Title: ABSORBENT ARTICLE CONTAINING A DENSITY GRADIENT IN AT LEAST TWO DIRECTIONS, AND METHOD FOR THE MANUFACTURE THEREOF

Abstract: An absorbent article includes a liquid permeable cover, a baffle material, and an absorbent structure disposed between the cover and baffle material. The absorbent structure includes a retention zone having a varying density gradient in at least two dimensions and a protection zone having a portion with a density less than a minimum density of the density gradient in the retention zone. The retention zone may be defined in a first region of the absorbent structure having a first basis weight and the protection zone may be defined in a second region of the absorbent structure having a second basis weight that is greater than the first basis weight.
ABSORBENT ARTICLE CONTAINING A DENSITY GRADIENT IN AT LEAST TWO DIRECTIONS, AND METHOD FOR THE MANUFACTURE THEREOF

Related Applications
The present application claims priority to Brazilian Patent Application No. PI0501157 filed on March 31, 2005.

Field of the Invention
The present invention refers to an absorbent article containing a density gradient in at least two dimensions forming an absorption/retention layer comprising a retention zone and a protection zone and furthermore absorbent lateral barriers. It furthermore refers to a method of manufacturing said absorbent article. The present invention also relates to an absorbent article having a retention zone and one or more protection zones defined in absorbent structure material having different basis weights and bulk.

Background of the Invention
In the prior art it is known that absorbent articles such as intimate absorbents (i.e., feminine care absorbent articles) have as principal characteristics being comfortable and discreet, with high absorption of bodily fluids and high dependability against leakages. Said requirements comprise variables which are not always combined in an effective manner.

An intimate absorbent should provide comfort when used in view of it being positioned in the female pubic region which applies stress during movement; a larger article may cause irritation and, consequently, discomfort even during a short period of use. On the other hand smaller articles increase the risk of leakage as the smaller size entails a smaller absorption area. Optimum dimensioning must be accompanied by material characteristics compensating for a smaller, more appropriate size for the product.

Furthermore the shape of the absorbent is important. Anatomical fit also provides comfort in use. The absorbent articles of the prior art have an approximately rectangular format wherein the vertices are rounded and have a slight narrowing in the middle portion. A greater narrowing provides a better anatomical fit, however the known solutions do not combine said characteristic
without loss of efficiency in the retention of bodily fluid; as a consequence, the more anatomical products have a shorter useful life, consequently requiring to be replaced at shorter intervals.

The absorption characteristic of an absorbent article is determined by the absorbent material employed and by the number of absorption layers provided. The known absorbent articles combine a large number of absorption layers in order to confer greater efficiency on the product. Hygroscopic articles are also used to more readily convey bodily fluid into the interior of the layers of the articles and in this manner provide increased comfort. What commonly occurs is that better absorption is associated with a greater volume of absorbent as a function of the greater number of layers and a greater quantity of hygroscopic article; in this manner the consuming public would require to choose between what is most discreet and what is most efficient.

A further aspect related to the art is dependability. A dependable absorbent article is capable of retaining bodily fluid (in particular menstrual fluid) without any leakage which, strictly speaking, comprises a characteristic of comfort combined with efficiency. When the limitations of the characteristics previously referred to are not observed, i.e. thickness, anatomical format, absorption capacity, etc, the risks of leakage are continuous and fairly frequent.

The prior art commonly solves said problem by sacrificing other characteristics, invariably eliminating the comfort, efficiency and dependability of the product; nevertheless it is still necessary to provide a product capable of combining the functional characteristics previously discussed.

In relation to said aspect innumerable documents are known proposing solutions such as:

Irish patent document 56006 referring to an absorbent article, particularly a disposable diaper having a decreasing density of the absorption layer commencing from the bottom; the differentiated density in levels of the absorption layer permits distribution of fluid, in this case urine;

U.S. Patent No. 3,871,378 referring to an absorbent article comprising a hydrophobic covering of low density in contiguous association with a material having a high density hydrophobic absorbent core to promote the transmission of
bodily fluids more rapidly from said covering to said core. Said arrangement provides a favorable density gradient for drainage of the fluid in the direction of the core wherein it is then retained;

U.S. Pat. No. 4,781,710 referring to an absorbent element having a density pattern comprising elevated regions of low density separated by encircling channels; the channels comprise regions of transport and storage wherein a storage region or transport region separates and encircles another storage region or transport region; the transport regions have a density greater than that of the storage regions, the density of which, in turn, is greater than the density of the elevated regions;

Brazilian Patent document BR 8105365 A referring to an absorbent structure comprising a pad having a substantially rectangular shape and a density gradient such that the density of the pad increases from the center to the transverse extremities;

Brazilian Patent document BR 0004245 A referring to an absorbent core to be used in disposable absorbent articles such as diapers for babies and for adults, disposable training underpants or feminine intimate absorbents, wherein the material is distributed in such a manner that there are formed within the absorbent core at least three zones: a distribution-storage zone, an anti-drainage zone and one or more transition zones.

In all the art referred to above the density gradient is unidirectional, generally vertical or longitudinal/transverse. In this case protection against leakage is partial not preventing part of the bodily fluid from draining in other directions and accumulating in small fractions until it extravasates.

Absorbent articles of the prior art having a unidirectional density gradient do not introduce elements of retention against lateral extravasation, in addition to not having multidirectional fluid distribution. If distribution of the bodily fluid eliminated onto the absorbent article is not achieved, providing less soaking of the surface of the article in contact with the body, it would be necessary to position elements of contention at the edges capable of holding the fluid retained on the absorbent.

A further aspect also not achieved by absorbent articles of the prior art is retention of the fluid conveyed to the absorption core. A decreasing density
commencing from the core permits drainage of bodily fluid in the direction of the absorption zone, but also permits return of the fluid in the direction of the outermost layers contributing to surface accumulation and lateral extravasation.

Lack of a configuration comprising a system of distribution of bodily fluid not solely in the direction of the absorption zone but throughout compromises the efficiency of the absorbent article and causes a sensation of discomfort and soaking and does not perform in an efficient manner, i.e. leading to replacement of the absorbent article at shorter intervals.

**Objectives of the Invention**

An objective of the present invention comprises the provision of an absorbent article having density gradients being vertical and transverse and optionally longitudinal permitting flow distribution through a greater area of the article increasing the sensation of comfort in use over a longer period.

Another objective of the present invention comprises the provision of a layer of superabsorbent material overlying a zone of lower density to increase protection against leakages.

A further objective of the present invention comprises positioning a zone of lower density underlying a hydrophobic covering zone to reduce fluid return and the sensation of dampness in use.

A still further objective of the present invention is to provide a method of manufacturing the absorbent article of the present invention.

Still a further object of the present invention is to provide an absorbent article having enhanced fluid intake, storage, and leakage prevention provided by an absorbent structure having regions of different basis weights in combination with a varying density retention zone. The regions of different basis weights may be defined by step changes or gradual changes in the basis weight of the absorbent structure material.

Another object of the present invention is to provide an absorbent article having an absorbent structure disposed between a cover and a baffle material, the absorbent structure including a retention zone having a varying density gradient in an X-dimension defined in a first region of the absorbent structure that has a first basis weight, and a protection zone having a density less than the minimum
density in the retention zone and defined in a second region of the absorbent article having a second basis weight that is greater than the first basis weight.

Additional objects and advantages of the invention will be set forth in part in the following description, or may be apparent from the description, or may be learned through practice of the invention.

**Description of Figures**

Figure 1 illustrates an exploded view of the possible configurations of the absorbent article showing all the layers of absorbent material;

Figures 2A - 2B illustrate a representation of options for the absorption/retention layer of the absorbent, showing the retention zone and the protection zone and the areas of density (density gradient) varying radially outwards from maximum density to minimum density;

Figures 3 and 4 illustrate an exploded view of the absorbent article showing absorbent lateral barriers and the area of the treated permeable covering (hydrophobic area).

Figure 5A illustrates a top plan view of the absorbent article in a configuration without the acquisition layer and without the superabsorbent barriers, having a density gradient in the X and Y directions.

Figure 5B illustrates a top plan view of the absorbent article in a configuration with acquisition layer and without superabsorbent barriers, having a density gradient in the X, Y and Z directions.

Figure 5C illustrates a top plan view of the absorbent article in another configuration with acquisition layer and without superabsorbent barriers, having a density gradient in the X, Y and Z directions.

Figure 5D illustrates a top plan view of the absorbent article in a further configuration with acquisition layer and superabsorbent barriers, having a density gradient in the X, Y and Z directions.

Figure 5E illustrates a top plan view of the absorbent article in a yet further configuration with acquisition layer and superabsorbent barriers, having a density gradient in the X, Y and Z directions.

Figure 6A illustrates a top plan view of the embossment pattern of the absorption layer having the preferred diamond pattern.
Figure 6B illustrates a top plan view of the embossment pattern of the absorption layer having a triangles pattern.

Figure 6C illustrates a top plan view of the embossment pattern of the absorption layer having a squares pattern.

Figure 6D illustrates a top plan view of the embossment pattern of the absorption layer having a lines pattern.

Figure 6E illustrates a top plan view of the embossment pattern of the absorption layer having a perpendicular lines pattern.

Figure 6F illustrates a top plan view of the embossment pattern of the absorption layer having a diagonal lines pattern.

Figure 6G illustrates a top plan view of the embossment pattern of the absorption layer having a sinusoidal pattern.

Figure 6H illustrates a top plan view of the embossment pattern of the absorption layer having a circle pattern.

Figure 7 illustrates an embossing roll embodiment for achieving a density variation in an embossment pattern.

Figure 8 illustrates another embossing roll embodiment for achieving a density variation in an embossment pattern.

Figure 9A illustrates a schematic view showing the shape of the product in use and the distribution of flow within the product, being a central cross-section showing the functioning of the absorbent material as a barrier.

Figure 9B illustrates a schematic view showing the shape of the product in use and the distribution of flow within the product, being a perspective view showing how the fluid is distributed as a function of the barriers formed in use and of the density gradient zone.

Figure 10A is a cross-sectional diagrammatic view of an alternate embodiment of an absorbent article according to various aspects of the present invention.

Figure 10B is a top planar view of the absorbent article embodiment illustrated in Fig. 10A.
Figure 10C is a top planar view of an alternate embodiment of an absorbent article according to the invention, particularly illustrating an alternate configuration of the retention zone.

Figure 11 is a top perspective view of an absorbent article embodiment according to the invention incorporating a particular retention zone configuration.

Figure 12 is a top perspective view of still another embodiment of an absorbent article according to the invention illustrating a different retention zone configuration.

Figure 13 is an end perspective view of an alternative embodiment of an absorbent article according to the invention, and particularly illustrates height differentials between various absorbent structure zones.

Figure 14 is a bottom perspective view of an absorbent core layer that may be used in various absorbent article embodiments according to the invention, and particularly illustrates a pattern of densified regions defined in the bottom surface of the absorbent core material.

Figure 15 is a top planer view of an alternate embodiment of an absorbent article according to the invention incorporating the absorbent core configuration illustrated in Fig. 14.

Figures 16A through 16D are top plan views of alternate embossing patterns that may be defined in one or more layers of the absorbent structure of an article according to the invention.

**Detailed Description of Preferred Embodiments**

Reference is now made to various embodiments of the invention, examples of which are illustrated in the figures. The embodiments are presented by way of explanation of the invention, and are not meant as a limitation of the invention. It should be appreciated that features illustrated or described with respect to one embodiment may be used with a different embodiment to yield still a further embodiment. It is intended that the present invention include such modifications and variations to the embodiments described herein.

In one particular embodiment, an absorbent article is provided which comprises a partially permeable covering (1); an absorption/retention layer (3) having a density gradient in the Y direction and in the X direction, said density
gradient being in a range from approximately 0.06 g/cm³ to 0.20 g/cm³, or any other density value with absorption area; an impermeable covering (5); a removable strip (7) and multiple adhesive layers (8).

The invention also encompasses a method of manufacturing an absorbent article which comprises the steps of:

- provision of a covering sheet, an absorption/retention layer, and a lower sheet, each having lateral and longitudinal edges;
- lamination of the absorption/retention layer to the covering sheet and to the lower sheet such that the absorption/retention layer is positioned between the covering sheet and the lower sheet; and
- obtainment of a density in a mechanical manner, in the laminated covering sheet, and in the absorption/retention layer in both X and Y directions, such that there is a density gradient diminishing generally from the center of the covering sheet to the lateral and longitudinal edges of the article.

The invention also encompasses an absorbent article, comprising:

- a liquid permeable cover;
- a baffle material;
- an absorbent structure disposed between said cover and said baffle material, said absorbent structure comprising a retention zone having a varying density gradient in an X-dimension defined in a first region of said absorbent structure having a first basis weight, and a protection zone having a substantially uniform density less than a minimum density of said density gradient in said retention zone and defined in a second region of said absorbent article having a second basis weight that is greater than said first basis weight, said protection zone defined longitudinally along opposite lateral sides of said absorbent structure.

According to Figure 1, the absorbent article of the present invention comprises a partially permeable covering (1) being the contact side with the body, an acquisition layer of low density (2), an absorption/retention layer (3) having a density gradient in the (Y) direction, a lateral absorbent barrier (4), an impermeable covering (5) being the garment side, removable strips (7) to protect the positioning adhesive, multiple layers of adhesive (8) responsible for maintaining all the components of the product joined to one another and layers of positioning
adhesive (6) responsible for maintaining the product affixed to underwear in use. In another configuration of the present invention, the absorption/retention layer (3) has a density gradient in the (X) and (Y) directions.

Although embodiments of absorbent articles according to the invention are illustrated in the figures as having a generally “dog bone” shape, it should be appreciated that the invention is not limited to this shape and encompasses any conventional absorbent article shape, including oval, hourglass, rectangular, and others.

The absorbent article comprises a partially permeable covering (1) that may be partially treated with a surfactant and define a central hydrophilic zone of a length in a range from approximately 35 mm to 65 mm, not exceeding approximately 70% of the total area of the absorbent article. Said characteristic renders the covering permeable to bodily fluids in the treated zone where the fluids are released, and impermeable at the sides acting as a barrier to fluids protecting the user against lateral leakages.

The acquisition layer (2) generates a density gradient in the Z direction having a density which may range from approximately 0.03 g/cm³ to 0.09 g/cm³. The acquisition layer may include soft fibers comprising approximately 85% cellulose pulp fibers and approximately 15% bicomponent polyethylene/polypropylene fibers, or of any other material composition serving for the same purpose or use. In another configuration the acquisition layer (2) may comprise a nonwoven fabric comprising approximately 50% bicomponent polyethylene/polypropylene fibers, or any other material composition serving for the same purpose or use.

The acquisition layer (2) has a width which may range from approximately 30 mm to approximately 50 mm, and a length which may range from approximately 50 mm up to the total length of the finished product. Said low density property permits very rapid fluid acquisition in the article and may provide greater comfort for the user as a function of the softness properties thereof.

The absorption/retention layer (3) has a density in a range from 0.06 g/cm³ to 0.20 g/cm³ (or any other density value with an absorption area) and may comprise soft cellulose pulp fibers, containing absorbent paper and a
superabsorbent polymer such as sodium acrylate. The retention/absorption layer (3) can have an hourglass shape with a minimum width in a range from approximately 42 mm to approximately 75 mm in the center and a maximum width in a range from approximately 60 mm to approximately 85 mm at the lobes. The absorption/retention layer is divided into two zones:

1. Retention zone (3a): being a region of variable density that may be delimited by a lateral embossed channel in a racetrack or hourglass format representing a maximum of approximately 60% of the absorption/retention layer (3) having a thickness in a range from approximately 1.5 mm to approximately 3.5 mm. Said retention zone can have a density gradient in a range from approximately 0.08 g/cm³ to approximately 0.20 g/cm³, preferably in a range from approximately 0.10 g/cm³ to 0.14 g/cm³. Said retention zone has a maximum density (0.20 g/cm³) in the center of the absorption/retention layer (3), said maximum density being constant over a length of approximately 20 mm to approximately 200 mm in the (X) direction and a width of approximately 15 mm to approximately 40 mm in the (Y) direction. Said area of maximum density provides optimum fluid distribution due to the high capillarity thereof. As the distance increases from the center of the absorbent article in the (Y) direction, said density reduces, creating a capillarity gradient and a fluid distribution gradient, attaining a minimum density of approximately 0.08 g/cm³ at the limits of the retention zone which may be delimited by an embossed channel. Said properties of the retention zone provide optimized fluid distribution in the (X) direction in the center of the absorption zone and reduce fluid distribution at the sides of the absorbent article reducing the probability of lateral leakage and increasing the utilization of the absorbent layer. Furthermore the speed of absorption is improved for repeated situations of bodily fluid discharge, given that the fibers located in the zone which receives the bodily fluid discharge are rendered less saturated as a function of maximized fluid distribution. Said retention zone corresponds to the area of the absorption/retention layer (3) having sufficient absorbent material to absorb at least 4 grams of menstrual fluid in a particular embodiment.

It is of note that said density gradients may be obtained in a mechanical manner, overlying the homogeneous absorption/retention layer, having the same
quantity of absorbent material distributed throughout the area thereof. Said density gradient may be obtained in two ways:

a) embossment studs (also referred to herein as “pins”) having different heights from the center to the edges, the greatest stud height being in the center of the absorbent article. Said height decreases as the distance from the center increases. Said variation in height from one area of studs to the following area may be in a range from approximately 0.01 mm to approximately 1 mm, desirably from approximately 0.3 mm to approximately 0.6 mm;

b) embossment studs having different areas of compression, the greatest area being in the center and small areas at locations furthest from the center. The area of each compression may be in a range from approximately 1 mm² to approximately 16 mm² in the center, desirably from approximately 2 mm² to 4 mm², being approximately 0.01 mm² to approximately 2 mm² in the external part of the retention zone, preferably from approximately 0.8 mm² to 1.5 mm².

Said embossment studs preferably have a diamond shape, but may have other patterns, such as square, lines, perpendicular lines, diagonal lines, sinusoidal lines or shapes (e.g., wave shapes), polygon, circle, triangle and others.

In the configuration wherein the density gradient of the absorption/retention layer (3) is three-dimensional, said gradient also varies in the (Z) direction such that when fluid approaches the extremities of the product it encounters greater difficulty in distribution, reducing the possibilities of leakage through the extremities of the product. Said configuration is especially valid for products for nocturnal use wherein the greater part of leakages occur through the extremities of the product.

2. Protection zone (3b): being a region of desirably constant density encircling the retention zone, as a maximum representing approximately 40% of the absorption/retention layer (3). Said protection zone is the area of lowest density of the absorption/retention layer (3), having a density in a range from approximately 0.04 g/cm³ to approximately 0.10 g/cm³, a desired density being in a range from approximately 0.07 g/cm³ to 0.08 g/cm³. Said zone has a thickness in a range from approximately 2.5 mm to approximately 8 mm, preferably from approximately 4 mm to approximately 7 mm. Said difference between the density of the center of the retention zone and the density of the protection zone is a
minimum of approximately 0.02 g/cm³. Said protection zone has the property of having the lowest capillarity of the absorption/retention layer, being located underlying a hydrophobic area of nonwoven covering. Said characteristics, low density and hydrophobic nonwoven fabric overlying it, maximize prevention against lateral leakage. Said protection zone may include an embossed channel in racetrack or hourglass format, and may contain different channel designs (in terms of shape, width and quantity), being areas of mechanically-compressed material functioning as a fluid barrier and as fluid distributors, reducing the probability of lateral leakages.

Said two zones also present an improvement in comfort and suitability given that the central part of the absorption/retention layer (3) has a greater density and because it comprises the area of least deformation in use, thus permitting better absorption, the external area of the absorbent article being softest providing greater comfort and less return resulting from the hydrophobic area of the said covering.

The combination of embossment of the retention zone and channels of the protection zone imparts an 'M' type shape in use, having the following benefits:

a. said channels, by virtue of their density/capillarity, improve distribution and create lateral barriersimpeding the occurrence of leakage;

b. said embossments of the retention zone cause preferred deformation of the product in use (from format "∧" to "M") which, by virtue of the high density thereof, distributes fluids very rapidly in the X direction. It also generates a deep zone or cavity (‘M’ type) providing lateral barriers of absorbent material preventing leakage, whilst the fluid is distributed and absorbed by the absorbent core. It simulates the properties of an acquisition layer mechanically without requiring a specific material or chemical treatment to realize said characteristics.

Said combination of retention zone and protection zone existing in the absorption/retention layer of the absorbent article of the present invention also introduces a thickness gradient into the product, with a lesser thickness obtained in the center of the absorbent article in the retention zone and a greater thickness in the protection zone.
In order to improve protection against lateral leakage, the absorbent article of the present invention may have absorbent lateral barriers.

The absorbent lateral barriers may be located at least on one of the sides of the acquisition layer (2), underlying the hydrophobic area of the treated covering zone and overlying the protection zone of the absorption/retention layer (3). Said lateral barriers represent additional absorption located in the region wherein the majority of leakages occur during use being the sides of the absorbent article. Said barriers may be considered as being made from different types of absorbent materials, such as:

a) A hot melt superabsorbent material such as HB Fuller HM1100: said superabsorbent being applied in at least one line on at least one of the sides of the absorbent article as a hot melt adhesive, and said superabsorbent line having a width in a range from approximately 0.5 mm to approximately 10 mm, preferably from approximately 3 mm to approximately 7 mm, and a length in a range from approximately 30 mm to approximately 300 mm, preferably from approximately 40 mm to approximately 60 mm, the concentration thereof being in a range from approximately 0.05 g/side to approximately 5 g/side, preferably from 0.1 g/side to 0.3 g/side. Said superabsorbent also has high capillarity properties assisting in distribution of fluid in the longitudinal direction of the absorbent article, assisting in reduction of saturation of the principal area of absorption which receives bodily fluids discharged when in use. Said property increases the speed of absorption when repeated discharges of fluids occur given that the absorbent fibers are less saturated, and increases the capacity of absorption given that the absorbent article will utilize a large area of the absorbent layer. Another benefit of said material is that positioning of the superabsorbent where it is desired is ensured, maximizing performance of the absorbent article.

b) Material of the airlaid type containing the superabsorbent in the composition thereof: said material being applied in at least one strip on at least one of the sides of the absorbent article; said superabsorbent strip has a width in a range from approximately 3 mm to approximately 10 mm, and a length in a range from approximately 30 mm to approximately 300 mm, preferably from approximately 40 mm to approximately 60 mm and having a basic weight in a
range from 100 g/m² to 500 g/m². A benefit of said material is that it is ensured that the superabsorbent is positioned in the desired place maximizing performance of the product. Another characteristic is that said material may have a color differing from the material of the absorption layer. Said difference in color assists the user in identifying the moment to replace the article given that indication is provided as to when the fluid reaches the protection zone. In view of the absorbent lateral barriers being located underlying the hydrophobic area of the treated covering zone, a further benefit is that the fluid is retained in said region reducing fluid return and the sensation of dampness given that the hydrophobic material reduces contact by the fluid with the skin.

The present invention differs from the prior art by having a density gradient in at least two of the three dimensions, for example in the (Y) direction and in the (X) direction. Said density gradient may be obtained mechanically in the absorbent layer of initial homogeneous density wherein, prior to compression, density is the same in the X and Y directions throughout the absorption/retention layer. Furthermore, in another configuration, it contains an acquisition layer wherein the density varies in the Z direction generating a total density gradient. In general the point 0, 0, 0 represents the maximum density of the product and said density diminishes along the X, Y and Z axes (Figures 2A and 2B) attaining their minimum values in the protection zone (X, Y directions) and in the acquisition layer (Z direction). The benefits of said density gradients may include any one or combination of:

a) optimized absorption speed by virtue of the low density of the acquisition layer;

b) optimized absorption speed by virtue of faster fluid distribution in the X direction;

c) optimized fluid distribution in the X direction by virtue of the high capillarity thereof;

d) optimized absorption speed in multiple insult incidents given that fluid distribution reduces saturation of the region receiving fluid insults;

e) increased absorption capacity by virtue of improved fluid distribution, permitting maximized use of the absorbent core;
f) optimized protection against lateral leakage given that the density gradient in the X and Y directions impedes fluid distribution in the lateral and end parts of the product;

g) reduced sensation of dampness as the fluid is absorbed and distributed by means of the absorbent retaining layer being located in the side of the product;

h) optimized shape by virtue of the greater bending strength in the center of the absorbent retaining layer, reducing accumulations and twisting.

Furthermore it generates an 'M' shape in use, differing from the 'X' shape in use encountered in products currently in the market.

The benefits of said density gradients and 'M' shape in use may include any one or combination of:

a) optimized fluid distribution in the X direction by virtue of the high capillary thereof;

b) optimized absorption speed in multiple insults given that fluid distribution reduces saturation of the region receiving fluid insults;

c) increased absorption capacity by virtue of improved fluid distribution, permitting maximized use of the absorbent core;

d) increased absorption capacity and protection against lateral leakage, with the same quantity of absorbent material, by virtue of the format of the product in use forming absorbent lateral barriers retaining fluid discharge permitting the occurrence of acquisition;

e) optimized protection against lateral leakage, given that the density gradient in the Y direction impedes fluid distribution in the lateral parts of the product;

f) optimized fluid acquisition, being a combination of different mechanical embossments/channels, without requiring additional materials;

g) optimized shape, by virtue of the greater strength in the center of the absorbent/retaining layer, reducing agglomeration and twisting.

A further feature is the use of a treated covering zone with a hydrophobic area overlying the protection zone in the X direction. Said treated covering zone may add any one or combination of the following benefits to the performance of the product:
a) increased absorption capacity and minimized lateral leakage, because
the sides of the absorption/retention layer are hydrophobic. Said characteristic
imposes displacement of fluid in the X direction and maximizes the use of the
absorbent core;

b) reduction in sensation of dampness in the area of the legs of the user,
because the hydrophobic nonwoven prevents fluid return through the covering
overlying the sides of the pad.

A further distinction is in respect of the superabsorbent lateral barriers,
located in the hydrophobic area of the treated covering zone and overlying the
absorbent layer. Said positioning may ensure that:

a) the superabsorbent is applied at the place where the action thereof is
most necessary;

b) the superabsorbent is located in the optimum area in order to reduce
lateral leakage and diminish dampness, because fluid retention is located under
the hydrophobic area of the covering, reducing the sensation of dampness.

The present invention may also provide a method to manufacture said
absorbent article, such method comprising the steps of:

- provision of a covering sheet, an absorption/retention layer, and a lower
  sheet, each having lateral and longitudinal edges;

- lamination of the absorption/retention layer to the covering sheet and to the
  lower sheet, such that the absorption/retention layer is positioned between the
  covering sheet and the lower sheet; and

- density obtainment in a mechanical manner, in the laminated covering sheet
  and in the absorption/retention layer in both X and Y directions, such that there is a
density gradient diminishing generally from the center of the covering sheet to the
lateral and longitudinal edges of the article.

The method of manufacturing the absorbent article, according to that
described previously, may furthermore comprise the steps of:

- provision of an acquisition layer;

- lamination of the acquisition layer between the covering sheet and the lower
  sheet prior to the stage of density obtainment in a mechanical manner, such that in
  the acquisition layer there is also obtained a density in a mechanical manner;
wherein the layers in which a density is obtained in a mechanical manner provide a density gradient diminishing generally from the center of the covering sheet to the lateral and longitudinal edges of the article.

It is notable that the stages of density may be obtained in a mechanical manner by, for example, stud embossment.

Said method may still furthermore comprise the stages of application of the absorbent lateral barriers in the sides.

Additional embodiments of absorbent articles incorporating various aspects of the present invention are illustrated in Figs. 10A through 15, and will be described in detail below. It should be appreciated, however, that the discussion set forth above with respect to the absorbent articles, or various components thereof, illustrated in Figs. 1 through 9 may pertain equally to the embodiments of Fig. 10A through Fig. 15. It should be appreciated that any feature of any of the embodiments illustrated or described herein may be incorporated with any other embodiment within the scope and spirit of the present invention.

Referring to Figs. 10A through 10C in particular, an embodiment of an absorbent article 100 is illustrated. The absorbent article 100 includes a liquid permeable cover 102, a baffle material 104, and an absorbent structure 108 disposed between the cover 102 and baffle 104. Various suitable materials for use as the cover 102 and baffle 104 are discussed above and are well known to those skilled in the art. The present invention is not particularly limited to any one type or combination of materials used as the cover 102 or baffle 104. The absorbent structure 108 may include an absorbent core material 140 alone or in combination with an acquisition material layer 148 (also referred to as an intake layer). Various suitable materials for use as the acquisition material 148 are also described above and are well known to those skilled in the art. The absorbent article 100 may include any combination of adhesive applications or layers 106 between the various components of the article. The article 100 is not particularly limited by application or location of such adhesive layers 106.

The absorbent structure 108 includes a retention zone 110 having a varying density gradient C in the X dimension, as particularly illustrated in Figs. 10B and 10C. Although not limited to such a method, the varying density gradient C may
be defined mechanically by embossing the absorbent core material 140 in the manner discussed in detail above with respect to the embodiments of Figs. 1 through 9.

The retention zone 110 is defined in a first region 116 of the absorbent structure having a first basis weight, as particularly illustrated in Fig. 10A. This basis weight can vary depending on any combination of factors, including size and capacity of the absorbent article 100, as well as the particular type of absorbent material used to form the absorbent core 140. In a particular embodiment, the first region 116 is formed at least in part of a cellulose fluff material and has a basis weight of about 370 gsm. The basis weight in the first region 116 may vary from between about 200 gsm to about 500 gsm. Other ranges are also within the scope and spirit of the invention. Commercially available cellulose fluff materials are manufactured by Weyerhauser or Georgia Pacific. In one embodiment, the average length of the wood pulp fibers is about 3.1 mm (by the Kajaani method). The coarseness of the pulp fibers is about 34 mg/100m, and the average denier of the pulp fibers, calculated from the coarseness, is about 3.06 dpf.

The absorbent structure 108 also includes one or more protection zones 118 laterally outboard of the retention zone 110 and oriented longitudinally along the absorbent structure 108. The protection zones 118 may have a relatively constant density that is less than the minimum value of the density gradient in the retention zone 110. In other words, the density of the protection zones 118 in a particular embodiment is generally less than the lowest density in the retention zone 110. The protection zones 118 are defined in a second region 120 (Fig. 10A) of the absorbent structure 108 having a second basis weight that is greater than the first basis weight. For example, referring to Fig. 10A, the second region 120 may be a portion of the absorbent core material 140 having an increased thickness defined in a step-wise manner. As illustrated in Fig. 10A, the absorbent core material 140 may have a U-shaped channel profile, with the increased height portions of the core material 140 defining the second region 120. In a particular embodiment, the second region may also be formed of the same cellulose fluff material as the first region 116 and have a basis weight of about 490 gsm, as compared to the lower basis weight of the first region 116. The second basis
weight may vary from about 400 gsm to about 800 gsm in alternate embodiments of the article 100. It should be appreciated that the first and second regions 116, 120, may be formed of the same absorbent material, or a different absorbent material. It should also be appreciated that the basis weights of the first and second regions may vary widely beyond the stated ranges as a function of the size and/or absorbent capacity of the absorbent article.

Although the first region 116 and second region 120 of different basis weights are illustrated in the figures as defined by step-wise differences in thickness (in the Z direction) of the core material 140, it should be appreciated that gradual or varying changes in basis weights are also contemplated and within the scope and spirit of the invention.

Referring to Figs. 10A and 10B, the protection zones 118 are defined as longitudinal regions on opposite lateral sides of the retention zone 110. In the embodiment of Fig. 10B, the retention zone 110 has longitudinal end regions 112 and lateral sides 114. The lateral sides 114 extend generally to the protection zones 118. In the embodiment of Fig. 10C, the lateral sides 114 of the retention zone 110 are spaced from the longitudinally extending protection zones 118. It should also be appreciated that the longitudinal dimension of the retention zone 110 may vary widely within the scope and spirit of the invention, as discussed above with respect to previous embodiments.

Still referring to Figs. 10B and 10C, the absorbent structure 108 includes longitudinal ends 124 and lateral sides 122. The protection zones 118 may extend generally along the longitudinal sides 122, as illustrated in the figures, or may also encompass all or a portion of the longitudinal ends 124. For example, the protection zones 118 may form a perimeter or border region around the entire absorbent structure.

In the illustrated embodiments, storage zone regions 126 are provided in the absorbent structure 108 generally in the first region 116 having the lower basis weight. In the embodiment of Fig. 10B, the storage regions 126 are defined by the longitudinal ends 112 of the retention zone 110 and the longitudinal ends 124 of the absorbent structure 108. In the embodiment of Fig. 10C, the storage zone 126 generally encircles the retention zone 110 and extends between the opposite
longitudinal ends 124 of the absorbent structure 108. The storage zone regions have a density gradient B1 and B2 that may be constant, or may vary. For example, the density gradient of the storage zone regions 126 may decrease in the either or both of the X and Y dimensions from a center point (0,0,0) of the absorbent structure 108.

The density profiles of the various regions and zones of the absorbent structure 108 as described above provide the absorbent article 100 with enhanced fluid intake and absorption characteristics. The central retention zone 110 with the lower basis weight and higher capillarity serves to rapidly intake and distribute bodily fluids to the storage zone 126 in the X direction, and to the protection zone 118 in the Y direction. The storage zones 126 with densities B1, B2, and lower capillarity receive fluid from the retention zone 110. The protection zones 118 with generally greater thickness in the Z direction, and lower density and capillarity, define side barriers against leakage and may effectively hold and distribute sudden gushes of fluid. The protection zones 118 may act as an effective surge material in this regard.

The various density and material differences of articles 100 also provide an improved product in-use fit to the consumer by reducing the probability of random deformation of the product, which may result in discomfort to the user and leakage. The absorbent article according to the invention deforms into an M-fit deformation with lateral compression with the retention zone 110 defining a bottom cavity of the "M" profile. This M-fit deformation contributes to a more uniform fluid distribution initially into the retention zone 110 and then more uniformly throughout the storage zones 126 and protection zones 118.

Fig. 11 illustrates an embodiment of an absorbent article 100 incorporating various aspects discussed above with respect to Figs. 10A through 10C. In this embodiment, the absorbent structure includes the retention zone 110 of highest density and capillarity. The storage zone 126 surrounds the retention zone 110 and extends longitudinally along the absorbent structure, and the protection zones 118 are defined along the lateral sides of the structure, as discussed above. An outer embossed channel 130 delineates the protection zones 118 from the storage zones 126. This channel 130 may extend in a longitudinal direction along each
lateral side of the absorbent structure 108, and may define a closed loop channel, as illustrated in Fig. 11, or an open loop configuration. In this particular embodiment, the longitudinal ends 124 of the absorbent structure include longitudinal end protection zones 119 delineated by the channel 130. These zones 119 may be defined in the first region of lower basis weight 116 (Fig. 10A) and, thus, may have essentially the same density and capillarity as the storage zones 126. In an alternate embodiment, the longitudinal protection zones 119 may be formed in the second region 120 of increased basis weight material (as with the protection zones 118) or even a third intermediate region having a basis weight between that of the first region 116 and second region 120, and thus include material of a lower density and capillarity, but increased thickness.

The retention zone 110 may include any manner of embossed pattern 134, as discussed in detail above. The embossed pattern may provide the retention zone 110 with a varying density gradient in the X and Y directions, and may be defined by embossing rolls having either a varying surface area pattern or varying pin depth penetration pattern, as discussed in detail above. Alternatively, the embossed pattern may be defined by a combination embossing roll having both a varying surface area pattern and pin depth penetration pattern. In the embodiment illustrated in Fig. 11, the embossed pattern 134 includes a wave and floral design that provides the zone 110 with a gradient in the X and Y dimensions, but not necessarily in the Z direction.

Figures 16A through 16D illustrate various alternative embodiments of suitable embossing patterns that may be defined in the retention zone of an absorbent article according to the invention. These patterns may be defined mechanically by embossing roll pin or stud patterns configured to provide the retention zone with a desired density gradient in the X and Y directions, as discussed above.

The retention zone 110 may be delineated by an inner embossed channel 128. The absorbent structure 108 may also include any number or pattern of transverse embossed channels 132 defined generally in the longitudinal end regions of the storage zones 126, as particularly illustrated in Fig. 11. These channels 132 may serve to rapidly distribute and channel fluid from one zone to
the other, particularly in the event of a sudden gush or rapid intake of fluid. The transverse embossed channels 132 may serve to more rapidly distribute the fluid throughout the entirety of the storage zone 126, and may also aid in generation of a more uniform M-fit deformation of the article 100.

It should be appreciated that any embodiment of an article 100 according to the invention may incorporate any manner of known conventional features utilized with absorbent articles. For example, referring to Fig. 11, the article 100 may include wings 111 configured to fold around the user's undergarment and to secure to the undergarment or to each other. For this purpose, an adhesive 109 or other suitable attachment mechanism, such as micro-hook or hook-and-loop material, may be provided on the wings 111, as is well known to those skilled in the art.

The embodiment of an absorbent article 100 illustrated in Fig. 12 is similar to the embodiment of Fig. 11. In this embodiment, the retention zone 110 includes an embossed pattern 134 in the form of embossed depressions having an inverted pyramid or truncated shape separated by raised land areas. This particular pattern 134 defining channels of varying depth in the X and Y directions provides the retention zone with the desired varying density gradients, as discussed above. The grid or pattern of relatively small embossed depressions may also serve to rapidly distribute fluid over the surface of the retention zone 110, particularly in the case of a sudden gush of fluid.

The view of the article 100 in Fig. 13 illustrates the height or thickness differentials between the various zones of the absorbent structure 108. The retention zone 110 has an overall height or thickness of the land areas (excluding embossed depressions) in the Z direction. This dimension may be substantially constant (non-varying) or may vary in the X and/or Y directions from the center point (0,0,0) of the retention zone depending on the density gradient in the respective X and Y directions. The surrounding storage zone 126 also has an overall height of the land areas (excluding any embossed depressions) in the Z direction that may vary in the X and/or Y dimension or may be substantially constant, and may be greater than the corresponding height of the retention zone 110. In a particular embodiment, the minimum height of the storage zone 126 is
equal to or greater than the maximum height in the retention zone 110. The protection zones 118 have an overall height in the Z direction that may vary or may be substantially constant in the X and/or Y directions, and may be greater than the corresponding overall height of the storage zones 126. In a particular embodiment, the minimum height of the protection zones 118 is equal to or greater than the maximum height in the storage zones 126. Thus, it should be understood, that the respective Z dimension heights may generally increase in a gradual or step-wise fashion as one moves outwards from a center point of the retention zone 110 in the X and Y directions.

Fig. 14 illustrates a bottom view of an absorbent core material 140 that may be used alone or in combination with another material as the absorbent structure in an article according to the invention. The absorbent core material 140 has a bottom surface 144 that is disposed towards the baffle in an absorbent article and an upper surface 142 that is disposed towards the cover when the core material 140 is disposed in an absorbent article 100. In this particular embodiment, the absorbent core material 140 includes a plurality of densified regions 146 in the lower surface 144. These densified regions 146 may define any manner of series or pattern of such regions, such as a series of spaced apart depressions separated by raised ridges or the like. The densified regions 146 may be defined by conventional mechanical means, such as embossing. In the embodiment of Figs. 14 and 15, the pattern of densified regions 146 is defined between a series of spaced apart ridges that extend generally along the entire length of the absorbent core. In alternate embodiments, the densified regions 146 may be delineated by either of the embossed channels 128 or 130 defined in the upper surface 142 of the absorbent core material. The densified regions may be embossed or otherwise defined in the X and/or Y directions and have a width dimension of between about 0.2 mm to 5.0 mm with an interval spacing of from about 1 mm to about 10 mm. Referring to Fig. 15, the Y dimension of the densified regions 146 may coincide with the outer peripheral channel 130 that defines the protection zones 118. The channel 130 may serve as a conduit to distribute fluid to the densified regions 146 for a faster absorption of the fluid into the absorbent core material. The densified regions 146 defined in the bottom surface 144 of the core
material 140 may also serve to prevent bunching of the absorbent core when
compressed laterally. This characteristic may further serve to generate the M-
shaped profile of the article 100, as discussed above.

It should be appreciated that an aspect of the invention includes
incorporation of the densified regions 146 discussed above in any manner of
absorbent article core construction regardless of any other feature. For example,
an absorbent article 100 incorporating the densified regions 146 may or may not
include a retention region having the density gradient as discussed above, or any
of the other features discussed above.

It should be readily appreciated that various materials are known to those
skilled in the art for use as the absorbent core material 140. A particularly desirable
embodiment of the core material 140 comprises a homogeneous mixture of
cellulosic fluff and superabsorbent particles (SAP). This composition may be
maintained throughout the first region of lower basis weight 116 and second region
120 of higher basis weight. The SAP particles are desirably distributed uniformly
throughout the first and second regions. In certain embodiments, the absorbent
core material 140 may have a total cellulosic fluff content of between about 2.5 g
and 5.0 g, and a total SAP content of between about 0.2 g and 0.4 g. Various
commercially available superabsorbent particle compositions are well known to
those skilled in the art and need not be described in detail herein. It should also be
appreciated that the invention encompasses concentrations of SAP significantly
greater, or less than, the ranges stated above.

As mentioned, the absorbent structure 108 may include any manner of
conventional acquisition or intake layer 148. Desirably, this acquisition layer 148 is
disposed below the cover material 102 and overlies at least a substantial surface
area portion of the retention zone 110, as illustrated for example in Fig. 15.
Suitable materials are known in the art for rapidly intaking and distributing fluid and
any manner or combination of such materials may be used as the acquisition
material layer 148. Such materials generally have a relatively low density (i.e.,
less than the underlying absorbent material) for this purpose. Thus, the use of an
acquisition or intake layer 148 may provide an overall density gradient in the Z
direction by overlying the more dense retention zone 110. The acquisition layer
148 may also be embossed with the core material 140 in defining the retention zone 110. In this manner, the acquisition layer 148 would also have a varying density gradient in the X and Y dimensions.

It should be appreciated by those skilled in the art that various modifications and variations may be made to the modifications described and illustrated herein without departing from the scope and spirit of the invention. It is intended that the invention include these changes and others as come within the scope and spirit of the appended claims.

The present invention is described in terms of the specific techniques thereof, nevertheless certain variations will be considered to be obvious to a specialist in the subject, the same being comprised within the scope of the present invention.
WHAT IS CLAIMED IS:

1. An absorbent article which comprises a partially permeable covering (1); an absorption/retention layer (3) having a density gradient in the Y direction and in the X direction, said density gradient being in a range from approximately 0.06 g/cm³ to 0.20 g/cm³, or any other density value with absorption area; an impermeable covering (5); a removable strip (7) and multiple adhesive layers (8).

2. The absorbent article as claimed in claim 1 wherein the partially permeable covering (1) is partially treated with a surfactant.

3. The absorbent article as claimed in claim 1 or 2 wherein the partially permeable covering (1) has a central hydrophilic zone of a length in a range from approximately 35 mm to 65 mm.

4. The absorbent article as claimed in claim 1, 2 or 3 wherein the partially permeable covering (1) has a central hydrophilic zone not exceeding approximately 70% of the total area of the absorbent article.

5. The absorbent article as claimed in claim 1, 2, 3 or 4 wherein the absorbent article may contain an acquisition layer.

6. The absorbent article as claimed in claim 5 wherein the acquisition layer (2) generates a density gradient in the Z direction.

7. The absorbent article as claimed in claim 5 or 6 wherein the acquisition layer has a density in a range from approximately 0.03 g/cm³ to approximately 0.09 g/cm³.

8. The absorbent article as claimed in claim 5, 6 or 7 wherein the acquisition layer (2) consists of soft fibers comprising approximately 85% cellulose pulp fibers and approximately 15% bicomponent polyethylene/polypropylene fibers, or any other material composition serving for the same purpose or use.

9. The absorbent article as claimed in claim 5, 6 or 7 wherein the acquisition layer (2) is constituted by a nonwoven fabric composed of approximately 50% bicomponent polyethylene/polypropylene fibers and approximately 50% polyester fibers, or any other material composition serving for the same purpose or use.

10. The absorbent article as claimed in claim 5, 6, 7, 8 or 9 wherein the acquisition layer (2) has a width which may be in a range from approximately 30
mm to approximately 50 mm, and a length which may be in a range from approximately 50 mm up to the total length of the finished product.

11. The absorbent article as claimed in claim 1 wherein the absorption/retention layer (3) includes soft cellulose pulp fibers.

12. The absorbent article as claimed in claim 1 or 11 wherein the absorption/retention layer (3) contains a superabsorbent polymer.

13. The absorbent article as claimed in claim 1, 11 or 12 wherein the absorption/retention layer (3) contains an absorbent paper.

14. The absorbent article as claimed in claim 12 wherein the superabsorbent polymer is sodium acrylate.

15. The absorbent article as claimed in any of claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 or 14 wherein the absorption/retention layer (3) has an hourglass shape and a minimum width in a range from approximately 42 mm to approximately 75 mm in the center and a maximum length in a range from approximately 60 mm to approximately 85 mm at the lobes.

16. The absorbent article as claimed in any of claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 or 15 wherein the absorption/retention layer (3) comprises two zones: a retention zone and a protection zone.

17. The absorbent article as claimed in claim 16 wherein the retention zone has a density gradient in a range from approximately 0.08 g/cm³ to approximately 0.20 g/cm³, preferably in a range from approximately 0.10 g/cm³ to approximately 0.14 g/cm³.

18. The absorbent article as claimed in claim 16 or 17 wherein the protection zone has a density in a range from approximately 0.04 g/cm³ to approximately 0.10 g/cm³, the preferred density being in a range from approximately 0.07 g/cm³ to approximately 0.08 g/cm³.

19. The absorbent article as claimed in claim 16, 17 or 18 wherein the difference between the density in the center of the retention zone and the density of the protection zone is a minimum of approximately 0.02 g/cm³.

20. The absorbent article as claimed in claim 16, 17, 18 or 19 wherein the protection zone comprises a channel embossed in a racetrack or hourglass format.
21. The absorbent article as claimed in claim 16, 17, 18, 19 or 20 wherein the retention zone represents a maximum of approximately 60% of the absorption/retention layer (3).

22. The absorbent article as claimed in claim 16, 17, 18, 19, 20 or 21 wherein the retention zone has a thickness being in a range from approximately 1.5 mm to approximately 3.5 mm.

23. The absorbent article as claimed in claim 16, 17, 18, 19, 20, 21 or 22 wherein the maximum density is constant over a length of approximately 20 mm to approximately 200 mm in the (X) direction and over a width of approximately 15 mm to approximately 40 mm in the (Y) direction.

24. The absorbent article as claimed in claim 16, 17, 18, 19, 20, 21, 22 or 23 wherein as the distance with respect to the center of the absorbent article increases in the (Y) direction the density reduces, creating a capillarity gradient and a fluid distribution gradient, attaining a minimum density of approximately 0.08 g/cm³ at the limits of the retention zone.

25. The absorbent article as claimed in any of claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23 or 24 wherein the density gradients are obtained, in a mechanical manner, overlying a homogeneous absorption/retention layer having the same quantity of absorbent material distributed throughout the area thereof.

26. The absorbent article as claimed in claim 25 wherein the density gradients are obtained by means of embossment studs of different heights from the center to the edges, with the greatest stud height in the center of the absorbent article.

27. The absorbent article as claimed in claim 25 or 26 wherein the height decreases as the distance from the center increases; the difference in height from one area of studs to the following area may be in a range from approximately 0.01 mm to approximately 1 mm, preferably from approximately 0.3 mm to approximately 0.6 mm.

28. The absorbent article as claimed in claim 25, 26 or 27 wherein the density gradients are obtained by means of embossment studs with different areas of compression, with the greatest area in the center and smaller areas at the
locations most distant from the center; the area of each compression may be in a range from approximately 1 mm\(^2\) to approximately 16 mm\(^2\) in the center, preferably from approximately 2 mm\(^2\) to 4 mm\(^2\), being from approximately 0.01 mm\(^2\) to approximately 2 mm\(^2\) in the external part of the retention zone, preferably being from approximately 0.8 mm\(^2\) to 1.5 mm\(^2\).

29. The absorbent article as claimed in claim 25, 26, 27 or 28 wherein the embossment studs define embossed regions having any one of the following shapes: diamond, square, perpendicular lines, diagonal lines, sinusoidal lines, polygon shape, circular, triangular, and other patterns or shapes.

30. The absorbent article as claimed in claim 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28 or 29 wherein the protection zone comprises a region of constant density encircling the retention zone and representing a maximum of approximately 40% of the absorption/retention layer (3).

31. The absorbent article as claimed in any of claims 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29 or 30 wherein the protection zone has a thickness being in a range from approximately 2.5 mm to approximately 8 mm, preferably from approximately 4 mm to approximately 7 mm.

32. The absorbent article as claimed in any of claims 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30 or 31 wherein the protection zone has the lowest capillarity of the absorption/retention layer being located underlying a hydrophobic area of nonwoven covering.

33. The absorbent article as claimed in any of claims 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31 or 32 wherein the protection zone may contain different designs of channel, in terms of form, length and quantity, being areas of mechanically-compressed material.

34. The absorbent article as claimed in any of claims 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32 or 33 wherein the combination of embossment of the retention zone and of the channels in the protection zone imparts an 'M' type shape in use.

35. The absorbent article as claimed in any of claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33 or 34 wherein furthermore comprises absorbent lateral barriers (4).
36. The absorbent article as claimed in claim 35 **wherein** the absorbent lateral barriers (4) are located on at least one of the sides of the acquisition layer (2), underlying the hydrophobic area of the treated covering zone and overlying the protection zone of the absorption/retention layer (3).

37. The absorbent article as claimed in claim 35 or 36 **wherein** the lateral barriers (4) comprise a superabsorbent material applied in at least one line on at least one of the sides of the absorbent article as a hot melt adhesive, said line of superabsorbent having a width in a range from approximately 0.5 mm to approximately 10 mm, preferably from approximately 3 mm to approximately 7 mm, and a length in a range from approximately 30 mm to approximately 300 mm, preferably from approximately 40 mm to approximately 60 mm.

38. The absorbent article as claimed in claim 35, 36 or 37 **wherein** the lateral barriers (4) have a concentration which may be in a range from approximately 0.05 g/side to approximately 5 g/side, preferably from 0.1 g/side to 0.3 g/side.

39. The absorbent article as claimed in claim 35 or 36 **wherein** the lateral barriers (4) comprise a material of the airlaid type containing the superabsorbent in the composition thereof, said material being applied in at least one strip on at least one of the sides of the absorbent article; said superabsorbent strip having a width in a range from approximately 3 mm to approximately 10 mm, and a length in a range from approximately 30 mm to approximately 300 mm, preferably from approximately 40 mm to approximately 60 mm.

40. The absorbent article as claimed in claim 39 **wherein** the lateral barriers (4) have a basic weight in a range from 100 g/m² to 500 g/m².

41. The absorbent article as claimed in any of claims 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28; 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39 or 40 **wherein** the combination of the retention zone and the protection zone existing in the absorption/retention layer furthermore exhibits a thickness gradient in the product, the least thickness being obtained in the center of the absorbent article in the retention zone and the greatest thickness in the protection zone.

42. The absorbent article as claimed in any of claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30,
31, 32, 33, 34, 35, 36, 37, 38, 39, 40 or 41 wherein generally the point 0, 0, 0 represents the product maximum density and said density diminishes along the X, Y and Z axes attaining their minimum values in the protection zone (X, Y directions) and in the acquisition layer (Z direction).

43. A method of manufacturing an absorbent article which comprises the steps of:

provision of a covering sheet, an absorption/retention layer, and a lower sheet, each having lateral and longitudinal edges;

lamination of the absorption/retention layer to the covering sheet and to the lower sheet such that the absorption/retention layer is positioned between the covering sheet and the lower sheet; and

obtainment of a density in a mechanical manner, in the laminated covering sheet, and in the absorption/retention layer in both X and Y directions, such that there is a density gradient diminishing generally from the center of the covering sheet to the lateral and longitudinal edges of the article.

44. The method as claimed in claim 43 wherein it furthermore comprises the following steps:

provision of an acquisition layer;

lamination of the acquisition layer between the covering sheet and the lower sheet prior to the stage of obtainment of a density in a mechanical manner, such that in the acquisition layer there is also obtained a density in a mechanical manner; wherein the layers in which there is obtained a density in a mechanical manner provide a density gradient diminishing generally from the center of the covering sheet to the lateral and longitudinal edges of the article.

45. The method as claimed in claim 43 or 44 wherein the step of density obtainment in a mechanical manner includes embossing with studs.

46. The method as claimed in claim 43, 44 or 45 which comprises furthermore the steps of application of lateral barriers at one or more the sides of the absorbent article.

47. An absorbent article, comprising:

a liquid permeable cover;

a baffle material;
an absorbent structure disposed between said cover and said baffle material, said absorbent structure comprising a retention zone having a varying density gradient in an X-dimension defined in a first region of said absorbent structure having a first basis weight, and a protection zone having a substantially uniform density less than a minimum density of said density gradient in said retention zone and defined in a second region of said absorbent article having a second basis weight that is greater than said first basis weight, said protection zone defined longitudinally along opposite lateral sides of said absorbent structure.

48. The absorbent article as in claim 47, wherein said protection zone has a Z-dimension height greater than said retention zone.

49. The absorbent article as in any of claims 47-48, wherein said absorbent structure further comprises a storage zone defined at opposite longitudinal ends of said retention zone, said storage zone having a density that is less than a minimum density of said density gradient in said retention zone and greater than said density of said protection zone.

50. The absorbent article as in claim 49, wherein said storage zone is defined in said region of said absorbent structure having said first basis weight.

51. The absorbent article as in claim 50, wherein said storage zone comprises a minimum Z-dimension height that is equal to or greater than a maximum Z-dimension height of said retention zone and equal to or less than a minimum Z-dimension height of said protection zone.

52. The absorbent article as in claim 49, wherein said storage zone surrounds said retention zone.

53. The absorbent article as in claim 52, further comprising an embossed channel delimiting said retention zone from said storage zone.

54. The absorbent article as in claim 52, wherein said storage zone extends to longitudinal transverse ends of said absorbent structure.

55. The absorbent article as in claim 53, further comprising an embossed channel delimiting said storage zone from said protection zone.

56. The absorbent article as in claim 49, comprising at least one transverse embossed channel defined in said storage zone spaced from each said opposite longitudinal end of said retention zone.
57. The absorbent article as in any of claims 47-56, wherein said retention zone extends laterally to said protection zone.

58. The absorbent article as in any of claims 47-57, wherein said retention zone is encircled by a storage zone, and further comprising an inner embossed channel delimiting said retention zone and said storage zone, and an outer embossed channel delimiting said protection zone and said storage zone.

59. The absorbent article as in claim 58, wherein said storage zone extends to transverse ends of said absorbent structure.

60. The absorbent article as in claim 58, wherein said storage zone comprises a substantially uniform basis weight and substantially uniform density.

61. The absorbent article as in claim 58, wherein said storage zone comprises an overall substantially constant Z-dimension height greater than a maximum Z-dimension height of said retention zone and less than a substantially constant Z-dimension height of said protection zone.

62. The absorbent article as in any of claims 47-61, wherein said retention zone further comprises a varying density gradient in a Y-dimension.

63. The absorbent article as in any of claims 47-62, wherein said varying density gradient in said retention zone is defined by a varying depth embossed pattern.

64. The absorbent article as in any of claims 47-63, wherein said varying density gradient in said retention zone is defined by a varying surface area embossed pattern.

65. The absorbent article as in claims 47-62, wherein said varying density gradient in said retention zone is defined by a combination of a varying depth and varying surface area embossed pattern.

66. The absorbent article as in any of claims 47-65, wherein said absorbent structure comprises a cellulosic fluff and superabsorbent particle (SAP) composition, said first region comprising a basis weight of between 230 gsm and 500 gsm, and said second region comprising a basis weight of between 400 gsm and 800 gsm.
67. The absorbent article as in claim 66, wherein said absorbent structure comprises a total fluff content of between 2.5 g and 5.0 g, and a total SAP content of between 0.2 g and 0.4 g.

68. The absorbent article as in claim 66, wherein said retention zone has a density gradient of from about 0.20 g/cm³ to about 0.08 g/cm³, and wherein said protection zone has a substantially uniform density with a density differential between a maximum density of said retention zone and said protection zone of at least about 0.02 g/cm³.

69. The absorbent article as in claim 68, wherein said absorbent structure further comprises a storage zone generally surrounding said retention zone, said storage zone having a substantially uniform basis weight less than said protection zone and a substantially uniform density less than a minimum density of said retention zone and greater than said protection zone.

70. The absorbent article as in claim 69, wherein said protection zone comprises a height in a Z-dimension, said retention zone comprising a maximum height in a Z-dimension less than said protection zone, and said storage zone comprising a height in a Z-dimension greater than said maximum height of said retention zone and less than said protection zone.

71. The absorbent article as in any of claims 47-70, wherein said absorbent structure comprises an absorbent core material having said retention zone and said protection zone defined therein, and an acquisition material layer overlying at least said retention zone, said acquisition material layer providing a Z-dimension density gradient to said absorbent structure.

72. The absorbent article as in any of claims 47-71, wherein said absorbent structure comprises an absorbent core material having an upper surface disposed towards said cover, and a lower surface disposed towards said baffle, and further comprising a plurality of spaced apart densified regions defined in said lower surface of said absorbent core.

73. The absorbent article as in claim 72, wherein said densified regions are defined by a pattern of embossed transversely extending regions.
74. The absorbent article as in claim 73, wherein said pattern of embossed regions extends generally along the entire longitudinal length of said absorbent core.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

INV. A61F13/15

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A61F

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

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

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<td>US 5 827 255 A (CRAINIC ET AL) 27 October 1998 (1998-10-27) column 1, line 54 - column 2, line 20; column 8, line 51 - column 9, line 34; claim 1</td>
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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search 13 July 2006

Date of mailing of the international search report 20/07/2006

Name and mailing address of the ISA European Patent Office, P.B. 3518 Patentlaan 2 NL - 2280 HV Rijswijk Tel: (+31-70) 340-3940, Tx: 3t 651 apx nl, Fax: (+31-70) 340-3316

Authorized officer Lanniel, G
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