United States Patent

Brandts et al.

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[54] REINFORCED LAMINATE PRODUCT

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[21] Appl. No.: **885,201**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 817,927, Apr. 21, 1969, abandoned.

[52] **U.S. Cl.**.....**161/57,** 15/209, 128/284, 156/85, 156/291, 156/306, 156/309, 161/59, 161/64, 161/148, 161/156, 161/402

[51] **Int. Cl.**.....**B32b 5/12,** B32b 27/10, D04h 1/04

[58] **Field of Search**.....161/55, 57–60, 161/140–143, 146, 148, 156, 79, 82, 84, 85, 64, 402; 264/146, 147; 156/166, 167, 176–179, 290, 291, 85, 306, 309; 15/209; 128/284

[56] **References Cited**

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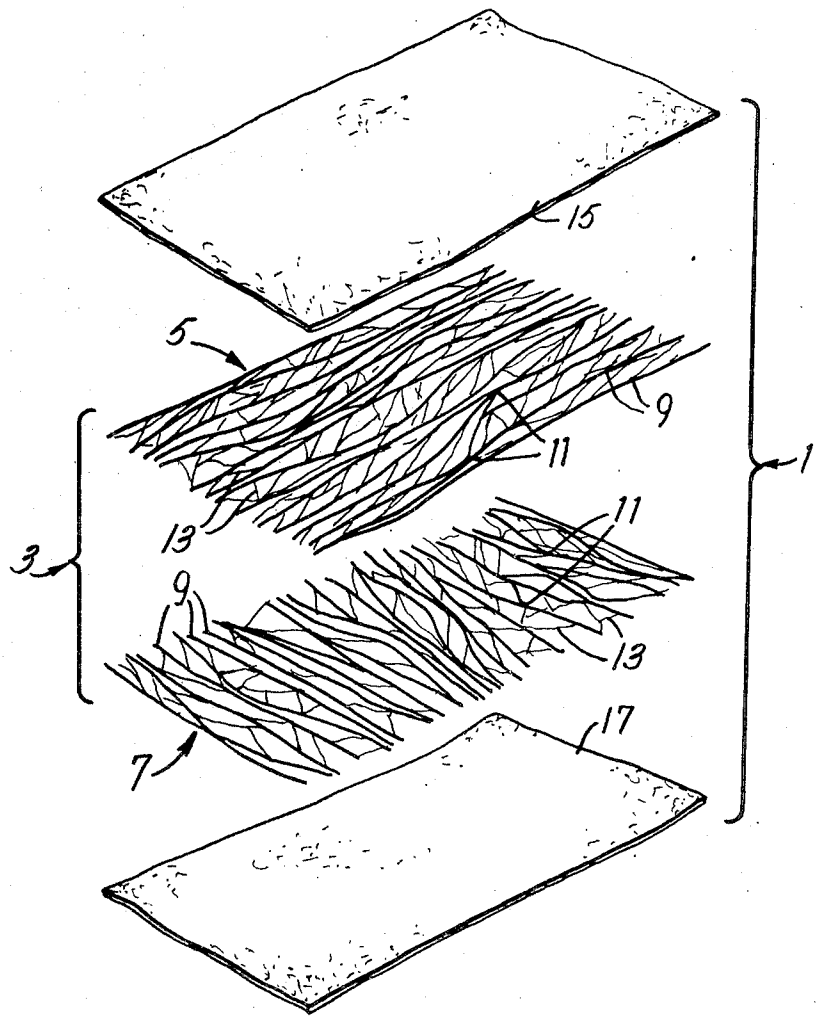
[57] **ABSTRACT**

A laminated, nonwoven fabric product and method of making same comprising a central reinforcing web of fibrillated sheet plastic material having a plurality of substantially parallel fibers integrally interconnected at spaced points along their length and outer layers formed of cellulosic material.

7 Claims, 1 Drawing Figure



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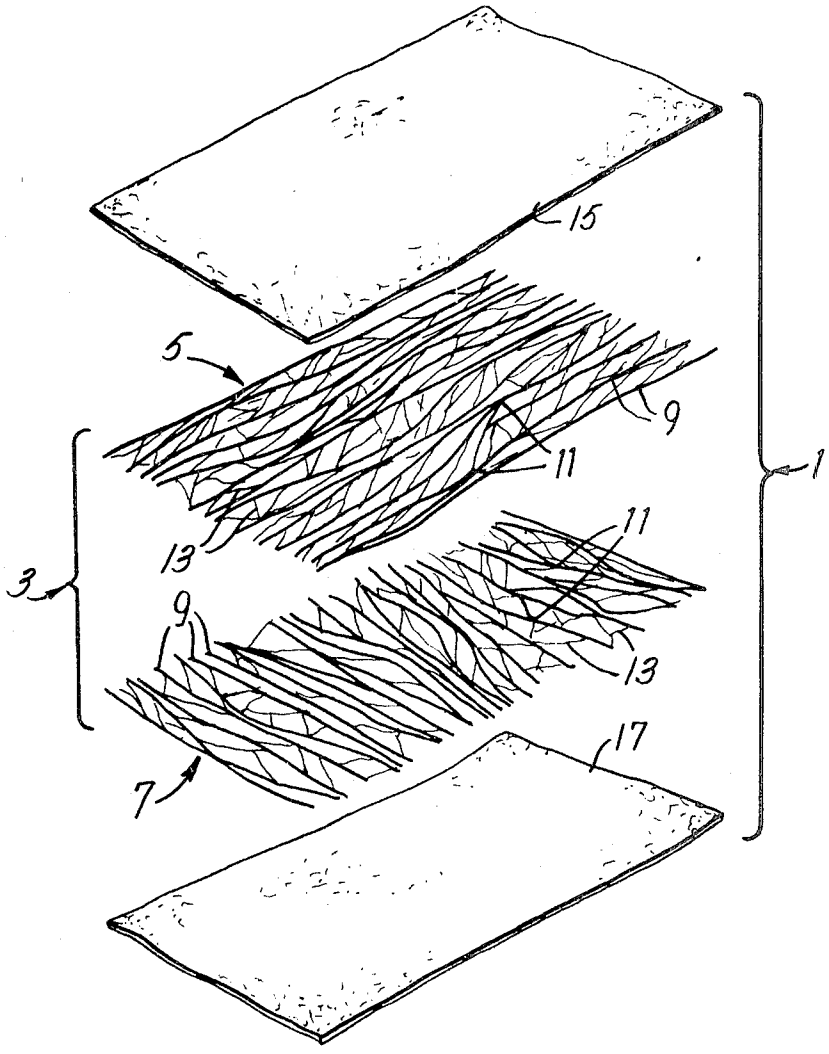

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REINFORCED LAMINATE PRODUCT

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of applicant's copending application Ser. No. 817,927, now abandoned, in the United States.

BACKGROUND OF THE INVENTION

a. Field of the Invention

The present invention relates to nonwoven fabrics. More particularly, the present invention relates to a nonwoven fabric formed of cellulose based material and having a central reinforcing layer formed by a fibrillated plastic web, said fabric having handle and strength characteristics simulating those of woven material.

b. Description of Prior Art

Many attempts have been made to produce nonwoven textile material having the handle and strength characteristics of woven textiles. As is well known, it is now relatively commonplace to hear of paper dresses, paper diapers and a host of other products that heretofore were primarily confined to woven webs.

Normally, such paper products are formed by either the wet laying or dry laying process and are laminated from a plurality of such webs secured together by suitable adhesive means. These nonwoven fabrics do not possess the characteristics, particularly the handle and tensile strength characteristics, that are sometimes required.

Attempts to reinforce paper webs for use as simulated woven fabrics by means of scrims of yarn or continuous monofilaments or even sheet plastic material, have been made, but each such laminate has its own inherent drawback. For example, scrim yarns which provide a strong and flexible laminate also result in relatively coarse texture to the material, and a relatively large percentage of the total area of the product is not reinforced because of the spacing between the yarn.

To applicant's knowledge, no low cost fabriclike material having a high tensile strength and yet being very flexible and possessing good handle and good texture is known.

SUMMARY OF INVENTION

It is thus the main object of the present invention to provide a nonwoven textilelike material that is relatively strong, has good handle and texture characteristics.

Broadly, the present invention comprises a first and second layer of cellulosic material, a reinforcing web between said first and second layer, said reinforcing web being formed of fibrillated plastic material having a plurality of substantially parallel fibers integrally interconnected at spaced points.

BRIEF DESCRIPTION OF DRAWINGS

Further features, objects and advantages of the present invention will be evident from the following description taken in conjunction with the accompanying drawing, in which:

The FIGURE is an exploded view illustrating a laminated product constructed according to the present invention, the specific product illustrated having a pair of fibrillated plastic film webs.

DESCRIPTION OF PREFERRED EMBODIMENTS

The reinforced laminated product of the present invention as illustrated in the FIGURE has a central reinforcing layer 3 formed of a pair of fibrillated webs 5 and 7 of synthetic plastic film. Each of these webs 5 and 7 has a plurality of substantially parallel main filaments 9 interconnected to adjacent filaments 9 at spaced locations 11 along its length either directly or by secondary filaments. These secondary filaments are normally of the same or smaller denier than the main filaments 9. The points or locations 11 where the filaments are connected can be uniformly or randomly spaced depending on the method of manufacture of such fibrillated films. Thus, for some films these interconnections may be widely spaced and for others they may be more numerous. But in general these fibrillated films form a meshlike web of integrally interconnected filaments.

In the illustrated arrangement, the reinforcing layer 3 shown has two reinforcing layers 5 and 7 with the main filaments of one web 5 extending substantially perpendicular to the main filaments of the other web 7 to provide equal reinforcing in the longitudinal and transverse directions of the laminate. The webs 5 and 7 may be adhesively bonded together, preferably at spaced locations, to form a single reinforcing layer 3 before the cellulosic webs 15 and 17 are laminated to the reinforcing layer. While two webs 5 and 7 have been shown to illustrate a laminated product having substantially equal strength in both directions, it is apparent that only a single web, i.e., either webs 5 or 7, may be the sole constituent of the reinforcing layer 3.

Any number of reinforcing webs could be incorporated between the two cellulosic layers. However, normally the number will never exceed three when producing a simulated textile material. Similarly, if desired, more than two cellulosic webs could be used, but again, this will not normally be the case.

Also, when a pair of reinforcing layers 5 and 7 are used, they may extend at 45° to the longitudinal axis of the paper, rather than one being substantially parallel and the other substantially perpendicular to the said axis. In this manner, the main filaments of the layers 5 and 7 would then extend at 90° to each other and 45° to the longitudinal axis of the paper web.

In some cases, it may also be desirable to substitute for one of the layers 5 or 7 or to provide an extra layer formed by spaced elongated ribbons or strips of highly oriented plastic with the strips having their longitudinal axis at an angle to the main filaments of the fibrillated film. Preferably the strips would be at an angle of 90° to the main filaments of the fibrillated film. However, angles of 45° are also contemplated, for example, a product could be made using fibrillated film extending in the longitudinal direction of the web with two layers of ribbons extending at 45° to the main filaments of the fibrillated film and the axis of the web and thus at 90° to themselves.

The central reinforcing web 5 or 7 comprises a fibrillated film made from a suitable fibrillatable polymer which has the required drape and strength characteristics. It has been found that polyethylene and polypropylene, for example, all operate very satisfactorily. Polyvinyl alcohol could be used where a disposable product, such as diapers, is to be manufactured, since this material can be made water dispersible.

The denier of the individual main filaments 9 of the fibrillated film web can range from 1 to 500, i.e., up to 500. These filaments and also the secondary filaments are characterized by having a substantially rectangular cross section. The fibrillated characteristic and the cross-sectional shape of the filaments provide unexpected improvements in the handle of the laminated product. Preferably, the cross section of the filaments is rectangular with a high width to thickness ratio, and thus the filaments lay substantially flat with their wide dimension in the plane of the product thereby increasing the flexibility and providing a laminated product having a smoother texture. For fine fabrics the thickness should be as low as possible while being consistent with the other properties of the product.

The fibrillated film used will be oriented to have an ultimate elongation substantially matched with that of the paper webs to which it is to be laminated. Thus, the ultimate elongation of the fibrillated film will be in the range of 5 to 30 percent. This matching is very important if the cellulose based material is to remain relatively intact as one approaches the breaking strength of the reinforcing layer.

The basis weight, or weight per unit area of each reinforcing layer, depends on the strength required and on the tenacity of the fibrillated film used. It can be easily calculated from the following formula:

$$\text{Basis Weight (oz./yd.}^2) = 0.0575\ T/t$$

where T is the desired tensile strength in lbs. per lineal inch and t is the tenacity of the fibrillated film in grams per denier (g.p.d.). It will be adjusted by spreading out the fibrillated film.

Preferably, a fibrillated film formed of isotactic polypropylene and having a tenacity as high as possible and normally in the range of 3 to 4 grams per denier and a stretch of 7 to 30 percent, preferably 7 to 9 percent and with the individual filaments, that is main filaments, having a denier of 75 grams per 9,000 square feet will be used.

Using present day methods of forming fibrillated film, lower denier main filament films generally have lower tenacity. However, it is believed that this will eventually be overcome by the film makers. In any event, although a low denier polyethylene fibrillated film gives superior handle characteristics, a stronger and cheaper laminate is achieved when polypropylene of high tenacity and greater denier is used and some of the handle characteristics are sacrificed.

When making a laminated product of the type described flexibility is an important characteristic. Using beam deflection analysis, it can be shown that flexibility is inversely proportional to the cube of the thickness and, therefore, a small decrease in thickness will result in a considerable increase in flexibility and the thickness, therefore, should be maintained at a minimum. It is also evident that greatest flexibility is obtained when the modulus and width of the individual filaments is kept to a minimum. However, this is an impossible proposition since strength is also required, which means a filament with a higher tenacity would be required and therefore a compromise must be reached. Obviously, because of the rectangular cross section of the individual main filaments, thickness is set by the film, the width of the individual main filaments determines their denier.

The tenacity figure presented herein for the fibrillated film was obtained as follows. A sample of the film was cut and the ultimate tensile strength in the filament direction was measured in lbs. The sample was weighed and the weight required to obtain a sample of 9,000 meters length calculated, and this weight was divided into the tensile strength to obtain the tenacity of the film.

For instance, by reinforcing two tissue grade papers of basis weight 0.63 oz./yd.^{2} with two cross-laid layers of fibrillated polypropylene film of tenacity 3 g.p.d., each layer having a basis weight of 0.24 oz./yd.^{2}, bonding the four layers with 0.15 oz./yd.^{2} of adhesive applied by spraying, calendering the laminate under 10 pounds per lineal inch, the following properties were obtained:

Tensile strength lb./in.	15
Tear (Elmendorf) g.	700
Handle (Handle-O-Meter) g.	30

A leading commercially available product formed by two layers of tissue paper with a reinforcement formed from highly drafted fibers secured therebetween by spots of adhesive was tested for comparison. Such a product having a handle of about 30, i.e., equivalent to that of the instant invention, had a very low tensile strength of 6 lbs. per inch and a low tear strength of 450 grams. By comparison, the present invention provides a product with equivalent handle, but with more than double the tensile strength and almost double the tear strength.

The cellulosic webs **15** and **17** of the laminated product are preferably made of tissue or toweling grade paper having a basis weight in the range of about 8 to 20 lbs. per ream. However, in some cases where heavier products are desired, such as bath mats or towels, the paper may have a basis weight of up to about 50 lbs. per ream.

Laminated products constructed in accordance with the present invention can be manufactured to have a handle of less than 40 grams and preferably in the range of 15 to 40 grams as measured on a Handle-O-Meter in accordance with Tappi Standard T498-su-66 and yet maintain a tensile strength in the range of about 5 to 35 lbs. per lineal inch. This means that one can now produce a nonwoven fabric with a handle of less than 40 grams as measured on a Handle-O-Meter and with a tensile strength of up to about 40 lbs. per lineal inch. Furthermore, the resultant product has good porosity, i.e., breathing characteristics, and has a relatively smooth texture which is dependent primarily on the texture of the cellulosic web forming the surface. Preferred products constructed in accordance with the present invention will have a drape or handle as measured on a Handle-O-Meter in the range of about 15 to 35 lbs. and a tensile strength of about 10 to 30 lbs. per lineal inch and will be formed from paper webs having a basis weight in the range of 8 to 10 lbs. per ream and a fibrillated film formed of filaments having a tenacity of 1 g.p.d. or more.

As above indicated, any suitable adhesive may be used. It has been found that with polyethylene or polypropylene as the fibrillated film, BOSTIK SI-1920, a water-based adhesive from USM Chemical Co. Middleton, Mass. 01949, Jedbond, a water-based adhesive from Jedco Chemical Corp., 601 North MacQuester Parkway, Mount Vernon, New York 10552, and Hycar (P2100×20), a solvent-based adhesive manufactured by B. F. Goodrich were very satisfactory. Normally, a print-type bond will be used wherein the webs are adhered together at spaced locations or the adhesive will be sprayed.

Another method of securing the fibrillated films to themselves and to the paper webs would be to use a flame-laminating technique wherein the surface of the film is heated by direct contact with the flame and the films and paper layers are brought directly into contact. Care should be taken of bringing to the melting point only the surface of the fibrillated film, for example, by flame sealing at high speed in the calender nip, to prevent the bulk of the film from reaching the temperature at which it has been stretched and annealed, in which case heavy shrinkage will occur. With such a technique, the heat does not penetrate deeply into the film and thus the orientation of the film is not appreciably reduced so that a product having the desired characteristics can be obtained. This flame-laminating technique is described in further detail in applicant's copending Canadian application, Ser. No. 043,756, filed Feb. 24, 1969.

In some cases, however, the above-mentioned latent shrinkage can be used to obtain special effects. For instance, controlled heating of the finished laminate under reduced tension will produce uniform shrinkage which confers to the laminate a more pleasant texture and a more textilelike appearance. In such cases, such shrinkage will not exceed 10 percent and will preferably be between about 5 and 2 percent.

As indicated above, the central reinforcing layer may be formed of one or more fibrillated webs. When a plurality of reinforcing webs are to be used, they may be presecured together or secured to the cellulose layers and then secured together. Cellulose fibers or mixtures of cellulosic and synthetic fibers can be deposited onto the adhesive-covered surface to produce a laminated reinforced nonwoven web of the type contemplated. Such discrete fibers can be deposited on the reinforcing layer by any suitable well-known means, such as by flocking, air-laying or the like.

In laminating the reinforcing webs together, or pressing the laminate together, when an adhesive is used, it is preferred to use a heated nip at a pressure of up to about 50 lbs. per lineal inch. When the cellulose layers pass through the nips, it is preferred to use at least one rubber roll to provide the resilient nip.

One system of laminating is to use a pair of films, one having a higher softening point than the other and heating the laminate as it is pressed together so that the film with the lower melting point is softened and functions as the adhesive to bond the film of the higher melting point to the paper layers and/or to another layer of higher melting point material. For example, a fibrillated film of polyethylene and a fibrillated film of polypropylene may be used as an adhesive and a reinforcing layer respectively, and the laminate heated to a temperature above the softening temperature of the polyethylene

to soften same while squeezing the polyethylene through the apertures in the polypropylene film thereby to bond the polypropylene film to the paper liners. If desired, a layer of polyethylene may be used between a pair of layers of polypropylene to form a reinforcement or, alternatively, a layer of polypropylene may be used with a single layer of polyethylene or with two layers of polyethylene on opposite sides, or any combination thereof.

The adhesive or polyethylene layer is preferably fibrillated so that its thickness may be correlated to that required and the main filaments spread to uniformly distribute the adhesive in the laminate, whereby an adhesive film of the required thickness to penetrate through the spaces between the filaments of the polypropylene films and bond the films and the paper layers together is provided.

A solid sheet of polyethylene may in some cases be used. However, generally, this will lead to waste of material as well as resulting in a laminate of increased stiffness. Similarly, a perforated sheet of polyethylene may be used but this generally would also lead to increased stiffness and excess of adhesive. Thus, it is preferred to use a fibrillated film as the adhesive layer if a two-component film system as described above is to be used.

Where a two film system is used care must be taken to ensure that the strength film (the polypropylene in the above example) does not shrink unduly. Preferably, this strength film will have been annealed at about the laminating temperature before laminating.

The improved laminated product is particularly suitable for use in the manufacture of nonwoven material such as bedsheets, towels, wiping cloths, bedclothes, wearing apparel, etc. Since the product of the present invention provides a material having physical characteristics of strength, handle and texture in particular, it is well suited for these applications.

We claim:

1. A reinforced laminate product comprising as essential layers adhesively secured together:

a. a first layer of paper material;

b. at least a pair of reinforcing layers, the members of said pair of layers being formed by fibrillated film webs of plastic material having a plurality of substantially parallel extending and substantially continuous filaments interconnected with adjacent filaments of the same member at spaced locations, and at least two of said members having their direction of fibrillation in an angular direction to each other in said laminate; and

c. a second layer of paper material; wherein the tensile strength of the laminate is provided essentially by said reinforcing layers said reinforcing layers having an ultimate elongation substantially matched with that of said paper material layers and said elongation being up to between about 5 percent to 30 percent, and said reinforcing layers being adhesively secured to said paper material layers.

2. A product as defined in claim 1, wherein said filaments are integrally interconnected by secondary filaments.

3. A product as defined in claim 2, wherein said filaments are substantially rectangular in cross section with a high width-to-thickness ratio.

4. A product as defined in claim 3, having a handle of up to 40 grams as measured on a Handle-O-Meter 34 lbs. per lineal inch, said longitudinally extending filaments having a denier of up to 500.

5. A product as defined in claim 3, having a handle of up to 40 grams as measured on a Handle-O-Meter and a tensile strength of up to 40 lbs. per lineal inch, said longitudinally extending filaments having a denier of up to 500.

6. A product as claimed in claim 3, wherein said product has a handle of less than 40 grams as measured on a Handle-O-Meter and a tensile strength of 5–40 lbs. per lineal inch.

7. A product as claimed in claim 6, wherein said filaments have a denier in the range of up to 500.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,639,199 Dated February 1, 1972

Inventor(s) Theodorus Gerardus Brandts & Joseph Alois Lichtenberger

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 10 delete "lbs."
Column 4, line 12 delete "10" and insert therefor --20--.
Claim 1, column 6, line 11 the phrase beginning "wherein the tensile" and continuing to the end of the claim should not be indented in said claim 1.
Claim 4, column 6, line 25 delete all words after "Handle-O-Meter" in said claim 4.

Signed and sealed this 18th day of July 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334