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Disposable wearable article

Abstract

A disposable wearable article including a top sheet having a skin-touching region that is brought into contact with skin of a wearer, wherein the top sheet is made from discontinuous fiber nonwoven fabric having a fineness of 1 to 3 dtex, a basis weight of 10 to 30 g/m.sup.2, and a thickness of 0.4 to 1.4 mm, wherein the skin-touching region has a lotion-bearing zone which bears a water-containing hydrophilic lotion, the lotion-bearing zone having a MD dimension of 30 mm or larger and a CD dimension of 5 mm or larger, and wherein an average coefficient of friction MIU of the lotion-bearing zone is 0.2 to 0.4.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS

(1) This application is the U.S. national stage application of International Application PCT/JP2021/010574, filed Mar. 16, 2021, which international application was published on Sep. 30, 2021, as International Publication WO 2021/193228 in the Japanese language. The International Application claims priority of Japanese Patent Application No. 2020-054788, filed Mar. 25, 2020. The international application and Japanese application are both incorporated herein by reference, in entirety.

TECHNICAL FIELD

(2) The present invention relates to disposable wearable articles, including disposable diapers and sanitary napkins.

BACKGROUND ART

(3) Disposable wearable articles, in particular, disposable diapers, often pose skin problems, particularly, skin rash of wearers. Such problems may result from physical irritation (friction or coarseness) to the skin or skin dryness of wearers.

(4) There is proposed to cause a wax-like substance having a higher softening point than the human body temperature to be contained in a nonwoven top sheet for reducing friction between the skin of a wearer and the top sheet (Patent Literature 1).

(5) For the purpose of reducing friction, there is also known to apply a hydrophilic lotion to a nonwoven top sheet (Patent Literature 2). This hydrophilic lotion is preferred for its capability of avoiding hardness of the wax-like substance or lowering of liquid-permeability. In particular, a water-containing hydrophilic lotion is preferred for keeping the skin from drying.

(6) However, application of a water-containing hydrophilic lotion to a top sheet made from discontinuous fiber nonwoven fabric resulted in a problem of less increase in the effect of reducing friction than expected.

PRIOR ART LITERATURE

Patent Literature

(7) Patent Literature 1: JP H08-52175 A Patent Literature 2: JP 2010-526630 A Patent Literature 3: JP 2002-509457 A Patent Literature 4: JP 2019-170534 A

SUMMARY OF THE INVENTION

Problems to be Solved by the Invention

(8) It is therefore a primary object of the present invention to improve the effect of reducing friction on a top sheet, or the like.

Means for Solving the Problem

(9) The present inventors, in studying nonwoven top sheets bearing water-containing hydrophilic lotions, have obtained the following knowledge. It is conceivable that, when a water-containing hydrophilic lotion is applied to a top sheet made from discontinuous fiber nonwoven fabric, the hydrophilic lotion is prone to transfer to the absorber body side after the production, and is harder to be retained in the top sheet than expected, which results in a lower friction-reducing effect than expected. The disposable wearable articles to be discussed below are based on such knowledge.

(10) <First Aspect>

(11) A disposable wearable article including a top sheet having a skin-touching region that is brought into contact with skin of a wearer, wherein the top sheet is made from discontinuous fiber nonwoven fabric having a fineness of 1 to 3 dtex, a basis weight of 10 to 30 g/m.sup.2, and a thickness of 0.4 to 1.4 mm, wherein the skin-touching region has a lotion-bearing zone which bears a water-containing hydrophilic lotion, the lotion-bearing zone having a machine direction dimension of 30 mm or larger and a cross direction dimension of 5 mm or larger, and wherein an average coefficient of friction MIU of the lotion-bearing zone is 0.2 to 0.4.

(Effect)

(12) According to the present disposable wearable article, in the combination of a hydrophilic

lotion and a discontinuous fiber nonwoven top sheet, nonwoven fabric of fine fibers is employed. With such discontinuous fiber nonwoven fabric, fineness of the fibers contributes to reduction of surface friction, which, in cooperation with the friction-reducing effect of the hydrophilic lotion, improves the overall friction-reducing effect. In addition, the fineness of the fibers also improves the hydrophilic lotion-retainability, which further improves the friction-reducing effect.
(13) Note that, with too small dimensions of the lotion-bearing zone, the friction-reducing effect is localized, which provides little significance in protection of the skin of a wearer.
(14) <Second Aspect>
(15) The disposable wearable article according to the first aspect, wherein the lotion-bearing zone has a surface moisture percentage of 3 to 10%.
(16) (Effect)
(17) With the surface moisture percentage of the lotion-bearing zone falling within the above-mentioned range, the skin of a wearer may be moistened moderately so as to be kept from drying.
(18) <Third Aspect>
(19) The disposable wearable article according to the second aspect, wherein the hydrophilic lotion contains 70 to 90 wt % glycerin and 10 to 30 wt % water, and wherein a content of the hydrophilic lotion per unit area of the lotion-bearing zone is 5 to 15 g/m.sup.2.
(Effect)
(20) The composition of the hydrophilic lotion and the content of the lotion in the lotion-bearing zone may suitably be decided, and preferably within the ranges of the present aspect.
(21) <Fourth Aspect>
(22) The disposable wearable article according to any one of the first to third aspects,
(23) wherein the discontinuous fiber nonwoven fabric is formed of nonwoven fabric of hydrophilized fibers in which hydrophobic resin fibers have been coated with a hydrophilizer.
(24) (Effect)
(25) The discontinuous fiber nonwoven fabric is preferably formed of hydrophobic resin fibers for their low cost, which as they are have poor retainability of the water-containing hydrophilic lotion. Accordingly, in the present aspect, it is preferred to use discontinuous fiber nonwoven fabric formed of hydrophilized fibers employing a hydrophilizer to improve the hydrophilic lotion-retainability of the discontinuous fiber nonwoven fabric.
(26) <Fifth Aspect>
(27) The disposable wearable article according to any one of the first to fourth aspects, wherein the hydrophilic lotion has a viscosity at a temperature of 20° C. of 150 to 400 mPa.Math.s.
(28) (Effect)
(29) The discontinuous fiber nonwoven fabric is preferably formed of hydrophobic resin fibers for their low cost, which as they are have poor retainability of the water-containing hydrophilic lotion. Accordingly, it is preferred to set the viscosity of the hydrophilic lotion within the range of the present aspect to improve the hydrophilic lotion-retainability of the discontinuous fiber nonwoven fabric.
Effect of the Invention
(30) The present invention provides advantages such as improvement in the effect of reducing friction on the top sheet.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) FIG. **1** is a plan view of a tape-type disposable diaper in its spread state, illustrating the interior surface thereof.
(2) FIG. **2** is a plan view of the tape-type disposable diaper in its spread state, illustrating the

exterior surface thereof.
(3) FIG. **3** is a cross-sectional view taken along lines **6**-**6** in FIG. **1**.
(4) FIG. **4** is a cross-sectional view taken along lines **7**-**7** in FIG. **1**.
(5) FIG. **5**(*a*) is a sectional view taken along lines **8**-**8** in FIG. **1**, FIG. **5**(*b*) is a sectional view taken along lines **9**-**9** in FIG. **1**, and FIG. **5**(*c*) is a sectional view taken along lines **10**-**10** in FIG. **1**.
(6) FIG. **6** shows plan views of various examples of the aperture pattern in the perforated nonwoven fabric.
(7) FIG. **7** is a plan view illustrating an example of the aperture pattern (Moroccan pattern) in the perforated nonwoven fabric.
(8) FIG. **8** is a plan view illustrating an example of the aperture pattern (chain pattern) in the perforated nonwoven fabric.
(9) FIG. **9** shows sectional views of the apertures in the perforated nonwoven fabric.
(10) FIG. **10** is a plan view of a tape-type disposable diaper in its spread state, illustrating the interior surface thereof.
(11) FIG. **11** is a plan view of a tape-type disposable diaper in its spread state, illustrating the interior surface thereof.
(12) FIG. **12** shows plan views for explaining a specimen.

EMBODIMENTS FOR CARRYING OUT THE INVENTION

(13) FIGS. **1** to **5** show a tape-type disposable diaper as an example of a disposable wearable article. In the figures, reference sign X refers to the overall width of the diaper exclusive of the connecting tapes, whereas reference sign Y refers to the overall length of the diaper. In the sectional views, dotted pattern regions represent an adhesive as joining means for joining various components. A hot melt adhesive may be applied using a known technique, such as slot application, bead application in continuous lines or dotted lines, spray application in spiral, Z, or wave shapes, or pattern coating (transfer of a hot melt adhesive by relief printing). In place of or in addition to these, fixing portions of elastic members may be fixed to adjacent members by application of a hot melt adhesive to the outer peripheral surface of the elastic members. Examples of the hot melt adhesive include, but not limited to, EVA-based, pressure-sensitive rubber-based (elastomer-based), polyolefin-based, and polyester/polyamide-based adhesives. The joining means for joining various components may alternatively be material melt-bonding, such as heat sealing or ultrasonic sealing.
(14) As the nonwoven fabric in the description hereinbelow, commonly known nonwoven fabric may suitably be used depending on the parts or purposes. Examples of the constituent fibers of the nonwoven fabric include, but not limited to, synthetic fibers, such as polyolefin-based, e.g., polyethylene or polypropylene, polyester-based, or polyamide-based fibers (including not only single component fibers, but also composite fibers, such as of core/sheath type), as well as regenerated fibers, such as rayon or cupra, or natural fibers, such as cotton, and also mixtures thereof. For improved flexibility of the nonwoven fabric, the constituent fibers may preferably be crimped fibers. The constituent fibers of the nonwoven fabric may also be hydrophilic fibers (including those rendered hydrophilic with hydrophilizers), hydrophobic fibers, or water-repelling fibers (including those rendered water-repelling with water repellents). Further, nonwoven fabric may generally be categorized into discontinuous fiber nonwoven fabric, continuous fiber nonwoven fabric, spunbonded nonwoven fabric, melt blown nonwoven fabric, spunlace nonwoven fabric, thermal bonded (air through) nonwoven fabric, needle-punched nonwoven fabric, point-bonded nonwoven fabric, composite nonwoven fabric (SSS nonwoven fabric having the same or similar nonwoven layers laid one on top of another, as well as SMS or SMMS nonwoven fabric having different nonwoven layers laid one on top of another, i.e., melt blown layer interposed between spunbonded layers), or the like, generally depending on the length of the fibers, method of forming the sheet, method of joining the fibers, or layered structure, and any of these nonwoven fabric may be used. The composite nonwoven fabric refers to those having all the layers integrally manufactured and subjected to fiber joining process all over the layers, and does not include those

having a plurality of nonwoven fabric layers separately manufactured and bonded with joining means, such as hot melt adhesives.
(15) The present tape-type disposable diaper has a ventral section F extending forward of the middle of the diaper in the front-back direction LD and a dorsal section B extending backward of the middle of the diaper in the front-back direction LD. The present tape-type disposable diaper is configured with a crotch section M extending from forward of the middle of the product to backward of the middle of the product in the front-back direction, front wings **80** extending on opposed sides in the right-left direction at a position spaced forward of the middle of the product in the front-back direction, and back wings **81** extending on opposed sides in the right-left direction at a position spaced backward of the middle of the product in the front-back direction. Further, the present tape-type disposable diaper includes an absorber body **56** internally disposed within a region including the crotch section, a liquid-pervious top sheet **30** covering the top side of the absorber body **56**, a liquid-impervious sheet **11** covering the underside of the absorber body **56**, and an exterior nonwoven sheet **12** covering the underside of the liquid-impervious sheet **11** to constitute the product exterior surface.
(16) Materials and features of each part will now be explained in turn.
(17) (Absorber Body)
(18) The absorber body **56** absorbs and holds excreted fluid, and may be formed of an assembly of fibers. Such an assembly of fibers may be a stack of discontinuous fibers of fluff pulp, synthetic fibers, or the like, as well as an assembly of filaments obtained by opening, where necessary, tows (fiber bundles) of synthetic fibers, such as cellulose acetate. The basis weight of the fibers may be about 100 to 300 g/m.sup.2 for a stack of fluff pulp or discontinuous fibers, and about 30 to 120 g/m.sup.2 for an assembly of filaments. The fineness of the synthetic fibers, when used, is, for example, 1 to 16 dtex, preferably 1 to 10 dtex, more preferably 1 to 5 dtex.
(19) The plan shape of the absorber body **56** may suitably be decided, and may be in a rectangular shape or a shape having a middle portion in the front-back direction LD narrowed so as to fit around each leg.
(20) (Superabsorbent Polymer Particles)
(21) The absorber body **56** may be caused partially or entirely to contain superabsorbent polymer particles. The superabsorbent polymer particles include not only “particles”, but also “powders”. Superabsorbent polymer particles used in this type of absorbent articles may be used as they are as the superabsorbent polymer particles here. The particle size of the superabsorbent polymer particles is not particularly limited and, for example, the particles may preferably have such a particle size that, when the particles are subjected to sieving (five-minute shaking) through a 500 μm standard sieve (JIS Z8801-1: 2006), followed by further sieving (five-minute shaking) through a 180 μm standard sieve (JIS Z8801-1: 2006) of the particles sieved through the previous sieve, the percentage of the particles remaining on the 500 μm standard sieve is 30 wt % or less and the percentage of the particles remaining on the 180 μm standard sieve is 60 wt % or more.
(22) Any materials of the superabsorbent polymer particles may be used without particular limitation, and those having a water absorption of 40 g/g or more are preferred. The superabsorbent polymer particles may be starch-based, cellulose-based, or synthetic polymer-based, and starch-acrylic acid (salt) graft copolymers, saponified products of starch-acrylonitrile copolymers, cross-linked sodium carboxymethyl cellulose, or acrylic acid (salt) polymers may be used. The superabsorbent polymer particles may preferably be in ordinary powder or granular form, but particles in other forms may also be used.
(23) The superabsorbent polymer particles having a water absorption rate of 70 seconds or less, particularly 40 seconds or less, may preferably be used. With too slow a water absorption rate, the absorber body **56** is likely to undergo so-called back flow, wherein liquid supplied into the absorber body **56** returns out of the absorber body **56**.
(24) The superabsorbent polymer particles may preferably be those having a gel strength of 1000

Pa or higher. With such property, when the superabsorbent polymer particles are formed into a bulky absorber body **56**, stickiness after liquid absorption may effectively be limited.
(25) The basis weight of the superabsorbent polymer particles may suitably be decided depending on the absorption amount required in a use of the absorber body **56**. Thus, it depends, but the basis weight may usually be 50 to 350 g/m.sup.2.
(26) (Packing Sheet)
(27) For limiting escape of the superabsorbent polymer particles, or for improving maintenance of the shape of the absorber body **56**, the absorber body **56** may be wrapped with a packing sheet **58** to produce an absorbent element **50**, which is to be disposed inside. The packing sheet **58** may be tissues, in particular, crepe paper, nonwoven fabric, polyethylene-laminated nonwoven fabric, perforated sheet, or the like, provided that sheets through which the superabsorbent polymer particles will not escape are preferred. When nonwoven fabric is used in place of crepe paper, hydrophilic SMMS (spunbonded/melt-blown/melt-blown/spunbonded) nonwoven fabric is particularly preferred, which may be made of polypropylene, polyethylene/polypropylene, or the like. The basis weight is preferably 5 to 40 g/m.sup.2, particularly 10 to 30 g/m.sup.2.
(28) One such packing sheet **58** may be used, as shown in FIG. **3**, to wrap the entire absorber body **56**, or a plurality of sheets, such as an upper sheet and a lower sheet, may be used to wrap the entire absorber body **56**. Alternatively, the packing sheet **58** may be omitted.
(29) (Top Sheet)
(30) The top sheet **30** extends in the front-back direction from the front end to the back end of the product, and in the width direction WD laterally beyond the absorber body **56**, but its shape may suitably be modified, for example, so that the width of the top sheet **30** is shorter than the entire width of the absorber body **56**, in case, for example, the starting points of standup gather parts **60** to be discussed later are located on the center side of the side edges of the absorber body **56** in the width direction WD, or otherwise required.
(31) The top sheet **30** has a skin-touching region that is brought into contact with the skin of a wearer, and is preferably made from nonwoven fabric in light of liquid permeability and texture. Various nonwoven fabric may be used as the top sheet **30** but, in view of cushioning property, flexibility, permeability of loose stool (watery or muddy stool), or the like factors, discontinuous fiber nonwoven fabric, such as air-through nonwoven fabric, is preferred rather than continuous fiber (long fiber) nonwoven fabric and, usually, discontinuous fiber nonwoven fabric generally having a fineness of 1 to 10 dtex, a basis weight of 10 to 30 g/m2, and a thickness of 0.4 to 1.4 mm, is preferred. The fiber length of the discontinuous fiber nonwoven fabric is not particularly limited, and is preferably about 0.5 to 1.0 mm.
(32) The top sheet **30** is particularly preferably a perforated nonwoven fabric having an aperture arrayed region wherein apertures **14** each penetrating two sides of the fabric are arrayed in a particular pattern. The shape and size of each aperture **14**, the pattern of the array, or the like, may suitably be decided. Note that, in FIG. **1**, for ready conception of the figure, the apertures **14** are illustrated only in a part D of the top sheet **30**, which, however, does not represent the aperture arrayed region.
(33) The aperture arrayed region may be positioned only in the middle of the top sheet **30** in the front-back direction LD or only in the middle of the top sheet **30** in the width direction WD (the top sheet **30** may partially have a zone without any aperture **14**). Alternatively, the aperture arrayed region may be provided all over the top sheet **30**. That is, the aperture arrayed region may extend, as long as it is provided over the skin-touching region, to the other region (for example, the regions where the gathered sheets **62** are bonded on opposed sides in the width direction WD).
(34) The plan shape of each aperture **14** (opening shape) may suitably be decided. Each aperture **14** may be in a slot shape as shown in FIGS. **6**(*a*) and **6**(*b*), perfect circular as shown in FIGS. **6**(*c*), **6**(*e*), and **6**(*f*) as well as in FIGS. **7** and **8**, elliptical as shown in FIG. **6**(*d*), polygonal, such as triangular, rectangular, or rhombic, start shaped, cloud shaped, or any arbitrary shape. Though not

shown, apertures **14** of different shapes may be present. The size of each aperture **14** is not particularly limited, and the dimension 14 L in the front-back direction (the maximum dimension) is preferably 0.5 to 2.0 mm, particularly 0.5 to 1.0 mm, and the dimension 14 W in the width direction (the maximum dimension) is preferably 0.5 to 2.0 mm, particularly 0.5 to 1.0 mm. When the shape of each aperture **14** is longer in the front-back direction (the overall dimension in one direction is longer than the overall dimension in the direction orthogonal thereto), such as a slot, elliptical, rectangular, or rhombic shape, the front-back dimension is preferably 1.2 to 2.5 times the dimension in the width direction orthogonal thereto. Further, when the shape of each aperture **14** is longer in one direction, the longitudinal direction of the apertures **14** is preferably aligned to the machine direction (MD) of the nonwoven fabric, but may be aligned to the cross direction (CD) or oblique thereto. Note that the MD of the perforated nonwoven fabric constituting the top sheet **30** is, in most cases, aligned to the front-back direction LD.

(35) The area of each aperture **14** and the area ratio of the apertures in the aperture arrayed region may suitably be decided, and the area may preferably be about 0.25 to 4.00 mm.sup.2 and the area ratio may preferably be about 0.1 to 10%.

(36) The pattern of the array of the apertures **14** may suitably be decided. For example, as shown in FIGS. **6**(*a*), **6**(*c*), and **6**(*d*), it is preferred that the pattern of the array of the apertures **14** is a matrix wherein lines of apertures **14** aligned linearly in the front-back direction LD at predetermined intervals are repeated in the width direction WD at predetermined intervals. In this case, the apertures **14** may be arranged with the intervals **14***y* of the apertures **14** in the front-back direction LD being smaller than the intervals **14***x* of the apertures **14** in the width direction WD as shown in FIGS. **6**(*a*) and **6**(*d*), with the intervals **14***y* of the apertures **14** in the front-back direction LD being generally equal to the intervals **14***x* of the apertures **14** in the width direction WD as shown in FIG. **6**(*c*), or with the intervals **14***y* of the apertures **14** in the front-back direction LD being larger than the intervals **14***x* of the apertures **14** in the width direction WD as shown in FIGS. **6**(*b*) and **6**(*e*). Further, as shown in FIGS. **6**(*a*), **6**(*b*), and **6**(*c*), the lines **95** of apertures aligned linearly in the front-back direction LD at predetermined intervals may be arranged in the width direction WD at intervals and shifted with each other in the front-back direction LD. FIGS. **6**(*a*) and **6**(*b*) show examples of the arrangement wherein the apertures **14** in the adjacent lines **95** are staggered, i.e., so-called staggered pattern (hexagonal lattice pattern).

(37) The intervals **14***y* of the apertures **14** in the front-back direction and the intervals **14***x* of the apertures **14** in the width direction may respectively be constant or varied, which may suitably be decided. For example, the intervals **14***y* of the apertures **14** in the front-back direction may be 0.9 to 8.0 mm, particularly 1.0 to 3.0 mm, whereas the intervals **14***x* of the apertures **14** in the width direction may be 2.0 to 10 mm, particularly 3.0 to 5.0 mm.

(38) The pattern of the array of apertures **14** may also be such that groups **90** of apertures **14** aligned in the front-back direction LD with each group forming a single wavy line **91**, **92** are arranged in the width direction WD at intervals in the same or different phases as shown in FIGS. **6**(*f*) and **7**. In the example of the pattern as shown in FIG. **7**, the wave phases of the groups **90** of apertures **14** adjacent to each other in the width direction WD are opposite, so that the imaginary lines connecting the apertures **14** form a Moroccan pattern (ogee pattern). Further, as shown in FIG. **8**, the pattern of the array of apertures **14** may also be such that groups **90** of apertures **14** aligned in the front-back direction LD at intervals with each group forming a chain-like pattern are arranged in the width direction WD at intervals. Here, "groups **90** of apertures **14** are arranged in the width direction WD at intervals" means that an imperforated zone **93** extending linearly unintermittently along the front-back direction LD is present between the groups **90** of apertures **14** adjacent to each other in the width direction WD.

(39) The sectional shape of each aperture **14** is not particularly limited. For example, each aperture **14** may be a punched aperture of which periphery is formed with cut ends of fibers, or a non-punched aperture which hardly has cut ends of fibers on its periphery and is formed by inserting a

pin into the space among fibers to expand (fiber density at the periphery is higher). The punched aperture may have a diameter tapered toward the middle of the thickness as shown in FIG. **9**(*d*), or a diameter tapered toward one end in the thickness direction, not shown.

(40) The non-punched aperture **14** has a diameter tapered from the pin-insertion side toward the opposite side of the aperture **14**, which includes a diameter continuously tapered all over the thickness of a nonwoven fabric layer, and a diameter whose tapering is substantially ceased in the middle of the thickness. Such non-punched apertures **14** include those as shown in FIGS. **9**(*a*) and **9**(*c*) wherein fibers at the periphery of each aperture **14** on the side opposite to the pin-insertion side are extruded from the side opposite to the pin-insertion side to form a protrusion (burr) **14***e*, whereas a protrusion **14***e* is not formed on the pin-insertion side, and those as shown in FIG. **9**(*b*) wherein fibers at the periphery of each aperture **14** on the side opposite to the pin-insertion side are extruded to the side opposite to the pin-insertion side to form a protrusion **14***e*, whereas fibers at the periphery of the aperture on the pin-insertion side are extruded to the pin-insertion side to form a protrusion **14***e*. The apertures **14** of the former type further include those as shown in FIG. **9**(*a*) wherein the height **14***h* of the protrusion **14***e* is substantially even, and those as shown in FIG. **9**(*c*) wherein the height **14***i* of the protrusion **14***e* is highest at two opposed locations whereas the level **14***j* of the protrusion **14***e* is lowest at two opposed locations orthogonal to the highest locations. It is preferred that the protrusion **14***e* continuously extends along the circumferential direction of the aperture to form a cylinder, but it is also conceivable that protrusions **14***e* of part or all of the apertures **14** are formed partially along the circumferential direction of the respective apertures **14**. The heights **14***h*, **14***i*, **14***j* of the protrusion (nominal height determined under optical microscope without pressure) are preferably about 0.2 to 1.2 mm. Further, it is preferred that the maximum height **14***i* of the protrusion **14***e* is about 1.1 to 1.4 times the minimum height **14***j* of the protrusion **14***e*. The height of protrusion **14***e* may vary along the circumferential direction of the aperture **14**.

(41) When an aperture **14** longer in one direction, for example, as shown in FIGS. **6**(*a*), **6**(*b*), **6**(*d*), is formed by pin insertion, the fibers at the periphery of the aperture **14** are displaced outwards or vertically to form a protrusion (burr) **14***e* having a height **14***i* at the longitudinally opposed locations of the aperture **14** higher than a height **14***j* at the opposed locations orthogonal to the longitudinal. The protrusion **14***e* around the aperture **14** may have a fiber density lower than the density around the protrusion, but preferably have a fiber density similar to or higher than the density around the protrusion.

(42) In particular, when the perforated nonwoven fabric is continuous fiber nonwoven fabric having a fineness of 0.1 to 5.0 dtex (more preferably 1.0 to 3.0 dtex), a basis weight of 15 to 20 g/m.sup.2 (more preferably 15 to 18 g/m.sup.2), and a thickness of 0.3 to 0.8 mm (more preferably 0.3 to 0.6 mm), and the apertures **14** are formed by pin insertion, the height of the protrusion **14***e* formed at the periphery of each aperture **14** is lower. More specifically, in the above-mentioned specific range of continuous fiber nonwoven fabric, the fibers are hard to be extruded in the thickness direction upon formation of the pin insertion apertures. This is because the fibers to which force is applied by the pin insertion are continuous and entangled all over the nonwoven fabric (continuous fiber), and displacement of a portion of the fibers to which force is applied by the pin insertion is withheld by the portions of the fibers continuous on the outer side thereof. Further, the above-mentioned specific range of continuous fiber nonwoven fabric basically has a moderately low fiber density, so that displacement of the fibers in the direction orthogonal to the thickness is relatively easy. As a result, when the above-mentioned specific range of continuous fiber nonwoven fabric is subjected to the pin insertion to form apertures **14** of the above-mentioned specific range of dimensions, during the pin insertion, the fibers around the pin are displaced toward the pin outlet side while the fibers are extruded radially outwardly of the direction of the pin insertion, which results in formation of the protrusions **14***e*, but with a lower height. Accordingly, at the periphery of each aperture **14**, a higher-density area is formed which has a fiber density higher than that of the vicinity. With such a higher-density area, the contrast between the aperture and the

periphery thereof is emphasized, so that the visibility of the apertures is advantageously improved.
(43) (Intermediate Sheet)
(44) For the purpose of immediately transferring the liquid permeated through the top sheet **30** to the absorber body, an intermediate sheet (also referred to as “second sheet”) **40** may be provided, which has a higher liquid permeation rate compared to the top sheet **30**. This intermediate sheet **40** is for immediately transferring the liquid to the absorber body to improve the absorption performance thereof, and to prevent the “back-flow” phenomenon of the absorbed liquid from the absorber body. The intermediate sheet **40** may be omitted.
(45) The intermediate sheet **40** may be of a liquid-pervious sheet, such as nonwoven fabric. The intermediate sheet **40** may preferably be of air-through nonwoven fabric for its bulkiness. The air-through nonwoven fabric is preferably made of composite fibers of a core-clad structure, wherein the resin for the core may be polypropylene (PP), or preferably polyester (PET), which has a higher stiffness. The basis weight is preferably 17 to 80 g/m.sup.2, more preferably 18 to 60 g/m.sup.2. The fineness of the raw material fibers of the nonwoven fabric is preferably 2.0 to 10 dtex. For making nonwoven fabric bulky, it is also preferred to use eccentric fibers having off-centered cores, hollow fibers, or eccentric hollow fibers, entirely as the raw material fibers or partially mixed fibers.
(46) In the illustrated embodiment, the intermediate sheet **40** is shorter than the absorber body **56** in width and is arranged in the center, but may be provided over the entire width. Further, the intermediate sheet **40** may be provided over the entire length of the diaper, or only in the middle portion in the front-back direction LD, including the excretion area, as in the illustrated embodiment.
(47) (Liquid-Impervious Sheet)
(48) The liquid-impervious sheet **11** is not particularly limited, and may preferably have moisture-permeability. As the liquid-impervious sheet **11**, for example, a microporous sheet may preferably be used which is obtained by kneading an inorganic filler in a polyolefin-based resin, such as polyethylene or polypropylene, forming the resulting mixture into a sheet, and then uni- or biaxially drawing the sheet. Alternatively, the liquid-impervious sheet **11** may be formed of nonwoven fabric as a basic material, to which improved waterproof property is applied.
(49) The liquid-impervious sheet **11** preferably extends over the same or wider extent than that of the absorber body **56** in the front-back direction LD and in the width direction WD but, when another liquid-shielding means is present, may not cover the ends or edges of the absorber body **56** in the front-back direction LD and in the width direction WD, as necessary.
(50) (Exterior Nonwoven Sheet)
(51) The exterior nonwoven sheet **12** covers the entire underside of the liquid-impervious sheet **11** to impart a fabric-like appearance to the product exterior. The exterior nonwoven sheet **12** preferably has a fiber basis weight of 10 to 50 g/m.sup.2, in particular 15 to 30 g/m.sup.2, which, however, is not limiting. The exterior nonwoven sheet **12** may be omitted, in which case the liquid-impervious sheet **11** may be extended to the side edges of the product.
(52) (Standup Gather Part)
(53) It is preferred to provide standup gather parts **60** which stand up toward the skin of the wearer on opposed sides in the width direction WD of the top face for blocking the bodily waste moving laterally on the top sheet **30** and thereby preventing so-called side leakage. Naturally, the standup gather parts **60** may be omitted.
(54) The standup gather parts, when employed, may be of any structure without particular limitation, and may be any of various known structures. The standup gather parts **60** in the illustrated embodiment are each composed of a gathered sheet **62** continuous substantially in the width direction WD, and elongate gathering elastic members **63** fixed in their stretched state to the gathered sheet **62** along the front-back direction LD. The gathered sheet **62** may be of a water-repelling nonwoven fabric, whereas the gathering elastic members **63** may be of a rubber thread or

the like. A plurality of the elastic members may be provided on each lateral side as shown in FIGS. **1** and **2**, or only one elastic member may be provided on each lateral side.

(55) The inner face of the gathered sheet **62** has a joining start edge positioned on a lateral side portion of the top sheet **30** in the width direction WD, and the portion outward in the width direction of this joining start edge is bonded to the inner face of the corresponding side flap SF, i.e., in the illustrate embodiment, a lateral side portion of the liquid-impervious sheet **11** and a lateral side portion of the exterior nonwoven sheet **12** located laterally outward thereof in the width direction, with a hot melt adhesive or the like.

(56) Around each leg, each standup gather part **60** is fixed to the top sheet **30** on the center side of the joining start edge in the width direction at both end portions in the product front-back direction, while the remaining portion therebetween of the standup gather part **60** is a non-fixed free portion, which will be raised by the contracting force of the elastic members **63** to be brought into close contact with the body surface.

(57) (End Flaps and Side Flaps)

(58) The tape-type disposable diaper of the illustrated embodiment has a pair of end flaps EF exclusive of the absorber body **56**, extending respectively on the front and back sides of the absorber body **56**, and a pair of side flaps SF exclusive of the absorber body **56**, extending respectively laterally beyond the opposed sides of the absorber body **56**. The side flaps SF may be formed of the main body sheet (exterior nonwoven sheet **12** or the like) continuing from the portion containing the absorber body **56**, or may be formed of another material and attached.

(59) (Planar Gathers)

(60) Each side flap SF is provided with side elastic members **64**, which are of elongate elastic members, such as rubber threads, and are fixed in their stretched state in the front-back direction LD, to thereby form the round-leg portion of each side flap SF into planar gathers. The side elastic members **64** may be provided between the gathered sheet **62** and the liquid-impervious sheet **11** in the joined portion of the gathered sheet **62** in the outer vicinity in the width direction of the joining start edge as in the illustrated embodiment, or between the liquid-impervious sheet **11** and the exterior nonwoven sheet **12** in each side flap SF. A plurality of the side elastic members **64** may be provided on each lateral side as shown in the illustrated embodiment, or only one side elastic member **64** may be provided on each lateral side. Naturally, the side elastic members **64** (planar gathers) may be omitted.

(61) The planar gathers are formed where the contracting force of the side elastic members **64** acts (in the illustrated embodiment, where the side elastic members **64** are shown). Thus, structures are conceivable, wherein the side elastic members **64** are present only in the area of the planar gathers, or wherein the side elastic members **64** are present on the front side, back side, or both of the planar gathers, but the contacting force of the side elastic members **64** acts only in the area of the planar gathers, while the contracting force is made not to act in the area other than the area of the planar gathers (substantially equivalent to absence of the elastic members) by finely cutting the side elastic members at one or a plurality of locations other than the area of the planar gathers, by not fixing the side elastic members **64** to the sheets between which the side elastic members **64** are interposed, or by both.

(62) (Front Wings)

(63) The present tape-type disposable diaper has front wings **80** extending on opposed sides of the product in the right-left direction at a position spaced forward of the middle of the product in the front-back direction. The front wings may be omitted (i.e., the product may be configured such that the width of the product is not varied from its narrowest portion to the front end).

(64) The dimension of each front wing **80** in the width direction WD may suitably be decided and, for example, may be 5 to 20% (in particular 7 to 15%) the overall product length Y. The dimension of each front wing **80** in the width direction WD may be generally the same as the dimension of each back wing **81** to be discussed later in the width direction WD.

(65) (Back Wings)
(66) The present tape-type disposable diaper has back wings **81** extending on opposed sides of the product in the right-left direction at a position spaced backward of the middle of the product in the front-back direction.
(67) The dimension of each back wing **81** in the width direction WD may suitably be decided and, for example, may be the same as the dimension of each front wing in the width direction WD, or smaller or larger than the dimension of the front wing in the width direction.
(68) (Middle Section)
(69) Each lateral edge of the product between the front wing **80** and the back wing **81** may have a generally linear portion passing the area of ±5 mm in the width direction on both sides of and in the direction orthogonal to a line at an acute angle of ±2 degrees or less with respect to the front-back direction LD. Each lateral edge of the product between the front wing **80** and the back wing **81** may extend in a wavy or arcuate manner (not shown), or in a linear manner as in the illustrated embodiment.
(70) (Formation of Wings)
(71) As in the illustrated embodiment, by cutting out each lateral side of the side flap SF in a concave shape, the overall concaved edge may be formed which extends from the lower edge of the front wing **80**, via the lateral edge of the product between the front wing **80** and the back wing **81**, to the lower edge of the back wing **81**. In this case, the layered structure of the side flaps SF decides the layered structure of the front wings **80** and the back wings **81** and, in the illustrated embodiment, the front wings **80** and the back wings **81** are formed with gathered sheet **62** and the exterior nonwoven sheet **12**. Though not shown, a front extension sheet may be provided extending laterally from each side flap SF to form all or edge-side part of each front wing **80** with the front extension sheet. Similarly, a back extension sheet may be provided extending laterally from each side flap SF to form all or edge-side part of each back wing **81** with the back extension sheet. The front extension sheet and the back extension sheet may be of various nonwoven fabric.
(72) (Connecting Part)
(73) Each back wing **81** is provided with a connecting part **13**A to be detachably connected to the ventral section F when the product is worn. That is, in fitting the product, the opposed lateral side portions of the back wings **81** are brought onto the ventral side of the wearer, and the connecting parts **13**A of the back wings **81** are connected to the exterior face of the ventral section F. The connecting part **13**A may be a hook member (male part) of a mechanical fastener (hook and loop fastener), or a pressure-sensitive adhesive layer. The hook member has a number of engaging projections on its connecting surface, and the engaging projections may be in various known shapes, such as tick-shaped, J-shaped, mushroom-shaped, T-shaped, or double J-shaped (wherein J-shaped parts are joined back to back).
(74) The connecting part **13**A may directly be attached to the back wing **81**, or a connecting tape **13** having the connecting part **13**A may be attached to the back wing **81**, as in the illustrated embodiment. The structure of the connecting tape **13** is not particularly limited and, in the illustrated embodiment, may have a tape attachment portion **13**C fixed to the side flap SF, a tape body **13**B protruding from the tape attachment portion **13**C, and the connecting part **13**A disposed in the middle of the tape body **13**B in the width direction WD, and the portion beyond this connecting part **13**A is a grip portion. The sheet material forming from the tape attachment portion **13**C to the tape body **13**B may be nonwoven fabric, plastic film, polyethylene-laminated nonwoven fabric, paper, or composites thereof.
(75) A connecting site on the exterior face of the ventral section F to which the connecting parts **13**A are to be connected, may suitably be decided, and only the body section located between the right and left front wings **80** may provide the connecting site, or the areas each extending from a lateral side portion of the body section toward the proximal side of the front wing **80** may provide the connecting site. To such connecting site, it is preferable that the connecting parts **13**A may be

easily connected. For example, when the connecting parts **13**A are hook members (male parts) of mechanical fasteners (hook and loop fasteners), the connecting site on the exterior face of the ventral section F may be made with a loop member (female part) **20** of mechanical fasteners, or nonwoven fabric. As such a loop member **20**, a plastic film stitched with a loop yarn is known, but in view of air permeability and flexibility, preferred is continuous fiber nonwoven fabric of which continuous fiber direction is its width direction WD (such as spunbonded nonwoven fabric generally having a fineness of 2.0 to 4.0 dtex, a basis weight of 20 to 50 g/m.sup.2, and a thickness of 0.3 to 0.5 mm), provided with melt-bonded portions wherein fibers are melt-bonded with each other intermittently at least in the width direction WD. When a region of the exterior face of the ventral section F including the connecting site is formed with the exterior nonwoven sheet **12**, the hook members may be connected to the exterior nonwoven sheet **12** without any other means added thereto. As in the illustrated embodiment, a loop member **20** may be adhered only to the connecting site on the exterior face of the ventral section F. Further, when the connecting parts **13**A are in the form of pressure-sensitive adhesive layers, a plastic film having a smooth surface to be strongly adhered to the pressure-sensitive adhesive layers may be attached to the connecting site on the exterior face of the ventral section F.

(76) (Fixing of Top Sheet)

(77) The top sheet **30** is preferably bonded, via a hydrophobic hot melt adhesive **31**, to an underside member arranged on the underside of the top sheet **30**. Instead of or in addition to this, the top sheet **30** may be joined to an underside member arranged on the underside of the top sheet **30** by melt-bonding of at least one of the top sheet **30** and the underside member arranged on the underside of the top sheet **30**. The area in which the top sheet **30** is fixed may, as long as the area extends at least over the entire aperture arrayed region, only be over the aperture arrayed region or extend beyond the aperture arrayed region to other areas (e.g., all over the top sheet **30**). The underside member includes the intermediate sheet **40**, the packing sheet **58**, and the liquid-impervious sheet **11** in the illustrated embodiment, but is not limited thereto.

(78) The hydrophobic hot melt adhesive **31** may be EVA-based, polyolefin-based, or polyester/polyamide-based adhesive or the like, and a pressure-sensitive rubber-based (elastomer-based) adhesive is particularly preferred.

(79) The amount of the hydrophobic hot melt adhesive **31** to be applied may suitably be decided, and may usually be about 0.1 to 10 g/m.sup.2. In particular, with the amount of the hydrophobic hot melt adhesive **31** being about 0.5 to 5 g/m.sup.2, the hot melt adhesive **31** may preferably be kept from sticking out through the apertures **14**, but interference with a hydrophilic lotion in bonding as will be discussed later is likely to occur, so that it is preferred to combine the application amount with designing of the application pattern of the hydrophilic lotion, or the like. The application pattern of the hydrophobic hot melt adhesive **31** may suitably be decided, and may preferably be a dense pattern with minute non-applied portions scattered all over (by spray application in spiral, Z, or wave shapes, or the like), or may be a continuous surface such as by slot application.

(80) (Lotion-Bearing Zone)

(81) The skin-touching region of the top sheet **30** has lotion-bearing zones **32** which bear a water-containing hydrophilic lotion, as shown in FIGS. **7**, **10**, and **11**. With too small dimensions of each lotion-bearing zone, the friction-reducing effect is localized, which provides little significance in protection of the skin of a wearer, so that each lotion-bearing zone **32** preferably has a MD (the front-back direction LD in the illustrated embodiment) dimension 32 L of 30 mm or more and a CD (the width direction WD in the illustrated embodiment) dimension 32 W of 5 mm or more. The MD dimension 32 L of the lotion-bearing zone **32** is more preferably 50 mm or more, and particularly preferably 100 mm or more. The upper limit of the MD dimension 32 L of the lotion-bearing zone **32** is the overall product length Y, but may be shorter than this. The CD dimension 32 W of the lotion-bearing zone **32** is more preferably 10 mm or more. The upper limit of the CD dimension 32

W of the lotion-bearing zone **32** is the dimension in the width direction WD of the top sheet **30**, but may be shorter than this.
(82) The lotion-bearing zone **32** may be provided in one location with a relatively large area, or may be provided in a plurality of locations. The lotion-bearing zones **32** may preferably be provided in a striped pattern as in the illustrated embodiment, or in a horizontal-striped pattern. In such cases, the intervals **32**X of the adjacent lotion-bearing zones **32** may suitably be decided, and may preferably be, for example, about 1.5 to 10 mm.
(83) The nonwoven fabric for the top sheet **30** may preferably be discontinuous fiber nonwoven fabric having a fineness of 1 to 3 dtex (more preferably 1.5 to 2.5 dtex), a basis weight of 10 to 30 g/m.sup.2 (more preferably 15 to 25 g/m.sup.2), and a thickness of 0.4 to 1.4 mm (more preferably 0.5 to 1.0 mm). That is, with such discontinuous fiber nonwoven fabric, fineness of the fibers contributes to reduction of surface friction, which, in cooperation with the friction-reducing effect of the hydrophilic lotion, improves the overall friction-reducing effect. In addition, the fineness of the fibers also improves the hydrophilic lotion-retainability, which further improves the friction-reducing effect. More specifically, by the combination of the discontinuous fiber nonwoven fabric and the hydrophilic lotion, the lotion-bearing zones of the top sheet **30** preferably have an average coefficient of friction MIU of 0.2 to 0.4.
(84) The surface moisture percentage of the lotion-bearing zones **32** is not particularly limited, and may preferably be 3 to 10%, particularly 4 to 8%, for moderately moistening and keeping the skin of a wearer from drying.
(85) The hydrophilic lotion, as long as it contains water, may have any ingredient composition but water. For example, the components other than water of the hydrophilic lotion may be one or a plurality of members selected from glycerin, propylene glycol, dipropylene glycol, 1,3-butylene glycol, polyethylene glycol, sorbitol, xylitol, and sodium pyrrolidone carboxylate; and further sugars, such as trehalose, mucopolysaccharides (e.g., hyaluronic acid and derivatives thereof, chondroitin and derivatives thereof, heparin and derivatives thereof, or the like), elastin and derivatives thereof, collagen and derivatives thereof, NMF-related materials, lactic acid, urea, higher fatty acid octyldodecyl esters, seaweed extracts, *Bletilla striata* root extract, various amino acids and derivatives thereof, and the like. The hydrophilic lotion may further contain one or a plurality of additives selected from the group consisting of emulsifiers, phosphates, paraffin, and surfactants. The surfactants may preferably be ether-type nonionic surfactants or nonionic surfactants including EO/PO-type. For improved product storage stability, the hydrophilic lotion may contain a preservative but, as the hydrophilic lotion is to be transferred to the skin for moistening the same, it is more preferred that the hydrophilic lotion is free of preservatives.
(86) A particularly preferred hydrophilic lotion contains 70 to 90 wt % glycerin and 10 to 30 wt % water. Such a hydrophilic lotion mainly composed of glycerin with a moderate amount of water, is preferred not only as a moisturizer when transferred to the skin, but also for its hardness to decay as the water is held in the glycerin as bound water (glycerin has an extremely high water retainability). That is, for using a water-containing hydrophilic lotion in this context, it is preferred to contain a large amount of glycerin, to ensure a sufficient surface moisture percentage (e.g., 3 to 10% as discussed above), and to keep a water activity value of the hydrophilic lotion low, for example, 0.8 or lower, more preferably 0.3 to 0.7, particularly preferably 0.3 to 0.5, so that, even in the absence of a preservative, development of microorganisms may be suppressed to provide improved shelf life, and the moisturizing effect upon transfer to the skin may be improved.
(87) The content of the hydrophilic lotion in the lotion-bearing zones **32** may suitably be decided depending on the purpose. For example, with a hydrophilic lotion containing 70 to 90 wt % glycerin and 10 to 30 wt % water, the content per unit area of the lotion-bearing zones **32** is preferably 5 to 15 g/m.sup.2. When a plurality of zones with different contents of the hydrophilic lotion is present as in the embodiment shown in FIG. **11**, or when the applied amount of the hydrophilic lotion varies gradually, it is preferred that the content of the hydrophilic lotion all over

the lotion-bearing zones is 2 to 20 g/m.sup.2, the area of the lotion-bearing zones **32** having the content of the hydrophilic lotion of 5 to 15 g/m.sup.2 is 20% or more, or both.
(88) The discontinuous fiber nonwoven fabric is preferably formed of hydrophobic resin fibers for their low cost, which as they are have poor retainability of the water-containing hydrophilic lotion. Thus, the hydrophilic lotion preferably has a viscosity at 20° C. of 150 to 400 mPa.Math.s. In this way, the hydrophilic lotion-retainability of the discontinuous fiber nonwoven fabric is preferably improved.
(89) The discontinuous fiber nonwoven fabric is preferably formed of hydrophobic resin fibers for their low cost, which as they are have poor retainability of the water-containing hydrophilic lotion. Thus, it is preferred to use, as the top sheet, discontinuous fiber nonwoven fabric formed of hydrophilized fibers wherein hydrophobic resin fibers have been coated with a hydrophilizer. In this way, the hydrophilic lotion-retainability of the discontinuous fiber nonwoven fabric is preferably improved.
(90) The hydrophilizer may preferably be, in consideration of safety for human body, safety in process, or the like factors, one or a mixture of nonionic activators obtained by addition of ethylene oxide to higher alcohols, higher fatty acids, alkylphenols, or the like, or anionic activators, such as alkyl phosphates (octyl or dodecyl) or alkyl sulfates. The amount to be applied may vary depending on the required performance, but may usually preferably be about 0.1 to 2.0 wt %, particularly about 0.2 to 1.0 wt % of the dry weight of the objective sheet.
(91) <Efficacy Test>
(92) Various samples of the top sheet as specified in Tables 1 to 3 were subjected to determination of various properties, including average coefficient of friction MIU, surface moisture percentage, and water activity value. Samples 1 to 10 were nonwoven fabric before fabrication into products, to which the hydrophilic lotion was or was not applied, and Samples 11 to 15 were top sheets removed from commercial products. Further, smoothness and moistness of each sample were perceived by stroking the top sheet surface in the longitudinal direction with the hand, and graded on three levels with respect to those of Sample 5 (⊙: excellent; Δ: better than Sample 5; ×: similar).
(93) TABLE-US-00001 TABLE 1 Sample number 1 2 3 4 5 Top sheet Fineness (dtex) 2.0(PE)/2.2(PET) 2.0(PE)/2.2(PET) 2.0(PE)/2.2(PET) 2.0(PE)/2.2(PET) 2.0(PE)/2.2(PET) Basis weight (g/m2) 25 20 20 20 20 Thickness (mm) 1.1 0.9 0.9 0.6 0.6 Material of fiber PE/PET(mixed) PE/PET(mixed) PE/PET(mixed) PE/PET(mixed) PE/PET(mixed) Fiber joining thermal bonding thermal bonding thermal bonding thermal bonding thermal bonding Lotion-bearing Arrangement striped striped striped striped striped zone MD dimension (mm) 200 200 200 200 — CD dimension (mm) 5 5 5 5 — Number (Interval 32 w) 4(5) 4(5) 4(10) 4(5) — Basis weight (g/m2) 8.5 8.5 8.5 8.5 0 Lotion composition Glycerin 76 76 76 76 — (wt %) Liquid paraffin 2 2 2 2 — Alkyl phosphate 2 2 2 2 — Water 20 20 20 20 — Lotion viscosity (Pa .Math. s) 20° c. 372 372 372 372 — Average coefficient of friction MIU 0.33 0.34 0.34 0.33 0.37 Variation deviation of 0.01 0.01 0.01 0.01 0.01 average coefficient of friction MMD Surface moisture percentage (%) 5.6 5.6 5.6 5.6 0.3 Smoothness ◎ ◎ ◎ ◎ — Moistness ◎ ◎ ◎ ◎ —
(94) TABLE-US-00002 TABLE 2 Sample number 6 7 8 9 10 Top sheet Fineness (dtex) 2.0(PE)/2.2(PET) 2.0(PE)/2.2(PET) 2.0(PE)/2.2(PET) 2.0(PE)/2.2(PET) 2.2/3.3 Basis weight (g/m2) 20 20 20 20 20 Thickness (mm) 0.6 0.6 0.6 0.6 0.6 Material of fiber PE/PET(mixed) PE/PET(mixed) PE/PET(mixed) PE/PET(mixed) PE/PET 2-layered Fiber joining thermal bonding thermal bonding thermal bonding thermal bonding thermal bonding Lotion-bearing Arrangement striped striped striped striped striped zone MD dimension (mm) 200 200 200 200 200 CD dimension (mm) 5 5 5 5 5 Number (Interval 32 w) 4(5) 4(5) 4(5) 4(5) 4(5) Basis weight (g/m2) 3.5 5.0 15.0 17.6 8.5 Lotion composition Glycerin 76 76 76 76 76 (wt %) Liquid paraffin 2 2 2 2 2 Alkyl phosphate 2 2 2 2 2 Water 20 20 20 20 20 Lotion viscosity (Pa .Math. s) 20° c. 372 372 372 372 372 Average coefficient of friction MIU 0.41 0.40 0.30 0.30 0.51 Variation deviation of 0.01 0.01 0.01 0.01 0.01 average coefficient of friction MMD Surface moisture percentage (%) 3.0 4.2

8.0 8.9 3.0 Smoothness ◯ ◯ ⊚ ⊚ Δ Moistness ◯ ◯ ⊚ ⊚ Δ
(95) TABLE-US-00003 TABLE 3 Sample number 11 12 13 14 15 Top sheet Fineness (dtex) Company A Company B Company A Company B Company C Basis weight (g/m2) Commercial Commercial Commercial Commercial Commercial Thickness (mm) diaper 1 diaper 1 diaper 2 diaper 2 diaper Material of fiber Fiber joining Lotion-bearing Arrangement — — — — — zone MD dimension (mm) — — — — — CD dimension (mm) — — — — — Number (Interval 32 w) — — — — — Basis weight (g/m2) — — — — — Lotion composition Glycerin — — — — — (wt %) Liquid paraffin — — — — — Alkyl phosphate — — — — — Water — — — — — Lotion viscosity (Pa .Math. s) 20° c. — — — — — Average coefficient of friction MIU 0.65 0.62 0.48 0.69 0.58 Variation deviation of 0.01 0.01 0.01 0.01 0.01 average coefficient of friction MMD Surface moisture percentage (%) 0.3 0.1 0.2 0.3 0.3 Smoothness X X Δ X X Moistness X X X X X
(96) As may be seen from Tables 1 to 3, it was revealed that the surface of the top sheets of Samples 1 to 4 and 6 to 9, in particular Samples 1 to 4, 8, and 9, were perceived as being very smooth and moist. Compared to these, Samples 10 to 15 were inferior in smoothness and moistness. Sample 9 was moist but provided sticky feel.
(97) <Explanation of Terms in the Specification>
(98) The following terms appearing in the present specification shall have the following means unless otherwise specified herein. The “front-back direction” refers to the direction shown by the reference sign LD (longitudinal direction) in the figures, whereas the “width direction” refers to the direction shown by the reference sign WD (right-left direction) in the figures, and the front-back direction and the width direction are orthogonal to each other. The “machine direction (MD)” and “cross direction (CD)” refer to the flow direction (MD) and the lateral direction orthogonal thereto (CD) in the production facilities, respectively, and either one of these is aligned to the front-back direction while the other is aligned to the width direction, depending on the parts of the product. The MD of nonwoven fabric is the direction of fiber orientation in the nonwoven fabric. The fiber orientation refers to the direction along which the fibers of the nonwoven fabric are aligned, and may be identified, for example, by a measurement method pursuant to the fiber orientation testing method using zero-span tensile strength prescribed in TAPPI Standard Method T481, or by a simplified measurement method for determining the fiber orientation by the ratio of tensile strengths in the front-back direction and in the width direction. The “top side” refers to the side, when the article is worn, closer to the skin of the wearer, whereas the “underside” refers to the side, when the article is worn, away from the skin of the wearer. The “top face” refers to the face, when the article is worn, closer to the skin of the wearer, whereas the “under face” refers to the face, when the article is worn, away from the skin of the wearer. The “area ratio” refers to the ratio of the objective area per unit area, and is calculated by dividing the sum of the areas of objective portions (e.g., apertures) in an objective region (e.g., cover nonwoven sheet) by the area of that objective region, and is represented in percentage. In a configuration where a number of objective portions are provided at intervals, the area ratio is preferably determined with the objective region being set to a size containing 10 or more objective portions. For example, the area ratio of the apertures may be determined in the following procedure, using, for example, VHX-1000 (trade name) manufactured by KEYENCE under the measurement conditions in ×200 magnification.
(1) Place a specimen under a ×20 magnification lens, and adjust the focus. Position the nonwoven fabric so that 4×6 apertures are in the field.
(2) Specify the brightness of the pore portions, and measure the area of the holes.
(3) Click the color extraction in “Area Measurement” under “Measurement and Comment”. Click the pore portions.
(4) Click “collective Measurement”, check “Display measurement result window”, and store in CSV data. The “stretch rate” refers to a value with respect to the natural length being 100%. For example, a 200% stretch rate is synonymous with stretch in two folds. The “gel strength” is

determined as follows. To 49.0 g of artificial urine (a mixture of 2 wt % urea, 0.8 wt % sodium chloride, 0.03 wt % calcium chloride dihydrate, 0.08 wt % magnesium sulfate heptahydrate, and 97.09 wt % ion-exchanged water), 1.0 g of superabsorbent polymer is added and stirred with a stirrer. The resulting gel is left in a chamber with constant temperature and humidity at 40° C. at 60% RH for 3 hours, and then the temperature is returned to the ordinary temperature. The gel strength is measured in a curd meter (Curdmeter-MAX ME-500 manufactured by I. techno Engineering). The "basis weight" is determined as follows. A specimen or test piece is preliminarily dried, left in a laboratory or in apparatus under the standard conditions (23±1° C. temperature and 50±2% relative humidity in the testing location) until constant mass is attained. The preliminary drying refers to attaining constant mass from a specimen or test piece in the environment at a temperature of 100° C. No preliminary drying may be performed on fibers with an official regain of 0.0%. From the test piece of the constant mass, a specimen of 100 mm×100 mm size is cut out using a sampling template (100 mm×100 mm). The weight of the specimen is measured and multiplied by 100 times to calculate the weight per 1 m.sup.2, which is taken as the basis weight. The "thickness" is automatically measured using an automatic thickness meter (KES-G5 handy compression tester program) under a load of 0.098 N/cm.sup.2 with the compression area of 2 cm.sup.2. The thickness of perforated nonwoven fabric is measured at a position other than the apertures and the protrusions therearound. The water absorption is determined in accordance with JIS K7223—1996 "Testing method for water absorption capacity of super absorbent polymers". The water absorption rate is defined as the "time spent until the end point is reached" in carrying out JIS K7224—1996 "Testing method for water absorption rate of super absorbent polymers" using 2 g of superabsorbent polymer and 50 g of saline. The "spread state" refers to the state in which an article is spread flatly without contraction or slack. The size of each part refers to the size not in the natural length state but in the spread state, unless otherwise specified. The "melt viscosity" is determined at a prescribed temperature using a Brookfield B-type viscometer (spindle No. 027) in accordance with JIS Z 8803. The "maximum dimension" of an aperture refers to the longer of the MD dimension and the CD dimension. The "average coefficient of friction MIU" and the "variation deviation of average coefficient of friction MMD" is determined using a friction tester KES-SE manufactured by KATO TECH CO., LTD. (10 mm square silicon sensor, 50 g load), and refers to the value measured for the sensor moving distance of 20 mm. The sensor moving direction (direction of friction) is the MD of the top sheet. When a product is to be subjected to the measurement, members constituting the product except for the top sheet are removed or cut out to the extent that the friction test on the top sheet surface would not be affected (as such, members, for example, melt-bonded to the top sheet will not be removed), and the test is conducted on the top sheet in its spread state.

(99) In addition, when the CD dimension of a lotion-bearing zone on the top sheet is less than the sensor dimension (10 mm), the top sheet **30** is cut along the lateral edges of the lotion-bearing zone **32** as shown in FIG. **12**(*a*) to obtain a specimen **300** solely of the lotion-bearing zone **32** (narrower in width than the sensor **100**), and this specimen is subjected to measurement with the center of the sensor **100** being aligned to the center of the specimen **300** in the CD as shown in FIG. **12**(*b*). In every measurement, the hydrophilic lotion remaining on the surface of the sensor **100** is thoroughly wiped off before next measurement.

(100) The lotion-bearing zones, if cannot be identified visually, may be identified through appropriate measures. For example, a necessary number of specimens (for measurement and for positional identification) are provided, which have the lotion-bearing zones **32** at the same positions, the lotion-bearing zones **32** on the top sheet **30** of a specimen for positional identification are colored with an appropriate coloring agent in a color different from that of the surroundings, the colored areas are identified using a ruler or other proper image measurement device, and then the measurement is made on a specimen for measurement at the same positions as those of the colored areas identified in the specimen for positional identification, which positions are regarded as the

lotion-bearing zones **32**. For coloring the lotion-bearing zones **32**, a water leak testing agent MORAYMILLE W manufactured by TASETO CO., LTD. may preferably be used. The lotion-bearing zones **32** may be identified by this process also for measurement of the MD dimension 32 L and CD dimension 32 W of a lotion-bearing zone **32**, or for determination of surface moisture percentage to be discussed below. The “surface moisture percentage” is an average calculated from the values measured at three arbitrary positions in the lotion-bearing zones **32** using a moisture checker MY-808S manufactured by SCALAR CORPORATION. Note that in every measurement, the hydrophilic lotion remaining on the measuring surface of the moisture checker is thoroughly wiped off before next measurement. The “water activity value” may be determined using an electric resistance-type water activity meter, such as EZ-100 ST (electric resistance type) manufactured by FREUND CORPORATION. Before measurement, calibration is performed with a saturated solution. Measurement may be made according to an electric resistance-type test based on Standard Methods of Analysis in Food Safety Regulation. Specifically, a sample is taken in a volume of 3% or more the inner capacity of the detector of the water activity meter, placed on an aluminum foil dish or an open flat plate, immediately introduced into and sealed in the detector, and subjected to the conditions of 25±2° C. The values are read every 10 minutes and, when fluctuation of the value is no longer observed, the water vapor pressure in the detector is regarded as in equilibrium, and the value at that point is taken as the measured value of that sample. Each sample is measured three times, and the average of the three measured values is taken as the water activity value. The “viscosity” is determined at a prescribed temperature using a Brookfield B-type viscometer (spindle No. 027) in accordance with JIS Z 8803/ A test or measurement shall be, in the absence of description about environmental conditions, performed in a laboratory or in apparatus under the standard conditions (23±1° C. temperature and 50±2% relative humidity in the testing location).

INDUSTRIAL APPLICABILITY

(101) The present invention is applicable not only to underpants-type disposable diapers or tape-type disposable diapers, but also to general disposable wearable articles, such as pad-type disposable diapers, disposable swim wears, diaper covers, or sanitary napkins.

DESCRIPTION OF REFERENCE SIGNS

(102) **11**: liquid-impermeable sheet **12**: exterior nonwoven sheet **14**: aperture **14***e*: protrusion **20**: loop member **30**: top sheet **40**: intermediate sheet **50**: absorbent element **56**: absorber body **58**: packing sheet **60**: standup gather part **62**: gathered sheet LD: front-back direction WD: width direction **90**: group **93**: imperforated zone **31**: hydrophobic hot melt adhesive **32**: lotion-bearing zone **94**: unit arrayed area

Claims

1. A disposable wearable article comprising a top sheet having a skin-touching region that is brought into contact with skin of a wearer, wherein the top sheet is made from discontinuous fiber nonwoven fabric having a fineness of 1 to 3 dtex, a basis weight of 10 to 30 g/m.sup.2, and a thickness of 0.4 to 1.4 mm, wherein the discontinuous fiber nonwoven fabric is nonwoven fabric formed of hydrophilized fibers in which hydrophobic resin fibers have been coated with a hydrophilizer, wherein the skin-touching region has a lotion-bearing zone in which a water-containing hydrophilic lotion is applied, wherein the hydrophilic lotion contains 70 to 90 wt % glycerin and 10 to 30 wt % water, wherein the hydrophilic lotion has a viscosity at a temperature of 20° C. of 150 to 400 mPa.Math.s, wherein the lotion-bearing zone has a machine direction dimension of 30 mm or larger and a cross direction dimension of 5 mm or larger, and wherein an average coefficient of friction MIU of the lotion-bearing zone is 0.2 to 0.4.

2. The disposable wearable article according to claim 1, wherein the lotion-bearing zone has a surface moisture percentage of 3 to 10%.

3. The disposable wearable article according to claim 2, wherein a content of the hydrophilic lotion per unit area of the lotion-bearing zone is 5 to 15 g/m.sup.2.