dried at 230°F. for 3 minutes. After drying the material flocked on both sides was then cured for 3 minutes at 300°F. until the adhesive was set. Average adhesive add-on was 1.5 ounces per square yard of selected substrate and the average total flock add-on was 2 ounces per square yard. The results were as follows:

Ex.	Substrate type	Substrate Weight oz./yd.^{2}	Observations
A	Acetate tricot knit	1.8	surface flocking not uniform and flock adhered poorly; generally deficient in dimensional stability
B	Spunbonded (fused) Nylon (nonwoven)	0.6	blanket material produced was relatively stiff, almost cardboard-like, surface flocking somewhat irregular
C	Spunbonded (fused) Nylon (nonwoven)	1.5	blanket material produced was relatively stiff, almost cardboard-like, surface flocking somewhat irregular
D	Spunbonded Nonwoven	2.0	blanket material produced poorly drapable, flocking fiber adherence very poor, product unacceptable
E	Cotton print cloth	4.3	somewhat stiff, flocking not adhered on several parts
F	Foam-Fabric-Foam Sandwich	—	product lighter in weight but stiff, almost cardboard like, very poor drapability, judged relative stiff
1	Spunlaced nonwoven	1.13	uniform, plush flock adherence product drapes well, flock resilient to touch
2	Spunlaced nonwoven	1.72	uniform, plush flock adherence product drapes well, flock resilient to touch
3	Apertured spunlaced nonwoven	1.5	distribution and adherence of flock excellent, product highly drapable and flexible

Thus it is apparent that the material so produced using, as the substrate, a nonwoven spunlaced textile exhibits desirable advantages over the products similarly produced but on different substrates. The use of spunlaced nonwoven substrates in the process of the present invention results in a flocked material that is aesthetically pleasing in hand, drapeability, resiliency and body conformity. The product is also functionally durable and capable of withstanding laundering and household treatment. These properties are thought to be due in large measure to the relative mobility of the fibers of the spunlaced nonwoven substrate. Manufacturing economies are also realized over previous methods and products.

What is claimed:

1. A process for producing a soft, durable textile fabric from nonwoven material comprising the steps of:
providing a spunlaced nonwoven material as a substrate;
providing an adhesive having a viscosity such that after application onto the substrate the adhesive remains substantially on the surface thereof without significant penetration into the substrate and coating the adhesive onto one surface of the substrate;
providing flock fibers; and
distributing the flock fibers evenly over the adhesive coating before the adhesive sets in an arrangement substantially perpendicular to the substrate.

2. The process of claim 1 comprising applying the adhesive in a continuous manner in an amount from about 0.9 to about 1.5 ounces per square yard of the substrate.

3. The process of claim 1 including the additional step of allowing the flocked, adhesive coated substrate to dry and then curing the adhesive.

4. The process of claim 1 wherein the flock fibers have a length of from about 0.5 to 8 mm and a denier from about 0.5 to about 10.0.

5. The process of claim 4 wherein the flock fibers of a length of from about 1 to about 6 mm and a denier from about 1 to about 6.

6. The process of claim 1 wherein the nonwoven spunlaced substrate has a fiber entanglement completeness of at least 0.5.

7. The process of claim 1 wherein the fiber entanglement frequency of the spunlaced substrate is at least 20 per inch.

8. The process of claim 1 wherein the nonwoven spunlaced substrate is made of polyester fibers having an average fiber length of between ¼ inch and 5 inches, and having an average denier of about 0.50 to 20 denier per filament.

9. The process of claim 8 wherein the polyester is polyethylene terephthalate.

10. The process of claim 1 wherein the nonwoven spunlaced substrate consists essentially of a major amount of polyester fibers and a minor amount of cellulosic fibers.

11. The process of claim 1 including the additional steps of:
coating the adhesive onto the other surface of the substrate;
distributing the flock fibers evenly over the thus applied adhesive coating before the adhesive sets in an arrangement substantially perpendicular to the substrate; and
allowing the flocked, adhesive coated substrate to dry and then curing the adhesive.

12. The process of claim 11 wherein said textile comprises a blanket product fabric.

13. In the process for preparing a soft, resilient nonwoven material comprising applying an adhesive to the first surface of the substrate, the adhesive of a viscosity such that when applied to the surface of the substrate it will remain on the thus coated surface of the substrate; applying flock fibers evenly over the adhesive coated first surface of the substrate before the adhesive sets; and allowing the adhesive to set; applying the adhesive to the second surface of the substrate; applying flock fibers evenly over the thus coated second surface

of the substrate before the adhesive sets; and allowing the adhesive to set;

the improvement wherein the substrate is a spunlaced nonwoven material and the resulting product is improved in drapeability and reduced bulk.

14. A durable textile fabric formed from a nonwoven material comprising a spunlaced nonwoven substrate having on at least one side thereof an adhesive and flock fibers distributed over and secured to said adhesive, the flock fibers standing substantially perpendicular to the surface of the substrate.

15. The durable textile product of claim **14** wherein the nonwoven substrate material has a fiber entanglement completeness of at least 0.5.

16. The durable textile product of claim **14** wherein the nonwoven spunlaced substrate is formed from polyester fibers having an average fiber length of between ¼ inch and 5 inches, and having an average fiber denier of about 1.0 to 3.0 denier per filament.

17. The durable textile product of claim **14** wherein the polyester is polyethylene terephthalate.

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