

S P E C I F I C A T I O N

PANTS-TYPE DISPOSABLE DIAPER AND METHOD FOR MAKING THE SAME

5 TECHNICAL FIELD

[0001]

The present invention relates to a pants type disposable
diaper and a method for making the same and, more particularly,
to such a diaper having a capability to prevent a top-sheet
10 covering a liquid-absorbent core from coming in contact with
a wearer's skin and a method for making such a diaper.

RELATED ART

[0002]

It is conventionally well known to provide a disposable
15 diaper on a side closer to a wearer's skin than a top-sheet
constituting a bodily fluid-absorbent structure with an
additional piece of sheet material adapted to be spaced from
the top-sheet in the thickness direction of the bodily
fluid-absorbent structure. It is also well known to form such
20 an additional piece of sheet material with let-through openings
for passage of feces and/or urine to be guided toward the bodily
fluid-absorbent structure. Body waste such as feces and urine
is retained within an open space serving as a pocket or pockets

defined between the additional piece of sheet material and the top-sheet. The additional piece of sheet material serves to prevent the top-sheet soiled with the body waste such as feces from coming in contact with the wearer's skin.

5 [0003]

For example, an open-type disposable diaper disclosed in Japanese Patent Application Laid-Open Publication No. 1993-305109 (PATENT DOCUMENT 1) includes a liquid-resistant second top-sheet lying on the side of a first top-sheet covering
10 a liquid-absorbent core facing a wearer's skin and formed with an opening dimensioned to be relatively long in a front-back direction of the diaper. The opening has elastic members attached thereto under tension along both side edges thereof. Upon contraction of these elastic members, the second top-sheet
15 is spaced upward from the first top-sheet and body waste discharged by the diaper wearer passes through the opening into an open space defined between these two top-sheets.

[0004]

An open-type diaper disclosed in Japanese Patent
20 Application, based on a Japanese translation of PCT international application Laid-Open Publication No. 1997-510385 (PATENT DOCUMENT 2) includes a pair of side flaps attached to the inner surface of a chassis along respective side

edges thereof and joined together in a crotch region so as to form an open space adapted to retain feces between a liquid-pervious sheet covering an absorbent structure and these side flaps. Once feces has passed the opening defined between these side flaps and retained within the open space, feces is restricted to come in contact with the wearer's skin. The respective side flaps include elastic members attached thereto under tension along free edges thereof.

[0005]

10 The pants type diaper disclosed in Japanese Patent Application Laid-Open Publication No. 2002-11044 (PATENT DOCUMENT 3) includes a skin-contact sheet above a liquid-pervious top-sheet covering an absorbent structure. A portion of the skin-contact sheet adapted to be spaced upward from the top-sheet is formed with an opening around which an elastic member is attached under tension to the skin-contact sheet. Feces discharged by a diaper wearer passes through the opening into an open space defined between the skin-contact sheet and the top-sheet and, in consequence, feces does not come in contact with the wearer's skin. The presence of the skin-contact sheet eliminates a possibility that the top-sheet wetted with bodily fluids might come in contact with the wearer's skin.

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PATENT DOCUMENT 1: Japanese Patent Application Laid-Open
Publication No. 1993-305109

PATENT DOCUMENT 2: Japanese Patent Application, based on a
Japanese translation of PCT international application,

5 Laid-Open Publication No. 1997-510385

PATENT DOCUMENT 3: Japanese Patent Application Laid-Open
Publication No. 2002-11044

DISCLOSURE OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

10 [0006]

In every case of the above-described diapers of prior art,
an additional piece of sheet material such as the second
top-sheet arranged above the liquid-permeable first top-sheet
covering the bodily fluid-absorbent core may have its dimension
15 in the front-back direction apparently be reduced under
contraction of the elastic members. Certainly such
contraction allows the additional piece of sheet material to
be spaced upward from the top-sheet and to form the open space
between the additional piece of sheet material and the top-sheet
20 adapted to retain feces therein. However, from a standpoint
of convenience for putting the diaper on the wearer's body and
feeling to wear, some problems are unsolved behind.
Specifically, contraction of the elastic members may create

many deep gathers which may complicate the inside geometry of the diaper and interrupt handling operation of a mother or a helper to guide the wearer's legs through the leg-openings of the diaper. If such gathers are formed in the crotch region
5 having relatively a small width, it may be difficult for the wearer to feel a snug fitting.

[0007]

In view of the problems as have been described above, it is a principal object of the present invention to provide a pants
10 type disposable diaper improved in comparison with the diapers of prior art and a method for making the diaper improved in such a way.

MEASURE TO SOLVE THE PROBLEM

[0008]

15 The present invention to solve the object set forth above comprises a first aspect relating to a pants-type disposable diaper and a second aspect relating to the method for making the same.

The object set forth above is achieved, according to the
20 first aspect of the present invention, by an improvement in the pants type disposable diaper having a front-back direction, a transverse direction and a longitudinal direction which are orthogonal one to another and a crotch region, a front waist

region extending forward from the crotch region and a rear waist region extending rearward from the crotch region which cooperate together to define a waist-opening and a pair of leg-openings, the pants type disposable diaper further including a bodily fluid-absorbent structure lying in the crotch region and formed by a bodily fluid-absorbent core sandwiched between a liquid-permeable inner sheet and a liquid-impermeable outer sheet and an innermost sheet and the innermost sheet lying further inside the inner sheet and having a region adapted to be spaced upward from the inner sheet in thickness direction of the core and functioning as a separator to prevent the inner sheet from coming in direct contact with a wearer's skin.

[0009]

The improvement according to the present invention is characterized in that the innermost sheet is joined to at least one of the inner sheet and the outer sheet in end regions thereof opposed to each other in the front-back direction and lying on a front-back center line extending in the front-back direction so as to bisect a dimension of the diaper in the transverse direction and adapted, in a region thereof defined between the end regions, to be spaced upward from the inner sheet in the thickness direction of the core; and the innermost sheet is

formed on a transverse center line extending in the transverse direction so as to bisect a dimension of the diaper in said front-back direction with a tuck extending downward from the region adapted to be spaced upward from the inner sheet toward
5 the inner sheet.

[0010]

According to one preferred embodiment of the present invention, the innermost sheet has at least one of a front let-through opening formed in front of the transverse center
10 line so as to allow urine discharged by the wearer to flow not through the innermost sheet but directly to the bodily fluid-absorbent structure and a rear let-through opening formed in the rear of the transverse center line so as to allow feces discharged by the wearer to move not through the innermost sheet
15 but directly to the bodily fluid-absorbent structure.

[0011]

According to another preferred embodiment of the present invention, the tuck is formed by partially joining regions of the innermost sheet put flat together as the diaper is folded
20 along the transverse center line.

[0012]

According to still another preferred embodiment of the present invention, the innermost sheet is a piece of sheet

material having an hourglass-like planar shape and folded along the transverse center line which is elastically stretchable and contractible in the transverse direction in the front and rear waist regions but neither stretchable nor contractible elastically as well as non-elastically at least in a section defined along the transverse center line in the crotch region.

[0013]

According to yet another preferred embodiment of the present invention, the bodily fluid-absorbent structure is provided in a form of a panel and any one of the inner sheet and the outer sheet extending outward beyond the peripheral edge of the core is joined to the outer surface of the innermost sheet.

[0014]

The object set forth above is achieved, according to the second aspect of the present invention, by an improvement in the method for making the diaper according to the first aspect of the present invention having at least the rear let-through opening.

[0015]

The improvement according to the second aspect of the present invention comprises steps of:

(1) continuously feeding a web having a predetermined width dimension as an original sheet material for the innermost

sheet in a machine direction;

(2) successively forming the innermost sheet at locations at a predetermined distance in a cross direction orthogonal the machine direction from the center line bisecting the width
5 dimension in the cross direction with the rear let-through openings at a regular pitch in the machine direction;

(3) joining the bodily fluid-absorbent structure to one of the opposite surfaces of the web in a manner that the core not only overlaps the rear let-through opening but also extends
10 across the center line;

(4) coating the web in one of a region defined between the center line and the rear let-through opening and a region in a symmetric relationship with the aforementioned region both on the surface opposite to the one surface with hot melt
15 adhesive;

(5) cutting the web along cutting lines defined between respective pairs of the adjacent bodily fluid-absorbent structures bonded to the web so as to extend in the cross direction and arranged at a regular pitch in the machine
20 direction; and

(6) bonding the web folded in two to itself along the cutting lines before cutting the web.

[0016]

One preferred embodiment of the method according to the invention further including a step of forming the web in regions opposite to the rear let-through openings about the center line with said front let-through openings at the regular pitch in
5 the machine direction.

[0017]

Another preferred embodiment of the method according to the invention further including a step of coating the web along the center line on the one surface with adhesive by means of
10 which the one surface is bonded to the bodily fluid-absorbent structure.

EFFECT OF THE INVENTION

[0018]

The pants type disposable diaper according to the present
15 invention is provided further inside the liquid-permeable inner sheet with the innermost sheet. The innermost sheet includes the region extending in the front-back direction along the front-back centerline and adapted to be spaced upward from the inner sheet and functioning as a separator to prevent the inner
20 sheet from coming in contact with the wearer's skin. The region functioning as the separator is formed with the tuck extending downward from the innermost sheet toward the inner sheet and has its dimension in the front-back direction which is reduced

by a dimension to form the tuck. In consequence, the region does not have noticeable gathers or a sag.

[0019]

The other effects provided by the preferred embodiments
5 of the present invention will be described later in details.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020]

[FIG. 1] Fig. 1 is a partially cutaway perspective view of a pants type disposable diaper.

10 [FIG. 2] Fig. 2 is a sectional view taken along a line II-II in Fig. 1.

[FIG. 3] Fig. 3 is a partially cutaway plan view showing the diaper in a flatly developed state.

[FIG. 4] Fig. 4 is a view similar to Fig. 3, showing one
15 embodiment of the pants type disposable diaper in a flatly developed state.

[FIG. 5] Fig. 5 is an exploded perspective view showing one preferred embodiment of the pants-type disposable diaper.

[FIG. 6] Fig. 6 is a sectional view taken along a line VI-VI
20 in Fig. 5.

[FIG. 7] Fig. 7 is a plan view showing the diaper of Fig. 5 in a flatly developed state.

[FIG. 8] Fig. 8 is an overhead view of the pants-type

disposable diaper as viewed in a direction indicated by interconnected two arrows VIII-VIII in Fig. 6.

[FIG. 9] Fig. 9 is partial diagram illustrating an embodiment of a method for making the diaper.

5 [FIG. 10] Fig. 10 is a diagram similar to Fig. 9, illustrating another embodiment of the method for making the diaper.

IDENTIFICATION OF REFERENCE NUMERALS USED IN THE DRAWINGS

[0021]

- | | | |
|----|----|------------------------------|
| | 1 | pants type disposable diaper |
| 10 | 6 | crotch region |
| | 7 | front waist region |
| | 8 | rear waist region |
| | 11 | waist-opening |
| | 12 | leg-openings |
| 15 | 21 | innermost sheet |
| | 23 | inner sheet |
| | 24 | outer sheet |
| | 26 | core |
| | 31 | front let-through opening |
| 20 | 32 | rear let-through opening |
| | 36 | tuck |
| | A | front-back direction |
| | B | transverse direction |

C longitudinal direction
P front-back center line
Q transverse center line
R longitudinal center line

5 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0022]

Details of a pants type disposable diaper according to the present invention and a method for making the same will be more fully understood from the following description given in
10 reference to the accompanying drawings.

[0023]

Fig. 1 is a partially cutaway perspective view of a pants type disposable diaper 1 put on a wearer's body wherein a front-back direction, a transverse direction and a longitudinal
15 direction are indicated by double-headed arrows A, B and C being orthogonal one to another. The diaper 1 comprises a crotch region 6, a front waist region extending forward from the crotch region 6 and a rear waist region 8 extending rearward from the crotch region 6 wherein side edges 7a, 7a of the front waist
20 region 7 are put flat and fusion-bonded together with side edges 8a, 8a of the rear waist region 8 at seam spots 9 arranged intermittently in the longitudinal direction C. The diaper 1 further includes a waist-opening 11, a pair of leg-openings 12,

an innermost sheet 21 directly facing the wearer's skin (not shown) and a bodily fluid-absorbent structure 22 attached to the outer surface 21b of the innermost sheet 21. Sections of the innermost sheet 12 defining the front and rear waist regions 7, 8 are elasticized to be stretchable and contractible in the transverse direction B while the section of the innermost sheet 12 defining the crotch region 6 is set substantially over its entire area to be non-stretchable elastically as well as non-elastically. While the innermost sheet 21 is preferably liquid-impermeable over its entire area and more preferably air-permeable but liquid-impermeable in its entire area, it is possible to make up the innermost sheet in a manner that the section defining the front and rear waist regions 7, 8 is liquid-impermeable and the section defining the crotch region 6 is liquid-permeable. The bodily fluid-absorbent structure 22 comprises a liquid-permeable inner sheet 23, a liquid-impermeable outer sheet 24 and a core 26 formed by bodily fluid-absorbent material wrapped with a piece of tissue paper and sandwiched between the sheets 23, 24 wherein these two sheets 23, 24 extend outward beyond the peripheral edge of the core 26 and put flat and joined together. At least one of these two sheets 23, 24 is joined to the innermost sheet 21. Along both side edges 27 of the crotch region 6, the innermost sheet

21, the inner sheet 23 and the outer sheet 24 are put flat and joined together. Also along these side edges 27, leg-surrounding elastic members 28 extending are sandwiched between the inner sheet 23 and the outer sheet 24 and bonded under tension to at least one of these two sheets 23, 24. Between the side edges 27, the innermost sheet 21 and the inner sheet 23 are spaced from each other in the thickness direction of the core 26. The innermost sheet 21 is formed ahead of the transverse center line Q-Q extending in the transverse direction B and bisecting a dimension of the diaper 1 in the front-back direction A with a front let-through opening 31 and in the rear of the transverse center line Q-Q with a rear let-through opening 32. The front let-through opening 31 is located so that the wearer's external genital may be exposed within this opening and the rear let-through opening 32 is located so that the wearer's anus may be exposed within this opening. With such a manner of the locations, urine and/or feces discharged by the diaper wearer can flow directly to the bodily fluid-absorbent structure 23 without permeating the innermost sheet 21. Urine having passed through the front let-through opening 31 as well as feces having passed through the rear let-through opening 32 can be securely retained within an open space defined between the innermost sheet 21 and the

inner sheet 23 and, in consequence, such urine and/or feces will not come in contact with the diaper wearer's skin.

[0024]

Fig. 2 is a sectional view taken along a line II-II in
5 Fig. 1 corresponding to the front-back center line P extending in the front-back direction A so as to bisect the dimension of the diaper 1 in the transverse direction B. The sections of the innermost sheet 21 lying in the front and rear waist regions 7, 8 are joined to each other in parallel to the longitudinal
10 center line R extending in the longitudinal direction C so as to bisect a dimension of the diaper 1 in the front-back direction A and to form upper edges of the respective leg-openings 12. In the crotch region 6, the innermost sheet 21 is formed with a tuck 36. The tuck 36 is formed by adhesive-bonding or
15 fusion-bonding the innermost sheet 21 to itself in a joint region 37 set on the longitudinal center line R so that, between the front let-through opening 31 and the rear let-through opening 32, the innermost sheet 21 is folded on itself along the longitudinal center line R. In other words, the tuck 36
20 extends downward from the section of the innermost sheet 21 spaced upward from the inner sheet 23 toward the inner sheet 23 along the longitudinal center line R (See Fig. 1). While the joint region 37 for the tuck 36 is illustrated to be defined

in the vicinity of the top 38 of the tuck 36, a dimension of the joint region 37 may be appropriately enlarged toward the bottom 39 of the tuck 36. While a dimension of the joint region 37 in the transverse direction B is illustrated to be smaller than the width dimension of the crotch region 6, the dimension of the joint region 37 may be enlarged unless the joint region 37 interferes with smooth handling of a mother or a helper to put the diaper 1 on the wearer's body. For example, in a case of the diaper 1 for baby use, the dimension of this joint region 37 is preferably in a range of 5 to 30mm. It is also possible to join the bottom 39 of the tuck 36 to the inner sheet 23 by appropriate joining means such as adhesive applied to the outer surface of the bottom 39. It should be noted that not only the section of the innermost sheet 21 forming the bottom 39 of the tuck 36 but also entire sections thereof lying transversely on both sides of the bottom 39 may be bonded to the inner sheet 23 (See Fig. 4).

[0025]

Between the innermost sheet 21 and the inner sheet 23, a front open space 42 is formed ahead of the transverse center line Q and a rear open space 43 is formed in the rear of the transverse center line Q. The tuck 36 is formed between these two open spaces 42, 43. The front let-through opening 31 of the

innermost sheet 21 ensures communication of the front open space 42 with its outside, allowing urine to flow into the front open space 42. Similarly, the rear let-through opening 32 ensures communication of the rear open space 43 with its outside, allowing feces to move into the rear open space 43.

[0026]

Fig. 3 is a partially cutaway plan view of the flatly developed diaper 1a obtained from the diaper 1 of Figs. 1 and 2 by disjoining the front and rear waist regions 7, 8 from each other at the seams 9, breaking the joint region 37 of the tuck 36 along which the innermost sheet 21 has been joined to itself and developing the crotch region 6 and the front and rear waist regions 7, 8 in the front-back direction A as well as in the transverse direction B against contractile force of the elastic members. For convenience, the regions of the diaper 1a common to those of the diaper 1 are designated by reference numerals same as those in the diaper 1.

[0027]

In the flatly developed diaper 1a, the innermost sheet 21 is formed by a composite sheet consisting of a first sheet 51, a second sheet 52 and a third sheet 53. The first sheet 51 is substantially hourglass-shaped and comprises the crotch region 6 and the front and rear waist regions 7, 8. The first

sheet 51 is neither stretchable nor contractible elastically as well as non-elastically and faces the inner sheet 23. The second sheet 52 is elastically stretchable and contractible in the transverse direction B and attached under tension to the inner surface of the first sheet 51 by means of hot melt adhesive 56 in the front waist region 7 and a part of the crotch region 6. The third sheet 53 is elastically stretchable and contractible in the transverse direction B and attached under tension to the inner surface of the first sheet 51 by means of hot melt adhesive 56 in the rear waist region 8 and a part of the crotch region 6. A pair of regions 57 provided on the inner surface of the first sheet 51 each indicated by a plurality of dots in Fig. 3 correspond to the joint region 37 in Fig. 2 and are symmetrically located about the transverse center line Q.

[0028]

In the bodily fluid-absorbent structure 22, the inner sheet 23 and the outer sheet 24 sandwiching the core 26 therebetween extend outward beyond the peripheral edge of the core 26 and put flat and bonded together by means of hot melt adhesive 58 outside the peripheral edges of the core 26. Along both side edges 27 of the crotch region 6 in the flatly developed diaper 1a include leg-surrounding elastic members 28 sandwiched between the inner sheet 23 and the outer sheet 24 and extending

under tension in the front-back direction A. The peripheral edge of the inner sheet 23 is bonded to the outer surface of the innermost sheet 21 by means of hot melt adhesive 59. The outer sheet 24 is preferably dimensioned to be same as the inner sheet 23 in shape as well as in size or to be slightly larger than the inner sheet 23. The outer sheet 24 dimensioned to be slightly larger than the inner sheet 23 preferably has its peripheral edge extending outward beyond the peripheral edge of the inner sheet 23 bonded to the outer surface of the innermost sheet 21.

[0029]

According to the illustrated embodiment, the inner sheet 21 has sections defined in the vicinity of its opposite ends but lying on extensions of the crotch region 6 bonded to the bodily fluid-absorbent structure 22 by means of adhesive 59 and an intermediate section between these two regions bonded to the bodily fluid-absorbent structure 22 by means of hot melt adhesive 41.

[0030]

To obtain the diaper 1 from the flatly developed diaper 1a, the flatly developed diaper 1a may be folded along the transverse center line Q on itself with the innermost sheet 21 inside, joining the regions 57 of the first sheet 51 to each

other and joining the side edges 7a, 7a of the front waist region 7 to the side edges 8a, 8a of the rear waist region 8 at the seam spots 9 (See Fig. 1).

[0031]

5 With this diaper 1 put on the wearer's body, the innermost sheet 21 in the crotch region 6 is spaced upward from the inner sheet 23 covering the bodily fluid-absorbent structure 22 and thereby functions as a separator which is capable of preventing the inner sheet 23 soiled with feces and/or urine from coming
10 in contact with the wearer's skin. Of the innermost sheet 21, the section defining the tuck 36 cooperates with the sections respectively extending outward from the tuck 36 in the transverse direction B to define a partitioning wall for the front open space 42 and the rear open space 43, which is capable
15 of preventing urine and feces from being mixed together. In this way, the diaper 1 is free from a trouble that feces might be mixed with urine and changed to low viscous ones which are easy to soil the wearer's skin in a broad area. Furthermore, the length dimension of the innermost sheet 21 in the front-back
20 direction A along the front-back center line P in Fig. 3 is reduced in the diaper 1 of Figs. 1 and 2 not by a contraction of elastic members but by the formation of the tuck 36. Consequentially, with the diaper 1 put on the wearer's body,

the innermost sheet 21 in the crotch region 6 might not be formed with many wrinkles. In other words, when a mother or a helper looks down the interior of the diaper 1 before putting the diaper 1 on the wearer's body, the leg-openings 12 might not be hidden
5 by the wrinkled innermost sheet 21. Thus the mother or the helper can smoothly guide the wearer's legs into the leg-openings 12. In the case of the diaper 1 having been put on the wearer's body in this manner the crotch region 6 might not become bulky due to the wrinkles and the diaper 1 will snugly
10 fit the wearer's body.

[0032]

In the front and rear waist regions 7, 8 of the exemplarily illustrated diaper 1, the elasticized second and third sheets 52, 53 are attached to the inner surface of the non-elasticized
15 first sheet 51, respectively, so that the first sheet 51 defining the outer surface of the diaper 1 in the state as illustrated by Figs. 1 and 2 may be formed with many gathers on the outer side but the second and third sheets 52, 53 defining the inner surfaces of the front and rear waist regions 7, 8 may
20 remain smooth. In consequence, the wearer's skin might not be irritated by gathers which would otherwise be formed on the inner surfaces of the front and rear waist regions 7, 8. However, if such an effect provided by the second and third sheets 52,

53 is not required, the second and third sheets 52, 53 may be attached under tension to the outer surface of the first sheet 51.

[0033]

5 While the innermost sheet 21 of the diaper 1 is preferably liquid-impermeable and more preferably air-permeable and liquid-impermeable, it is possible to form the innermost sheet 21 by a composite sheet comprising two component sheets having properties different from each other so that the innermost sheet
10 21 may be liquid-permeable in the crotch region 6 but liquid-impermeable in the front and rear waist regions 7, 8. For example, a piece of non-woven fabric formed by thermoplastic synthetic fiber or a piece of film formed by thermoplastic synthetic resin may be used as the first sheet 51 in the innermost
15 sheet 21. It is also possible to use a laminated sheet consisting of two or more non-woven fabric layers or a laminated sheet consisting of a non-woven fabric layer and a plastic film layer. As stock materials for the second and third sheets 52, 53, elastically stretchable and contractible non-woven fabric
20 containing elastic filaments such as urethane filaments or elastically stretchable and contractible film made of, for example, natural or synthetic rubber may be used. As stock materials for the inner sheet 23, although not meant to be

limiting, liquid-permeable non-woven fabric, thermoplastic film or composite sheet consisting of a non-woven fabric layer and a plastic film layer laminated on each other may be used. As stock materials for the outer sheet, although not meant to be limiting, liquid-impermeable non-woven fabric, thermoplastic film or composite sheet consisting of a non-woven fabric layer and a plastic film layer laminated on each other may be used.

[0034]

Fig. 4 is a view similar to Fig. 3, illustrating another embodiment of the present invention. In the flatly developed diaper 1a depicted in Fig. 4, the innermost sheet 21 comprises the first sheet 51 which is substantially hourglass-shaped and not stretchable elastically as well as non-elastically, the second sheet 52 which is also not stretchable elastically as well as non-elastically and attached to the inner or outer surface of the front waist region 7 plus a part of the crotch region 6 of the first sheet 51 by means of hot melt adhesive 56 and the third sheet 53 attached to the inner or outer surface of the rear waist region 8 plus a part of the crotch region 6 of the first sheet 51 by means of hot melt adhesive 56. To any one of the first sheet 51 and the second sheet 52, two or more first elastic members 61 extending in the transverse direction

B are attached under tension in the vicinity of the waist-opening 11 and two or more second elastic members 62 extending in the transverse direction B are attached under tension in the vicinity of the crotch region 6. To any one of
5 the first sheet 51 and the third sheet 53, two or more third elastic members 63 extending in the transverse direction B are attached under tension in the vicinity of the waist-opening 11 and two or more fourth elastic members 64 are attached under tension in the vicinity of the crotch region 6. To the outer
10 surface of the first sheet 51 in the crotch region 6, crotch region elasticizing members 66, 67 extending in the transverse direction B between the region 57 and the front let-through opening 31 and between the region 57 and the rear let-through opening 32, respectively, are attached under tension. The
15 outer surface of the first sheet 51 is attached, in its section extending fully across the crotch region 6 along the transverse center line Q, to the inner sheet 23 by means of hot melt adhesive 41.

[0035]

20 With the diaper 1 obtained from the flatly developed diaper 1a depicted in Fig. 4, the first through fourth elastic members 61 through 64 allow the front and rear waist regions 7, 8 of the diaper 1 to put in contact around the wearer's waist

snugly. While the crotch region elasticizing members 66, 67 are not essential for the diaper 1, these members 66, 67 facilitates the section of the innermost sheet 21 extending in the vicinity of the tuck 36 to fit snugly around the thighs and
5 the other areas of the wearer.

[0036]

While the innermost sheet 21 is preferably formed with the front let-through opening 31 and the rear let-through opening 32 for the diaper 1, the innermost sheet 21 may be formed
10 with only one let-through opening without departing from the scope of the present invention.

[0037]

Figs. 5, 6 and 7 are views similar to Figs. 1, 2 and 3, showing one preferred embodiment of the present invention. It
15 should be appreciated here that the innermost sheet 21 and the bodily fluid-absorbent structure 22 are illustrated in Fig. 5 as spaced from each other in the longitudinal direction C. The innermost sheet 21 of the diaper 1 comprises the front waist region 7 adapted to come in contact with the wearer's ventral
20 side, the rear waist region 8 adapted to come in contact with the wearer's dorsal side and the crotch region 6 extending between the front and rear waist regions 7, 8 and adapted to come in contact with the wearer's crotch. The bodily

fluid-absorbent structure 22 extends from the front waist region 7 to the rear waist region 8 of the diaper 1 and is bonded to the outer surface of the innermost sheet 21 opposing to the skin-contact surface thereof.

5 [0038]

In the flatly developed diaper 1a of Fig. 7, the outer peripheral edges of the innermost sheet 21 comprises a front end 74 and a rear end 75 both extending in the transverse direction B and a pair of side edges 76, 76 extending in the longitudinal direction C. Of the side edges 76, 76, the side edges 27, 27 defined in the crotch region 6 are curved convexly toward the center line P of the innermost sheet 21. Of the side edges 76, 76, the side edges 7a, 7a extending in the front waist region 7 shall be joined to the side edges 8a, 8a extending in the rear waist region 8 to obtain the pants-shaped diaper 1 and thereupon the waist-opening 11 and a pair of leg-openings 12 are formed. Peripheral edges 74, 75 of the waist-opening 11 and peripheral edges 27 of the leg-openings 12 are elastically stretchable respectively, since waist-surrounding elastic members 82 and the leg-surrounding elastic members 28 are attached under tension thereto or the innermost sheet 21 itself is elastically stretchable.

[0039]

The bodily fluid-absorbent structure 22 comprises the core 26 sandwiched between the inner sheet 23 and the outer sheet 24. As the core 26, various assemblies of well known art such fluff pulp wrapped with tissue paper may be used. Both the inner
5 sheet 23 and the outer sheet 24 extend outward beyond the peripheral edge of the core 26. The core 26 has a sufficient area and an appropriate shape (for example, rectangular shape or dumbbell-shape). As the inner sheet 23 covering the bodily fluid-absorbent structure 22, a liquid-permeable sheet is used
10 and, as the outer sheet 24, a liquid-impermeable sheet is used.

Referring to Fig. 7, the bodily fluid-absorbent structure 22 has its dimensions in the longitudinal direction as well as in the transverse direction are smaller than those of the innermost sheet 21 and, in the diaper 1 having such bodily
15 fluid-absorbent structure 22, the innermost sheet 21 functions as so-called skin-contact sheet.

[0040]

Referring to Fig. 7, the crotch region 6 of the innermost sheet 21 is formed at the location at a distance from the
20 transverse center line Q bisecting the dimension of the flatly developed diaper 1a in the front-back direction A toward the rear waist region 8 with the rear let-through opening 32 for passage of feces and formed at the location at a distance from

the transverse center line Q toward the front waist region 7 with the front leg-through opening 31 for passage of urine. It should be noted here that the present invention can be implemented without forming the front let-through opening 31.

5 [0041]

When the bodily fluid-absorbent structure 22 is attached to the outer surface of the innermost sheet 21, the bodily fluid-absorbent structure 22 is located so that the core 26 may face to the front let-through opening 31 and the rear
10 let-through opening 32. Then, the peripheral edge 86 of the bodily fluid-absorbent structure 22 is joined to the innermost sheet 21 by means of well known art such as hot melt adhesive 59 or thermal welding. Even when the innermost sheet 21 is not formed with the front let-through opening 31, the bodily
15 fluid-absorbent structure 22 is joined to the innermost sheet 21 so that the core 26 may extend beyond the transverse center line Q so as to face the wearer's urethral orifice through the innermost sheet 21.

[0042]

20 As will be apparent from the sectional view of Fig. 6, the front opening space 42 and the rear opening space 43 are formed between the bodily fluid-absorbent structure 22 and the innermost sheet 21 in the crotch region 6 of the diaper 1. With

this diaper 1 put on the wearer's body, body waste passes these front and rear let-through openings 31, 32 into these opening spaces 42, 43 and is kept away from the wearer's skin.

[0043]

5 Then, the innermost sheet 21 is folded along the transverse center line Q in Fig. 7 in face-to-face relation and the regions 57, 57 are bonded to each other by means of hot melt adhesive HM to form the tuck 36. The tuck 36 lies between the front open space 42 and the rear open space 43 so as to extend
10 in the transverse direction B of the diaper 1 (See Fig. 5) and to extend downward to the bodily fluid-absorbent structure 22. The presence of this tuck 36 makes it possible to prevent feces from being mixed with urine. In this way, the innermost sheet 21 protecting the wearer's skin from being soiled with body
15 waste functions also to prevent feces from being mixed with urine.

[0044]

Fig. 8 is an overhead view in a direction indicated by interconnected two arrows VIII-VIII in Fig. 6. When the
20 interior of the diaper 1 is looked down from above, the bodily fluid-absorbent structure 22 can be seen below the front let-through opening 31 and the rear let-through opening 32 through the front open space and the rear open space,

respectively. With the diaper 1 put on the wearer's body, the innermost sheet 21 comes in contact with the wearer's skin over a sufficiently large area to protect the wearer's skin from being soiled with body waste.

5 [0045]

Now one embodiment of methods for making the diaper 1 exemplarily illustrated by Figs. 5 through 8 will be described in reference to Fig. 9. Continuous web 121 having a predetermined width dimension W from which the innermost sheets
10 21 are to be obtained is continuously fed in a machine direction indicated by an arrow MD. Opposite side edges 174, 175 of the web 121 extend in parallel to the machine direction MD and are to define the front end 74 and the rear end 75 in Fig. 7, respectively. An imaginary center line M bisecting the width
15 dimension W of the web 121 in a cross direction CD orthogonal to the machine direction MD corresponds to the transverse center line Q of the diaper 1. The crotch region 6 of the diaper 1 is formed along the imaginary center line M and the front and rear waist regions 7, 8 are formed on both sides of the crotch
20 region 6 in the cross direction CD.

[0046]

Referring to Fig. 9, the web 121 is formed with openings 112 intermittently in the machine direction MD at predetermined

intervals to define the leg-openings 12 of the diaper 1. The web 121 is further provided along the side edges 174, 175 with two or more waist-surrounding elastic members 182 attached under tension thereto, respectively. It should be understood
5 here that the term "predetermined intervals" used herein means the intervals at which the web 121 is cut to obtain the respective innermost sheets 21 of the individual diapers 1 and this interval is predetermined depending on a dimension of the waist-opening 11 in the diaper 1, in other words, on the waist
10 size of the diaper 1 as the final product.

[0047]

The web 121 is successively formed on both sides of the imaginary center line M in the cross direction CD with sets of the front let-through opening 31 for passage of urine and the
15 rear leg-through opening 32 for passage feces at a predetermined center-to-center distance in the machine direction MD. Both the front let-through opening 31 and the rear let-through opening 32 are shaped to be substantially symmetric about an imaginary perpendicular F which is orthogonal to the imaginary
20 center line M. Both the front let-through opening 31 and the rear let-through opening 32 are not limited to any particular shape so far as feces and urine can smoothly pass them. For example, the front and rear leg-through openings 31, 32 may be

formed in circular or oval shapes and located symmetrically about the imaginary center line M. If the rear let-through opening 32 and the front let-through opening 31 are formed symmetrically about the imaginary center line M, a tension
5 exerted on the web 121 running to the machine direction MD may be kept substantially same on both sides of the imaginary center line M in the cross direction CD. This is preferable to stabilize the shape of the web 121. It should be noted here that there may be a case in which the web 121 is not formed with
10 the front let-through openings 31 in the step illustrated in Fig. 9 within the scope of the present invention.

[0048]

The bodily fluid-absorbent structures 22 obtained in a production line differing from that for the web 121 are now
15 joined to the web 121 so that a center-to-center distance D of the adjacent bodily fluid-absorbent structures 22 in the machine direction MD may be maintained constant. As the bodily fluid-absorbent structure 22 to be joined to the web 121, the bodily fluid-absorbent structure 22 of Fig. 5 stretched in the
20 machine direction MD as well as in the cross direction CD against contractile force of the leg-surrounding elastic members 28 attached thereto along the both side edges 27, 27 may be used. The bodily fluid-absorbent structure 22 may be joined to the

web 121 so as to be located midway between each pair of the adjacent through-holes 112.

[0049]

In the step of joining the bodily fluid-absorbent structure 22 to the web 121, the bodily fluid-absorbent structure 22 is bonded along its peripheral edge 86 to the web 121 with the core 26 positioned to extend across the imaginary center line M and to cover the front let-through opening 31 and the rear let-through opening 32 symmetrically about the imaginary perpendicular V. The peripheral edge 86 is previously coated with hot melt adhesive 59. It is possible to bond the bodily fluid-absorbent structure 22, not only along its peripheral edge 86 but also in a part of the region thereof in which the core 26 is present, to the web 121.

It should be noted that the peripheral edge 86 is bonded to the web 121 preferably over the entire area of the peripheral edge 86.

[0050]

Now the surface of the web 121 opposite to the surface to which the bodily fluid-absorbent structure 22 has been bonded is coated between the imaginary center line M and the rear let-through opening 32 with hot melt adhesive HV in a pattern substantially symmetric about the imaginary perpendicular V.

[0051]

Preferably hot melt adhesive HM is applied in a limited range which does not reach the respective peripheral edges 31a, 32a of the front let-through opening 31 and the rear let-through opening 32. Application of hot melt adhesive HM in this manner makes it possible to avoid a problem that the portions of the web 121 relatively stiffened by hot melt adhesive HM might irritate the wearer's skin.

[0052]

10 A range in which the web 121 is coated with hot melt adhesive HM in the case of the web 121 not to be formed with the front let-through opening 31 is preferably limited so that a distance from the imaginary center line M is smaller than the minimum distance between the peripheral edge 32a of the rear let-through opening 32 and the imaginary center line M. Hot melt adhesive HM may be applied between the imaginary center line M and the peripheral edge 32a of the rear let-through opening 32 or on the side opposite to the rear let-through opening 32 about the imaginary center line M.

20 [0053]

Then, the web 121 is folded along the imaginary center line M in two with the surface of the web 121 coated with hot melt adhesive HM inside and the web 121 is bonded to itself.

In consequence, the tuck 36 shown by Fig. 6 is formed by the portion coated with hot melt adhesive HM. While the coating pattern is not limited to any particular patterns and coating patterns conventionally used in making diapers such as a dotted
5 pattern or a spiral pattern, the so-called solid pattern may be used to enhance stiffness of the tuck 36 compared other areas in the diaper 1.

[0054]

After the step of bonding the web 121 to itself by means
10 of hot melt adhesive HM to form the tuck 36, the web 121 is cut at predetermined regions F each lying in the middle between each pair of the bodily fluid-absorbent structures 22, 22 adjacent in the machine direction MD, extending in the cross direction CD and arranged intermittently in the machine direction MD at
15 regular intervals. Before the step of cutting, the regions allocated to define the side edges 7a, 7a of the front waist region 7 and the regions allocated to define the side edges 8a, 8a of the rear waist region 8 may be previously joined together to obtain the pants-type diaper 1. The regions to be previously
20 joined may sometimes overlap the cutting regions F.

[0055]

While the case in which the web 121 has previously been formed with the through-holes 112 has been described above in

reference to Fig. 9, it is possible to form the web 121 with the through-holes 112 after the step of joining the bodily fluid-absorbent structures 22 to the web 121.

[0056]

5 Fig. 10 is a diagram similar to Fig. 9, illustrating another embodiment of methods for making the diaper 1. The method illustrated by Fig. 10 is different from the method illustrated by Fig. 9 in that the surface of the web 121 facing the bodily fluid-absorbent structure 22, i.e., the surface
10 corresponding to the outer surface of the innermost sheet 21 of the diaper 1 is coated with hot melt adhesive 41 on the imaginary center line M. The bodily fluid-absorbent structure 22 may be put flat and bonded together with the outer surface of the web 121 in the same manner as in the case of Fig. 9 to
15 bond the bodily fluid-absorbent structure 22 to the web 121 also by means of hot melt adhesive 41. In the diaper 1 obtained by the method illustrated by Fig. 10, the bottom 39 (See Fig. 6) of the tuck 36 is bonded to the outer sheet 23 by means of hot melt adhesive 41 and the resulting tuck 36 is similar to that
20 illustrated by Fig. 4.

[0057]

While in the steps illustrated by Figs. 9 and 10, a liquid-impermeable sheet, more preferably a breathable but

liquid-impermeable sheet may be used as the web 121 in the steps illustrated by Figs. 9 and 10, it is also possible to use the web 121 made of a composite sheet consisting of component sheets respectively having different properties so that the web 121
5 is liquid-permeable in an region corresponding to the crotch region 6 but liquid-impermeable in regions corresponding to the front and rear waist regions 7, 8. It is also possible to combine two or more sheets having elastical stretchabilities different from each other to form the web 121 and the inner and
10 outer sheets 23, 24 so that regions such as the waist-opening 11 and the leg-openings 12 requesting elastical stretchabilities may be formed with non-woven fabrics having elastical stretchabilities and regions requesting no stretchabilities may be formed with non-woven fabrics having
15 no elastical stretchabilities.

C L A I M S

[1] A pants type disposable diaper having a front-back direction, a transverse direction and a longitudinal direction
5 which are orthogonal one to another and a crotch region, a front waist region extending forward from said crotch region and a rear waist region extending rearward from said crotch region which cooperate together to define a waist-opening and a pair of leg-openings, said pants type disposable diaper further
10 including a bodily fluid-absorbent structure lying in said crotch region and formed by a bodily fluid-absorbent core sandwiched between a liquid-permeable inner sheet and a liquid-impermeable outer sheet and the innermost sheet and the innermost sheet lying further inside said inner sheet and having
15 a region adapted to be spaced upward from said inner sheet in thickness direction of said core and functioning as a separator to prevent said inner sheet from coming in a direct contact with the diaper wearer's skin, said pants type disposable diaper being characterized in that:

20 said innermost sheet is joined to at least one of said inner sheet and said outer sheet in end regions thereof opposed to each other in said front-back direction and lying on a front-back center line extending in said front-back direction

so as to bisect a dimension of said diaper in said transverse direction and adapted, in a region thereof defined between said end regions, to be spaced upward from said inner sheet in said thickness direction of said core; and

5 said innermost sheet is formed on a transverse center line extending in said transverse direction so as to bisect a dimension of said diaper in said front-back direction with a tuck extending downward from said region adapted to be spaced upward from said inner sheet toward said inner sheet.

10

[2] The diaper defined by Claim 1, wherein said innermost sheet has at least one of a front let-through opening formed in front of said transverse center line so as to allow urine discharged by a wearer of said diaper to flow not through said
15 innermost sheet but directly to said bodily fluid-absorbent structure and a rear let-through opening formed in the rear of said transverse center line so as to allow feces discharged by said wearer to move not through said innermost sheet but directly to said bodily fluid-absorbent structure.

20

[3] The diaper defined by Claim 1 or 2, wherein said tuck is formed by partially joining regions of said innermost sheet put flat together as said diaper is folded along said transverse

center line.

[4] The diaper defined by any one of Claims 1 through 3,
wherein said innermost sheet is a piece of sheet material having
5 an hourglass-like planar shape and folded along said transverse
center line which is elastically stretchable and contractible
in said transverse direction in said front and rear waist
regions but neither stretchable nor contractible elastically
as well as non-elastically at least in a section defined along
10 said transverse center line in said crotch region.

[5] The diaper defined by any one of Claims 1 through 4,
wherein said bodily fluid-absorbent structure is provided in
a form of a panel and any one of said inner sheet and said outer
15 sheet extending outward beyond a peripheral edge of said core
is joined to the outer surface of said innermost sheet.

[6] A method for making the diaper defined by Claim 2 having
at least said rear let-through opening, said method comprising
20 at least following steps of:

(1) continuously feeding a web having a predetermined
width dimension as an original sheet material for said innermost
sheet in a machine direction;

(2) successively forming said innermost sheet at locations at a predetermined distance in a cross direction orthogonal said machine direction from the center line bisecting said width dimension in said cross the direction with
5 said rear let-through openings at a regular pitch in said machine direction;

(3) joining said bodily fluid-absorbent structure to one of the opposite surfaces of said web in a manner that said core not only overlaps said rear let-through opening but also extends
10 across said center line;

(4) coating said web in one of a region defined between said center line and said rear let-through opening and a region in a symmetric relationship with said aforementioned region both on the surface opposite to said one surface with hot melt
15 adhesive;

(5) cutting said web intermittently along cutting lines defined between respective pairs of the adjacent bodily fluid-absorbent structures bonded to said web so as to extend in said cross direction and arranged at a regular pitch in said
20 machine direction; and

(6) bonding said web folded in two to itself along said cutting lines before cutting said web.

[7] The method defined by Claim 6, further including a step of forming said web in regions opposite to said rear let-through openings about said center line with said front let-through openings at said regular pitch in said machine direction.

5

[8] The method defined by Claim 6 or 7, further including a step of coating said web along said center line on said one surface with adhesive by means of which said one surface is bonded to said bodily fluid-absorbent structure.

10