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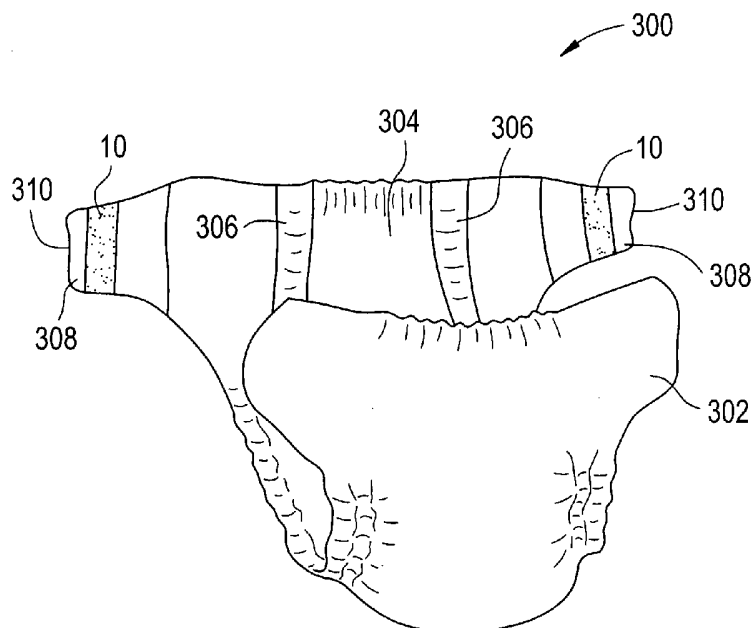
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(54) Title: MECHANICAL FASTENING SYSTEMS



(57) Abstract: In one embodiment, the mechanical fastening system can comprise: a hook material, and a nonwoven material having a nonwoven basis weight of less than or equal to about 30 g/m². The hook material can comprises a plurality of hook elements with a hook density of greater than or equal to about 1,800 hook elements per square inch. The hook elements can be capable of engaging the nonwoven material to attain an initial peel strength therebetween of greater than or equal to about 50 g-f.

Attends Healthcare Products, Inc

EX1025

Page 1 of 30

WO 2006/071211 A1



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

MECHANICAL FASTENING SYSTEMS

BACKGROUND

[0001] This disclosure relates to mechanical fastening systems.

[0002] Mechanical fastening systems, and in particular hook and loop fastening systems, have become increasingly widely used in various consumer and industrial applications. For example, such applications include disposable personal care absorbent articles, clothing, sporting goods equipment, and so forth. Such hook and loop fastening systems are employed in situations where a refastenable connection between two or more materials or articles is desired.

[0003] Mechanical fastening systems typically employ two components--a male (hook) component and a female (loop) component. The hook component usually includes a plurality of semi-rigid, hook-shaped elements anchored or connected to a base material. The loop component generally includes a resilient backing material from which a plurality of upstanding loops project. The hook-shaped elements of the hook component are designed to engage the loops of the loop material, thereby forming mechanical bonds between the hook and loop elements of the two components. These mechanical bonds function to prevent separation of the respective components during normal use. Such mechanical fastening systems are designed to avoid separation of the hook and loop components by application of a shear force or stress, which is applied in a plane parallel to or defined by the connected surfaces of the hook and loop components, as well as certain peel forces or stresses. However, application of a peeling force in a direction generally perpendicular or normal to the plane defined by the connected surfaces of the hook and loop components can cause separation of the hook elements from the loop elements, for example, by breaking the loop elements and thereby releasing the engaged hook elements, or by bending the resilient hook elements until the hook elements disengage the loop elements.

[0004] Mechanical fastening systems can be advantageously employed in disposable personal care absorbent articles, such as disposable diapers, disposable garments, disposable incontinence products, and the like. These systems provide the advantage that, even if contaminated with the typical ointments, creams etc. (e.g., used to protect a baby's skin), they still provide effective closure and allow the proper product performance. Such disposable products generally are single-use items that are discarded

after a relatively short period of use and are not intended to be washed and reused. As a result, it is desirable to avoid expensive components in the design of such products. Thus, to the extent that the hook and loop components are employed in such products, the hook and loop components need to be relatively inexpensive in terms of both the materials used and the manufacturing processes for making these components. On the other hand, the hook and loop components must have sufficient structural integrity and resiliency to withstand the forces applied thereto during normal wear of the absorbent article, in order to avoid potential premature separation or disengagement of the hook and loop components.

[0005] One hook and loop system comprises a loop fastening material useful in a mechanical fastening system for disposable articles. The loop fastening material includes a fibrous layer having a plurality of loops on a first surface adapted to be releasably engaged by a mating hook fastener portion and a layer of thermoplastic resin adhered to a second surface of the fibrous structure opposite the first surface. The thermoplastic resin anchors the loops in the fibrous structure.

[0006] In another system, the loop fastening material includes a backing of orientable material and a multiplicity of fibrous elements extending from the backing. The fibrous elements are formed by continuous filaments positioned on and intermittently secured to the backing desirably when the orientable material of the backing is in its dimensionally unstable state. The fibrous elements are formed by the shirring of the filaments between spaced, fixed regions of securement to the backing when the orientable material is caused to be transformed to its dimensionally stable state such that it is caused to contract or gather along its path of response. Thus, the loop material requires a backing of orientable material, such as an elastic or elastomeric or heat shrinkable material, that is caused to be transformed from a dimensionally stable state to a dimensionally unstable state and returned to its dimensionally stable state.

[0007] The hook and loop fastening systems generally comprise hooks that engage fluffy, loop fastening material, e.g., having a basis weight of greater than 80 grams per square meter (g/m^2). The use of the fastening systems requires attaching the hook or material comprising the hooks to one side of the element to be fastened, and applying the fluffy, loop material to the other side of the element to be fastened, such that, when the hooks engage the fluffy, loop material, the element is fastened as desired.

[0008] There remains a need for simplified re-usable mechanical fastening systems.

SUMMARY

[0009] Disclosed herein are mechanical fastening systems, disposable articles comprising mechanical fastening systems and methods for forming the disposable articles. In one embodiment, the mechanical fastening system can comprise: a hook material, and a nonwoven material having a nonwoven basis weight of less than or equal to about 30 g/m². The hook material can comprises a plurality of hook elements with a hook density of greater than or equal to about 1,800 hook elements per square inch. The hook elements can be capable of engaging the nonwoven material to attain an initial peel strength therebetween of greater than or equal to about 50 g-f.

[0010] In one embodiment, the disposable article can comprise: an outer cover comprising a nonwoven material, a liquid permeable bodyside liner that is connected in superposed relation to the outer cover, an absorbent body that is located between the bodyside liner and the outer cover, and a mechanical fastening system. The mechanical fastening system can comprise: a hook material, wherein the hook material comprises a plurality of hook elements with a hook density of greater than or equal to about 1,800 hook elements per square inch; and the nonwoven material, wherein the nonwoven material has a nonwoven basis weight of less than or equal to about 30 g/m². The hook elements can be capable of engaging the nonwoven material to attain an initial peel strength therebetween of greater than or equal to about 50 g. The hook material can be disposed on the article such that the hook material can engage the nonwoven material in a fastened state.

[0011] The above described and other features are exemplified by the following detailed description.

BRIEF DESCRIPTION OF DRAWINGS

[0012] Refer now to figures, which are exemplary, not limiting, and wherein like elements are numbered alike in several figures and, as such may not be discussed in relation to each figure.

[0013] Figure 1 is a perspective view of one embodiment of a hook material.

[0014] Figure 2 is a top view of one embodiment of a nonwoven material.

[0015] Figure 3 is a cross-sectional side view of the nonwoven material of Figure 2.

[0016] Figure 4 is a perspective view of one embodiment of a disposable diaper comprising the mechanical fastening system.

DETAILED DESCRIPTION

[0017] Disclosed herein are mechanical fastening systems, disposable articles comprising mechanical fastening systems and methods for forming the disposable articles. The mechanical fastening systems comprise a hook material and a nonwoven material. All ranges disclosed herein are inclusive and combinable (e.g., ranges of “up to about 25 wt%, or, more specifically about 5 wt% to about 20 wt%” is inclusive of the endpoints and all intermediate values of the ranges of “about 5 wt% to about 25 wt%,” etc.). The terms “first,” “second,” and the like, herein do not denote any order, quantity, or importance, but rather are used to distinguish one element from another, and the terms “a” and “an” herein do not denote a limitation of quantity, but rather denote the presence of at least one of the referenced item. The modifier “about” used in connection with a quantity is inclusive of the stated value and has the meaning dictated by the context (e.g., includes the degree of error associated with measurement of the particular quantity).

[0018] Referring now to Figure 1, in one embodiment, a hook material 10 comprises a plurality of hook elements 18 extending from a base layer 12. The base layer 12 comprises an upper surface 14 and a lower surface 16. The hook elements 18 extend away from at least one surface of the base layer 12.

[0019] The terms “hook” and “hook element” should be understood to encompass various geometries of protuberances that are suitable for engaging into a loop material such as a nonwoven loop material. Each of the hook elements can comprise a stem portion 20 attached to the base layer and a head portion 22 positioned at an end of the stem portion 20 opposite the base layer 12. The head portion 22 can have a design capable of fixedly engaging into a loop material such as a nonwoven material having a basis weight of less than or equal to about 30 g/m².

[0020] The geometry of the hook element 18 can enable engagement with this nonwoven material until a desired force is applied to the hook material 10, e.g., a force of greater than or equal to about 50 grams. Possible head portion geometries include a prong, stem, mushroom, J-hook, bi-directional hook, stud(s) protruding at various angle(s), barb, hook, trees (such as the shapes connoted by “evergreen” and “palm” trees), and so forth, as well as combinations comprising at least one of the foregoing geometries. Illustrated in Figure 1 is a head portion 22 having a cap like structure projecting radially past or overhanging the stem portion 20. Various hook geometries and dimensions are further described and illustrated in U.S. Pat. No. 6,730,069 to Tanzer et al., U.S. Pat. No.

5,339,499 to Kennedy et al., and U.S. Pat. No. 6,588,073 to Zoromski et al. Exemplary hook members are readily available commercially from, for example, Velcro USA, Inc. of Manchester, New Hampshire, and from the 3M Company, St. Paul, Minnesota.

[0021] In addition to the various possible geometries of hooks, the hooks may protrude from a backing material at various angles and may have various heights. The hook elements can have a sufficient height to enable the desired engagement with the nonwoven material. For example, an average height can be less than or equal to about 2 millimeters, e.g., about 0.01 millimeters (mm) to about 1.30 mm, or, more specifically about 0.03 mm to about 1.00 mm, and, even more specifically, about 0.10 mm to about 0.50 mm, measured from the base layer 12 to the highest point on the hook elements.

[0022] The distribution of the hook elements 18 on the base layer 12 is dependent upon the design of the nonwoven to be engaged. To enhance engagement integrity, the hook elements 18 can be distributed substantially uniformly over the desired area of the base layer 12. As with the hook shape design, the hook density can be sufficient to enable the desired engagement with a nonwoven material having a basis weight of less than or equal to about 30 g/m². For example, hook material 10 can have a hook density of greater than or equal to about 1,800 hook elements per square inch (e.g., 1,800 to about 4,000 hook elements per square inch), or, more specifically, about 2,500 to about 3,000 hook elements per square inch, or, even more specifically, about 2,600 to about 2,800 hook elements per square inch. As used herein, the term "hook density" refers to number of hook elements per square inch of the base layer 12.

[0023] The composition, geometry, and size of the base layer 12 are dependent upon the particular application of the mechanical fastening system. In order to enable flexibility in the engagement and disengagement of the hook elements 18 with the nonwoven material, the base layer 12 can comprise a combined composition and geometry that provides the desired flexibility and structural integrity to enable attachment to a substrate and to enable retention of the hook elements 18 during disengagement. For example, the base layer of the hook material can be thin enough to afford desirable flexibility, but is also thick enough and/or strong enough to allow it to be attached to a substrate by any desired means such as sonic or ultrasonic welding, heat bonding, sewing, through use of adhesives, and the like, as well as combinations comprising at least one of the foregoing. To have both good flexibility and strength, the base layer 12 of the hook material 10 can have a thickness of about 0.02 millimeters (mm) to about 0.5 mm, or, more

specifically, about 0.06 mm to about 0.3 mm. For some uses, a stiffer base layer could be used, or the base layer can be coated with a layer of pressure sensitive adhesive on a surface opposite the hook elements to enable adhesion of the base layer to a substrate, such as a hook tab. In this embodiment, the base layer can employ the strength of the substrate to help anchor the hook elements to the base layer.

[0024] Various materials can be employed for the hook material. For example, thermoplastic resin that is suitable for extrusion molding may be used to produce the hook material. Possible thermoplastic resin includes, but is not limited to, polyesters (such as poly(ethylene terephthalate)), polyamides (such as nylon, poly(styrene-acrylonitrile), poly(acrylonitrile-butadiene-styrene)), polyolefins (such as polypropylene), plasticized polyvinyl chloride, and so forth, as well as combinations comprising at least one of the foregoing.

[0025] Various methods can be used to form the hook material. An exemplary method includes extruding a thermoplastic resin through a die shaped to form a base layer equipped with spaced ridges with flanges or arms that project above an upper surface of the base layer. These ridges have the cross-sectional shape of the hook elements to be formed. The ridges can then be transversely cut at spaced locations along their length to form discrete elements of the ridges, and the base layer is stretched to separate those portions of the ridges, which are then the spaced hook elements.

[0026] The hook material is adapted for releasable engagement with a nonwoven material. The nonwoven material can comprises fibrous nonwoven fabrics, webs, and so forth, with sufficient void portions between the fibers such that the fibers can engage the hook elements. As used herein, the term “nonwoven” web is a structure of individual fibers or threads that are interlaid, but not in a regular or identifiable manner as in a knitted fabric. The basis weight of nonwoven fabrics may be usually expressed in ounces of material per square yard (osy) or grams per square meter (gsm) and the fiber diameters useful may be expressed in micrometers. (Note that to convert from osy to gsm, multiply osy by 33.91). The nonwoven material can have a basis weight of less than or equal to about 30 grams per square meter (g/m^2), or, more specifically, less than or equal to about 25 g/m^2 , or, even more specifically, less than or equal to about 20 g/m^2 , and, even more specifically, less than or equal to about 15 g/m^2 .

[0027] Optionally, the nonwoven material can be laminated, bonded, or otherwise attached, to additional layer(s) on a side opposite the side that engages the hook material 18

(hereinafter layered nonwoven material). The nonwoven material and/or the additional layer(s) of such a layered material may desirably be printed (e.g., surface printed). The printing can be on any portion of the nonwoven material and/or additional layer(s), such as on the portion of the material facing the user, the inner portion, the second layer adjacent to the nonwoven, the backside of the second layer, and so forth. Printing can be used as a visual cue to enhance the aesthetics of the product as well as to provide a visual cue to the user as to the recommended hook placement/fastening location to allow or provide the best product fit. Such printing may be provided as a multi-color printing, such as via registered graphics methods as are known in the art and which are described, for example, with respect to absorbent articles in U.S. Pat. No. 5,766,389 to Brandon et al., the disclosure of which is incorporated herein by reference in its entirety.

[0028] Desirably, the printing comprises rub-off resistant inks that to reduce the possibility of having ink transferring to the users clothing (e.g., a crockfastness value of greater than or equal to about 3 is desirable). In ink printing fabrics such as nonwovens it is desirable to have the ink strongly adhere to the nonwoven substrate. The degree of durability or adhesion of the ink to the substrate can be reflected by a parameter called crockfastness. Crockfastness value (CR) is measured on a scale from 0 to 5, with 5 being the highest, of the resistance of a material to the transfer of its color to another material. The dry crock test method may be used to measure whether the combination of ink and nonwoven used have sufficient abrasion (ink rub-off) resistance. A modification of ASTM test method F 1571-95 (for measuring abrasion resistance/smudge tendency of typewritten and impact written images) using a Sutherland Ink Rub Tester may be used to determine the crockfastness of printed materials.

[0029] The ASTM test method is modified in that two 1x2 inch (about 2.5 cm x 5 cm) rubber pads (available from the Danilee Company of San Antonio, Texas) are applied at the ends (one pad at each end) of the bottom surface of the weight so that a stress of 1 pound per square inch (psi) is achieved across the pads. The second modification of the standard ASTM test method is that instead of using a microcloth available from Buehler, a 80x80 count bleached muslin cloth, Crockmeter Cloth #3 (available from Testfabrics, Inc., Pittston, Pennsylvania), is used to rub against the printed material. The ASTM procedure is also modified such that the tester runs for 40 cycles, rather than 10. The modified method also includes a visual comparison of the color (if any) which is transferred onto the muslin cloth to the AATCC 9-Step Chromatic Transference Scale (1996 Edition) (available

from American Association of Textile Chemists and Colorists, having offices in Research Triangle Park, North Carolina) so as to determine a crockfastness rating between 1 and 5. A rating of 5 indicates no transfer of color onto the muslin cloth; therefore a crock value of 1 corresponds to a low or poor result while a value of 5 is the highest possible test result and this value would indicate that essentially no color was rubbed off the sample material.

[0030] Possible additional layer(s) for such a layered loop material include film layers such as monolayers or coextrusion of multiple layers (e.g., made of different resins), that can include polyethylene, polypropylene, polyethylene terephthalate (PET), and so forth, as well as combinations comprising at least one of the foregoing materials. Additionally, the nonwoven material may desirably comprise multicomponent (e.g., bicomponent) fibers. These materials can comprise different densities and various mixtures of the materials. The film can also be breathable (e.g., a film filled or loaded with a filler material such as calcium carbonate particles, and then stretched thin to make micropores in the material to make it vapor permeable, a monolithic film in which the film resin itself is vapor permeable and results in a breathable material, and so forth), or non-breathable. Ranges for breathability can comprise a water vapor transmission rate (WVTR) per 24 hours of about 100 gram per square meter per 24 hours ($\text{g/m}^2/24 \text{ hrs}$) to about 14,000 $\text{g/m}^2/24 \text{ hrs}$, or even higher.

[0031] The water vapor transmission rate (WVTR) for the sample materials can be calculated in general accordance with ASTM Standard E96-80. For example, circular samples measuring three inches (7.62 cm) in diameter can be cut from each of the test materials and a control (e.g., a piece of CELGARD® 2500 film from Hoechst Celanese Corporation of Sommerville, NJ. CELGARD® 2500 film is a microporous polypropylene film). The test dishes can be number 681 Vapometer cups distributed by Thwing-Albert Instrument Company of Philadelphia, PA. One hundred milliliters (ml) of distilled water can be poured into each Vapometer cup and individual samples of the test materials and control material can be placed across the open tops of the individual cups. Screw-on flanges can be tightened to form a seal along the edges of each cup (e.g., without sealant grease), leaving the associated test material or control material exposed to the ambient atmosphere over a 6.5 centimeter (cm) diameter circle having an exposed area of approximately 33.17 square centimeters. The cups can be weighed and placed in a forced air oven set at a temperature of 37°C (100°F). The oven can be a constant temperature oven with external air circulating through it to prevent water vapor accumulation inside (e.g., a

Blue M Power-O-Matic 60 oven distributed by Blue M Electric Co. of Blue Island, IL.) After 24 hours, the cups can be removed from the oven and again weighed. The preliminary test water vapor transmission rate values can then be calculated as follows:

$$\text{Test WVTR} = (\text{grams weight loss over 24 hours}) \times 315.5 \text{ (g/m}^2\text{/24 hrs)}$$

[0032] The relative humidity within the oven need not be specifically controlled. Under predetermined set conditions of 100°F (37°C) and ambient relative humidity, the WVTR for the CELGARD® 2500 film control has been determined to be 5,000 g/m²/24 hrs. Accordingly, the control sample can be run with each test and the preliminary test values can be corrected to set condition using the following equation:

$$\text{WVTR} = (\text{Test WVTR/control WVTR}) \times 5,000 \text{ g/m}^2\text{/24 hrs}$$

[0033] Other methods for determining WVTRs are possible using other testing systems. One specific test system used to measure WVTR is the PERMATRAN-W 100K water vapor permeation analysis system, commercially available from Modern Controls, Inc. (MOCON) of Minneapolis, MN.

[0034] Such a film/nonwoven layered or laminated material may desirably have a basis weight of less than or equal to about 60 g/m², or, more specifically less than or equal to about 50 g/m², or, even more specifically, less than or equal to about 40 g/m², and yet even more specifically, less than or equal to about 30 g/m².

[0035] The layered nonwoven material can have a sufficient peel strength and shear strength to prevent an undesirable amount of layer separation or “delamination” of the individual layers of the nonwoven when the hook material and the layered nonwoven material are separated from each other. As mentioned above, the layers may desirably be bonded together into a laminate material by any desired bonding means such as sonic or ultrasonic welding, heat bonding, sewing, through use of adhesives, and the like, as well as combinations of the foregoing. In one embodiment the layered nonwoven material can have a peel strength between layers of greater than or equal to about 200 grams. Peel test: In peel or delamination testing a laminate is tested for the amount of tensile force which will pull the layers of the laminate apart. Values for peel strength are obtained using a specified width of fabric, clamp jaw width and a constant rate of extension. For samples

having a film side, the film side of the specimen is covered with masking tape, or some other suitable material, in order to prevent the film from ripping apart during the test. The masking tape is on only one side of the laminate and so does not contribute to the peel strength of the sample. This test uses two clamps, each having two jaws with each jaw having a facing in contact with the sample, to hold the material in the same plane, usually vertically, separated by 2 inches to start. The sample size is 4 inches wide by as much length as necessary to delaminate enough sample length. The jaw facing size is 1 inch high by at least 4 inches wide, and the constant rate of extension is 300 mm/min. The sample is delaminated by hand a sufficient amount to allow it to be clamped into position, and the clamps move apart at the specified rate of extension to pull the laminate apart. The sample specimen is pulled apart at 180.degree. of separation between the two layers, and the peel strength reported is an average of three tests, peak load in grams. Measurement of the force begins when 16 mm of the laminate has been pulled apart, and it continues until a total of 170 mm has been delaminated. The Sintech 2 tester, available from the Sintech Corporation, Cary, North Carolina, the Instron Model TM, available from the Instron Corporation, Canton, Massachusetts, or the Thwing-Albert Model INTELLECT II available from the Thwing-Albert Instrument Co., Philadelphia, Pennsylvania, may be used for this test. The test may be performed with the specimen in the cross machine or transverse direction or in the machine direction.

[0036] In addition, a fastener component peel force can be measured by measuring the peel force required to separate the nonwoven loop material from engaged hook members. This fastening peel force value can, for example, be determined in accordance with standard procedure ASTM D5170, approved September 15, 1991 and published November 1991; with the following particulars. The test specimen is the fastener tab from the article being assessed. The test specimen length is the dimension aligned along the direction in which a peel-away force is typically applied to disengage and remove the fastener during the ordinary use of the article with which the fastener is employed. The specimen "width" lies within the general plane of the fastener and is perpendicular to the specimen length. The roller device weighs 4.5 pounds (2.05 kg) and includes a rubber coating around the roller circumference. During the engagement of the fastener components, the roller is rolled over the test specimen (gauge 3 inches (76.2 mm) loop sample is 76.1 mm machine direction (MD) and 152.4 mm cross-direction (CD)) through one cycle, in the direction of the cross-wise "width" of the sample. In addition, the initial

peel by hand to “raise the loops” is omitted. During testing, the fastener material held by the stationary clamp can be larger in area, as compared to the fastener material held in the moving clamp. The initial separation distance between the clamps of the tensile tester is 3 inch (7.62 cm), and the extension speed of the tensile testing machine is 20 inch/minute (50.8 cm/minute). The reported value of a peel test result is a “three-peak average” value employing MTS TESTWORKS software with a peak criteria of 2%. Additionally, the peel force value is normalized to be stated in terms of force per unit length of the “width” dimension of the fastener component on the test specimen, such as grams per inch or grams per centimeter. The MTS TESTWORKS software is available from MTS Systems Corporation, a business having offices in Eden Prairie, Minnesota. In addition to determining an initial or first peel force value, this test can be repeated multiple times by attaching the hook to the same loop surface again and repeating the procedure to determine a peel value for multiple cycles. Such multi-cycle testing is valuable for modeling or estimating the in-use characteristics of a hook and loop fastening system, and desirably the hook and loop fastener will exhibit adequate attachment (as measured by peel force) through at least a third cycle of testing.

[0037] The shear force value can be determined in accordance with the standard procedure ASTM D-5169, approved September 15, 1991 and published November 1991 with the following particulars. The test specimen is composed of the fastener tab from the article being assessed. The test specimen length and width typically correspond to the length and width employed to conduct the testing for peel force value. Ordinarily, the test specimen length is the dimension aligned along the direction in which a shear force is typically applied to the fastener during the ordinary use of the article with which the fastener is employed. The specimen “width” lies within the general plane of the fastener and is perpendicular to the specimen length. The roller device weighs 4.5 pounds and includes a rubber coating around the roller. During the engagement of the fastener components, the roller is rolled over the test specimen (gauge 3 inches (76.2 mm) loop sample is 76.1 mm machine direction (MD) and 152.4 mm cross-direction (CD)) through one cycle, in the direction of the cross-wise “width” of the sample, at a cross head speed of 254 mm/min. In addition, the initial peel by hand to “raise the loops” is omitted. During testing, the fastener material (e.g., the loop material) held by the stationary clamp can be larger in area, as compared to the fastener material (e.g., hook material) held in the moving clamp. The initial separation distance between the clamps of the tensile tester is 4 inch,

and the extension speed of the tensile testing machine is 10 inch/minute (25.4 cm/minute). The shear force value is normalized to be stated in terms of force per unit area of the test specimen, such as grams per square inch. In addition to determining an initial or first shear force value, this test can be repeated multiple times by attaching the hook to the same loop surface again and repeating the procedure to determine a shear value for multiple cycles. As mentioned above, multi-cycle testing is valuable for modeling or estimating the in-use characteristics of a hook and loop fastening system, and desirably the hook and loop fastener will exhibit adequate attachment (as measure by shear force) through at least a third cycle of testing.

[0038] Referring to Figures 2 and 3, a layered nonwoven material 50 can have bonded areas such as those illustrated by exemplary bond points 52 with unbonded areas 54 on its surface. Between the bond points 52, there exist portions of fibers in the nonwoven web material which define an arch, semi-circle or similar configuration extending above the flat length-width plane of the nonwoven web material. These arches or similar configurations act as “loops” by having loop-ends or arch-ends which are anchored or secured by the bond points. In the unbonded areas 54 the fibers of the nonwoven material 56 are substantially or completely free of bonding or fusing such that they retain their open fibrous structure and are available to act as loops. In another embodiment, the nonwoven material 56 can be laminated to the additional layer(s) 58 (such as a film or another nonwoven) such that the basis weight and openness of the fibrous structure is substantially uniform across the nonwoven material 56, thereby leaving the whole surface of the nonwoven material 56 open for engagement with the hook elements.

[0039] The bond points in the nonwoven web may be produced by “thermal point bonding” as known in the art, which involves passing a fabric or web of fibers or other sheet layer material to be bonded between a heated calender roll and an anvil roll. The calender roll is usually, though not always, patterned on its surface in some way so that the entire fabric is not bonded across its entire surface. As a result, various patterns for calender rolls have been developed for functional as well as aesthetic reasons. One example of a pattern has points and is the Hansen Pennings or “H&P” pattern with about a 30 percent bond area with about 200 bonds per square inch (about 31 bonds per square centimeter) as taught in U.S. Pat. No. 3, 855,046 to Hansen and Pennings. The H&P pattern has square point or pin bonding areas wherein each pin has a side dimension of 0.038 inches (0.965 mm), a spacing of 0.070 inches (1.778 mm) between pins, and a depth of bonding of 0.023 inches (0.584

mm). The resulting pattern has a bonded area of about 29.5 percent. Another typical point bonding pattern is the expanded Hansen and Pennings or "EHP" bond pattern which produces a 15 percent bond area with a square pin having a side dimension of 0.037 inches (0.94 mm), a pin spacing of 0.097 inches (2.464 mm) and a depth of 0.039 inches (0.991 mm). Other common patterns include a high density diamond or "HDD pattern", which comprises point bonds having about 460 pins per square inch (about 71 pins per square centimeter) for a bond area of about 15 percent to about 23 percent, a "Ramish" diamond pattern with repeating diamonds having a bond area of about 8 percent to about 14 percent and about 52 pins per square inch (about 8 pins per square centimeter) and a wire weave pattern looking as the name suggests, e.g. like a window screen. As still another example, the nonwoven web may be bonded with a point bonding method wherein the arrangement of the bond elements or bonding "pins" are arranged such that the pin elements have a greater dimension in the machine direction than in the cross-machine direction. Linear or rectangular-shaped pin elements with the major axis aligned substantially in the machine direction are examples of this. Alternatively, or in addition, useful bonding patterns may have pin elements arranged so as to leave machine direction running "lanes" or lines of unbonded or substantially unbonded regions running in the machine direction, so that the nonwoven web material has additional give or extensibility in the cross machine direction. Such bonding patterns as are described in U.S. Pat. No. 5,620,779 to Levy et al., incorporated herein by reference in its entirety, may be useful, such as for example the "rib-knit" bonding pattern therein described. Typically, the percent bonding area varies from around 10 percent to around 30 percent or more of the area of the fabric or web. Another known thermal calendering bonding method is the "pattern unbonded" or "point unbonded" or "PUB" bonding as taught in U.S. Pat. 5,858,515 to Stokes et al., wherein continuous bonded areas define a plurality of discrete unbonded areas. Thermal bonding (point bonding or point-unbonding) imparts integrity to individual layers or webs by bonding fibers within the layer and/or for laminates of multiple layers, such thermal bonding holds the layers together to form a cohesive laminate material.

[0040] The degree of bonding imparted to the nonwoven material by the can be expressed as a percent bond area, i.e., the portion of the area of at least one surface of nonwoven material occupied by the bonded areas designated in Figures 2 and 3 by reference numeral 52. Alternatively this may be expressed in terms of the percent unbonded area, that is, the portion of the nonwoven material comprising loose fibers.

Stated generally, the lower limit on the percent bond area suitable for a nonwoven material (or, alternatively the upper limit on the percent unbonded area) is the point at which fiber pull-out excessively reduces the surface integrity and durability of the pattern-unbonded material. The nonwoven material can have a percent bond area of less than or equal to about 20 percent, or, more specifically less than or equal to about 15 percent, or, even more specifically less than or equal to about 10 percent. It is noted that the bond area, which can generally be a result of a calender roll, might have different geometries and pin densities that achieve the desired bond area. Different pin sizes and arrangements can result in similar bond areas. Desirably, the bond pattern will allow some unbonded areas or enough space for the hooks to be attached.

[0041] Also, depending upon the desired application, the nonwoven material can comprise softening additives to impart a softened texture the nonwoven material. In some cases, the nonwoven can comprise botanical(s), ointment(s), skin wellness additive(s) (e.g., that can help to protect a user's skin in the areas of contact), and so forth. Examples of such botanicals, ointments, and additives include: aloe vera, cotton extract, chamomile, jojoba, sunflower oil, citric oils, carrot oils, avocado oil, almond oil, wheat germ, mint, olive oil, vitamins (e.g., E, D, A, and so forth), isopropyl palmitate, eucalyptus oil, lavender, peppermint oil, and so forth, as well as derivatives thereof, and combinations comprising at least one of the foregoing. Other optional ingredients include, but are not limited to, alkyldimethyl benzylammonium chloride, allantoin (5-ureidohydantoin), aluminum acetate, aluminum hydroxide, amylum, balsam peru, benzethonium chloride, bismuth subnitrate, boric acid, calamine, calcium carbonate, camphor, casein, cod liver oil, cysteine hydrocholyde, dibucaine, disperodon, glycerin, lanolin, petrolatum, phenol, silicone sorbitane, talc, zinc oxide, zinc, and so forth, as well as combinations comprising at least one of the foregoing. Perfumes and fragrances can optionally be applied to the formulation to enhance the user's perception of an absorbent article product, and/or to help mask, hide, or neutralize odors.

[0042] Commercially available thermoplastic substances, for example, can be employed in the nonwoven material. Possible thermoplastic substances include, but are not limited to, polyolefins, polyesters, polyamides, polycarbonates, polyurethanes, polyvinyl chloride, polytetrafluoroethylene, polystyrene, polyethylene terephthalate, biodegradable polymers such as polylactic acid, and so forth, as well as combinations comprising at least one of the foregoing thermoplastic polymeric substances. Suitable polyolefins include, but

are not limited to, polyethylene, e.g., high density polyethylene, medium density polyethylene, low density polyethylene, and linear low density polyethylene; polypropylene, e.g., isotactic polypropylene, syndiotactic polypropylene, blends of isotactic polypropylene and atactic polypropylene; polybutylene, e.g., poly(1-butene) and poly(2-butene); polypentene, e.g., poly(1-pentene) and poly(2-pentene); poly(3-methyl-1-pentene); poly(4-methyl 1-pentene); and so forth, as well as combinations comprising at least one of the foregoing. Suitable copolymers include random and block copolymers prepared from two or more different unsaturated olefin monomers, such as ethylene/propylene and ethylene/butylene copolymers. Suitable polyamides include nylon 6, nylon 6/6, nylon 4/6, nylon 11, nylon 12, nylon 6/10, nylon 6/12, nylon 12/12, copolymers of caprolactam and alkylene oxide diamine, and the like, as well as combinations comprising at least one of the foregoing polyamides. Suitable polyesters include polyethylene terephthalate, polytrimethylene terephthalate, polybutylene terephthalate, polytetramethylene terephthalate, polycyclohexylene-1,4-di-methylene terephthalate, and isophthalate, and so forth, as well as copolymers and combinations comprising at least one of the foregoing.

[0043] The nonwoven material can be formed by a variety of processes, including spunbonding (S), airlaying, melt-blowing (M), bonded carded web formation processes, and so forth, as well as combinations comprising at least one of the foregoing. This nonwoven material can be formed, for example, from a single spunbond bank (e.g., S), or multiple banks (e.g., S in combination with other bank(s)), e.g., SS, SSS, SMS, SSMMS, and so forth, wherein M refers to meltblown fibers). All such nonwoven webs may be pre-bonded, using nonwoven web bonding techniques as described above, and/or bonded using the pattern-unbonded method and apparatus such as described in U.S. Pat. No. 5,858,515 to Stokes et al. The nonwoven material can have fibers of about 0.8 to about 10 denier per filament (dpf), or, more specifically, about 1.5 to about 7 dpf, or, even more specifically, about 1.5 dpf to about 5 dpf, and, yet more specifically, about 1.8 dpf to about 3 dpf.

[0044] Spunbond nonwoven webs can be made from melt-spun filaments. As used herein, the term "melt-spun filaments" refers to small diameter fibers and/or filaments which are formed by extruding a molten thermoplastic material as filaments from a plurality of fine, usually circular, capillaries of a spinnerette with the diameter of the extruded filaments then being rapidly reduced, for example, by non-eductive or eductive fluid-drawing or other spunbonding mechanisms. Also, the nonwoven webs can be made from bonded carded webs and airlaid webs, which typically are formed of non-continuous,

staple fibers. Staple fiber webs may desirably comprise monocomponent fibers, multicomponent fibers, or be blends of monocomponent and multicomponent fibers. Example of monocomponent staple fibers include polyolefin staple fibers such as polyethylene or polypropylene, polyester or nylon or other staple fibers as are known in the art. Examples of multicomponent fibers include bicomponent fibers such as for example sheath-and-core fibers, a specific example of which may be polyethylene sheath and polypropylene core fibers.

[0045] The mechanical fastening system (i.e., between the hooks and the nonwoven material) also desirably has a peel value and a shear value such that there is sufficient structural integrity to remain fastened during use, but so as to allow disengagement when desired. In one embodiment the mechanical fastening system can have a peel strength of greater than or equal to about 50 grams-force (g-f), e.g., a peel strength of about 50 g-f to about 300 g-f, or, more specifically, about 60 g-f to about 200 g-f, or, even more specifically, about 80 g-f to about 180 g-f. The shear strength can be greater than or equal to about 1,500 g-f, or, more specifically, about 1,800 g-f to about 5,000 g-f, and, even more specifically, about 2,000 g-f to about 4,000 g-f. Desirably, the above peel and shear strengths are retained for multiple cycles, or, more specifically, for greater than or equal to three cycles, and, even more specifically, greater than or equal to 5 cycles. Additionally, if the nonwoven material and/or additional layer(s) are printed (e.g., by flexographic printing, rotogravure, ink jet printing, and so forth), it is desirable that such printing does not adversely affect the peel and shear, e.g., the peel and shear will remain in the above described ranges.

[0046] The mechanical fastening system can be employed in a wide variety of disposable articles including disposable personal care absorbent articles and disposable protective articles. Disposable absorbent articles include, but are not limited to, infant and child care absorbent articles such as diapers and training pants, disposable swimwear, adult care incontinent garments, feminine care articles such as sanitary napkins, bandages and wound dressings, and the like. Disposable protective articles include, but are not limited to, such articles as surgical gowns and surgical drapes, patient examination gowns, industrial workwear and cleanroom apparel.

[0047] Disposable absorbent articles, for example, can have a body facing side or body side liner that is worn or placed against or towards the body of the user and a non-body facing side or outer cover facing away from the body of the user. The nonwoven

material of the mechanical fastening system can be disposed on and/or attached to the outer cover of the article, or alternatively the outer cover of the article may be composed wholly of the nonwoven material. The hook material can be placed on or comprise a hook tab on the article which is conveniently located on the article such that the user or wearer is able to superpose the hook tab with the nonwoven material, that is, is easily able to place the hook tab in face to face relation with the nonwoven material, such that hook elements of the hook material can engage the fibers of the nonwoven material.

[0048] Referring to Figure 4, in one embodiment, the disposable absorbent article comprising the mechanical fastening system is a disposable diaper 300. Diaper 300 can comprise a liquid permeable body side liner 304, i.e., a body-facing or inner side, and a liquid impermeable outer cover 302, i.e., a non-body facing or outer side. Various woven or nonwoven fabrics can be used for body side liner 304 such as a spunbond nonwoven web of polyolefin fibers, a bonded carded web of natural and/or synthetic fibers, and so forth. Outer cover 302 can be formed of a thin liquid barrier material such as for example a spunbond-meltblown layer, spunbond-meltblown-spunbond layer, a thermoplastic polymer film layer, and so forth. A polymer film outer cover may be embossed and/or matte finished, and/or printed, to provide a more aesthetically pleasing appearance, or may be a laminate formed of a woven or nonwoven fabric and thermoplastic film. When printed, "reactive" inks (e.g., inks which change color or color intensity upon contact with some triggering mechanism, such as moisture/water, heat, ultraviolet (UV), and the like) may desirably be used to provide additional visual cues. These visual cues could be ornamental and/or can be functional, e.g., advising that the product needs to be changed due to its saturation level.

[0049] Disposed between liner 304 and outer cover 302 can be an absorbent core (not shown) formed, for example, of a blend of hydrophilic cellulosic wood pulp fluff fibers and highly absorbent gelling particles (e.g., superabsorbent material). Absorbent core can be compressible, conformable, non-irritating to the wearer's skin, and capable of absorbing and retaining liquid body exudates. The absorbent core can comprise a single, integral piece of material, or a plurality of individual separate pieces of material. The size and absorbent capacity of the absorbent core should be compatible with the size of the intended user and the liquid loading imparted by the intended use of the diaper 300. Diaper 300 may further include optional containment flaps 306 made from or attached to body side liner 304. Still further, the diaper 300 can optionally include additional elements,

including, but not limited to, elasticized leg cuffs, elastic waist band, and so forth, as well as combinations comprising at least one of the foregoing additional elements.

[0050] To secure the diaper 300 about the wearer, the diaper has the mechanical fastening system comprising the hook material and the nonwoven material. As shown in Figure 4, in one embodiment, the hook material 10 (of Figure 1) is on hook tabs 308 attached to the inner and/or outer surface of outer cover 302 in a back waistband region of diaper 300. Referring again to Figure 4, end portion or tip 310 of the hook tab 308 can be left uncovered by the hook material 10, such that it can be lifted or flexed and grasped by a user as they disengage or peel back the hook tabs. In other embodiments, the entire hook tab 308 is configured as a hook material 10.

[0051] The nonwoven material 50 (of Figure 2) can be secured to outer cover 302 of diaper 300 with adhesive(s), thermal bonding, ultrasonic bonding, and so forth, as well as a combination comprising at least one of the foregoing. As an alternative embodiment, the nonwoven material may cover substantially all of the outer cover, or the whole outer surface of the outer cover 302 can be formed of the nonwoven material. An example of this would be an outer cover material constructed of a thermoplastic film/nonwoven material laminate. In such embodiments, the hook material on the hook tab can be attached at various positions on the outer cover formed of the nonwoven material, depending on the shape and size of the wearer and/or the desirable tension to be applied to the wearer. This feature allows the user to adjust the article as many times as needed. Also, the mechanical fastening system provides easy disposal of the article by engaging the hook material at a suitable place on the outer cover to wrap up the article.

[0052] The mechanical fastening system can also be used advantageously as closures for bags or other containers; as bundling straps for bulk items such as carpet, linen, linoleum, fabric, and wrapping paper; for bundling pipes, sticks, lumber, and other longitudinal objects; as fasteners for commodity items such as paper and rolled goods.

[0053] Also, the mechanical fastening systems can be used for purposes other than, or in addition to, fastening or bundling. Thus, for example, the mechanical fastening system may be used for labeling or identification. In these applications, the hook material and/or nonwoven material may be provided with color coding, printing, and other indicia useful for these purposes.

[0054] Another use for the mechanical fastening system could be for pouches to protect various types of products. For example, a feminine care product (e.g., sanitary

napkins, and so forth) can be protected inside of a pouch made of a nonwoven laminate that has mechanical attachment to allow the user to seal and reseal the pouch. In another example, this system can be employed for the attachment of the wings in a feminine care product. By engineering the nonwoven material e.g., as a laminate to a film of the feminine care product, a system that allows the user to place the hook in multiple locations will be formed.

[0055] While the disclosure has been described with reference to exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the disclosure. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the disclosure without departing from the essential scope thereof. Therefore, it is intended that the disclosure not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this disclosure, but that the disclosure will include all embodiments falling within the scope of the appended claims.

CLAIMS:

1. A mechanical fastening system, comprising:
a hook material, wherein the hook material comprises a plurality of hook elements with a hook density of greater than or equal to about 1,800 hook elements per square inch;
and
a nonwoven material having a nonwoven basis weight of less than or equal to about 30 g/m²;
wherein the hook elements are capable of engaging the nonwoven material to attain an initial peel strength therebetween of greater than or equal to about 50 g-f.
2. The mechanical fastening system of Claim 1, wherein a subsequent peel strength is greater or equal to about 50 g-f after a third cycle test.
3. The mechanical fastening system of Claim 1, wherein an initial shear strength is greater or equal to about 1,500 g-f.
4. The mechanical fastening system of Claim 1, where a subsequent shear strength is greater or equal to about 1,500 g-f after a third cycle test.
5. The mechanical fastening system of Claim 1, wherein the hook density is about 2,000 to about 4,000 hook elements per square inch.
6. The mechanical fastening system of Claim 5, wherein the hook density is about 2,500 to about 3,000 hook elements per square inch.
7. The mechanical fastening system of Claim 1, wherein the nonwoven basis weight is less than or equal to about 25 g/m²
8. The mechanical fastening system of Claim 7, wherein the nonwoven basis weight is less than or equal to about 20 g/m².

9. The mechanical fastening system of Claim 1, further comprising a layered nonwoven material comprising the nonwoven material attached to an additional layer, and wherein the layered nonwoven material has a layered material basis weight of less than or equal to about 50 g/m².

10. The mechanical fastening system of Claim 9, wherein the layered nonwoven material basis weight is less than or equal to about 50 g/m².

11. The mechanical fastening system of Claim 10, wherein the layered nonwoven material basis weight is less than or equal to about 30 g/m².

12. The mechanical fastening system of Claim 9, wherein laminate exhibits a breathability of greater than or equal to 100 gr/m²/24 hours.

13. The mechanical fastening system of Claim 9, wherein the layer nonwoven has been printed and has a crockfastness value greater than or equal to about 3.

14. The mechanical fastening system of Claim 9, wherein the layer nonwoven has been printed using registered graphics.

15. The mechanical fastening system of Claim 9, wherein the layer nonwoven has been printed with a reactive ink.

16. The mechanical fastening system of Claim 9 wherein the layer nonwoven includes a skin wellness additive.

17. A disposable article, comprising:
an outer cover comprising a nonwoven material;
a liquid permeable bodyside liner that is connected in superposed relation to the outer cover;
an absorbent body that is located between the bodyside liner and the outer cover;
and
a mechanical fastening system comprising
a hook material, wherein the hook material comprises a plurality of hook elements with a hook density of greater than or equal to about 1,800 hook elements per square inch; and
the nonwoven material, wherein the nonwoven material has a nonwoven basis weight of less than or equal to about 30 g/m²;
wherein the hook elements are capable of engaging the nonwoven material to attain an initial peel strength therebetween of greater than or equal to about 50 g; and
wherein the hook material is disposed on the article such that the hook material can engage the nonwoven material in a fastened state.
18. The disposable article of Claim 17, wherein the nonwoven material forms the outer cover.
19. The disposable article of Claim 17, wherein the hook elements are capable of engaging the nonwoven material to attain a subsequent peel strength therebetween of greater or equal to about 50 g-f after a third cycle test.
20. The disposable article of Claim 17, where the hook elements are capable of engaging the nonwoven material to attain a subsequent shear strength of greater or equal to about 1,000 g-f after a third cycle test.
21. The disposable article of Claim 17, wherein the hook density is about 2,000 to about 4,000 hook elements per square inch.
22. The disposable article of Claim 17, wherein the nonwoven basis weight is less than or equal to about 25 g/m².

23. The disposable article of Claim 22, wherein nonwoven the basis weight is less than or equal to about 20 g/m^2 .

24. The disposable article of Claim 17, wherein the outer cover further comprises an additional layer attached to the nonwoven material, and wherein the outer cover has a cover basis weight of less than or equal to about 50 g/m^2 .

25. The disposable article of Claim 24, wherein the cover basis weight is less than or equal to about 30 g/m^2 .

26. The disposable article of Claim 17, wherein the mechanical fastening system has a peel strength of about 80 g-f to about 150 g-f.

27. The disposable article of Claim 17, wherein the mechanical fastening system has a shear strength of about 1,000 g-f to about 4,000 g-f.

28. The disposable article of Claim 17, wherein laminate exhibits a breathability of greater than or equal to about $100 \text{ gr/m}^2/24 \text{ hours}$.

29. The disposable article of Claim 17, wherein the layer nonwoven has been printed and has a crockfasteness value of greater than or equal to about 3.

30. The mechanical fastening system of Claim 17, wherein the layer nonwoven has been printed using registered graphics.

31. The disposable article of Claim 17, wherein the layer nonwoven has been printed with a reactive ink.

32. The disposable article of Claim 17, wherein the layer nonwoven includes a skin wellness additive.

1/2

FIG. 1

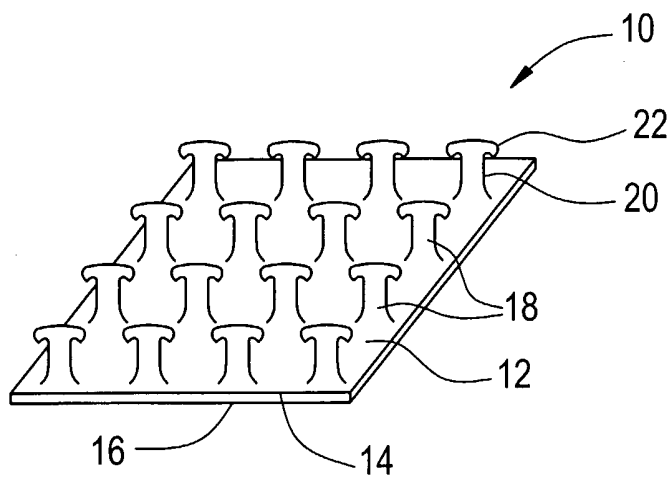


FIG. 2

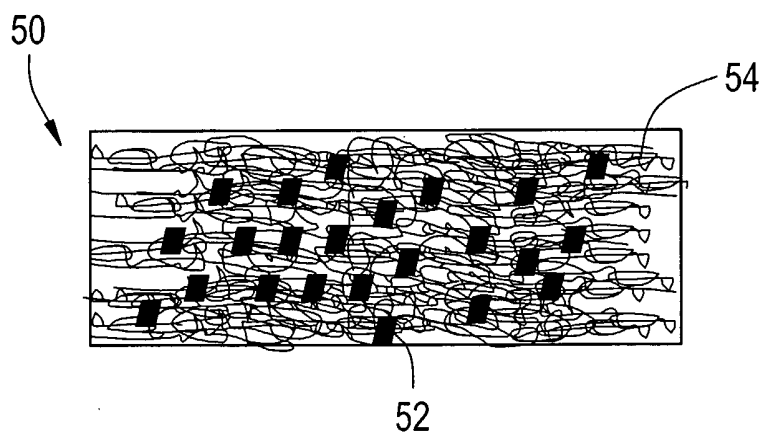
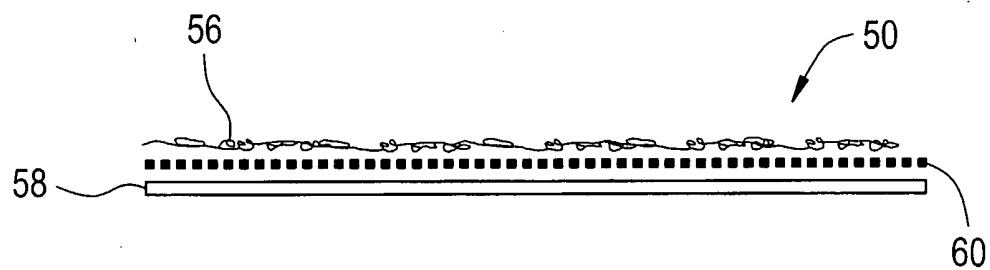
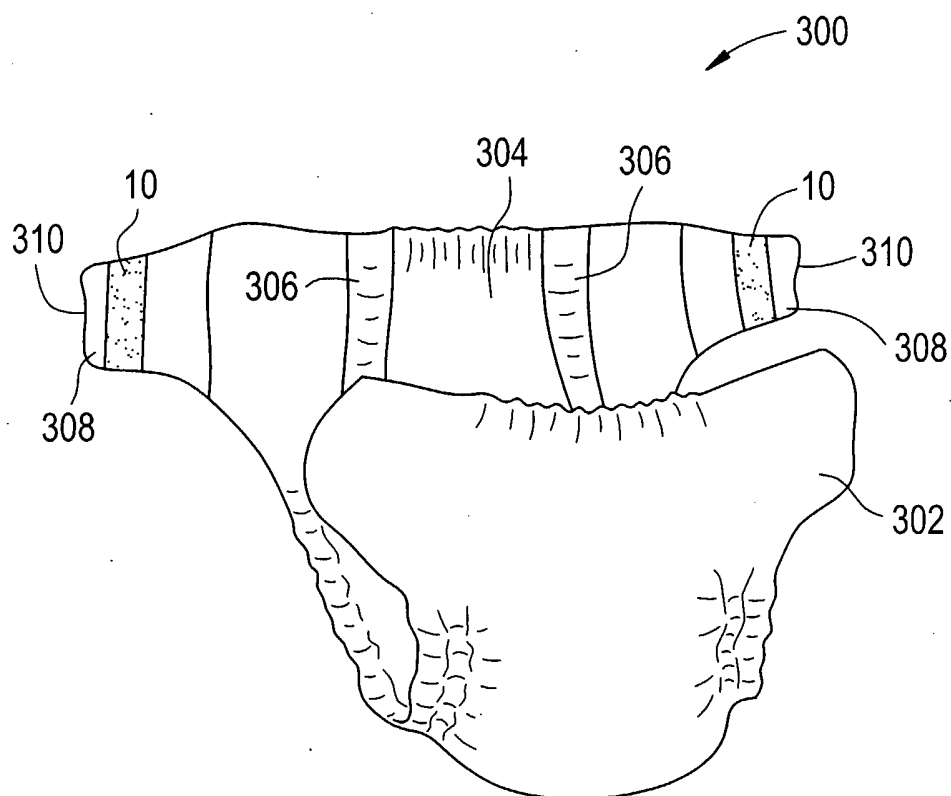


FIG. 3



2/2

FIG. 4



INTERNATIONAL SEARCH REPORT

International Application No
PCT/US2004/043311

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61F13/62 A61F13/15

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61F A44B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004/072491 A1 (GILLETTE SAMUEL MARK ET AL) 15 April 2004 (2004-04-15) paragraphs '0017!, '0018!, '0030! - '0034!, '0039!, '0040!, '0049! - '0053!; claims 30,31,34,36-39,44,53,54,56,59; figures 1-7 -----	1-32
X	EP 1 181 873 A (KAO CORPORATION) 27 February 2002 (2002-02-27) paragraphs '0058!, '0061! - '0070!, '0073!, '0084!, '0103! - '0087!; figures 1(a)-15; tables 1-5 ----- -/--	1-32

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

14 July 2005

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Joly, F

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US2004/043311

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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information on patent family members

International Application No

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