

SURFACE MATERIALS FOR ABSORBENT ARTICLES

5 This invention relates to a surface material for absorbent articles, such as catamenial napkins and diapers, and to a method of manufacturing the same.

10 In general, absorbent sanitary articles, such as sanitary napkins or diapers, comprise an absorbent member for absorbing fluid such as blood and urine, a surface material covering the inner surface of the absorbent member and in contact with the skin of the user, and a backing material adapted for covering the reverse surface of the absorbent member for preventing leakage of the fluid.

15 It is, of course, required that such a surface material has a fluid permeating property for transferring fluid, such as blood and urine, rapidly to the absorbent member to be absorbed in it. In addition, it is further required that it has a fluid return prevention property for prohibiting the fluid, once it has been absorbed, from returning to the user's skin, a dryness property for preventing discharged fluid from remaining substantially on the skin and a masking property for concealing the colour of blood, etc. dispersed in the absorbent member.

25 Heretofore, in order to meet with the above requirements, various techniques have been proposed in which a hydrophobic material is used so that fluid is not retained in the surface material itself, and openings are formed or the fluid permeation resistance is minimised in order to provide the fluid permeating property. For example, a surface material has been proposed in which a non-woven material formed of an aggregate of hydrophobic fine fibres is used, whereby a hydrophobic space is formed between the user's skin and the absorbent member

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so that return of the fluid from the absorbent member is reduced without impairing the fluid permeating property (see Japanese Early Laid-Open Publication No. Sho 58-180602). A surface material has also been proposed in which a hydrophobic fluid impermeable sheet is provided with openings in order to reduce the return of the fluid from the absorbent member (see Japanese Utility Model Early Laid-Open Publication No. Sho 54-124398, Japanese Patent Publication No. Sho 57-17081, Japanese Patent Early Laid-Open Publication No. Sho 57-1340 and Japanese Patent Early Laid-Open Publication No. Sho 61-45753.

As a further improvement of the latter surface material, another surface material has been proposed which is provided with micron-sized embossing in order not to produce an unpleasant feel which is often caused if a non-apertured surface intimately contacts the skin.

The former surface material has the shortcoming that fluid tends to accumulate in the fine spaces formed in the aggregate of the fibres because hydrophobic fibres are used, and the accumulated fluid migrates to the surface adjacent the skin when pressure is applied, with the result that unpleasant feel, such as stickiness, is produced and in addition a visually unpleasant effect, such as blood staining, is produced.

Furthermore, since a hydrophobic film is used in the latter surface material, sweat and discharged fluid are likely to be retained between the skin and the film, thus creating an unpleasant feel and causing irritations, such as rashes and itchiness. In the improvement of the latter surface material in which the micron-sized irregularities are formed on the surface, some advantages are produced in the early stage of wear (while the surface material is still dry). However, once the surface material has been wetted with fluid, the

advantageous effect produced by the micro embossing is no longer produced and the material no longer feels comfortable and dry.

Moreover, although the above surface materials are formed of a flexible material, since their area of contact with the user's body is large, the resistance between the surface material and the user's body is also large when a force in the direction of the plane of the material is applied to the surface of the surface material, and as a result the user experiences a feeling of physical discomfort when the surface material is put on.

It is therefore an object of the present invention to provide a surface material for an absorbent article which has a fluid permeating property for permitting free migration or transfer of a fluid, a fluid return prevention property for preventing a fluid, once absorbed, from returning to the skin of the user, a dryness property for preventing discharged fluid from remaining in contact with the skin, a fit which does not produce a feeling of physical discomfort when the surface material is adjacent the skin as part of an absorbent article, and a masking property for shielding the absorbed fluid so that it is not visible from the exterior.

According to the present invention a surface material comprises a fluid impermeable material having a plurality of hole portions each defining a fluid permeating passage; the surface material comprising a plurality of top portions each having a convex curved surface and defining an empty internal space, a plurality of open bottom portions and a plurality of annular wall portions, each hole portion comprising a plurality of adjacent top portions defining an opening, a single open

bottom portion and a single annular wall portion connecting the said top portions and the said bottom portion, each permeating passage having a smallest portion of minimum cross-sectional area situated between the mouth of the opening formed by the associated top portions and the open bottom portion, the cross-sectional area of the permeating passage increasing from the smallest portion towards the mouth of the opening defined by the top portions and remaining substantially constant or increasing towards the open bottom portion.

The sheet of surface material in accordance with the invention thus has a plurality of permeating openings or passages which are defined in part by a plurality of the top portions and in part by depending tubular structures, each of which comprises a cylindrical or annular wall portion and an open or apertured bottom portion.

The smallest portion may be located in the portion of the permeating passage defined by the top portions. The open area of the open bottom portion may be equal to or larger than the cross-sectional area of the annular wall portion.

In one embodiment of the invention the cross-sectional area of the annular wall portion increases from the smallest portion towards the open bottom portion and the cross-sectional area of the open bottom portion connected thereto decreases in the same direction, the height of the open bottom portion being less than that of the top portions and/or that of the annular wall portions.

The present invention also provides a method of manufacturing a surface material for an absorbent article comprising supplying a resin to one side of a template formed of a spiral knitted wire net defining a plurality of openings, the wires defining the said side of the

template having a convex curved surface, applying a reduced pressure to the other surface of the template and blowing air at the resin from the said one side of the template, thereby forming the resin into a sheet whose surface configuration matches that of the template and drawing portions of the sheet through the said openings to form closed end tubular structures and rupturing the closed ends of the tubular structures by forming an opening therein, whereby the surface material has a plurality of permeating passages formed therein, each being defined by a plurality of top portions formed by the said wires, an annular wall portion and a single bottom portion in which the opening is formed, each permeating passage having a smallest portion of minimum cross-sectional area situated between the mouth of the opening formed by the associated top portions and the open bottom portion, the cross-sectional area of the permeating passage increasing from the smallest portion towards the mouth of the opening defined by the top portions and remaining substantially constant or increasing towards the open bottom portion.

In one embodiment the method includes heating the open ends of the tubular structures thereby causing the peripheral edge of the openings therein to contract. This is a typical method of manufacturing the second surface material in accordance with Claim 4.

When an absorbent article with the surface material in accordance with the present invention is worn, blood, urine and the like are transferred through the surface material to the absorbent member and absorbed therein. The surface material has a fluid transfer property owing to the provision of the hole portions with an open bottom portion. In addition, the surface material can follow complicated movements of the user with its top portions

in point-contact with the skin. As a result, the surface material of the present invention has a feel similar to that of cloth. Furthermore, the cylindrical wall portions have a sheltering or masking property for concealing the fluid absorbed in the absorbent member. These effects are particularly significant with respect to bodily fluids of high viscosity.

Moreover, when a tensile force is exerted on the surface material of the present invention in its own plane, it is deformed in such a manner as to close the hole portions permeating passages. On the other hand, when the tensile force is removed, the surface material returns to its initial state and the hole portions open again. Thus when a large force is exerted on the surface material at the time the absorbent article is put on, which would tend to return fluid absorbed in the absorbent member to the skin, the surface material closes

its openings and exhibits its fluid return prevention property, thereby preventing the fluid from returning to the skin.

5 Furthermore, the surface material of the present invention has a large volume for holding the fluid compared to conventional material in which the wall portion is vertical or merely has a narrower tip portion. Even when a bodily pressure is applied to the hole portions from the open bottom portion side, the open 10 bottom portions, the cylindrical wall portions, and the top portions deform to reduce this stress. Since the top portions deform with variations of the wearing pressure, the surface material has a soft feel when the absorbent article is worn. In addition, the passages in the hole 15 portions are prevented from being closed and fluid is guided to the open bottom portion from the opening defined between the top portions.

Since the surface material of the present invention has a plurality of top portions, each having a convex 20 curved surface, the area of contact is very small when they contact the user's body and the physiological function of the skin is thus not disturbed.

Also, if a fluid is discharged, since the area of contact is small, even if a hydrophobic film is used the 25 fluid is scarcely retained in contact with the body and the user always has a feeling of dryness.

The above-mentioned effects of the surface material of the present invention are not obtained by the conventional surface material in which cubic openings are 30 formed in a continuous planar surface.

As described above, the surface material of the present invention is substantially different from the conventional surface material provided with openings, each having a convergent shape in the manner of a

capillary tube and with opening portions having the shape of a vertical cylinder and formed of hydrophobic film. Since the surface material of the present invention has a plurality of top portions, each having a convex curved surface which does not form a continuous planar surface, this surface material is superior to known materials as regards the pooling of fluid adjacent the body side and the fluid permeating property for transferring a large quantity of discharged fluid to the absorbent member.

The surface material of the present invention is, in actual practice, used in a state where it is subjected to stresses. Under these stresses, the surface material of the present invention remains satisfactory as regards absorbency, area of contact with the skin and adhesion of fluid to the skin.

Furthermore, in the first embodiment of surface material, the open area of the open bottom portion of each hole portion is larger than the area of the smallest portion of each hole portion, and thus each hole portion gradually widens towards the open bottom portion or is of cylindrical shape. Accordingly, resistance to the flow of fluid is minimised and fluid, even of high viscosity, can be transferred effectively towards the absorbent member.

Moreover, each hole portion of the first embodiment of surface material defines an opening or passage which progressively widens towards the associated top portions which, when in use, directly contact the user or is of cylindrical shape. The opening or passage also progressively widens towards the peripheral edge of the open bottom portion or is of a cylindrical shape. Accordingly, when stress is applied to the surface material as the user moves, this stress is relieved and that portion of the passage between the top portions and

the open bottom portion is prevented from being closed.

5 In the second embodiment of surface material, the height of the open bottom portion is shorter than that of the top portion and/or that of the cylindrical wall portion. Accordingly, even when bodily pressure is applied to the surface material the open bottom portion is scarcely deformed or closed.

10 If the second embodiment of surface material is designed such that vertical sections thereof at various positions are asymmetric with respect to a centre line passing through the centre of the opening, the spaces for holding the fluid are substantially increased when the surface material is actually used. Even if a large quantity of fluid is discharged, it can be transferred
15 effectively to the absorbent member and can be absorbed in any direction.

Further features and details of the invention will be apparent from the following descriptive of certain specific embodiments of the invention which is given by way of example with reference to the accompanying drawings, in which:-
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Figure 1 is a perspective view, partly cutaway, of an absorbent article including a sheet of surface material of the present invention;

25 Figure 2(A) is a plan view showing a piece of one embodiment of the first surface material of the present invention, Figure 2(B) is an enlarged scrap perspective view of the embodiment of Figure 2(A) and Figure 2(C) is a further enlarged scrap sectional perspective view of the embodiment of Figure 2(A);
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Figure 3 is a sectional view on the line X-X in Figure 2(C);

Figure 4 is a sectional view on the line Y-Y in Figure 2(C);

Figure 5 is a scrap sectional view of the surface material of Figure 2 with a force applied thereto in the direction shown by the arrow;

5 Figure 6 is a scrap sectional view of a portion of the surface material of Figure 2 before formation of the open bottom portion in a method of manufacturing the surface material;

10 Figure 7 is a sectional view similar to Figure 3 showing another embodiment of the surface material of the present invention;

Figure 8 is a sectional view of a portion of a further embodiment of the surface material of the present invention;

15 Figure 9(A) is an enlarged plan view showing part of a spiral knitted wire net used in a method of manufacturing the surface material of the present invention, and Figure 9(B) is an enlarged perspective view of a part thereof;

20 Figure 10 is an enlarged plan view of part of the wire net of Figure 9(A), the arrows indicating the viewing directions of Figures 12(A) to 12(C), respectively;

25 Figure 11(A) is an enlarged plan view showing part of one embodiment of the second surface material of the present invention and Figure 11(B) is a similar view with the lines a-a, b-b and c-c corresponding to the viewing directions (a), (b) and (c) in Figure 10, respectively;

30 Figures 12(A) to 12(C) are enlarged vertical sectional views showing the hole portion of the surface material of Figures 11(A) and 11(B) viewed in the direction of the arrows (a), (b) and (c), respectively in Figure 10;

Figure 13(A) is a plan view showing part of another embodiment of the second surface material of the

present invention, and Figure 13(B) is an enlarged perspective view showing a part thereof on an enlarged scale;

5 Figure 14(A) is an enlarged plan view showing a part of a spiral knitted wire net used in the method of manufacturing the surface material of Figures 13(A) and 13(B), and Figure 14(B) is an enlarged perspective view showing a part thereof; and

10 Figure 15 is a schematic diagram showing one embodiment of the method of manufacturing the surface material of the present invention.

The first embodiment of surface material 2 shown in Figures 1 to 4 is intended for covering the surface of an absorbent member of an absorbent sanitary article 1. The
15 surface material 2 is formed of a fluid impermeable material and is provided with a plurality of opening portions 4 each of which defines a fluid permeating opening or passage.

The surface material 2 comprises a plurality of
20 elongate top portions or ridges 5, each constituting a convex curved surface with an empty space behind it, a plurality of open bottom or depending portions 6, and a plurality of cylindrical wall portions 7 connecting the top portions 5 to the open bottom portions 6. Each hole
25 portion 4 is a communicating or open structure comprising a number, in this case four, of adjacent top portions 5, a single open bottom portion 6 and a single cylindrical wall portion 7.

Each hole portion has a smallest portion 5b, which
30 is smallest in cross-sectional area, between the opening 5a defined by the top portions 5 and the open bottom portion 6. The cross-sectional area of each hole portion 4 is larger than that of the smallest portion 5b towards the upper edge portion 5c of the top portion 5, and equal

to or larger than it towards the open bottom portion 6. The cylindrical wall portions of the surface material of the present invention may be of any cross-sectional shape provided that they are of short pipe-like construction. The cross-section of the wall portions need not be circular but may be of any appropriate shape.

The film thickness of the surface material 2 is preferably 15 to 50 μm having regard to its feel and appearance and preferably 20 to 40 μm having regard to its strength and cost.

Examples of fluid impermeable materials (hydrophobic sheet) for the surface material 1 include a hydrophobic thermoplastic resin sheet, e.g. of polyolefin, a copolymer of olefin and other vinyl monomers such as acrylic ester and vinyl acetate, polyester, polyamide and the like. Of these, a hydrophobic thermoplastic resin sheet of materials such as polyolefin, a copolymer of olefin and other monomers, or polymer blend series is preferred having regard to its feel, appearance and handling.

The fluid impermeable material is also preferably opaque. Although the colour of fluid, such as blood and urine, absorbed in the absorbent member can be masked by means of the configuration of the top portions 5, the open bottom portions 6 and the cylindrical wall portions 7 even if the fluid impermeable material is transparent, the fluid impermeable material can effectively conceal the colour of the fluid if the material itself is opaque. Various ways of making the fluid impermeable material itself opaque are possible. For example, the addition of fillers, either alone or in combination with others such as titanium oxide, white pigment such as zinc oxide, calcium carbonate and clay to the surface material during its manufacture is popular.

In order to balance the fluid permeating property and fluid return prevention property, the thickness of the surface material 2, i.e. the height difference d between the upper edge portions 5c of the top portions 5 and the lower end of the peripheral portion 6a of the open bottom portion 6 is preferably 0.2 to 3.0 mm, and more preferably 0.5 to 2.0 mm. The density of the hole portions 4 (number of the hole portions per unit area of the surface material) is determined taking into consideration the balance between the fluid permeating property and fluid return prevention property and varies in dependence on the difference in the open area of each open bottom portion 6 and that at the top of the hole portion. However, it is preferably 2 cm^2 to 200 cm^2 . If the open area of the open bottom portion 6 is small and the density of the hole portions 4 is low, the fluid permeating property is substantially inferior, and the tendency of the sheet material to tear increases as the open area of the open portion 5a of the top portion 5 increases and the density of the hole portions 4 increases also. Taking these factors into consideration, the density of the hole portions 4 is preferably $2/\text{cm}^2$ to $200/\text{cm}^2$, and particularly preferably $2/\text{cm}^2$ to $100/\text{cm}^2$.

The top portions 5 have a convex curved surface with an empty interior 9. By virtue of this empty space, when the top portions 5 contact the user's body a free space is formed between the surface material 2 and the user's body which inhibits the retention of sweat and discharged substances between the body and the surface material 2. In addition, as shown in Figure 5, even when a force (in the direction indicated by the arrow) is applied as a result of movements of the user's body, the surface material 2 can follow complicated movements of the wearer with the top portions 5 in point or line contact with the

skin and no feeling of physical discomfort is produced. The top portions 5, as shown in Figure 4, are thus convexly rounded and produce a feeling of dryness.

Furthermore, due to the configuration of the top portions 5, the hole portions 4 are elastically deformed in dependence on the movements of the user, and a discharged fluid, particularly of a highly viscous nature, is transferred effectively towards the absorbent member by the action of the hole portions 4 which may be likened to the ciliary movement of the human oesophagus.

The size or height of this empty space 9, i.e. the height difference d_1 between the upper edge portion 5c of the top portion 5 and the lower edge portion 5d of the top portion 5 is 0.05 to 1.0 mm, and preferably 0.1 to 0.6 mm if the elasticity of the surface material (film) 2 is taken into consideration.

The height of the empty space 9 is substantially equal to the height of the top portion 5. Therefore, the "height of the top portion" as will be described later is represented by the height difference d_1 , and the lower edge portions 5d of the top portions 5 are connected together by a respective connecting portion 2c.

The smallest portion 5b of the opening or passage 8 in the hole portion 4 is located between the opening 5a defined by the top portions 5 and the peripheral edge portion 6a of the open bottom portion 6 and is preferably located in the opening 5a between the top portions 5, as shown in Figure 3. This cross-sectional area of the smallest portion 5b is preferably 0.02 to 9 mm², and particularly preferably 0.1 to 3 mm². If this cross-sectional area is smaller than 0.02 mm², the fluid permeating property is inferior, and if it is larger than 9 mm², the fluid return prevention property is inferior.

The length around the opening 5a is at least 5% and

preferably 8% larger on the upper edge portion 5c side of the opening 5a and at least 10% and preferably 15% larger on the lower edge portion side than the peripheral distance around the passage 8 at the smallest portion 5b.

5 The length of the periphery of the opening 5a at the opening portion 5e defined by the upper edge portion 5c is preferably 0.04 to 15 mm², and particularly preferably 0.2 to 5 mm².

10 The cross-sectional area of the portion 7a of the cylindrical wall portion 7 below the smallest portion 5b is larger than that of the smallest portion 5b. In this embodiment, the cylindrical wall portion 7 broadens downwardly in the portion 7a toward the open bottom portion 6, in other words, the portion 7 is downwardly
15 divergent in section. Furthermore, in this embodiment, the cylindrical wall portion 7 has a convex curved surface towards the interior.

20 The cross-sectional area of the portion 7a of the cylindrical wall portion 7 is preferably 0.03 to 10 mm², and particularly preferably 0.15 to 3.0 mm².

 The cross-sectional area of the opening 6b in the open bottom portion 6 surrounded by the peripheral edge portion 6a is larger than the cross-sectional area of the portion 7a of the cylindrical wall portion 7.

25 The area of the opening 6b is preferably 0.04 to 15 mm², and particularly preferably 0.2 to 5 mm².

 The peripheral portion 6a of the open bottom portion 6 is that portion which contacts the absorbent member 3 when the surface material 2 of the present invention is
30 used as the surface material of an absorbent article.

 The absorbent member 3 is provided at its rear surface with a back surface material 2' (see Figure 1) adapted to cover the rear surface to prevent fluid leakage from it.

The formation of the hole portions 4 in the manner mentioned above results in the surface material exhibiting favourable absorption characteristics in spite of the reduction in the capillary effect. It exhibits a significant absorption characteristic, particularly for discharged substances with a high viscosity and low flowability. Furthermore, the surface material 2 of the present invention exhibits a greater absorptivity than the conventional surface materials operating by capillary action, particularly when the user is moving, e.g. walking.

The second embodiment of surface material 20 of the present invention will now be described with reference to Figures 10 to 12. In general terms the structure of the second embodiment is similar to that of the first embodiment and is as shown in Figures 2(A) and 2(B). However, the hole portions 4 are of somewhat different construction, as shown in Figures 10 to 12.

More specifically, each of the hole portions 4, which are of communication opening structure, has the open bottom portion 6 of a height M_3 (distance in a width direction of the surface material 20, between a lower peripheral edge 61 and an upper peripheral edge 62 at the open bottom portion 6) shorter than a height M_1 (distance in a width direction of the surface material 20) of a formation portion of the top portion 5 and/or a height M_2 (distance in a width direction of the surface material 20) of a formation portion of the cylindrical wall portion 7.

In this embodiment, each of the hole portions is of different cross-sectional shape in different cross-sectional planes which include the central axis of the hole portion in the width direction of the surface material 20. As representative examples, sectional views

are shown in Figures 12(A), 12(B) and 12(C) which are viewed from the directions indicated by the arrows (a), (b) and (c) in Figures 10 and 11.

In Figures 12(A) to 12(C), the height M_1 of the top portion 5 is preferably 0.05 to 2.0 mm and more preferably 0.1 to 0.5 mm. The height M_2 of the cylindrical wall portion 7 is preferably 0.05 mm to 2.0 mm and more preferably 0.1 to 0.5 mm. The height M_3 of the open bottom portion 6 is preferably 0.05 to 1.0 mm and more preferably 0.05 to 0.2 mm. M_3 is always set to be smaller than M_1 and/or M_2 . The distance L (see Figure 11(A)) between adjacent parallel top portions 5 is preferably in the range of from 0.05 to 8 mm, and more preferably 0.2 to 5 mm.

The length around the open bottom portion 6 is preferably 0.1 to 15 mm and more preferably 0.5 to 5 mm.

The open area and density of the opening portions 5a between the top portions 5 are the same as in the first embodiment 2.

By setting the dimensions of the top portions 5, the cylindrical wall portions 7 and the open bottom portions 6 to those mentioned above, the second surface material 20 exhibits excellent expansion/contraction properties and compressive elasticity and has a small shearing yield stress even if a material having a high elastic modulus is used. Therefore, the shearing force in any direction along the surface of the surface material 20 is small. As a result, the surface material can follow complicated movements of the wearer with the top portions 5 in point-contact with the skin, displacement during wear does not occur and a feeling of stickiness and physical discomfort are not produced, even when the surface material 20 is in intimate contact with the skin.

Figures 13(A) and 13(B) show a modified version 21

of the second surface material. This surface material 21 is formed of a sheet-like molten resin whose surface configuration reproduces that of a spiral knitted wire net 70 (see Figures 14(A) and 14(B)) formed of alternate right and left handed spirals 71 connected by rods 72. The surface material 21 has hole portions 41 at positions corresponding to opening portions defined by the wire rods of the spiral knitted wire net 70. Its construction is substantially similar to that of the second surface material 20 described above.

In this embodiment, the top portions 51 have an upwardly rounded, non-circular convex shape in section. When no load is applied, the top portions 51 afford a point or linear contact surface. When a load is applied, it affords a contact surface with an elliptical outer periphery whose length corresponds to the load. As a result, the same effect as with the surface material 20 is obtained.

The present invention is not limited to the above embodiments. It can be modified in various ways without departing from the scope of the present invention.

For example, the surface material 2 may be provided with micro irregularities 12, as shown in Figure 8. This construction produces a further improvement in the feel and appearance of the surface material and the feeling of physical discomfort is further reduced, in use. The irregularities 12 can be formed by means of, for example, filler mixing or by applying pressure onto the surface material.

As shown in Figure 7, the hole portion 4 may be designed such that the smallest portion 5b of the permeating passage is located within the opening portion 5a and the cross-sectional area of the portion 7a of the cylindrical portion 7 is made generally equal to that of

the opening 6b surrounded by the peripheral edge portion 6a of the open bottom portion 6, whereby the cylindrical wall portion 7 and the open bottom portion 6 are of substantially cylindrical shape.

5 One method of manufacturing the first surface material of the present invention will now be described with reference to Figure 15 and others.

10 The method shown in Figures 15, 9(A) and 9(B), comprises supplying surface material forming resin 50 to the upper surface of a surface material forming template comprising a spiral knitted wire net 11, drawing the resin under reduced pressure from the lower surface of the template 11 to form the depending portions 7, 6 and spraying air from above to rupture the ends of the depending portions and form the openings 6b, thereby forming the resin 50 into a sheet (i.e. the surface material 2) having a shape corresponding to the surface configuration of the template 11 and having hole portions at positions corresponding to the spaces defined by the wire rods of the wire net.

20 The material of the spiral knitted wire net 11 is preferably metal because strength cooling ability for hardening the molten resin are required. When the spiral knitted wire net 11 is made of metal, its reverse surface is preferably coated with resin to improve its anti-corrosion properties and removability of the surface material from the template etc.

25 The spiral knitted wire net 11 may be formed of a plurality of twisted wire rods or it may be a spiral knitted wire net with irregularities or a spiral knitted wire net formed of a combination of wire rods of different thickness.

30 One example of the surface material forming resin 50, which is to be supplied to the surface of the wire

net 11, is a molten resin drawn in sheet form (12 to 50 g/m²) from molten thermoplastic resin (150 to 300°C) in a tank 51 through a T-die. A sheet (10 to 50 g/m²) obtained by forming a thermoplastic resin and heating it may also be used as the surface material forming resin 50.

After the sheet-like molten resin 50 is applied to the surface of the wire net 11, heated air (80 to 300°C) is sprayed against the resin 50 from an air sprayer 52 facing the upper surface of the wire net 11 to apply a pressure to the resin 50 and at the same time the resin 50 is vacuum drawn from below by a vacuum drawing device 53 to form the hole portions 4 each having an open bottom portion. Thus the sheet-like molten resin 50 may be applied continuously to the surface of an endless rotating spiral knitted wire net 11 which is rotated in the direction indicated by the arrow in Figure 15. The sheet-like molten resin 50 is carried along by the wire net 11 and cooled and hardened by the wire rods 11a. Air bubbles (hole portions) 4', shown in Figure 6, are formed in the space between the wire rods 11a of the wire net 11, and the bottom portion of the hole portions 4' are burst to form the open bottom portions 6.

As shown in Figure 6, when the hole portions 4' have not yet been burst, the plurality of top portions 5, each affording a convex curved surface are formed in a shape matching the surface configuration of the wire rods 11a which are located at the uppermost region of the spiral knitted wire net 11. The plurality of open bottom portions 6 of the surface material 2 are formed at the lower portions of the non-open hole portions 4' which project through the spaces between the wire rods 11a of the spiral knitted wire net 11.

The surface material of the present invention can be obtained easily and rapidly by the manufacturing method

of the present invention thus described by appropriately controlling the air pressure applied to the surface material forming resin supplied to the wire net and the temperature of the molten resin.

5 The second surface material of the present invention may be manufactured as follows:

10 Initially the method steps are the same as in the method of manufacturing the first embodiment but after a large number of hole portions 4, each having an open bottom portion 6 have been formed and the sheet-like molten resin has been cooled and hardened on the wire net 11, heated air (at 150 to 500°C) is blown against the resin from below the wire net 11 in order to heat the peripheral edge portions of the open bottom portions 6.
15 As a result, the peripheral edge portions of the open bottom portions contract and the second surface material is obtained. The length of the hole portions is not less than the thickness of the metal net 11.

20 The method for manufacturing the surface materials of the present invention will now be further described by way of specific examples.

EXAMPLE 1

(FOR MANUFACTURING THE FIRST SURFACE MATERIAL)

25 A wire net (SP-26-0.3 manufactured by Kansai Kanaami K.K.) of 26 meshes formed of spirals in the same sense of wire with a diameter of 0.35 mm was used as the spiral knitted wire net 11 and low density polyethylene molten resin containing 5% of TiO_2 was used as the surface material forming resin.

30 As shown in Figure 15, the molten resin was supplied from the T-die of the tank 51 onto the spiral knitted wire net 11 to constitute the sheet-like molten resin 50 with a density of 25 g/m². The molten resin 50 is vacuum drawn from below the spiral knitted wire net 11 by the

vacuum nozzle of the vacuum drawing device 53 and, at the same time, air heated up to 50°C is linearly blown against the sheet-like molten resin 50 at a rate of 40 m³/min from above the spiral knitted wire net 11 to form the surface material 2 was obtained. The surface material 2 has a number of fluid permeating openings and hole portions corresponding to that of the meshes of the wire net and has a surface configuration corresponding to that of the spiral knitted wire net 11.

The smallest portion 5b of the cross-sectional area of the permeating passages in the surface material 2 was 0.1 mm across, the open area of the mouth 5e of the permeating passages was 0.7 mm across and the open area of the opening 6b in the bottom portion 6 was 0.5 mm across.

A catamenial napkin (absorbent article) 1 as shown in Figure 1 was manufactured using the surface material 2. The catamenial napkin thus manufactured was superior in absorption compared with a catamenial napkin using the conventional surface material. It had a dry feel and fitted well and followed the movements of the wearer. Moreover, it did not produce any feeling of physical discomfort.

EXAMPLE 2

(FOR MANUFACTURING THE SECOND SURFACE MATERIAL)

The method was the same as that of Example 1 but after the hole portions 4 were formed heated air (at 300°C to 400°C), normally 340°C to 360°C) was applied to the resin from below the wire net 11. The peripheral edge portions 6a of the surface material partly contracted as a result of the heating and the resulting surface material 21 had the structure and effects described above.

CLAIMS

1. A surface material comprising a fluid impermeable material having a plurality of hole portions each defining a fluid permeating passage; the surface material comprising a plurality of top portions each having a convex curved surface and defining an empty internal space, a plurality of open bottom portions and a plurality of annular wall portions, each hole portion comprising a plurality of adjacent top portions defining an opening, a single open bottom portion and a single annular wall portion connecting the said top portions and the said bottom portion, each permeating passage having a smallest portion of minimum cross-sectional area situated between the mouth of the opening formed by the associated top portions and the open bottom portion, the cross-sectional area of the permeating passage increasing from the smallest portion towards the mouth of the opening defined by the top portions and remaining substantially constant or increasing towards the open bottom portion.

2. A surface material as claimed in claim 1, wherein the smallest portion is located in the portion of the permeating passage defined by the top portions.

3. A surface material as claimed in claim 1 or 2, wherein the open area of the open bottom portion is equal to or larger than the cross-sectional area of the annular wall portion.

4. A surface material as claimed in any one of the preceding claims in which the cross-sectional area of the annular wall portion increases from the smallest portion towards the open bottom portion and the cross-sectional



area of the open bottom portion connected thereto decreases in the same direction, the height of the open bottom portion being less than that of the top portions and/or that of the annular wall portions.

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5. A surface material as claimed in claim 4, wherein each of the hole portions is asymmetrical in different planes which include the axis of the permeating passage.

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6. A method of manufacturing a surface material for an absorbent article comprising supplying a resin to one side of a template formed of a spiral knitted wire net defining a plurality of openings, the wires defining the said side of the template having a convex curved surface, applying a reduced pressure to the other surface of the template and blowing air at the resin from the said one side of the template, thereby forming the resin into a sheet whose surface configuration matches that of the template and drawing portions of the sheet through the said openings, to form closed end tubular structures and rupturing the closed ends of the tubular structures by forming an opening therein, whereby the surface material has a plurality of permeating passages formed therein, each being defined by a plurality of top portions formed by the said wires, an annular wall portion and a single bottom portion in which the opening is formed, each permeating passage having a smallest portion of minimum cross-sectional area situated between the mouth of the opening formed by the associated top portions and the open bottom portion, the cross-sectional area of the permeating passage increasing from the smallest portion towards the mouth of the opening defined by the top portions and remaining substantially constant or increasing towards the open bottom portion.



7. A method as claimed in claim 6, further comprising heating the open ends of the tubular structures thereby causing the peripheral edge of the openings therein to contract.

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8. A method as claimed in claim 6 or claim 7, wherein the resin is applied to the template in sheet-like molten form.

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9. A method as claimed in claim 6 or 7, wherein the resin is pre-formed into sheet-like form prior to its application to the template.

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10. A surface material for an absorbent article substantially as specifically herein described with reference to Figures 2 to 5, optionally as modified in Figure 7 or Figure 8, or Figure 12 or Figure 13 of the accompanying drawings.

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11. A method of manufacturing a surface material for an absorbent article substantially as specifically herein described with reference to Figure 15 in conjunction with Figure 9 and 10 or Figure 4 of the accompanying drawings.

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12. An absorbent sanitary article comprising a sheet of permeable material connected to a sheet of impermeable material with an absorbent member therebetween, the sheet of permeable material being as claimed in any one of claims 1 to 5 and 10 or being manufactured by a method as claimed in any one of claims 6 to 9 or 11, the open bottom portions of the hole portions or tubular structures being situated adjacent to the absorbent member.

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