

[54] <b>NON-WOVEN MATERIALS</b>	3,669,818	6/1972	Stark.....	161/62
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[22] Filed: **July 18, 1972**

[21] Appl. No.: **272,841**

[52] U.S. Cl..... **428/88; 428/92**

[51] Int. Cl..... **D04h 11/08**

[58] Field of Search ..... 161/67.62, 172, 63, 65

[56] **References Cited**

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[57] **ABSTRACT**

The present invention relates to non-woven fabrics and particularly to non-woven fabrics having a high pile on a surface. The invention is also concerned with such non-woven fabrics containing, and bonded by, composite fibres or filaments which possess at least one component which can be rendered adhesive under conditions which leave the other component(s) of the composite fibre or filament unaffected.

**17 Claims, No Drawings**

## NON-WOVEN MATERIALS

In this specification, the term "fibre" is to be construed as including continuous filaments as well as staple fibre, unless the context clearly indicates otherwise.

The use of composite fibres having a potentially adhesive component as a convenient means to bond textile articles, such as non-woven structures, has been described. Such composite fibres are sold by Imperial Chemical Industries Limited under the Registered Trade Mark "Cambrelle", and the term "melded structure" is used to describe non-woven structures containing, and bonded by, fibres having such a potentially adhesive component. The use of composite fibres, such as "Cambrelle" fibres, as a bonding agent in melded structures, as well as providing a convenient, simply controlled, method of manufacture, also endows the bonded product with properties superior to those obtained with alternative bonding techniques, such as the application of adhesive as a powder or in a solvent, or by the use of a blend of two types of homofibres, one of which can be rendered adhesive under conditions which do not substantially affect the other specie. In particular, for a given breaking strength and tear strength, improved drape, a more pleasant soft handle is imparted to the non-woven structure by the use of composite fibres as the bonding means as compared with the alternative bonding techniques described above.

For many years it has been desired to make a non-woven fabric, particularly for floor-covering and upholstery end-uses. Many solutions to this problem have been proposed but until recently there has been no truly non-woven structure which could compete with conventional loop-pile corded products or velour goods. However, recent developments have resulted in a new type of needle-loom which can process a non-woven fibrous web and produce a loop-pile tufted non-woven material, the appearance of which is strikingly akin to conventional loop-pile cord carpets. In order to increase the strength and stability of these non-woven materials it is necessary to form bonds between the fibres of which they are constituted. However, such structures, when bonded by adhesive systems in such a way that a soft pile is retained, for example by application of a layer of adhesive at the back of the structure, have been found to shed fibres readily from their pile, and further the pile itself is readily flattened. Furthermore, if the proportion of the bonding agent is increased in an effort to improve the fibre retention properties of the product, an unacceptably stiff, boardy product is obtained and the excessive bonding agent may penetrate into the pile layer to the detriment of the handle and feel of the product. Thus, although an aesthetically pleasing product can be produced, there has up to now been no means to ensure the long-term stability of the product. We have now discovered that surprisingly the above-mentioned disadvantages can readily be overcome if the non-woven web to be processed comprises, or contains composite fibres.

The present invention therefore provides a textile material comprising a base fabric formed from a non-woven web having a loop-pile surface in which the fibres in the loops extend at angles between 45°-90° to the plane of the base fabric and are integral with the base fabric and derived therefrom, wherein the fibres in both the base fabric and the pile comprise at least 5 percent, preferably at least 10 percent composite fibres

and in that the structure is bonded at a multiplicity of points between contiguous fibres in both the base fabric and the loop-pile.

The loops forming the pile are preferably arranged in rows and we prefer that the pile surface is in the form of rows of fibre tufts each tuft being formed by a needling operation whereby several fibres are pushed through the fabric to form loops by one penetration of the needles. The height and density of the individual tufts and the tuft density itself may be controlled by appropriate choice of the type of needle that is used, the depth to which the needles penetrate the web, and the pattern of needles employed. Furthermore, the tuft density also depends on the speed at which the web moves relative to the needles and the frequency of penetration of the needles.

The textile material of the invention can be made by forming, in a conventional manner, a non-woven web of fibres comprising at least 5 percent, preferably at least 10 percent composite fibres, passing this web through a specially designed needle-loom, described in greater detail hereinafter, to form the loop-pile structure, and subsequently treating the structure so that the potential adhesive component of the composite fibre is activated and causes bonds to be formed between contiguous fibres in both the base fabric and the loop-pile.

If the non-woven web consists of staple fibres, it may be prepared from a bat of staple fibres by any of the methods well known in the art. For example, the bat may be processed on a carding machine and may be cross-lapped to provide the desired weight per unit area. Alternatively, random-lay staple webs may be used, as prepared by the deposition of fibres from air onto a foraminous surface, such equipment as a Rando-webber being typical of the equipment commercially available for the manufacture of such webs. Again a wet-laid web made by paper-making techniques may be employed.

Continuous filament webs may also be used and numerous methods of manufacture of such webs has been described in the art.

If desired, the webs may be treated before being transformed into the loop-pile fabric. For example, conventional treatments such as an overall needle-punching to provide a coherent, easily handled web may be used. If desired more than one web having different properties may be used as the feed-stock for the patterning needle loom; the webs differing for example, in colour, fibre type denier or crimp. Alternatively a web of staple fibres may be combined with a web of continuous filaments. In addition, a woven or non-woven scrim material may be incorporated in the feed-stock. Accordingly, it will be appreciated that the non-woven web as fed to the machine may have a simple or complex structure.

The specially designed needle-looms which we have found suitable for the production of the products of the present invention consist of needles which are preferably of the loop-forming type and may be either single barb needles or forked needles. The arrangement of the needles may be chosen according to the loop-pile pattern required. We have however found that needle looms in which the needles are arranged in rows which may be straight lines or staggered or a combination of the two are particularly suitable. Slightly different products are obtained depending on the type of needle and its orientation relative to the machine direction, as

is described in greater detail hereinafter. If the needles are in rows they may be staggered in adjacent rows. In the needle loom that is preferred for the production of the textile materials of the present invention the base plate of the needle-loom is provided with slots corresponding to the arrangement of the needles.

As stated above, we prefer that the needles be in rows and the minimum tuft density therefore depends on the mechanical limitations of the machine particularly on the minimum distance attainable between the slots in the base-plate without undue flexing of the base plate under the loading, thereby introducing non-uniform needle penetration. It is believed that a minimum spacing of about 2.00 mm is attainable. There is no such limit on the maximum spacing between rows of needles and the choice depends on the texture of the product required. We have found that if the spacing is greater than about 5 mm the product lacks aesthetic appearance, although for certain applications a wider spacing could be used.

The loops of fibres on the upper surface of the structure will be spaced apart at substantially the spacing between the needles, and the width of the tufts formed from the loops will be governed by a number of factors, including gauge of the needles and type (ie, whether single barbed or forked) as well as type of web, denier of the constituent fibres and so on. The density of the loops, that is the number of fibres per unit length measured along a row of loops will principally depend upon the frequency of penetration of the needles in relation to the speed that the web travels through the machine. It will however also be determined by the type and dimensions of the needles and the fibre denier. Considerable variation in these features are possible and simple experimentation will make clear the set-up giving the desired result. The speed at which the web travels through the machine and the frequency of penetration of the needles should be adjusted to ensure that the tufts produced by different penetrations do not reinforce each other. We have found for example, that if machine speeds are chosen correctly an attractive simulated corded carpet can be made from a cross-lapped, carded web using single-barb needles, on a machine in which the needle rows are spaced at 3.5 mm from each other. Similar products can be made using a forked needle, in which the slots of the needle lie substantially at right angles to the direction of travel of the web.

In one example of the product of the invention rows of loops extend continuously along and parallel to the length of the product. However, the rows need not necessarily be straight but may be in a wavy pattern: this may be obtained using a machine in which the needles are in straight rows, by introducing a cylindrical relative movement between web and needle-loom. Furthermore, the pattern of loops need not be continuous in the machine direction, and attractive patterns may be readily produced by intermittent feed of web, or by intermittently removing the web from the zone of operation of the needles, for example, by lowering the bed-plate of the machine upon which the web is supported during needling. Attractive velour goods may be readily produced from the loop-pile goods of the invention by cutting or cropping the pile top. Depending upon the arrangement and spacing of the loops, the cropping operation will produce a simulated cut-pile material or a corduroy-type material. It is possible when manufacturing such goods to use a different needle

type in addition to those described above in relation to the manufacture of loop-pile goods, such needles being of the forked type in which the slot of the needle lies substantially in the direction of travel of the web. The use of such needles produces a tufted product having a very dense pile, but in which the pile height is not uniform. Cropping this pile to a uniform height produces very attractive velour goods.

The non-woven web of the present invention contains at least 5 percent by weight of composite fibres having a component which can be made adhesive under conditions which leave the remainder of the fibre unaffected. We prefer, however, that the web contain at least 10 percent by weight of composite fibres. If however, the overall content is as low as 5 percent we prefer that the web is constructed so that the part from which the loop pile is formed contains at least 10 percent by weight of the composite fibre. The treatment used to render the fibre adhesive will normally be a heat treatment or a solvation treatment, or a combination of both (for example, the treatment of a polyamide with steam). If desired, the composite fibre may be potentially crimpable, in which case the arrangement of the components with respect to each other, as well as the choice of the components will need to be considered. The composite fibres may be blended with other fibres which are not essentially affected by the bonding treatment. These other fibres may be natural fibres such as wool and cotton or synthetic fibres such as viscose or polyester fibres.

The composite fibres in the non-woven web consist of at least two fibre-forming synthetic polymeric components arranged in distinct zones across the cross section of the fibre. The various components may be arranged in side by side relationship or in sheath and core relationship. It is however important for the purposes of the present invention that the component with the lowest softening temperature forms at least part of the outer surface of the fibre. In this way the various fibres may be bonded together without destroying the fibrous character of the web by heating to a temperature above the softening temperature of the lowest melting layer but below that of the principal fibre-forming component. The composite fibres may conveniently be prepared by any of the techniques already known for the production of such materials. We have found composite fibres based on polyester and polyamide to be particularly useful especially fibres having a polyethylene terephthalate core and a copolyester, such as an ethylene terephthalate ethylene isophthalate copolymer sheath; composite fibres with a nylon 6:6 core and nylon 6 sheath are also suitable.

The fabrics of the present invention may contain from 5 percent, preferably from 10 percent to 100 percent by weight of the composite fibres. The preferred amount depends upon the nature and uses required of the fabrics. As mentioned previously, if the overall content of composite fibre is as low as 5 percent we prefer that the web is constructed so that after needling the loop-pile part of the web contains at least 10 percent by weight of the composite fibre, as we have found that at least 10 percent by weight of composite fibre should preferably be present in the pile to ensure adequate bonding of the pile to prevent undue shedding of fibres over a long period of time.

The higher the proportion of composite fibre used the better the bonding but for economic reasons blends

are preferred and where blends of composite fibres and homofibres are used the homofibres may be of any suitable natural or synthetic material; if a synthetic thermoplastic material is used it should have a softening temperature above that of the lowest softening component of the composite fibres. When a blend is used, the homofil component may itself be a blend of two or more homofils. We have found that the fabrics of the present invention provide particularly useful carpeting materials and in this embodiment we prefer that the web is a blend containing from 40 percent to 80 percent by weight of composite fibres and from 60 percent to 20 percent by weight of homofil fibres.

The advantages of the use of composite fibres to bond a non-woven fabric as compared with alternative bonding methods lies in the fact that the "adhesive" is distributed uniformly throughout the non-woven structure, yet remains associated with the fibres except where fibres are in contiguous relationship. Hence bonds between fibres are of the same order of size as the fibre diameters, and there is substantially no adhesive within the bonded structure except at fibre cross-over points. We believe that the excellent abrasion resistance, resiliency and retention of tuft definition of the product of the invention is attributable to the presence of strong inter-fibre bonds not only within the base web, but also within the tuft layers.

The fabrics of the present invention also have substantially greater pile and velour than non-woven fabrics previously produced by needlepunching. The fabrics of this invention have a pile similar to that of woven tufted materials which has not hitherto been possible to obtain when using needlepunching techniques. In addition, the fabrics have improved tenacity, abrasion resistance and feel compared to non-woven webs produced from composite or homofil fibres by identical needling techniques which are bonded by conventional backing techniques. If desired, the fabric of the present invention may be embossed to provide a patterned effect on the surface. The embossing may conveniently be achieved by passing the fabrics through an embossing calender as they emerge from the bonding oven. In this way the fabric itself is still in a plastic state as it contacts the embossing surface thus facilitating the production of the pattern. This is a much simpler technique than that required to emboss non-woven webs produced from homofil fibres where chemical rather than heat bonding is used. Although this is preferred, other techniques could be used such as passing the fabric through a heated embossing calender in a separate stage.

The invention is further described in the following examples:

#### EXAMPLE 1

A non-woven fibrous web containing 60 percent by weight of 13 decitex staple polyamide composite fibre of length 80 millimetres and having a nylon 6:6 core and a nylon 6 sheath and 40 percent by weight of 18 decitex polyethylene terephthalate staple fibre of staple length 150 mm, was passed through a standard needleloom, wherein it was needled to a density of 70 punches per square centimetre. The web was then turned over and passed again through the same needleloom wherein it was needled under the same conditions as in the first pass. The needles employed had the standard classification 15×18×32×3''R. This pre-needled web

thus obtained weighed 800 grams per square metre, and was about 2 metres wide.

The web was fed to a second needling machine (a Dilo SND needleloom) at a rate of 90 centimetres per minute. This machine contained a needle bed extending transversely to the direction of travel of the web containing parallel rows of needles lying in the machine direction, there being 11 needles in each row and the rows being 3.5 mm apart.

Needles in say, odd rows, were staggered 5 mm backwards from the needles in even rows. The bed plate consisted of a series of parallel slots extending in the direction of travel of the web the centres of which were 3.5 mm apart.

The needle board was reciprocated up and down at a frequency of 340 passes of the needles per minute and the needles were such that they penetrated the web to a depth of 11 mm. Each needle had a forked head the slot width of which was about 0.5 mm and the slot was oriented at right angles to the direction of advance of the web. The width of the web decreased by 2 percent and the length increased by 30 percent during needling.

This second needling produced a fabric with a high looped pile. The web was then passed through an oven at a speed of 7 metres per minute. The oven was heated to 227° C with an air steam mixture which contained 90 percent steam. The web became bonded during this treatment as the nylon 6 component of the composite fibre was rendered adhesive and formed bonds with contiguous fibres to form a melded structure when it cooled. The web shrank approximately 3 percent in length and approximately 5 percent in width during fusing to give a finished web weighing about 700 grams per square metre.

The final web had a looped high pile with excellent fibre retention and the appearance and texture of a woven tufted material. Further, when the loops were sheared a particularly pleasing high pile velour fabric was obtained.

A second portion of high loop pile product produced by the above needling process but which had not been subjected to the bonding process was back coated with a latex at a temperature below the softening point of the potentially adhesive component of the composite fibre. The latex layer was cured and the properties of this sample were compared with those of the melded structure. Although the appearance of both samples was virtually identical, wear quickly showed the melded product to have vastly superior tuft definition retention, fibre retention and resiliency.

#### EXAMPLE 2

Equal proportions of nylon 6:6 staple fibres of 6.7 decitex and 65 staple mm length and of composite fibres having a length of 50 mm and being of 6.7 decitex were blended together. These composite fibres are available from Imperial Chemical Industries Limited under their trade mark "Cambrelle", and have a core-sheath configuration, the core being composed of nylon 6:6 and the sheath being a copolymer of hexamethylene adipamide (70 percent) and epsilon caprolactam (30 percent). Both species of fibre were mechanically crimped by a conventional stuffer-box technique and possessed approximately 5 crimps per centimetre.

A staple cross-laid web weighing 300 grams per square metre was made from the blend of fibres and was needled with 32 gauge standard barbed needles at 12 mm penetration to a density of about 46 punches per square centimetre on a bywater needle loom provided with a needle board having 126 needles per inch width. This needled web was fed to a Fehrer NL21 needle-tufting loom fitted with rows of needles extending across the width of the web, each row containing 5 needles. The needles in the first four rows were staggered but the remainder were parallel with a spacing of 3.2 mm between the adjacent needles in the rows. The needles were forked with the slot oriented across the width of the needle loom. The bed-plate was grooved at a pitch of 3.2 mm, each groove corresponding to the arrangement of the needles. The web moved through the machine at 1 metre/minute and was punched at 500 punches per minute to a depth of 8 mm. The punched web was then bonded by passing through an oven held at 230°C by pressurised steam. The resulting fabric had a pleasant rib pile, was flexible and performed very well as both a floor covering and an upholstery material.

We claim:

1. A textile material comprising a base fabric formed from a non-woven web having a loop-pile surface in which the fibres in the loops extend at angles of 45° to 90° to the plane of the base fabric, said fibres being integral with the base fabric and derived therefrom wherein at least 5 percent of the fibres in both the base fabric and the pile are composite fibres each formed of at least two fibre-forming synthetic polymer components arranged in distinct zones across the cross-section of the fibre, at least one of said components being potentially adhesive under conditions which leave the remainder of the components unaffected and occupying at least part of the outer surface of the composite fibre, the structure being bonded by the potentially adhesive components of said composite fibres at a multiplicity of points between contiguous fibres in both the base and the loop-pile.

2. A textile material according to claim 1 containing at least 10 percent by weight of composite fibres.

3. A textile material according to claim 1 in which

the non-woven web is based on staple fibre.

4. A textile material according to claim 1 in which the non-woven web is based on continuous filaments.

5. A textile material according to claim 1 in which the loops forming the pile are arranged in rows.

6. A textile material according to claim 5 in which the rows are wavy.

7. A textile material according to claim 1 in which the non-woven web consists of cross lapped webs of staple fibre.

8. A textile material according to claim 5 in which the distance between the rows of the loops forming the pile is between 2 and 5 mm.

9. A textile material according to claim 5 in which the rows of loops are discontinuous in the machine direction.

10. A textile material having a velour finish produced by cutting or cropping the pile top of a textile material according to claim 1.

11. A textile material according to claim 1 in which the fibre-forming synthetic polymeric components of the composite fibres are arranged in a sheath and core relationship and wherein the sheath component has a lower melting point than the core component.

12. A textile material according to claim 1 in which the fibre-forming synthetic polymeric components are arranged in a side-by-side relationship.

13. A textile material according to claim 1 in which the composite fibre has a nylon 6:6 core component and a nylon 6 sheath component.

14. A textile material according to claim 1 in which the non-woven web is a blend of composite fibres and homofil fibres.

15. A textile material according to claim 14 containing from 40 percent to 80 percent by weight of composite fibres and from 60 percent to 20 percent by weight of homofil fibres.

16. A textile material according to claim 1 having an embossed surface.

17. A textile material according to claim 1 in which the loop-pile is discontinuous.

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