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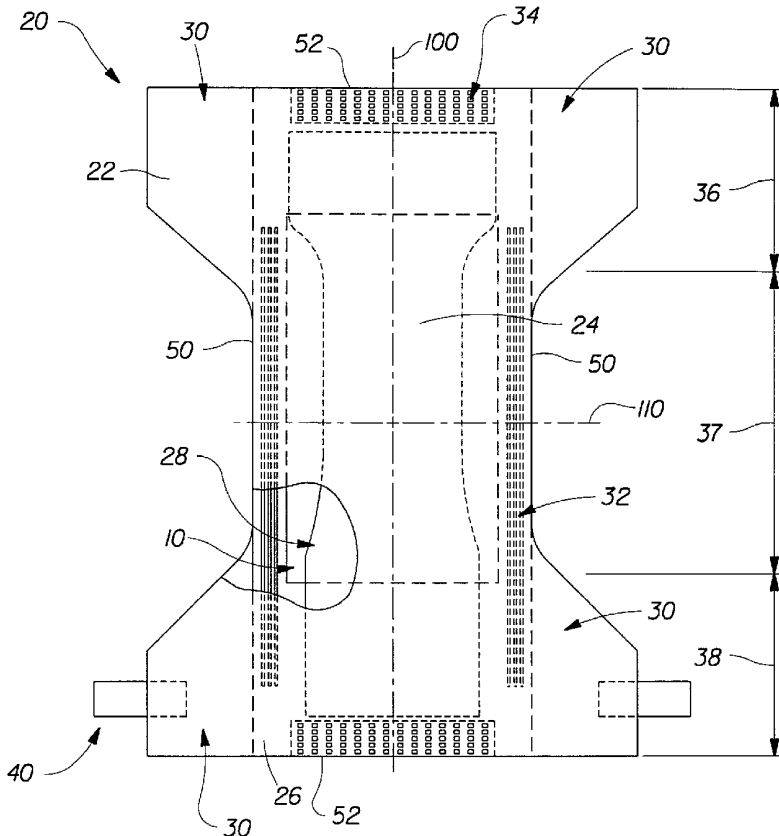
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(54) Title: ABSORBENT BARRIER STRUCTURES HAVING A HIGH CONVECTIVE AIR FLOW RATE AND ARTICLES MADE THEREFROM



(57) Abstract: The present invention relates to absorbent articles with improved protection and comfort by use of an absorbent barrier structure. This is achieved by the selection of individual components meeting specific requirements such that the combination thereof provides the absorbent articles having desired performance



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**ABSORBENT BARRIER STRUCTURES HAVING A HIGH CONVECTIVE AIR FLOW RATE
AND ARTICLES MADE THEREFROM**

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CROSS REFERENCE TO RELATED APPLICATIONS

This patent application claims priority under 35 U.S.C. §119 to PCT Application No.
10 US 00/17084, filed June 21, 2000, in the names of Sprengard-Eichel et al.

FIELD OF INVENTION

The present invention relates to absorbent articles which provide superior protection against wet
through under impact or sustained pressure, and high convective air flow therethrough for skin health and
comfort benefits. In particular, the present invention relates to an absorbent barrier structure for such
15 articles.

BACKGROUND OF THE INVENTION

Many known absorbent articles such as diapers, incontinence articles, feminine hygiene products,
training pants, typically comprise absorbent core materials located between a liquid pervious body-side
liner or topsheet and a vapor permeable, liquid impermeable outer cover or backsheet. The bodyside liner
20 allows bodily liquids to flow through easily and towards the absorbent core. The absorbent core takes up the
liquids quickly. Thus, no excessive pooling of liquids occurs on the body-facing surface of the absorbent
article. The outer cover is typically liquid impermeable such that there would be no leakage from the
absorbent article. However, because the disposable absorbent article may be worn for hours, sometimes
after the absorbent article has taken up liquids, perspiration from the wearer's body, and liquid vapors
25 escaped from the absorbent core, can get entrapped in the space between the absorbent article and the
wearer's skin, resulting in an increased relative humidity in the occluded area. As is known in the art, the
increased relative humidity leads to discomfort and overhydrated skin, which is prone to skin health
problems, especially rashes and other contact dermatitis.

Such backsheets are well suited to prevent the leakage of bodily fluids (such as urine, menses or
30 fecal matters) from the absorbent material to the outer garment of a wearer. Unfortunately, the use of such
an impermeable backsheet can result in a high degree of humidity in the absorbent article when the
absorbent article is in use such that a relatively elevated skin hydration levels may result.

The problem of high relative humidity near the skin in an absorbent article has been addressed in
the art through a number of means. For example, U.S. Pat. No. 5,137,525 uses mechanical means to
35 increase airflow in the article. Alternatively, breathable outer covers comprising, for example, microporous
or monolithic films, allow air and water vapor diffusion and have been disclosed previously. PCT
Publication WO 98/58609 discloses absorbent article with good liquid retention in the absorbent core
combined with water vapor permeability, liquid impermeable barrier materials for backsheet.

PCT Publication WO 00/10497, WO 00/10498, WO 00/10499, WO 00/10500, WO 00/10501 relate to breathable absorbent articles including the diffusion properties of the wet articles. These publications disclose absorbent articles having high permeability zones within the absorbent core, such as by aperturing the absorbent core or by creating portions in the core containing substantially less high absorbency materials than in other portions of the core. These publications disclose gas or vapor transfer mechanism through the absorbent article by diffusion mechanism such as diffusion through the use of a microporous film. Since diffusion mechanism is not very effective, the absorbent articles disclosed therein can lead to relatively good humidity conditions while being worn so long as the article is not substantially loaded with a large amount of liquids such as urine. However, these absorbent articles will still exhibit significantly increased relative humidity between the skin of the wearer and the article when the article is loaded.

Another performance parameter of interest for the loaded/wet absorbent article is its ability to hold the liquid and prevent leakage especially when the article is subjected to pressure or impact force due to the wearer's motion, such as sitting, walking, bending, and falling. Prior art also failed to provide satisfactory absorbent article which can hold liquids when its loaded to its absorbent capacity especially when the loaded absorbent article is under pressure or impact due to wearer's motion. Consequently there is a need for absorbent articles which have a balance of property – on one hand it is able to keep the relative humidity within the diaper in the range that's generally accepted as being comfortable, typically between about 30% to about 70% and more typically between about 30% to about 50% relative humidity. Such an absorbent article should also have the ability to hold liquids without leakage, especially when the article is loaded with bodily fluids. There is further a need to provide an absorbent article which manages the relative humidity within the absorbent article by a convective transport mechanism. There is further a need for absorbent articles wherein good microclimate conditions are achieved by carefully designing the chassis elements.

Typically to reduce the humidity level within the space between the absorbent article and the wearer's skin, breathable polymer films have been used as the outer cover for the absorbent article. The breathable films are typically constructed with micropores to provide substantial liquid impermeability and some level of diffusive air/vapor permeability, which is not as effective as the convective air/vapor permeability.

Other disposable absorbent articles have been designed to provide breathable regions in the form of breathable panels or perforated openings in the backsheet or in the core to help ventilate the garment. Articles using perforated components or breathable panels often exhibit excessive leakage or wet through of liquids from the article. Moreover, wearer's movements (e.g., sitting, falling, walking, lying) may subject the absorbent article to physical exertions, such as impact, compression, bending and the like, which may lead to increased leakage and wet through. The leakage/wet through problem becomes more severe under higher impact or pressure, heavy discharges and/or extended wear time.

Alternatively, multi-layered backsheets or outer covers have been used to address the wet through problem. For example, breathable materials such as a fibrous textile or a nonwoven web have been used in the outer cover, either alone or in laminates with the microporous film. The relatively open structures of such materials allow air or vapor to diffuse through easily. The laminates may provide improved liquid

impermeability and diffusive air/vapor permeability. The materials may be treated to further improve the liquid impermeability. However, the laminates still do not provide satisfactory protection against wet through under impact and/or sustained pressure. Further, the transport of air or vapor through the laminates via a diffusive mechanism is not as effective as the transport via a convective mechanism.

5 An alternative approach to the wet through problem is to improve the absorbent material such that little or no liquid comes into contact with the backsheet, thereby preventing wet through. This is typically achieved by increasing the amount of absorbent material in the article. However, this approach may lead to an increase in thickness of the article and a decrease in comfort as well as a decrease in vapor/air permeability through the article.

10 Another approach to the wet through problem is to place formed films between the core and the backsheet. Formed films having apertures in the shape of slanted cones are disclosed in PCT publications WO 99/39672, WO 99/39673 and WO 99/39674. However, after compaction or sustained pressure, these formed films fail to maintain its formed shape, consequently, they fail to provide the desired balance of properties. Thus, while these formed films may appear to have material properties to provide air
15 permeability and adequate leakage protection, they are not useful as a component within an absorbent article, which typically is subjected to a series of processes that compacts the article (including packaging, shipping and storage) before consumer use, and may be subjected to sustained pressure (e.g., being sat on by the wearer) during use.

Therefore, there is a need to have absorbent articles that provide consumer comfort, in terms of
20 reduced relative humidity within the absorbent article at a desirable overall thickness, and still achieve satisfactory wet through protection.

There is also a need to provide absorbent articles which manage the relative humidity within the space between the article and the wearer's skin to maintain good skin health. Further, there is a need to manage the relative humidity within the absorbent article by an effective convective transport mechanism,
25 and, optionally some degree of diffusive transport mechanism may be incorporated as well.

Additionally, there is a need for absorbent articles wherein the optimal microclimate condition within the space between the article and the wearer's skin is achieved by careful designs of components of the article. Specifically, there is a need for an absorbent barrier structure which provides the desired wet through protection and air/vapor permeability. Further, such an absorbent barrier structure has a desirable
30 thickness for wearer comfort.

There is a further need to provide absorbent articles comprising a barrier absorbent structure that can be exposed to compact and/or sustained pressure conditions for at least 24 hours without substantially degrading its performance, such as air permeability, liquid impermeability and resistance to leakage under impact or sustained pressure.

35 SUMMARY OF THE INVENTION

The present invention relates to absorbent articles with improved protection and comfort by use of an absorbent barrier structure. This is achieved by the selection of individual components meeting specific

requirements such that the combination thereof provides the absorbent articles having desired performance.

A typical absorbent article comprises an air/vapor permeable, liquid impermeable outer cover, a liquid permeable bodyside liner or topsheet, an absorbent body between the outer cover and the bodyside liner and an absorbent barrier structure positioned between the outer cover and the absorbent body.

5 The absorbent barrier structure of the present invention has a balanced property between convective air flow and absorptive barrier property. The convective air flow property is effective to reduce the relative humidity within the space between the absorbent article and the wearer's skin. The combination of liquid absorption and liquid barrier property provides protection against the wet through problem, and is especially beneficial when the absorbent article is under impact and/or sustained pressured conditions.

10 The absorbent barrier structure is a composite structure having at least one barrier zone and at least one reservoir zone. The barrier zone is resistant to liquid penetration so that the outflow of liquids from the absorbent core is substantially slowed or retarded to allow additional time for the absorbent core to acquire, distribute and retain the liquids to its full capacity. Suitable materials for the barrier zone should have a hydrohead value of at least about 10 mBars. The reservoir zone absorbs and retains any errant liquids that escape both the core and the barrier zone, thus, provides added protection against wet through. Cooperatively, the zones of the absorbent barrier structure effectively protect against wet through problem even under extreme conditions, such as impact or sustained pressure.

15 The absorbent barrier structure typically has a hydrohead value of at least about 10 mBars, a convective air permeability of at least about 10 Darcy/mm, a dynamic liquid impact (LIT) value of less than about 10 grams per square meters and an absorbency of at least about 1 g/g.

20 In one embodiment, the absorbent barrier structure comprises one barrier layer disposed adjacent to the garment-facing surface of the absorbent core, and one reservoir layer disposed adjacent to the garment-facing surface of the barrier layer. An additional barrier layer may be disposed on the opposite surface of the reservoir layer. In another embodiment, the absorbent article may further include a dampness management layer.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is partially broken top plan view of an absorbent article containing the absorbent barrier structure of the present invention;

30 Figure 2A is a cross sectional view of an absorbent barrier structure of the present invention which has a barrier layer and a reservoir layer;

Figure 2B is a cross sectional view of an absorbent barrier structure of the present invention which has a reservoir layer disposed between two barrier layers;

35 Figures 3A-3D are cross sectional views of alternative embodiments of the absorbent barrier structure of Figure 2A;

Figure 4A is a top plan view of the absorbent barrier structure of the present invention which has a barrier zone and a reservoir zone in a side-by-side arrangement;

Figure 4B is a top plan view of the absorbent barrier structure of the present invention in an alternative arrangement;

Figure 5 is a schematic illustration of the Dynamic Liquid Impact Tester.

DETAILED DESCRIPTION OF THE INVENTION

5 **DEFINITIONS**

As used herein, the term "absorbent articles" refers to devices which absorb and contain body exudates, and, more specifically, refers to devices which are placed against or in proximity to the body of the wearer to absorb and contain the various exudates discharged from the body. Absorbent articles may include diapers, training pants, adult incontinence undergarments, feminine hygiene products, breast pads, and the like. As used herein, the term "body fluids" or "body exudates" includes, but is not limited to, urine, blood, vaginal discharges, sweat and fecal matters.

The term "disposable" is used herein to describe absorbent articles which are not intended to be laundered or otherwise restored or reused as an absorbent article (i.e., they are intended to be discarded after use and, preferably, to be recycled, composted or otherwise disposed of in an environmentally compatible manner).

As used herein, the term "zone" refers to a region or an area comprising a material being physically, chemically, or visually distinguishable from surrounding or adjoining materials. Various zones of materials may include transitional zones in between. The zones may be positioned in the z-dimension or in the xy-dimension. As used herein, the term "z-dimension" refers to the dimension orthogonal to the length and width of the structure or article. The z-dimension usually corresponds to the thickness of the structure or article. As used herein, the term "xy-dimension" refers to the plane orthogonal to the thickness of the member, core or article when the member, core or article is in a flat-out state. The xy-dimension usually corresponds to the length and width, respectively, of the structure or article in a flat-out state.

As used herein, the term "unitary structure" refers to a structure comprising materials having different characteristics joined together to form an integral entity such that the materials are substantially inseparable physically, and the unitary structure exhibits properties resulting from the combination of the materials therein. The materials may be arranged in a face-to-face relationship in the z-dimension, or in a side-by-side relationship in the xy-dimension.

As used herein, the term "operatively associated" refers to a structure comprising different materials positioned at least in partial contact with each other in use. The materials are physically separable and each exhibits properties that can be measured individually. The materials may be arranged in a face-to-face relationship in the z-dimension, or in a side-by-side relationship in the xy-dimension.

As used herein, the term "bonded" refers to different materials being attached (cohesively or adhesively) in at least a portion thereof. The attached portions may be random or may have a pattern such as stripes, spirals, dots, and the like. The attached portions may be located at the peripheries, throughout the surface area, or both. Suitable attachment means known in the art may be used, including but not limited to adhesives, heat, pressure, crimping, ultrasonic, chemical (via hydrogen bonds or other cohesive forces), mechanical (e.g., fasteners, entanglements), hydraulic, vacuum and combinations thereof.

As used herein, the term "composite structure" refers to a multi-zoned structure wherein the materials comprising the zones may be operatively associated or bonded. The zones may even be in intimate contact such that the composite has a unitary structure. Further, the zones may be positioned in a layered (face-to-face) arrangement, or a side-by-side arrangement

5 As used herein, the term "absorbent core" refers to the component of the absorbent article that is primarily responsible for fluid handling properties of the article, including acquiring, transporting, distributing and storing body fluids. As such, the absorbent core typically does not include the topsheet, backsheet or outer cover of the absorbent article.

10 As used herein, the term "pulp" or "cellulosic fibers" include those natural fiber derived from trees or vegetations (e.g., hardwood fibers, softwood fibers, hemp, cotton, flax, esparto grass, milkweed, straw, bagasse and the like), their processed/regenerated fibers (e.g., Rayon®) or chemically derivatized fibers (e.g., cellulose esters), and combinations thereof. Suitable hardwood fibers include eucalyptus fibers. Suitable hardwood fibers may be prepared by kraft or other chemical pulping methods. Suitable softwood fibers include southern softwood (SS) fibers and northern softwood (NS) fibers. Softwood fibers for use
15 herein can be chemically (e.g., without limitation, kraft pulp) or mechanically pulped (e.g., without limitation, chemithermal mechanical pulp (CTMP) and thermal mechanical pulp (TMP)).

20 As used herein, the term "nonwoven web" refers to a web that has a structure of individual fibers which are interlaid forming a matrix, but not in an identifiable repeating manner. Nonwoven webs may be formed by a variety of processes known to those skilled in the art, for example, meltblowing, spunbonding, wet-laying, air-laying, and various bonding-carding processes.

25 As used herein, the term "spunbonded web" refers to a web having fibers formed by extruding a molten thermoplastic material as filaments from a plurality of fine capillaries of a spinnerette having a circular or other configuration, then rapidly reducing the diameter of the extruded filaments by fluid drawing or other well known spunbonding mechanisms. Spunbond fibers are quenched and generally not tacky when they are deposited onto a collecting surface. Spunbond fibers are generally continuous and often have average between 20 to 30 microns.

30 As used herein, the term "meltblown web" refers to a web having fibers formed by extruding a molten thermoplastic material through a plurality of fine, usually circular, die capillaries as molten threads or filaments into converging high velocity heated gas/air streams which attenuate the molten filaments to reduce their diameter. The reduction in fiber diameter is substantial greater than the reduction of fiber diameter in the spunbonding process, resulting in microfibers having average fiber diameter larger than 0.2 microns and typically in the range of 0.6 to 10 microns. Thereafter, the meltblown fibers are carried by the high velocity gas stream and are deposited on a collecting surface to form a web of randomly disbursed fibers. Various melt blown processes are known in the art.

35 The following detailed description of the absorbent barrier structure of the present invention is in the context of a disposable diaper. However, it is readily apparent that the absorbent barrier structure of the present invention is also suitable for use in other absorbent articles such as feminine hygiene products, training pants, incontinence articles, and the like. It is also apparent that the absorbent barrier structure of

the present invention is suitable for use in other hygiene or health care products, such as bandages, dressings, wipes, bibs, surgical drapes, surgical gowns, and the like.

The Barrier Structure or The Absorbent Barrier Structure

5 The present invention provides a barrier structure which allows convective air or water vapor transport though this structure. Particularly, the structure of the present invention achieves the desirable convective air flow capacity without sacrificing the barrier protection against wet through. When the barrier structure is included in an absorbent article, the resulting absorbent article shows effective reduction of the relative humidity in the space between the absorbent article and the wearer, thus, improves and/or maintains skin health and wearer comfort.

10 Convective transport capacity is different from the diffusive transport capacity. The convective transport is driven by a gas or air pressure differential and is typically at a much higher transport rate than the diffusive transport, which is driven by random molecular movements. Typical example of the diffusive transport includes the moisture migration through the pores of a microporous films such as those known in the art as the backsheet materials, or through the molecular structure of a nonporous monolithic film such as that made from Hytrel® (available from DuPont, Wilmington, DE). Convective transport, on the other hand, is directed by the air pressure differential between the inside and the outside of the article. Though the local pressure (i.e., the local pressure within the space between the article and the wearer) and the pressure of the environment (i.e., outside the article) are substantially the same, small changes in the local pressure may cause convective air flow, typically through the gaps between the wearer and the article. 15 Factors that may lead to convective transport include, but are not limited to, movements by the wearer, small pressure and/or temperature differential between the local and the outside environment, and the like.

With the advances made to the absorbent articles, using elastic materials and elastic components, the absorbent articles now provide a tighter seal (i.e., less gaps) against the wearer's body to minimize fluid leakage to the outside. Consequently, the convective air flow through the gaps are substantially reduced, leading to a humid and hot local environment in the space between the article and the wearer. While 25 absorbent cores are typically air permeable; the air permeability typically is reduced when the cores absorb liquid (i.e., become loaded). The loaded cores can be vented (i.e., made air permeable) relatively easily, typically by venting means. Alternatively, openness of the core structures can be achieved by selecting particular arrangements of permeable materials.

30 These vented or open-structured cores generally require a leakage protection component, which is typically a microporous film backsheet or a relatively thick nonwoven fabric that provides liquid impermeability and leakage protection. However, these liquid impermeable components will reduce the air permeability of the article. In contrast, the barrier structure of the present invention allows the convective air flow through the structure itself.

35 The barrier structure of the present invention also provides liquid absorbency and good liquid retention capability. Thus, it is also an absorbent barrier structure. The liquid retention capability is especially beneficial when wearer's motions, such as sitting, falling, lying, bending, walking, may apply pressure/forces on the loaded (i.e., wetted with bodily fluids) absorbent body and/or the adjacent

absorbent barrier structure and may lead to leakage. Thus, when the absorbent barrier structure is included in an absorbent article, the resulting absorbent article not only provides effective convective air flow capacity, it also provides effective protection against wet through, even when the article is subjected to impact forces.

5 Typically, the absorbent barrier structure is positioned between the absorbent core and the outer cover, preferably adjacent to the garment-facing side of the absorbent core. The absorbent barrier structure is a composite structure, which comprises a plurality of individual zones of materials that are joined or operatively associated together. Alternatively, the plurality of zones may be combined into a unitary structure such that the individual zones become physically inseparable. The individual zones of the
10 absorbent barrier structure may be coextensive or non-coextensive, depending on the requirements of the absorbent article. The individual zones may be joined by attachment means such as those well known in the art.

As used herein, the term "joined" encompasses configuration whereby a member is directly secured to the other member by affixing the member directly to the other member, and configurations
15 whereby a member is indirectly secured to the other member by affixing one member to intermediate member(s), which in turn are affixed to the other member. For example, the zones may be secured together by a uniform continuous layer of adhesive, or an array of separate lines, spirals, or droplets or beads of adhesive. The adhesive may be applied continuously or intermittently. For example, each application of the adhesive spans the length of the absorbent barrier structure and is separated from one another by a selected
20 distance. The adhesive is applied to tack the zones together for handling the webs in the assembly process. Preferably, the adhesive is applied to portions of the surface of the absorbent barrier structure, leaving sufficient open (i.e., free of adhesives) surface areas for air/vapor permeability. Alternatively, the adhesive may be applied to modify the liquid impermeability. Typically, the open or adhesive-free surface area is no less than about 50%, preferably no less than about 70%, more preferably no less than about 80%, and most
25 preferably no less than about 90% of the total surface area of the absorbent barrier structure. Suitable adhesives are manufactured by H.B. Fuller Company of St. Paul, Minnesota and marketed as HL-1258 and by Ato-Findley Inc. of Milwaukee, Wisconsin, under the trade designation H2031F.

In one embodiment, the adhesive is applied in a stripe along the peripheries of the zones. In another embodiment, the adhesive is applied in spaced-apart stripes aligned with the longitudinal centerline
30 of the diaper when it is used in a diaper. In another embodiment, the adhesive is applied to the web in three stripes along the longitudinal centerline of the diaper. Each stripe is 22mm wide (in the lateral direction of the diaper) and the two outer stripes are disposed at or near (about 4 mm from) the longitudinal peripheries.

The adhesive is typically applied from its softened or melt state to the surface of at least one of the webs comprising the absorbent barrier structure. The adhesive is heated to at least above its softening
35 temperature prior to being applied to a substrate surface. Once applied, the adhesive is allowed to cool and harden/solidify. Various methods for softened or melt state application are known. Methods particularly suitable for use herein include, but are not limited to, spraying, dipping, gravure printing, and extrusion.

Alternatively, the attachment means may comprise heat bonds, pressure bonds, ultrasonic bonds, mechanical bonds (via, for example, entanglements, cohesive forces, electric or static charges) or any other suitable attachment means or combinations of these attachment means as are known in the art.

The individual zones may be arranged in layers, wherein individual zones are in an operable, intimate contact with at least a portion of the adjacent layer. Such contacts may be random, or may have a regular pattern, such as dots, stripes, and the like. Preferably, each layer is connected to at least a portion of an adjacent layer of the absorbent barrier structure by a suitable bonding and/or attachment means, such as ultrasonic bonding, adhesive bonding, mechanical bonding, or hydraulic needling. In another embodiment, the individual zones may be arranged in an operable, intimate contact along at least a portion of its boundary with the adjacent layer of the absorbent barrier structure.

The absorbent barrier structure of the present invention may be constructed to have a convective air permeability of at least about 1 Darcy/mm, preferably at least about 10 Darcy/mm, more preferably at least about 30 Darcy/mm, and most preferably at least about 50 Darcy/mm. Convective air permeability is especially effective in removing moisture vapor from inside the absorbent article, resulting in a lower humidity in the local environment next to the skin. Thus, the absorbent barrier structure reduces incidences of skin irritation or rash, promotes skin health and provides better comfort.

Though the liquids are mainly absorbed by the absorbent core, the absorbent barrier structure provides additional leakage protection against errant liquids that are not absorbed by or are released from the absorbent core. Thus, the absorbent barrier structure of the present invention should have a minimal liquid absorbency.

Liquid absorbency may vary, depending on the materials used in the absorbent structure, the surface tension of the liquid being tested for absorbency, and the contact angle between the test liquid and the material. The absorbent barrier structure suitable for use herein typically has an absorbency (as measured by Test Method G using a 0.2 wt % Triton® solution) of at least about 1 g/g, typically from about 1 to about 100 g/g, preferably from about 5 to about 50 g/g, more preferably from about 10 to about 30 g/g.

Further, in order to provide the additional leakage protection, the absorbent barrier structure of should also have a liquid retention capability, especially under impact and/or sustained pressure conditions. This property is especially beneficial in the absorbent article applications. When an absorbent article is wet, wearer motions, such as sitting, falling, lying, rolling, may squeeze the absorbed liquids out of the absorbent core, resulting in leakage through the article. Thus, the absorbent barrier structure of the present invention preferably has a liquid impact value (as measured by Test Method C) of less than about 30 g/m², more preferably less than about 20 g/m², more preferably less than about 15 g/m², more preferably less than about 10 g/m², and most preferably less than about 6.5 g/m².

Also related to the leakage protection performance, the absorbent barrier structure should have a certain degree of resistance to liquid penetration. Thus, the absorbent barrier structure of the present invention has a hydrohead value (as measured by Test Method B) of at least about 10 mBars, preferably at least about 30 mBars, more preferably at least about 50 mBars, and most preferably at least about 75 mBars. In some embodiments, the absorbent barrier structure has a hydrohead value in the range from

about 30 to about 100 mBars.

The absorbent barrier structure of the present invention also has desired leakage protection in terms of a static liquid transmission value (measured according to Test Method D). In this respect, the absorbent barrier structure of the present invention has a static liquid transmission value of less than about 45 g/m², preferably less than about 30 g/m², more preferably less than about 20 g/m², and most preferably less than 13 g/m², at 15 minutes after impact. Further, the absorbent barrier structure of the present invention has a static liquid transmission value of no more than about 50 g/m², preferably no more than about 35 g/m², more preferably no more than about 20 g/m², at 60 minutes after impact.

In another aspect, after the absorbent barrier structure has been subjected to the compaction condition such as that described below in the Test Method F, it does not suffer substantial changes in barrier properties. The structural integrity during compaction and recovery after compaction are important for practical purposes. The absorbent articles are typically packaged into a compacted condition for shipping and storage. When the articles are eventually removed from the compaction for the intended use, the material or structure that fail to recover to its pre-compaction state may fail to provide the properties it was originally designed for. The absorbent barrier structure of the present invention should typically have a post-compaction air permeability decrease of no more than 35 %, preferably no more than 25 % decrease and most preferably no more than 15 % decrease, compared to its pre-compaction air permeability. In a preferred embodiment, the absorbent barrier structure has the post-compaction air permeability as disclosed above, after 7 days, preferably after 30 days, more preferably after 90 days.

The thickness and basis weight of the absorbent barrier structure may vary, depending on the materials used, the properties desired, the intended use, the construction, and the like. For example, thickness and/or basis weight may affect the diffusive breathability and/or the convective air permeability between the interior of an article and the outside, the absorbency and/or leakage protection of the article, the fit of the article to the wearer's body, the wearer's comfort, and like effects that typically relate to thickness of a structure. Typically, the absorbent barrier structure of the present invention intended for use in an absorbent article has a thickness of less than about 1.5 mm, preferably less than about 1.2 mm, and more preferably less than about 1.0 mm. The thickness of the absorbent barrier structure suitable for use in an absorbent article should also have a minimal thickness greater than about 0.1 mm, preferably greater than about 0.2 mm. Further, the absorbent barrier structure of the present invention suitable for use in an absorbent article typically has a basis weight in the range of from about 20 gsm (g/m²) to about 200 gsm (g/m²), preferably from about 30 gsm (g/m²) to about 150 gsm (g/m²), more preferably from about 40 gsm (g/m²) to about 120 gsm (g/m²), and most preferably from about 50 gsm (g/m²) to about 100 gsm (g/m²).

The absorbent barrier structure typically comprises two zones: a barrier zone and a reservoir zone. The barrier zone is "substantially impermeable" to liquids, including water, urine, menses, and other bodily fluids. The term "substantially impermeable" means that the barrier zone exhibits a resistance to liquid penetration but does not necessarily eliminate liquid wet through. In other words, it is possible for liquid to penetrate and flow through the barrier zone under certain conditions, such as under impact force, high applied pressure, or under sustained (i.e., continuously applied) pressure for a period of time. The

reservoir zone is liquid absorbent. When the reservoir zone is positioned adjacent to the barrier zone, any wet-through and/or leakage from the barrier zone is absorbed by the reservoir zone. In addition, the reservoir zone will also absorb errant liquids from the absorbent core. Thus, the combination of the barrier zone and the reservoir zone achieves the unique balance of properties that when exposed to liquids, the barrier zone provides a resistance to liquid wet through, and the reservoir zone absorbs any errant liquids that break through the resistance of the barrier zone. That is, the absorbent zone provides the added protection against liquid wet through problem. When the absorbent barrier structure of the present invention is positioned adjacent to a loaded absorbent core, it provides the additional protection against wet through, particularly when the liquid loading level is high and/or the loaded absorbent core is under a sudden, high impact force or a sustained forces/pressure.

This added wet through protection is especially beneficial in diapers, training pants, pull-on diapers, or adult incontinence products, for which the liquid loading level can be fairly high (in comparison to feminine hygiene products) and the probability of sudden impact or sustained pressure (e.g., when babies or incontinent adults fall, sit down, roll, sleep) is also high. The absorbent barrier structure of the present invention is also beneficial when the absorbent core is subjected to gushes of liquids. The resistance to liquid wet through provided by the barrier zone serves to temporarily slow down the gushes of liquids, possibly pooling the liquids at the interface between the absorbent core and the barrier zone. The slowed flow and pooling provide the additional time for the absorbent core to acquire and distribute the liquids to other regions of the core beyond the point of insult. Consequently, the absorbent core may achieve its full absorbent capacity.

The absorbent barrier structure of the present invention can be more clearly understood by referring to the following illustrative figures. FIG. 2A is a cross sectional view of an embodiment of the absorbent barrier structure of this invention. The absorbent barrier structure 10 comprises a barrier layer 12 and a reservoir layer 14. Optionally, an additional barrier layer 16, as shown in FIG. 2B, may be disposed on the other side of the reservoir layer 14 such that the reservoir layer 14 is sandwiched between the barrier layers 12 and 16. The first and the second barrier layers may be made of identical or different (in terms of construction of the web, basis weight, thickness, porosity, fiber denier, material, and the like) fibrous webs.

Various arrangements of the barrier zone and the reservoir zone are shown in FIG. 3A-3D. In FIG. 3A, multiple barrier zones 12 and reservoir zones 14 are arranged in a side-by-side relation, wherein the barrier zones 12 and the reservoir zones 14 are preferable stripes. In FIG. 3B, the barrier zone 12 is a continuous web and the reservoir zone 14 is disposed adjacent thereto in a discontinuous pattern, such as stripes, circles, ellipses, squares, and the like. In FIG. 3C, the reservoir zone 14 is a continuous web and the barrier zone 12 is disposed adjacent thereto in a discontinuous pattern, such as stripes, circles, ellipses, squares and the like. In FIG. 3D, the discontinuous barrier zones 12 overlap at least partially with the discontinuous reservoir zones 14, each may have the shape of stripes, circles, ellipses, squares, and the like.

In all of the embodiments illustrated in FIG. 2A-3D, at least a portion of the barrier zone is positioned adjacent to the garment-facing side of the absorbent core. In one embodiment, the absorbent barrier structure may extend through substantially the entire portion of the absorbent core or the

absorbent barrier structure may be stripes or patches that extend to portions of the absorbent core. In another embodiment, the absorbent barrier structure may extend beyond the outer edges of the absorbent core or only through the length and width of the central portion of the absorbent core. In a preferred embodiment, the barrier zone and the reservoir zone are arranged in a layered relation, wherein the barrier layer is disposed immediately adjacent to the garment-facing side of the absorbent core. Configurations in which the barrier zone has at least the same length and width of the absorbent core are highly preferred. Furthermore, the reservoir zone needs not have the same dimensions as the barrier zone.

The Reservoir Zone

The reservoir zone should be capable of absorbing, spreading and retaining liquids such as urine, blood and other body exudates. The reservoir zone has a garment-facing surface, a body-facing surface, front and rear edges, and side edges. The reservoir zone absorbs and retains the errant liquids that escape from other components such as the absorbent core and the barrier zone. Thus, the reservoir zone provides additional protection against wet through.

The thickness and basis weight of the reservoir zone may vary, depending on the materials used, the properties desired, the intended use, the openness of the construction, and the like. Specifically, the thickness of the reservoir zone may affect the air/gas permeability, the absorbency and/or leakage protection of the barrier absorbent structure, as well as the comfort and fit of the absorbent article, and like effects typically related to the thickness of a structure. Thus, the reservoir zone typically has a thickness of less than about 1.5 mm, preferably less than about 1.0 mm, and more preferably less than about 0.8 mm. The reservoir zone should also have a minimal thickness to provide for adequate absorbency and structural integrity. The minimal thickness of the reservoir zone is typically no less than about 0.2 mm, preferably no less than about 0.1 mm, more preferably no less than 0.05 mm, and most preferably no less than 0.02 mm. Further, the basis weight of the reservoir zone is typically in the range from about 5 gsm (g/m^2) to about 120 gsm (g/m^2), preferably from about 10 gsm (g/m^2) to about 100 gsm (g/m^2), and more preferably from about 30 gsm (g/m^2) to about 80 gsm (g/m^2).

When compared to the absorbent core, the reservoir zone absorbs fluids more readily (i.e., a faster fluid uptake) and releases fluids more readily. The reservoir zone typically has an absorbency of at least about 1 g/g, preferably at least about 5 g/g, more preferably at least about 10 g/g, based on Test Method G and using 0.2 wt% Triton® as the test fluid. The absorbency of the reservoir zone is preferably less than about 30 g/g, and more preferably less than about 20 g/g. Further, the reservoir should have an absorbency that is less than that of the absorbent core by at least about 20%, preferably by about 30%.

The reservoir zone may be of any form having an open structure such that its air or gas permeability is at least equal to that of the resulting absorbent barrier structure. The convective air/vapor permeability of the reservoir zone is typically at least about 1 Darcy/mm, preferably at least about 10 Darcy/mm, more preferably at least about 30 Darcy/mm, and most preferably at least about 50 Darcy/mm.

Further, the openness of the structure may enhance absorbency by holding or absorbing the fluids in the interstitial spaces in the open structure. Suitable open structures may include fibrous webs (e.g.,

woven or nonwoven webs); absorbent foams (e.g., porous or reticulated foams); fibrous wads; and the like.

In one embodiment, the reservoir zone is made of fibrous webs. The fibrous webs constituting the reservoir zone need not necessarily comprise absorbent fibers, so long as the webs are absorbent. Thus, the constituent fibers may simply be hydrophilic fibers and have no absorptive capacity by themselves.

5 The reservoir zone may be made from a wide variety of hydrophilic fibers, such as cellulosic fibers; natural wood pulp; synthetic fibers made from hydrophilic polymers such as polyesters and polyamides (such as Nylon); hydrophobic fibers, such as polyolefins surface-treated to improve its hydrophilicity; or any combinations of materials such as bi-component fibers, sheathed fibers. In one
10 embodiment, the reservoir zone is made of primarily cellulosic fibers which are primarily hydrogen bonded to one another. Cellulosic fibers may be natural or processed, and may be chemically stiffened, modified or cross-linked. Processed cellulosic fibers may include commercially available fibers made of regenerated cellulose or derivatized cellulosic, such as Rayon. In a preferred embodiment, the reservoir zone can be composed of at least about 70 wt% of cellulosic fibers, preferably at least about 80 wt% and more preferably at least about 90 wt%. Alternatively, the reservoir zone can be composed of from about 95 to
15 100 wt% cellulosic fibers.

In another embodiment, the reservoir zone may be in the form of single or multi-ply tissue; creped tissue; tissue wadding; and airfelt mat. High wet strength tissue may also be used as the reservoir zone. In another embodiment, the reservoir zone may be of any form having an open structure whereby the bodily fluids are held or absorbed in the fine interstitial spaces in the open structure. Further, inter-ply spaces and
20 surface textures may provide additional interstitial, liquid holding spaces, which enhance the absorbency of the reservoir zone.

The reservoir zone may include supplemental chemical bonding agents that are well known in the art. For example, the reservoir zone may include a chemical bonding agent such as vinyl acrylic copolymers, polyvinyl acetate, crosslinkable polyamides, polyvinyl alcohol and the like. Additionally, wet
25 strength resins and/or resin binders may be added to improve the strength of the cellulosic web. Useful binders and wet strength resins include commercially available resins, for example, Kymene®, available from Hercules Chemical Company and Parex® available from American Cyanamid, Inc. Crosslinking agents and/or hydrating agents may also be added to the pulp mixture to reduce the degree of hydrogen bonding if an open or loose fibrous web is desired. An exemplary debonding agent is available from
30 Quaker Chemical Company, Conshohocken, Pennsylvania, under the trade name Quaker 2008. The reservoir zone may contain no more than 5 weight percent and optionally may contain no more than about 2 weight percent of the chemical bonding agent to provide desired benefits. The reservoir zone typically comprises a high wet strength tissue. Alternatively, the reservoir zone may comprise a synthetic fibrous web. The reservoir zone can be bonded, such as with adhesives, to the barrier zone or other components of
35 the diaper construction.

Suitable materials for the reservoir zone may comprise a primarily cellulosic fibrous web, such as commercially available consumer paper towels Bounty®, manufactured by The Procter & Gamble Company, Cincinnati, Ohio, or Hi-Dry®, manufactured by The Kimberly-Clark Corporation.

Suitable fibrous webs may have a single-ply or a multi-ply construction. As used herein, the term "ply" means individual webs being disposed in a substantially contiguous, face-to-face relationship, forming a multiple layered web. Further, a single web may form two plies, for example, by folding on itself. In a multi-ply construction, the individual webs are at least partially joined, typically via point bonding,
5 with or without adhesives.

It is found that the multi-ply construction provides higher resistance to liquid breakthrough than a single-ply construction on a unit weight basis. Further, the absorbency of a two-ply fibrous web is at least double that of the single-ply fibrous web, on a unit weight basis. Without being bound by theory, it is believed that the interstitial spaces (i.e., structural voids) between the plies provide additional liquid holding
10 space, consequently, a higher absorptive capacity. Furthermore, post-treatments of the cellulosic web, including, but not limited to, aperturing, creping, embossing, or otherwise texturizing, increases the absorbency of the web. Fibrous webs having apertured or texturized surfaces show higher absorptive capacity, possibly due to the microvoids and/or interstitial spaces created by the treatments. In a preferred embodiment, the reservoir zone is made from a fibrous web having a construction of at least two plies and a
15 texturized surface. Additionally, certain additives, such as debonding agents, may also increase the absorbency of the web by reducing the inter-fiber bondings (e.g., hydrogen bonds between cellulosic fibers), thus, loosening the compacted fibrous network in the webs. The openness of the resulting web provides more interstitial spaces to hold liquids, which enhances the absorbency of the web.

In an alternative embodiment, other types of wettable and/or hydrophilic fibrous materials may be
20 used to form the reservoir zone of the absorbent barrier structure. Exemplary fibers include naturally occurring organic fibers made from intrinsically wettable material, such as cellulose or processed cellulose fibers, including regenerated or derivatized cellulose fibers commercially available as Rayon® fiber, Viscose® fibers; synthetic fibers made from inherently wettable thermoplastic polymers, such as polyesters, polyamides, their copolymers, polyvinyl alcohols, polyalkylene oxides, and mixtures of these polymers; and
25 synthetic fibers made from a nonwetable thermoplastic polymers, such as polyethylene, polypropylene, polybutylene and other polyolefins, which may be hydrophilized by appropriate means. These nonwetable fibers may be hydrophilized by treatments with surfactants or surface active agents having suitable hydrophilic functionalities, or by sheathing. These nonwetable fibers may also become of more wettable by grafting hydrophilic functionalities onto the polymer chains. Suitable hydrophilic functionalities include,
30 but are not limited to, acrylic, methacrylic, ester, amide, and mixtures thereof.

The reservoir zone may contain additives such as chemical bonding agents, crosslinking agents, wet strength resins, debonding agents, liquid or moisture absorbing agents, odor absorbing agents, antimicrobials, coloring agents, stiffening agents, and mixtures thereof. The liquid or moisture absorbing agents, include, but are not limited to, clays, silicas, talc, diatomaceous earth, perlite, vermiculite, carbon,
35 kaolin, mica, barium sulfate, aluminum silicates, sodium carbonate, calcium carbonate, other carbonates, superabsorbent polymers or other osmotic liquid holding agents, and mixtures thereof.

In one embodiment, the reservoir zone additionally contains superabsorbent polymers, which are coated onto the fibers, blended into the fibers in-situ, or are made into fibers or particles.

The Barrier Zone

The barrier zone preferably has a "barrier-like" property, which provides resistance to liquid wet through. The barrier property is typically measured by the Test Method B (Hydrohead Pressure Test) described below. The hydrohead value of the barrier zone should be higher than that of the absorbent core and of the reservoir zone. The barrier zone material suitable for use herein should exhibit a hydrohead value of at least
5 about 10 mBars, preferably at least about 30 mBars, more preferably at least about 50 mBars, and most preferably at least about 75 mBars. In some embodiments, the suitable barrier zone has a hydrohead value in the range from about 30 to about 100 mBars.

In addition, the barrier zone should not substantially reduce the air/vapor permeability of the
10 absorbent article. In that respect, the barrier zone should have a convective air permeability of at least about 10 Darcy/mm and preferably at least about 30 Darcy/mm.

The hydrohead value of a fibrous web increases with finer fiber diameter, higher fiber density, higher basis weight, or combinations thereof. Suitable fibrous web for the barrier zone typically has a basis weight of at least about 2 gsm, preferably from about 5 to about 100 gsm, more preferably from about 10 to
15 about 75 gsm, and most preferably from about 15 to about 55 gsm.

The thickness of the barrier zone may vary, depending on the materials used, the properties desired, the intended use, the construction, and the like. Specifically, the thickness of the barrier zone may affect the air/gas permeability, the absorbency and/or leakage protection of the barrier absorbent structure, as well as the comfort and fit of the absorbent article, and like effects typically related to the thickness of a
20 structure. Thus, the barrier zone typically has a thickness of less than about 1.5 mm, preferably less than about 1.0 mm, more preferably less than about 0.8 mm, and most preferably less than about 0.5 mm.

It has been found that some materials which do not appreciably limit the air permeability of the absorbent article in the dry state, will significantly decrease the air permeability of the article when the absorbent core becomes loaded with liquids. Thus, suitable materials for use in the barrier zone should
25 allow sufficient water vapor transmission, when the absorbent article is in a dry state, such that the air/water vapor permeability of the diaper does not change substantially from that of an equivalent diaper without the barrier zone material. When the absorbent core becomes loaded from absorbing liquids discharged from the body, the barrier zone may lower the air/vapor permeability of the absorbent article (relative to an equivalent article without a barrier zone), thereby reducing or eliminating the dampness
30 which may develop on the garment side of the outer cover.

In order to provide the desired hydrohead value or the "barrier-like" property, suitable materials are preferably hydrophobic, though this is not a required characteristic. Exemplary hydrophobic polymeric materials are typically polyolefins, such as polyethylene, polypropylene, polybutylene and copolymers thereof. Materials that are not hydrophobic, such as polyamides, polyesters, polyalkylene oxides, polyvinyl
35 alcohols, may be treated by suitable hydrophobic agents to achieve the desired hydrophobicity. Additionally, the reservoir layer may also be treated on at least one surface to improve its hydrophobicity, hence, barrier property.

Treatments for improved hydrophobicity may include chemical, radiation, plasma or combinations thereof. Further, the surface treatment to modify the surface characteristics may be accomplished by a coating on the surface, by pre-blending with a hydrophobic agent or by incorporating a hydrophobic agent in-situ, which blooms to the surface by further processing.

5 In one embodiment, fluorocarbon treatments of the web material provides the desired hydrophobicity such that the web exhibits the desired water resistance characteristics, measured, for example, by the hydrohead test. In another embodiment, fluorocarbon treatment using plasma or like technology provides a very thin, hydrophobic coating such that the air permeability of the treated web is substantially unchanged. If desired, the treatment may be applied to only portions of the substrate surface.
10 These treatments may be applied to materials that are suitable for use herein as the barrier zone, the reservoir zone, the outer cover, or other diaper components. Suitable substrate materials for this treatment include, but are not limited to, nonwoven webs, cellulosic webs, thermoplastic films, modified/processed films (e.g., formed, apertured) and the like. Exemplary surface treatments using fluorocarbons are described in U.S. Patent 5,876,753, issued to Timmons et al. on March 2, 1999; U.S. Patent 5,888,591 issued to
15 Gleason et al. on March 30, 1999; U.S. Patent 6,045,877 issued to Gleason et al. on April 4, 2000; PCT Patent Application 99/20504 by D'Agostino et al., published on March 7, 1999; PCT Publication 00/14296 by D'Agostino et al., published on March 16, 2000; the disclosures of each is hereby incorporated by reference.

Other surface coating methods using silicones or fluoro chemicals are known in the art and may be
20 used herein. The conventional coating or surface treatment methods typically fill the voids within the web, thus, lowers its air permeability. Coating methods to provide hydrophobicity to the substrate without the decrease in air permeability can be found in U.S. Patent 5,322,729 and PCT Publication WO 96/03501, the disclosure of each is hereby incorporated by reference.

The barrier zone may comprise fibrous web materials such as nonwoven webs including, but not
25 limited to, meltblown (MB) webs; spunbond (SB) webs, particularly fine fiber spunbond webs such as those having fiber deniers of about 2 or less; composite webs having layers of meltblown and spunbonded fibers, commonly known as MS nonwovens, and SMS nonwovens; bonded and carded webs; air laid webs; hydro-entangled webs; knitted webs; and woven webs. Fine denier fibrous webs are particularly suitable for use herein, for example, meltblown webs comprising nanofibers.

30 The melt blowing process is well suited to make fine, low denier fibers, particularly low denier microfiber nonwoven webs. Suitable meltblown nonwoven webs preferably comprise fine fibers having as small a diameter as possible and dispersed in the web as uniformly as possible. Such nonwoven webs provide the desired combination of high liquid resistance and high air permeability.

In one embodiment, the barrier zone comprises a meltblown web of polypropylene fibers having a
35 basis weight of from about 4 to about 80 g/m², preferably from about 6 to about 70 g/m², more preferably from about 8 g/m² to about 50 g/m², and most preferably from about 10 to about 30 g/m².

The meltblown fibers typically have an average diameter in the range of less than about 20 microns, preferably less than about 10 microns. Most typically, the meltblown fibers have an average

fiber diameter in the 5 to 10 microns range. Particularly suitable for use herein are nanofibers having an average fiber diameter in the range of less than about 500 nanometers, preferably less than about 300 nanometers, and more preferably less than about 150 nanometers. Exemplary nonwoven webs made from nanofibers (having average fiber diameters from about 10 to about 100 nanometers) are available from E-Spin Technologies (Chattanooga, TN).

While the strength of the meltblown nonwoven web generally decreases with decreasing fiber fineness, the strength can be improved by lamination with a reinforcing scrim or another web such as tissues, paper towels, or spunbonded nonwoven webs. Any conventional lamination process may be used, including adhesive bonding, thermal bonding, ultrasonic bonding, calendaring, needling, and combinations thereof. However, the lamination process should be carefully exercised to minimize adverse effects on the air permeability of the resulting laminate. In one embodiment, the microfiber nonwoven web may be integrally laminated during the manufacture by direct melt blowing onto another web or a reinforcing scrim.

The fibrous barrier zone may comprise a single web or multiple layers of webs which collectively have the desired characteristics. However, when using multiple layers of webs, it is desirable that they are juxtaposed without being point bonded across a substantial surface area of the zones or otherwise bonded in a manner which would substantially limit the breathability of the zones. In one embodiment, the barrier zone is not thermally point bonded or otherwise laminated to the absorbent core and/or the reservoir zone in a manner which destroys the breathability of the article. In this regard, it may be desirable that the barrier zone be attached to other components of the absorbent article (such as the absorbent core, the reservoir zone) primarily at the peripheries of the barrier zone. The multiple zones can be bonded by heat, pressure, ultrasonic, adhesive or by other means known in the art.

The barrier zone may contain additives such as chemical bonding agents, crosslinking agents, liquid or moisture absorbing agents, odor absorbing agents, antimicrobials, coloring agents, stiffening agents, and mixtures thereof. The liquid or moisture absorbing agents, including, but not limited to, clays, silicas, talc, diatomaceous earth, perlite, vermiculite, carbon, kaolin, mica, barium sulfate, aluminum silicates, sodium carbonate, calcium carbonate, other carbonates, superabsorbent polymers or other osmotic liquid holding agents, and mixtures thereof.

Absorbent Article Components

FIG. 1 is a partially broken top plan view of a diaper 20 containing the absorbent barrier structure 10 of the present invention. The diaper 20 is in a flat-out state with portions of the structure cut away to more clearly show the construction of the diaper 20. The garment-facing surface of the diaper 20 is oriented away from the viewer.

A "unitary" absorbent article refers to absorbent articles which are formed of separate parts united together to form a coordinated entity so that they do not require separate manipulative parts like a separate holder and/or liner. As used herein, the term "diaper" refers to an absorbent article generally worn by infants and incontinent persons about the lower torso. A "unitary" absorbent article refers to absorbent articles which are formed of separate parts united together to form a coordinated entity so that they do not require separate manipulative parts. The term "disposable" is used herein to describe absorbent

articles which generally are not intended to be laundered or otherwise restored or reused as absorbent articles (i.e., they are intended to be discarded after a single use and, preferably, to be recycled, composted or otherwise discarded in an environmentally compatible manner).

As shown in FIG. 1, the diaper 20 comprises a liquid pervious topsheet 24; a dampness management means 26; an absorbent core 28, which is positioned between at least a portion of the topsheet 24 and the outer cover 22; an absorbent barrier structure 10 positioned between the absorbent core 28 and the outer cover 22; side panels 30; elasticized leg cuffs 32; elastic waist features 34; and a fastening system 40. An absorbent barrier structure 10 of the present invention is disposed adjacent to the absorbent core 28 on the garment facing surface 45 of the absorbent core 28.

Diaper 20 is shown in FIG. 1 to have a front waist region 36, a rear waist region 38 opposed to the front waist region 36 and a crotch region 37 located between the front and the rear waist regions. The peripheries of the diaper 20 are defined by the outer edges of the diaper 20 in which the longitudinal edges 50 run generally parallel to the longitudinal centerline 100 of the diaper 20 and end edges 52 run between the longitudinal edges 50 generally parallel to the lateral centerline 110 of the diaper 20.

The main body of the diaper 20 comprises at least the absorbent core 28, the topsheet 24, and preferably, though not necessarily the dampness management means 26. An outer cover 22 forms the chassis, onto which other components of the diaper 20 are added to form the unitary structure of the diaper.

FIG. 1 shows an embodiment of the diaper 20 in which the topsheet 24 and the dampness management means 26 have length and width dimensions generally no smaller than those of the absorbent core 28 and the absorbent barrier structure 10. The topsheet 24 and the dampness management means 26 may extend to the peripheries of the diaper 20. In another embodiment, the absorbent barrier structure 10 may extend beyond the edges of the absorbent core 28 to the peripheries of the diaper 20.

While the components of the diaper 20 may be assembled in various well known configurations, preferred diaper configurations are described generally in U.S. Pat. No. 3,860,003 entitled "Contractible Side Portions for Disposable Diaper" issued to Kenneth B. Buell on January 14, 1975; U.S. Pat. No. 5,151,092 issued to Buell on September 9, 1992; and U.S. Pat. No. 5,221,274 issued to Buell on June 22, 1993; and U.S. Pat. No. 5,554,145 entitled "Absorbent Article With Multiple Zone Structural Elastic-Like Film Web Extensible Waist Feature" issued to Roe et al. on September 10, 1996; U.S. Pat. No. 5,569,234 entitled "Disposable Pull-On Pant" issued to Buell et al. on October 29, 1996; U.S. Pat. No. 5,580,411 entitled "Zero Scrap Method For Manufacturing Side Panels For Absorbent Articles" issued to Nease et al. on December 3, 1996; and U.S. Patent No. 6,004,306 entitled "Absorbent Article With Multi-Directional Extensible Side Panels" issued to Robles et al. on December 21, 1999; each of which is incorporated herein by reference.

Topsheet or Body-side Liner

The topsheet is compliant, soft feeling, and non-irritating to the wearer's skin. The topsheet material can also be elastically stretchable in one or two directions. Further, the topsheet is fluid pervious, permitting fluids (e.g., urine, menses, other bodily fluids) to readily penetrate through its thickness. A suitable topsheet can be manufactured from a wide range of materials such as woven and nonwoven

materials; apertured or hydroformed thermoplastic films; porous foams; reticulated foams; reticulated thermoplastic films; and thermoplastic scrims. Suitable woven and nonwoven materials may comprise of natural fibers such as wood or cotton fibers; synthetic fibers such as polyester, polypropylene, or polyethylene fibers; or combinations thereof.

5 Preferred topsheet for use in the present invention are selected from high loft nonwoven topsheets and apertured film topsheet. Apertured film topsheet typically are pervious to bodily exudates, yet non-absorbent, and have a reduced tendency to allow fluids to pass back through and rewet the wearer's skin. Suitable apertured films include those described in U. S. Patent 5,628,097, U.S. Patent 5,916,661, EP 1,051,958, EP 1,076,539; the disclosure of each is hereby incorporated by reference.

10 Nonwoven materials, such as described in EP 774,242 (Palumbo), which is incorporated herein by reference, generally exhibit high gas permeability, thus, do not exhibit a significant resistance to air flow.

Further, suitable topsheet materials for depositing solid excretions thereon may include nonwovens having apertures, which are at least in the portions that are aligned with the feces deposition region of the article. Suitable apertured nonwovens are described in more detail in EP 714,272 or EP 702,543, and both
15 of which are incorporated herein by reference. In another embodiment of feces handling articles, such topsheets can be combined with feces handling members e.g. underlying such topsheets, and further described in these applications.

The material forming the topsheet may be hydrophilic so as to facilitate fluid transport through the topsheet. Surfactants may be incorporated into the polymeric materials to improved the hydrophilicity of
20 the topsheet, such as is disclosed in EP-A-166,056 and U. S. Patent Application 07/794,745, filed on November 19, 1991, both of which are incorporated herein by reference. Alternatively, the topsheet may be treated with a surfactant to render the body-facing surface hydrophilic, such as is disclosed in U.S. Patent 4,950,254, which is hereby incorporated by reference.

Absorbent Core

25 The absorbent core may includes the following components: (a) optionally, a primary fluid distribution layer; (b) optionally, a secondary fluid distribution layer; (c) a fluid storage layer; (d) other optional components, such as a fibrous "dusting" layer.

The optionally primary fluid distribution layer is typically disposed under the topsheet and is in fluid communication with the topsheet. The topsheet transfer the acquired bodily fluids to the primary
30 distribution layer to ultimate distribution to the storage layer. This transfer of fluid through the primary distribution layer occurs not only in the thickness, but also along the length and width directions of the absorbent core. The optionally secondary fluid distribution layer is typically disposed under the primary fluid distribution layer and is in fluid communication therewith. The secondary fluid distribution layer readily acquires fluid from the primary distribution layer and transfers it rapidly to the underlying storage
35 layer. Thus, the fluid capacity of the underlying storage layer may be fully utilized, especially when gushes of bodily discharge occur.

The fluid storage layer typically comprises absorbent materials including absorbent gelling materials, which are usually referred to as "hydrogels", "superabsorbent" "hydrocolloid" materials.

Absorbent gelling materials are those materials that, upon contact with aqueous fluids, such as bodily fluids, imbibes such fluids and form hydrogels. These absorbent gelling materials are typically capable of absorbing large quantities of aqueous bodily fluids, and further capable of retaining such absorbed fluids under moderate pressures. These absorbent gelling materials are typically in the form of discrete, nonfibrous particles. Other forms, such as fibers, foams, sheets, strips, or other macrostructures, are also suitable for use herein. Suitable absorbent gelling materials in the form of open cell foams may include those disclosed in U.S. Patent 3,563,243 (Lindquist), U.S. Patent 4,554,297 (Dabi), U.S. Patent 4,740,520 (Garvey), U.S. Patent 5,260,345 (DesMarais et al.), all of which are incorporated herein by reference. Improvements of these foams can be found in WO 96/21679, WO 96/21680, WO 96/21681, WO 96/21682, WO 97/07832 and WO 98/00085, all of which are incorporated herein by reference.

The absorbent gelling materials suitable for use herein may comprise a substantially water-insoluble, slightly crosslinked, partially neutralized, polymeric gelling material. This material forms a hydrogel upon contact with water. Suitable absorbent gelling materials include those disclosed in U.S. Patent 4,654,039, U.S. Patent 5,562,646, U.S. Patent 5,599,335, U.S. Patent 5,669,894, each of which is incorporated herein by reference.

It has been found, that superabsorbent materials are particularly suited to be used in articles according to the present invention, if they exhibit high Saline Flow Conductivity performance (SFC), preferably of more than $30 * 10^{-7} \text{ cm}^3 \text{ sec/g}$, when evaluated according to the disclosure of U.S. Patent 5,599,335, which is incorporated herein by reference.

Such materials can be arranged in a homogeneous mixing with fluff pulp, or can be layered between suitably open and permeable layers of porous materials, such as tissues, especially if these are air-laid, or nonwoven materials.

Particularly suitable materials are superabsorbent materials as described in the above referenced U.S. Patent 5,599,335, when arranged in a homogeneous blend with conventional fluff pulp, at a concentration of 50% superabsorbent, preferably 80% and even more preferably more than 90% concentration based on the weight of the superabsorbent/fluff mixture. Suitable mixtures can further exhibit densities of between 0.1 g/cm^3 and 0.3 cm^3 , preferably between 0.15 cm^3 and 0.2 cm^3 .

In particular embodiments, such mixtures can comprise means which enhance the integrity of the mixture, especially in the dry state. Thus, low amounts of adhesive may be added to the mixture, or other binders, such as thermobondable synthetic fibers.

In addition to the liquid storage elements in the core, the core may comprise other liquid handling members, such as for enhancing fluid acquisition, or distribution.

The fluid storage layer may comprise of absorbent gelling materials alone or dispersed in a suitable carrier, homogeneously or inhomogeneously, or may comprise of absorbent carrier materials alone. The storage layer may also include filler materials, such as perlite, diatomaceous earth, vermiculite, and the like, which absorb and retain the fluid, thus, reduces the rewet through the topsheet.

Suitable carrier materials include cellulose fibers, in the form of fluff, tissues or paper. Modified cellulose fibers (e.g., stiffened, chemically treated, crosslinked) may also be used. Synthetic fibers

may also be used. Suitable synthetic fibers may be made of cellulose acetate, polyvinyl fluoride, polyvinylidene chloride, acrylics (such as Orlon®), polyvinyl acetate, non-soluble polyvinyl alcohol, polyethylene, polypropylene, polyamides (such as Nylon®), polyesters, bi- or tri- component fibers thereof, and mixtures of these materials. Preferably, the fiber surfaces are hydrophilic or are treated to be hydrophilic.

Typically, the storage layer comprises from about 15 to 100 wt% of the absorbent gelling material dispersed in a carrier material. Preferably the storage layer comprises from about 30 to about 95 wt%, more preferably from about 60 to about 90 wt% of the absorbent gelling material. The carrier material typically comprises from about 0 to about 85wt%, preferably from about 5 to about 70 wt%, and more preferably from about 10 to about 40 wt% of the storage layer.

An optional component for inclusion in the absorbent core is a fibrous layer adjacent to, and typically underlying the storage layer. This underlying fibrous layer is typically referred to as a “dusting” layer since it provides a substrate on which to deposit absorbent gelling material in the storage layer during manufacture of the absorbent core. Further, the “dusting” layer provides some additional fluid handling capability such as rapid wicking of fluid along the length of the absorbent core.

The absorbent core may include other optional components. For example, a reinforcing scrim may be positioned within the respective zones, or between the respective zones, of the absorbent core. Optionally, odor control agents may be included in the absorbent core. Suitable odor control agents include active carbons, zeolites, clays, silicas, and mixtures thereof. The configuration and construction of the absorbent core may also be varied (e.g., the absorbent core may have varying caliper zones, a hydrophilicity gradient, a pore size gradient, a superabsorbent gradient, or lower average density and lower average basis weight acquisition zones; or may comprise one or more zones or structures). The total absorbent capacity of the absorbent core should, however, be compatible with the design loading and the intended use of the diaper. Further, the size and absorbent capacity of the absorbent core may be varied to accommodate wearers ranging from infants through adults. Suitable absorbent cores include those disclosed in EP 1,051,958, EP 797,968 and EP 774,242, each of which is incorporated by reference herein.

Outer Cover

The term “outer cover” as used herein means a structural element positioned on the garment-facing surface of the absorbent article. The outer cover typically forms the chassis onto which other components of the diaper are added. However, the outer cover may just be a coating layer on the garment side of the absorbent article.

Suitable material for the outer cover should provide a barrier function with respect to liquids (i.e., liquid impervious) while allowing air or vapor to flow through (i.e., vapor permeable). The outer cover should not be the rate limiting element to gas or vapor transport through the absorbent article. Preferably, the outer cover has a structure that is relatively open to allow for convective air or gas permeability. The suitable outer cover typically has a moisture vapor transmission rate (MVTR) of at least about 500 g/24hrs/m², more preferably of at least about 1500 g/24hrs/m², and most preferably at least about 3000 g/24hrs/m². Additionally, the outer cover provides a soft, pleasant feel to the skin, either by the material

property, or by texturizing or embossing its surface, or both.

The outer cover may be a single layer of homogeneous or multi-component material, or a composite of various layers of materials. The outer cover suitable for use herein comprises porous materials such as an apertured film (e.g., having a plurality of shaped openings or angled capillaries), a knitted web, a porous woven or nonwoven web, a foam, or combinations or laminates thereof. In one embodiment, the outer cover comprises nonwoven webs or multi-layered nonwovens such as spunbond/meltblown (SB) nonwoven, spunbond/meltblown/spunbond (SBS) nonwoven.

The outer cover, or any portion thereof, may be elastically extensible in one or more directions. In one embodiment, the outer cover may comprise a structural elastic-like film ("SELF") web. A SELF web is an extensible material that exhibits an elastic-like behavior in the direction of elongation without the use of added elastic materials and is described in more detail in U.S. Patent No. 5,518,801 entitled "Web Materials Exhibiting Elastic-Like Behavior" issued to Chappell, et al. on May 21, 1996, which is incorporated herein by reference. In alternate embodiments, the outer cover may combine elastomeric components (such as films, foams, strands, or combinations thereof) with nonwovens or synthetic films.

In another embodiment, the outer cover may be a nonwoven web constructed to provide the required level of liquid impermeability. For example, a nonwoven web of spunbonded or meltblown polymer fibers may be treated, at least partially, with a hydrophobic coating. Exemplary treatments using fluorocarbons are described in U.S. Patent 5,876,753, issued to Timmons et al. on March 2, 1999; U.S. Patent 5,888,591 issued to Gleason et al. on March 30, 1999; U.S. Patent 6,045,877 issued to Gleason et al. on April 4, 2000; U.S. Patent Application Serial No. 99/20504 by D'Agostino et al., filed on March 7, 1999; the disclosures of which are hereby incorporated by reference.

Optionally, the outer cover material may comprise the absorbent and swellable materials described in U.S. Patent 5,955,187 issued to McCormack et al. on September 21, 1999; or the absorbent and shrinkable materials described in U.S. Patent Application Serial no. 97/22604 by Corzani et al. on December 15, 1997; or the absorbent and differential strainable materials described in PCT Publication WO 00/68003 by Dawson et al.; the disclosures of which are hereby incorporated by reference.

The absorbent article may comprise an outer cover which is separated from the absorbent core at least partially by the absorbent barrier structure of the present invention and is preferably joined to the absorbent barrier structure and/or the absorbent core by attachment means such as those well known in the art. As used herein, the term "joined" encompasses configurations wherein an element is directly secured to the other element by affixing the element directly to the other element, and configurations wherein the element is indirectly secured to the other element by affixing the element to intermediate member(s), which in turn are affixed to the other element.

The outer cover may be secured to the absorbent barrier structure and/or the absorbent core by a uniform continuous layer of adhesive, an open pattern network of filaments of adhesive, or an array of separate lines, spirals, or spots of adhesive, as disclosed in U.S. Patent 4,573,986 issued to Minetola et al. on March 4, 1986; U.S. Patent 3,911,173 issued to Sprague, Jr. on October 7, 1975; U.S. Patent 4,785,996 issued to Ziecker, et al. on November 22, 1978; and U.S. Patent 4,842,666 issued to Werenicz on June

27, 1989; the disclosure of each is incorporated herein by reference. Adhesives which have been found to be satisfactory are manufactured by H.B. Fuller Company of St. Paul, Minnesota and marketed as HL-1258. Alternatively, the attachment means may comprise heat bonds, pressure bonds, ultrasonic bonds, dynamic mechanical bonds, or any other suitable attachment means or combinations of these attachment means as are known in the art.

The outer cover material should not significantly lower the convective air permeability of the absorbent article. More importantly, the combination of the absorbent barrier structure and the outer cover (hereinafter referred to as the "combined structure" or "combination") provide the desired balance of properties, including, but not limited to, absorbency, barrier property and convective air permeability.

The combined structure of the present invention may be constructed to have a convective air permeability of at least about 10 Darcy/mm, preferably at least about 20 Darcy/mm, more preferably at least about 30 Darcy/mm, and most preferably at least about 50 Darcy/mm. Convective air permeability is especially effective in removing moisture vapor from inside the absorbent article, resulting in a lower humidity in the local environment next to the skin, which reduces incidences of skin irritation or rash and promotes skin health.

Further, the combined structure of the present invention preferably has a dynamic liquid impact value (as measured by Test Method C) of no more than about 10 g/m², more preferably no more than about 8 g/m², and most preferably no more than about 5 g/m².

Moreover, the combined structure should exhibit a hydrohead value of at least about 20 mBars, preferably at least about 35 mBars, more preferably at least about 50 mBars, and most preferably at least about 75 mBars.

In a preferred embodiment, the combined structure of the present invention exhibits desired leakage protection or barrier properties at least equal to that of the absorbent barrier structure.

Dampness Management Means

Optionally, as shown in FIG. 3, a dampness management means 26 may be included in the absorbent article of the present invention. The dampness management means 26 may provide further leakage protection. Suitable dampness management means materials are breathable materials which permit vapors to escape from the diaper 20 while still preventing exudates from passing through the dampness management means 26. Exemplary materials may include apertured films; monolithic or microporous films, preferably with apertures; modified (with respect to pore structures and distributions) nonwovens or composite materials such as film/nonwoven laminates.

Suitable apertured films typically has open surface area at least about 1%, preferably at least about 5% more preferably at least about 10%. In another embodiment, the open surface area may be 0.1% or more, provided there are sufficient amount of relatively large pores present. Further, suitable apertured films should have an open surface area less than about 20% such that it would have insubstantial effect on the leakage protection properties of the article. Apertured films may be vacuum formed or hydro-formed to provide macro and/or micro apertures. More detailed descriptions of suitable apertured films can be found in U.S. Patent 4,629,643, U.S. Patent 4,609,518 and U.S. Patent 4,695,422, U.S. Patent 4,342,314 and

U.S. 4,463,045; the disclosure of each is incorporated by reference herein.

In another embodiment, the dampness management means may include zones of different breathability and/or liquid permeability. For example, the dampness management means may be higher in breathability and/or liquid permeability in zones which do not coincide with the absorbent core. As used
5 herein, the term "breathability" refers to the diffusive transport of water vapor through the material. The dampness management means may be assembled of one or more layers and preferably includes at least one layer which is liquid impermeable, the liquid impermeable layer preferably located adjacent the absorbent core and preferably covers an area at least as large as the absorbent core.

Further, moisture condensation on the outer surface (i.e., the garment side) of the absorbent article
10 leads to dampness to the touch, which reduces wearer comfort and is often perceived as a performance problem with the article. The convective transport of moisture vapor through the absorbent article of the present invention is very effective such that it may lead to moisture condensation on the outer surface of the article and the perceived dampness problem. Thus, it may be beneficial to incorporate a relatively low breathability dampness management means into the article of the present invention. Suitable low
15 breathability dampness management means should have a MVTR of no more than about 4500 g/m²/24hrs, preferably of no more than about 3500 g/m²/24hrs, more preferably no more than about 3000 g/m²/24hrs, and most preferably no more than about 2500 g/m²/24hrs.

The dampness management means may be disposed between the outer cover and the absorbent barrier structure of the present invention. Alternatively, the dampness management means may be disposed
20 within the absorbent barrier structure between the absorbent layer and one or both of the barrier layers.

Other Components

In addition, the diaper, as represented in FIG. 3, may further include a pair of fasteners 40 which are employed to secure the diaper about the waist of the wearer. Suitable fasteners include hook-and-loop type fasteners, adhesive tape fasteners, buttons, snaps, mushroom-and-loop fasteners and the like. The
25 diaper of the present invention may also include elasticized leg bands which help securing the diaper to the wearer and, thus, help reduce leakage from the diaper. Similarly, it is also known to include a pair of elasticized, longitudinally extending containment flaps which are configured to maintain a substantially upright, perpendicular arrangement along the central portion of the diaper to serve as an additional barrier to the lateral flow of body exudates.

It is also common to include a surge management layer positioned between the topsheet and the
30 absorbent core in order to help prevent pooling of fluids on the portion of the diaper adjacent the wearer's skin.

The articles of the present invention may also include waste management features, such as pockets for receiving and containing waste, spacers which provide voids for waste, barriers for limiting the
35 movement of waste in the article, compartments or voids which accept and contain waste materials deposited in the diaper 20, and any combinations thereof.

Optionally, the absorbent articles of the present invention may include a skin care composition, preferably on the skin-contacting surfaces of the article. The skin care composition useful herein is

directed to maintain and/or improve the skin condition of the skin under an absorbent article or skin that is subjected to chronic or acute exposures to body exudates, moisture, irritants, etc. It is preferred that the skin care composition provides a protective, and preferably non-occlusive function (e.g., a relatively liquid impervious but vapor pervious barrier) to avoid skin overhydration and skin exposure to materials contained in body exudates (e.g., urine, feces, menstrual fluids). It is also preferable that the skin care composition provides an abrasion minimizing function to reduce skin irritation in the areas where the absorbent article is in contact with the wearer's skin. Additionally, the skin care composition may contain skin care ingredients, which directly or indirectly, deliver skin care benefits, such as reduction of overhydration, reduction of redness, skin conditioning, and removal or reduction of skin irritants in body exudates. It is also preferred that the skin care composition contains emollients that protect or improve the skin against chaffing, roughness, wrinkled appearance or itchiness. The skin care composition may also contain skin soothing agents, such as aloe vera, chamomile.

Skin care compositions suitable for use in the present invention are described in co-pending U.S. Patent Application Serial Nos. 08/926,532 and 08/926,533, each filed on September 10, 1997; U.S. Patent Application Serial Nos. 09/041,509, 09/041,232 and 09/041,266, each filed on March 12, 1998; U.S. Patent Application No. 09/563,638, filed on May 2, 2000; U.S. Patent No. 5,607,760 issued March 4, 1997; U.S. Patent Application No. 09/466,343, filed on December 17, 1999; U.S. Patent No. 5,609,587 issued March 11, 1997; U.S. Patent No. 5,635,191 issued June 3, 1997; U.S. Patent No. 5,643,588 issued July 1, 1997; and U.S. Patent No. 6,153,209 issued November 28, 2000; the disclosures of which are hereby incorporated by reference.

Making The Absorbent Barrier Structure

In one embodiment, the nonwoven web and the cellulosic web forming the absorbent barrier structure are adhesively bonded together using Ato-Findley adhesive H2031F. The nonwoven web is unwound from a supply roll and advances to the spray station where the adhesive is pre-heated to its melt state and sprayed (using a Dynatec® spray head) onto the web substrate before the nonwoven web is assembled with the cellulosic web to form the absorbent barrier structure. The adhesive forms three continuous stripes along the longitudinal direction of the advancing web. The stripes are substantially parallel. Each stripe is 22 mm in width and the outer stripes are about 4 mm from the peripheries of the web.

In another embodiment, the first nonwoven web and the cellulosic web may be adhesively joined together according to the method described above. A second nonwoven web is unwound from a supply roll, spray-coated with adhesives, then joined to the free surface of the cellulosic web. In another three-layered absorbent barrier structure, the two nonwoven webs may be unwound from separate supply rolls and spray-coated with adhesives, then simultaneously joined to the opposed surfaces of the cellulosic web.

The absorbent barrier structure may be incorporated into a disposable diaper having the general construction as the diaper shown in FIG. 1 following well-known assembly processes. Typically, the absorbent barrier structure is disposed between the absorbent core and the outer cover. In a two-layered construction, the barrier layer is disposed adjacent to the garment-facing side of the absorbent core and

the absorbent layer is disposed adjacent to the outer cover. In a three-layered construction, the first barrier layer is disposed adjacent to the garment-facing side of the absorbent core and the second barrier layer is disposed adjacent to the outer cover. Other well known components may be incorporated within the diaper without departing from the spirit of the present invention. Further, the manner and method of using these well known components in connection with the absorbent article of the present invention will likewise be readily appreciated by those skilled in the art.

TEST METHODS

A. Air Permeability

The air permeability is determined by measuring the time in which a standard volume of air is drawn through the test specimen at a constant pressure and temperature. This test is particularly suited to materials having relatively high permeability to gases, such as nonwovens, apertured films and the like.

A TexTest FX3300 instrument is used. The Test Method conforms to ASTM D737. The test is operated in a laboratory environment typically about 22 ± 2 ° C and about $35\% \pm 15\%$ relative humidity. The test specimen has to be conditioned for at least 2 hrs. The test pressure is 125 Pascals and the test area is 38 cm^2 . In this test, the instrument creates a constant differential pressure across the sample which draws air through the sample. The rate of air flow through the sample is measured in $\text{ft}^3/\text{min}/\text{ft}^2$ and converted to permeance (in Darcy/mm) according to the Darcy's Law:

$$K/d \text{ (Darcy/mm)} = (V * \mu) / (t * A * \Delta p)$$

wherein k is the permeability per unit area of the specimen; V/t is the volumetric flow rate in cm^3/sec ; μ is the viscosity of air ($1.86 * 10^{-5}$ Pa sec); d is the test material thickness in mm; A is the cross sectional area of the specimen in cm^2 ; Δp is the pressure differential in Pascal or Pa; and 1 Darcy = $9.869 * 10^{-9}$ cm^2 .

For each sample, three replicates should be run, and the averaged result is reported.

B. Hydrostatic Head (Hydrohead) Pressure Test

This property determined by this test is a measure of the liquid barrier property (or liquid impermeability) of a material. Specifically, this test measures the hydrostatic pressure the material will support when a controlled level of water penetration occurs.

A rising water column tester, TexTest Hydrostatic Head Tester FX3000 (available from Advanced Testing Instruments, Corp., Spartanburg, SC) is used. The test method conforms to Edana 120.1-18. For this test, pressure is applied to a defined sample portion gradually increases until water penetrates through the sample.

The test is conducted in a laboratory environment typically about $73 \text{ }^{\circ}\text{F} \pm 2.0 \text{ }^{\circ}\text{F}$ ($22.8 \text{ }^{\circ}\text{C} \pm 0.6 \text{ }^{\circ}\text{C}$) and a relative humidity of about $50 \pm 2\%$. The sample is clamped over the top of the column fixture, using an appropriate gasketing material (o-ring style) to prevent side leakage during testing. When an absorbent barrier structure having a layer of a barrier material and a layer of a reservoir material is the sample being tested, the sample is oriented such that the layer of the barrier material faces the water column during the test. The area of water contact with the sample is equal to the cross sectional area of the water column, which equals 28 cm^2 .

Water is pumped into the water column at a rate of 3 mBar/min. Thus, the sample is subjected to a steadily increasing water pressure on one surface. When water penetration appears on three locations on the other surface of the sample, the pressure at which the third penetration occurs is recorded. If water immediately penetrates the sample (i.e., the sample provided no resistance), a zero reading is recorded. For each material, three specimens are tested and the results are averaged.

C. Dynamic Liquid Impact Test

The properties determined by this method correlates with the fluid resistance capability under sudden impact, which relates to leakage protection, provided by the absorbent structure of the present invention. In this test, a sample of the absorbent structure is positioned adjacent to a loaded absorbent core simulant, and the combination is subjected to an impact force. The properties determined by this method is relevant to the actual use condition where the wearer (especially a baby) falling from a standing position, thus, applying an impact force on a loaded diaper.

Dynamic liquid impact test is measured with the apparatus 9100 shown in Figure 1. According to this test, an absorbent core simulant 9104 is placed directly on top of the energy absorbing impact pad 9103. The absorption core simulant comprises four layers of No. 4 filter paper available from Whatman Laboratory Division, Distributed by VWR Scientific of Cleveland, OH. The absorbent core simulant is loaded with 2 grams of simulated urine. The simulated urine is an aqueous 0.9% by weight saline solution, exhibiting a surface energy value as conventionally determined of 72.5 mN/m.

The energy absorbing impact pad 9103 is a carbon black filled crosslinked rubber foam. The impact pad 9103 is 12.7 cm by 12.7 cm (5 inch by 5 inch) and has a density of 0.1132 g/cm³ and a thickness of 0.79 cm (0.3125 inches). The impact pad 9103 has a Durometer Value of A/30/15 according to ASTM 2240-91.

A sample 9105 of the absorbent structure of the present invention, including a barrier zone and a reservoir zone arranged in layered relation, is placed over the absorbent core simulant 9104, with the barrier layer facing down (i.e., the barrier layer is placed directly over the absorbent core simulant). The sample/core simulant assembly is positioned in the center of the pad 9103.

An absorbent material 9102 weighted to the nearest 0.0001 gram is placed on top of the sample 9105 to be tested. The absorbent material 9102 comprises a No. 4 filter paper available from Whatman Laboratory Division. The absorbent material 9102 should be able to absorb and retain simulated urine which passes through the test sample 9105. The absorbent core simulant 9104 and the sample 9105 should have an area slightly larger than that of the impact area of the surface 9110.

The impact arm 9108 is raised to a desired impact angle (about 30⁰) to provide the desired impact energy. The impact arm 9108 is dropped and the impact arm 9108 is then allowed to rest on the sample for two minutes after impact. The arm is then raised and the filter paper 9102 is removed and placed on a digital scale. The mass of the wet filter paper is then recorded at the three minute mark. The liquid impact transmission (LIT) value is calculated and expressed in g/m² using the following formula:

$$\text{LIT} = [\text{mass of the wet filter paper (grams)} - \text{mass of the dry filter paper (grams)}] / [\text{impact area (m}^2\text{)}]$$

The impact area, expressed in m², is the area of the absorbent core simulant 9104. The impact area is 0.003848 m². For each material, three specimens are tested and the averaged result is reported.

D. Static Liquid Transmission Test

The property determined by this test correlates with the fluid retaining ability (or leakage protection) provided by the absorbent barrier structure of the present invention under an impact and sustained pressure condition. The property determined by this test is relevant to the actual use condition where the wearer suddenly moves from a standing position to a second position (e.g., sitting), and maintains the second position for an extended time period.

The equipment and sample set-up are the same as those described above in the Dynamic Liquid Impact Test, except in this test, the impact arm 9108 is dropped and is allowed to rest on the sample for a controlled period of time after impact. Arm 9108 is then raised, the filter paper 9102 is removed and weighed, and the change in weight is reported as described above. The hold times at the resting position are 2, 5, 8, 15, 30 and 60 minutes.

E. Moisture Vapor Transmission Rate

The Moisture Vapor Transmission Rate (MVTR) determines the amount of moisture adsorbed by calcium chloride in a "cup" like container that is covered by a test specimen where the moisture source is a controlled temperature/humidity environment ($40\pm 3^{\circ}\text{C}$ / 75 ± 3 % relative humidity) separated from the calcium chloride by the test specimen. This method is applicable to thin films, multi layer laminates and the like.

The sample holding a cup is a cylinder with an inner diameter of 30 mm and an inside height from bottom to top flange of 49 mm. A flange having a circular opening to match the opening of the cylinder can be fixed by screws, and a silicone rubber sealing ring with an opening matching the inner diameter of the cup, fits between the top flange and the cylinder. The test specimen is positioned such that it covers the cylinder opening. The specimen is tightly fixed between the silicone rubber sealing and the upper flange of the cylinder so it acts as a barrier to moisture transport.

The equipment as well as the test specimen should be equilibrated to the temperature of the controlled environment prior to testing.

The absorbent desiccant material is CaCl_2 , such as can be purchased from Wako Pure Chemical Industries Ltd., Richmond, VA under the product designation 030-00525. If kept in a sealed bottle, it can be used directly. It also can be sieved to remove lumps, or excessive amounts of fines, if existing. It also can be dried at 200°C for about 4 hours.

The CaCl_2 is weighed (15.0 ± 0.02 g) into the cup, and tapped lightly so as to level it out, such that the surface is about 1 cm from the top of the cup.

A test sample, cut to about 3.2 cm by 6.25 cm, is placed flat and overlapping with the seal over the opening, and the seal and the top flange are affixed by the screws without over tightening. The total weight of the cup assembly is accurately recorded to four decimal places, and the assembly is placed into the constant temperature/humidity chamber.

After 5 hours exposure to the test humidity (without opening of chamber), the sample is removed and immediately covered tightly with a non-vapor permeable plastic film such as SARAN WRAP. After

cooling about 30 minutes to allow for temperature equilibration, the plastic film is removed and the assembly is reweighed.

The MVTR value is then calculated by determining the moisture increase over 5 hours due to transport through the 3 cm circular opening and converting the result to units of "g/m²/24 hr". For each sample, three replicates should be run, the resulting values will be averaged, and the result rounded to the nearest 100 value.

F. Post-Compression Air Permeability

When a material, especially one with a relatively flexible or open structure, is subjected to compaction or sustained pressure, the material may experience structural changes. After the applied forces are removed, the material may not return to its original state completely. This residual structure changes often result changes in properties, such as air permeability. This test method is a measure of the resilience of the sample material after it has been subjected to compaction or a sustained pressure for a pre-determined period of time.

When an absorbent barrier structure of the present invention is incorporated into absorbent articles, such as diapers, the articles are often packaged in a highly compact condition, and stored under such condition for an extended period of time. Moreover, while the absorbent article is worn, the wearer may subject the article to sudden impact force (e.g., the wearer moves from a standing to a sitting position abruptly), which may be followed by a sustained pressure (e.g., the wearer maintains the sitting position). Certain materials or structures are susceptible to change under such conditions, and does not recover to its original state even after the compaction or pressure has been removed. Thus, a material or structure may have high air permeability when made but may not be able to deliver such performance after it has been compacted and stored in a package or when it suffers sustained pressure applied by a wearer.

Sample sheets or laminates are cut to 40 mm by 165 mm in size. The sample sheets are stacked and placed between two Plexiglas plates. Pressure is applied over the glass plates to reduce the overall caliper of the stack of sample sheets to a controlled value. The level of compression is calculated according to the following:

$$H = k \times n \times d$$

wherein H is the overall caliper after pressure is applied to compress the sample stack;
 d is the initial caliper of the sample stack;
 n is the number of layers of sample sheets; and
 k is compression level.

The compressed sample stacks are placed inside a climate-controlled chamber at 60°C, 50%RH, for a pre-determined time period. Typically, the test is done with five sample sheets or laminates in each stack and at 50% compression. The test may be adapted to any number of layers of the sample sheets or at different compression levels.

Air permeability of the sample is determined before compression and after 24 hours in compression. The post compression air permeability is measured after a waiting period, which is sufficient to allow the sample to recover (taking into consideration that the sample may exhibit permanent deformation and will not recover to its original, pre-compression state). For this test, the air permeability is determined by measuring the time in which a standard volume of air is drawn through the test specimen at a constant pressure and temperature.

The test is operated in a temperature and humidity controlled environment, at 22 ± 2 ° C and $35\% \pm 15$ % relative humidity. The test specimen has to be conditioned for at least 2 hrs.

The test equipment as manufactured by Hoppe & Schneider GmbH, Heidelberg, Germany, under the designation "Textiluhr nach Kretschmar", is essentially a bellows in a vertical arrangement, with its upper end being mounted in a fixed position, and the lower end being releasably hold at its upper position, which can be loosened by means of a release handle to slide under controlled conditions to the lower position, thereby increasing the volume inside the bellows by pulling air through the test specimen which is covering the air entering opening at the upper end of the bellows. The test specimen is firmly hold to cover the air entering opening by means of a fastening ring of 5 cm² or 10 cm² to allow for different samples sizes and/or different permeability ranges. If the 10 cm² ring is used, the sample should be at least 55 mm wide, for the 5 cm² ring at least 35 mm. For both, the samples should have a length of about 150 mm.

In case of very high permeability materials, the opening can be further reduced, with appropriate adjustments to the equipment and calculation.

The equipment comprises a stopwatch (1/100 sec) which automatically measures the time between the operation of the release handle thus starting the sliding of the bellows, and the bottom of the bellows reaching its lower end position.

The air permeability k of the material is calculated by the Darcy law as described above, wherein different parameters are used (due to the differences in equipment set-up). Specifically for the test equipment used here, V is 1900 cm³, A is 4.155 cm² and Δp is 160 Pa.

The test is repeated once for each test specimen (either sheets made of single material or laminates of different materials), and should be repeated on five specimens. For each sample material or laminate, the average of at least three satisfactory runs is reported. The averaged value is reported in Darcy/mm, taking into account the unit thickness of the material.

G. Absorption Test

This test measures the high suction capillary absorption of absorbent materials. Capillary sorption is a fundamental property of any absorbent that governs how fluid would be absorbed by the absorbent structure. High suction capillary sorption characterizes the ability of a material to partition fluid from competing materials.

A porous glass frit is connected via an uninterrupted column of fluid to a fluid reservoir whose fluid level is located at the same height as the horizontal center of the frit porous structure. The sample absorbs fluid upon demand and its weight at equilibrium is recorded. The fixed height capsorption experiment thus gives information about the liquid uptake (g/g) in the horizontal direction.

Experimental Setup

The test liquid used herein is 0.2 wt% Triton® X-100 (available from Sigma-Aldrich Inc.) aqueous solution having a surface tension of about 33 dyne/cm). This test method may be adapted to use other test liquids such as water or synthetic urine (having a surface tension of about 75 dyne/cm and about 55 dyne/cm, respectively).

A porous glass fritted funnel is filled with the test liquid. The fritted funnel (available from VWR Scientific Products, Cleveland, OH) has a 350 ml volume and 10-15 micron pores; its bottom outlet is modified by glass blower to accommodate tubing. A 1.40 m long piece of Tygon tubing (Part No. R3603, available from VWR Scientific Products) is attached to the funnel bottom and filled with test liquid. The fritted funnel is clamped onto a stand. The Tygon tubing end is attached to the fritted funnel with the tubing end raised several centimeters above the fritted disk.

The funnel is filled with 100 ml of test liquid (the raised tubing end prevents the liquid from draining through the frit) and covered with plastic wrap. The frit is then stored for 5-12 hours to allow any air trapped in the frit pores to escape. Any observable air bubbles should also be removed from the frit or the tubing. The Tygon tubing is placed in the glass fluid reservoir (20-25 cm diameter) filled with test liquid. The center of the frit and the fluid level in the reservoir are set to the same height. A level is used to ensure that the frit surface is horizontal.

In between experiments the fritted funnel is covered with plastic wrap to prevent evaporation and drying of the test liquid in the frit pores; however, during an experiment the fritted funnel is not covered.

If frits are not used for several hours, they should be stored as follows: the Tygon tubing is removed from the fluid reservoir and attached to the fritted funnel with the tubing end raised several cm above the fritted disk. The funnel is filled with 100 ml of test liquid (the raised tubing end prevents the liquid from draining through the frit) and covered with plastic wrap.

Experimental Procedure

Ensure that no observable air bubbles are trapped below the frit or in the tubing. Cut a 5.40 cm diameter sample using an arch punch. Weigh the sample. Clamp off tubing below fritted funnel. Evenly spread the sample over the central area of the frit surface. Place a ring weight on the sample. Remove clamp and allow the samples to absorb for 2.5 minutes. Remove the ring weight, then the sample from frit. If it is necessary to lower the fritted funnel or tilt it for sample removal, the fritted funnel tubing has to be clamped off below the fritted funnel prior to removing the sample from the frit (to ensure that no additional fluid is absorbed by the sample during removal). Weigh the samples. Repeat procedure with the next sample. Perform two replicates for each sample and report the net uptake obtained for each frit as well as the average net uptake. Report which frits were used (frit # or other id). If results of the two tests differ by more than 10% (based on the higher value), check frits and sample preparation and repeat the experiment.

The liquid absorption (or uptake) by the sample is calculated according to the following:

Net uptake, g/g = (sample wet weight, g - sample dry weight, g) / sample dry weight, g

EXAMPLES

Example 1

In this example, the absorbent barrier structure of the present invention is a two-layered laminate comprising an absorbent zone and a barrier zone substantially superimposed over the barrier zone. FIG. 2A illustrates this embodiment schematically, wherein the absorbent barrier structure 10 includes a barrier layer 12 and an absorbent layer 14. The absorbent layer is a natural fiber cellulosic web commercially available as BOUNTY® paper towel (manufactures by the Procter and Gamble Company, Cincinnati, OH). The web has a two-ply construction. The total basis weight is about 43 gsm, and the total thickness is about 0.686 mm. The barrier layer is a polypropylene spunbond/meltblown nonwoven web (manufactured by BBA Nonwovens, Simpsonville, SC under the designation MD2005) which has a basis weight of about 27 gsm and a thickness of about 0.305 mm.

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Example 2

In this example, the absorbent barrier structure has a three-layered structure, which includes a first and a second barrier zones are disposed on the opposed sides of the absorbent zone. FIG. 2B illustrates this embodiment schematically, wherein the absorbent barrier structure 10 includes two barrier layers 12 and 16 and an absorbent layer 14 between the two barrier layers. The absorbent layer is a two-ply BOUNTY® paper towel. The first and the second barrier layers are meltblown polypropylene nonwoven webs (manufactured by Jentex Corporation, Buford, GA with the designation PP-015-F-N). Each of the MB nonwoven web has a basis weight of about 15 gsm.

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Example 3

In this example, the absorbent barrier structure having substantially the same construction as described in Example 2, except that the first barrier layer is a MB polypropylene nonwoven web from Jentex with a basis weight of about 10 gsm, the second barrier layer is a spunbond/spunbond polypropylene nonwoven web made of microdenier fibers with a basis weight of about 17 gsm (available from First Quality Fibers Nonwovens, Hazelton, PA under the designation GCAS 16002184).

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Example 4

In this example, the absorbent barrier structure having substantially the same construction as described in Example 2, except that the first barrier layer is a MB nonwoven web from Jentex with a basis weight of about 5 gsm and the second barrier layer is a MB nonwoven web from Jentex with a basis weight of about 10 gsm.

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Example 5

In this example, the absorbent barrier structure having substantially the same construction as described in Example 3, except that the first barrier layer is a MB nonwoven web from Jentex with a basis weight of about 10 gsm and the second barrier layer is a MB nonwoven web from Jentex with a basis weight of about 5 gsm.

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Example 2b

In this example, the absorbent barrier structure having substantially the same construction as described in Example 2, except that the absorbent layer is a single-ply BOUNTY®.

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Example 3b

In this example, the absorbent barrier structure having substantially the same construction as described in

Example 3, except that the absorbent layer is a single-ply BOUNTY®.

Example 2c

In this example, the absorbent barrier structure having substantially the same construction as described in Example 2, except that the absorbent layer comprises two superimposed layers of single-ply BOUNTY®.

Comparative Examples

Comparative Example 1 is a two-ply BOUNTY® towel available from the Procter & Gamble Company, Cincinnati, OH.

Comparative example 2 is a formed film having angled capillaries on its surface such as those described in EP 934,735 and EP 934,736. The formed film is made of polyethylene and is available from Tredegar Film Products Corporation, Terre Haute, IN.

Comparative example 3 is a microporous film. The microporous is made of polyethylene having 40-45 wt% CaCO₃ fillers. The microporous film is available from Clopay Plastic Products Company, Cincinnati, OH.

Comparative example 4 is a polypropylene SS nonwoven web available from First Quality Fibers Nonwovens, Hazelton, PA under the designation GCAS 16002184.

Comparative Example 5 is a polypropylene MB nonwoven web available from Jentex Corporation, Buford, GA) with the designation PP-015-F-N.

Example 6

The properties of the above examples are tested according to the Test Methods disclosed herein. For the three-layered structure, the first barrier layer is disposed adjacent to the absorbent core during the tests. The test results are summarized in Table 1a and Table 1b.

Table 1a

EXAMPLE	AIR PERMEABILITY (Darcy/mm)	HYDROHEAD PRESSURE (mBars)	LIQUID IMPACT VALUE (gsm)	BASIS WEIGHT (gsm)
1	57	41.3	7.2	70
2	24	49.3	6.8	73
3	51	45.3	8.3	69.3
4	47	23.5	7.4	57.1
5	46	39.3	8.5	57.1
2b	24	55.5	10.5	54
3b	40	38.3	9.6	42.5
2c	21.4	81.5	7.1	78

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Table 1b

COMPARATIVE EXAMPLE	AIR PERMEABILITY (Darcy/mm)	HYDROHEAD PRESSURE (mBars)	LIQUID IMPACT VALUE (gsm)	BASIS WEIGHT (gsm)
1	143	<0.5	57	43
2	133	3	5	42
3	0.05	>100	0.2	52
4	407	10.8	37	17
5	53	68.5	25	15

The test results in Table 1a indicate that the present invention provides a unique structure having the desirable balance of properties.

The test results in Table 1b indicate that the comparative examples fail to provide the desirable balance of properties. BOUNTY® paper towel (Comparative example 1) has excellent air permeability but poor liquid impermeability. Microporous film (Comparative example 2) has excellent liquid impermeability but is substantially air impermeable. The nonwoven webs (Comparative examples 3-5) are air permeable and liquid impermeable under general conditions. However, the nonwoven webs become liquid permeable under impact and/or pressure conditions.

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Example 7

In this example, the absorbent barrier structure having a three-layered construction as described in Example 2 is combined with an outer cover material, which is a polypropylene SM nonwoven web having a 16gsm SB layer and a 11.5 gsm MB layer. The combination structure is tested according to the Test Methods described herein. The test results are summarized in Table 2.

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Table 2

EXAMPLE	AIR PERMEABILITY (Darcy/mm)	HYDROHEAD PRESSURE (mBars)	LIQUID IMPACT VALUE (gsm)
7	13	71.7	5.1
2	24	49.3	6.8

When compared to the absorbent barrier structure of Example 2, the combined structure enhances the liquid impermeability and resistance to wet through under impact but decreases the air permeability. Overall, the combined structure also provides the desired balance of properties.

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Example 8

In this example, the absorbent barrier structure of Example 2 is combined with an outer cover material according to Example 7. Further, an apertured film is disposed between the second barrier layer of Example 2 and the outer cover of Example 7. The apertured film is made of polyethylene having 11.7% open area. The apertures are hexagonal-shaped openings. The apertured film used herein is manufactured by BP Chemicals, Wassergurg, Germany under the trade designation (HEX-B Type 45109). Apertured films manufactured by Tredegar Film Products Corporation, Terre Haute, IN, under the

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designation HEX-B, are equally suitable for use herein.

The overall structure, including the absorbent barrier structure, the apertured film and the outer cover, are tested according to the Test Methods described herein, and are compare with Example 7, which does not include the apertured film. The results are summarized in Table 3 below.

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Table 3

EXAMPLE	AIR PERMEABILITY (Darcy/mm)	HYDROHEAD PRESSURE (mBars)	LIQUID IMPACT VALUE (gsm)	MVTR (g/m ² /24hrs)
7	13	71.7	5.1	3972
8	13	66.2 (± 10)	2.5	3434

The open structure of the apertured film has insubstantial effect on the convective air permeability overall. The apertured film reduces the liquid impermeability of the overall structure, especially under impact condition. The results show that the overall structure including the addition of the apertured film, still achieves the desired balance of properties. More importantly, the apertured film reduces the diffusive MVTR of the overall structure. Thus, the unique combination of permeabilities provides a structure that desirably exhibits reduced dampness or condensation on the outer surface of the structure.

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Example 9

In this example, the absorbent layer is a cellulosic web (namely, a two-ply BOUNTY® towel) which has been surface-treated with a hydrophobic agent on both sides. The surface treatment method is described in PCT publication WO 00/14296 (D'Agostino et al.), the disclosure of which is incorporated herein by reference. The hydrophobic agent used is a fluorocarbon, namely, perfluoromethylcyclohexane. The treated cellulosic web is disposed between two barrier layers to form a three-layered absorbent barrier structure. Example 9a has substantially the same structure as Example 2 except that the treated BOUNTY® is used in place of the untreated BOUNTY® as the absorbent layer. Table 4 below shows the properties of this example in comparison to the example using the untreated web.

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Table 4

EXAMPLE	AIR PERMEABILITY (Darcy/mm)	HYDROHEAD PRESSURE (mBars)	LIQUID IMPACT VALUE (gsm)
9a	27	74.3	4.7
3	24	49.3	6.8

The results show that the hydrophobic treatment significantly enhances the liquid impermeability while maintaining the air permeability.

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Example 10

In this example, example 3 and Comparative example 2 are tested according to Test Method G (Post-Compaction Air Permeability). The results are summarized below in Table 5.

Table 5

EXAMPLE	PRE-COMPACTION AIR PERMEABILITY (Darcy/mm)	POST-COMPACTION AIR PERMEABILITY (Darcy/mm)
Comp. 2	109 ±10	66 ±16
3	115 ± 7	94 ± 8

As the test results show that compaction results in insubstantial change in air permeability of example 3 of the absorbent barrier structure of the present invention. In contrast, a material, such as Comparative example 2, suffers significant loss in air permeability, which is attributable to its structural changes under compaction and its inability to recover its original structure.

While particular embodiments of the present invention have been described, it would be obvious to those skilled in the art that various other changes and modifications can be made without departing from the spirit and scope of the invention.

What is claimed is:

1. An absorbent article comprising an absorbent core and an absorbent barrier structure, wherein the absorbent barrier structure has
 - a hydrohead value of at least 10 mBars, preferably at least 30 mBars, more preferably at least 50 mBars, and most preferably at least 75 mBars;
 - a convective air permeability of at least 10 Darcy/mm, preferably at least 30 Darcy/mm, and most preferably at least 50 Darcy/mm; and
 - a dynamic liquid impact value of less than 10 g/m^2 , more preferably less than 6.5 g/m^2 .
2. An absorbent article comprising a topsheet, an absorbent core, an absorbent barrier structure and an outer cover, wherein
 - the absorbent core is disposed between the topsheet and the outer cover; and
 - the absorbent barrier structure is disposed between the absorbent core and the outer cover;wherein a combination of the absorbent barrier structure and the outer cover has
 - a hydrohead value of at least 10 mBars, preferably at least 30 mBars, more preferably at least 50 mBars, and most preferably at least 75 mBars;
 - a convective air permeability of at least 10 Darcy/mm, preferably at least 30 Darcy/mm, and most preferably at least 50 Darcy/mm; and
 - a dynamic liquid impact value of less than 10 g/m^2 , more preferably less than 6.5 g/m^2 .
3. An absorbent article of claims 1 or 2 wherein the absorbent barrier structure has an absorbency of at least 1 g/g, preferably from 5 to 50 g/g, more preferably from 10 to 30 g/g.
4. An absorbent article of any of the preceding claims wherein the absorbent barrier structure has a static liquid transmission value of less than 6.5 g/m^2 at 2 minutes after impact and less than 13 g/m^2 at 15 minutes after impact.
5. An absorbent article of any of the preceding claims wherein the absorbent barrier structure comprises a reservoir zone, a barrier zone at least partially disposed between the absorbent core and the reservoir zone, and optionally, a second barrier zone disposed at least partially between the reservoir zone and the outer cover.
6. An absorbent article of any of the preceding claims wherein the reservoir zone has an absorbency at least 20%, preferably at least 30%, less than that of the absorbent core and the hydrohead value of the barrier zone is higher than the hydrohead value of the reservoir zone and the hydrohead value of the absorbent core.

7. An absorbent article of any of the preceding claims wherein the hydrohead value of the barrier zone is at least 10 mBars, preferably at least 30 mBars, more preferably at least 50 mBars, and most preferably at least 75 mBars.
8. An absorbent article of any of the preceding claims further comprises a dampness management means disposed between the absorbent barrier structure and the outer cover, or between the reservoir zone and one of the barrier zones, wherein the dampness management means has a MVTR of no more than 4500 g/m²/24hrs.
9. An absorbent article of any of the preceding claims wherein the reservoir zone is a cellulosic web, the barrier zone is a nonwoven web, the outer cover is a nonwoven web, an apertured film or a laminate thereof, and the dampness management means is an apertured film having no more than 20% open surface area.
10. An absorbent article of any of the preceding claims wherein the reservoir zone further comprises additives selected from the group consisting of synthetic fibers, chemical bonding agents, crosslinking agents, debonding agents, wet strength resins, liquid or moisture absorbing agents, odor absorbing agents, antimicrobials, coloring agents, stiffening agents and mixtures thereof.
11. An absorbent article of any of the preceding claims wherein at least one surface of the reservoir zone or the barrier zone is treated with a hydrophobic agent, which is preferably a fluorocarbon.
12. An absorbent article comprising an absorbent core and a barrier structure, wherein the barrier structure has
 - a convective air permeability of greater than 10 Darcy/mm, preferably at least 30 Darcy/mm, and most preferably at least 50 Darcy/mm;
 - a dynamic liquid impact value of less than 10 g/m², more preferably less than 6.5 g/m²;
 - and
 - a post-compression air permeability decrease of no more than 35%, preferably no more than 25% and most preferably no more than 15%.
13. An absorbent article comprising a topsheet, an absorbent core, a barrier structure and an outer cover, wherein
 - the absorbent core is disposed between the topsheet and the outer cover; and
 - the barrier structure is disposed between the absorbent core and the outer cover;wherein a combination of the barrier structure and the outer cover has
 - a convective air permeability of at least 10 Darcy/mm, preferably at least 30 Darcy/mm, and most preferably at least 50 Darcy/mm;

a dynamic liquid impact value of less than 10 g/m^2 , more preferably less than 6.5 g/m^2 ;
and
a post-compression air permeability decrease of no more than 35%, preferably no more than 25% and most preferably no more than 15%.

14. An absorbent article according to claims 12 or 13 wherein the barrier structure has a hydrohead value of at least 10 mBars, preferably at least 30 mBars, more preferably at least 50 mBars, and most preferably at least 75 mBars.
15. An absorbent article according to any of claims 12-14 wherein the barrier structure comprises a reservoir zone, a barrier zone at least partially disposed adjacent to the absorbent core, and optionally, a second barrier zone disposed at least partially between the reservoir zone and the outer cover.
16. An absorbent article according to any of claims 12 - 15 wherein the reservoir zone has an absorbency at least 20% less than that of the absorbent core and the barrier zone has a hydrohead value that is higher than the hydrohead value of the reservoir zone and the hydrohead value of the absorbent core.
17. An absorbent article according to any of claims 12 - 16 further comprises a dampness management means disposed between the absorbent barrier structure and the outer cover, or between the reservoir zone and one of the barrier zones, wherein the dampness management means has a MVTR of no more than $4500 \text{ g/m}^2/24\text{hrs}$.
18. An absorbent article according to any of claims 12 - 17 wherein the reservoir zone is a cellulosic web having at least 70wt% of cellulosic fibers, the barrier zone is a nonwoven web, the outer cover is a nonwoven web, an apertured film or a laminate thereof, and the dampness management means is an apertured film having no more than 20% open surface area.
19. An absorbent article according to any of claims 12 - 18 wherein the reservoir zone further comprises additives selected from the group consisting of synthetic fibers, chemical bonding agents, crosslinking agents, debonding agents, wet strength resins, liquid or moisture absorbing agents, odor absorbing agents, antimicrobials, coloring agents, stiffening agents and mixtures thereof.
20. An absorbent article according to any of claims 12 - 19 wherein at least one surface of the reservoir zone or the barrier zone is treated with a hydrophobic agent, which is preferably a fluorocarbon.

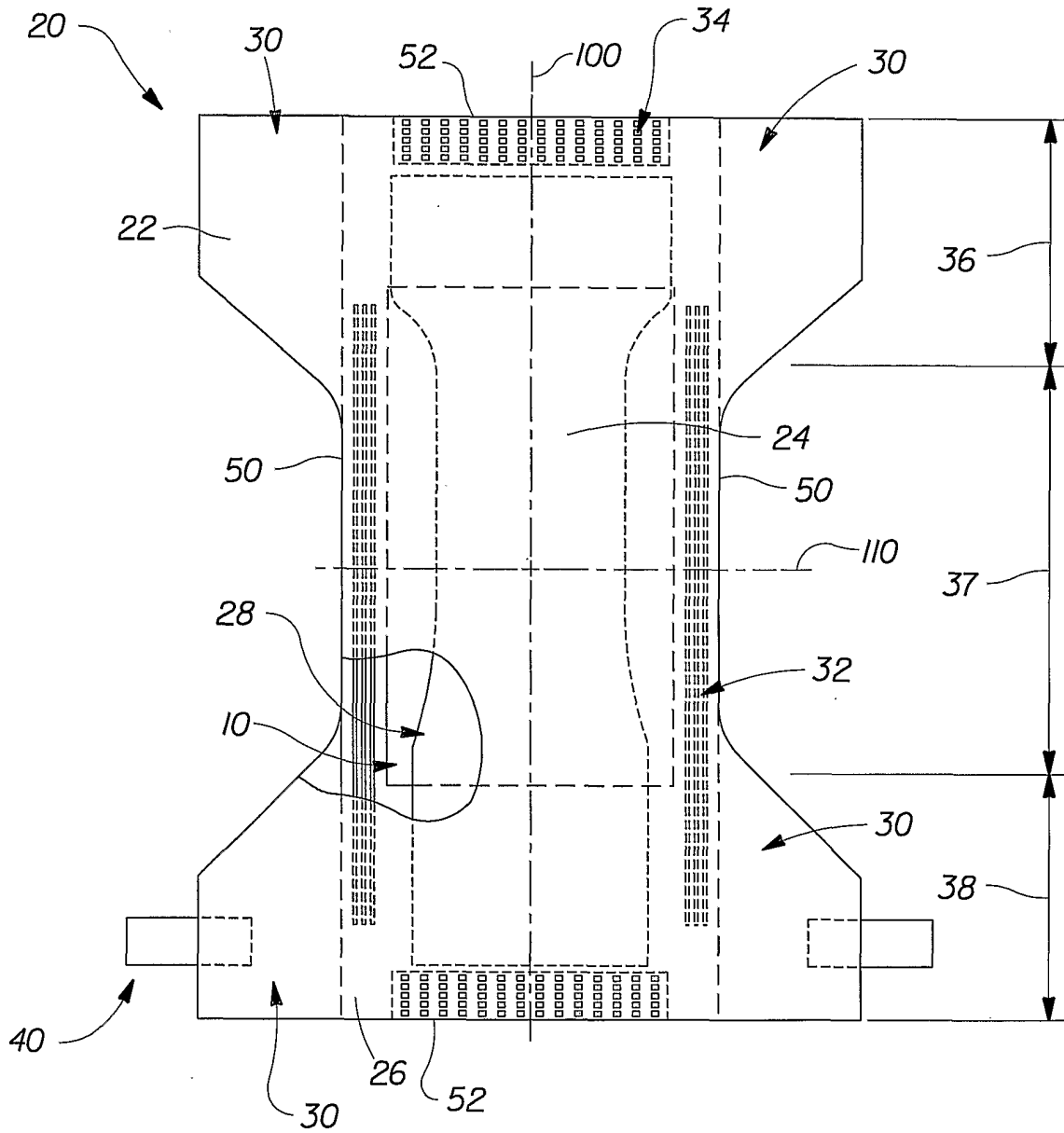


Fig. 1

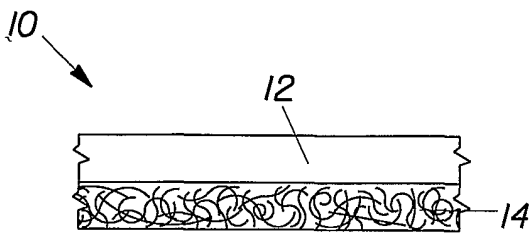


Fig. 2A

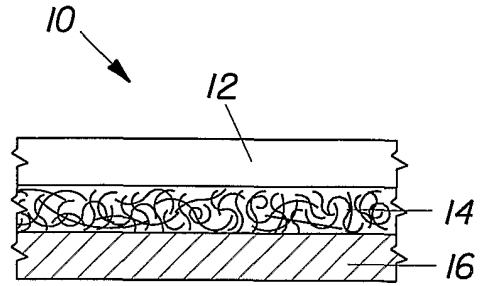


Fig. 2B

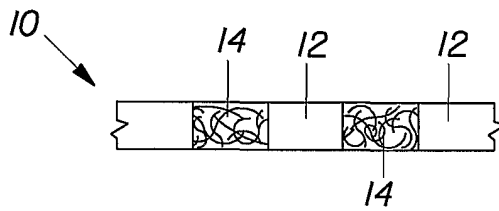


Fig. 3A

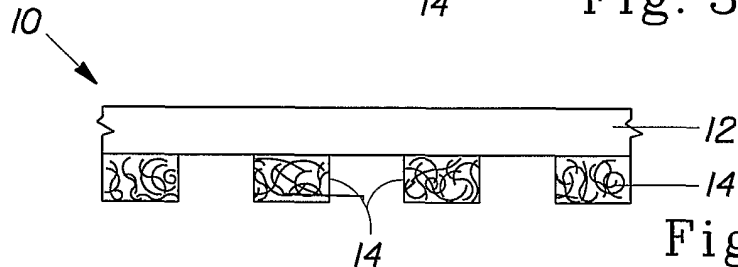


Fig. 3B

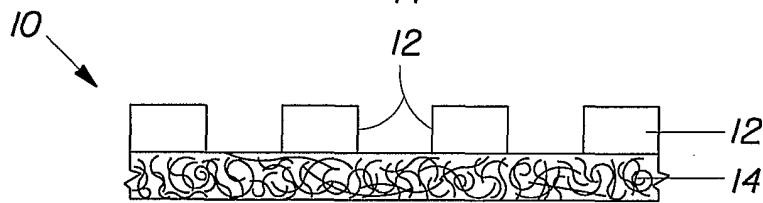


Fig. 3C

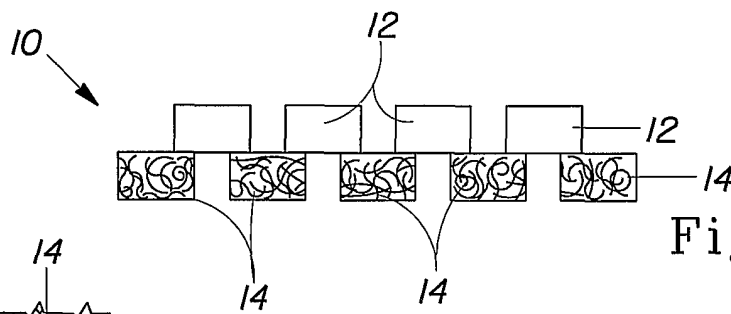


Fig. 3D

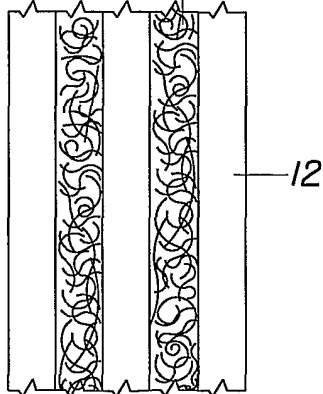


Fig. 4A

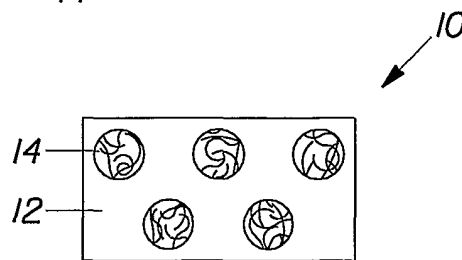


Fig. 4B

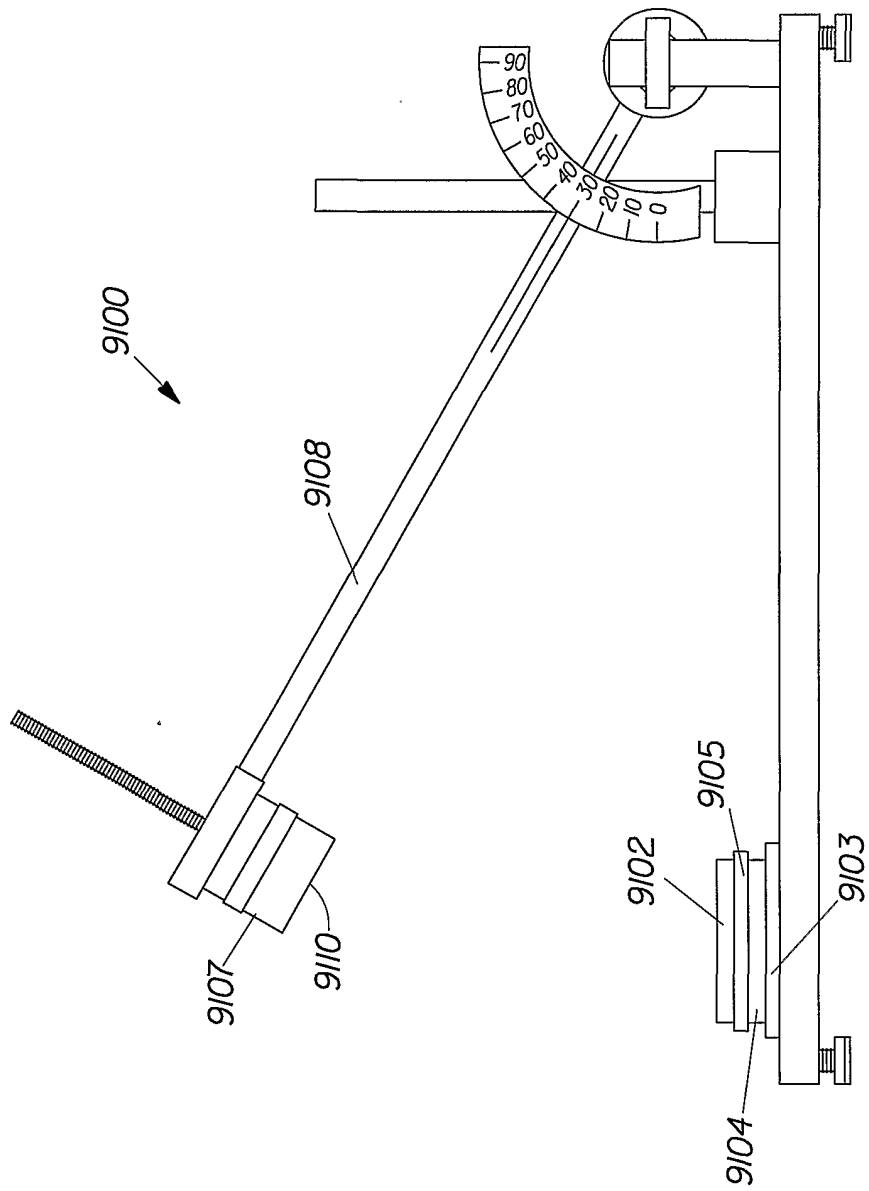


Fig. 5