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(54) ELASTIC STRANDED LAMINATE WITH ADHESIVE BONDS AND METHOD OF MANUFACTURE

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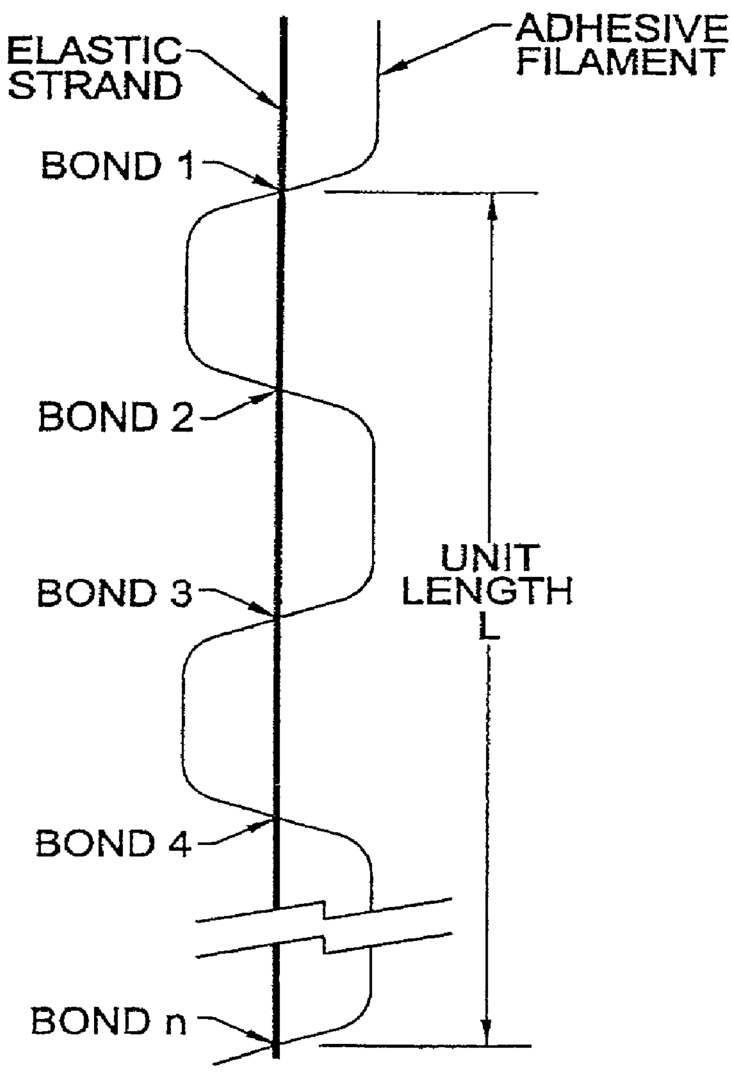
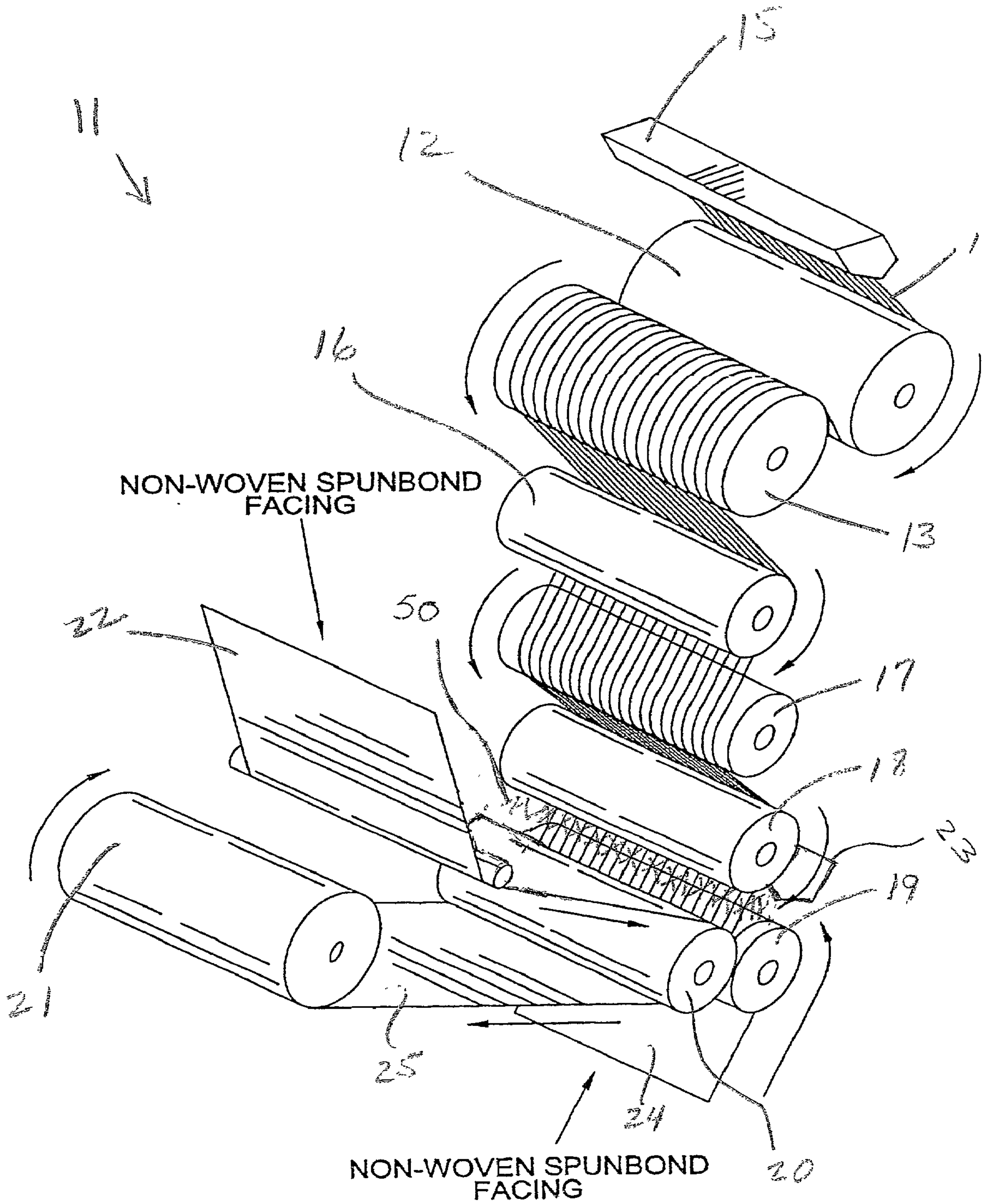
(57) **ABSTRACT**

A laminated article having elastic strands or filaments contained therein for providing elasticity to the article, are provided. The particular adhesive pattern bonds the relatively inelastic nonwoven layers to the more elastic continuous filaments in a pattern that allows adhesive-to-adhesive, adhesive-to-nonwoven layer, and adhesive-to-elastic filament bonding.




11
12
15
14
16
13
NON-WOVEN SPUNBOND FACING
22
50
17
18
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21
25
24
20
NON-WOVEN SPUNBOND FACING

FIG. 1.

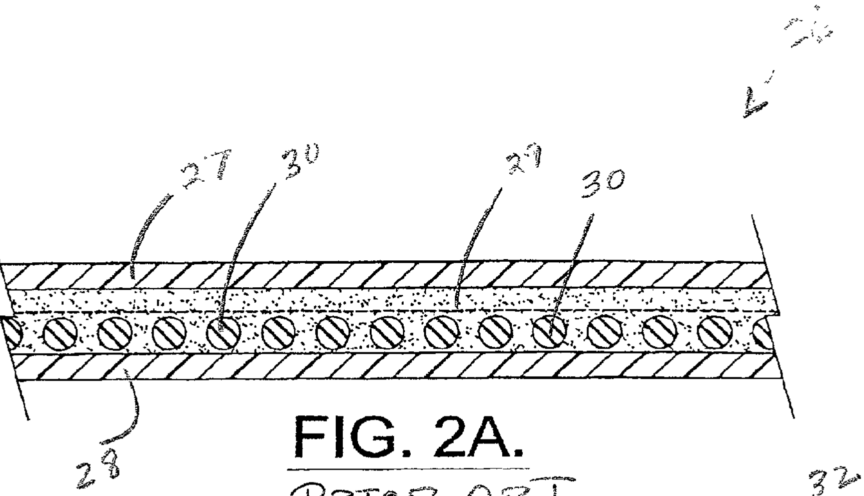

FIG. 2A.

PRIOR ART

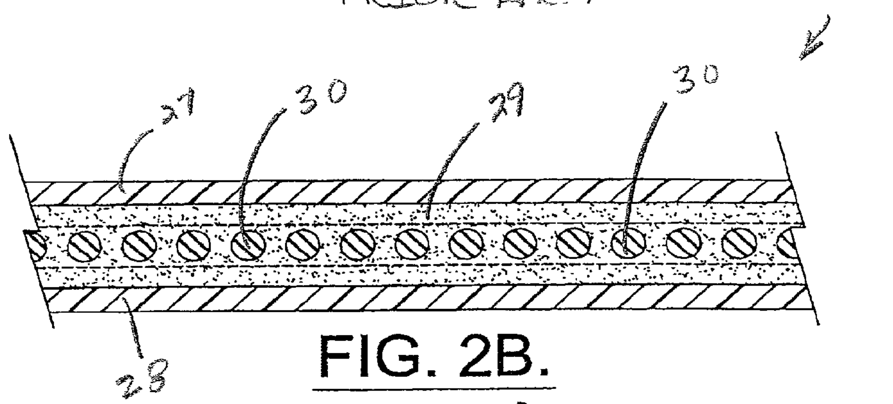

FIG. 2B.

PRIOR ART

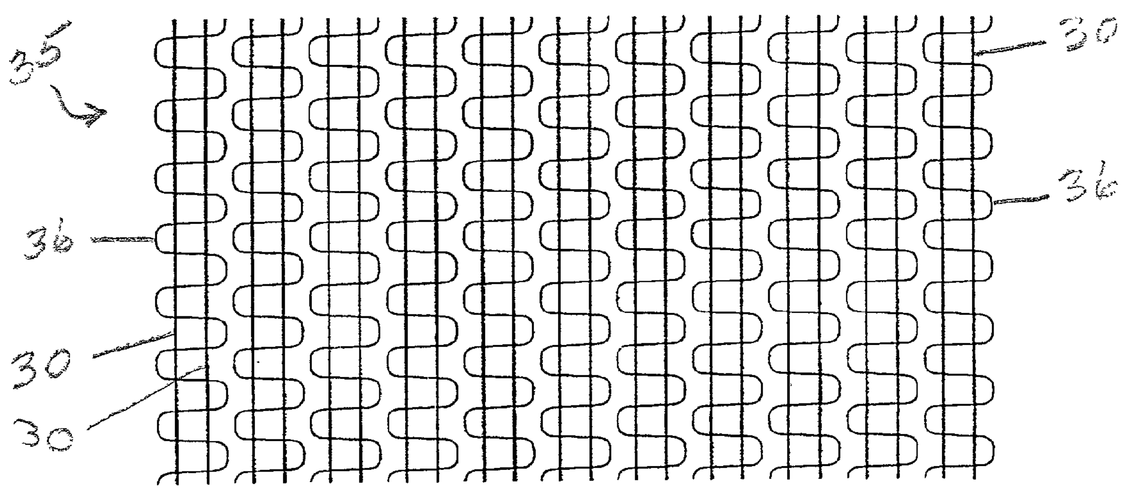

FIG. 3A.

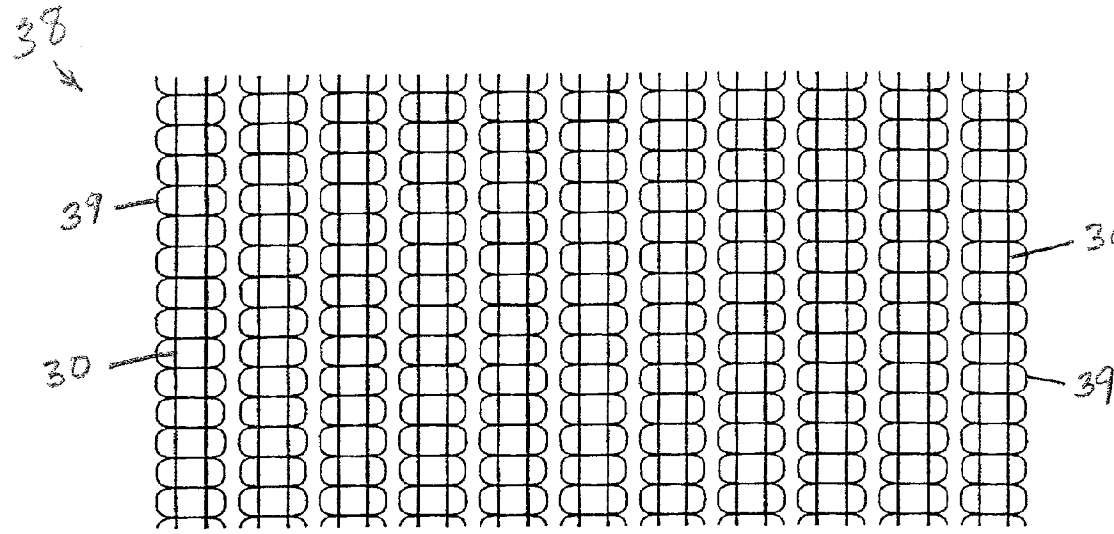

FIG. 3B.

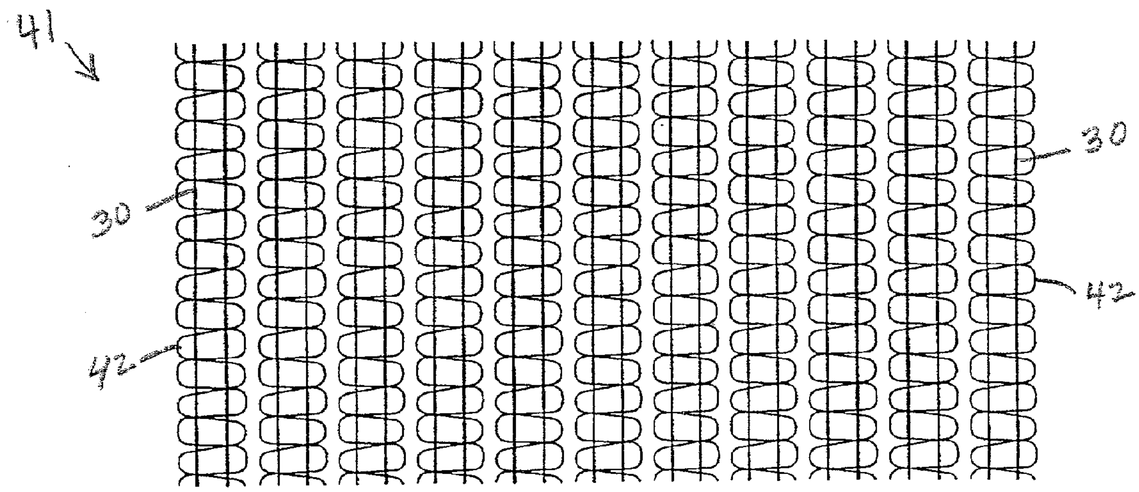

FIG. 3C.

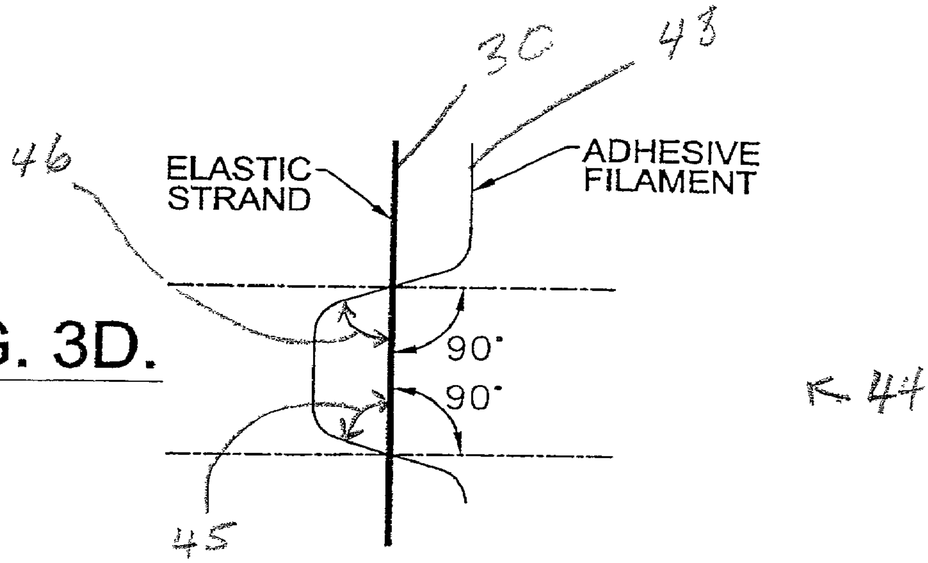
30
48
46
ELASTIC STRAND
ADHESIVE FILAMENT
90°
90°
45
44

FIG. 3D.

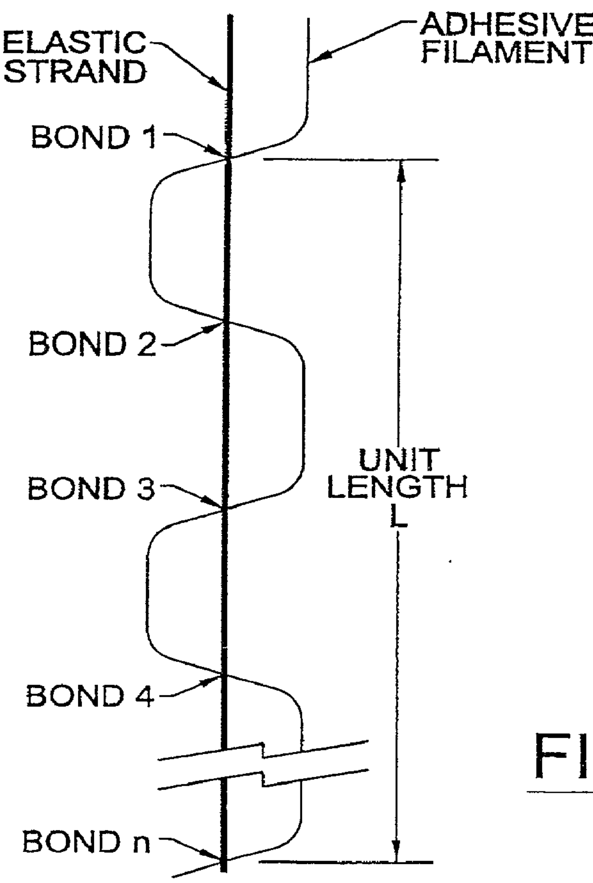
ELASTIC STRAND
ADHESIVE FILAMENT
BOND 1
BOND 2
BOND 3
BOND 4
BOND n
UNIT LENGTH L

FIG. 4.

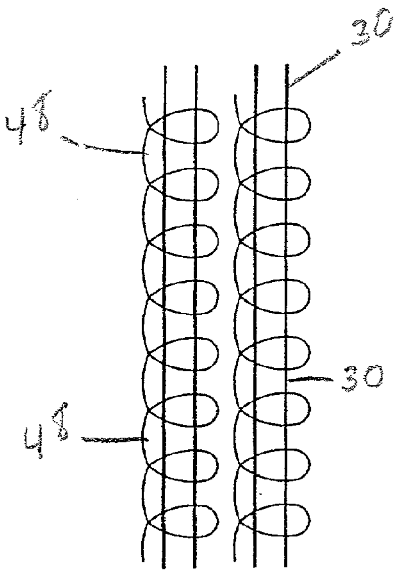

FIG. 5A.

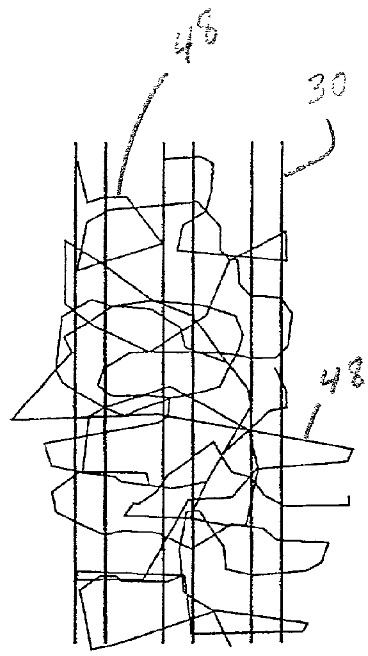

FIG. 5B.

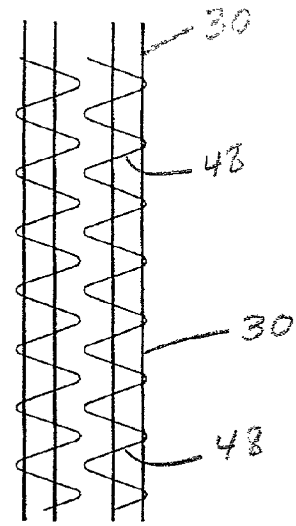

FIG. 5C.

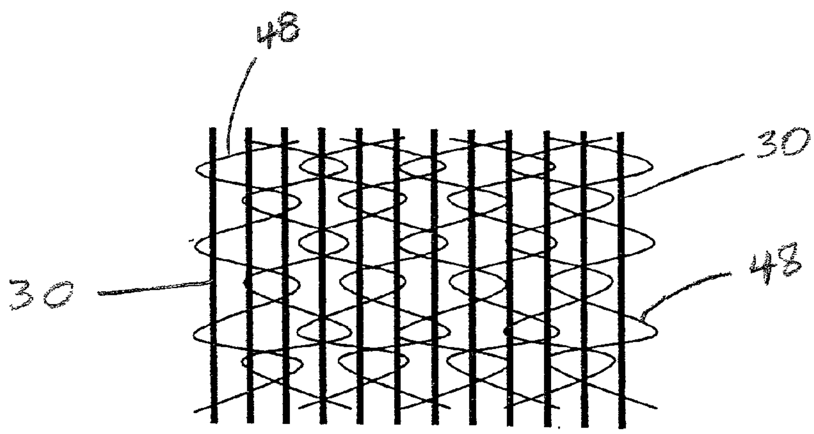

FIG. 5D.

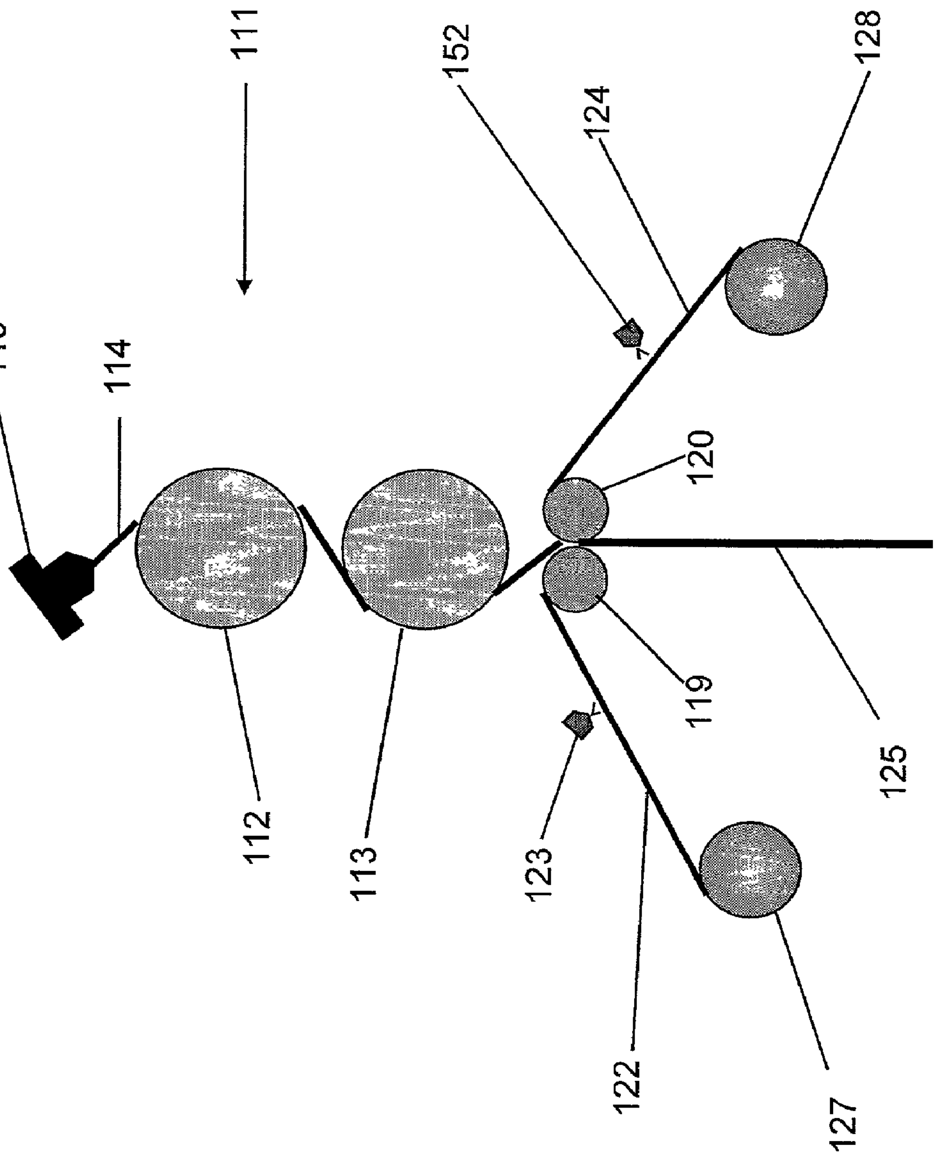

FIG. 6

ELASTIC STRANDED LAMINATE WITH ADHESIVE BONDS AND METHOD OF MANUFACTURE

FIELD OF THE INVENTION

[0001] This invention relates to laminated composite nonwoven articles and, in particular, to a process for producing an elastic and/or relatively inelastic nonwoven laminate that may be used for a variety of applications such as in diapers, athletic bandages or other products that require a degree of elasticity.

BACKGROUND OF THE INVENTION

[0002] Composites of elastic and nonelastic materials are commonly made by combining elastics and nonelastics in a lamination process to provide the entire composite with a degree of stetchability or elasticity. These elasticized composites may then be used as the elastic components for various articles disposable personal care products such as, for example, diapers, pads, medical bandages, and the like.

[0003] Generally, when forming such composites, a nonelastic material (or at least a less elastic material) is joined by bonding to an elastic material (or at least a more elastic material) while the elastic material or sheet is in a stretched condition. When the tension on the more elastic material is released, the less elastic component of the combination is allowed to gather in the spaces between the bonding sites. The resulting composite elastic material is stretchable to the extent that the less elastic material gathered between the bond locations allows the more elastic sheet to elongate. Examples of these types of composite laminate articles and materials are set forth in U.S. Pat. Nos. 4,720,415 and 5,385,775, each of which is incorporated by reference herein.

[0004] In some stretchable laminate articles, elastic strands of continuous filaments are bonded to relatively inelastic sheet materials while the elastic strands are in a stretched condition. Such elastic continuous filaments may, in certain articles, be sandwiched between two or more relatively inelastic sheets. The relatively inelastic sheets may include nonwoven webs formed by meltblowing or spunbonding various polymers. Examples of such laminates are shown in U.S. Pat. No. 5,385,775 to Wright, which is incorporated herein in its entirety by reference thereto.

[0005] As shown in Wright, elastic continuous filaments may be extruded onto a horizontally moving sheet of material. The continuous filaments are extruded from above the horizontal plane of sheet material and directly onto the material for bonding thereto.

[0006] In other exemplary laminates, after bonding the elastic continuous filaments to the sheet material, which will often be relatively inelastic, the bonded elastic continuous filament/inelastic nonwoven sheet material will then be stretched and another relatively The forces that are holding the elastic continuous filaments in a stretched condition are then released to gather the inelastic nonwoven sheet(s) between the sheet bonding points. In use, the product may be stretched to expand and ungather the inelastic sheet(s), but will, upon release, return to the shortened, gathered state.

[0007] Other lamination processes have also been developed for forming a stretchable laminate product from elastic and inelastic materials. For example, U.S. Pat. No. 4,910,064 to Sabee shows an apparatus for manufacturing an integral filamentary web comprising continuous filaments and meltblown fibers. A multiple number of continuous filaments are spun in curtain-like form, one side of which will have molten meltblown fibers deposited thereon and self-bonded to fix the continuous filaments in a controlled alignment. The process involves drawing continuous filaments either before, during, or after the deposition of the meltblown fibers in order to molecularly orient the continuous filaments. After stabilizing elastic continuous filaments by bonding to the meltblown fibers and relaxing the filaments, the elastic filaments and the web contract to form buckles, curls, or kinks in the non-elastic molecularly oriented permanently lengthened continuous filaments. The patent further describes the bonding of a second opposing meltblown web to the opposite side of the continuous filaments after the meltblown fiber/continuous filament composite is at least partially drawn to provide some degree of molecular orientation.

[0008] In addition, U.S. Pat. Nos. 5,200,246 and 5,219,633, also to Sabee, show a vertically-oriented process and apparatus for producing a fabric that combines elongatable continuous filaments with fibrous meltblown webs for interlocking the continuous filaments in an integrated, fibrous, continuous filament matrix. An extruder provides molten elastomeric continuous filaments which are cooled, solidified, and stretched as they are drawn from the meltblowing nozzle by counter-rotating temperature-controlled pull rolls. The solidified continuous filaments are then subsequently pulled into the nip of a pair of temperature-controlled deposition rolls whereat two opposing meltblown gas-fiber streams or sprays are simultaneously and turbulently intermingled with each other and between the tensioned continuous elastomeric filaments. Passing the fabric between higher velocity draw rolls may then further stretch the composite fabric.

[0009] In the manufacture of such laminates, adhesives have been used to hold elastic strands or filaments in place, thereby bonding the elastic strands or filaments to nonwoven facing materials. U.S. Pat. No. 4,880,420 to Pomparelli discloses a method of applying adhesive to bond elastic strands to a fabric by using a sinusoidal-shaped line of adhesive. In Pomparelli, a relatively thick portion of adhesive is applied in a line along one or more elastic filaments in a direction generally parallel to the elastic filaments. However, the line of adhesive disclosed in Pomparelli does not intersect itself at any point. Instead, the sinusoidal adhesive line intersects a predetermined number of the same elastic strands several times as the line winds its way across the strands.

[0010] One problem in the manufacture of elasticized articles is that using adhesives to bond elastic strands to a nonwoven sometimes causes the article to be stiff, rather than soft. In diapers, for example, excessive adhesive results in a stiff or inflexible diaper product that is undesirable to consumers. Also, if the adhesive is not applied in a preferred pattern, and is not efficiently utilized, it cannot reach optimum performance to provide the greatest bonding strength for each gram of adhesive applied to the article. Thus, a challenge in making products of this type is to find ways to use less adhesive, but still impart sufficient bonding strength to securely fix elastic filaments into a nonwoven.

SUMMARY OF THE INVENTION

[0011] The present invention provides new methods for and patterns of applying adhesive materials to elastic strand-containing laminate articles. The articles in which the present invention may be utilized include various articles that require portions of elasticity such as diapers, tampons, and absorbent garments. Such articles will typically include one or more nonwoven layers and a plurality of elastic filaments or strands bonded to the nonwoven layer(s) to provide the desired degree of elasticity. Typically, an adhesive material is used to bond the strands to the nonwoven layer(s). In the bonding arrangement of the present invention, the adhesive material is applied in lines that intersect the elastic filaments to form a bonding network comprised of adhesive-to-elastic bonds, adhesive-to-facing bonds, and adhesive-to-adhesive bonds.

[0012] The adhesive patterns utilized in the present invention will typically be lines that lie perpendicular or nearly perpendicular to the elastic components. Although true 90-degree bond angles may be desirable, the average or mean bond angle may be as small as 50 degrees, and will typically be approximately 60 degrees. A greater bond angle will generally result in increased bonding strength between the continuous filaments and the nonwoven layer to which the filaments are bonded.

[0013] In the bonding arrangement of the present invention, the adhesive-to-elastic bonds are formed at the points where the lines of adhesive and elastic material join or intersect and the adhesive-to-adhesive bonds are formed at the points where the lines of adhesive intersect or join themselves.

[0014] One particular embodiment in which the present invention may be utilized is an absorbent article (garment) or infant diaper wherein less than 0.6 grams of adhesive is applied per article to bond the elastic strands of the articles to the contiguous nonwoven facing layers. This results in a product that is generally free from unnecessary stiffness while retaining a solid and stable bonding of elastic filaments to nonwoven facing material.

[0015] In one aspect of the invention, a process of manufacturing an absorbent laminated article is utilized. The process comprises providing a nonwoven layer and spraying an adhesive upon the surface of the nonwoven layer, wherein the adhesive is applied to the nonwoven layer in a non-random pattern that is capable of providing predetermined strength characteristics to the laminate structure. Further, the process includes providing a plurality of substantially parallel elastic filaments adjacent the nonwoven layer, the elastic filaments being extruded from a die in molten form and then cooled. Finally, the process includes pressing the (1) nonwoven layer, (2) elastic filaments, and (3) adhesive together in a nip to form a laminated article.

[0016] Other objects, advantages and applications of the present invention will be made clear by the following detailed description of embodiments of the invention and the accompanying drawings wherein reference numerals refer to like or equivalent structures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] **FIG. 1** is a perspective view of one particular apparatus for laminating together continuous filaments and nonwoven facing(s);

[0018] **FIG. 2A** shows a cross-section of a laminated absorbent article of the invention wherein an adhesive spray has been applied onto the surface of one nonwoven facing;

[0019] **FIG. 2B** depicts a cross-section of a laminated absorbent article of the invention wherein an adhesive spray has been applied onto both opposing nonwoven facings;

[0020] **FIG. 3A** shows a bonding pattern in which the adhesive has been applied to the elastic filaments with attenuation in the cross-direction;

[0021] **FIG. 3B** shows an adhesive bonding spray or scrim pattern;

[0022] **FIG. 3C** shows another adhesive bonding spray or scrim pattern;

[0023] **FIG. 3D** illustrates conceptually the bond angle in a scrim bonding pattern of this invention;

[0024] **FIG. 4** shows the bonding pattern and method of calculating the number of bonds per unit length on elastic strands or filaments in accordance with the present invention;

[0025] **FIG. 5A** illustrates a swirled type of adhesive bonding pattern;

[0026] **FIG. 5B** shows a randomized adhesive bonding pattern having a majority of adhesive lines in a perpendicular orientation to the elastic filaments;

[0027] **FIG. 5C** is a graphical representation of an adhesive laydown pattern with attenuation of adhesive lines in the cross-machine direction;

[0028] **FIG. 5D** shows a "chain-link fence" type pattern of adhesive bonded to the elastic filaments; and

[0029] **FIG. 6** is a schematic view of another particular apparatus for laminating together continuous filaments and nonwoven facing(s).

DEFINITIONS

[0030] The term "continuous filaments", as used herein, refers to strands of continuously formed polymeric filaments. Such filaments will typically be formed by extruding molten material through a die head having a certain type and arrangement of capillary holes therein.

[0031] The term "elastic" or "elasticized", as used herein, refers to a material which, upon application of a biasing force, is stretchable, which is elongatable to at least about 60 percent (i.e., to a stretched, biased length which is at least about 160 percent of its relaxed unbiased length), and which will recover at least 55 percent of its elongation upon release of the stretching force. A hypothetical example of an elastic material would be a one (1) inch sample of a material which is elongatable to at least 1.60 inches and which, when released, will recover to a length of not more than 1.27 inches. Many elastic materials may be elongated by more than 60 percent (i.e., more than 160 percent of their relaxed length). For example, some elastic material may be elongated 100 percent or more, and many of these will recover to substantially their initial relaxed length such as, for example, within 105 percent of their original relaxed length upon release of the stretching force.

[0032] As used herein, the term "polymer" generally includes, but is not limited to, homopolymers, copolymers, such as, for example, block, graft, random and alternating copolymers, terpolymers, etc. and blends and modifications thereof. Furthermore, the term "polymer" includes all possible geometrical configurations of the material, such as isotactic, syndiotactic and random symmetries.

[0033] The term "composite nonwoven fabric", "composite nonwoven", "laminate", or "nonwoven laminate", as used herein, unless otherwise defined, refers to a material having at least one elastic material joined to at least one sheet material. In most embodiments such laminates or composite fabric will have a gatherable layer which is bonded to an elastic layer or material so that the gatherable layer may be gathered between bonding locations. As set forth herein, the composite elastic laminate may be stretched to the extent that the gatherable material gathered between the bond locations allows the elastic material to elongate. This type of composite elastic laminate is disclosed, for example, in U.S. Pat. No. 4,720,415 to Vander Wielen et al., which is incorporated herein in its entirety by reference thereto.

[0034] As used herein, the term "nonwoven web" refers to a web having a structure of individual fibers or threads that are interlaid, but not in an identifiable, repeating manner. Nonwoven webs have been, in the past, formed by a variety of processes such as, for example, meltblowing processes, spunbonding processes and bonded carded web processes.

[0035] As used herein, the term "meltblown fibers" means fibers formed by extruding a molten thermoplastic material through a plurality of fine, usually circular, die capillaries as molten thermoplastic material or filaments into a high velocity gas (e.g. air) stream which attenuates the filaments of molten thermoplastic material to reduce their diameter, which may be to microfiber diameter. Thereafter, the meltblown fibers are carried by the high velocity gas stream and are deposited on a collecting surface to form a web of randomly disbursed meltblown fibers. Such a process is disclosed, for example, U.S. Pat. No. 3,849,241 to Butin, which is incorporated herein in its entirety by reference thereto.

[0036] As used herein, the term "spunbonded fibers" refers to small diameter fibers formed by extruding a molten thermoplastic material as filaments from a plurality of fine, usually circular, capillaries of a spinerette with the diameter of the extruded filaments then being rapidly reduced as by, for example, eductive stretching or other well-known spunbonding mechanisms. The production of spun-bonded nonwoven webs is illustrated in patents such as, for example, U.S. Pat. No. 4,340,563 to Appel et al., and U.S. Pat. No. 3,692,618 to Dorschner et al. The disclosures of these patents are incorporated herein in their entireties by reference thereto.

[0037] As used herein, "scrim" refers generally to a fabric or nonwoven web of material which may be elastic or inelastic, and having a machine direction oriented along the path of manufacture and a cross-direction.

DETAILED DESCRIPTION OF THE INVENTION

[0038] Reference now will be made to the embodiments of the invention, one or more examples of which are set forth below. Each example is provided by way of explanation of the invention, not as a limitation of the invention. In fact, it will be apparent to those skilled in the art that various modifications and variations can be made in this invention without departing from the scope or spirit of the invention. For instance, features illustrated or described as part of one embodiment can be used on another embodiment to yield a still further embodiment. Thus, it is intended that the present invention cover such modifications and variations as come within the scope of the appended claims and their equivalents. Other objects, features and aspects of the present invention are disclosed in or are obvious from the following detailed description. It is to be understood by one of ordinary skill in the art that the present discussion is a description of exemplary embodiments only, and is not intended as limiting the broader aspects of the present invention, which broader aspects are embodied in the exemplary constructions.

[0039] As mentioned above, elastic stranded laminates are used in a variety of personal care product applications such as waistbands, leg cuffs, side panels, and the like in which a tight, yet comfortable, elastic fit is needed. Products requiring such an elastic-stranded laminate include disposable diapers, disposable training pants, and adult-care briefs. Soft, flexible facings made from materials such as polymer films and nonwovens surround the strands of elastomeric polymers in these laminates. Adhesives are commonly used to bond the facings to the strands, and the facings to the facings.

[0040] One particular means of applying adhesives to the laminates utilizes meltblown spray technology. In this technology, meltblowing equipment presents the adhesive to the laminate layer in a random fibrous configuration. Multiple adhesive-to-elastic strand bonds per unit length of elastic are formed, along with multiple facing to facing adhesive bonds per unit area. In general, strong, flexible adhesive bonds are required to maintain the flexibility and integrity of the laminate in use. If the adhesive-to-elastic bonds are too few in number or are too weak, then the elastic tension properties of the laminate will be compromised as the tension of the elastic strands will break the adhesive joints. The common remedy in prior art processes for remedying this condition is to increase the number of bonding sites by either increasing the meltspray air pressure, or by slowing the lamination speed. As the meltspray air pressure is increased, the resulting adhesive fiber size is reduced in these known processes, creating weaker bonds. Increasing the amount of adhesive used per unit area to create larger adhesive filaments usually repairs this, but this usually increases the cost of the laminate. Lowering the lamination speed decreases machine productivity, but negatively impacts product cost.

[0041] **FIGS. 2A and 2B** illustrate the use of such meltspray webs. In **FIG. 2A, a** cross-section of a laminated article produced with the typical meltspray adhesive is shown. A laminated article **26** is shown as having a first nonwoven facing **27** and second nonwoven facing **28**. Meltspray adhesive layer **29** is applied between the nonwoven facings, and continuous elastic filaments **30** are seen in cross-section. **FIG. 2B** depicts a cross-section of a laminated article **32** wherein melt-spray adhesive **29** has been applied on both nonwoven facings **27** and **28**.

[0042] The present invention, however, employs an elastic stranded laminate where the number of bond sites per length elastic strand are prescribed or predetermined, and the adhesive-to-elastic strand joints are generally perpendicular in orientation to provide enhanced strength. This allows the laminate to be made at minimal cost by optimizing the adhesive and elastomer content to match the product needs.

[**0043**] The adhesives are applied according to the present invention in a continuous, wave-shaped pattern that intersects the elastic strands in a predominantly perpendicular fashion. The bonding of the continuous adhesive filaments to the elastic strands at their intersections is also controlled to a known number per unit elastic strand length so that predictable and controllable laminate properties are achieved. By encapsulating high-strength adhesive to elastic strand bonds with a perpendicular orientation and optimizing the number of bonds per unit elastic strand length, the elastic strand laminates of the present invention can be produced with only a minimal amount of adhesive and elastomer. In addition, the adhesives are applied in some embodiments of the present invention to obtain both adhesive-to-elastic bonds and adhesive-to-adhesive bonds as well as adhesive-to-facing bonds, with the adhesive-to-adhesive bonding contributing to the strength characteristics of the present invention.

[**0044**] Although the invention will be described and depicted in the context of a continuous filament/nonwoven laminate forming apparatus that is in a vertical orientation, it is to be understood that various other apparatuses may be employed in forming the laminates. The vertically-oriented laminate forming apparatus is depicted in **FIG. 1**. This apparatus includes an extruder **15** that forms continuous filaments **14** and then guides the continuous filaments through a series of rollers until the filaments are placed into position for bonding to one or more nonwoven facings. In other embodiments, such as in **FIG. 6**, the series of rollers may be eliminated. Various apparatuses may be employed in the present invention and are described more specifically in co-pending application owned by the present assignee and bearing Ser. No. 60/204,307 and filed on May 15, 2001, as a Provisional Application (and later filed as a Utility application) with the title: "Method and Apparatus for Producing Laminated Articles". That application (both the Provisional application and the corresponding Utility application) is incorporated herein in its entirety by reference thereto.

[**0045**] Various types of compositions and various processing conditions may be utilized to form the elastic continuous filaments. For example, a Kraton®-brand elastic polymer may be fed into an extruder where the polymer is melted at a controlled temperature of between about 260° and 460° F., and in certain instances at about 385° F. In other embodiments, depending on the particular polymer employed, the melt temperature may be approximately 470° F. to 480° F. The polymer is then extruded through a predetermined number of apertures in a die head in a generally downward direction into separate continuous filaments at a pressure of approximately 300 to 4000 psi (typically from about 1500 to about 2000 psi).

[**0046**] One particular class of polymers that may be utilized in the present process is the Kraton® G series of polymers distributed by Shell Chemical Company (now available from Kraton Products U.S.-LLC). Various Kraton® G polymers may be utilized.

[**0047**] In one embodiment, the blend used to form the elastomeric continuous filaments as well as the facings include, for example, from about 40 to about 80 percent by weight elastomeric polymer, from about 5 to about 40 percent polyolefin, and from about 5 to about 40 percent resin tackifier. For example, a particular composition may include, by weight, about 61 to about 65 percent KRATON® G-1657 (in one instance, about 63 percent), about 17 to about 23 percent polyethylene NA 601-04 wax (in one instance, about 20 percent), and about 15 to about 20 percent REGALREZ™ 1126 (in one instance, about 17 percent). The G-1657 is, in particular, a styrene-ethyl butylene-styrene (S-EB-S) triblock base rubber polymer.

[**0048**] In another embodiment, a polymer blend consisting of approximately 85% A-B-A'-B' tetrablock base rubber polymer (sold as G1730 by Kraton Products) and 15% polyethylene NA601 wax may be employed. In this particular instance, the A and A' in the rubber polymer may be thermoplastic blocks containing a styrene moiety and B and B' may be elastomeric polymer blocks consisting of poly(ethylene-propylene).

[**0049**] In an additional embodiment, a polymer blend consisting of approximately 80% A-B-A'-B' tetrablock base rubber polymer, 7% polyethylene NA601 wax, and 13% REGALREZ™ 1126 tackifier may be used. As above, the A and A' in the rubber polymer may be thermoplastic blocks containing a styrene moiety and B and B' may be elastomeric polymer blocks consisting of poly(ethylene-propylene).

[**0050**] In another embodiment, a polymer blend consisting of approximately 70% A-B-A'-B' tetrablock base rubber polymer and 30% polyethylene NA601 wax may be utilized. As above, the A and A' in the rubber polymer may be thermoplastic blocks containing a styrene moiety and B and B' may be elastomeric polymer blocks consisting of poly(ethylene-propylene).

[**0051**] These various compositions may be utilized to form both the continuous filaments and the spunbond outer facing(s). However, the present invention is not limited to these or any particular polymer or material from which to form the continuous filaments. For example, various materials, including the following, may be used: polypropylene, polyethylene, polyesters, polyethylene terephthalate, polybutane, polymethyidentene, ethylenepropylene co-polymers, polyamides, tetrablock polymers, styrenic block copolymers, polyhexamethylene adipamide, poly-(oc-caproamide), polyhexamethylenesebacamide, polyvinyls, polystyrene, polyurethanes, thermoplastic polymers, polytrifluorochloroethylene, ethylene vinyl acetate polymers, polyetheresters, polyurethane, polyurethane elastomerics, polyamide elastomerics, polyamides, viscoelastic hot melt pressure sensitive adhesives, cotton, rayon, hemp and nylon. In addition, such materials may be utilized to extrude single-constituent, bi-constituent, and bi-component filaments within the scope of the presently described invention.

[**0052**] Other exemplary elastomeric materials that may be used include polyurethane elastomeric materials such as those available under the trademark ESTANE from B. F. Goodrich & Co., polyamide elastomeric materials such as those available under the trademark PEBAX from the Rilsan Company, and polyester elastomeric materials such as those available under trade designation HYTREL from E. I. DuPont De Nemours & Company.

[**0053**] However, the invention is not limited to only such elastomeric materials. For example, various latent elastic materials such as the Arnitel-brand polymers may be utilized to provide the necessary elasticity characteristics to the continuous filaments.

[0054] Various extruder dies may be utilized in forming the continuous filaments. In addition, various processing steps and parameters may be employed, depending on the characteristics desired in the final product. For example, the die of the extruder that forms the continuous filaments may be positioned with respect to the first roller so that the continuous filaments meet this first roller at a predetermined angle. The angle between the die exit of the extruder and the vertical axis (or the horizontal axis of the first roller, depending on which angle is measured) may be as little as a few degrees or as much as 90°. Angles such as about 20°, about 35°, or about 45° away from vertical may be utilized.

[0055] The rollers are positioned and operated so as to cause the continuous filaments to be stretched as they vertically flow through the bank of rollers. Each successive roller turns in a direction opposite to the immediately preceding roller so that the strands of continuous filaments are handed off from roller to roller. In addition, the speed of each successive roller may be varied from the preceding roller so as to obtain the desired stretching and elongation characteristics.

[0056] The number of separate rollers used to convey the continuous filaments to the bonding location may vary depending on the particular attributes desired in the final product. In one particular embodiment, at least four rollers—a first chilled (or positioning) roller, a second chilled roller, a third unchilled roller, and a fourth unchilled roller—may be utilized. In certain embodiments, the rollers may be plasma coated to provide good release properties. In other embodiments, the rollers may additionally be grooved or channeled to ensure that the extruded continuous filaments maintain a proper separation between individual filaments as the filaments pass over the surface of the rolls and flow through the system. In some embodiments, smooth rolls maybe used for one or all of the rolls. After passing through the chill rollers (either the series or the one or two chill rollers shown in **FIG. 6**) and becoming stretched, the continuous filaments are then conveyed into a position so that a sheet material may be bonded to the continuous filaments. In other embodiments, the number of rollers in the series may be substantially reduced. In fact, only one or two chilled rollers may be necessary to achieve the products of the present invention.

[0057] In certain embodiments, this sheet material will be less elastic than the continuous filaments. The sheet material may be various nonwoven webs such as meltblown webs, spunbond webs, or carded webs, various woven webs, or a film material. Certain enhanced properties and production efficiencies, however, arise from the use of polymeric spunbond nonwoven webs. In one particular embodiment, a polypropylene spunbond facing having a basis weight of approximately 0.4 ounces per square yard ("osy") may be employed.

[0058] The materials utilized to form the continuous filaments may also be utilized in forming the outer facings of the presently described laminate. In particular, various webs may be utilized that are formed from elastomeric or non-elastomeric fibers. Various polyester elastic materials are, for example, disclosed in U.S. Pat. No. 4,741,949 to Morman et al., which is incorporated herein in its entirety by reference thereto. Other useful elastomeric polymers also include, for example, elastic copolymers of ethylene and at least one vinyl monomer such as, for example, vinyl acetates, unsaturated aliphatic monocarboxylic acids, and esters of such monocarboxylic acids. The elastic copolymers and formation of elastomeric fibers from these elastic copolymers are disclosed in, for example, U.S. Pat. No. 4,803,117, which is also incorporated herein in its entirety by reference thereto.

[0059] The facing(s) of the present invention may be a mixture of elastic and nonelastic fibers or particulates. For example, U.S. Pat. No. 4,209,563 is incorporated herein in its entirety by reference thereto and describes the process by which elastomeric and nonelastomeric fibers are commingled to form a single coherent web of randomly dispersed fibers. Another example of such an elastic composite web is shown in U.S. Pat. No. 4,741,949, which is also incorporated herein in its entirety by reference thereto wherein an elastic nonwoven material is described as including a mixture of meltblown thermoplastic fibers and other materials. The fibers and other materials may be combined in the forming gas stream in which the fibers are borne so that an intimate entangled commingling of fibers and other materials, e.g., wood pulp, staple fibers or particulates such as, for example, activated charcoal, clays, starches, or hydrocolloid (hydrogel) particulates, occurs prior to collection of the fibers upon a collecting device to form a coherent web of randomly dispersed fibers.

[0060] Various processing aids may also be added to the elastomeric polymers utilized in the present invention. For example, a polyolefin may be blended with the elastomeric polymer (e.g., the A-B-A elastomeric block copolymer) to improve the processability of the composition. The polyolefin should be one which, when so blended and subjected to an appropriate combination of elevated pressure and elevated temperature conditions, is extrudable in blended form with the elastomeric polymer. Useful blending polyolefin materials include, for example, polyethylene, polypropylene and polybutene, including ethylene copolymers, propylene copolymers and butene copolymers. A particularly useful polyethylene may be obtained from the U.S.I. Chemical Company under the trade designation Petrothene NA 601 (also referred to herein as PE NA 601 or polyethylene NA 601). Two or more of the polyolefins may be utilized. Extrudable blends of elastomeric polymers and polyolefins are disclosed in, for example, U.S. Pat. No. 4,663,220, which is incorporated herein in its entirety by reference thereto.

[0061] The elastomeric materials that are utilized to form the melt-spray adhesive and/or the elastomeric filaments may have sufficient tackiness to enhance the bonding strength of the laminate by allowing a degree of autogenous bonding. For example, the elastomeric polymer itself may be tacky when formed into fibers and/or filaments or, alternatively, a compatible tackifying resin may be added to the extrudable elastomeric compositions described above to provide tackified elastomeric fibers and/or filaments that autogenously bond. Various known tackifying resins and tackified extrudable elastomeric compositions may be employed, such as those described in U.S. Pat. No. 4,787,699, which is incorporated herein in its entirety by reference thereto.

[0062] Any tackifier resin can be used that is compatible with the elastomeric polymer and can withstand the extrusion processing conditions. If the elastomeric polymer (e.g., A-B-A elastomeric block copolymer) is blended with processing aids such as, for example, polyolefins or extending oils, the tackifier resin should also be compatible with those processing aids. Generally, hydrogenated hydrocarbon resins exhibit enhanced temperature stability and, thus, may be desirable tackifiers. REGALREZ™ hydrocarbon and ARKON™ series tackifiers are examples of hydrogenated hydrocarbon resins. ZONATAK™ 501 lite is an example of a terpene hydrocarbon. REGALREZ™ hydrocarbon resins are available from Hercules Incorporated. ARKON™ series resins are available from Arakawa Chemical (U.S.A.) Incorporated. Of course, the present invention is not limited to use of such tackifying resins, and other tackifying resins that are compatible with the other components of the composition and that can withstand the processing conditions may also be used.

[0063] The adhesive employed to bond the continuous filaments to the sheet(s) will be applied to the laminate after the continuous filaments have been positioned on the sheet(s). The adhesive lines may be applied by using a stationary spray head capable of forming the predetermined pattern or by using moving nozzle(s) that are designed to follow the predetermined pattern path required for the adhesive line. In addition, one or two, or more, spray heads may be utilized. Various equipment for applying the adhesive lines of the present invention may be utilized and the invention is not limited to any particular apparatus.

[0064] In general, the adhesive bonds anchoring the elastic strands in the present laminate are regulated per unit area by the application system such that key properties such as stretch and elongation can be controlled to precisely match product performance needs.

[0065] This invention allows for the optimization of the adhesive, elastomer, and facings in the laminate, thus providing a preferred match of laminate properties and laminate cost. Laminate properties that can be more precisely adjusted with this invention include the softness or drapability of the material—a minimal amount of adhesive can be utilized to provide a less rigid structure. Further, the laminate tension characteristics can be better tailored to product requirements using this invention because the adhesive bonds can be prescribed and/or predetermined along the elastic strands. Thus, a minimal number of the adhesive bonds can be used in certain embodiments to allow more flexibility in the elastomer. Laminate elongation and retraction properties also may be designed to meet product needs by controlling the number of adhesive bonding sites. The level of strand slippage in the laminate (i.e., the amount that the strands slide between the facings among bonding sites) may be regulated to meet product needs by also prescribing the number of adhesive bonding sites. The amount of laminate bulk may be also be modulated since the retraction and resulting buckling of the facings can be controlled due in part to the ability to regulate the number of adhesive bond sites along the elastic strands.

[0066] Adhesives are typically employed in laminates of the type provided by the present invention because the facing materials and elastomeric components are constructed of polymers that often do not readily bond to each other. The use of an external adhesive-bonding agent, however, rectifies this problem. In addition, the elastomer utilize to form the continuous filaments may be pre-compounded with a selective adhesive component that readily migrates to the surface of the elastic, thus making the continuous filaments perform more like a sheath-core filament. This migration to the surface can provide the needed bonding agent while preserving the elasticity of the elastomer.

[0067] Various types of adhesives may be employed in the present invention, including those having elastomeric properties such as Kraton®-containing adhesives that are available from the Findley Adhesives Company (known also as Bostik Findley). Among the various adhesives that may be employed are Findley-brand H2096 and Findley-brand H2525A.

[0068] In the absence of autogenous bonding, the adhesives may be used to bond the facings to the strands, and the facings to the facings. The particular adhesive system utilized may result in a composite fabric composite with improved texture and drape. Various adhesives as discussed herein or that are otherwise available may be employed in the present system. For some products, such as a coformed stretch-bonded laminate wet wipe, the use of a high melt flow rate metallocene-catalyzed polyethylene elastomeric resin that has low tack may be advantageously utilized to provide improved texture and drape. Because of its low melting temperature, such a resin is capable of forming a physical interlock when thermally bonded. That is, the resin can penetrate into porous facings.

[0069] Dow Chemical Company resins having a relatively low density (between about 0.86 and about 0.88 g/cm^3) may be efficiently utilized in the adhesive system of the present invention. Other Dow resins having lower melt flow rates have also demonstrated the ability to create a physical interlock under thermal bonding conditions. The resin also could be blended with a tackifier or a lower melt flow elastomer to produce an optimized adhesive system. High melt flow elastomers may be suitable as alternate adhesive systems in the VFL process described herein.

[0070] The system employs nip rolls to apply pressure to the adhesive-coating facing and the continuous filaments to result in the necessary lamination. The outer facing is bonded together with the continuous filaments at a fairly high surface pressure, which may be between about 20 and about 300 pounds per linear inch ("pli"). A typical bonding pressure may be about 50 pli or about 100 pli.

[0071] The bonder, or nip roll, (sometimes referred to as "laminator") section of the laminating apparatus performs the primary stretching on the continuous filaments. The speed ratio of the bonder or nip rolls relative to the chilled rolls can be varied, and in most cases is between about 2:1 and 8:1, and in some approximately 4:1 to 6:1.

[0072] In certain embodiments, one or more additional facings may be bonded to the other unattached surface of the stretched continuous filaments so as to achieve a stretchable article wherein the continuous filaments are sandwiched between at least two outer facings. Various bonding techniques may be utilized to form this two-layer/continuous filament laminate. The adhesive line techniques of the present invention may be employed or known melt-spray techniques may be employed, depending on the particular characteristics desired in the final product. The requirement of the present invention is that at least one of the facings is bonded to the continuous filaments utilizing the described predetermined patterns.

[0073] Several patents describe various spray apparatuses and methods that may be utilized in supplying the meltspray adhesive to the outer facing(s) or, when desired, to the elastic strands themselves. For example, the following United States patents assigned to Illinois Tool Works, Inc. ("ITW") are directed to various means of spraying or meltblowing fiberized hot melt adhesive onto a substrate: U.S. Pat. Nos. 5,882,573; 5,902,540; 5,904,298. These patents are incorporated herein in their entireties by reference thereto. The types of adhesive spray equipment disclosed in the aforementioned patents are generally efficient in applying the adhesive onto the nonwoven facings in the process of this invention. In particular, ITW-brand Dynatec spray equipment, which is capable of applying about 3 gsm of adhesive at a run rate of about 1100 fpm, has been used successfully in the melt-spray adhesive applications contemplated by the present inventive process.

[0074] After bonding of the facing(s) to the continuous filaments to form a spunbond/elastomeric continuous filament/spunbond laminate, the laminate is then allowed to relax and contract to an unstretched or less stretched, condition. The laminate is then wound onto a take-up roll via a surface driven winder. The speed ratio of the winder relative to the bonder rollers results in relaxation of the stretched continuous filaments and a retraction of the laminate into a gathered state as the laminate is wound onto the roll. The contraction of the continuous filaments results in a gathered, stretchable laminate article where the outer facing(s) is gathered between the bonding points.

[0075] The overall basis weight of the laminate can vary, but in some applications is between about 2 and about 4 ounces per square yard ("osy"). In one particular embodiment, the basis weight is between about 2.85 and about 3.2 osy.

[0076] **FIG. 1** illustrates an exemplary vertically-configured apparatus **11** for forming the continuous filament/spunbond laminates of the present invention. An extruder **15** is mounted for extruding continuous molten filaments **14** downward from a die at a canted angle onto chilled positioning roller **12**. Chilled positioning roller **12** ensures proper alignment through the remainder of the system as it spreads the filaments. As the filaments travel over the surface of chilled positioning roller **12**, they are cooled and solidified as they travel towards and over the chilled surface of first chilled roller **13**. The filaments then travel downward in an "s-shaped" progression, in this particular embodiment, to second roller **16** and then across the surface of third roller **17**, fourth roller **18** and into the nip formed by nip roller **19** and nip roller **20**.

[0077] The continuous filaments may be combined at the nip with various types of facings. In the embodiment depicted in **FIG. 1, a** first non-woven spunbond facing **22** and second non-woven spunbond facing **24** are combined on opposing surfaces of the continuous filaments to form a bonded laminate **25**. In some embodiments, only one facing may be used, and in other embodiments it is possible to combine the elastic continuous filaments with three, four, or more layers of facing material.

[0078] Bonding of the facings to the continuous filaments typically occurs by utilizing an adhesive as described above. The adhesive may be applied with a stationary spray head **23** that delivers adhesive to the surface of at least one of the non-woven spunbond facings in a predetermined adhesive line pattern or may be applied with a moving adhesive nozzle (not shown) that is guided on the apparatus to follow the predetermined bonding pattern. As shown in **FIG. 1**, stationary spray head **23** may be positioned on the back side of the point where facing **22** will meet with continuous filaments **14**. Nip rollers **19** and **20** may be aligned so that adhesive **50** can be applied to the continuous filaments **14** and facing **22** as they are brought together into the laminating nip section. A second adhesive-applying spray head or nozzle (not shown) may be employed in some embodiments to provide an adhesive line to the other facing **24** to allow bonding to the other surface of the continuous filaments.

[0079] Alternatively, the adhesive may be applied to the surface of the nonwoven sheet material prior to the sheet material being placed into contact with the continuous filaments. In this embodiment, the facing carries the adhesive lines until the continuous filaments are brought into adhering contact at the adhesive bonding points.

[0080] In another embodiment of the present system, the aforementioned series of s-wrap rollers may be eliminated as shown in **FIG. 6**. In this Figure, as in **FIG. 1**, an exemplary apparatus is depicted in order to carry out the above-described process. The VFL system **111** is vertically configured. An extruder **115** is mounted for extruding continuous molten filaments **114** downward from a die at a canted angle onto chilled positioning roller **112**. Chilled positioning roller **112** ensures proper alignment through the remainder of the system as it spreads the filaments. As the filaments travel over the surface of chilled positioning roller **112**, they are cooled and solidified as they travel towards and over the chilled surface of chilled roller **113**. As in other embodiments, the filaments then travel downward toward the laminator section of the system comprising a nip formed by nip roller **119** and nip roller **120**, but in this instance, do so without the need for the series of s-wrap rollers described above. The continuous filaments in this embodiment may also be combined at the nip with various types of facings. In the embodiment depicted in **FIG. 6, a** first non-woven spunbond facing **122** and a second non-woven spunbond facing **124** are combined on opposing surfaces of the continuous filaments to form a bonded laminate **125**. The spunbond facings **122** and **124** are provided to the nip by first outer facing roll **127** and second outer facing roll **128**.

[0081] Bonding of the facings to the continuous filaments is accomplished in this embodiment by the use of two spray-type adhesive applicators. A spray head **123** delivers adhesive to the surface of at least one of the non-woven spunbond facings **122** prior to compression and lamination at the nip; and a second spray head **152** applies adhesive to the other non-woven spunbond facing **124**.

[0082] Take-up roll **21** (shown in **FIG. 1**) may be employed for receiving and winding the bonded spunbond/continuous filament/spunbond laminate **25** for storage.

[0083] **FIG. 3A** illustrates one exemplary adhesive pattern useful in the present invention in which the adhesive has been applied to the elastic filaments with attenuation of the adhesive lines in the cross-machine direction. Pattern **35** includes adhesive lines **36** and elastic filaments **30**. This pattern utilizes only adhesive-to-elastic bonds.

[**0084**] **FIG. 3B** illustrates another exemplary scrim pattern **38** having adhesive lines **39** applied to elastic strands **30** and the adhesive lines **39** themselves. This pattern takes advantage of additional bonding at the adhesive-to-adhesive points. In fact, the adhesive overlaps itself in a generally perpendicular fashion to provide greater bonding strength. The bond angle is very high, approaching 90° at the intersection between the adhesive and the elastic filaments.

[**0085**] **FIG. 3C** illustrates another scrim pattern **41** having adhesive lines **42** and continuous elastic strands **30**. This embodiment utilizes adhesive-to-adhesive bonding, but not to the extent of the pattern illustrated in **FIG. 3B**.

[**0086**] **FIG. 3D** illustrates the relatively high bond angle that may be employed in products produced according to the present invention. In particular, lay down angle **44** is shown as the angle formed by the adhesive line **48** and the elastic strand **30**. Adhesive/elastic angle **46** and adhesive/elastic angle **45** are shown as being less than 90°.

[**0087**] **FIG. 4** utilizes an exemplary bonding pattern to conceptually illustrate the measurement for determining the number of bonds per unit length on elastic strands or filaments. By employing specified bonds per unit length, various desirable characteristics can be obtained.

[**0088**] **FIG. 5A** shows another exemplary bonding pattern employing adhesive-to-adhesive bonding wherein a swirled type of configuration is employed. **FIG. 5B** illustrates a more randomized pattern wherein a large percentage of adhesive lines are in a perpendicular, or almost perpendicular, orientation to the elastic filaments. **FIG. 5C** is another exemplary embodiment of a bonding pattern having no adhesive-to-adhesive bonds, but numerous adhesive-to-elastic strand bonds.

[**0089**] **FIG. 5D** illustrates another exemplary bonding pattern that has both adhesive-to-adhesive and adhesive-to-elastic strand bonds. The configuration shown in **FIG. 5D** is similar to the design of a chain-link fence and provides excellent bonding strength.

[**0090**] The present invention may be better understood by reference to the Examples below. However, it is to be understood that the invention is not limited thereto.

EXAMPLE 1

[**0091**] In this Example, an ITW-brand nozzle having 17 holes per inch was employed for creating and analyzing various spray pattern characteristics. In particular, an adhesive polymer melt (Findley-brand H2525A) was employed at various fiber diameters, basis weights, and nozzle pressures to determine percent coverage and orientation (i.e., "anisotropy"). Orientation is the tangent of the average orientation of the spray pattern. In Table 1, when the orientation is less than 1.000, then orientation of the adhesive spray was in the machine direction and when the orientation is more than 1.000, then orientation of the adhesive spray was in the cross-machine direction. When the orientation has a value of 1.00, then the orientation is 45°, meaning that the orientation is neither dominant in the machine direction nor in the cross-machine direction. In addition, coverage is the ratio of adhesive presence to no adhesive presence. "%COV" equals 100(standard deviation/mean of the percent-area histogram), with the smaller % coverage exhibiting better overlap of the adhesive to form the adhesive-to-adhesive bonds. "Formation" is the coefficient of variation for formation. The fiber diameter is the average fiber size in micro-milliliters.

TABLE 1

Basis Weight	PSI	Fiber Diameter, mean (μm)	Orientation (Tan θ)	Formation, % Coverage	Coverage, % Area
3	20	85.4	1.20	33.5	14.2
3	40	53.9	1.18	23.6	16.9
4	40	79.9	1.16	29.5	20.8
3	60	65.1	1.13	16.5	23.7
3	80	55.6	0.89	13.6	23.1

EXAMPLE2

[**0092**] In this Example, an ITW-brand nozzle having 5 holes per inch was employed for creating and analyzing various spray pattern characteristics. In particular, an adhesive polymer melt (Findley-brand H2525A) was employed as described above at various fiber diameters, basis weights, and nozzle pressures.

TABLE 2

Basis Weight	PSI	Fiber Diameter, mean (μm)	Orientation (Tan θ)	Formation, % Coverage	Coverage, % Area
3	16	139	1.18	41.9	11.9
3	30	120	1.37	34.3	12.2
4	16	152	1.49	27.6	14.6

EXAMPLE 3

[**0093**] In this Example, an ITW-brand nozzle having 14 holes per inch was employed for creating and analyzing various spray pattern characteristics. In particular, an adhesive polymer melt consisting of Findley-brand H2096 was employed at various fiber diameters, nozzle pressures, and basis weights as above to determine percent coverage and orientation. The temperature of the adhesive was 360° F. and the temperature of the air was 420° F. The height of the nozzle above the laydown materials was 1.25 inches. As with Table 1, when the orientation is less than 1.000, then orientation of the adhesive spray was in the machine direction and when the orientation is more than 1.000, then orientation of the adhesive spray was in the cross-machine direction. In addition, "%COV" equals 100(standard deviation/mean of the percent-area histogram), with the smaller % coverage exhibiting better overlap of the adhesive to form the adhesive-to-adhesive bonds.

[**0094**] The lines speeds of the various samples were varied. The first four samples employed a line speed of 500 feet per minute; the next three samples employed a line speed of 1000 feet per minute; and the last seven samples employed a line speed of 1500 feet per minute.

TABLE 3

Basis Weight	PSI	Fiber Diameter, mean (μm)	Orientation (Tan θ)	Formation, % Coverage	Coverage, % Area
1.5	11	128	1.095	48.1	15.6
1.5	17	116	1.19	37.7	19.6
3.0	11	153	1.439	33.5	24.8
3.0	17	135	1.488	25.7	24.8
1.5	17	134	1.259	37.1	14
3.0	17	157	1.12	37.5	17.6
3.0	17	158	1.425	48.1	18.2
1.5	17	139	0.807	29.4	25.6
1.5	17	129	0.869	36.7	24.8
1.5	23	139	0.996	45.2	14.2
1.5	23	135	1.118	39.3	13.8
3.0	17	160	0.913	34.3	34.4
3.0	17	163	0.944	29.2	33.2
3.0	23	160	1.007	17.8	14.6

[0095] It is understood by one of ordinary skill in the art that the present discussion is a description of exemplary embodiments only, and is not intended as limiting the broader aspects of the present invention, which broader aspects are embodied in the exemplary constructions. The invention is shown by example in the appended claims.

What is claimed is:

1. An laminated fabric article comprising:

(a) a facing layer;

(b) a plurality of elastic filaments adjacent to a surface of the facing layer; and

(c) an adhesive component, wherein the adhesive component is applied to the surface of the nonwoven layer in adhesive lines, the adhesive lines intersecting both the elastic filaments and themselves to form a bonding network comprised of adhesive-to-elastic bonds, adhesive-to-facing layer, and adhesive-to-adhesive bonds.

2. The laminated fabric article of claim 1 wherein said adhesive lines intersect said elastic filaments at an angle of greater than 45° and less than 90°.

3. The laminated fabric article of claim 1 wherein said adhesive lines intersect said elastic filaments at an angle of between about 50° and about 90°.

4. The laminated fabric article of claim 1 wherein said adhesive lines intersect said elastic filaments at an angle of between about 60° and about 90°.

5. The laminated fabric article of claim 1 wherein said adhesive lines intersect said elastic filaments at an angle of about 60°.

6. The laminated fabric article of claim 1 comprising an additional facing.

7. The laminated fabric article of claim 1 wherein said adhesive component is about 3 to about 5 gsm in weight.

8. The laminated fabric article of claim 1 wherein said article has a basis weight of between about 2 to about 4 osy.

9. The laminated fabric article of claim 1 wherein said facing layer comprises a spunbonded nonwoven web.

10. The laminated fabric article of claim 6 wherein said additional facing comprises a spunbonded nonwoven web.

11. The laminated fabric article of claim 6 wherein said continuous filaments and said adhesive component are between said facing layers.

12. A method of manufacturing a laminated fabric article comprising:

(a) providing a facing layer;

(b) providing a plurality of elastic filaments adjacent to a surface of the facing layer; and

(c) applying an adhesive component to bond said elastic filaments to said facing layer in adhesive lines that intersect both the elastic filaments and themselves to form a bonding network comprised of adhesive-to-elastic bonds, adhesive-to-facing layer, and adhesive-to-adhesive bonds.

13. The method of claim 12 further comprising the steps of:

providing a second facing layer and applying an adhesive component to said second facing layer to bond said elastic filaments to said facing layer in adhesive lines that intersect both the elastic filaments and themselves to form a bonding network comprised of adhesive-to-elastic bonds, adhesive-to-facing layer, and adhesive-to-adhesive bonds.

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