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(71) **Applicant** (for all designated States except US): **KIMBERLY-CLARK WORLDWIDE, INC.** [US/US]; Neenah, Wisconsin 54956 (US).

(72) Inventors; and

(75) **Inventors/Applicants (for US only): WILSON, Lenox** [US/US]; 6185 Yorkridge Drive, Alpharetta, Georgia 30005-2200 (US). **AMENDOLA, Marcus** [US/US]; 925 Canterbury Road, NE Apt. 1121, Atlanta, Georgia 30324 (US). **KRUEGER, Jeffrey** [US/US]; 1050 Cranberry Creek, Roswell, Georgia 30076 (US). **LAKE, Matthew** [US/US]; 6640 Fox Creek Drive, Cumming, Georgia

30040 (US). **MCCORMACK, Ann** [US/US]; 262 White-water Trail, Dahlonega, Georgia 30533 (US).

(74) **Agents:** **FLACK, Steven, D.** et al.; 2300 Winchester Road, Neenah, WI 54956 (US).

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(54) Title: METHOD OF MAKING A SMOOTH ELASTIC NONWOVEN COMPOSITE

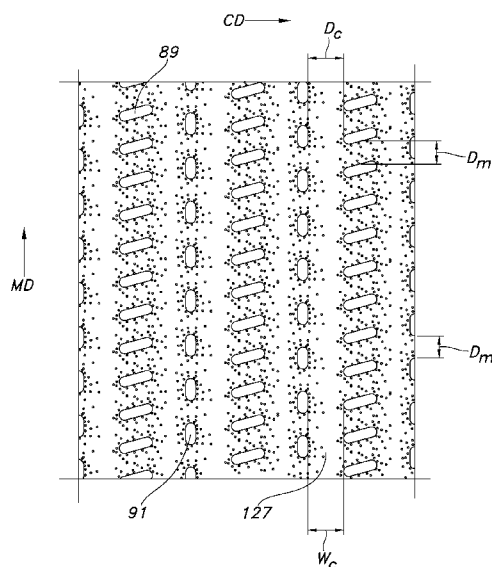


FIG. 2

(57) Abstract: A method making an elastic nonwoven composite that contains an elastic film laminated to one or more nonwoven web materials is provided. The method includes forming an elastic film from a polymer composition and passing the film and a nonwoven web material, the nonwoven material having a basis weight from about 5 gsm to about 30 gsm, through a nip formed by at least one patterned roll. The patterned roll includes raised bonding elements repeating in the machine direction, the elements being spaced in the machine direction by less than about 760 micrometers. At the nip, the film and the nonwoven web material are concurrently melt fused while the film is under tension at a stretch ratio of about .5 or more in the machine direction.



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METHOD OF MAKING A SMOOTH ELASTIC NONWOVEN COMPOSITE

Background of the Invention

Elastic composites are commonly incorporated into disposable absorbent products (e.g., diapers, training pants, garments, etc.) to improve their ability to better fit the contours of the body. For example, the elastic composite may be formed from an elastic film and one or more nonwoven web materials. The nonwoven web material may be joined to the elastic film while the film is in a stretched condition so that the nonwoven web material can gather between the locations where it is bonded to the film when it is relaxed. The resulting elastic composite is stretchable to the extent that the nonwoven web material gathered between the bond locations allows the elastic film to elongate. Unfortunately, the nonwoven web material gathered between the bond locations can result in an elastic composite material that is excessively textured and excessively thick. That is, when the nonwoven web material gathers, it may result in areas of gathered nonwoven web that extend from the surface of the film to create a bumpy or textured surface. Users of the disposable absorbent products value discreteness, so there is a desire for thinner products that are not as visible when worn underneath clothing. Therefore, there remains a need for elastic nonwoven composites that are thinner with improved surface smoothness, yet still provide the desired elastic performance.

Summary of the Invention

In accordance with one embodiment of the present invention, a method of forming a smooth elastic nonwoven/film composite is disclosed. The method includes forming an elastic film from a polymer composition and passing the film and a nonwoven web material, the nonwoven web material having a basis weight from about 5 gsm to about 30 gsm, through a nip formed by at least one patterned roll. The patterned roll includes raised bonding elements repeating in the machine direction, the elements being spaced in the machine direction by less than about 760 micrometers. At the nip, the film and the nonwoven web material are concurrently melt fused while the film is under tension at a stretch ratio of about 1.5 or more in the machine direction. In some embodiments, the raised bonding elements further create apertures in the film, the apertures having a perimeter about which bond sites are proximately located.

Other features and aspects of the present invention are described in more detail below.

Brief Description of the Drawings

A full and enabling disclosure of the present invention, including the best mode thereof, directed to one of ordinary skill in the art, is set forth more particularly in the remainder of the specification, which makes reference to the appended figures in which:

Fig. 1 schematically illustrates a method for forming a composite according to one embodiment of the present invention;

Fig. 2 illustrates one embodiment of a “rib-knit” bonding pattern that may be used in accordance with the present invention;

Fig. 3 illustrates one embodiment of a “wire-weave” bonding pattern that may be used in accordance with the present invention;

Fig. 4 is a perspective view of grooved rolls that may be used in one embodiment of the present invention; and

Fig. 5 is a cross-sectional view showing the engagement between two of the grooved rolls of Fig. 4;

Fig. 6 is cross-sectional view of one embodiment of the nonwoven composite of the present invention;

Fig. 7 is a perspective view of a personal care product that may be formed in accordance with one embodiment of the present invention.

Repeat use of reference characters in the present specification and drawings is intended to represent same or analogous features or elements of the invention.

Detailed Description of Representative Embodiments

Definitions

As used herein the term “nonwoven web” generally refers to a web having a structure of individual fibers or threads which are interlaid, but not in an identifiable manner as in a knitted fabric. Examples of suitable nonwoven fabrics or webs include, but are not limited to, meltblown webs, spunbond webs, bonded carded webs, airlaid webs, coform webs, hydraulically entangled webs, and so forth.

As used herein, the term “meltblown web” generally refers to a nonwoven web that is formed by a process in which a molten thermoplastic material is

extruded through a plurality of fine, usually circular, die capillaries as molten fibers into converging high velocity gas (e.g. air) streams that attenuate the fibers 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 dispersed meltblown fibers. Such a process is disclosed, for example, in U.S. Pat. No. 3,849,241 to Butin, et al., which is incorporated herein in its entirety by reference thereto for all purposes. Generally speaking, meltblown fibers may be microfibers that are substantially continuous or discontinuous, generally smaller than 10 micrometers in diameter, and generally tacky when deposited onto a collecting surface.

As used herein, the term "spunbond web" generally refers to a web containing small diameter substantially continuous fibers. The fibers are formed by extruding a molten thermoplastic material from a plurality of fine, usually circular, capillaries of a spinnerette with the diameter of the extruded fibers then being rapidly reduced as by, for example, eductive drawing and/or other well-known spunbonding mechanisms. The production of spunbond webs is described and illustrated, for example, in U.S. Patent Nos. 4,340,563 to Appel, et al., 3,692,618 to Dorschner, et al., 3,802,817 to Matsuki, et al., 3,338,992 to Kinney, 3,341,394 to Kinney, 3,502,763 to Hartman, 3,502,538 to Levy, 3,542,615 to Dobo, et al., and 5,382,400 to Pike, et al., which are incorporated herein in their entirety by reference thereto for all purposes. Spunbond fibers are generally not tacky when they are deposited onto a collecting surface. Spunbond fibers may sometimes have diameters less than about 40 micrometers, and are often between about 5 to about 20 micrometers.

As used herein, the terms "machine direction" or "MD" generally refers to the direction in which a material is produced. The term "cross-machine direction" or "CD" refers to the direction perpendicular to the machine direction.

As used herein the terms "extensible" or "extensibility" generally refers to a material that stretches or extends in the direction of an applied force by at least about 25%, in some embodiments about 50%, and in some embodiments, at least about 75% of its relaxed length or width. An extensible material does not necessarily have recovery properties. For example, an elastomeric material is an

extensible material having recovery properties. A meltblown web may be extensible, but not have recovery properties, and thus, be an extensible, non-elastic material.

As used herein, the term “elastomeric” and “elastic” and refers to a material that, upon application of a stretching force, is stretchable in at least one direction (such as the CD direction), and which upon release of the stretching force, contracts/returns to approximately its original dimension. For example, a stretched material may have a stretched length that is at least 50% greater than its relaxed unstretched length, and which will recover to within at least 50% of its stretched length upon release of the stretching force. A hypothetical example would be a one (1) inch sample of a material that is stretchable to at least 1.50 inches and which, upon release of the stretching force, will recover to a length of not more than 1.25 inches. Desirably, the material contracts or recovers at least 50%, and even more desirably, at least 80% of the stretched length.

As used herein, the terms “necked” and “necked material” generally refer to any material that has been drawn in at least one dimension (e.g., machine direction) to reduce its transverse dimension (e.g., cross-machine direction) so that when the drawing force is removed, the material may be pulled back to its original width. The necked material generally has a higher basis weight per unit area than the un-necked material. When the necked material is pulled back to its original width, it should have about the same basis weight as the un-necked material. This differs from the orientation of a film in which the film is thinned and the basis weight is reduced. The necking method typically involves unwinding a material from a supply roll and passing it through a brake nip roll assembly driven at a given linear speed. A take-up roll or nip, operating at a linear speed higher than the brake nip roll, draws the material and generates the tension needed to elongate and neck the material.

As used herein, the term “thermal point bonding” generally refers to a process performed, for example, by passing a material between a patterned roll (e.g., calender roll) and another roll (e.g., anvil roll), which may or may not be patterned. One or both of the rolls are typically heated.

As used herein, the term “ultrasonic bonding” generally refers to a process performed, for example, by passing a material between a sonic horn and a

patterned roll (e.g., anvil roll). For instance, ultrasonic bonding through the use of a stationary horn and a rotating patterned anvil roll is described in U.S. Patent Nos. 3,939,033 to Grgach, et al., 3,844,869 to Rust Jr., and 4,259,399 to Hill, which are incorporated herein in their entirety by reference thereto for all purposes.

Moreover, ultrasonic bonding through the use of a rotary horn with a rotating patterned anvil roll is described in U.S. Patent Nos. 5,096,532 to Neuwirth, et al., 5,110,403 to Ehlert, and 5,817,199 to Brennecke, et al., which are incorporated herein in their entirety by reference thereto for all purposes. Of course, any other ultrasonic bonding technique may also be used in the present invention.

Detailed Description

Reference now will be made in detail to various embodiments of the invention, one or more examples of which are set forth below. Each example is provided by way of explanation, not limitation of the invention. In fact, it will be apparent to those skilled in the art that various modifications and variations may be made in the present invention without departing from the scope or spirit of the invention. For instance, features illustrated or described as part of one embodiment, may be used on another embodiment to yield a still further embodiment. Thus, it is intended that the present invention cover such modifications and variations.

Generally speaking, the present invention is directed to a nonwoven composite that contains an elastic film laminated to one or more nonwoven web materials. The composite is formed by passing the film through a nip to bond the film to the nonwoven web material(s). The nip is formed by at least one patterned roll having raised bonding elements repeating in the machine direction. The raised bonding elements have a spacing in the machine direction desirably less than about 760 micrometers. Concurrent with bond formation, apertures may be formed in the elastic film. The spacing of the bond elements suitably provides a gathered elastic laminate having a desirable surface smoothness. In this regard, various embodiments of the present invention will now be described in more detail.

I. Elastic Film

The elastic film of the present invention is formed from one or more elastomeric polymers that are melt-processable, i.e. thermoplastic. Any of a variety of thermoplastic elastomeric polymers may generally be employed in the

present invention, such as elastomeric polyesters, elastomeric polyurethanes, elastomeric polyamides, elastomeric copolymers, elastomeric polyolefins, and so forth. In one particular embodiment, elastomeric semi-crystalline polyolefins are employed due to their unique combination of mechanical and elastomeric properties. That is, the mechanical properties of such semi-crystalline polyolefins allows for the formation of films that readily aperture during thermal bonding, but yet retain their elasticity.

Semi-crystalline polyolefins have or are capable of exhibiting a substantially regular structure. For example, semi-crystalline polyolefins may be substantially amorphous in their undeformed state, but form crystalline domains upon stretching. The degree of crystallinity of the olefin polymer may be from about 3% to about 30%, in some embodiments from about 5% to about 25%, and in some embodiments, from about 5% and about 15%. Likewise, the semi-crystalline polyolefin may have a latent heat of fusion (ΔH_f), which is another indicator of the degree of crystallinity, of from about 15 to about 75 Joules per gram ("J/g"), in some embodiments from about 20 to about 65 J/g, and in some embodiments, from 25 to about 50 J/g. The semi-crystalline polyolefin may also have a Vicat softening temperature of from about 10°C to about 100°C, in some embodiments from about 20°C to about 80°C, and in some embodiments, from about 30°C to about 60°C. The semi-crystalline polyolefin may have a melting temperature of from about 20°C to about 120°C, in some embodiments from about 35°C to about 90°C, and in some embodiments, from about 40°C to about 80°C. The latent heat of fusion (ΔH_f) and melting temperature may be determined using differential scanning calorimetry ("DSC") in accordance with ASTM D-3417 as is well known to those skilled in the art. The Vicat softening temperature may be determined in accordance with ASTM D-1525.

Exemplary semi-crystalline polyolefins include polyethylene, polypropylene, blends and copolymers thereof. In one particular embodiment, a polyethylene is employed that is a copolymer of ethylene and an α -olefin, such as a C₃-C₂₀ α -olefin or C₃-C₁₂ α -olefin. Suitable α -olefins may be linear or branched (e.g., one or more C₁-C₃ alkyl branches, or an aryl group). Specific examples include 1-butene; 3-methyl-1-butene; 3,3-dimethyl-1-butene; 1-pentene; 1-pentene with one or more

methyl, ethyl or propyl substituents; 1-hexene with one or more methyl, ethyl or propyl substituents; 1-heptene with one or more methyl, ethyl or propyl substituents; 1-octene with one or more methyl, ethyl or propyl substituents; 1-nonene with one or more methyl, ethyl or propyl substituents; ethyl, methyl or dimethyl-substituted 1-decene; 1-dodecene; and styrene. Particularly desired α -olefin comonomers are 1-butene, 1-hexene and 1-octene. The ethylene content of such copolymers may be from about 60 mole% to about 99 mole%, in some embodiments from about 80 mole% to about 98.5 mole%, and in some embodiments, from about 87 mole% to about 97.5 mole%. The α -olefin content may likewise range from about 1 mole% to about 40 mole%, in some embodiments from about 1.5 mole% to about 15 mole%, and in some embodiments, from about 2.5 mole% to about 13 mole%.

The density of the polyethylene may vary depending on the type of polymer employed, but generally ranges from 0.85 to 0.96 grams per cubic centimeter (g/cm^3). Polyethylene "plastomers", for instance, may have a density in the range of from 0.85 to 0.91 g/cm^3 . Likewise, "linear low density polyethylene" ("LLDPE") may have a density in the range of from 0.91 to 0.940 g/cm^3 ; "low density polyethylene" ("LDPE") may have a density in the range of from 0.910 to 0.940 g/cm^3 ; and "high density polyethylene" ("HDPE") may have density in the range of from 0.940 to 0.960 g/cm^3 . Densities may be measured in accordance with ASTM 1505.

Particularly suitable polyethylene copolymers are those that are "linear" or "substantially linear." The term "substantially linear" means that, in addition to the short chain branches attributable to comonomer incorporation, the ethylene polymer also contains long chain branches in that the polymer backbone. "Long chain branching" refers to a chain length of at least 6 carbons. Each long chain branch may have the same comonomer distribution as the polymer backbone and be as long as the polymer backbone to which it is attached. Preferred substantially linear polymers are substituted with from 0.01 long chain branch per 1000 carbons to 1 long chain branch per 1000 carbons, and in some embodiments, from 0.05 long chain branch per 1000 carbons to 1 long chain branch per 1000 carbons. In contrast to the term "substantially linear", the term "linear" means that the polymer lacks measurable or demonstrable long chain branches. That is, the polymer is

substituted with an average of less than 0.01 long chain branch per 1000 carbons.

The density of a linear ethylene/ α -olefin copolymer is a function of both the length and amount of the α -olefin. That is, the greater the length of the α -olefin and the greater the amount of α -olefin present, the lower the density of the copolymer. Although not necessarily required, linear polyethylene "plastomers" are particularly desirable in that the content of α -olefin short chain branching content is such that the ethylene copolymer exhibits both plastic and elastomeric characteristics – i.e., a "plastomer." Because polymerization with α -olefin comonomers decreases crystallinity and density, the resulting plastomer normally has a density lower than that of polyethylene thermoplastic polymers (e.g., LLDPE), but approaching and/or overlapping that of an elastomer. For example, the density of the polyethylene plastomer may be 0.91 grams per cubic centimeter (g/cm^3) or less, in some embodiments, from 0.85 to 0.88 g/cm^3 , and in some embodiments, from 0.85 g/cm^3 to 0.87 g/cm^3 . Despite having a density similar to elastomers, plastomers generally exhibit a higher degree of crystallinity, are relatively non-tacky, and may be formed into pellets that are non-adhesive and relatively free flowing.

The distribution of the α -olefin comonomer within a polyethylene plastomer is typically random and uniform among the differing molecular weight fractions forming the ethylene copolymer. This uniformity of comonomer distribution within the plastomer may be expressed as a comonomer distribution breadth index value ("CDBI") of 60 or more, in some embodiments 80 or more, and in some embodiments, 90 or more. Further, the polyethylene plastomer may be characterized by a DSC melting point curve that exhibits the occurrence of a single melting point peak occurring in the region of 50 to 110°C (second melt rundown).

Preferred plastomers for use in the present invention are ethylene-based copolymer plastomers available under the designation EXACT™ from ExxonMobil Chemical Company of Houston, Texas. Other suitable polyethylene plastomers are available under the designation ENGAGE™ and AFFINITY™ from Dow Chemical Company of Midland, Michigan. Still other suitable ethylene polymers are available from The Dow Chemical Company under the designations DOWLEX™ (LLDPE) and ATTANE™ (ULDPE). Other suitable ethylene polymers

are described in U.S. Patent Nos. 4,937,299 to Ewen et al.; 5,218,071 to Tsutsui et al.; 5,272,236 to Lai, et al.; and 5,278,272 to Lai, et al., which are incorporated herein in their entirety by reference thereto for all purposes.

Of course, the present invention is by no means limited to the use of ethylene polymers. For instance, propylene polymers may also be suitable for use as a semi-crystalline polyolefin. Suitable plastomeric propylene polymers may include, for instance, copolymers or terpolymers of propylene include copolymers of propylene with an α -olefin (e.g., C_3 - C_{20}), such as ethylene, 1-butene, 2-butene, the various pentene isomers, 1-hexene, 1-octene, 1-nonene, 1-decene, 1-unidecene, 1-dodecene, 4-methyl-1-pentene, 4-methyl-1-hexene, 5-methyl-1-hexene, vinylcyclohexene, styrene, etc. The comonomer content of the propylene polymer may be about 35 wt.% or less, in some embodiments from about 1 wt.% to about 20 wt.%, and in some embodiments, from about 2 wt.% to about 10 wt.%. Preferably, the density of the polypropylene (e.g., propylene/ α -olefin copolymer) may be 0.91 grams per cubic centimeter (g/cm^3) or less, in some embodiments, from 0.85 to 0.88 g/cm^3 , and in some embodiments, from 0.85 g/cm^3 to 0.87 g/cm^3 . Suitable propylene polymers are commercially available under the designations VISTAMAXX[™] from ExxonMobil Chemical Co. of Houston, Texas; FINA[™] (e.g., 8573) from Atofina Chemicals of Feluy, Belgium; TAFMER[™] available from Mitsui Petrochemical Industries; and VERSIFY[™] available from Dow Chemical Co. of Midland, Michigan. Other examples of suitable propylene polymers are described in U.S. Patent No. 6,500,563 to Datta, et al.; 5,539,056 to Yang, et al.; and 5,596,052 to Resconi, et al., which are incorporated herein in their entirety by reference thereto for all purposes.

Any of a variety of known techniques may generally be employed to form the semi-crystalline polyolefins. For instance, olefin polymers may be formed using a free radical or a coordination catalyst (e.g., Ziegler-Natta). Preferably, the olefin polymer is formed from a single-site coordination catalyst, such as a metallocene catalyst. Such a catalyst system produces ethylene copolymers in which the comonomer is randomly distributed within a molecular chain and uniformly distributed across the different molecular weight fractions. Metallocene-catalyzed polyolefins are described, for instance, in U.S. Patent. Nos. 5,571,619 to McAlpin et al.; 5,322,728 to Davis et al.; 5,472,775 to Obijeski et al.; 5,272,236 to

Lai et al.; and 6,090,325 to Wheat, et al., which are incorporated herein in their entirety by reference thereto for all purposes. Examples of metallocene catalysts include bis(n-butylcyclopentadienyl)titanium dichloride, bis(n-butylcyclopentadienyl)zirconium dichloride, bis(cyclopentadienyl)scandium chloride, bis(indenyl)zirconium dichloride, bis(methylcyclopentadienyl)titanium dichloride, bis(methylcyclopentadienyl)zirconium dichloride, cobaltocene, cyclopentadienyltitanium trichloride, ferrocene, hafnocene dichloride, isopropyl(cyclopentadienyl,-1-flourenyl)zirconium dichloride, molybdocene dichloride, nickelocene, niobocene dichloride, ruthenocene, titanocene dichloride, zirconocene chloride hydride, zirconocene dichloride, and so forth. Polymers made using metallocene catalysts typically have a narrow molecular weight range. For instance, metallocene-catalyzed polymers may have polydispersity numbers (M_w/M_n) of below 4, controlled short chain branching distribution, and controlled isotacticity.

The melt flow index (MI) of the semi-crystalline polyolefins may generally vary, but is typically in the range of about 0.1 grams per 10 minutes to about 100 grams per 10 minutes, in some embodiments from about 0.5 grams per 10 minutes to about 30 grams per 10 minutes, and in some embodiments, about 1 to about 10 grams per 10 minutes, determined at 190°C. The melt flow index is the weight of the polymer (in grams) that may be forced through an extrusion rheometer orifice (0.0825-inch diameter) when subjected to a force of 5000 grams in 10 minutes at 190°C, and may be determined in accordance with ASTM Test Method D1238-E.

Of course, other thermoplastic polymers may also be used to form the elastic film, either alone or in conjunction with the semi-crystalline polyolefins. For instance, a substantially amorphous block copolymer may be employed that has at least two blocks of a monoalkenyl arene polymer separated by at least one block of a saturated conjugated diene polymer. The monoalkenyl arene blocks may include styrene and its analogues and homologues, such as o-methyl styrene; p-methyl styrene; p-tert-butyl styrene; 1,3 dimethyl styrene p-methyl styrene; etc., as well as other monoalkenyl polycyclic aromatic compounds, such as vinyl naphthalene; vinyl anthracene; and so forth. Preferred monoalkenyl arenes are styrene and p-methyl styrene. The conjugated diene blocks may include homopolymers of conjugated diene monomers, copolymers of two or more

conjugated dienes, and copolymers of one or more of the dienes with another monomer in which the blocks are predominantly conjugated diene units.

Preferably, the conjugated dienes contain from 4 to 8 carbon atoms, such as 1,3 butadiene (butadiene); 2-methyl-1,3 butadiene; isoprene; 2,3 dimethyl-1,3 butadiene; 1,3 pentadiene (piperylene); 1,3 hexadiene; and so forth.

The amount of monoalkenyl arene (e.g., polystyrene) blocks may vary, but typically constitute from about 8 wt.% to about 55 wt.%, in some embodiments from about 10 wt.% to about 35 wt.%, and in some embodiments, from about 25 wt.% to about 35 wt.% of the copolymer. Suitable block copolymers may contain monoalkenyl arene endblocks having a number average molecular weight from about 5,000 to about 35,000 and saturated conjugated diene midblocks having a number average molecular weight from about 20,000 to about 170,000. The total number average molecular weight of the block polymer may be from about 30,000 to about 250,000.

Particularly suitable thermoplastic elastomeric copolymers are available from Kraton Polymers LLC of Houston, Texas under the trade name KRATON®. KRATON® polymers include styrene-diene block copolymers, such as styrene-butadiene, styrene-isoprene, styrene-butadiene-styrene, and styrene-isoprene-styrene. KRATON® polymers also include styrene-olefin block copolymers formed by selective hydrogenation of styrene-diene block copolymers. Examples of such styrene-olefin block copolymers include styrene-(ethylene-butylene), styrene-(ethylene-propylene), styrene-(ethylene-butylene)-styrene, styrene-(ethylene-propylene)-styrene, styrene-(ethylene-butylene)-styrene-(ethylene-butylene), styrene-(ethylene-propylene)-styrene-(ethylene-propylene), and styrene-ethylene-(ethylene-propylene)-styrene. These block copolymers may have a linear, radial or star-shaped molecular configuration. Specific KRATON® block copolymers include those sold under the brand names G 1652, G 1657, G 1730, MD6673, and MD6973. Various suitable styrenic block copolymers are described in U.S. Patent Nos. 4,663,220, 4,323,534, 4,834,738, 5,093,422 and 5,304,599, which are hereby incorporated in their entirety by reference thereto for all purposes. Other commercially available block copolymers include the S-EP-S elastomeric copolymers available from Kuraray Company, Ltd. of Okayama, Japan, under the trade designation SEPTON®. Still other suitable copolymers include the S-I-S and

S-B-S elastomeric copolymers available from Dexco Polymers of Houston, Texas under the trade designation VECTOR®. Also suitable are polymers composed of an A-B-A-B tetrablock copolymer, such as discussed in U.S. Patent No. 5,332,613 to Taylor, et al., which is incorporated herein in its entirety by reference thereto for all purposes. An example of such a tetrablock copolymer is a styrene-poly(ethylene-propylene)-styrene-poly(ethylene-propylene) ("S-EP-S-EP") block copolymer.

The amount of elastomeric polymer(s) employed in the film may vary, but is typically about 30 wt.% or more of the film, in some embodiments about 50 wt.% or more, and in some embodiments, about 80 wt.% or more of the of the film. In one embodiment, for example, the semi-crystalline polyolefin(s) constitute about 70 wt.% or more of the film, in some embodiments about 80 wt.% or more of the film, and in some embodiments, about 90 wt.% or more of the film. In other embodiments, blends of semi-crystalline polyolefin(s) and elastomeric block copolymer(s) may be employed. In such embodiments, the block copolymer(s) may constitute from about 5 wt.% to about 50 wt.%, in some embodiments from about 10 wt.% to about 40 wt.%, and in some embodiments, from about 15 wt.% to about 35 wt.% of the blend. Likewise, the semi-crystalline polyolefin(s) may constitute from about 50 wt.% to about 95 wt.%, in some embodiments from about 60 wt.% to about 90 wt.%, and in some embodiments, from about 65 wt.% to about 85 wt.% of the blend. It should of course be understood that other elastomeric and/or non-elastomeric polymers may also be employed in the film.

Besides polymers, the elastic film of the present invention may also contain other components as is known in the art. In one embodiment, the film may contain a pigment suitable for imparting a tint, hue, or color to the film. Pigments may suitably be colored, pearlescent, metallic, and so forth as is generally known in the art. Desirably, the pigment is present in the film at a level sufficient to allow the pigmented film to be visible through a nonwoven facing material bonded to the film. In some embodiments, the pigment may be constitute from about 0.5 wt.% to about 30 wt.% of the film, in other embodiments from about 1 wt.% to about 6 wt.% of the film, and in even other embodiments from about 1.5 wt. % to about 4 wt.% of the film.

In another embodiment, for example, the elastic film contains a filler. Fillers

are particulates or other forms of material that may be added to the film polymer extrusion blend and that will not chemically interfere with the extruded film, but which may be uniformly dispersed throughout the film. Fillers may serve a variety of purposes, including enhancing film opacity and/or breathability (i.e., vapor-permeable and substantially liquid-impermeable). For instance, filled films may be made breathable by stretching, which causes the polymer to break away from the filler and create microporous passageways. Breathable microporous elastic films are described, for example, in U.S. Patent Nos. 5,997,981; 6,015,764; and 6,111,163 to McCormack, et al.; 5,932,497 to Morman, et al.; 6,461,457 to Taylor, et al., which are incorporated herein in their entirety by reference thereto for all purposes.

The fillers may have a spherical or non-spherical shape with average particle sizes in the range of from about 0.1 to about 7 micrometers. Examples of suitable fillers include, but are not limited to, calcium carbonate, various kinds of clay, silica, alumina, barium carbonate, sodium carbonate, magnesium carbonate, talc, barium sulfate, magnesium sulfate, aluminum sulfate, titanium dioxide, zeolites, cellulose-type powders, kaolin, mica, carbon, calcium oxide, magnesium oxide, aluminum hydroxide, pulp powder, wood powder, cellulose derivatives, chitin and chitin derivatives. A suitable coating, such as stearic acid, may also be applied to the filler particles if desired. When utilized, the filler content may vary, such as from about 25 wt.% to about 75 wt.%, in some embodiments, from about 30 wt.% to about 70 wt.%, and in some embodiments, from about 40 wt.% to about 60 wt.% of the film.

Other additives may also be incorporated into the film, such as melt stabilizers, processing stabilizers, heat stabilizers, light stabilizers, antioxidants, heat aging stabilizers, whitening agents, antiblocking agents, bonding agents, tackifiers, viscosity modifiers, etc. Examples of suitable tackifier resins may include, for instance, hydrogenated hydrocarbon resins. REGALREZ™ hydrocarbon resins are examples of such hydrogenated hydrocarbon resins, and are available from Eastman Chemical. Other tackifiers are available from ExxonMobil under the ESCOREZ™ designation. Viscosity modifiers may also be employed, such as polyethylene wax (e.g., EPOLENE™ C-10 from Eastman Chemical). Phosphite stabilizers (e.g., IRGAFOS available from Ciba Specialty

Chemicals of Terrytown, N.Y. and DOVERPHOS available from Dover Chemical Corp. of Dover, Ohio) are exemplary melt stabilizers. In addition, hindered amine stabilizers (e.g., CHIMASSORB available from Ciba Specialty Chemicals) are exemplary heat and light stabilizers. Further, hindered phenols are commonly used as an antioxidant in the production of films. Some suitable hindered phenols include those available from Ciba Specialty Chemicals of under the trade name "Irganox®", such as Irganox® 1076, 1010, or E 201. Moreover, bonding agents may also be added to the film to facilitate bonding of the film to additional materials (e.g., nonwoven web). When employed, such additives (e.g., tackifier, antioxidant, stabilizer, etc.) may each be present in an amount from about 0.001 wt.% to about 25 wt.%, in some embodiments, from about 0.005 wt.% to about 20 wt.%, and in some embodiments, from 0.01 wt.% to about 15 wt.% of the film.

The elastic film of the present invention may be mono- or multi-layered. Multilayer films may be prepared by co-extrusion of the layers, extrusion coating, or by any conventional layering process. Such multilayer films normally contain at least one base layer and at least one skin layer, but may contain any number of layers desired. For example, the multilayer film may be formed from a base layer and one or more skin layers, wherein the base layer is formed from a semi-crystalline polyolefin. In such embodiments, the skin layer(s) may be formed from any film-forming polymer. If desired, the skin layer(s) may contain a softer, lower melting polymer or polymer blend that renders the layer(s) more suitable as heat seal bonding layers for thermally bonding the film to a nonwoven web. For example, the skin layer(s) may be formed from an olefin polymer or blends thereof, such as described above. Additional film-forming polymers that may be suitable for use with the present invention, alone or in combination with other polymers, include ethylene vinyl acetate, ethylene ethyl acrylate, ethylene acrylic acid, ethylene methyl acrylate, ethylene normal butyl acrylate, nylon, ethylene vinyl alcohol, polystyrene, polyurethane, and so forth.

The thickness of the skin layer(s) is generally selected so as not to substantially impair the elastomeric properties of the film. To this end, each skin layer may separately comprise from about 0.5% to about 15% of the total thickness of the film, and in some embodiments from about 1% to about 10% of the total thickness of the film. For instance, each skin layer may have a thickness

of from about 0.1 to about 10 micrometers, in some embodiments from about 0.5 to about 5 micrometers, and in some embodiments, from about 1 to about 2.5 micrometers. Likewise, the base layer may have a thickness of from about 1 to about 40 micrometers, in some embodiments from about 2 to about 25 micrometers, and in some embodiments, from about 5 to about 20 micrometers.

The properties of the resulting film may generally vary as desired. For instance, prior to stretching, the film typically has a basis weight of about 100 grams per square meter or less, and in some embodiments, from about 20 to about 75 grams per square meter. Upon stretching, the film typically has a basis weight of about 60 grams per square meter or less, and in some embodiments, from about 10 to about 35 grams per square meter. The stretched film may also have a total thickness of from about 1 to about 150 micrometers, in some embodiments, from about 10 to about 100 micrometers, and in some embodiments, from about 20 to about 80 micrometers.

II. Nonwoven Web Material

As will be described in more detail below, the polymers used to form the nonwoven web material typically have a softening temperature that is higher than the temperature imparted during bonding. In this manner, the polymers do not substantially soften during bonding to such an extent that the fibers of the nonwoven web material become completely melt flowable. For instance, polymers may be employed that have a Vicat softening temperature (ASTM D-1525) of from about 100°C to about 300°C, in some embodiments from about 120°C to about 250°C, and in some embodiments, from about 130°C to about 200°C. Exemplary high-softening point polymers for use in forming nonwoven web materials may include, for instance, polyolefins, e.g., polyethylene, polypropylene, polybutylene, etc.; polytetrafluoroethylene; polyesters, e.g., polyethylene terephthalate and so forth; polyvinyl acetate; polyvinyl chloride acetate; polyvinyl butyral; acrylic resins, e.g., polyacrylate, polymethylacrylate, polymethylmethacrylate, and so forth; polyamides, e.g., nylon; polyvinyl chloride; polyvinylidene chloride; polystyrene; polyvinyl alcohol; polyurethanes; polylactic acid; copolymers thereof; and so forth. If desired, biodegradable polymers, such as those described above, may also be employed. Synthetic or natural cellulosic polymers may also be used, including but not limited to, cellulosic esters; cellulosic ethers; cellulosic nitrates; cellulosic

acetates; cellulosic acetate butyrates; ethyl cellulose; regenerated celluloses, such as viscose, rayon, and so forth. It should be noted that the polymer(s) may also contain other additives, such as processing aids or treatment compositions to impart desired properties to the fibers, residual amounts of solvents, pigments or colorants, and so forth.

Monocomponent and/or multicomponent fibers may be used to form the nonwoven web material. Monocomponent fibers are generally formed from a polymer or blend of polymers extruded from a single extruder. Multicomponent fibers are generally formed from two or more polymers (e.g., bicomponent fibers) extruded from separate extruders. The polymers may be arranged in substantially constantly positioned distinct zones across the cross-section of the fibers. The components may be arranged in any desired configuration, such as sheath-core, side-by-side, pie, island-in-the-sea, three island, bull's eye, or various other arrangements known in the art. and so forth. Various methods for forming multicomponent fibers are described in U.S. Patent Nos. 4,789,592 to Taniguchi et al. and U.S. Pat. No. 5,336,552 to Strack et al., 5,108,820 to Kaneko, et al., 4,795,668 to Kruege, et al., 5,382,400 to Pike, et al., 5,336,552 to Strack, et al., and 6,200,669 to Marmon, et al., which are incorporated herein in their entirety by reference thereto for all purposes. Multicomponent fibers having various irregular shapes may also be formed, such as described in U.S. Patent. Nos. 5,277,976 to Hogle, et al., 5,162,074 to Hills, 5,466,410 to Hills, 5,069,970 to Largman, et al., and 5,057,368 to Largman, et al., which are incorporated herein in their entirety by reference thereto for all purposes.

Although any combination of polymers may be used, the polymers of the multicomponent fibers are typically made from thermoplastic materials with different glass transition or melting temperatures where a first component (e.g., sheath) melts at a temperature lower than a second component (e.g., core). Softening or melting of the first polymer component of the multicomponent fiber allows the multicomponent fibers to form a tacky skeletal structure, which upon cooling, stabilizes the fibrous structure. For example, the multicomponent fibers may have from about 20% to about 80%, and in some embodiments, from about 40% to about 60% by weight of the low melting polymer. Further, the multicomponent fibers may have from about 80% to about 20%, and in some

embodiments, from about 60% to about 40%, by weight of the high melting polymer. Some examples of known sheath-core bicomponent fibers available from KoSa Inc. of Charlotte, North Carolina under the designations T-255 and T-256, both of which use a polyolefin sheath, or T-254, which has a low melt co-polyester sheath. Still other known bicomponent fibers that may be used include those available from the Chisso Corporation of Moriyama, Japan or Fibervisions LLC of Wilmington, Delaware.

Fibers of any desired length may be employed, such as staple fibers, continuous fibers, etc. In one particular embodiment, for example, staple fibers may be used that have a fiber length in the range of from about 1 to about 150 millimeters, in some embodiments from about 5 to about 50 millimeters, in some embodiments from about 10 to about 40 millimeters, and in some embodiments, from about 10 to about 25 millimeters. Although not required, carding techniques may be employed to form fibrous layers with staple fibers as is well known in the art. For example, fibers may be formed into a carded web by placing bales of the fibers into a picker that separates the fibers. Next, the fibers are sent through a combing or carding unit that further breaks apart and aligns the fibers in the machine direction so as to form a machine direction-oriented fibrous nonwoven web. The carded web may then be bonded using known techniques to form a bonded carded nonwoven web.

If desired, the nonwoven web material used to form the nonwoven composite may have a multi-layer structure. Suitable multi-layered materials may include, for instance, spunbond/meltblown/spunbond (SMS) laminates and spunbond/meltblown (SM) laminates. Various examples of suitable SMS laminates are described in U.S. Patent Nos. 4,041,203 to Brock et al.; 5,213,881 to Timmons, et al.; 5,464,688 to Timmons, et al.; 4,374,888 to Bornslaeger; 5,169,706 to Collier, et al.; and 4,766,029 to Brock et al., which are incorporated herein in their entirety by reference thereto for all purposes. In addition, commercially available SMS laminates may be obtained from Kimberly-Clark Corporation under the designations Spunguard® and Evolution®.

Another example of a multi-layered structure is a spunbond web produced on a multiple spin bank machine in which a spin bank deposits fibers over a layer of fibers deposited from a previous spin bank. Such an individual spunbond

nonwoven web may also be thought of as a multi-layered structure. In this situation, the various layers of deposited fibers in the nonwoven web may be the same, or they may be different in basis weight and/or in terms of the composition, type, size, level of crimp, and/or shape of the fibers produced. As another
5 example, a single nonwoven web may be provided as two or more individually produced layers of a spunbond web, a carded web, etc., which have been bonded together to form the nonwoven web. These individually produced layers may differ in terms of production method, basis weight, composition, and fibers as discussed above.

10 A nonwoven web material may also contain an additional fibrous component such that it is considered a composite. For example, a nonwoven web may be entangled with another fibrous component using any of a variety of entanglement techniques known in the art (e.g., hydraulic, air, mechanical, etc.). In one embodiment, the nonwoven web is integrally entangled with cellulosic fibers using
15 hydraulic entanglement. A typical hydraulic entangling process utilizes high pressure jet streams of water to entangle fibers to form a highly entangled consolidated fibrous structure, e.g., a nonwoven web. Hydraulically entangled nonwoven webs of staple length and continuous fibers are disclosed, for example, in U.S. Patent Nos. 3,494,821 to Evans and 4,144,370 to Boulton, which are
20 incorporated herein in their entirety by reference thereto for all purposes. Hydraulically entangled composite nonwoven webs of a continuous fiber nonwoven web and a pulp layer are disclosed, for example, in U.S. Patent Nos. 5,284,703 to Everhart, et al. and 6,315,864 to Anderson, et al., which are
25 incorporated herein in their entirety by reference thereto for all purposes. The fibrous component of the composite may contain any desired amount of the resulting substrate. The fibrous component may contain greater than about 50% by weight of the composite, and in some embodiments, from about 60% to about 90% by weight of the composite. Likewise, the nonwoven web may contain less
30 than about 50% by weight of the composite, and in some embodiments, from about 10% to about 40% by weight of the composite.

Although not required, the nonwoven web material may necked in one or more directions prior to lamination to the film of the present invention. Suitable techniques necking techniques are described in U.S. Patent Nos. 5,336,545,

5,226,992, 4,981,747 and 4,965,122 to Morman, as well as U.S. Patent Application Publication No. 2004/0121687 to Morman, et al. Alternatively, the nonwoven web may remain relatively inextensible in at least one direction prior to lamination to the film. In such embodiments, the nonwoven web may be optionally stretched in one or more directions subsequent to lamination to the film.

The basis weight of the nonwoven web material may generally vary, such as from about 5 grams per square meter ("gsm") to about 30 gsm, in some embodiments from about 5 gsm to about 20 gsm, in some embodiments from about 5 gsm to about 17 gsm, in some embodiments from about 5 gsm to about 14 gsm, and in some embodiments from about 5 gsm to about 10 gsm. When multiple nonwoven web materials are used, such materials may have the same or different basis weights.

Desirably, the opacity of the nonwoven web material is sufficiently low to allow a film to be visible through the nonwoven web material when the nonwoven web material is laminated to the film. For example, the color of a pigmented film may be visible through a low opacity nonwoven web material laminated to the pigmented film. A low opacity nonwoven web material is also believed to enhance the visual appearance, including the appearance of surface smoothness, in a laminate of the nonwoven web material with a film. Low opacity may be achieved in the nonwoven web material by reducing basis weight or reducing the level of pigments, such as, for example, TiO_2 , in the fibers of the nonwoven web material. Diffuse opacity of the nonwoven web material may be measured using test method TAPPI 519 on a DataColor SpectraFlash 600 spectrophotometer. The diffuse opacity of the nonwoven web material is suitably less than about 40%, desirably between about 5% and about 25%, and more desirably between about 5% and about 10%, and even more desirably between about 8% and about 10%.

III. Lamination Technique

To form bonds between the film and the nonwoven web material, lamination is generally accomplished in the present invention via a patterned bonding technique (e.g., thermal point bonding, ultrasonic bonding, etc.) in which the materials are supplied to a nip defined by at least one patterned roll. Thermal point bonding, for instance, typically employs a nip formed between two rolls, at least one of which is patterned. Ultrasonic bonding, on the other hand, typically

employs a nip formed between a sonic horn and a patterned roll. Regardless of the technique chosen, the patterned roll contains a plurality of raised bonding elements to concurrently bond the film to the nonwoven web material(s) and, if desired, form apertures in the film. The size of the bonding elements may be specifically tailored to facilitate the formation of apertures in the film and enhance bonding between the film and the nonwoven material(s). For example, the bonding elements are typically selected to have a relatively large length dimension. The length dimension of the bonding elements may be from about 300 to about 5000 micrometers, in some embodiments from about 500 to about 4000 micrometers, and in some embodiments, from about 1000 to about 2000 micrometers. The width dimension of the bonding elements may likewise range from about 20 to about 500 micrometers, in some embodiments from about 40 to about 200 micrometers, and in some embodiments, from about 50 to about 150 micrometers. In addition, the "element aspect ratio" (the ratio of the length of an element to its width) may range from about 2 to about 100, in some embodiments from about 4 to about 50, and in some embodiments, from about 5 to about 20.

Besides the size of the bonding elements, the overall bonding pattern may also be selectively controlled. In one embodiment, for example, a bonding pattern is selected in which the longitudinal axis (longest dimension along a center line of the element) of one or more of the bonding elements is skewed relative to the machine direction ("MD") of the elastic film. For example, one or more of the bonding elements may be oriented from about 30° to about 150°, in some embodiments from about 45° to about 135°, and in some embodiments, from about 60° to about 120° relative to the machine direction of the film. In this manner, the bonding elements will present a relatively large surface to the film in a direction substantially perpendicular to that which the film moves. This increases the area over which shear stress is imparted to the film and, in turn, facilitates aperture formation.

The pattern of the bonding elements is generally selected so that the nonwoven composite has a total bond area of less than about 50% (as determined by conventional optical microscopic methods), in some embodiments, less than about 30%, and in other embodiments from about 3% to about 20%. In particular embodiments, the total bond area may suitably be from about 5 % to about 15%,

or more suitably from about 7% to about 10%. The bond density is also typically greater than about 50 bonds per square inch, and in some embodiments, from about 75 to about 500 pin bonds per square inch. One suitable bonding pattern for use in the present invention is known as a “rib-knit” pattern and is described in U.S. Patent No. 5,620,779 to Levy, et al., which is incorporated herein in its entirety by reference thereto for all purposes. Rib-knit patterns typically have a bonding element density of from about 150 to about 400 bonding elements per square inch, and in some embodiments, from about 200 to about 300 bonding elements per square inch. An example of a suitable “rib-knit” pattern is shown in Fig. 2, which illustrates bonding elements 89 and bonding elements 91, which are oriented in a different direction. Yet another suitable pattern is the “wire weave” pattern, which has a bonding element density of from about 200 to about 500 bonding elements per square inch, and in some embodiments, from about 250 to about 350 bonding elements per square inch. An example of a suitable “wire-weave” pattern is shown in Fig. 3, which illustrates bonding elements 93 and bonding elements 95, which are oriented in a different direction. Other bond patterns that may be used in the present invention are described in U.S. Patent Nos. 3,855,046 to Hansen et al.; 5,962,112 to Haynes et al.; 6,093,665 to Sayovitz et al.; D375,844 to Edwards, et al.; D428,267 to Romano et al.; and D390,708 to Brown, which are incorporated herein in their entirety by reference thereto for all purposes.

Besides the size and orientation of the bonding elements, the spacing of the bonding elements in the machine direction and in the cross machine direction may be selected to increase the smoothness of the final laminate material. Referring to Figs. 2 and 3, in some embodiments the distance or spacing between repeating bonding elements in the machine direction (edge to edge distance between bonding elements), “Dm”, is suitably less than about 750 micrometers. In other embodiments, “Dm” may be from about 40 micrometers to about 750 micrometers, more particularly from about 40 micrometers to about 500 micrometers, or even more particularly from about 100 micrometers to about 400 micrometers. In some embodiments, the distance or spacing between repeating bonding elements in the cross machine direction (edge to edge distance between bonding elements), “Dc”, is suitably less than about 1200 micrometers. In other embodiments, “Dc” may be

from about 40 micrometers to about 1200 micrometers, more particularly from about 40 micrometers to about 1000 micrometers, or even more particularly from about 100 micrometers to about 700 micrometers. Without being bound to theory, it is believed that reducing the value for "Dm" primarily results in a smoother composite material, while reducing the value for "Dc" primarily results in providing better visibility of the pigmented film through the nonwoven facing material.

In particular embodiments the bonding elements may define a plurality of uninterrupted regions that extend continuously in the machine direction without intersecting another bonding element 127. In other embodiments, the bonding elements may define a plurality of uninterrupted regions that extend continuously in the cross machine direction without intersecting another bonding element 129. The width "Wc" of the uninterrupted region that extends continuously in the machine direction without intersecting another bonding element 127 (measured as the largest width of the uninterrupted region in the cross machine direction) is suitably less than about 1200 micrometers, particularly from about 40 micrometers to about 1200 micrometers, more particularly from about 40 micrometers to about 1000 micrometers, or even more particularly from about 100 micrometers to about 700 micrometers. The width "Wm" of the uninterrupted region that extends continuously in the cross machine direction without intersecting another bonding element 129 (measured as the largest width of the uninterrupted region in the machine direction) is suitably less than about 750 micrometers, particularly from about 40 micrometers to about 750 micrometers, more particularly from about 40 micrometers to about 500 micrometers, or even more particularly from about 100 micrometers to about 400 micrometers.

The selection of an appropriate bonding temperature (e.g., the temperature of a heated roll) will help melt and/soften the low-softening point elastomeric polymer(s) of the film at regions adjacent to the bonding elements. The softened elastomeric polymer(s) may then flow and become displaced during bonding, such as by pressure exerted by the bonding elements. The displaced portions of the film surrounding the apertures can also fuse to the nonwoven web material(s), thereby forming an integral nonwoven composite. Furthermore, because the elastomeric polymer(s) may physically entrap or adhere to the fibers at the bond sites, adequate bond formation may be achieved without requiring substantial

softening of the polymer(s) used to form the nonwoven web material. Thus, the nonwoven web material remains substantially unbonded to the film or other materials at those regions located directly adjacent to (e.g. above or below) the apertures. Further, the nonwoven web material is also generally unapertured, although it may of course develop some small cuts or tears during processing.

To achieve concurrent aperture and bond formation without substantially softening the polymer(s) of the nonwoven web material, the bonding temperature and pressure may be selectively controlled. For example, one or more rolls may be heated to a surface temperature of from about 50°C to about 160°C, in some embodiments from about 60°C to about 140°C, and in some embodiments, from about 70°C to about 120°C. Likewise, the pressure exerted by rolls ("nip pressure") during thermal bonding may range from about 75 to about 600 pounds per linear inch, in some embodiments from about 100 to about 400 pounds per linear inch, and in some embodiments, from about 120 to about 200 pounds per linear inch. Of course, the residence time of the materials may influence the particular bonding parameters employed.

As stated, another factor that influences concurrent aperture and bond formation is the degree of tension in the film during lamination. An increase in film tension, for example, typically correlates to an increase in aperture size. Of course, a film tension that is too high may adversely affect the integrity of the film. Thus, in most embodiments of the present invention, a stretch ratio of about 1.5 or more, in some embodiments from about 2.5 to about 7.0, and in some embodiments, from about 3.0 to about 5.5, is employed to achieve the desired degree of tension in the film during lamination. The stretch ratio may be determined by dividing the final length of the film by its original length. The stretch ratio may also be approximately the same as the draw ratio, which may be determined by dividing the linear speed of the film during lamination (e.g., speed of the nip rolls) by the linear speed at which the film is formed (e.g., speed of casting rolls or blown nip rolls).

The film may be "pre-stretched" (prior to lamination) by rolls rotating at different speeds of rotation so that the sheet is stretched to the desired stretch ratio in the machine direction. This uniaxially stretched film may also be oriented in the cross-machine direction to form a "biaxially stretched" film. The orientation

temperature profile during the “pre-stretching” operation is generally below the melting point of one or more polymers in the film, but high enough to enable the composition to be drawn or stretched. For example, the film may be stretched at a temperature from about 15°C to about 50°C, in some embodiments from about 25°C to about 40°C, and in some embodiments, from about 30°C to about 40°C. When “pre-stretched” in the manner described above, the degree of stretch during lamination may be increased, maintained, or slightly reduced (retracted) to desired degree of tension.

As noted above, upon lamination, the elastic film is bonded to the nonwoven web material(s) and may be concurrently apertured. The size and/or pattern of the resulting apertures generally correspond to the size and/or pattern of the bonding elements. That is, the apertures may have a length, width, aspect ratio, and orientation as described above. For example, the length dimension of the apertures may be from about 200 to about 5000 micrometers, in some embodiments from about 350 to about 4000 micrometers, and in some embodiments, from about 500 to about 2500 micrometers. The width dimension of the apertures may likewise range from about 20 to about 500 micrometers, in some embodiments from about 40 to about 200 micrometers, and in some embodiments, from about 50 to about 150 micrometers. In addition, the “aspect ratio” (the ratio of the length of an aperture to its width) may range from about 2 to about 100, in some embodiments from about 4 to about 50, and in some embodiments, from about 5 to about 20. Similarly, the longitudinal axis of one or more of the apertures (longest dimension along a center line of the aperture) may be skewed relative to the machine direction of the elastic film, such as from about 30° to about 150°, in some embodiments from about 45° to about 135°, and in some embodiments, from about 60° to about 120° relative to the machine direction of the film.

Various embodiments of the present invention will now be described in greater detail. Of course, it should be understood that the description provided below is merely exemplary, and that other methods are contemplated by the present invention. Referring to Fig. 1, for instance, one embodiment of a method for forming a composite from an elastic film and a nonwoven web material is shown. As shown, the raw materials of the film (e.g., elastomeric polymer) may be

dry mixed together (i.e., without a solvent) and added to a hopper (not shown) of an extrusion apparatus 40. The raw materials may alternatively be blended with a solvent. In the hopper, the materials are dispersively mixed in the melt and compounded using any known technique, such as batch and/or continuous
5 compounded techniques that employ, for example, a Banbury mixer, Farrel continuous mixer, single screw extruder, twin screw extruder, etc.

Any known technique may be used to form a film from the compounded material, including blowing, casting, flat die extruding, etc. In one particular embodiment, the film may be formed by a blown process in which a gas (e.g., air)
10 is used to expand a bubble of the extruded polymer blend through an annular die. The bubble is then collapsed and collected in flat film form. Processes for producing blown films are described, for instance, in U.S. Patent Nos. 3,354,506 to Raley; 3,650,649 to Schippers; and 3,801,429 to Schrenk et al., as well as U.S. Patent Application Publication Nos. 2005/0245162 to McCormack, et al. and
15 2003/0068951 to Boggs, et al., all of which are incorporated herein in their entirety by reference thereto for all purposes. For example, in the particular embodiment of Fig. 1, the compounded material (not shown) is supplied to the extrusion apparatus 40 and then blown into nip rolls 42 to form a single-layered precursor elastic film 10. The rolls 42 may be kept at temperature sufficient to solidify and
20 quench the precursor elastic film 10 as it is formed, such as from about 20 to 60°C. Typically, the resulting precursor elastic film is generally unapertured, although it may of course possess small cuts or tears as a result of processing. The use of an initially unapertured film can provide a variety of benefits, including the avoidance of registration steps needed to align the apertures with bond sites during
25 lamination.

Referring again to Fig. 1, one method for forming a uniaxially stretched film is shown. In the illustrated embodiment, the film 10 is stretched and thinned in the machine direction by passing it through a film-orientation unit or machine direction orienter ("MDO") 44, such as commercially available from Marshall and Willams,
30 Co. of Providence, Rhode Island. In the illustrated embodiment, the MDO has a plurality of stretching rolls 46 that progressively stretch and thin the film 10 in the machine direction. While four pairs of rolls 46 are illustrated in Fig. 1, it should be understood that the number of rolls may be higher or lower, depending on the level

of stretch that is desired and the degrees of stretching between each roll. The film 10 may be stretched in either single or multiple discrete stretching operations. The film 10 may also be stretched in other directions. For example, the film may be clamped at its lateral edges by chain clips and conveyed into a tenter oven. In the
5 tenter oven, the film may be drawn in the cross-machine direction to the desired stretch ratio by chain clips diverged in their forward travel.

A nonwoven web material is also employed for laminating to the elastic film 10. For example, the nonwoven web material may simply be unwound from a supply roll. Alternatively, as shown in Fig. 1, a nonwoven web material 30 may be
10 formed in-line, such as by spunbond extruders 48. The extruders 48 deposit fibers 50 onto a forming wire 52, which is part of a continuous belt arrangement that circulates around a series of rolls. If desired, a vacuum (not shown) may be utilized to maintain the fibers on the forming wire 52. The spunbond fibers 50 form a mat 54 that may optionally be compressed via compaction rolls 56. Although not
15 necessarily required, a second material 30a originating from a supply roll 62 may also be laminated to the elastic film 10. The second material 30a may be a second nonwoven web material, film, etc.

Regardless, thermal bonding techniques are employed to laminate the material(s) to the elastic film. In Fig. 1, for instance, the materials 30 and 30a are
20 directed to a nip defined between rolls 58 for laminating to the elastic film 10. One or both of the rolls 58 may contain a plurality of raised bonding elements and/or may be heated. Upon lamination, the elastic film 10 is melt fused to the nonwoven web materials 30 and 30a at a plurality of discrete bond sites 31. (See Fig. 6). That is, the elastomeric polymer(s) of the film 10 are softened and/or melted so
25 that they may physically entrap fibers of the nonwoven web materials 30 and 30a. Of course, the elastic film 10 may possess a certain tack so that it also adheres to the fibers upon lamination. As shown in Fig. 6, the bond sites 31 may be located proximate (adjacent or near to) a perimeter 37 defined by corresponding apertures 33, which are formed by displacement of the film 10. The particular location of the
30 bond sites 31 adjacent to or near the apertures 33 may enhance the integrity of the resulting composite 32 by strengthening the area surrounding the apertures 33. Because thermal bonding occurs at a temperature that is insufficient to substantially soften the polymer(s) of the nonwoven web materials 30 and 30a, as

described above, they are not substantially melt fused to each other. In this manner, the composite 32 may better retain the physical properties (e.g., liquid permeability, softness, bulk, and hand feel) of the individual nonwoven web materials.

5 The resulting composite 32 may then be wound and stored on a take-up roll 60. Optionally, the composite 32 is kept under tension, such as by using the same linear velocity for the roll 60 as the speed of one or more of the stretching rolls 46. More preferably, however, the composite 32 is allowed to slightly retract prior to winding on to the take-up roll 60. This may be achieved by using a slower linear
10 velocity for the roll 60. Because the elastic film 10 is tensioned prior to lamination, it will retract toward its original machine direction length and become shorter in the machine direction, thereby buckling or forming gathers in the composite. The resulting elastic composite thus becomes extensible in the machine direction to the extent that the gathers or buckles in the web may be pulled back out flat and allow
15 the elastic film 10 to elongate.

 While not shown in Fig. 1, various additional potential processing and/or finishing steps known in the art, such as slitting, treating, printing graphics, etc., may be performed without departing from the spirit and scope of the invention. For instance, the composite may optionally be mechanically stretched in the cross-
20 machine and/or machine directions to enhance extensibility. In one embodiment, the composite may be coursed through two or more rolls that have grooves in the CD and/or MD directions. Such grooved satellite/anvil roll arrangements are described in U.S. Patent Application Publication Nos. 2004/0110442 to Rhim, et al. and 2006/0151914 to Gerndt, et al., which are incorporated herein in their entirety
25 by reference thereto for all purposes. For instance, the laminate may be coursed through two or more rolls that have grooves in the CD and/or MD directions. The grooved rolls may be constructed of steel or other hard material (such as a hard rubber).

 Figs. 4-5 further illustrate the manner in which groove rolls may
30 incrementally stretch the composite. As shown, for example, satellite rolls 182 may engage an anvil roll 184, each of which include a plurality of ridges 183 defining a plurality of grooves 185 positioned across the grooved rolls in the cross-machine direction. The grooves 185 are generally oriented perpendicular to the

direction of stretch of the material. In other words, the grooves 185 are oriented in the machine direction to stretch the composite in the cross-machine direction. The grooves 185 may likewise be oriented in the cross-machine direction to stretch the composite in the machine direction. The ridges 183 of satellite roll 182 intermesh with the grooves 185 of anvil roll 184, and the grooves 185 of satellite roll 182 intermesh with the ridges 183 of anvil roll 184.

The dimensions and parameters of the grooves 185 and ridges 183 may have a substantial effect on the degree of extensibility provided by the rolls 182 and 184. For example, the number of grooves 185 contained on a roll may generally range from about 3 and 15 grooves per inch, in some embodiments from about 5 and 12 grooves per inch, and in some embodiments, from about 5 and 10 grooves per inch. The grooves 185 may also have a certain depth "D", which generally ranges from about 0.25 to about 1.0 centimeter, and in some embodiments, from about 0.4 to about 0.6 centimeters. In addition, the peak-to-peak distance "P" between the grooves 185 is typically from about 0.1 to about 0.9 centimeters, and in some embodiments, from about 0.2 to about 0.5 centimeters. Also, the groove roll engagement distance "E" between the grooves 185 and ridges 183 may be up to about 0.8 centimeters, and in some embodiments, from about 0.15 to about 0.4 centimeters. Regardless, the composite 32 (Fig. 5) may be stretched in one or more directions at a stretch ratio of from about 1.5 to about 8.0, in some embodiments by at least about 2.0 to about 6.0, and in some embodiments, from about 2.5 to about 4.5. If desired, heat may be applied to the composite just prior to or during the application of incremental stretch to cause it to relax somewhat and ease extension. Heat may be applied by any suitable method known in the art, such as heated air, infrared heaters, heated nipped rolls, or partial wrapping of the laminate around one or more heated rolls or steam canisters, etc. Heat may also be applied to the grooved rolls themselves. It should also be understood that other grooved roll arrangement are equally suitable, such as two grooved rolls positioned immediately adjacent to one another.

Besides the above-described grooved rolls, other techniques may also be used to mechanically stretch the composite in one or more directions. For example, the composite may be passed through a tenter frame that stretches the

composite. Such tenter frames are well known in the art and described, for instance, in U.S. Patent Application Publication No. 2004/0121687 to Morman, et al. The composite may also be necked. Suitable techniques necking techniques are described in U.S. Patent Nos. 5,336,545, 5,226,992, 4,981,747 and 4,965,122 to Morman, as well as U.S. Patent Application Publication No. 2004/0121687 to Morman, et al., all of which are incorporated herein in their entirety by reference thereto for all purposes.

The nonwoven composite of the present invention may be used in a wide variety of applications. As noted above, for example, the nonwoven composite may be used in an absorbent article. An "absorbent article" generally refers to any article capable of absorbing water or other fluids. Examples of some absorbent articles include, but are not limited to, personal care absorbent articles, such as diapers, training pants, absorbent underpants, incontinence articles, feminine hygiene products (e.g., sanitary napkins), swim wear, baby wipes, and so forth; medical absorbent articles, such as garments, fenestration materials, underpads, bedpads, bandages, absorbent drapes, and medical wipes; food service wipers; clothing articles; and so forth. Materials and processes suitable for forming such absorbent articles are well known to those skilled in the art. Absorbent articles may include a substantially liquid-impermeable layer (e.g., outer cover), a liquid-permeable layer (e.g., bodyside liner, surge layer, etc.), and an absorbent core.

In one particular embodiment, the nonwoven composite of the present invention may be used to form a liquid-permeable layer (e.g., bodyside liner, surge layer) of the absorbent article. As described above, the elastic film may be bonded to the nonwoven web material at discrete bond sites located proximate to the perimeter of apertures. By selectively controlling the conditions of the lamination process, however, the nonwoven web material remains substantially unbonded (e.g., not substantially melt fused together) at the regions located adjacent to the apertures. For example, when the elastic film is positioned between two nonwoven web materials, melt bond sites are not generally formed between the nonwoven web materials at those regions adjacent to the apertures. The conditions of the lamination process may also allow the nonwoven web material(s) to remain generally unapertured at those regions adjacent to the apertures in the elastic film. The existence of such generally unbonded and unapertured regions in

the nonwoven web material(s) enhances the ability of the composite to be employed as a liquid-permeable layer in an absorbent article. Namely, because the nonwoven web material is not fused together at those regions adjacent to the film apertures, a liquid may more readily flow through the nonwoven web material and into the aperture. Likewise, the absence of substantial aperturing in the nonwoven web material allows it to retain other desirable properties (e.g., bulk, softness, handfeel, etc.).

Besides liquid-permeable materials (e.g., liners, surge layers, etc.), the nonwoven composite of the present invention may have a wide variety of other uses, such as in providing an elastic waist, leg cuff/gasketing, stretchable ear, side panel, outer cover, or any other component in which elastic properties are desirable.

Various embodiments of an absorbent article that may be formed according to the present invention will now be described in more detail. For purposes of illustration only, an absorbent article is shown in Fig. 7 as a diaper 201. However, as noted above, the invention may be embodied in other types of absorbent articles, such as incontinence articles, sanitary napkins, diaper pants, feminine napkins, children's training pants, and so forth. In the illustrated embodiment, the diaper 201 is shown as having an hourglass shape in an unfastened configuration. However, other shapes may of course be utilized, such as a generally rectangular shape, T-shape, or I-shape. As shown, the diaper 201 includes a chassis 202 formed by various components, including an outer cover 217, bodyside liner 205, absorbent core 203, and surge layer 207. It should be understood, however, that other layers may also be used in the present invention. Likewise, one or more of the layers referred to in Fig. 7 may also be eliminated in certain embodiments of the present invention.

The bodyside liner 205 is generally employed to help isolate the wearer's skin from liquids held in the absorbent core 203. For example, the liner 205 presents a bodyfacing surface that is typically compliant, soft feeling, and non-irritating to the wearer's skin. Typically, the liner 205 is also less hydrophilic than the absorbent core 203 so that its surface remains relatively dry to the wearer. As indicated above, the liner 205 may be liquid-permeable to permit liquid to readily penetrate through its thickness. Exemplary liner constructions that contain a

nonwoven web are described in U.S. Patent Nos. 5,192,606 to Proxmire, et al.;
5,702,377 to Collier, IV, et al.; 5,931,823 to Stokes, et al.; 6,060,638 to Paul, et al.;
and 6,150,002 to Varona, as well as U.S. Patent Application Publication Nos.
2004/0102750 to Jameson; 2005/0054255 to Morman, et al.; and 2005/0059941 to
5 Baldwin, et al., all of which are incorporated herein in their entirety by reference
thereto for all purposes. In one particular embodiment, the liner includes the
nonwoven composite of the present invention.

As illustrated in Fig. 7, the diaper 201 may also include a surge layer 207
that helps to decelerate and diffuse surges or gushes of liquid that may be rapidly
10 introduced into the absorbent core 203. Desirably, the surge layer 207 rapidly
accepts and temporarily holds the liquid prior to releasing it into the storage or
retention portions of the absorbent core 203. In the illustrated embodiment, for
example, the surge layer 207 is interposed between an inwardly facing surface 216
of the bodyside liner 205 and the absorbent core 203. Alternatively, the surge
15 layer 207 may be located on an outwardly facing surface 218 of the bodyside liner
205. The surge layer 207 is typically constructed from highly liquid-permeable
materials. Examples of suitable surge layers are described in U.S. Patent No.
5,486,166 to Ellis, et al. and 5,490,846 to Ellis, et al., which are incorporated
herein in their entirety by reference thereto for all purposes. In one particular
20 embodiment, the surge layer 207 includes the nonwoven composite of the present
invention.

The outer cover 217 is typically formed from a material that is substantially
impermeable to liquids. For example, the outer cover 217 may be formed from a
thin plastic film or other flexible liquid-impermeable material. In one embodiment,
25 the outer cover 217 is formed from a polyethylene film having a thickness of from
about 0.01 millimeter to about 0.05 millimeter. The film may be impermeable to
liquids, but permeable to gases and water vapor (i.e., "breathable"). This permits
vapors to escape from the absorbent core 203, but still prevents liquid exudates
from passing through the outer cover 217. If a more cloth-like feeling is desired,
30 the outer cover 217 may be formed from a polyolefin film laminated to a nonwoven
web. For example, a stretch-thinned polypropylene film may be thermally
laminated to a spunbond web of polypropylene fibers.

Besides the above-mentioned components, the diaper 201 may also contain various other components as is known in the art. For example, the diaper 201 may also contain a substantially hydrophilic tissue wrapsheet (not illustrated) that helps maintain the integrity of the fibrous structure of the absorbent core 203. The tissue wrapsheet is typically placed about the absorbent core 203 over at least the two major facing surfaces thereof, and composed of an absorbent cellulosic material, such as creped wadding or a high wet-strength tissue. The tissue wrapsheet may be configured to provide a wicking layer that helps to rapidly distribute liquid over the mass of absorbent fibers of the absorbent core 203. The wrapsheet material on one side of the absorbent fibrous mass may be bonded to the wrapsheet located on the opposite side of the fibrous mass to effectively entrap the absorbent core 203. Furthermore, the diaper 201 may also include a ventilation layer (not shown) that is positioned between the absorbent core 203 and the outer cover 217. When utilized, the ventilation layer may help insulate the outer cover 217 from the absorbent core 203, thereby reducing dampness in the outer cover 217. Examples of such ventilation layers may include a nonwoven web laminated to a breathable film, such as described in U.S. Patent No. 6,663,611 to Blaney, et al., which is incorporated herein in its entirety by reference thereto for all purposes.

In some embodiments, the diaper 201 may also include a pair of side panels (or ears) (not shown) that extend from the side edges 232 of the diaper 201 into one of the waist regions. The side panels may be integrally formed with a selected diaper component. For example, the side panels may be integrally formed with the outer cover 217 or from the material employed to provide the top surface. In alternative configurations, the side panels may be provided by members connected and assembled to the outer cover 217, the top surface, between the outer cover 217 and top surface, or in various other configurations. If desired, the side panels may be elasticized or otherwise rendered elastomeric by use of the elastic nonwoven composite of the present invention. Examples of absorbent articles that include elasticized side panels and selectively configured fastener tabs are described in PCT Patent Application WO 95/16425 to Roessler; U.S. Patent 5,399,219 to Roessler et al.; U.S. Patent 5,540,796 to Fries; and U.S. Patent 5,595,618 to Fries, each of which is incorporated herein in its entirety by reference thereto for all purposes.

As representatively illustrated in Fig. 7, the diaper 201 may also include a pair of containment flaps 212 that are configured to provide a barrier and to contain the lateral flow of body exudates. The containment flaps 212 may be located along the laterally opposed side edges 232 of the bodyside liner 205 adjacent the side edges of the absorbent core 203. The containment flaps 212 may extend longitudinally along the entire length of the absorbent core 203, or may only extend partially along the length of the absorbent core 203. When the containment flaps 212 are shorter in length than the absorbent core 203, they may be selectively positioned anywhere along the side edges 232 of diaper 201 in a crotch region 210. In one embodiment, the containment flaps 212 extend along the entire length of the absorbent core 203 to better contain the body exudates. Such containment flaps 212 are generally well known to those skilled in the art. For example, suitable constructions and arrangements for the containment flaps 212 are described in U.S. Patent No. 4,704,116 to Enloe, which is incorporated herein in its entirety by reference thereto for all purposes.

To provide improved fit and to help reduce leakage of body exudates, the diaper 201 may be elasticized with suitable elastic members, as further explained below. For example, as representatively illustrated in Fig. 7, the diaper 201 may include leg elastics 206 constructed to operably tension the side margins of the diaper 201 to provide elasticized leg bands which can closely fit around the legs of the wearer to reduce leakage and provide improved comfort and appearance. Waist elastics 208 may also be employed to elasticize the end margins of the diaper 201 to provide elasticized waistbands. The waist elastics 208 are configured to provide a resilient, comfortably close fit around the waist of the wearer. The elastic nonwoven composite of the present invention is suitable for use as the leg elastics 206 and waist elastics 208. Exemplary of such materials are laminate sheets that either comprise or are adhered to the outer cover 217 so that that elastic constrictive forces are imparted thereto.

The diaper 201 may also include one or more fasteners 230. For example, two flexible fasteners 230 are illustrated in Fig. 7 on opposite side edges of waist regions to create a waist opening and a pair of leg openings about the wearer. The shape of the fasteners 230 may generally vary, but may include, for instance, generally rectangular shapes, square shapes, circular shapes, triangular shapes,

oval shapes, linear shapes, and so forth. The fasteners may include, for instance, a hook-and-loop material, buttons, pins, snaps, adhesive tape fasteners, cohesives, fabric-and-loop fasteners, etc. In one particular embodiment, each fastener 230 includes a separate piece of hook material affixed to the inside surface of a flexible backing.

The various regions and/or components of the diaper 201 may be assembled together using any known attachment mechanism, such as adhesive, ultrasonic, thermal bonds, etc. Suitable adhesives may include, for instance, hot melt adhesives, pressure-sensitive adhesives, and so forth. When utilized, the adhesive may be applied as a uniform layer, a patterned layer, a sprayed pattern, or any of separate lines, swirls or dots. In the illustrated embodiment, for example, the outer cover 217 and bodyside liner 205 are assembled to each other and to the absorbent core 203 using an adhesive. Alternatively, the absorbent core 203 may be connected to the outer cover 217 using conventional fasteners, such as buttons, hook and loop type fasteners, adhesive tape fasteners, and so forth. Similarly, other diaper components, such as the leg elastic members 206, waist elastic members 208 and fasteners 230, may also be assembled into the diaper 201 using any attachment mechanism.

Although various configurations of a diaper have been described above, it should be understood that other diaper and absorbent article configurations are also included within the scope of the present invention. In addition, the present invention is by no means limited to diapers. In fact, any other absorbent article may be formed in accordance with the present invention, including, but not limited to, other personal care absorbent articles, such as training pants, absorbent underpants, adult incontinence products, feminine hygiene products (e.g., sanitary napkins), swim wear, baby wipes, and so forth; medical absorbent articles, such as garments, fenestration materials, underpads, bandages, absorbent drapes, and medical wipes; food service wipers; clothing articles; and so forth. Several examples of such absorbent articles are described in U.S. Patent Nos. 5,649,916 to DiPalma, et al.; 6,110,158 to Kielpikowski; 6,663,611 to Blaney, et al., which are incorporated herein in their entirety by reference thereto for all purposes. Still other suitable articles are described in U.S. Patent Application Publication No. 2004/0060112 A1 to Fell et al., as well as U.S. Patent Nos. 4,886,512 to Damico et

al.; 5,558,659 to Sherrod et al.; 6,888,044 to Fell et al.; and 6,511,465 to Freiburger et al., all of which are incorporated herein in their entirety by reference thereto for all purposes.

The present invention may be better understood with reference to the following examples.

EXAMPLES

The ability to form a smooth elastic film/nonwoven composite with good visibility of the film through the nonwoven facing was demonstrated. The elastic film was formed from 98 wt.% of VISTAMAXX™ 6102 (ExxonMobil Chemical Co.) and 2 wt.% of various pigments, including pearlescent and metallic pigments. The polymers were compounded by weighing appropriate portions of pellets of each polymer, combining them into one container, and mixing them together by stirring. After compounding, the film samples were cast onto a chill roll (operated at 38 feet per minute) at various basis weights ranging from about 27 to about 36 gsm and at a melt temperature of about 390°F. The cast film was thermally bonded between two polypropylene spunbond facings having a basis weight of approximately about 8.5 grams per square meter. Specifically, the film and facings were fed between an anvil and patterned roll (rib-knit, as shown in Fig. 2), the patterned roll having raised bonding elements spaced in the machine direction (unbonded length between the bonding elements), "Dm", by 295 micrometers for the MD oriented elements 91 and 231 micrometers for the elements that are oriented 15 degrees away from the CD direction 89. The raised bonding elements were spaced in the cross machine direction (unbonded length between the bonding elements), "Dc", by about 430 micrometers. The raised bonding elements defined a plurality of uninterrupted regions that extended continuously in the machine direction without intersecting another bonding element, the uninterrupted regions having a width, "Wc", of 231 micrometers. The patterned roll was heated to a roll surface temperature of 193°F, the anvil roll was heated to a roll surface temperature of 203°F, and the pressure was 117 pounds per linear inch. The rolls operated at a speed of 265 feet per minute so that the film was stretched in the machine direction at a stretch ratio of about 5.3 (i.e., 5.3 times its original length). Finally, the composite was transferred to a winder, which, for six different codes (1 through 6), was operated at speeds of 88, 91, 94, 98, 102, and 106 feet per

minute respectively to allow the composite to retract different amounts so as to vary the Strain property of the material. The final basis weights were approximately 80 to 89 grams per square meter.

The materials were tested to determine Strain at 2000 g_f (%). For this test, the sample size was 3 inches in the cross-machine direction by 7 inches in the machine direction. The grip size was 3 inches in width, and intermeshing grips were utilized so that material would not slip while tested. The grip separation was 4 inches. The samples were loaded such that the machine direction of the sample was in the vertical direction. A preload of approximately 10 to 15 grams was set. The test pulled the sample until 2000 grams of tension was produced, and then the test stopped. The test speed was 500 millimeters per minute of extension or strain. The test reported the elongation or strain in percent from start when 2000 grams of tension was produced in the material. The testing was done on a Sintech Corp. constant rate of extension tester 2/S with a Renew MTS mongoose box (controller) using TESTWORKS 4.07b software (Sintech Corp, of Cary, NC). The tests were conducted under ambient conditions. The results are set forth below in Table 1.

Table 1: Strain at 2000 g_f

Code	Strain at 2000 g _f (%)
1	246
2	225
3	223
4	212
5	203
6	203

As indicated above, the composites of the present invention were highly stretchable. The samples also demonstrated good surface smoothness and good visibility of the pigmented film through the nonwoven facing material.

While the invention has been described in detail with respect to the specific embodiments thereof, it will be appreciated that those skilled in the art, upon attaining an understanding of the foregoing, may readily conceive of alterations to, variations of, and equivalents to these embodiments. Accordingly, the scope of the present invention should be assessed as that of the appended claims and any equivalents thereto.

WHAT IS CLAIMED IS:

1. A method of forming a nonwoven composite, the method comprising:
forming an elastic film from a polymer composition;
passing the film and a nonwoven web material, the nonwoven web material
5 having a basis weight from about 5 gsm to about 30 gsm, through a nip formed by
at least one patterned roll, wherein the patterned roll comprises raised bonding
elements repeating in the machine direction, the elements being spaced in the
machine direction by less than about 760 micrometers; and
at the nip, concurrently melt fusing the film to the nonwoven web material,
10 wherein the film is under tension at a stretch ratio of about 1.5 or more in the
machine direction at the nip.

2. The method of claim 1, wherein the elements are spaced in the machine
direction by from about 40 micrometers to about 500 micrometers.

3. The method of claim 1, wherein the raised bonding elements cover from
15 about 3% to about 20% of a surface area of the patterned roll.

4. The method of claim 1, wherein the nip is formed between two rolls.

5. The method of claim 4, wherein at least one of the rolls is heated to a
surface temperature of from about 50°C to about 160°C.

6. The method of claim 4, wherein a pressure of from about 75 to about
20 600 pounds per linear inch is applied at the nip.

7. The method of claim 1, wherein the nonwoven web material contains
spunbond fibers, meltblown fibers, staple fibers, or a combination thereof.

8. The method of claim 1, wherein the polymer of the nonwoven web
material is a polyolefin.

9. The method of claim 1, wherein an additional nonwoven web material is
25 passed through the nip so that the elastic film is positioned between the nonwoven
web materials.

10. The method of claim 1, further comprising allowing the composite to
retract in the machine direction prior to or during winding onto a roll.

11. The method of claim 1, further comprising forming apertures in the film.

12. The method of claim 1, wherein the melt fusing occurs without
30 substantially softening a polymer of the nonwoven web material.

13. The method of claim 1, wherein the nonwoven web material is generally unapertured after being melt fused to the film.

14. The method of claim 11, wherein at least one discrete bond site is formed between the film and the nonwoven web material that is located proximate to a perimeter defined by at least one of the apertures.

15. The method of claim 1, wherein the bonding elements are spaced in the cross direction by less than about 1200 micrometers.

16. The method of claim 1, wherein the polymer composition is pigmented.

17. The method of claim 1, further comprising mechanically stretching the composite in at least the cross-machine direction.

18. The method of claim 1, wherein the raised bonding elements define a plurality of uninterrupted regions that extend continuously in the machine direction without intersecting another raised bonding element.

19. A nonwoven composite formed by the process of claim 1.

20. An absorbent article comprising an outer cover, a bodyside liner joined to the outer cover, and an absorbent core positioned between the outer cover and the bodyside liner, wherein the absorbent article includes the nonwoven composite of claim 19.

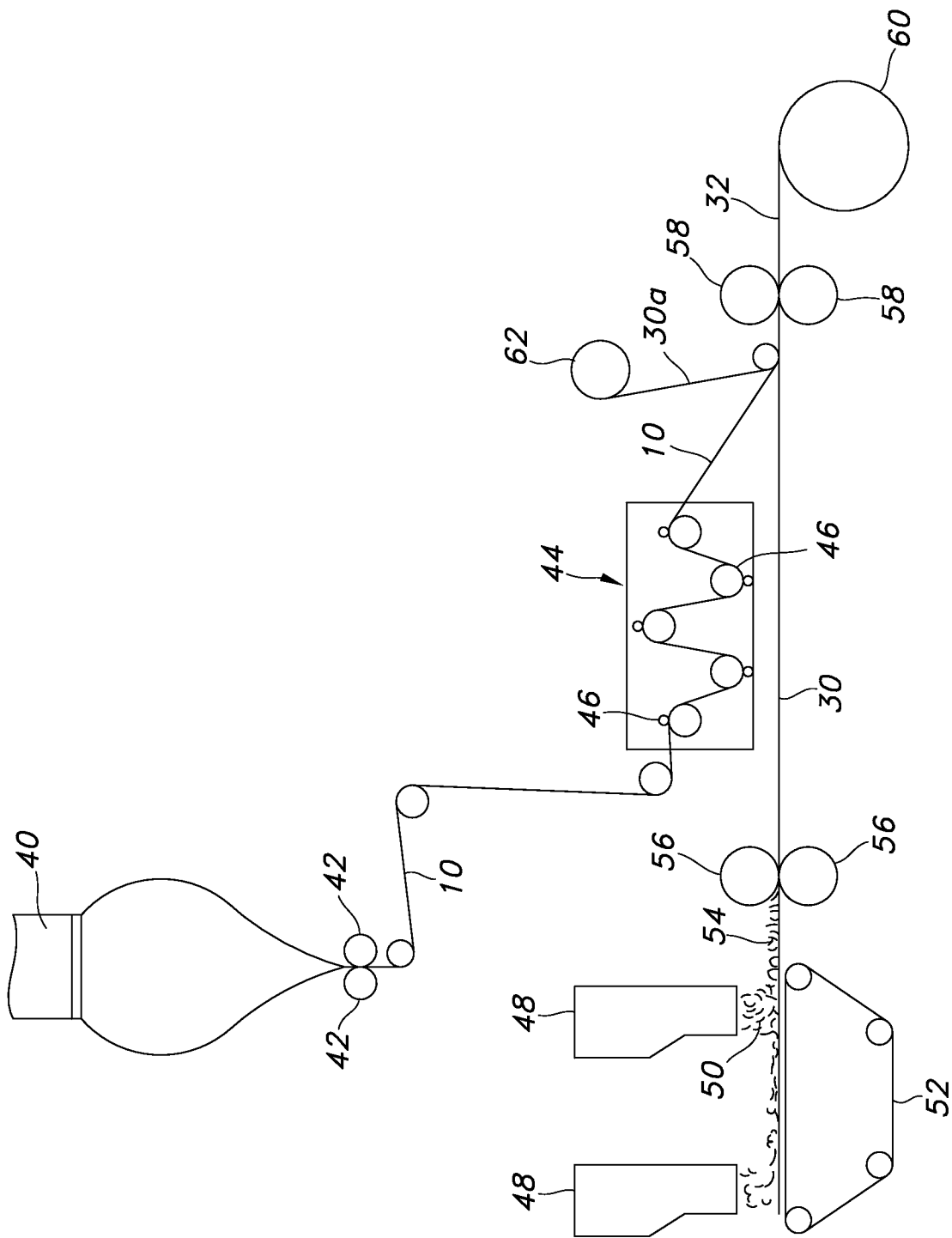


FIG. 1

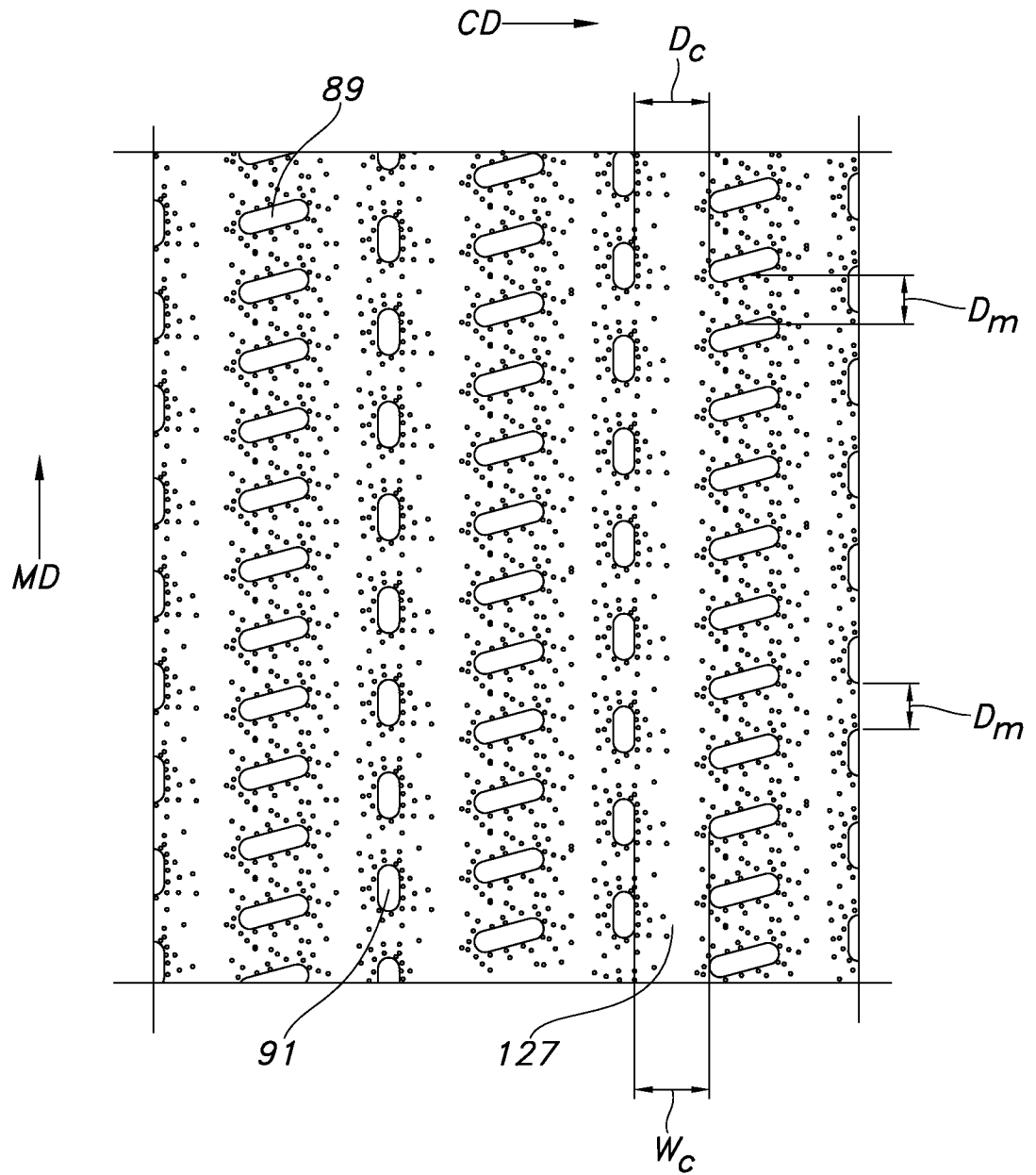


FIG. 2

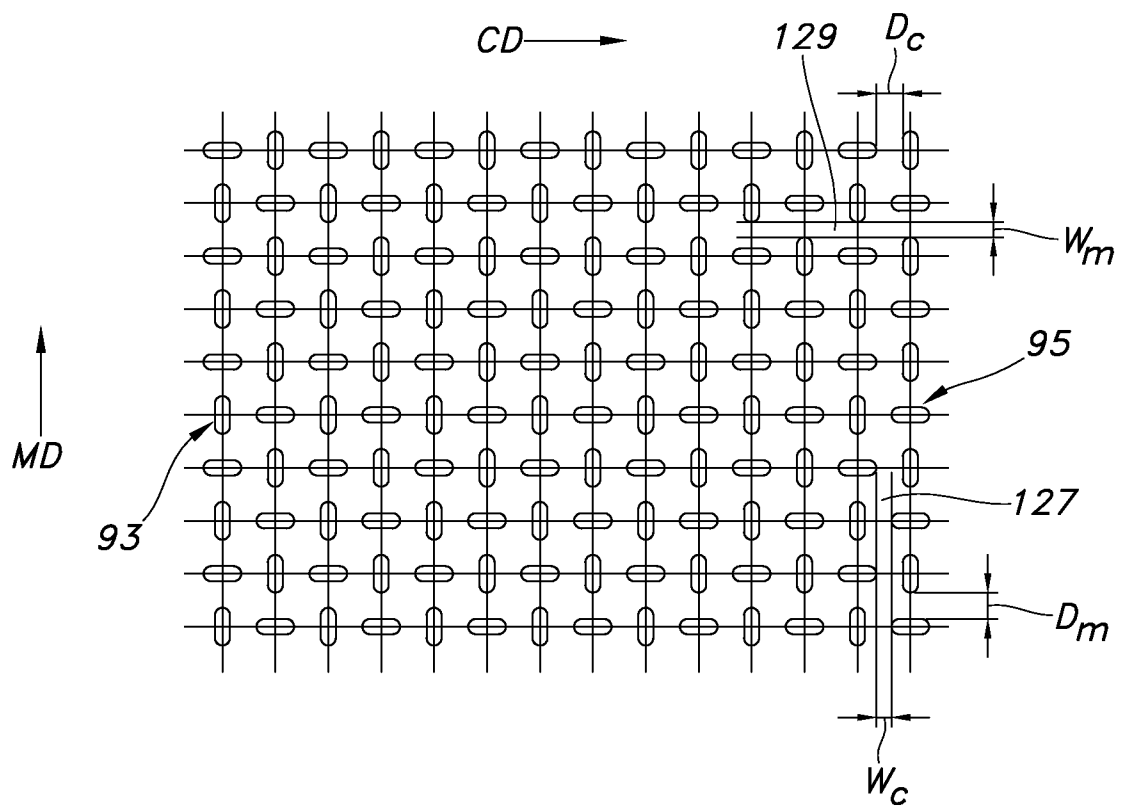


FIG. 3

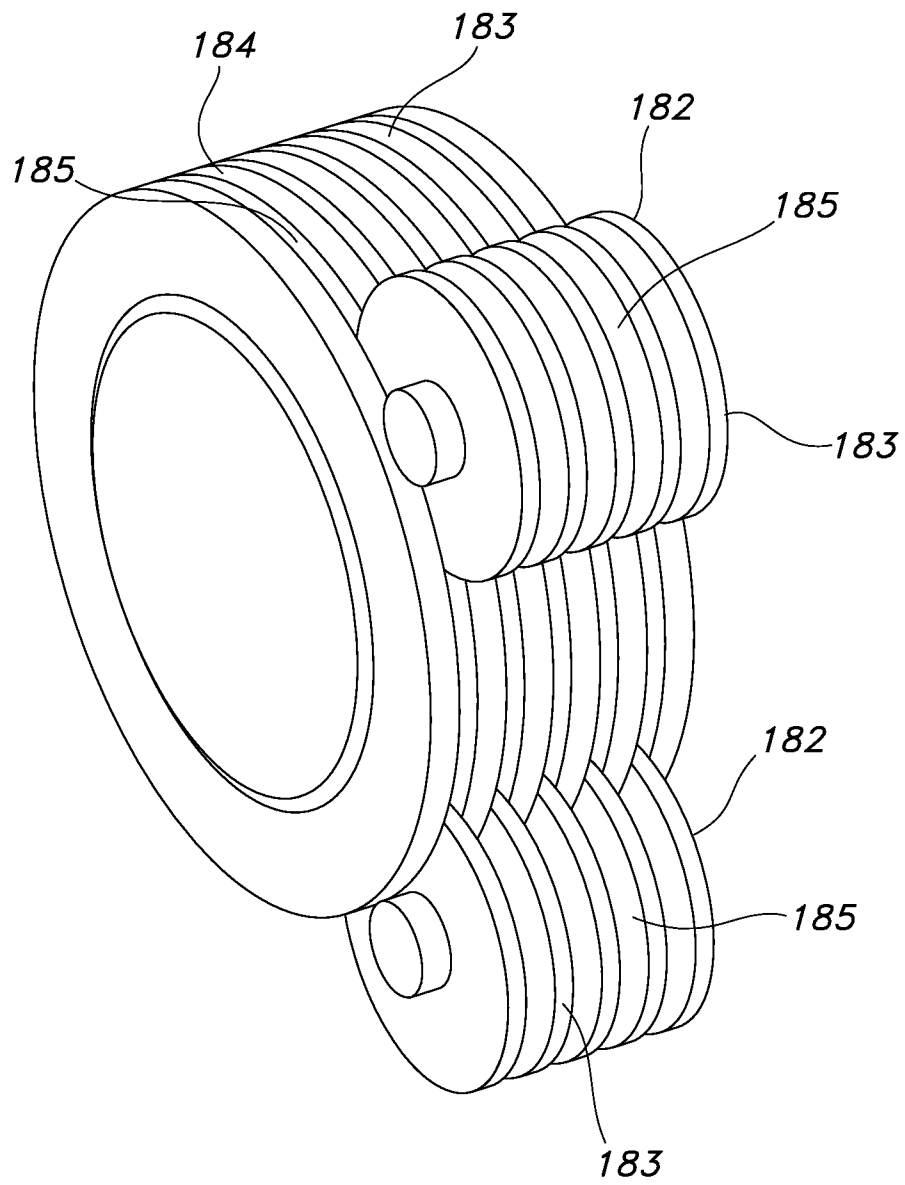


FIG. 4

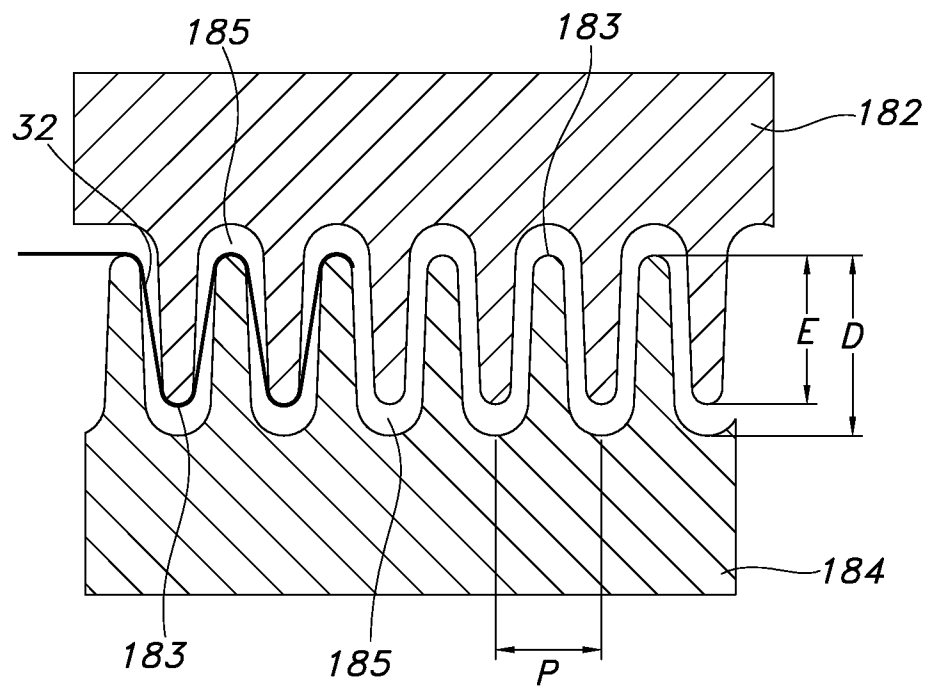


FIG. 5

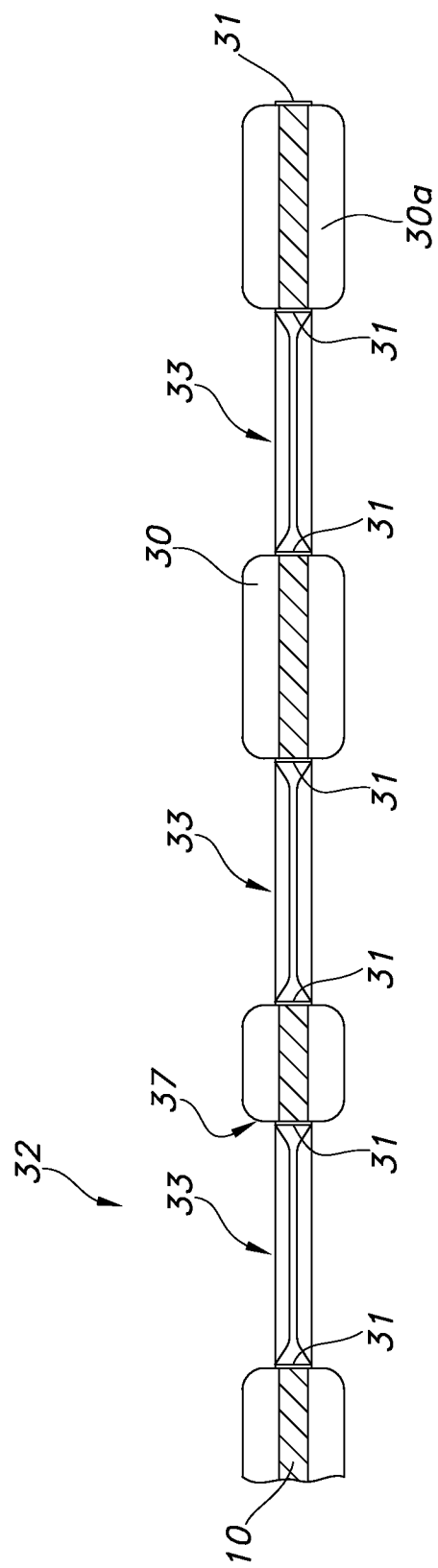


FIG. 6

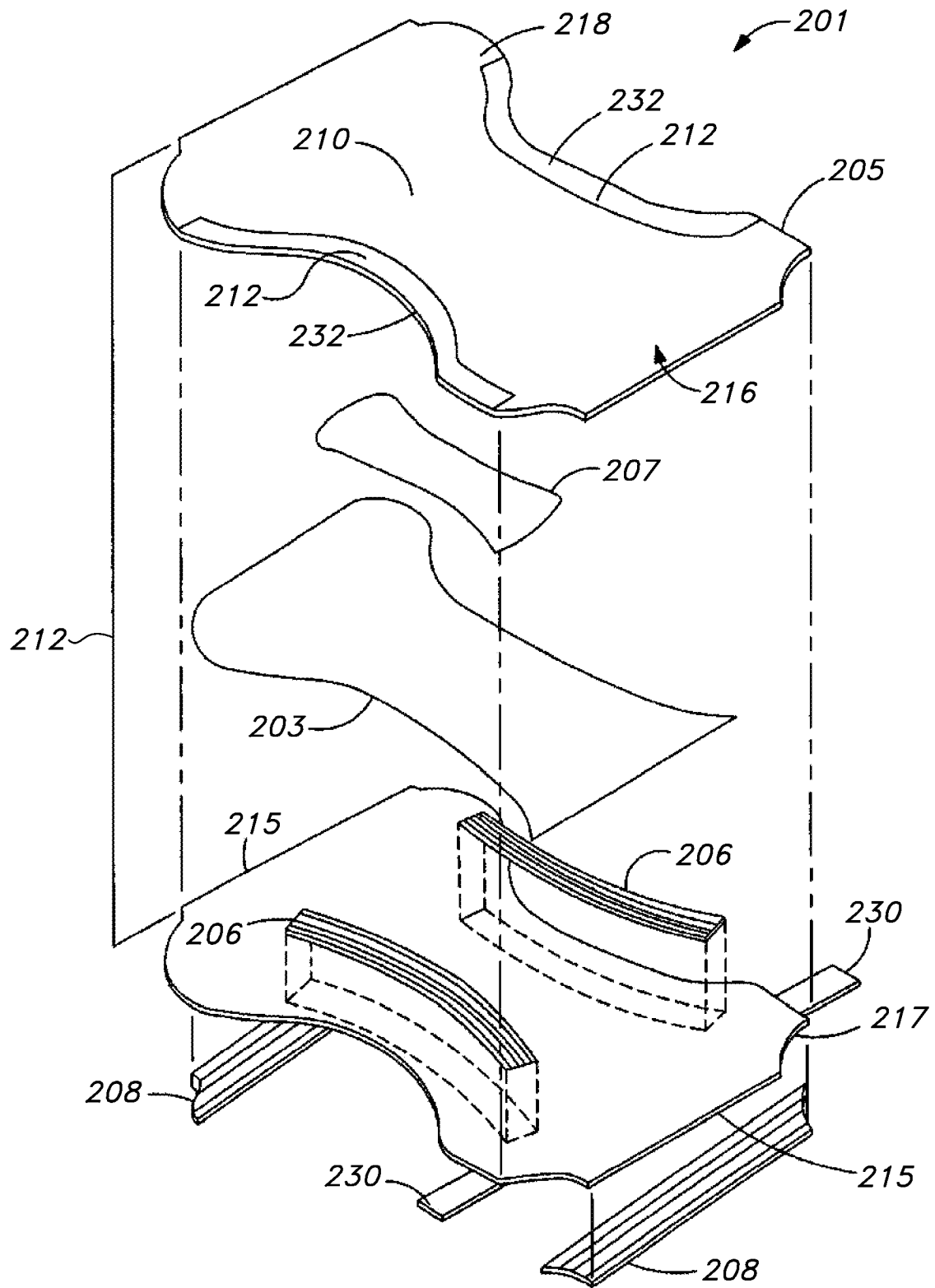


FIG. 7