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(54) **NONWOVEN FABRIC AND METHOD FOR PRODUCTION THEREOF**

VLIESSTOFF UND VERFAHREN ZU DESSEN HERSTELLUNG

TEXTILE NON-TISSE ET PROCEDE PERMETTANT DE LE PRODUIRE

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Description

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates to an elastically stretchable nonwoven fabric having a smooth touch to skin and also to a process for making the same.

RELATED ART

[0002] Japanese Patent Application Publication No. 1994-184897 discloses an elastically stretchable web formed by laminating a fibrous layer of elastically stretchable polymer with a fibrous layer of inelastic stretchable polymer.

[0003] Japanese Patent Application Publication No. 1997-512313 also discloses an elastically stretchable web formed by laminating the fibrous layer of elastically stretchable polymer with the fibrous layer of inelastic stretchable polymer.

[0004] Japanese Patent Application Publication No. 1992-11021 discloses an elastically stretchable conjugated thread comprising a core-sheath-type conjugated fiber of which the core fiber is made of elastically stretchable urethane and the sheath fiber is made of inelastic stretchable polyamide.

[0005] Japanese Patent Application Publication No. 1997-316748 discloses an elastically stretchable fabric including a core-sheath-type conjugated filament as a weft. In this fabric, the elastomeric core and the non-elastomeric sheath of the filament are separated from each other and the sheath slackens to form bellows-like wrinkles as the filament is drawn.

[0006] Japanese Patent Publication No. 3262803 discloses an invention relating to multi-component thermoplastic continuous filaments obtained by melt spinning, a product formed of such filaments and a process for forming such a product. According to the disclosure of the above-cited Publication, multi-component thermoplastic filaments extruded from the extruder is introduced through a quenching chamber into a Lurgi-duct within which the filaments are drawn and split under the effect of compressed air supplied thereinto. The filaments split in this manner are accumulated on a collecting surface formed by perforated screen or the like.

[0007] Japanese Patent Application Publication No. 1997-291454 discloses an invention relating to an elastically stretchable nonwoven fabric. According to the disclosure of the above-cited Publication, the elastically stretchable non-woven fabric is formed using elastically stretchable conjugated fibers consisting of a hard elastic member comprising crystalline polypropylene as a first component and a thermoplastic elastomer as a second component. The conjugated fibers may be selected from a group including those of various types such as side-by-side and sheath-and-core. Such conjugated fibers can be finished into nonwoven fabric by various processes such as spun bonding and thermal bonding processes.

[0008] JP 05131580 discloses a stretchable fiber sheet and the manufacture thereof. A composite filament is made up of elastic fibers represent non-elastic fibers, and has a surface area such that the elastic fibers represent preferably 50-75% of the surface area of the composite fiber as a whole.

[0009] EP-A-1184163 discloses an elastically stretchable composite sheet including an elastically stretchable first web and an inelastically stretchable second web of thermoplastic synthetic resin fiber which is intermittently bonded to the first web, and a process for making the same.

DISCLOSURE OF THE INVENTION

[0010] In the web and the nonwoven fabric disclosed in the above-cited Publication Nos. 1994-184897 and 1997-512313, respectively, the fibrous layer made of elastically stretchable polymer is exposed on the surface of the fabric. The fibers made of such polymer exhibit a relatively high friction coefficient and correspondingly rough touch. The elastically stretchable web or non-woven fabric formed by laminating the fibrous layers tend to be a thick one.

[0011] The conjugated thread and the fabric disclosed in the above-cited Publication Nos. 1992-11021 and 1997-316748, use the core-sheath type conjugated fiber of which the core is formed by elastomeric fiber and the sheath is formed by non-elastomeric fiber. The sheath functions to cover the elastically stretchable polymer, i.e., the elastomeric fiber and thereby to prevent the elastomeric fiber from coming in direct contact with the user's body. In this way, the conjugated thread as well as the fabric disclosed in the above-cited Publications are able to offer a smooth touch to the skin and a comfortable touch for the user's body. However, the sheath fiber presenting bellows-like wrinkles obstructs the core fiber from elastically contracting and, in consequence, limits an extension coefficient as well as a contraction coefficient of the conjugated thread and the fabric. The conjugated fiber has its sheath formed with the bellows-like wrinkles and therefore it is difficult for these conjugated thread and fabric to offer the soft and flexible touch peculiar to the fiber having a small fineness.

[0012] According to the above-cited Publication No. 3262803, the multi-component thermoplastic filaments are split to a plurality of more fine filaments within the Lurgi duct and then formed into a nonwoven fabric. Repective components constituting the multi-component thermoplastic filament appear on the surface of this nonwoven fabric in a form of more

fine filaments in accordance with the mixing proportion of these components. If one of the components is a thermoplastic elastomer, the filament of such a thermoplastic elastomer will be exposed on the surface of the nonwoven fabric and a wearer of a wearable article made of the nonwoven fabric may experience a rough touch with poor slip properties of the nonwoven fabric depending on a proportion of the thermoplastic elastomer filament.

[0013] According to the above Publication No. 1997-291454, the elastically stretchable conjugated fiber consisting of the hard elastic member comprising polypropylene as the first component and the thermoplastic elastomer as the second component are intermittently welded into an elastically stretchable nonwoven fabric. The circumferential surface of the conjugated fiber is defined by zones occupied by polypropylene and zones occupied by the elastomer. In this case the thermoplastic elastomer is inevitably exposed on the surface of the nonwoven fabric. Consequently, this nonwoven fabric may have a rough touch and poor slip properties. The above Publication No. 1997-291454 describes as one of embodiments a sheath-and-core type conjugated fiber of which the sheath is formed by polypropylene as the first component and the core is formed by the elastomer comprising ethylene-α-olefin copolymer as the second component. The elastic stretchability of such a conjugated fiber is governed by the stretchability of the hard elastic member comprising polypropylene and the stretchability of the elastomer might be thereby suppressed.

[0014] It is an object of the present invention to provide a novel elastic nonwoven fabric adapted to have a broad elastic extension range as well as a broad elastic contraction range and to offer a smooth touch to the skin.

[0015] The present invention has a first aspect relating to a nonwoven fabric and a second aspect relating to a process for making the nonwoven fabric.

[0016] According to the first aspect of the invention, there is provided an elastically stretchable nonwoven fabric as defined in claim 1.

[0017] The first aspect of the invention can be implemented in preferable manners as follows:

(1) the first and second fibers intersect with each other in such a manners that the first fiber lies inside and the second fiber lies outside in any one of the first and second surfaces;

(2) the first fiber has on its circumferential surface first curved surfaces each bulging radially outward from an axis of the first fiber and second curved surfaces each depressed radially toward the axis of the first fiber, the first and second curved surfaces alternately appearing in a circumferential direction of the first fiber, and each pair of the first curved surfaces neighboring to each other in the circumferential direction cooperate with the second curved surface lying between the pair of the first curved surfaces neighboring to each other to form a groove extending in a longitudinal direction of the first fiber so that the second curved surface defines a bottom of the groove. In the case that the nonwoven fabric having such a first fiber is used for a wearable article, these are little chances where the first fiber contacts the skin of a wearer of the article, because the curved surfaces of the first fiber cannot contact the skin.

(3) one of the first and second surfaces has a slip angle of 25° to 40°. The nonwoven fabric having the slip angle of such a range is suitable for a wearable article and other products.

(4) the first polymer is selected from the group consisting of thermoplastic polyurethane and thermoplastic polyurethane containing a lubricant and the second polymer is selected from the group consisting of polyolefin-based polymer and polyamide-based polymer.

[0018] The object set forth above is achieved according to the second aspect of the invention as defined in claim 5.

[0019] The second aspect of the invention can be implemented in preferable manners as follow:

(1) the first fibrous component of the conjugated fiber has on its circumferential surface first curved surfaces each bulging radially outward from an axis of the first fibrous component and second curved surfaces each depressed radially toward an axis of the first fibrous component, the first and second curved surfaces alternately appearing in the circumferential direction of the first fibrous component, and each pair of the first curved surfaces neighboring to each other in the circumferential direction cooperate with the second curved surface lying between the pair of the first curved surfaces neighboring to each other to form a groove extending in the longitudinal direction of the first fibrous component so that the second fibrous component extends in parallel to the first fibrous component in the groove.

(2) the circumferential length of the conjugated fiber occupied by the second fibrous component is in a range of 40 to 90% of the whole circumferential length of the conjugated fiber.

(3) the number of the second fibrous component constituting the conjugated fiber is in a range of 1 to 16 per one of the first fibrous component.

(4) the first polymer is selected from the group consisting of thermoplastic polyurethane and thermoplastic polyurethane containing a lubricant and the second polymer is selected from the group consisting of polyolefin-based polymer and polyamide-based polymer.

[0020] In the present invention the slip angle is measured in an apparatus depicted by an accompanying drawing, i.e.

Fig. 11. The measuring method of the slip angle is included in the explanation of Fig. 11.

[0021] The nonwoven fabric according to the present invention, even when the nonwoven fabric contains the elastic fiber, allows the smooth touch of the nonwoven fabric to the article wearer' s skin to be adjusted by placing in the vicinity of each of the elastic fiber at least one inelastic fiber which is longer than the elastic fiber. The smooth touch to the article wearer's skin can be effectively adjusted by placing a plurality of the inelastic fibers in the vicinity of the elastic fiber so as to surround this elastic fiber. Since the segment of the inelastic fiber defined between a pair of the neighboring attaching areas in which the inelastic fiber is inseparably attached to the elastic fiber is longer than the associated segment of the elastic fiber, the elastic stretchability of the elastic fibers as well as the nonwoven fabric is not disturbed by the inelastic fiber.

[0022] The process according to the present invention for making the nonwoven fabric is primarily characterized in that the conjugated fibers consisting of the elastic fibrous component and the inelastic fibrous component separably attached to the surface of the elastic fibrous component are split into the respective fibrous components so that the inelastic fibers having a smaller fineness may surround the elastic fiber having a larger fineness. In this way, the process according to the present invention can provide thin nonwoven fabric which is elastically stretchable and contractible and allows also at least one of the upper and lower surfaces of the nonwoven fabric to present a smooth touch and high slip properties of the inelastic fiber having a smaller fineness instead of those of the elastic fiber having a larger fineness.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

Fig. 1 is a perspective view showing a typical embodiment of a nonwoven fabric;
Fig. 2 is a photograph showing cross-sections of conjugated fibers;
Fig. 3 is a diagram tracing the conjugated fibers in photograph of Fig. 2;
Fig. 4 is a scale-enlarged plan view showing a part of Fig. 1;
Fig. 5 is a sectional view taken along a line V-V in Fig. 4;
Fig. 6 is a scale-enlarged portion of Fig. 5;
Fig. 7 is a view similar to Fig. 5 illustrating a relative position of the respective fibers when the nonwoven fabric is stretched;
Fig. 8 is a photograph similar to Fig. 2 showing a preferred embodiment of the present invention;
Fig. 9 is a diagram similar to Fig. 3 showing the preferred embodiment;
Figs. 10A, 10B and 10C are sectional views of the conjugated fibers; and
Fig. 11 is a side view of a tester.

DESCRIPTION OF THE BEST MODE FOR WORKING OF THE INVENTION

[0024] Details of the nonwoven fabric and the process for making the same according to the present invention will be more fully understood from the description given hereunder with reference to the accompanying drawings.

[0025] A substantially hexahedral fragment of nonwoven fabric 1 shown in Fig. 1 in a perspective view has upper and lower surfaces 2, 3 which extend parallel to each other and define the thickness of the nonwoven fabric 1 and side surfaces defined by cut surfaces 4a, 4b, 4c, 4d each intersecting the upper and lower surfaces 2, 3. The nonwoven fabric 1 comprises elastically stretchable fibers 11 made of a first thermoplastic polymer, inelastically stretchable fibers 12 made of a second thermoplastic polymer and conjugated fiber regions 13 formed by the elastic fibers 11 and the inelastic fibers 12 which are joined together side by side. In the nonwoven fabric 1, these fibers 11, 12 and the conjugated fiber regions 13 are welded, adhesively bonded or mechanically intertwined together at a plurality of attaching area 16 so that these fibers 11, 12 and the conjugated fiber regions 13 may be substantially fixed in the area 16. The elastic fibers 11 and the inelastic fibers 12 are obtained by splitting each conjugated fiber 13a corresponding to each of the conjugated fiber regions 13 into a fiber component 21 and a fiber component 22 (see Fig. 2) during a production process as will be described later. As will be seen in Fig. 1, the conjugated fiber regions 13 principally lie in the vicinity of the respective attaching area 16.

[0026] In the nonwoven fabric 1, the elastic fibers 11 have a fineness in a range of 0.1 dtx to 10 dtx and the inelastic fibers 12 have a fineness in a range of 0.05 dtx to 2 dtx. The fineness of the inelastic fiber 12 is preferably smaller than the fineness of the elastic fiber 11. Except for the area 16, in the surrounding area of each of the elastic fibers 11, one to sixteen of the inelastic fibers 12 extends or extend between the neighboring areas 16, for example, the area 16a and the area 16b depicted in Fig. 1. In the nonwoven fabric 1, at least three inelastic fibers 12a, 12b, 12c lie in the surrounding area of the individual elastic fiber 11a (see Fig. 5) and wrap around this elastic fiber 11a. In the vicinity of the areas 16a and 16b, the inelastic fibers 12a, 12b, 12c are branched and spaced apart from the elastic fiber 11a. Thus the elastic fiber 11 and the inelastic fibers 12 are repeatedly joined together (at the areas 16) and spaced apart from each other in

a longitudinal direction of the elastic fiber 11. Between the neighboring areas 16a and 16b, each segment of the inelastic fibers 12a, 12b, 12c is longer than the segment of the elastic fiber 11a, and the elastic fiber 11a is substantially rectilinear and the inelastic fibers 12a, 12b, 12c describe various curves, respectively. On the upper surface 2 and preferably on the lower surface 3, the ratio of the number of the elastic fiber 11a to the number of the inelastic fibers 12a, 12b, 12c is approximately 1:3. The elastic fiber 11a and the inelastic fibers 12a, 12b, 12c have ends thereof exposed on the cut surface 4a and the number of these ends approximately corresponds to the number of the elastic fibers 11a and the inelastic fibers 12a, 12b, 12c. In other words, a ratio of the ends of the elastic fibers 11a to the ends of the inelastic fibers 12a, 12b, 12c exposed on the cut surface 4a is approximately 1:3.

[0027] uses of the nonwoven fabric 1 are not specified. The nonwoven fabric 1 can be used for a wearable article, for example, a disposable diaper, disposable pants or a disposable medical gown, and household goods, for example, disposable wipes. In the nonwoven fabric 1 used in these fields it is preferable that a straight distance between the neighboring attaching areas 16a and 16b on the elastic fiber 11a is 0.5 - 10 mm, and that the lengths of the inelastic fibers 12a, 12b, 12c between the neighboring attaching areas 16a and 16b are 1.2 - 5 times of the length of the associated elastic fiber 11a.

[0028] The elastic fibers 11 are elastically stretched when the nonwoven fabric 1 of the arrangement as has been described above is held with the hands and pulled in a direction A or in a direction B intersecting orthogonally the direction A, whereupon the inelastic fibers 12 are oriented to extend in the direction A or in the direction B. Upon releasing from the pulled condition, an elastic recovery force of the elastic fibers 11 causes the nonwoven fabric 1 to shrink to the state of Fig. 1. It is well known that such an elastic material as the elastic fiber 11 has a rubbery rough touch, but the presence of the plural inelastic fibers 12 wrapping around the respective elastic fibers 11 is effective to provide the upper and lower surfaces 2, 3 of the nonwoven fabric 1 with a smooth and slipping touch similar to that of the inelastic fiber 12. In addition, the smooth and slipping touch of the nonwoven fabric 1 of the present invention can be controlled by a fineness, a shape of the cross section and a number of the inelastic fiber 12. The fineness of the inelastic fibers 12 may be minimized, for example, in the order of 0.5 dtx to 1.5 dtx to make the touch of the upper and lower surfaces 2, 3 more smooth and flexible.

[0029] Fig. 2 is a photograph showing cross-sections of conjugated fibers 13a used to make the nonwoven fabric 1 and Fig. 3 is a diagram tracing the conjugated fibers 13a in the photograph of Fig. 2. A plurality of the conjugated fibers 13a appearing in Fig. 2 are substantially identical one to another. Each of these fibers 13a has a diameter of 25 μm to 30 μm and comprises a single elastic fiber component 21 and three inelastic fiber components 22 separably attaching to the surface of the elastic fiber component 21 substantially at regular intervals in a circumferential direction. The conjugated fiber 13a is substantially identical to the conjugated fiber component 13 depicted in Fig. 1 in construction as well as in composition. The conjugated fiber 13a can be obtained by extruding simultaneously an elastic thermoplastic polymer to form the elastic fiber component 21 and an inelastic thermoplastic polymer to form the inelastic fiber component 22 through nozzles of an extruder for melt spinning well known in the art. The elastic fibrous component 21 has on its circumferential surface first curved surface portions 51 each bulging radially outward from an axis of the elastic fibrous component 21 and second surface portions 52 each depressed radially toward the axis of the elastic first fibrous component 21 so that these first and second surface portions 51, 52 alternately appearing in the circumferential direction of the elastic fibrous component 21. Each pair of first surface portions 51, 51 neighboring to each other in the circumferential direction cooperate with the second surface portion 52 lying between the pair of neighboring first surface portions 51 to form a groove 53 wherein the second surface portion 51 defines a bottom of the groove 53 and a total of three grooves 53a, 53b, 53c extend in the longitudinal direction of the elastic fibrous component 21. The inelastic fibrous component 22 comprises three inelastic fibrous components 22a, 22b, 22c extending in the longitudinal direction of the elastic fibrous component 21 in the grooves 53a, 53b, 53c, respectively.

[0030] The first polymer to be used to obtain the elastic fiber component 21 includes a thermoplastic polyurethane, a thermoplastic polyurethane containing lubricant and any other thermoplastic elastomers. The second polymer to be used to obtain the inelastic fiber component 22 includes thermoplastic polymer which is incompatible with the first polymer and stretches inelastically. The term "incompatible" used herein means that a conjugation strength of the inelastic fiber component 22 to the elastic fiber component 21 is relatively low and the inelastic fiber component 22 can be easily separated or split from the elastic fiber component 21, when the conjugated fiber 13a is stretched. The second polymer having such properties may be selected from the group including polyolefine polymer such as polyethylene or polypropylene and polyamide polymer such as nylon. Either homopolymer or copolymer of polypropylene can be used. The inelastic fiber 12 of polypropylene has preferably crystallinity less than 30 % and, more preferably, less than 20 % and does not include a fiber to be deemed as a hard elastic fiber. The crystallinity of the inelastic fiber 12 is measured by a DSC method in the present invention. The first elastic fiber component 21 may be made by thermoplastic polyurethane containing a lubricant such as fatty amide to facilitate the inelastic fiber component 22 to be separated easily from the elastic fiber component 21. An example of the elastic fibrous component 21 is a thermoplastic polyurethane whose melt viscosity based on JIS K 7311 is 23×10^3 - 180×10^3 poise. An example of the inelastic fiber component 22 is a polypropylene whose Melt Flow Rate (MFR) is 30 at 230°C and 2.16 kg/cm^2. A preferable weight ratio of the elastic

fibrous component 21 to the inelastic fibrous component 22 is 20:80 - 90:10. In a preferable case of the conjugated fiber 13a, the inelastic fibrous components 22 associated with each elastic fibrous component 21 have a circumferential length occupying 40 % to 90 % of the whole circumferential length of the composite fiber 13a. The areas and shapes of the elastic fibrous component 21 and the inelastic fibrous component 22 in the cross-section of the conjugated fiber 13a are formed in such a way that the elastic fiber 11 from the elastic fibrous component 21 may have a fineness of 0.1 - 10 dtx and the inelastic fiber 12 from the inelastic fibrous component 22 may have a fineness of 0.05 - 2 dtx and less than that of the elastic fiber 11. A preferable inelastic fibrous component 22 may have a flat cross-section such as an oval shape and the inelastic fiber 12 derived from the inelastic fibrous component 22 may have also a flat corss-section. If the inelastic fiber 12 has a flat cross-section, the length of the long axis may be longer than two times of the length of the short axis so that the inelastic fiber 12 can be easily bent.

[0031] Using such a conjugated fiber 13a, the nonwoven fabric 1 of Fig. 1 is formed in a manner as will be described. Preferably, the conjugated fiber 13a of continuous type is used. A plurality of conjugated fibers 13a is supplied in a machine direction to make a web having a basis weight of 10 g/m^2 to 500 g/m^2. In the course of making such a web, the attaching areas 16 depicted in Fig. 1 in which the conjugated fibers 13a are joined or intertwined together in an inseparable manner may be formed intermittently in one of the machine direction and the cross direction intersecting orthogonally the machine direction by an appropriate treatment, for example, by embossing the web under heating or by jetting high pressure columnar water to the web or by blowing a heated air to the web. This web may be stretched within an elastic range of the elastic fibrous component 21 and under a failure point of the inelastic fibrous component 22, for example, by 70 % or more in one direction or in two directions along which the attaching areas 16 are formed intermittently. Thereafter, the web is relieved from the stretched condition and is contracted by the elastic recovery force of the elastic fiber component 21 to obtain the nonwoven fabric 1 depicted in Fig. 1. Between each pair of the neighboring attaching areas 16, 16, for example, the areas 16a and 16b in Fig. 1, the conjugated fiber 13a is separated or split along the interfaces of the elastic fiber component 21 and the inelastic fiber components 22 into one elastic fiber 11 and three inelastic fiber components 12. At the same time, the inelastic fibers 12 also elongate so as to be permanently deformed and a diameter of each inelastic fiber 12 is reduced. In the nonwoven fabric 1 obtained by contracting the web, between each pair of the neighboring areas 16, 16, the elastic fibers 11 contract so as to describe a substantially straight line or a gentle curve while each of the inelastic fibers 12 longer than the elastic fiber 11 describes a curve which is more complicated than the elastic fibers 11 and intersect the elastic fibers 11 and the inelastic fibers 12.

[0032] Fig. 4 is a scale-enlarged plan view showing the elastic fibers 11a representing the elastic fiber 11 and the inelastic fibers 12a, 12b, 12c representing the inelastic fiber 12 on the upper surface 2 of the nonwoven fabric 1 of Fig. 1 obtained in the manner as has been described above, and Fig. 5 is a sectional view taken along a line V-V in Fig. 4. In the vicinity of the areas 16a, 16b, as will be apparent from Fig. 4, the elastic fiber component 21 and the inelastic fiber components 22 of the conjugated fiber 13a are not separated, and therefore, the conjugated fiber 13a forms the conjugated fiber regions 13. Between each pair of the neighboring areas 16a, 16b on the elastic fiber 11a separated from the inelastic fibers 12a, 12b, 12c, the elastic fiber 11a describes a substantially straight line while the inelastic fibers 12a, 12b, 12c describe various curves. The inelastic fiber 12b are intersecting the elastic fiber 11a so as to provide crossing points. At the crossing points the elastic fiber 11a lies inside and the inelastic fiber 12b lies outside in the thickness direction of the nonwoven fabric 1. On the cut surface shown in Fig. 5, the inelastic fibers 12a, 12b, 12c are distributed around the elastic fiber 11a so as to surround the elastic fiber 11a.

[0033] Fig. 6 is a scale-enlarged perspective view of the elastic fiber 11a of Fig. 5. The circumferential surface of the elastic fiber 11a is defined by first curved surface portions 61 each radially bulging outward from an axis of the elastic fiber 11a with a relatively small curvature radius and second curved surface portions 62 each radially depressed toward the axis of the elastic fiber 11a so that these first and second curved surface portions 61, 62 alternately appear on the circumferential surface of the elastic fiber 11a. The second curved surface portion 62 lies between each pair of the first curved surface portions 61 neighboring to each other in the circumferential direction and these first and second curved surface portions 61, 62 cooperate together to form a groove 63 extending in the longitudinal direction of the elastic fiber 11a. These first curved surface portion 61, second curved surface portion 62 and groove 63 respectively correspond to the first surface portion 51, the second surface portion 52 and the groove 53 of the conjugated fiber 13a depicted by Fig. 3.

[0034] With a wearable article made of the nonwoven fabric 1 including the elastic fiber 11 and the inelastic fiber 12 depicted in Figs. 4, 5 and 6, the article wearer's skin readily comes in contact with the inelastic fibers 12a, 12b, 12c rather than with the elastic fiber 11a. Consequently, a touch and slip properties of the nonwoven fabric 1 are similar to those of the inelastic fiber 12. This is very true, when the number of the inelastic fibers 12 intersecting the elastic fiber 11a is relatively large as in the case depicted in Fig. 4 and the elastic fiber 11a having a rough touch and poor slip properties to the article wearer's skin is embedded among the inelastic fibers 12 on the upper surface 2 of the nonwoven fabric 1. As will be apparent from Fig. 6, the elastic fiber 11a comes in contact with the article wearer's skin 69 indicated by imaginary lines merely in the vicinity of the first curved surface portions 61 but the second curved surface portions 62 rarely comes in contact with the skin 69. In this way, the circumferential surface of the elastic fiber 11a possibly coming in contact with the skin 69 is limited to an extremely small area having a small curvature radius. Compared to

an elastic fiber having a circular cross-section of the same area as that of the elastic fiber 11a, the surface area of the elastic fiber 11a coming in contact with the skin 69 is substantially reduced. The smaller the surface area of the elastic fiber 11a possibly coming in contact with the skin 69 is, the higher the smooth touch and slip properties of the nonwoven fabric 1 to the article wearer' s skin 69 are. Even if the elastic fiber 11a comes in contact with the skin 69, a gap is left in many cases between the skin 69 and the grooves 63 of the elastic fiber 11a and such a gap serves to relieve the skin 69 from a high humid condition since the gap allows a vapour generated within the article to escape outward. The nonwoven fabric 1 according to the invention can be implemented also in a manner that not the upper surface 2 but the lower surface 3 is constructed as depicted in Fig. 1 or the both surfaces 2, 3 are constructed as depicted in Fig. 1.

[0035] Fig. 7 is a view similar to Fig. 5 showing the nonwoven fabric 1 being pulled in the direction A indicated in Fig. 4. The inelastic fibers 12a, 12b, 12c of Fig. 5 move in directions indicated by arrows P, Q, R and get nearer to the elastic fiber 11a as the elastic fiber 11a is stretched in the direction A so that these inelastic fibers 12a, 12b, 12c may closely surround the elastic fiber 11a as shown in Fig. 7. If most of the inelastic fibers 12 of Fig. 7, orientate in the direction A, the touch and slip properties of the nonwoven fabric 1 may be further similar to the smooth touch and high slip properties of the inelastic fibers 11.

[0036] Figs. 8 and 9 are views similar to Figs. 2 and 3, exemplarily showing the conjugated fiber 13a suitably used in the present invention. This conjugated fiber 13a has a diameter of about 15μ and consists of the elastic fibrous component 21 presenting a semicircular cross-section and the inelastic fibrous component 22 presenting a semicircular cross-section which are separably attached together. The conjugated fiber 13a thus presents a substantially circular cross-section and the inelastic fibrous component 22 appearing on a circumferential surface of this conjugated fiber 13a occupies approximately 50% of the circumferential length of the conjugated fiber 13a. Also in the nonwoven fabric 1 obtained from the web comprising these conjugated fibers 13a by stretching the web and then allowing the web to contract, a length of the inelastic fiber derived from the inelastic fibrous component 22 is longer than the elastic fiber derived from the elastic fibrous component 21. With such inelastic fibers flexing and/or curving so as to intersect the elastic fibers, the inelastic fibers function to prevent the elastic fibers from coming in direct contact with the article wearer's skin. Consequently, the nonwoven fabric obtained from these conjugated fibers 13a exhibits a smooth touch and high slip properties to the article wearer's skin although a level of its slip properties can not be comparative to those exhibited by the nonwoven fabric 1 depicted in Fig. 1.

[0037] Since the nonwoven fabric 1 of the invention may be formed using the web of the conjugated fiber 13a comprising the elastic fibrous component 21 having the groove 53 as shown in Fig. 3 and the inelastic fibrous component 22 extending in this groove 53, it is easy to obtain the inelastic fiber 12 which has a fineness smaller than a fineness of the elastic fiber 11.

[0038] Figs. 10A, 10B and 10C exemplarily illustrate the cross-sections of the conjugated fibers 13a. The conjugated fiber 13a depicted in Fig. 10A presents a cross-section distinguished from that of the conjugated fiber 13a depicted in Fig. 9 in that the elastic fibrous component 21 is formed with a single groove 53. In the case of the conjugated fiber 13a depicted in Fig. 10B, the elastic fibrous component 21 is formed with a pair of grooves 53. Finally, in the case of the conjugated fiber 13a depicted in Fig. 10C, the elastic fibrous component 21 is formed with four grooves 53. In this manner, it is possible without departing from the scope of the invention to form the elastic fibrous component 21 with a selective number of the grooves 53 in a range of one to sixteen.

[0039] Fig. 11 is a side view of a tester 70 used in the present invention to evaluate the nonwoven fabric with respect to its slip properties. The tester 70 comprises a plate 71 driven by an electric motor 73 so that its angle α of a gradient relative to the horizontal plane may be increased at a predetermined rate and a block 72 to be covered with the nonwoven fabric to be evaluated. The plate 71 has its upper surface formed of stainless steel having a surface roughness of 12.5s as measured in accordance with JIS B 0601. The block 72 is made of stainless steel having a weight adjusted to exert a surface pressure of 10g/cm^2 upon the nonwoven fabric. The nonwoven fabric is attached to the block 72 so as to cover the entire lower surface of the block 72. The plate 71 supporting the block 72 is rotated around a pivot 74 so that the angle α increases at a rate of 2°/sec until the block 72 begins to slip over the upper surface of the plate 71. The angle α at which the block 72 begins to slip is defined as a slip angle as. The smaller the value of α_s is, the higher the slip properties relative to the article wearer's skin are. Based on the tester 70, clothing fabric for men' s and women' s shirts and pants as undergarments made of 100 % cotton exhibit the slip angle α_s in a range of about 21° to about 25°.

[0040] TABLE 1 indicates the slip angle α_s exhibited by the examples of nonwoven fabric of the conjugated fiber 13a depicted in Figs. 2 and 3 and control nonwoven fabrics. The nonwoven fabrics of the invention were obtained by subjecting the web having a basis weight of 50g/m^2 to heat embossing both in the machine direction and in the cross direction. The conjugated fiber 13a consisted of thermoplastic polyurethane and polypropylene at a weight ratio in a range of 84.4 : 15.6 to 67.9 : 32.1 and polypropylene occupied about 70 to 90 % of the circumferential length of the conjugated fiber 13a. The comparative embodiments of nonwoven fabric were made of thermoplastic polyurethane fiber or polypropylene fiber and obtained by subjecting the web having a basis weight of 50 g/m^2 to heat embossing in the same manner as in the case of embodiments of the invention. Both in the embodiments of the invention and in the comparative embodiments, a plurality of heat embossed zones each of 0.3 mm^2 were formed at a pitch of 2 mm in the machine direction

as well as in the cross direction. As will be apparent from TABLE 1, the slip angle α_s of the nonwoven fabric 1 depends on the percentage by which polypropylene as the inelastic fibrous component 22 occupies the circumferential length of the conjugated fiber 13a. In other words, the invention allows the slip angle α_s of the nonwoven fabric 1 to be controlled by adjusting the proportion of the inelastic fibrous component 22 occupying the circumferential length of the conjugated fiber 13a. When the nonwoven fabric 1 is used in a wearing article, the slip angle α_s of the upper surface 2 and/or the lower surface 3 is controlled preferably in a range of 25° to 40°.

[0041] In order to control the slip angle α_s of the nonwoven fabric 1, it is possible without departing from the scope of the invention to use, in addition to those indicated as the embodiments, the conjugated fiber 13a consisting of thermoplastic polyurethane and polypropylene at a weight ratio in a range of 20 : 80 to 90 : 10. It is also possible to use the conjugated fiber 13a in which polypropylene occupies 40 to 90% of the circumferential length of this conjugated fiber 13a.

[TABLE 1]

	Constituents of conjugated fiber (wt%)		Length occupied by polypropylene in the whole peripheral length of conjugate fiber (%)	Slip angle α_s
	Thermoplastic polyurethane	Polypropylene		
Example 1	84.4	15. 6	70. 92	39.3
Example 2	76. 5	23. 5	75. 04	34.3
Example 3	67. 9	32.1	86.07	30.3
Control 1	100	-	0	49.1
Control 2	—	100	100	21.3

[0042] The nonwoven fabric of the present invention can be used industrially for disposable wearable articles and the nonwoven fabric can be industrially manufactured through the manufacturing process of the present invention.

Claims

1. An elastically stretchable nonwoven fabric comprising elastically stretchable first fibers made of a first polymer and inelastically stretchable second fibers made of a second polymer, said nonwoven fabric being **characterized by** that:

   said nonwoven fabric has first and second surfaces as viewed in its thickness direction, said first and second surfaces extending in parallel to each other, said second fiber is bonded to said first fiber at attaching areas formed intermittently along said first fiber and spaced apart from said first fiber between each pair of said attaching areas neighboring to each other, each segment of said second fiber spaced apart from said first fiber between each pair of said attaching areas neighboring to each other being longer than an associated segment of said first fiber, the number of said second fiber is in a range of 3 to 16 per each first fiber
   , and said first and second fibers intersect with each other in such a manner that said first fiber lies inside and said second fiber lies outside in one of said first and second surfaces.

2. The nonwoven fabric according to Claim 1 , wherein said first fiber has on its circumferential surface first curved surfaces each bulging radially outward from an axis of said first fiber and second curved surfaces each depressed radially toward said axis of said first fiber, said first and second curved surfaces alternately appearing in a circumferential direction of said first fiber, and each pair of said first curved surfaces neighboring to each other in said circumferential direction cooperate with said second curved surface lying between said pair of said first curved surfaces neighboring to each other to form a groove extending in a longitudinal direction of said first fiber so that said second curved surface defines a bottom of said groove.

3. The nonwoven fabric according to claim 1 or 2 , wherein one of said first and second surfaces has a slip angle of 25° to 40°.

4. The nonwoven fabric according to any one of Claims 1 through 3, wherein said first polymer is selected from the group consisting of thermoplastic polyurethane and thermoplastic polyurethane containing a lubricant and said second polymer is selected from the group consisting of polyolefin-based polymer
   and polyamide-based polymer.

5. A process for making an elastically stretchable nonwoven fabric formed by elastically stretchable first fibers made of a first polymer and inelastically stretchable second fibers made of a second polymer, said process comprising steps of:

feeding, in a machine direction, a plurality of conjugated fibers each consisting of a first fibrous component made of said first polymer and a second fibrous component extending in parallel to and releasably attached to a surface of said first fibrous component and thereby forming a web from said conjugated fibers having a basis weight in a range of 10 to 500g/m^2;
forming said web with a plurality of attaching areas intermittently formed in at least one direction of said machine direction and a cross direction intersecting orthogonally said machine direction so that said conjugated fibers can not be separated one from another at said attaching areas;
stretching said web at least in said one direction within an elastic range of the first fibrous component and under a failure point of said second fibrous component and thereby separating said first and second fibrous components one from another between each pair of said attaching areas neighboring to each other and permanently deforming said second fibrous component; and
allowing said web to contract under an elastic recovery force of said first fibrous component so that said first fiber is obtained from said first fibrous component, said second fiber is obtained from said second fibrous component and said nonwoven fabric is obtained from said web the number of said second fibrous component constituting said conjugated fiber is in a range of 3 to 16 per one of said first fibrous component, said non woven fabric has first and second surfaces as viewed in its thickness direction, said first and second surfaces extending in parallel to each other and said first and second fibers intersect with each other in such a manner that said first fiber lies inside and said second fiber lies outside in one of said first and second surfaces.

6. The process according to Claim 6, wherein said first fibrous component of said conjugated fiber has on its circumferential surface first curved surfaces each bulging radially outward from the axis of said first fibrous component and second curved surfaces each depressed radially toward said axis of said first fibrous component, said first and second curved surfaces alternately appearing in a circumferential direction of said first fibrous component, and each pair of said first curved surfaces neighboring to each other in said circumferential direction cooperate with said second curved surface lying between said pair of said first curved surfaces neighboring to each other to form a groove extending in a longitudinal direction of said first fibrous component so that said second fibrous component extends in parallel to said first fibrous component in said groove.

7. The process according to claim 5 or 6, wherein the circumferential length of said conjugated fiber occupied by said second fibrous component is in a range of 40 to 90% of the whole circumferential length of said conjugated fiber.

8. The process according to any one of claims 5 through 7, wherein the number of said second fibrous component constituting said conjugated fiber is in a range of 1 to 16 per one of said first fibrous component.

9. The process according to any one of claims 5 through 8 wherein said first polymer is selected from the group consisting of thermoplastic polyurethane and thermoplastic polyurethane containing a lubricant and said second polymer is selected from the group consisting of polyolefin-based polymer and polyamide-based polymer.

Patentansprüche

1. Elastisch dehnbarer Vliesstoff, der elastisch dehnbare erste Fasern aus einem ersten Polymer und unelastisch dehnbare zweite Fasern aus einem zweiten Polymer aufweist, wobei der genannte Vliesstoff **dadurch gekennzeichnet ist, dass**:

der genannte Vliesstoff in seiner Dickenrichtung betrachtet eine erste und eine zweite Oberfläche hat, wobei die genannte erste und zweite Oberfläche parallel zueinander verlaufen, wobei die genannten zweiten Fasern an Anbringungsbereichen, die an den genannten ersten Fasern entlang diskontinuierlich ausgebildet sind, an die genannten ersten Fasern gebunden sind und zwischen jedem Paar der genannten miteinander benachbarten Anbringungsbereiche von den genannten ersten Fasern beabstandet sind, wobei jedes von der genannten ersten Faser beabstandete Segment der genannten zweiten Faser zwischen jedem Paar der genannten miteinander benachbarten Anbringungsbereiche länger als ein assoziiertes Segment der genannten ersten Fasern ist, die Zahl der genannten zweiten Fasern pro jeder ersten Faser im Bereich von 3 bis 16 beträgt und wobei die genannten ersten und zweiten Fasern einander so überkreuzen, dass in der genannten ersten oder zweiten

Fläche die genannten ersten Fasern innen und die genannten zweiten Fasern außen liegen.

2. Vliesstoff nach Anspruch 1, wobei die genannte erste Faser an ihrer Umfangsfläche erste gekrümmte Oberflächen, die sich jeweils von einer Achse der genannten ersten Fasern radial nach außen wölben, und zweite gekrümmte Oberflächen, die sich jeweils in Richtung auf die genannte Achse der genannten ersten Fasern radial vertiefen, hat, wobei die genannten ersten und zweiten gekrümmten Oberflächen in einer Umfangsrichtung der genannten ersten Faser abwechselnd erscheinen und wobei jedes Paar der genannten ersten gekrümmten Oberflächen, die in der genannten Umfangsrichtung miteinander benachbart sind, mit der genannten zweiten gekrümmten Oberfläche, die zwischen dem genannten Paar der genannten ersten miteinander benachbarten gekrümmten Oberflächen liegt, zusammenwirkt, um eine Nut zu bilden, die in einer Längsrichtung der genannten ersten Faser verläuft, so dass die genannte zweite gekrümmte Oberfläche einen Boden der genannten Nut definiert.

3. Vliesstoff nach Anspruch 1 oder 2, wobei die genannte erste oder zweite Oberfläche einen Rutschwinkel von 25° bis 40° hat.

4. Vliesstoff nach einem der Ansprüche 1 bis 3, wobei das genannte erste Polymer aus der Gruppe bestehend aus thermoplastischem Polyurethan und einen Schmierstoff enthaltendem thermoplastischem Polyurethan ausgewählt ist und das genannte zweite Polymer aus der Gruppe bestehend aus Polymer auf Polyolefinbasis und Polymer auf Polyamidbasis ausgewählt ist.

5. Verfahren zum Herstellen eines elastischen dehnbaren Vliesstoffs, der von elastisch dehnbaren ersten Fasern aus einem ersten Polymer und unelastisch dehnbaren zweiten Fasern aus einem zweiten Polymer gebildet wird, wobei das genannte Verfahren die folgenden Schritte aufweist:

Zuführen, in einer Maschinenrichtung, einer Vielzahl von konjugierten Fasern, die jeweils aus einer ersten faserförmigen Komponente aus dem genannten ersten Polymer und einer zweiten faserförmigen Komponente bestehen, die parallel zu und lösbar an einer Oberfläche der genannten ersten faserförmigen Komponente angebracht ist, und dadurch Herstellen einer Bahn aus den genannten konjugierten Fasern, die ein Flächengewicht im Bereich von 10 bis 500 g/m^2 hat,
Bilden der genannten Bahn mit einer Vielzahl von Anbringungsbereichen, die in wenigstens einer Richtung der genannten Maschinenrichtung und einer die genannte Maschinenrichtung orthogonal durchkreuzenden Querrichtung diskontiniuierlich ausgebildet sind, so dass die genannten konjugierten Fasern an den genannten Anbringungsbereichen nicht voneinander getrennt werden können,
Dehnen der genannten Bahn in wenigstens einer Richtung innerhalb eines elastischen Bereichs der ersten faserförmigen Komponente und unter einem Ausfallpunkt der genannten zweiten faserförmigen Komponente und dadurch Trennen der genannten ersten und zweiten faserförmigen Komponenten voneinander zwischen jedem Paar der genannten miteinander benachbarten Anbringungsbereiche und bleibendes Verformen der genannten zweiten faserförmigen Komponente und
Zusammenziehenlassen der genannten Bahn unter einer elastischen Rückstellkraft der genannten ersten faserförmigen Komponente, so dass die genannte erste Faser von der genannten ersten faserförmigen Komponente erhalten wird, die genannte zweite Faser vonder genannten zweiten faserförmigen Komponente erhalten wird und der genannte Vliesstoff von der genannten Bahn erhalten wird, wobei die Zahl der genannten zweiten faserförmigen Komponenten, welche die genannte konjugierte Faser bilden, in einem Bereich von 3 bis 16 pro einer der genannten ersten faserförmigen Komponente beträgt, wobei der genannte Vliesstoff in seiner Dikkenrichtung betrachtet eine erste und eine zweite Oberfläche hat, wobei die genannte erste und zweite Oberfläche parallel zueinander verlaufen und die genannten ersten und zweiten Fasern einander so überkreuzen, dass in der genannten ersten oder der genannten zweiten Oberfläche die genannten ersten Fasern innen und die genannten zweiten Fasern außen liegen.

6. Verfahren nach Anspruch 6, wobei die genannte erste faserförmige Komponente der genannten konjugierten Faser an ihrer Umfangsfläche erste gekrümmte Oberflächen, die sich jeweils von der Achse der genannten ersten faserförmigen Komponente radial nach außen wölben, und zweite gekrümmte Oberflächen, die sich jeweils in Richtung auf die genannte Achse der genannten ersten faserförmigen Komponente radial vertiefen, hat, wobei die genannten ersten und zweiten gekrümmten Oberflächen abwechselnd in einer Umfangsrichtung der genannten ersten faserförmigen Komponente erscheinen und wobei jedes Paar der genannten ersten gekrümmten Oberflächen, die in der genannten Umfangsrichtung miteinander benachbart sind, mit der genannten zweiten gekrümmten Oberfläche, die zwischen dem genannten Paar der genannten ersten gekrümmten miteinander benachbarten Oberflächen liegt, zusammenwirkt, um eine Nut zu bilden, die in einer Längsrichtung der genannten ersten faserförmigen Komponente

verläuft, so dass die genannte zweite faserförmige Komponente parallel zu der genannten ersten faserförmigen Komponente in der genannten Nut verläuft.

7. Verfahren nach Anspruch 5 oder 6, wobei die Umfangslänge der genannten konjugierten Faser, die von der genannten zweiten faserförmigen Komponente besetzt ist, im Bereich von 40 bis 90 % der gesamten Umfangslänge der genannten konjugierten Faser ist.

8. Verfahren nach einem der Ansprüche 5 bis 7, wobei die Zahl der genannten zweiten faserförmigen Komponenten, die die genannte konjugierte Faser bilden, im Bereich von 1 bis 16 pro einer der genannten ersten faserförmigen Komponenten beträgt.

9. Verfahren nach einem der Ansprüche 5 bis 8, wobei das genannte erste Polymer aus der Gruppe bestehend aus thermoplastischem Polyurethan und einen Schmierstoff enthaltendem thermoplastischem Polyurethan ausgewählt wird und das genannte zweite Polymer aus der Gruppe bestehend aus Polymer auf Polyolefinbasis und Polymer auf Polyamidbasis ausgewählt wird.

Revendications

1. Tissu non tissé extensible de manière élastique comportant des premières fibres extensibles de manière élastique réalisées à partir d'un premier polymère et des secondes fibres extensibles de manière non élastique réalisées à partir d'un second polymère, ledit tissu non tissé étant **caractérisé en ce que** :

   ledit tissu non tissé a des première et seconde surfaces lorsque l'on observe dans le sens de l'épaisseur de celui-ci, lesdites première et seconde surfaces s'étendant de manière parallèle l'une par rapport à l'autre, ladite seconde fibre est liée à ladite première fibre au niveau de zones de fixation formées de manière intermittente le long de ladite première fibre et espacées par rapport à ladite première fibre entre chaque paire desdites zones de fixation voisines les unes des autres, chaque segment de ladite seconde fibre espacée par rapport à ladite première fibre entre chaque paire desdites zones de fixation voisines les unes des autres étant plus long par rapport à un segment associé de ladite première fibre, le nombre de ladite seconde fibre est compris dans une plage allant de 3 à 16 par chaque première fibre, et lesdites première et seconde fibres se croisent l'une par rapport à l'autre d'une telle manière que ladite première fibre repose à l'intérieur et ladite seconde fibre repose à l'extérieur dans l'une parmi lesdites première et seconde surfaces.

2. Tissu non tissé selon la revendication 1, dans lequel ladite première fibre a sur sa surface circonférentielle des premières surfaces courbes chacune bombant dans le sens radial vers l'extérieur en provenance d'un axe de ladite première fibre et des secondes surfaces courbes chacune déprimées dans le sens radial vers ledit axe de ladite première fibre, lesdites premières et secondes surfaces courbes apparaissant tour à tour dans le sens de la circonférence de ladite première fibre, et chaque paire desdites premières surfaces courbes voisines les unes des autres dans ledit sens de la circonférence coopérant avec lesdites secondes surfaces courbes reposant entre ladite paire desdites premières surfaces courbes voisines les unes des autres pour former une rainure s'étendant dans un sens longitudinal de ladite première fibre de sorte que ladite seconde surface courbe définit un fond de ladite rainure.

3. Tissu non tissé selon la revendication 1 ou la revendication 2, dans lequel l'une desdites première et seconde surfaces a un angle de glissement de 25° à 40°.

4. Tissu non tissé selon l'une quelconque des revendications 1 à 3, dans lequel ledit premier polymère est sélectionné dans le groupe constitué par un polyuréthane thermoplastique et un polyuréthane thermoplastique contenant un lubrifiant et ledit second polymère est sélectionné dans le groupe constitué par un polymère à base de polyoléfine et un polymère à base de polyamide.

5. Procédé permettant de réaliser un tissu non tissé extensible de manière élastique formé par des premières fibres extensibles de manière élastique réalisées à partir d'un premier polymère et des secondes fibres extensibles de manière non élastique réalisées à partir d'un second polymère, ledit procédé comportant les étapes consistant à :

   alimenter, dans un sens machine, une pluralité de fibres conjuguées constituées chacune à partir d'un premier composant fibreux réalisé à partir dudit premier polymère et d'un second composant fibreux s'étendant de manière parallèle par rapport à et fixé de manière libérable par rapport à une surface dudit premier composant

fibreux et pour ainsi former une bande à partir desdites fibres conjuguées ayant une masse surfacique de l'ordre de 10 à 500 g/m^2;
former ladite bande avec une pluralité de zones de fixation formées de manière intermittente dans au moins un sens parmi ledit sens machine et un sens transversal croisant de manière orthogonale ledit sens machine de sorte que lesdites fibres conjuguées ne peuvent pas être séparées les unes des autres au niveau desdites zones de fixation ;
étirer ladite bande au moins dans ledit un sens dans les limites d'une zone d'élasticité du premier composant fibreux et sous un point de défaillance dudit second composant fibreux pour de ce fait séparer lesdits premier et second composants fibreux l'un par rapport à l'autre entre chaque paire desdites zones de fixation voisines les unes des autres et déformer de manière permanente ledit second composant fibreux ; et
permettre à ladite bande de se contracter sous l'effet d'une force de récupération élastique dudit premier composant fibreux de sorte que ladite première fibre est obtenue à partir dudit premier composant fibreux, ladite seconde fibre est obtenue à partir dudit second composant fibreux et ledit tissu non tissé est obtenu à partir de ladite bande, le nombre dudit second composant fibreux constituant ladite fibre conjuguée est compris dans une plage allant de 3 à 16 par unité dudit premier composant fibreux, ledit tissu non tissé a des première et seconde surfaces lorsque l'on observe dans le sens de l'épaisseur de celui-ci, lesdites première et seconde surfaces s'étendant de manière parallèle l'une par rapport à l'autre, et lesdites première et seconde fibres se croisent l'une par rapport à l'autre d'une telle manière que ladite première fibre repose à l'intérieur et ladite seconde fibre repose à l'extérieur dans l'une parmi lesdites première et seconde surfaces.

6. Procédé selon la revendication 6, dans lequel ledit premier composant fibreux de ladite fibre conjuguée a sur sa surface circonférentielle des premières surfaces courbes chacune bombant dans le sens radial vers l'extérieur en provenance de l'axe dudit premier composant fibreux et des secondes surfaces courbes chacune déprimées dans le sens radial vers ledit axe dudit premier composant fibreux, lesdites premières et secondes surfaces courbes apparaissant tour à tour dans le sens de la circonférence dudit premier composant fibreux, et chaque paire desdites premières surfaces courbes voisines les unes des autres dans ledit sens de la circonférence coopérant avec ladite seconde surface courbe reposant entre ladite paire desdites premières surfaces courbes voisines les unes des autres pour former une rainure s'étendant dans un sens longitudinal dudit premier composant fibreux de sorte que ledit second composant fibreux s'étend de manière parallèle par rapport audit premier composant fibreux dans ladite rainure.

7. Procédé selon la revendication 5 ou la revendication 6, dans lequel la longueur circonférentielle de ladite fibre conjuguée occupée par ledit second composant fibreux est de l'ordre de 40 à 90 % de la longueur circonférentielle totale de ladite fibre conjuguée.

8. Procédé selon l'une quelconque des revendications 5 à 7, dans lequel le nombre dudit second composant fibreux constitué par ladite fibre conjuguée est compris dans une plage allant de 1 à 16 par unité dudit premier composant fibreux.

9. Procédé selon l'une quelconque des revendications 5 à 8, dans lequel ledit premier polymère est sélectionné dans le groupe constitué par un polyuréthane thermoplastique et un polyuréthane thermoplastique contenant un lubrifiant et ledit second polymère est sélectionné dans le groupe constitué par un polymère à base de polyoléfine et un polymère à base de polyamide.

FIG.1

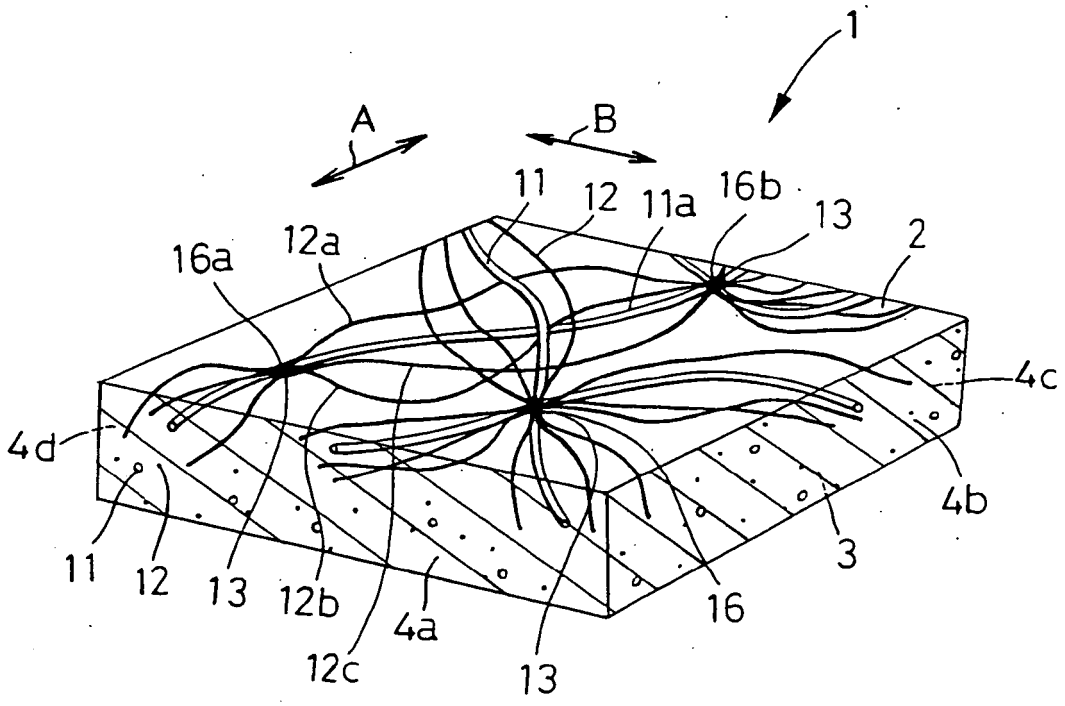


FIG.2

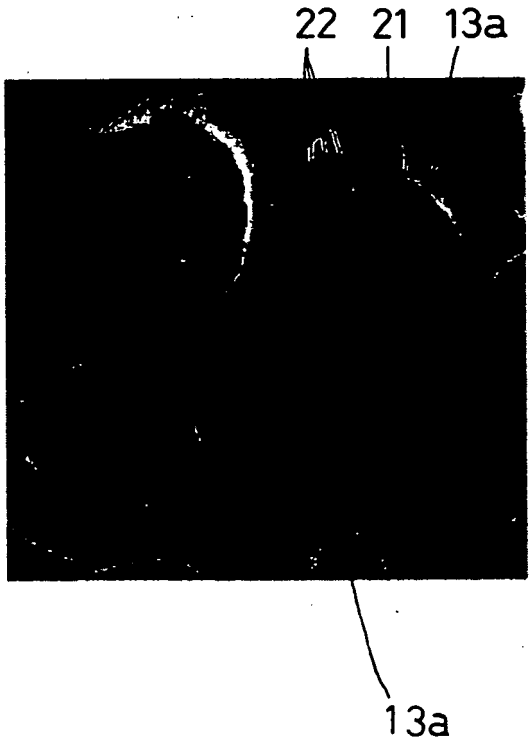


FIG.3

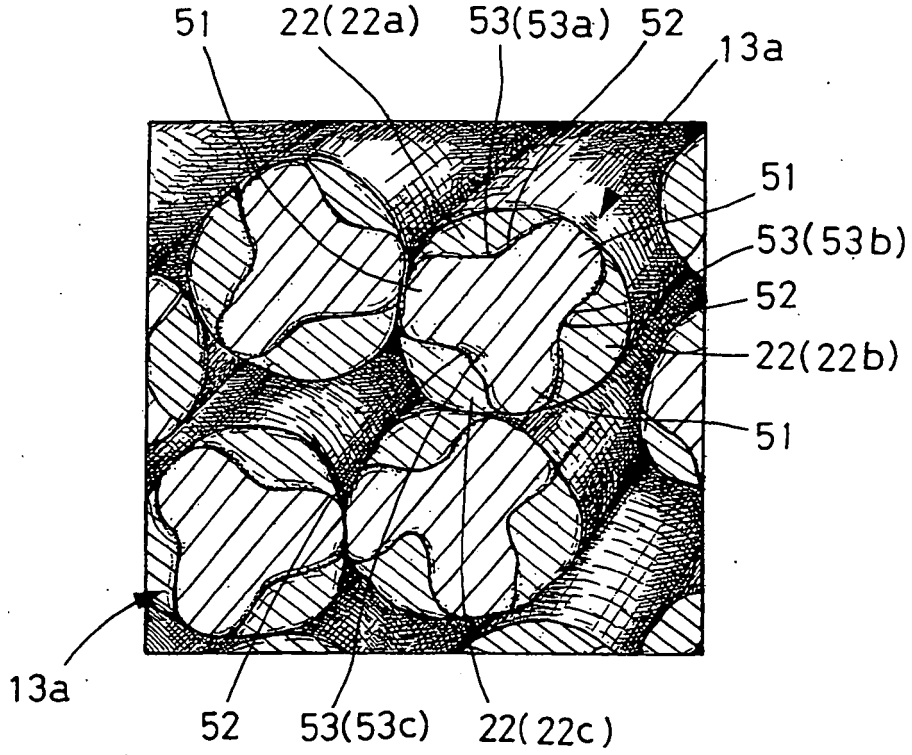


FIG.4

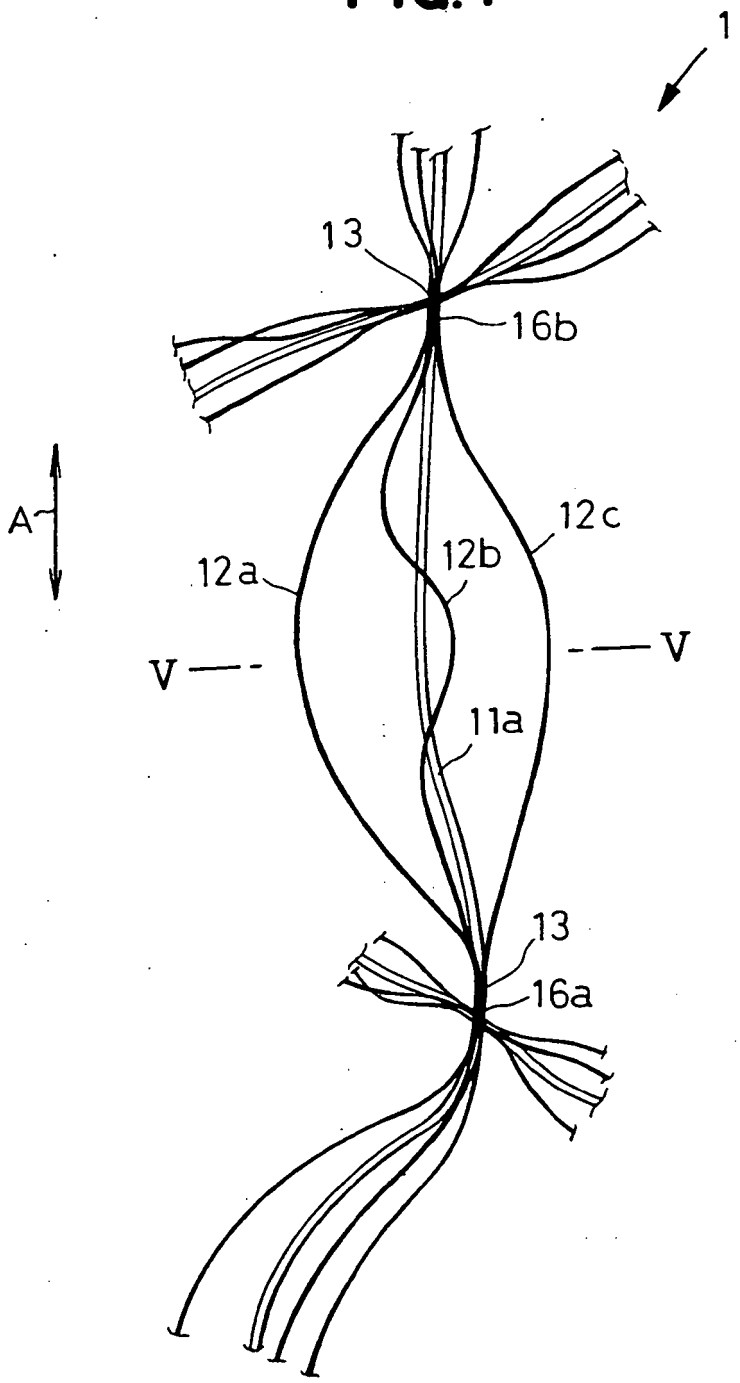


FIG.5

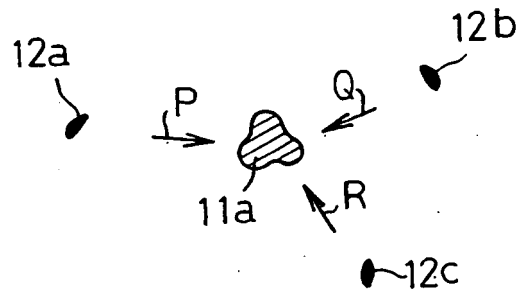


FIG.6

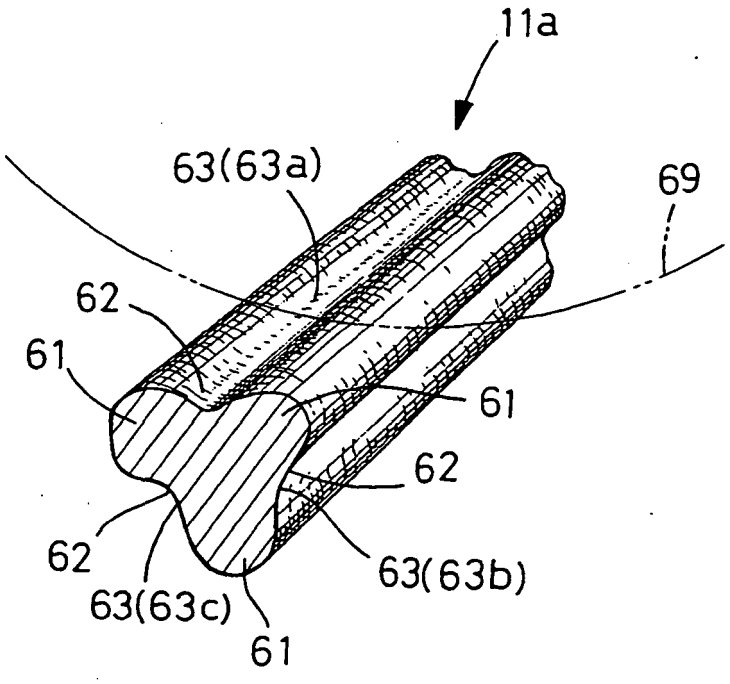


FIG.7

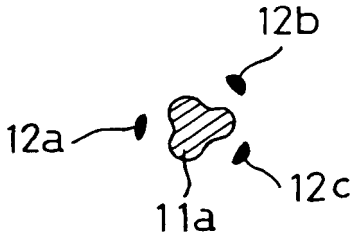


FIG.8

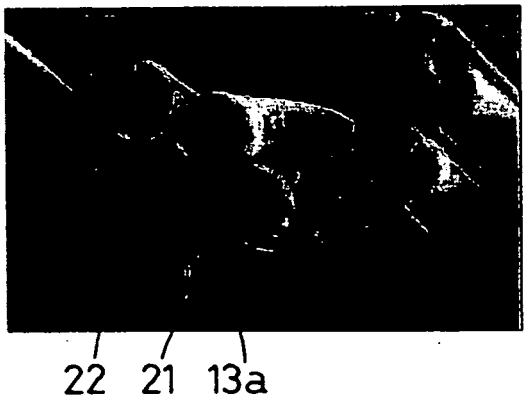


FIG.9

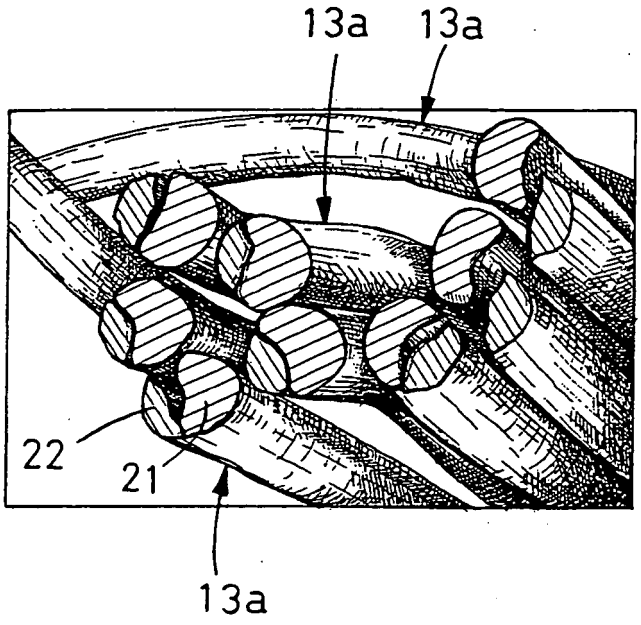


FIG.10A

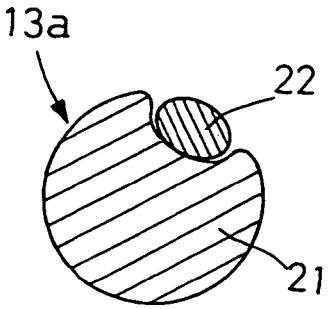


FIG.10B

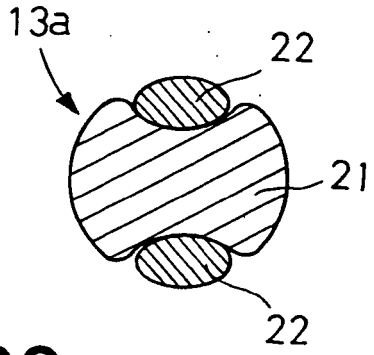


FIG.10C

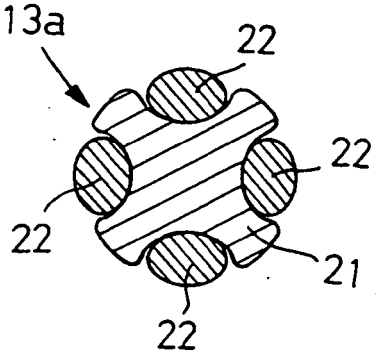
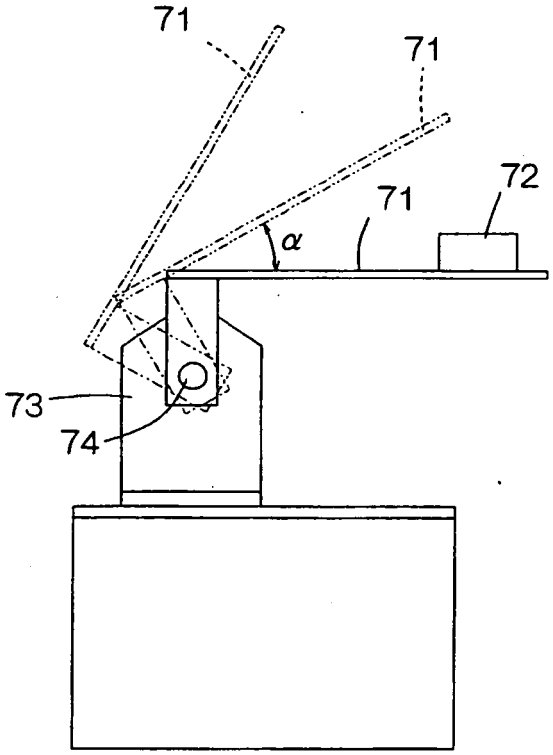


FIG. 11



REFERENCES CITED IN THE DESCRIPTION

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