

DISPOSABLE ABSORBENT ARTICLE HAVING LIQUID-PASSAGES
ON TOP SURFACE THEREOF

This invention relates to a disposable absorbent article having liquid-passages on a top surface thereof such as a sanitary napkin or pad serving to contain menstrual discharge or a ladies' incontinence pad.

Japanese Laid-Open Patent Application Nos. Hei7-328060 and Hei8-117277 disclose a disposable absorbent article having a top layer structure comprising a heat-sealable/hydrophobic upper layer sheet and a heat-sealable/hydrophilic lower layer sheet underlying the upper layer sheet. More specifically, the former document discloses an arrangement according to which these upper and lower layer sheets are integrally heat-sealed at debosses intermittently formed by embossing treatment along imaginary lines extending obliquely with respect to a longitudinal direction of the article and intersecting one another to an imaginary lattice pattern. The latter document discloses an arrangement according to which the upper layer sheet is formed with a plurality of liquid-passages and heat-sealed with the lower layer sheet along transversely opposite side regions of the article by embossing treatment and the side

regions are thinned by compressing. As a result of this compression, a middle region extending between the side regions bulges in an arc-shape as viewed in a section taken along transversely of the article.

With the article disclosed by Japanese Laid-Open Patent Application No. Hei7-328060, the upper and lower layer sheets as well as a bat-structure underlying them extend flatly both longitudinally and transversely of the article. Consequently, the upper layer sheet is apt to generate creases undesirable for absorption of body fluids as the article is deformed during its use. With the article disclosed by Japanese Laid-Open Patent Application No. Hei8-117277, a middle region of the article certainly bulges in the arc-shape. However, the upper and lower layer sheets are not heat-sealed together in the middle region and, in consequence, the upper layer sheet is apt to generate creases undesirable for absorption of body fluids as in the case of the article disclosed by Japanese Laid-Open Patent Application No. Hei7-328060.

In view of the problem as has been described above, it is a principal object of the invention to solve such problem with neither trouble some labor nor increase in manufacturing

cost.

The object set forth above is achieved, according to the invention, by a disposable absorbent article including a laminate panel defined by a longitudinal axis, a transversal axis, skin-contactable side and a skin-noncontactable side, the absorbent article being characterized in that: the laminate panel comprises a liquid-permeable topsheet extending on the skin-contactable side, a liquid-impermeable backsheet extending on the skin-noncontactable side and a liquid-absorbent bat-structure disposed between these two sheets; the topsheet comprises a heat-sealable/hydrophobic upper layer sheet having a plurality of liquid-passages and a heat-sealable/hydrophilic lower layer sheet underlying the upper layer sheet; the laminate panel is formed substantially in parallel to its transversely opposite side regions with a pair of compression-molded grooves, respectively, the grooves being formed so as to depress the topsheet into an upper surface of the bat-structure and to define therebetween a middle region in which the topsheet and the upper surface of the bat-structure bulge in an arc-shape as viewed in a section taken along the transversal axis; and at least in the middle region, the upper and lower layer sheets are heat-sealed together by a plurality of debosses distributed in a

pattern formed by individual dot-like debosses at least occupying crossings of imaginary lines defining a plurality of substantially rectangular blocks each having a pair of angles opposed to each other substantially on the longitudinal axis and a pair of angles opposed to each other substantially on the transversal axis.

The term "debosses" used herein should be understood to be upwardly opened recesses or through-holes having shapes corresponding to embosses, for example, on rolls, which are formed as the topsheet is pressed between these rolls. The term "rectangular" used herein should be understood to include substantially "square" as well as substantially "rhombic", i.e., a shape defined by a pair of angles opposed to each other in one direction and another pair of angles opposed to each other in the other direction in which the one pair of angles are of degree different from the other pair of angles.

Fig. 1 is a perspective view of an article according to the invention as viewed from a skin-contactable side thereof;

Fig. 2 is a fragmentary scale-enlarged sectional view taken along a transversely middle line of the article;

Fig. 3 is a schematic plan view illustrating a deboss

pattern;

Fig. 4 is a scale-enlarged sectional view of a topsheet shown by Fig. 1;

Fig. 5 is a scale-enlarged sectional view showing a variant of the individual deboss; and

Figs. 6 (A) ~ (C) are plan views illustrating various configurations of compression-molded groove.

Details of a disposable absorbent article having liquid-passages on a top surface according to the invention will be more fully understood from the description given hereunder with reference to the accompanying drawings.

Referring to Figs. 1 and 2, a disposable absorbent article includes a laminate panel 1 which is defined by a longitudinal axis 2, a transversal axis 3, a skin-contactable surface 4 (top surface as viewed in Figs. 1 and 2) and a skin-noncontactable surface 5 (bottom surface as viewed in Figs. 1 and 2). The laminate panel 1 comprises a liquid-permeable topsheet 6, a liquid-impermeable backsheet 7 and a liquid-absorbent bat structure 8 disposed between these two sheets 6, 7. The topsheet 6 is sufficiently large to cover an upper surface of the bat structure 8 and consists of an upper layer sheet 6a and a lower layer sheet 6b integrally

bonded to a bottom surface of the upper layer sheet 6a. The backsheet 7 is sufficiently large to cover a bottom surface of the bat structure 8 and to further extend outward beyond transversely opposite side edges of the bat structure 8. The laminate panel 1 is formed in its transversely opposite side regions with a pair of back-to-back opposite compression-molded grooves 9a, 9b. Along these grooves 9a, 9b, the topsheet 6 and the backsheet 7 are depressed into the upper and lower surfaces of the bat structure, respectively. Two pairs of such grooves 9a, 9b divide the panel 1 in three regions, i.e., a pair of transversely opposite outer regions 1B and a middle region 1A and function as guides along which the outer regions 1B can be easily bent relatively to the middle region 1A. In the middle region 1A, the topsheet 6 bulges upward together with an upper portion of the bat structure 8, presenting an arc-shaped cross-section as viewed in a section taken along the transversal axis 3. The laminate panel 1 having such a configuration and function is obtained by molding. The laminate panel 1 provides not only a good fitting to the crotch, particularly to the vulva of a wearer with a comfortable feeling to wear but also a high preventive effect against leakage of body fluids.

The laminate panel 1 is provided along its transversely

opposite side edges with liquid-resistant side flaps 10 functioning to effectively prevent body fluids from leaking beyond the transversely opposite side edges. Each of these side flaps 10 is folded substantially in a Z-shape as viewed in its cross-section comprising three sections 10a, 10b and 10c. The section 10b is bonded to an extension 7a of the backsheet 7 by means of adhesive or heat-sealing while the section 10c is bonded to the associated side edge of the topsheet 6 by the similar means. The section 10a is folded so as to form a sleeve and an elastic member 11 is bonded under an appropriate tension to an inner side of the sleeve along its outer edge by means of adhesive. The section 10a is fixed at its longitudinally opposite ends to the section 10b by means of adhesive or heat-sealing technique so that the section 10a is normally biased under the effect of the elastic member to rise on the sections 10b, 10c.

The upper layer sheet 6a is made of a hot melt (thermoplastic) synthetic resin film or fibrous nonwoven fabric. The synthetic resin film may be, for example, a low density polyethylene film. The nonwoven fabric may be a melt blown, spun laced, needle punched, thermally bonded, spun bonded or chemically bonded nonwoven fabric made of polyolefine, polyester or polyamide. Such nonwoven fabric

may be made of fiber generally having a basis weight of 10 ~ 45 g/m², a density of 0.15 ~ 1.5 g/cm³ and a fineness of 0.1 ~ 10 deniers and preferably made of melt blown superfine fiber. The upper layer sheet 6a has a plurality of liquid-passages 12. Preferably, these liquid-passages 12 are respectively defined by tapered capillary walls 12a extending downward with their lower ends being in contact with the lower layer sheet 6b which is integrally formed with the capillary walls 12a, as will be apparent from Fig. 4. To assure that the capillary walls 12a can effectively introduce body fluids into the laminate panel 1 under their capillary action and prevent any amount of the body fluids from flowing upstream to the upper surface of the upper layer sheet 6a, each of the liquid-passages 12 preferably has a diameter of 0.15 ~ 6.0 mm at its proximal end and a diameter of 0.1 ~ 2.5 mm at its distal end. Each of the capillary walls 12a preferably has a height of 0.05 ~ 1.5 mm in order that the capillary wall 12a can be maintained in contact with the lower layer sheet 6b without any undesirable deformation such as collapse which may obstruct a desired introduction of body fluids into the laminate panel 1. Additionally, the liquid-passages 12 are preferably distributed with a density of 5 ~ 150/cm² for rapid introduction of body fluids into the

article.

The lower layer sheet 6b is made of a hot melt (thermoplastic) fibrous nonwoven fabric. The lower layer sheet 6b generally has a fineness of 1 ~ 12 deniers, a basis weight of 8 ~ 35 g/m² and a density of 0.005 ~ 0.15 g/cm³. Such nonwoven fabric is preferably made of core-sheath or side-by-side type conjugated fiber material comprising low melting point resinous constituent and high melting point resinous constituent, in which a heat-sealing effect of the low melting point resinous constituent keep a desired configuration of this nonwoven fabric. The nonwoven fabric is preferably treated by the well known technology to make it hydrophilic. It should be understood here that the density of the lower layer sheet 6b must be lower than the density of the upper layer sheet 6a. In the case of the core-sheath type conjugated fiber material, the treatment to make the nonwoven fabric hydrophilic is achieved by mixing the well known hydrophilic surfactant into the low melting point resinous constituent forming a surface of the lower layer sheet 6b or applying this surface with the hydrophilic surfactant. In the case of the side-by-side type conjugated fiber material, the treatment is achieved by treating the low melting point resinous constituent and/or the high melting

point resinous constituent with the hydrophilic surfactant in the same manner as in the case of the core-sheath type conjugated fiber material. The low melting point resinous constituent may typically be polyethylene and the high melting point resinous constituent may typically be polypropylen. The lower layer sheet 6b preferably presents an elastic recovery after compression (cushioning property) under its wetted condition substantially higher than that of the upper layer sheet 6a. To further improve such characteristics, it is preferable to select the conjugated fiber material tending to be crimped as it is heat-treated.

Referring to Figs. 3 and 4 (referring also to Figs. 1 and 2), the upper layer sheet 6a has a plurality of liquid-passages 12. This upper layer sheet 6a is integrally heat-sealed with the lower layer sheet 6b by a deboss pattern composed of individual dot-like debosses 13 formed by heating. The deboss pattern comprises the debosses defining intersecting points, i.e., angles of respective imaginary lines (single dot chain lines) describing a plurality of substantially rectangular blocks 14 each having a pair of angles opposite to each other substantially on the longitudinal axis 2 as well as a pair of angles opposite to each other on the transversal axis 3 and debosses 13 arranged

between the intersecting points, respectively. Reference numerals 13(a), 13(b) designate the debosses arranged on the pair of angles opposite to each other substantially on the longitudinal axis 2 and reference numerals 13(c), 13(d) designate the debosses arranged on the pair of angles opposite to each other substantially on the transversal axis 3. The term "rectangular" used herein should be understood to include "square" and "rhombic", as has already been described in the final paragraph of SUMMARY OF THE INVENTION.

As has previously been described, the middle region 1A of the laminate panel 1 defined by the pair of transversely opposed grooves 9a bulges upward in an arc-shape and at least this middle region 1A has a plurality of debosses 13. In addition, the lower layer sheet 6b has a high elastic recovery after compression. Such a unique arrangement allows the upper layer sheet 6a at least in the middle region 1A to be always maintained in an appropriate tensioned state under the elastic recovery of the lower layer sheet 6b underlying it. This is true also with respect to the individual blocks 14, as will be apparent from Fig. 4. More specifically, the upper layer sheet 6a bulges in an arc-shape and is maintained in the tensioned state in the individual blocks 14. Accordingly, the upper layer sheet 6a and the lower layer

sheet 6b are maintained in close contact with each other and, even if the laminate panel 1 is deformed during use of the article, the liquid-passages 12 are well resistant to their collapses which might prevent body fluids from being smoothly introduced into the article.

To achieve a desired effect of the invention, each of the debosses 13 preferably have, on the top surface of the upper layer sheet 6a, a diameter of 0.5 ~ 2 mm, an inter-deboss distance (i.e., a pitch) of 2.5 ~ 25 mm and a length of each side in the respective blocks of 2.5 ~ 25 mm. With the diameter of the deboss 13 being less than 0.5 mm, it will be difficult to maintain the upper layer sheet 6a in close contact with the lower layer sheet 6b and with the diameter being larger than 2 mm, on the other hand, the liquid-passages 12 will be collapsed with a higher possibility. With the inter-deboss distance being less than 2.5 mm, an arrangement of the debosses 13 will become substantially continuous and consequently a desired flexibility of the topsheet 6 will be deteriorated. With the inter-deboss distance being larger than 25 mm, on the other hand, it will be difficult to obtain the bulging of the blocks 14 and consequently the liquid-passages 12 will be liable to be collapsed. With the length of each side in the respective

blocks 14 being less than 2.5 mm, the number of these blocks 14 will become excessive and consequently the flexibility of the topsheet 6 will be deteriorated. With the length being larger than 25 mm, on the other hand, it will be difficult to maintain the bulging of the respective blocks 14. Generally, the deboss 13 has a tapered configuration and its distal end 15 is heat-sealed with the lower layer sheet 6b. It should be understood that the deboss 13 may have its bottom 16 being open as in the embodiment illustrated by Fig. 4 or may have its bottom 16a being closed as in the embodiment illustrated by Fig. 5. The deboss 13 having the open bottom 16 functions to introduce body fluids into the laminate panel 1 in a manner similar to the liquid-passages 12.

Configuration of the groove 9a (and the groove 9b also) is not limited to that illustrated by Fig. 1 but may be implemented in various configurations, for example, as illustrated by Fig. 6 (A) ~ (C) so far as the shortest distance between a pair of transversely opposite grooves approximately at the middle of the laminate panel 1 is 20 ~ 60 mm, more preferably, 25 ~ 40 mm. With the shortest distance being less than such dimension, a flexibility of the topsheet 6 will be deteriorated, and with the distance being larger than such dimension, it will be difficult to maintain

the topsheet 6 in the tensioned state.

The bat-structure 8 is obtained by molding a mixture principally of woody pulp fluff and particles of superabsorptive hydrogel in a panel-shape and entirely covering this with a water-absorbent sheet such as tissue paper. The hydrogel includes self-crosslinked polymer of alkali metal salt acrylate, graft polymer of starch, modified cellulose or crosslinked water-soluble polymer. The bat-structure made of such material has not only a semi-rigidity but also an appropriate elastic recovery after compression, both contributing to maintain the topsheet 6 in the tensioned state. If it is considered preferable to heat-seal the bat-structure with the lower layer sheet 6b, the bat-structure 8 may also contain heat-sealable fibers such as polyolefine of an acceptable amount, for example, up to 30 % by weight in view of the desired absorptivity. In this case, these fibers are preferably heat-sealed together within the bat-structure 8 and thereby form a three-dimensional network to improve a shape stability of the bat-structure 8.

The side flaps 10 are made of hydrophobic fibrous nonwoven fabric and sometimes treated with well known water repellent in order to improve a liquid-resistance. It is possible to make the side flaps 10 using elastically

stretchable material such as polyurethane and, in this case, the elastic member 11 will be unnecessary.

With the article according to the invention, the top surface in its middle region bulges in an arc-shape so that the middle region can be maintained in an appropriately tensioned state to assure a good fitting to the wearer's crotch zone, on one hand, and the liquid-passages can be effectively protected against undesirable deformation which would cause leakage of body fluids from the article. According to the most important feature of the invention, the debosses are distributed on the topsheet in a pattern describing imaginary rectangular blocks each having a pair of angles opposed to each other substantially on the longitudinal axis, i.e., each line of debosses arranged on each side of the rectangular imaginary lines extend obliquely with respect to both the longitudinal axis and the transversal axis. The debosses distributed in such pattern is advantageous over the well known lattice pattern merely comprising lines of debosses extending on and in parallel to the longitudinal axis and lines of debosses extending on and in parallel to the transversal axis from the viewpoint that the respective blocks are protected against undesirable deformation during use of the article and thereby the effect

is improved.

Appropriate dimensioning of the deboss size, inter-deboss distance and length of each side in each rectangular block defined by the deboss pattern further improves the effect.

According to the invention, it is possible to manufacture the article providing the effect at a lower cost and with less time-consuming labor than the well known articles of this type. This is for the reason that no consideration is necessary in addition to the appropriate dimensioning of the deboss size, the inter-deboss distance, the length of each side in each rectangular block and selection of material for the topsheet, particularly, for the lower layer sheet making part of the topsheet.



WHAT IS CLAIMED IS:

1. A disposable absorbent article including a laminate panel defined by a longitudinal axis, a transversal axis, a skin-contactable side and a skin-noncontactable side, the absorbent article being characterized in that:

the laminate panel comprises a liquid-permeable topsheet extending on the skin-contactable side, a liquid-impermeable backsheet extending on the skin-noncontactable side and a liquid-absorbent bat-structure disposed between these two sheets;

the topsheet comprises a heat-sealable/hydrophobic upper layer sheet having a plurality of liquid-passages and a heat-sealable/hydrophilic lower layer sheet underlying the upper layer sheet;

the laminate panel is formed substantially in parallel to its transversely opposite side regions with a pair of compression-molded grooves, respectively, the grooves being formed so as to depress the topsheet into an upper surface of the bat-structure and to define therebetween a middle region in which the topsheet and the upper surface of the bat-structure bulge in an arc-shape as viewed in a section taken along the transversal axis; and



at least in the middle region, the upper and lower layer sheets are heat-sealed together by a plurality of debosses distributed in a pattern formed by individual dot-like debosses at least occupying crossings of imaginary lines defining a plurality of substantially rectangular blocks each having a pair of angles opposed to each other substantially on the longitudinal axis and a pair of angles opposed to each other substantially on the transversal axis.

2. The absorbent article according to Claim 1, wherein each of the individual debosses has, on the top surface of the upper layer sheet, a diameter of 0.5 ~ 2 mm, an inter-deboss distance of 2.5 ~ 25 mm and a length of each side in the blocks of 2.5 ~ 25 mm.

3. The absorbent article according to Claim 1, wherein the upper layer sheet is made of a synthetic resin film while the lower layer sheet is made of a fibrous nonwoven fabric and the lower layer sheet has an elastic recovery after compression higher than that of the upper layer sheet.

4. The absorbent article according to Claim 1, wherein both the upper layer sheet and the lower layer sheet are made



of a fibrous nonwoven fabric and the lower layer sheet has an elastic recovery after compression in its wetted condition higher than that of the upper layer sheet.

5. The absorbent article according to Claim 1, wherein the lower layer sheet is made of conjugated fiber material comprising low melting point resinous constituent and high melting point resinous constituent so that individual fibers of the conjugated fiber material are heat-sealed together by heat-sealing effect of the low melting point constituent to stabilize the configuration of the lower layer sheet and wherein the conjugated fiber material has previously been treated to be made hydrophilic.

6. The absorbent article according to Claim 4 or 5, wherein the lower layer sheet has a density lower than that of the upper layer sheet.

7. The absorbent article according to Claim 5, wherein the conjugated fiber material is polyethylene/polypropylene core-sheath type fiber material in which hydrophilic surfactant is mixed into polyethylene forming an upper surface of the fiber material or the upper surface is applied



with the hydrophilic surfactant.

8. The absorbent article according to Claim 5, wherein the conjugated fiber material has previously been treated to be crimped.

9. The absorbent article according to Claim 1, wherein the liquid-passages are distributed with a density of 5 ~ 150 passages/cm².

10. The absorbent article according to Claim 1, wherein each of the liquid-passages is defined by a capillary wall extending downward until its distal end comes in contact with the lower layer sheet and having a diameter of 0.15 ~ 6.0 mm at its proximal end and a diameter of 0.1 ~ 2.5 mm at the distal end.

11. The absorbent article according to Claim 1, wherein a distal end of the deboss is open and the upper and lower layer sheets are heat-sealed together at least at the distal end.

12. The absorbent article according to Claim 1, wherein a



distal end of the deboss is closed and the upper and lower layer sheets are heat-sealed together at least at the distal end.

13. The absorbent article according to Claim 1, wherein the upper and lower layer sheets are heat-sealed along bottoms of the compression-molded grooves.

14. The absorbent article according to Claim 1, wherein the laminate panel is formed on its bottom side also with a pair of grooves having the same configuration as the grooves compression-molded in the topsheet and depressed into both the backsheet and the bat-structure.

15. The absorbent article according to Claim 1, wherein each of the blocks includes the debosses not only on the respective intersecting points but also between each pair of adjacent intersecting points.

16. The absorbent article according to Claim 1, wherein the shortest distance between the pair of compression-molded grooves as measured transversely of the laminate panel is 20 ~ 60 mm.