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(54) **GLITTERING COMPOSITE YARN AND FABRIC WITH GLITTERING COMPOSITE YARN**

(57) The invention relates to a composite yarn (1), comprising a fibrous strand (5) and at least one flat filament (3) having a cross-section with a thickness (T) and a width (W) of at least three times the thickness.

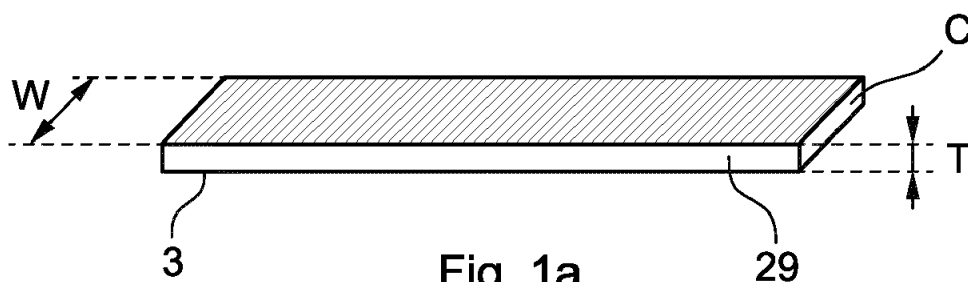


Fig. 1a

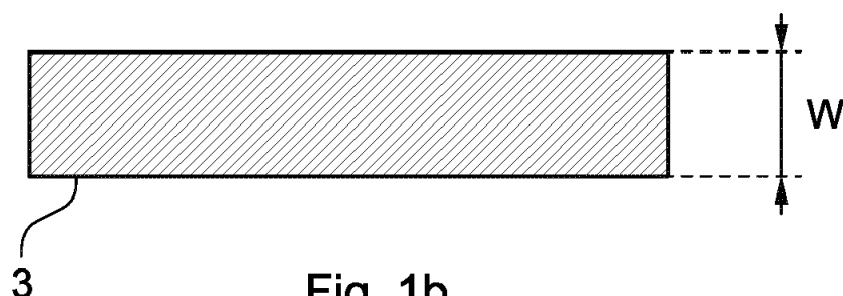


Fig. 1b

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Description

[0001] The invention relates to a composite yarn and a fabric, in particular a woven fabric, comprising the composite yarn. In particular, the composite yarn is a glittering yarn.

[0002] Glittering fabrics are known and appreciated for their optical appearance. To provide a glittering fabric, JP S 632 708 35 A suggests to weave a fabric with flat filaments in the warp direction and ultra-fine filaments in the weft direction. Thereby, the flat filaments shall provide a strong specific gloss while the ultra-fine filaments shall provide an irregular reflection. A problem of known glittering fabrics is that strong gloss usually comes with an unpleasant touch and/or a difficult manufacturing process. For instance, JP S 632 708 35 A explains that a high flatness of the filaments increases on the one hand the gloss but on the other hand makes it difficult to process the filament. When it comes to the filament count, JP S 632 708 35 A explains that a large count is beneficial for the gloss but disadvantageous for the touch of the fabric. Regarding the ultra-fine fibers, JP S 632 708 35 A explains that fibers exceeding a count of 0,8 denier led to a bad touch, in particular a rough feeling. Further, JP S 632 708 35 A explains that a minimum amount of 40% of flat filaments and 30% of ultra-fine filaments is necessary to obtain the desired glittering effect. However, such large contents of flat filaments and ultra-fine fibers have been found to be disadvantageous in terms of a soft feeling of the fabric and an easy processability of the fabric and its yarn components.

[0003] Thus, known glittering fabrics suffer from the conflict of, on the one hand, providing a desired glittering effect and, on the other hand, being easily processable and providing a pleasant feeling.

[0004] It is an object of the present invention to overcome deficiencies of the prior art, in particular to provide a composite yarn and a fabric comprising a composite yarn, which provides a desired glittering effect in combination with a pleasant feeling and/or an increased processability of the yarn and/or the fabric.

[0005] The object is solved by the subject of independent claim 1. Preferred embodiments are given in the dependent claims.

[0006] The invention relates to a composite yarn. The composite yarn comprises at least one flat filament having a cross section with a thickness and a width of at least three times the thickness. In particular, the composite yarn can comprise at least two, three, four or five flat filaments. For an easier legibility, the at least one flat filament will in the following be designated as the flat filament. However, it shall be clear that every feature described for the at least one flat filament can be realized by any of the at least one, two, three, four or five flat filaments. In cases where the surface of the yarn covered by the flat filament and the weight content of the flat filament is concerned, the respective values shall be interpreted to represent the sum for all of the flat filaments.

In cases where the count of the flat filament is concerned, the respective values shall apply to each of the flat filaments.

[0007] The composite yarn further comprises a fibrous strand. A fibrous strand as used particularly means a strand comprising a plurality of fibers. A plurality of fibers as used herein particularly means a number of at least 2, 3, 5, 10, 15, 20, 30, 50, 100 or 150 fibers, in particular in the cross section of the composite yarn. In particular, a fibrous strand can be a roving. A roving as used herein particularly refers to a strand comprising a plurality of parallelly arranged, in particular untwisted, fibers. Fibers as used herein particularly encompasses staple fibers and filaments.

[0008] In particular, the fibrous strand can be a staple fiber strand. A staple fiber strand as used herein refers to a strand comprising, in particular consisting of, a plurality of staple fibers. A staple fiber strand is in particular a strand comprising a plurality of staple fibers being aligned, in particular by opening, drawing and/or spinning, and consolidated into a strand, in particular via twisting, winding or other means. In particular, a staple fiber strand can be a spun strand. In particular, the staple fiber strand can be selected from a carded strand, a combed strand, a woolen strand, a worsted strand, a ring-spun strand, a compact-spun strand, a rotor (open-end) spun strand, an air-jet spun strand and/or a friction spun strand.

[0009] A carded strand as used herein particularly comprises a single strand made using cotton processing equipment in which fibers are opened, cleaned, carded and drawn prior to spinning. Carded strands particularly have a poor fiber orientation, moderate to high trash content (when made from cotton), and relatively high neps.

[0010] A combed strand as used herein particularly comprises a single strand made using the same cotton processing equipment as for the carded strand, but with the addition of the so-called combing process. Combing particularly removes short fibers (< 1.3 cm), removes neps and reduces trash content to nearly zero. It also results in a superior fiber orientation in the strand, leading to smoother and softer strands, compared to carded strands.

[0011] A woolen strand as used herein is in particular made on the so-called woolen system comprising the steps of fiber selection, dusting, scouring, drying, carding and spinning.

[0012] A worsted strand as used herein is in particular made by a series of operations to yield stronger and finer quality compared to that of woolen yarns. The manufacturing of a worsted strand particularly involves sorting, blending, dusting, scouring, drying-oiling, carding, combing, gilling operations and drawing.

[0013] A ring-spun strand as used herein is in particular made by the ring-spinning system. It can be carded or combed. Fibers in the strand may exhibit largely true twist and take a helical path crossing the strand layers. Some fiber points can be in the core of the strand and others

can be in intermediate or outer layers owing to the phenomenon of fiber migration. They can be made in a wide range of yarn count and twist. It can exhibit high hairiness and high mass variation.

[0014] A compact-spun strand as used herein is in particular made by compact spinning which is a modified ring-spinning system in which fibers are aerodynamically condensed to reduce hairiness and improve strand strength.

[0015] A rotor (open-end) spun strand as used herein is in particular made by rotor spinning. It can be carded or combed. It particularly comprises a three-layer structure, comprising truly twisted core fibers, partially twisted outer layer fibers and belt fibers.

[0016] An air-jet spun strand as used herein is in particular made by air-jet spinning. It particularly comprises two kinds of fibers, namely core-parallel fibers and wrapping fibers. The strand particularly exhibits no twist. In particular, the strength of the strand is provided by the wrapping fibers.

[0017] A friction-spun strand as used herein is particularly made by friction spinning. The strand particularly comprises true twisted fibers and fiber loops. In particular, it can comprise a blend of raw fibers and waste fibers.

[0018] In particular, one or more of the previously described strands can be produced and subsequently merged with the at least one flat filament to provide the composite yarn. Alternatively, producing the strand and merging it with the at least one flat filament to provide the composite yarn can be realized simultaneously. For example, a ring spun strand can be produced by merging a roving of fibers with the flat filament and ring spinning the roving and the flat filament into the composite yarn, comprising the ring-spun strand produced thereby and the flat filament being twisted with the ring-spun strand.

[0019] Alternatively, the fibrous strand can be a multifilament strand. A multifilament strand as used herein particularly comprises, in particular consists of, a plurality of filaments. The plurality of filaments can extend substantially parallel to each other, in particular be not twisted with respect to each other. Alternatively, the plurality of filaments can be twisted around each other. In particular, the multifilament can be a texturized multifilament strand, in particular a bulked multifilament strand or a stretch multifilament strand.

[0020] It is also possible that the fibrous strand comprises filaments and staple fibers, in particular as described with respect to the staple fiber strand and the multifilament strand.

[0021] In particular, the composite yarn is a glittering yarn. A glittering yarn as used herein is in particular a yarn glittering when being touched by light. In particular, a glittering yarn is a yarn comprising sections with different reflection when being touched by light, in particular high reflective sections and low reflective sections. "Reflection" as used herein can in particular be quantified by the gloss unit (gloss/gloss value), in particular measurable according to ASTM D2457-21 and/or by a REFO 3-

M reflectometer (Dr. Lange). A glittering yarn with sections of different reflection can in particular be realized by using different material and/or structures, such as cross section and count, for the flat filament and the fibrous strand. Preferably, the fibrous strand and the flat filament have different gloss units. More preferably, the fibrous strand has a smaller gloss unit than the flat filament. In particular, the gloss unit of the fibrous strand and of the flat filament differ from each other to at least 5%, 10%, 20%, 30%, 40%, 50%, 60%, 70% or 80% measured according to ASTM D2457-21 and/or by a REFO 3-M reflectometer (Dr. Lange), in particular under the same gloss angle.

[0022] In particular, the fibrous strand partially covers the flat filament, in particular wherein the fibrous strand and the flat filament are spun, in particular ring spun or core spun, into the composite yarn. Partially covering the flat filament can in particular be realized in that the fibrous strand and the flat filament extend straight, in particular not twisted or winded, with respect to each other. Thereby, the fibrous strand partially covers the flat filament in that it covers the part of the flat filament facing the fibrous strand. Alternatively, the flat filament and the fibrous strand can be twisted around each other and/or wrapped around a filament core. Thereby, the fibrous strands can partially cover the flat filament by partially extending over and/or partially under the flat filament in radial direction (with respect to the longitudinal axis of the composite yarns) and/or by forming revolutions of the fibrous strand and of the flat filament alternating in longitudinal direction of the composite yarn so that the flat filament is partially covered where its revolutions face the revolutions of the fibrous strand. Preferably, partially covering is to be understood in that the fibrous strand partially covers the outside, in particular in radial direction, of the flat filament, in particular from being seen and felt. In particular, the flat filament is at least partially exposed to the outside of the composite yarn, in particular in that it can be seen.

[0023] In particular, the fibrous strand partially covers the flat filament in that it separates the composite yarn in sections with different gloss units, namely into sections having the gloss unit of the fibrous strand and sections having the gloss unit of the flat filament.

[0024] In particular, the wording "partially covering" as used herein means that a part of the flat filament is hidden by the fibrous strand from being seen and/or felt. Preferably, the fibrous strand partially covers the flat filament in that at least 1%, 2%, 3%, 5%, 10%, 15%, 20%, 25%, 30%, 35%, 40%, 45% or 50% and/or maximally 99%, 98%, 95%, 90%, 85%, 80%, 75%, 70%, 65%, 60%, 55% or 50 % of the surface of the flat filament, in particular of the surface of the flat filament facing the outside of the composite yarn, in particular in radial direction, is covered by the fibrous strand, in particular by the fibers of the fibrous strand as described below.

[0025] In particular, the flat filament serves to provide a strong gloss. The function of the fibrous strand is in particular twofold, namely

i) changing, in particular reducing, the gloss of the composite yarn at sections where the flat filament is covered by the fibrous strand and

ii) avoiding or at least reducing skin contact with the flat filament.

[0026] Thanks to the fibrous strand, the width of the flat filament can be increased to increase its gloss. In particular, the fibrous strand transforms this increased gloss into a glittering effect by partially covering the flat filament. Additionally, the fibrous strand avoids or at least reduces skin contact with the flat filament, which enables further increasing the width and thereby the gloss of the filament. Thereby, the fibrous strand and the flat filament work together in a synergetic manner enabling both, a strong glittering effect and a pleasant feeling. The word "feeling" as used herein particularly refers to the feeling at the skin of a person wearing or touching the yarn or a fabric comprising the yarn. The word "pleasant" particularly refers to relatively soft surface of the yarn, in particular of the fibrous strand, such as in the case of a cotton strand, and/or to a surface avoiding or at least reducing the risk of contact of the skin with sharp edges, such as those of a flat filament within the meaning of the invention.

[0027] In particular, the inventors have found that the inventive concept enables to use flat filaments with a width being at least 5 times, 10 times, 15 times or 20 times larger than the thickness of the cross section. In particular, it has been found to be advantageous to select a width to be between 5 and 60 times, more preferably between 10 and 45 times, most preferably between 20 and 30 times, larger than the thickness. In particular, a preferred width of the flat filament has been shown to be between 50 and 1000 micrometers, more preferably between 100 and 500 micrometers, most preferably between 200 and 400 micrometers. A preferred thickness for the flat filament has been found to be between 5 micrometers and 100 micrometers, more preferably between 7 micrometers and 50 micrometers, most preferably between 10 and 30 micrometers.

[0028] Particularly preferred examples for the flat filament have a width of 370 micrometers and a thickness of 12 micrometer, a width of 370 micrometers and a thickness of 25 micrometer, a width of 370 micrometers and a thickness of 30 micrometer, a width of 300 micrometers and a thickness of 12 micrometer, a width of 300 micrometers and a thickness of 25 micrometer, a width of 300 micrometers and a thickness of 30 micrometer, a width of 280 micrometers and a thickness of 12 micrometer, a width of 280 micrometers and a thickness of 25 micrometer, a width of 280 micrometers and a thickness of 30 micrometer, a width of 250 micrometers and a thickness of 12 micrometer, a width of 250 micrometers and a thickness of 25 micrometer, a width of 250 micrometers and a thickness of 30 micrometer, a width of 230 micrometers and a thickness of 12 micrometer, a width of 230 micrometers and a thickness of 25 micrometer, a width of 230

micrometers and a thickness of 30 micrometer, a width of 200 micrometers and a thickness of 12 micrometer, a width of 200 micrometers and a thickness of 25 micrometers or a width of 200 micrometers and a thickness of 30 micrometers.

[0029] The wording "flat filament" as used herein particularly refers to filament having a square cross section. In cases in which the cross section is not perfectly quadrangular, the thickness relates to the averaged thickness along the width of the cross section while the width relates to the averaged width along the thickness of the cross section.

[0030] Preferably, the flat filament is obtained by cutting a film. In particular, the film has the thickness of the later flat filament. By cutting the flat filament from a film, sharp cutting edges are produced, which have been found to enhance the glittering effect. Thanks to the fibrous strand partially covering the flat filament, an unpleasant feeling imposed by the sharp cutting edges can be minimized, in particular avoided.

[0031] In particular, the flat filament has a yarn count between 20 and 150 dtex, preferably between 30 and 120 dtex, more preferably between 40 and 120 dtex, even more preferably between 50 and 90 dtex, most preferably between 60 and 80 dtex. It has been shown that such dtex range is of particular advantage in that a large flat surface can be provided by the flat filament which can still be processed in most common spinning technics, such as core spinning and ring spinning.

[0032] In particular, the flat filament comprises a polymer. Preferably, the polymer is selected from a synthetic polymer, a polysaccharide, a copolymer of two or more thereof or a mixture of two or more thereof.

[0033] The term "synthetic polymer" as used herein refers to human-made polymers, in particular to polymers synthesized by polymerizing one or more kinds of monomers under laboratory/industrial conditions. In particular, the synthetic polymer is selected from the group consisting of a polyester, a polyethylene, a polypropylene, polystyrene, a polyamid, a polyaramid, a polyoxymethylene, a polytetrafluorethylene, a polyetheretherketone, a polyphenylenesulfid, polyalkyleneterephthalate, preferably a polybutyleneterephthalate, a polytrimethyleneterephthalate, a polyethyleneterephthalate, a polyurethane, a polyvinylalcohol, polyimide, polyacrylate a copolymer of two or more thereof or a mixture of two or more thereof.

[0034] More preferably, the synthetic polymer is selected from a polyester, most preferably from a polyethylene terephthalate. Additionally or alternatively, the polysaccharide is selected from a cellulose or derivatives thereof, most preferably from a cellulose hydrate. In particular, these polymers can be colored in various colors, which can be used to provide individual glittering effects. Without being bound to an explanation, it seems that the polar monomer units of these preferred polymers are beneficial for coloring the flat filament. Thus, additionally or alternatively to these preferred polymers, it is preferred

to use polymers with polar monomer units, and in particular no non-polar polymers, for the flat filament. Particularly preferred, the polar monomer units comprise polar end group monomers, such as ester groups and/or amide groups. Examples for polymers with polar monomer units are in particular polyester, preferably polyethylene terephthalate, polyamide, polyimide, polyurethan, polyacrylate, cellulose and its derivatives, preferably cellulose hydrate, a copolymer of two or more thereof or a mixture of two or more thereof. Examples for non-polar polymers are in particular polyethylene, polypropylene and rubber, in particular natural rubber.

[0035] Preferably, the flat filament comprises one or more of the previously described polymers in a weight content of at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 95%, 98%, 99% or 100%. In particular, the flat filament comprises a polymer layer comprising one or more of the previously described polymers. Particularly preferred, the polymer layer comprises one or more of the previously described polymers in a weight content of at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 95%, 98%, 99% or 100%. In particular, the polymer layer has a flat cross section with the previously described width and/or thickness.

[0036] In some embodiments, the flat filament consists of the previously described polymer layer. In preferred embodiments, the flat filament comprises a metallic layer, in particular an aluminum layer, and at least one polymer layer, in particular at least one polymer layer on each side of the metallic layer. Preferably, the at least one polymer layer is designed as described above. The metallic layer can be a metal layer, in particular an aluminum layer, or a metallized polymer layer, in particular a polymer layer being metallized with metal, in particular aluminum. A metal layer shall in particular be understood as a layer comprising metal in a weight content of at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 95%, 97%, 98%, 99% or 100%. A metallized polymer layer can in particular be understood as a layer having polymer basis layer on which a metal, in particular aluminum, is deposited, in particular by vapor deposition.

[0037] In one embodiment, the flat filament comprises a metallic core layer, in particular a metal core layer, more in particular an aluminum core layer, and a synthetic polymer layer, in particular a polyester layer, more in particular a polyethylene terephthalate layer, on each side of the metallic core layer. According to an alternative embodiment, the flat filament comprises a metallic core layer, in particular a metal core layer, more in particular an aluminum core layer, and a polysaccharide layer, in particular cellulose layer, more in particular a cellulose hydrate layer, on each side of the metallic core layer. In yet another embodiment, the flat filament comprises a metallized synthetic polymer core layer, in particular a metallized polyester core layer, more in particular a metallized polyethylene terephthalate core layer, and a synthetic polymer layer, in particular a polyester layer, more in particular a polyethylene terephthalate layer, on each

side of the metallized polymer core layer. In yet another embodiment, the flat filament comprises a metallized polymer core layer, in particular a metallized polyester core layer, more in particular a metallized polyethylene terephthalate core layer, and a regenerated cellulose layer, in particular a cellulose hydrate layer, on each side of the metallized polymer layer.

[0038] The wording "polymer layer", "synthetic polymer layer", "polyester layer" or "polyethylene terephthalate layer" or "xxx layer" or "metal layer" particularly relates to a layer comprising the respective polymer or metal in a weight content of at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 95%, 97%, 98%, 99% or 100%, wherein "xxx" can be interchange by one or more of the previously described polymers.

[0039] Preferably, the flat filament comprising a metallic layer and at least one polymer layer is produced by cutting a film comprising a metallic layer, in particular a metallic core layer, and at least one polymer layer, in particular on each side of the metallic layer. Preferably, the material composition of the different layers can be selected as described above with respect to the different embodiments of the flat filament. The inventors have found that cutting the flat filament from films comprising metallic layers is of particular advantage in that the cutting edges enhance the glittering effect are provided.

[0040] The inventors have found that the metallic layer, in particular the aluminum layer, provides the composite yarn a plurality of functions, namely reflection of light, insulation of heat radiation and conductivity with respect to heat and electricity. The reflection of light enhances glossing of the yarn and thereby the glittering effect. The insulation of heat radiation enables producing heat protective fabrics from the composite yarns. Further, the heat insulation enables providing fabrics, for example clothing, such as trousers, with heat protective properties. The conductivity with respect to heat enables conducting heat, absorbed for instance by the fibrous strand, in particular the cotton strand, to the skin of a person wearing a fabric comprising the yarn. The conductivity with respect to electricity allows using the composite yarn in smart fabrics.

[0041] Preferably, the flat filament comprises a RMS (Root Mean Square) roughness of less than 1 μm , preferably of less than 0,5 μm , more preferably of less than 0,3 μm , even more preferably of less than 0,15 μm , most preferably of less than 0,1 or less than 0,06 μm , for example of 0,056 μm . It has been found that choosing flat filaments with such RMS roughness provides a significant glossing. It has for example been found that Al 99,5 with a RMS roughness of 0,056 μm (measured by the ARM method) provides a Gloss Value of 817 (measured with a REFO 3-M reflectometer (Dr. Lange)) under a measuring angle of 20 °. It has further been found that AlMg₃ with a RMS roughness of 0,102 μm (measured by the ARM method) provides a Gloss Value of 175 (measured with a REFO 3-M reflectometer (Dr. Lange) under a measuring angle of 20 °). Further, it has been found

that even a RMS roughness of 0,36 μm (measured by the ARM method) provides sufficient glossing for the purpose of the invention. However, a lower roughness value is more preferred.

[0042] In particular, the inventors found that a Gloss Value (measured with a REFO 3-M reflectometer (Dr. Lange) under a measuring angle of 20 °) of at least 50, preferably of at least 100, more preferably of at least 200, 300, 400 or 500, most preferably of at least 600, 700, 800, 900 or 1000, provides the flat filament with sufficient glossing for the desired glittering effect. The skilled person knows how to achieve such Gloss Values for different materials by different treatment methods. As one example, it is referred to the publication "BUHLERT, M., et al. Characterisation of electropolished aluminium surfaces. Galvanotechnik, 2004, 95. Jg., Nr. 7, S. 1629-1634, ISSN: 00164232), which is hereby incorporated by reference.

[0043] Additionally or alternatively, the flat filament has a gloss unit of at least 10, preferably at least 20, 30, 40, 50, 60, 70, 80 or 90, more preferably of at least 90, measured according to ASTM D2457-21 under a gloss angle of at least 85%, preferably under a gloss angle of 75%, 60%, 45% or 20%, most preferably under a gloss angle of 20%.

[0044] Selecting the flat filament to have a gloss unit / gloss value as defined above particularly makes sure that the sections of the composite yarn in which the flat filament is not covered by the fibrous strand emit a strong gloss when being touched by light, which leads to strong glittering in combination with the covered sections of the flat filament.

[0045] In particular, the flat filament comprises a colorant. The colorant can be a pigment and/or a dye. Preferably, the colorant is a pigment. Preferably, the flat filament comprises a polymer layer, in particular one of the previously described polymer layers, which is produced by adding the pigments into molten polymers during extrusion. The colorant can have any color, in particular red, orange, yellow, gray, green, turquoise, blue, purple and/or rose. Preferably, flat filaments comprising a metallic layer as described above comprise a colorant, in particular a colorant providing the flat filament with any color, in particular with a color being selected from red, orange, yellow, gray, green, turquoise, blue, purple and/or rose. In particular, the composite yarn further comprises at least one support filament. Preferably, the support filament comprises a synthetic polymer, more preferably a polyamide, most preferably a polyamide 6.6. In particular, the at least one support filament comprises the synthetic polymer in a weight content of at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 95%, 98%, 99% or 100%. In particular, the at least one support filament has a less flat cross section than the flat filament, in particular has a cross section with a width of maximally 2.5 times, 2 times, 1.5 times, 1.3 times or 1.1 times the thickness. In particular, the at least one support filament has a substantially circular cross section. Substantially

circular shall in particular encompass cross sections with a smallest radius and a largest radius of at least 2.5 times, 2 times, 1.5 times, 1.3 times or 1.1 times the smallest radius.

[0046] In particular, the at least one support filament is wrapped around the flat polyester filament. Wrapped, as used herein, in particular means that the support filament is helically wrapped around the longitudinal axis of the flat filament. In particular, the support filament being wrapped around the flat filament means that the flat filament remains substantially straight with respect to the support filament, in other words is not twisted around the at least one support filament. In this regard, the word "substantially" can encompass wrapping of the flat filament around the at least one support filament in an amount of up to 0.5, 0.3, 0.1, 0.05 or 0.03 wraps per wrapping of the at least one support filament around the flat filament.

[0047] Preferably, the at least one support filament has a yarn count between 5 and 50 dtex, more preferably between 10 and 40 dtex, most preferably between 15 and 30 dtex.

[0048] Preferably, the at least one support filament comprises two support filaments. Preferably each of the two support filaments have the previously described filament count. Preferably, each of the two support filaments are separately twisted around the flat filament, in particular in different directions. For instance, one support filament can be wrapped in s-direction around the flat filament while the other support filament can be wrapped in z-direction around the flat filament.

[0049] It has been found that the use of at least one support filament being wrapped around the flat filament or otherwise combined with the flat filament as described below increases the glittering effect of the composite yarn. Without being bound to an explanation, this seems to be explainable in that the support filament changes the reflectance of the flat filament at the sections where it covers a flat filament, thereby leading to a different glossing along the extension of the flat filament, which appears as glittering effect.

[0050] The inventors have found that using two support filaments, in particular being twisted in opposite directions as described above, further enhances the glittering effect of the composite yarn. Further, it has been found advantageous to use different materials for the flat filament and the support filament.

[0051] The most preferred combination has turned out to be the use of polyester, more preferably of polyethylene terephthalate, for the flat filament and of a polyamide, more preferably of polyamide 6.6, for the at least one support filament. Even more preferably, the above-mentioned polymer for the flat filament is used as polymer layer in combination with a metallic layer as described above.

[0052] Alternatively to wrapping the at least one support filament around the flat filament, the flat filament can be wrapped around the at least one support filament.

Thereby, the flat filament is preferably wrapped around the support filament in that it contacts the support filament with its flat side and is helically wrapped around the support filament. In particular, the flat filament can be wrapped around the support filament in that its edges, in particular cutting edges, substantially contact each other or are spaced from each other. Substantially contacting each other shall in particular be understood in that a space between two adjacent revolutions of the flat filament is less than 30%, 20%, 10%, 5%, 3% or 1% of the width of the cross-section of the flat filament. It seems that the space between the revolutions of the flat filament and/or its edges facing each other between two revolutions lead to a change of gloss along the extension of the support filament which promotes the glittering of the composite yarn. For embodiments, in which the flat filament is wrapped around the support filament, the support filament preferably has a yarn count between 50 and 500 dtex, more preferably between 70 and 400 dtex, most preferably between 100 and 300 dtex. In these embodiments, the support filament preferably comprises polyester, in particular polyethylene terephthalate, and/or polyamide, in particular polyamide 6.6.

[0053] In yet other embodiments, the flat filament and the at least one support filament can be twisted around each other. Thereby, both, the flat filament and the support filament are preferably twisted around a common twist axis. In such embodiments, the support filament preferably has a yarn count between 30 and 150 dtex, more preferably between 50 and 100 dtex, most preferably between 60 and 80 dtex. The support filament in such embodiments preferably comprises polyester, in particular polyethylene terephthalate, and/or a polyamide, in particular polyamide 6.6.

[0054] The at least one support filament can be a texturized filament, in particular a texturized polyester filament.

[0055] All of the previously described embodiments relating to the use of at least one support filament can be combined with each of the previously described embodiments of the flat filament.

[0056] In the composite yarn, the support filament can be distinguished from potential filaments in the fibrous strand or in a core of the yarn in that the support filament is exclusively wrapped around the flat filament or vice versa or the flat filament and the support filament are exclusively twisted around each other. Exclusively means in this regard that the flat filament and the at least one support filament form a unit which is produced before producing the composite yarn. If this unit is subsequently processed into the composite yarn, together with the previously described fibrous strand or the subsequently described core, this unit remains a unit which can be separated from the composite yarn as a unit. Further, if this unit is for example twisted around the core or twisted with a fibrous strand, both, the flat filament and the support filament, are twisted in the same manner.

[0057] In particular, the fibrous strand has a count be-

tween 100 and 1000 dtex, preferably between 200 and 800 dtex, more preferably between 250 and 700 dtex, most preferably between 300 and 600 dtex. In particular preferred embodiments, the fibrous strand has account of about 330 dtex, 420 dtex and 590 dtex.

[0058] It has been found that the above-mentioned counts for the fibrous strand, in particular in combination with the previously mentioned counts for the flat filament and optionally for the support filament, enable covering enough of the flat filament to avoid or at least decrease unpleasant feeling imposed by the flat filament. Further, such count has been found to be beneficial in terms of processability, in particular during spinning the composite yarn, during weaving a fabric comprising the composite yarn and/or during further processing of fabrics such as sizing, de-sizing and dyeing.

[0059] Additionally, or alternatively, the fibrous strand comprises a plurality of fibers having an individual fiber count between 0.1 and 10 dtex, preferably between 0.5 and 5 dtex, more preferably between 1 and 3 dtex, most preferably between 1.3 and 2.3 dtex. A particularly preferred individual fiber count is about 1.6 dtex. Additionally, or alternatively, the at least three fibers have an individual fiber diameter between 3 and 100 micrometers, preferably between 5 and 60 micrometers, more preferably between 8 and 50 micrometers, most preferably between 10 and 40 micrometers. Additionally, or alternatively, the at fibers have a density between 0.5 and 5 g/cm³, preferably between 0.7 and 3 g/cm³, more preferably between 1 and 2 g/cm³. It has been found that a selection of fibers in the above-identified individual fiber count, diameter and/or density range, which will in the following be designated as "thin fibers", enhances the glittering effect and provides the composite yarn with a pleasant feeling, in particular a soft touch. In particular, it has been found that the use of such thin fibers increases the glittering effect of the fabric. Without being bound to an explanation, it seems that this can be explained by the thin areas of the flat filament being covered by the thin fibers thereby separating the flat filament in sections with high glossing being separated only by thin areas. Further, the use of such thin fibers turned out to provide the composite yarn with a more pleasant, in particular softer, feeling compared to thicker fibers.

[0060] In particular, the fibrous strand comprises at least 2, 3, 5, 10, 15, 20, 30, 50, 100 or 150, preferably between 50 and 600, more preferably between 100 and 450, most preferably between 150 and 400, fibers, in particular in the cross section of the composite yarn. It turned out that the use of a plurality of fibers, in particular a plurality of thin fibers, as defined above, enables to separate the flat filament in a plurality of segments being separated by the fibers, thereby enhancing the glittering effect. Further, such high number of fibers ensures that the flat filament is only uncovered along small sections thereby reducing the risk of skin contact with the flat filament. This is of particular importance to ensure a pleasant feeling, in particular in cases in which the flat filament

is produced by cutting from films and/or comprises metallic layers, which can both lead to a skin irritation.

[0061] The fibers of the fibrous strand can comprise or consist of staple fibers and/or filaments. In particular preferred embodiments, the fibrous strand has a yarn count of about 330 dtex, 420 dtex or 590 dtex with an individual fiber thickness of about 0.6 dtex, wherein the fibers are staple fibers and/or filaments.

[0062] In particular, the fibrous strand comprises cellulosic and/or synthetic fibers. Preferably, the at fibrous strand comprises cellulosic fibers in a weight content of at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 95%, 98%, 99% or 100%. Cellulosic fibers are in particular made with ethers or esters of cellulose, which can be obtained from the bark, wood or leaves of plants, or from other plant-based material. In addition to cellulose, the fibers may particularly comprise hemicellulose and lignin. The cellulosic fibers can particularly be natural cellulosic fibers or manufactured (regenerated) cellulosic fibers. For instance, natural cellulosic fibers in the form of cotton fibers, silk fibers and/or linen fibers can be used. Manufactured cellulose fibers are particularly produced by processing plants into a pulp and then extruding the pulp in the same ways as synthetic fibers, such as polyester or nylon. For instance, manufactured cellulose fibers can be used in the form of rayon, lyocell (tencel), modal and/or viscose fibers. Particularly preferred, the fibrous strand comprises cotton fibers. In particular, the fibrous strand comprises cotton fibers in a weight content of at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 95%, 98%, 99% or 100%. Most preferably, the fibrous strand comprises cotton fibers in a weight count, a number and/or an individual fiber count as specified above.

[0063] However, in alternative embodiments, the at fibrous strand can also comprise synthetic fibers. The term "synthetic fiber" as used herein in particular incorporates fibers comprising a synthetic polymer, in particular fibers comprising a synthetic polymer in a weight content of at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 95%, 97%, 98%, 99% or 100%. In particular, the synthetic polymer can be one or more of the previously described synthetic polymers. In such embodiments, the fibrous strand particularly comprises the fibers with synthetic polymers in a weight content of at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 95%, 98%, 99% or 100%. Particularly preferred, the fibers of such embodiments have an individual fiber count as specified above and/or are comprised in the fibrous strand in a number of fibers as defined above. Further, the fibrous strand comprising or consisting of fibers with synthetic polymers preferably has a count as described above.

[0064] The term "fiber" as used herein in particular incorporates staple fibers and filaments. However, preferably, staple fibers, most preferably cotton fibers, are used for the fibrous strand. Staple fibers are in particular fibers of a definite length, in particular a length greater than 2 mm, 3 mm, 5 mm, 8 mm or 10 mm and/or a length of

maximally 500 mm, 200 mm, 150 mm, 100 mm, 80 mm, 60 mm, or 45 mm. Filaments are in particular fibers with a length which is larger than the length of staple fibers, more in particular a length which extends along the entire length of the yarn, most in particular with an indefinite length.

[0065] In particular, the composite yarn is produced by spinning, in particular by ring spinning and/or core spinning. In particular, the flat filament and the fibrous strand are twisted around each other and/or wrapped around a filament core. In particular, according to one embodiment, the composite yarn is produced by spinning, in particular by ring spinning or by hollow spindle spinning, the fibrous strand and the flat filament. In particular thereby, the flat filament and the fibrous strand become helically twisted around each other. In particular thereby, the flat filament becomes partially covered by the fibrous strand and is partially free from the fibrous strand thereby exposing its flat surface so that it emits a strong gloss when being touched by light.

[0066] Preferably, the fibrous strand covers at least 30%, 40%, 50 %, 60%, 70% or 80% of the outer surface of the composite yarn. Additionally, or alternatively, the fibrous strand covers at least as much of the surface of the composite yarn as the flat filament. More preferably, the fibrous strand covers at least 1,5 times, 2,0 times, 3,0 times 4,0 times, 5,0 times, 6,0 times, 7,0 times or 8,0 times more of the surface of the composite yarn than the flat filament. Additionally or alternatively, the flat filament covers at least 5 %, 10 %, 15% or 20% of the surface of the composite yarn. In particular in combination with the previously described preferred design of the flat filament and of the fibrous strand, this provides a composite yarn with a remarkable glittering effect while the risk of skin contact with the fibrous strand is remarkably reduced.

[0067] Additionally or alternatively, the fibrous strand and the flat filament can be spun, in particular core spun, around a filament core. In such cases, the composite yarn comprises a filament core, in particular comprising elastic filaments and/or control filaments being in particular less elastic than the elastic filaments, in particular wherein the fibrous strand and/or the flat filament partially cover the core, in particular are spun around the core. Thereby, the fibrous strand, and preferably the flat filament, form a sheath at least partially, preferably entirely, surrounding the filament core.

[0068] In particular, the filament core has a count between 30 and 200 dtex, preferably between 50 and 150 dtex, more preferably between 60 and 120 dtex, most preferably between 70 and 90 dtex. The core can comprise a plurality of individual filaments. Preferably, the core comprises at least one elastic filament and at least one control filament.

[0069] Preferably, the at least one elastic filament is elastic in that it is capable of being stretched at least about 2 times its package length and having at least 90 % up to 100 % elastic recovery after having been released from a stretching 2 times its package length. Pref-

erably, the at least one elastic filament is an elastomeric filament, more preferably an elastane filament, most preferably a lycra filament and/or a rubber, in particular natural rubber, filament. The elastic recovery is a parameter for the elastic performance of the at least one elastic filament as mentioned above. The elastic recovery in percent represents a ratio of the length of the elastic filament following the release of tension stress with respect to the length of the elastic performance filament prior to be subjected to said tension stress (package length). An elastic recovery having a high percentage, i.e. between 90 % and 100 %, is to be considered as providing an elastic capability of returning substantially to the initial length after the stress was applied. In this regard, the control filament, as will be mentioned below, is preferably defined by a low percentage elastic recovery, i.e. the control filament will not be able to return substantially to its initial length, if a stretching of at least two times of its initial length is realized. Said percent elastic recovery of filaments can be tested and measured according to the standard ASTM D3107, the entire content of which is expressly incorporated hereinto by reference. Said test method ASTM D3107 is a testing method for a fabric made from yarns. A yarn testing method and testing device can be used for individual measuring filaments and/or yarns. For instance, USTER TENSOR RAPID-3 device (Uster, Switzerland) is able to measure elasticity, breaking force, etc. of yarns or filaments. An example of said testing device is described in WO 2012/062480 A2 which shall be incorporated hereinto by reference. Additionally or alternatively, an elastic filament within the meaning of the present invention can be understood as a filament having, at the maximum tensile strength according to DIN EN ISO 2062:2010-04, an elongation compared to its package length of at least 150%, 180%, 210 %, 230 % or 260%.

[0070] Preferably, the at least one control filament is less elastic than the elastic filament, in particular is not capable of being stretched beyond a maximum length without permanent deformation said maximum length being less than 1.5 times of its package length. In particular, the control filament provides a safety function, which avoids overstretching of the yarn, and thereby the undesired growth of the yarn. Thereby, the elastic recovery of the filamentary core can be increased. In particular, the less control filament is less elastic than the elastic filament in that it is not capable of being stretched about 1.5, 1.6, 1.7, 1.8, 1.9 or 2 times its package length while having at least 90 % up to 100 % elastic recovery after having been released from a stretching of 1.5, 1.6, 1.7, 1.8, 1.9 or 2 times its package length. Preferably, the at least one control filament cannot be stretched beyond a maximum length without permanent deformation said maximum length being less than 1.5 times of its original package length. In this case, the at least one less elastic control filament can also be called inelastic filament. Suitable inelastic control filaments include filaments formed of synthetic polymer such as polyamide, particularly nylon

6, nylon 66, PBT and the like. Further, also polyesters, polyolefins (e.g. polypropylene, polyethylene) and the like as well as mixtures and copolymers of the same can be used. For the inelastic control filament, polyester, nylon or any other synthetic with the above-mentioned definition of elasticity can be used. For instance, an elastomultiester or an elastomerel, as T400®, being a bicomponent elastic polyester can be used. T400® is produced by Invista for which two different polyesters can be extruded together.

[0071] In embodiments with a filament core, the composite yarn preferably comprises a filament core with a yarn count between 70 and 80 dtex, a fibrous strand with a yarn count between 300 and 600 dtex, and a flat filament, in particular a flat filament comprising at least one or two support filaments, with a yarn count between 100 and 150 dtex.

[0072] In cases with at least one, in particular at least two, support filament, the at least one support filament is preferably spun around the flat filament in a preliminary step to obtain a flat-filament-support-filament unit. Preferably subsequently, the flat-filament-support-filament unit is spun together with the fibrous strand into a composite yarn, in particular by ring spinning. This two-step production can particularly be seen in the final yarn in that the at least one support filament is twisted twice, namely once with the flat filament and once with the fibrous strand. Additionally or alternatively, the flat-filament-control-filament unit is spun together with the fibrous strand around the filament core, in particular by core spinning. This two-step production can also be seen in that final yarn in that the at least one support filament is twisted twice, namely once with the flat filament and once around the filament core.

[0073] In particular, the composite yarn comprises a flat filament, in particular the flat filament and the at least one support filament as described above, in a weight content between 5 and 35%. Additionally, or alternatively, the composite yarn comprises the fibrous strand, in particular the fibrous strand and the filament core as described above, in a weight content between 95 and 65%. It has been shown that a minimum weight content of 5% is beneficial in that it provides the yarn with sufficient glittering effect. The maximum content of 35% has been shown beneficial to avoid unpleasant feeling imposed by the flat filament and/or adverse effects on the processability of the composite yarn.

[0074] In particular, the fibrous strand is colored, in particular dyed, preferably with a vat dye, a sulfur dye and/or a reactive dye, more preferably with indigo. The inventors have found that in particular the combination of an indigo-dyed fibrous strand, in particular with the use of cotton for the strand, with flat filaments, in particular with flat filaments comprising a metallic layer as described above, leads to a glittering denim look.

[0075] The invention further relates to a fabric, in particular a woven fabric, a non-woven fabric or a knitted fabric, comprising at least one composite yarn as de-

scribed above. Preferably, at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 95%, 98%, 99% or 100% of the yarns of the fabric are composite yarns as described above. Preferably, the fabric is a woven fabric, most preferably a denim fabric. Particularly preferred, the denim fabric comprises indigo-dyed yarns, wherein the indigo-dyed yarns can be the previously described composite yarns or can be other yarns. However, the fabric can also be any other kind fabric, in particular woven fabric, such as gabardine, in particular non-denim and/or undyed gabardine.

[0076] The invention further relates to a woven fabric comprising a front and a back. In particular, the front of the fabric can be referred to as the technical face side which, for a typical warp faced fabric, such as a twill fabric, has the most pronounced wale. The front is the side which will be visibly presented on the front of the products made from the woven fabric according to the invention. The selvage always runs in the warp (lengthwise) direction of a woven fabric. It is possible to identify the warp yarns in a woven fabric with the aid of so-called reed lines. By slightly stretching the fabric, in particular in the weft direction, light can pass through the fabric from the back to the front through the reed line, which extends in warp direction. The reed lines are invariably created during the weaving process, although they may sometimes be difficult to see for an inexperienced observer. Although all the warp yarns come relatively closely together after weaving, there will, in particular upon stretching, always remain a small space between immediately neighboring warp yarns due to the thickness of a steel reed dents, which dents are formed during weaving as the reed of the loom pushes the latest pick of weft yarn towards the produced fabric, which can be called beating. The front side warp yarns are usually the warp yarns which are dyed, in particular with a vat dye, a sulfur dye and/or a reactive dye, preferably with indigo, and may be the only dyed yarns of the fabric. Usually, the front is also the side which is visible during weaving. The back of the fabric can also be called the technical back. The back of the fabric is the side intended to be in contact with the wearer's body. Denim fabric is a typical warp-faced fabric in which the front of the fabric is visibly dominated by indigo-dyed warp yarns, whereas the back of the fabric commonly shows mainly weft yarn(s). Other warp-faced fabrics include twill, cavalry twill, chino, covert, denim, drill, fancy twill, gabardine, and lining twill.

[0077] The woven fabric further comprises plurality weft yarns and a plurality of warp yarns, wherein the warp yarns bypass weft yarns on the front side to define over portions and at their backside to define under portions. Further, the weft yarns bypass the warp yarns on their front side to define over portions and on their backside to define under portions.

[0078] The frontside of a warp yarn and/or weft yarn is in particular the side of said yarn facing towards the front of the fabric. It shall be clear that one or more yarns may be in front of a yarns frontside so that the frontside of the

pick may not always be visible to a person looking at the front of the woven fabric. In the same manner, the back side of a warp yarn and/or weft yarn is in particular the side of the yarn which faces towards the back of the fabric, wherein one or more yarns may be behind the back side of the yarn. However, if a yarn is visible on the front of the fabric, the portion visible will in particular be part of a frontside of that yarn. The portion of yarn visible at the back of a fabric is in particular part of the yarns back side. The under portions and the over portions of each yarn in particular form a generally sinusoidal pattern, when looking at a yarn from a side view. The yarns, for instance the warp yarns, particularly form alternately arranged under portions and over portions with respect to the other yarns, for instance the weft yarns. An over portion particularly extends between two adjacent under portions of yarn. In particular, each under portion extends on the back side of the yarns between two adjacent over portions. In particular, the over portions of the yarns are usually visible at the front of a fabric and therefore dominate the appearance of the fabric's front. In particular, the under portions of the yarns will be visible on the back of the fabric and come into contact with a wearer's skin.

[0079] At least a part of the warp yarns or of the weft yarns are composite yarns as described above. In particular, the warp yarns and/or weft yarns comprise composite yarns in a numeral content of at least 25%, at least 50%, at least 75%, at least 80%, at least 90% or 100%.

[0080] In particular, for at least at least 25%, at least 50%, at least 75%, at least 80%, at least 90% or 100% of the composite yarns, the over portions, preferably all or most of the over portions, bypass more yarns than the under portions of the composite yarn, preferably all or most of the under portions of the composite yarns. Preferably, the composite yarns are provided for visibly appearing on the front of a fabric or, in other words, for showing on the front of the fabric. By selecting the number of yarns which are bypassed by over portions of the composite yarns to be larger than the number of yarns bypassed by the under portions of composite yarns, a weave pattern is achieved in which the composite yarns are primary arranged towards the front of the fabric and seldom appear on the back of the fabric. In particular, the total amount of yarns bypassed by over portions of the composite yarns is larger than the total amount of yarns bypassed by under portions of the composite yarns. In particular, the total amount of yarns bypassed by over portions of the composite yarns is at least two times, preferably at least three times, the number of yarns bypassed by the under portions of the composite yarns. In particular, the composite yarns are woven according to a repeat unit selective from one or more of the repeat units $2/1$, $3/1$, $3/2$, $4/1$, $4/2$ or $4/3$, where the first digit represents the number of yarns bypassed by the over portions and the second digit represents the number of yarns bypassed by the under portions.

[0081] The inventors have found that, by the previously described relation of over portions to under portions, a

woven fabric can be provided having a front being visually dominated by the composite yarns. Further, the presence of the composite yarns on the back of the fabric can be reduced. Thereby the front side can be provided with a desired glittering effect, while the risk of skin contact on the backside is reduced. In particular, the back is the side being intended to be touched by the skin of the user wearing the fabric.

[0082] Most preferably, the composite yarns are woven in a 3/1 repeat unit, wherein the first digit represents the number of yarns bypassed by the over portions and the second digit represents the number of yarns by passed by the under portions.

[0083] According to one embodiment, only the warp yarns or only the weft yarns are composite yarns within the meaning of the invention. In embodiments, in which the front is dominated by warp yarns, such as in warp-dominated fabrics, the composite yarns are preferably comprised by the warp yarns. In embodiments, in which the front is dominated by weft yarns, such as in weft dominated fabrics, the composite yarns are preferably comprised by the weft yarns. Preferably the weft yarns or the warp yarns comprise the composite yarns in a weight content of at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 95%, 98% or 100%. Preferably, the yarns not comprising the composite yarns, for example the weft yarns, have a smaller yarn count than the yarns comprising the composite yarns, for example the warp yarns. It has been found that the smaller count of the yarns not comprising the composite yarn enables to partially hide these yarns from the front of the fabric by the yarns comprising the composite yarns thereby reducing the impairment of the glittering effect on the front of the fabric. In particular, the yarns not comprising the composite yarn have a yarn count which is at least 5 dtex, 10 dtex, 20 dtex, 30 dtex, 50 dtex, 70 dtex, 80 dtex, 100 dtex, 120 dtex, 150 dtex, 200 dtex or 250 dtex smaller than the yarns comprising the composite yarn. Preferably, the yarns not comprising the composite yarn have a yarn count, which is between 50 and 400 dtex smaller, more preferably between 75 and 300 dtex smaller, most preferably between 100 and 200 dtex smaller, than the yarns comprising the composite yarn. Additionally or alternatively, the yarn count of the yarns comprising the composite yarn is between 200 and 800 dtex, more preferably between 250 and 600 dtex, most preferably between 300 and 500 dtex. Additionally or alternatively, the count of the yarns not comprising the composite yarn is between 50 and 500 dtex, more preferably between 75 and 300 dtex, most preferably between 100 and 250 dtex. Most preferably, the count of the yarns comprising the composite yarn and of the yarns not comprising the composite yarn are in the previously described ranges, particularly preferred in combination with the previously described differences between their yarn count.

[0084] In embodiments, in which the warp yarns comprise composite yarns, the composite yarns are preferably colored in particular dyed, preferably with a vat dye,

a sulfur dye and/or a reactive dye, more preferably with indigo. Using the composite yarns as warp yarns has been found particular advantageous. In particular, the preferred use of cotton for the fibrous strand in the composite warp yarns provides two effects, namely a pleasant soft feeling and an increased processibility in that cotton in warp yarns can be colored cost-effective by classic warp dyeing methods, such as vat dyeing, in particular of a warp of yarns being bunched into a rope. Further, it turned out that the use of the composite yarns as warp yarns instead of weft yarns increases the processibility in that less manufacturing errors occur. Without being bound to an explanation, it seems that beating up the weft yarns after their insertion in between the warp yarns during weaving bears the risk of breakage of the flat filaments.

[0085] However, it is also possible to use the composite yarns as weft yarns. It has been found that the previously described design of the fibrous strand, in particular in terms of yarn count, individual fiber count, fiber material, fiber diameter and fiber number, reduces the risk of manufacturing problems when using the composite yarns as weft yarn. When the composite yarns are comprised by weft yarns, it is preferred to keep the weft yarns undyed, in particular not indigo-dyed, and to preferably color, in particular dye, the warp yarns.

[0086] In embodiments, in which a particularly high glittering effect is required, the composite yarns can also be used for warp yarns and for weft yarns. In particular, the respective woven fabric can comprise the composite yarn in a numeral content of at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 100%. In such embodiments, it is of particular advantage to apply the previously described preferred design for the fibrous strand, in particular in terms of yarn count, individual fiber count, fiber material, fiber diameter and fiber number, for the fibrous strand in order to avoid unpleasant feeling of the composite yarns, in particular on the back of the fabric.

[0087] In particular, at least a part of the warp yarns or of the weft yarns comprise front side yarns and back side yarns. Preferably, in particular for at least 25%, at least 50%, at least 75%, at least 80%, at least 90% or all of the frontside and backside yarns, the under portions of the backside yarns, preferably all or most of the under portions of the backside yarns, bypass more picks than the under portions of the frontside yarns, preferably all or most of the under portions of the frontside yarns. Preferably, the frontside yarns are provided for visibly appearing on the face of a fabric or, in other words, for showing on the front of the fabric. The backside yarns are preferably provided for contacting skin of a wearer and/or covering the back of the fabric. By selecting the number of yarns which are bypassed by loop portions or under portions of backside yarns such that they are larger than the number of yarns bypassed by the under portions of frontside yarns, a weave pattern is achieved in which most of the backside yarns are arranged towards the back of the fabric, wherein the frontside yarns are ar-

ranged towards the front of the fabric. The visible impression of the faced is thus dominated by the appearance of the frontside yarns which hide behind them the backside warp yarns.

[0088] Preferably, the fabric that has two distinguishable sets of yarns. A first set of yarns, for example of warp yarns, which are referred to as frontside yarns, are generally woven with other yarns, for example weft yarns, to create a woven fabric of a typical design, preferably having a denim-like look. The second set of yarns, for example of warp yarns, which are herein referred to as backside yarns, can be imagined as being an interwoven with the woven fabric of the first set of yarns such that the second set of yarns is arranged mainly at the back of the fabric. This can be realized for instance by weaving the second set of yarns with relatively large under portions and possibly small over portions and/or by using a number of backside yarns which may be significantly smaller in relation to the number of the frontside yarns and/or by selecting thinner backside than frontside yarns and/or by selecting frontside yarns having a greater shrinkage ratio than the selected backside yarns and/or by selecting a weaving pattern that results in a larger crimping of the frontside yarns with respect to the backside yarns and/or by subjecting the frontside yarns to a larger tensile tension than the backside yarns during weaving to create a woven fabric having a draft ratio, preferably a draft ratio between 5% and 50%, more preferably between 10% and 25%. Alternatively or additionally, the frontside yarns and the backside yarns may differ in their behavior with respect to heat treatment, treatment by washing, treatment by solvents, or the like, in order to obtain a woven fabric as described above. In such a woven fabric, the backside yarns are the yarns which predominantly come into contact with the skin of person wearing clothing comprising a fabric in accordance with the invention. Those backside yarns provide a very soft feeling, very similar to the feeling provided by a knitted fabric. At the same time, the front of the fabric is visually dominated by the frontside yarns. A woven fabric in accordance with the invention can also be realized for a fabric having the outward appearance of a sateen weave or a plain weave. The visible weave pattern of the front can be very similar to different known patterns. It is preferred that the visible pattern shall appear as a common denim weave, such as a 3/1-weave. Other weaves are also possible. Common weaves are for example 2/1, 1/1, 4/1, 3/1 broken twill, 4/1 sateen or the like. The patterns that are visible on the front are essentially realized using only the frontside yarns, for example frontside warp yarns, being interwoven with yarns extending orthogonal to the frontside yarns, for example weft yarns. The additional backside yarns, which are arranged at the back of the fabric, particularly realize a knitted-like behavior so that the back of the fabric looks like a knitted fabric and feels softer and more flexible than a typical woven fabric. Also, in comparison to typical denim fabrics which stretch only in weft direction, the fabric according to the invention

may easily be produced as a so-called bi-stretch fabric due to the use of different frontside and backside yarns.

[0089] Additionally or alternatively, the frontside and backside yarns are differently designed and/or woven such that the frontside yarns, in particular at least 25%, at least 50%, at least 75%, at least 90% or all of the front side yarns, in particular are laterally in contact with each adjacently neighboring frontside yarn, form a closely woven frontside yarn arrangement. Laterally, regarding the arrangement of frontside yarns, refers to the orthogonal direction of the yarn extension, in the case of frontside warp yarns the weft direction and in the case of frontside weft yarns the warp direction. Preferably, the frontside yarns are constantly and/or continuously in contact with each other along at least 50%, at least 75%, at least 90% or all of their length. It shall be clear that two neighboring yarns, for example warp yarns, that are in lateral contact with one another can, preferably at regular intervals, have yarns, for example weft yarns, passing between their contacting side. When both lateral sides of the frontside yarn (horizontal right and horizontal left) are in contact with a respective immediately adjacent yarn, the realized arrangement of frontside yarns is very closely woven and structurally isolate the backside yarns from the front of the fabric, wherein in particular the frontside yarns adjacent to each other are laterally in contact with each other. Such a closely woven frontside yarn arrangement can be achieved or enhanced for example by using frontside yarns that are thicker than backside yarns or by arranging the frontside yarns in a first yarn plane and the backside yarns in a second yarn plane, such that the first yarn plane is offset from the second yarn plane towards the front of the fabric. The frontside yarns adjacent to each other are preferably arranged laterally in contact with each other after the first or the first couple of washings of the woven fabric.

[0090] Additionally or alternatively, the frontside yarns have axial center lines and define a central warp/weft plane extending through the axial centerlines of the frontside yarns along the over portions of the frontside yarns, wherein all of the backside yarns have axial centerlines and wherein most or all of the backside yarns have axial central lines particularly along their entire extension extending on the back side of the central warp/weft plane, preferably towards the back of the woven fabric, in a thickness direction perpendicular to the warp direction and perpendicular to the weft direction. The central warp/weft plane is spanned in warp direction and in weft direction. The central warp/weft plane, defined by particularly the over portions of the frontside yarns, is particularly apparent when the woven fabric is on the loom and/or when tension is applied to the woven fabric in the direction of the frontside yarns, for example in warp direction.

[0091] In particular, the under portions of the backside yarns comprise loop portions. In particular, the frontside yarns, in particular the composite yarns, and said backside yarns are designed and/or woven, preferably differently designed and/or differently woven, such that under

portions, or loop portions, of the backside yarns extend loos, in particular looser than the under portions of said frontside yarns. The under portions of the backside yarns can extend curved, in particular more curved than the frontside yarn's under portions. The under portions of the frontside yarns can extend straight, in particular straighter than the under portions of the backside yarns. A loose loop easily identified in a woven fabric in that the length of the backside yarn forming the under portion or loop portion is larger than the distance between the connecting points or over portions between which said loose loop under portion extends. The length of the backside yarn along the loose loop is preferably at least 25 %, at least 50 %, at least 75 % or at least 100 % larger than the distance between the connecting points between which said loose loop extends. The distance between the connecting points framing one loose loop can be determined by measuring the distance between the respective contact surfaces of those weft yarns where the backside yarn passes from its under portion (or loop portion) to a neighboring over portion. The loose loops of the backside yarn can be formed after the woven fabric is taken off the loom or after a first or first couple of washings of the fabric. In the loose loops, the respective yarn tension after removal from the loom and/or after washing can be much less than in the frontside yarns that do not comprise loose loops. Preferably, the tension in the frontside yarns of the woven fabric according is at least as high, particularly higher than, the tension in the backside yarns, in particular during weaving and/or before the fabric is taken off the loom and/or before washing for the first time. The formation of loose loops can be achieved or enhanced for example by selecting a backside yarn having a smaller shrinkage ratio than the frontside yarns and/or for example by weaving the frontside yarns with a higher weave tightness than the backside yarns. A higher shrinkage ratio can in particular mean a higher elastic retraction upon taking the fabric from the loom or after stretching the fabric.

[0092] In particular, the backside yarns and the composite yarns are both warp yarns and/or both weft yarns. Particularly preferred, the composite yarns are frontside yarns. In particular, the composite yarns are alternated with the backside yarns. The wording "alternated", as used herein, particularly encompasses a 1/1 alternation, a 1/2 alternation, a 2/1 alternation, a 2/2 alternation, a 3/1 alternation, a 3/2 alternation, a 3/3 alternation, a 1/3 alternation or a 2/3 alternation, wherein the first digit represents frontside yarns and the second digits represents backside yarns. In other word, a 2/1 alternation of frontside and backside warp yarns means that two adjacent frontside warp yarns are followed in weft direction by one single backside warp yarn.

[0093] The inventors have found that the combination of composite yarns according to the invention with backside yarns comprising loop portions on the back of the fabric is of benefit in that the loop portions on the back of the fabric reduce the risk of skin contact with the com-

posite yarns while the composite yarns can provide a desired glittering effect on the front.

[0094] Preferably, the backside yarns have a smaller count than the composite yarns. It has been found that the smaller count of the backside yarns enables hiding the backside yarns by the front side yarns thereby reducing the risk that the backside yarns can be seen and felt on the front of the fabric. Thereby, impairment of the glittering effect on the front side by the backside yarns can be reduced, in particular avoided. In particular, the backside yarns have a yarn count which is at least 5 dtex, 10 dtex, 20 dtex, 30 dtex, 50 dtex, 70 dtex, 80 dtex, 100 dtex, 120 dtex, 150 dtex, 200 dtex or 250 dtex smaller than the yarn count of the front side yarns. Preferably, the backside yarns have a yarn count, which is between 50 and 400 dtex smaller, more preferably between 75 and 300 dtex smaller, most preferably between 100 and 200 dtex smaller, than the frontside yarns. Additionally or alternatively, the yarn count of the frontside yarns is between 200 and 800 dtex, more preferably between 250 and 600 dtex, most preferably between 300 and 500 dtex. Additionally or alternatively, the count of the backside yarns is between 50 and 500 dtex, more preferably between 75 and 300 dtex, most preferably between 100 and 250 dtex. Most preferably, the yarn count of the frontside yarns and of the backside yarns are in the previously described ranges, particularly preferred in combination with the previously described differences between their yarn count.

[0095] Additionally or alternatively, the backside yarns are undyed, wherein the front side yarns, in particularly the composite yarns, are dyed, in particularly indigo-dyed. Thereby, the risk of staining on the skin of a wearer can be reduced, in particular avoided.

[0096] Further aspects, properties and features of the invention will become apparent and more appreciated from the following description of exemplary embodiments, taking in conjunction with the company drawings, in which are dedicated in:

- Figure 1a a schematic perspective view on a flat filament;
- Figure 1b a top view on the flat filament of figure 1a;
- Figure 2 a top view on the flat filament of figure 1a with two support filaments wrapped around the flat filaments;
- Figure 3 a schematic illustration of a flat filament being twisted with a support filament;
- Figure 4 a schematic illustration of a flat filament wrapped around a support filament;
- Figure 5 a schematic illustration of a flat filament being wrapped with spaces between each revolution around a support filament;

- Figure 6a a side view on a device for providing a composite yarn;
- Figure 6b a perspective sectional view on the device of figure 6a;
- Figure 6c a front sectional view on the device of figure 6a during the production of a composite yarn with one flat filament;
- Figure 7 a front sectional view on the device of figure 6a during the production of a composite yarn with two flat filaments;
- Figure 8a a side view on a schematically illustrated composite yarn with one flat filament;
- Figure 8b a cross section view of a composite yarn with one flat filament;
- Figure 9a a side view on a schematically illustrated composite yarn with two flat filaments;
- Figure 9b a cross section view of a composite yarn with two flat filaments;
- Figure 10 a perspective view on a woven fabric comprising composite yarns in warp direction;
- Figure 11 a perspective view on a woven fabric comprising composite yarns in weft direction; and
- Figure 12 a perspective view on a woven fabric with composite yarns in warp direction and in weft direction.

[0097] Figure 8a schematically illustrates a composite yarn 1 within the meaning of the invention. The composite yarn 1 comprises a flat filament 3, a fibrous strand 5 and a filament core 7. The flat filament 3 and the fibrous strand 5 are wrapped around the filament core 7. In other embodiments (not shown), the composite yarn 1 can be free of a filament core 7. In figure 8a, the flat filament 3 is illustrated as being uniformly helically wrapped together with the fibrous strand 5 around the filament core 7. Therein, the flat filament 3 is illustrated by thin black lines. This shall represent an embodiment, in which only the edges 29 of the flat filament 3 are exposed to the outside of the yarn 1 while the fibrous strand 5 covers the flat surface of the flat filament 3. However, it shall be clear that other configurations are also covered by the invention. Partially covering particularly means that at least a part of the flat filament is hidden from being seen and/or felt.

[0098] Figure 9a schematically illustrates a composite yarn 1 as shown in figure 8a, with the only difference that the composite yarn comprises an additional flat filament

3'. The additional flat filament 3' is illustrated by a thick black line. This shall represent an embodiment in which the flat filament 3' exposes its flat surface completely to the outside, in particular in radial direction R, of the yarn. In such embodiments, the flat filament 3' is only covered on its inside by the fibrous strand 3. In other words, the fibrous strand 5 does not partially covers the outside of the additional flat filament 3', in particular from being seen and felt.

[0099] Figures 8b and 9b schematically illustrate cross sectional views of composite yarns 1 with a filament core 7, a fibrous strand 5 and at least one flat filament 3, 3'. The filament core 7 is schematically shown as a mono-filament core 7. As previously explained, the filament core 7 can also comprise more than one filament. Further, the composite yarn can be free of a filament core 7. The filament core 7 is completely covered by the fibrous strand 5. In other words, the fibrous strand 5 is a sheath covering, in particularly surrounding, the filament core 7. The fibrous strand 5 is schematically shown to contain staple fibers 43 and filaments 45. The staple fibers 43 are illustrated by the small black lines extending in radial direction R. The filaments are 45 illustrated by the white circles. However, as explained above, the fibrous strand can also purely consist of staple fibers 43 or of filaments 45. The flat filament 3 is schematically illustrated by the black circle 3. In figure 8b, the composite yarn 1 comprises one flat filament 3. In figure 9b, the composite yarn 1 comprises two flat filaments 3, 3'. In figures 9a and 9b, the flat filaments are located at the outside of the composite yarn 1. Thereby, they are only covered on their inside by the fibrous strand 5. However, as described above, the flat filament can also be partially covered on its outside by the fibrous strand 5. For instance, in particular along the longitudinal axis L of the composite yarn 1, the flat filament 3 can partially extend on the outside of the fibrous strand 5, as shown in figures 8b and 9b, and partially in between fibers 43, 45 of the fibrous strand 5 and/or directly at the filament core 7. As shown in figure 9b, where the composite yarn comprises two or more flat filaments, they can be, at least partially, offset from each other in circumferential direction U. It shall be clear that Figures 8a, 8b, 9a, and 9b are only intended to schematically show possible positions of the flat filaments 3, 3' with respect to the fibrous strand 5 and/or the filament core 7. In particular, these figures shall not show the realistic dimensions and forms of the flat filaments 3, 3', the fibrous strand 5 and the filament core 7.

[0100] Figure 6a and figure 6b schematically illustrate a device for manufacturing a composite yarn as shown in Figure 8a and 9a. As can be seen in Figure 6b, the device can be used to manufacture two composite yarns 1 simultaneously. In the following, the manufacturing of one composite yarn 1 will be described. The flat filament 3 is obtained from a spool 13 from which it is conveyed to a merging unit 15. Simultaneously, the fibrous strand 5, for example in the form of a roving, is obtained from a spool 17 and conveyed through a drafting unit 19. From

the drafting unit 19, the fibrous strand 5 is conveyed to the merging unit 15. Further, a filament core 7 is conveyed to the merging station 15. The merging unit 15 comprises two rolls 21 between which the fibrous strand 5, the filament core 7 and the flat filament 3 is conveyed. In particular, the fibrous strand 5, the filament core 7 and the flat filament 3 are guided in between the two rolls 21 in that they contact each other and preferably are pressed against each other while being conveyed through the rolls 21. After leaving the merging unit 15, the fibrous strand 5, the filament core 7 and the flat filament 3 can be spun into a composite yarn for instance, by ring spinning, core spinning and/or hollow spindle spinning.

[0101] The merging station 15 further comprises three rolls 47 with a recess for guiding filaments 3, 3', 7 to the rolls 21. The rolls 47 comprise a V-shaped recess. The rolls 47 with recess are mounted, in conveying direction, upwards the two rolls 21. Contrary to the rolls 47, the rolls 21 have a flat surface. The three rolls 47 with recess are mounted on a shaft 47, in particular at idle. The rolls 47 serve to arrange the at least one flat filament 3, 3' and the optional filament core 7 in a predetermined location with respect to each other and with respect to the fibrous strand 5. For example, as shown in figure 6c, the fibrous strand is guided over the middle one of the three rolls 47 so that it subsequently contacts the fibrous strand 5 in its middle so that, after spinning, the filament core is located in the middle of the composite yarn. The flat filament 3 is guided over the right one of three rolls 47 with recess. Thereby, it is ensured that the flat filament 3 contacts the fibrous strand 5 at its outside so that, after spinning, the flat filament 3 is located at least partially at the outside of the composite yarn 1 so that it is at least partially exposed to a person looking at the composite yarn. Figure 7 shows an example where, additionally, a second flat filament 3' is guided over the left roll 47 with recess to come in contact with the fibrous strand 5 at its opposite (left) outside. Thereby, it can be ensured that the second flat filament 3', after spinning, appears at least partially at the outside of the composite yarn 1 and is at least partially spaced from the flat filament 3 in circumferential direction U which leads to a more uniform distribution of gloss in the composite yarn. It shall be clear that the merging unit could also only comprise one, two or more than three rolls 47 with recess. The number of rolls 47 with recess particularly depends on the number of flat filaments 3, 3' and filaments in the filament core 7 to be used. Of course, the device could also be used to produce composite yarns 1 having no filament core 7 but only at least one flat filament 3, 3'.

[0102] Preferred embodiments of the flat filament 3 will now be described with respect to the figures 1 to 5.

[0103] Figure 1a schematically illustrates a flat filament 3 in perspective view. Figure 1b shows the flat filament of figure 1a in top view. The thickness T, the width W and the cross-section C are designated with respective capitals T, W and C.

[0104] Figure 2 illustrates an embodiment in which two

support filaments 9 are wrapped around a flat filament 3. The support filaments 9 are wrapped in opposite directions around the flat filament 3. It has been found that the combination of a flat filament 3 and two support filament 9 as illustrated in Figure 2 can provide a remarkable glittering effect. A preferred embodiment uses a flat filament having a thickness T of 12 micrometers, a width W of 372 micrometers, a flat filament yarn count of about 70 dtex and a support filament count of about 20 dtex for each support filament. Preferably, the material of the flat filament comprises a metallic layer, in particular an aluminum layer, being covered by two polymer layers, in particular polyester layers, more in particular polyethylene terephthalate layers. The two support filaments preferably comprise a polyamide, more preferably a polyamide 6.6.

[0105] Figure 3 illustrates an embodiment of a flat filament 3 and one support filament 9, wherein the flat filament 3 and the support filament 9 are twisted around each other. Thereby, the support filament 9 and the flat filament 3 are twisted around a common twist axis 23. Contrary thereto, in the above discussed figure 2, the flat filament 3 remains substantially untwisted while the two support filaments 9 are twisted around the longitudinal axis 25 of the flat filament 3.

[0106] In the embodiment shown figure 3, the flat filament 3 is preferably designed as discussed with respect to figure 2 while the support filament 9 is preferably chosen with a larger filament count, in particular with a filament count of about 70 dtex. The material of the support filament 9 is also preferably a polyamide, in particular a polyamide 6.6.

[0107] Figures 4 and 5 illustrate embodiments in which the flat filament 3 is wrapped around one support filament 9. Thereby, the support filament 9 remains substantially untwisted, while the flat filament 3 is wrapped around the longitudinal axis 27 of the support filament 9. In embodiments as shown in figure 4 and 5, the support filament 27 is preferably larger compared to the embodiments shown in figure 2 and 3. In particular preferred embodiments, the support filament has a filament count of about 140 dtex.

[0108] Figure 4 illustrates an embodiment in which the filament 3 is wrapped around the support filament 9, wherein the edges 29 of the flat filament 3, in particular cutting edges, substantially contact each other. Contrary thereto, figure 5 illustrates an embodiment in which the edges 29 of the flat filament 3 are spaced from each other along the longitudinal axis 27 of the support filament 9.

[0109] Figure 10 shows an embodiment of a woven fabric 11, in which all warp yarns 31 are composite yarns 1 within the meaning of the invention. The weft yarns 33 in figure 10 are not composite yarns 1 within the meaning of the invention. In particular, the weft yarns 33 are free of flat filaments. In figure 10, the warp yarns 31 and the weft yarns 33 are woven according to a 3/1 repeat unit. The side facing the reader in figure 10 represents the back of the fabric. As it can be seen, the under portions

35 of the warp yarns 31 extend over one weft yarn 33 on the back while the over portions 37 extend over three weft yarns 33 on the front. Thereby, it is ensured that the composite warp yarns 1, 31 appear only seldom on the back of the fabric 11, thereby reducing the risk of skin contact with the composite warp yarns 1, 31. At the same time, this structure leads to a front being dominated by the composite warp yarns, thereby providing a remarkable glittering effect on the front. At the same time, the weft yarns comprise under portions 39 extending over three warp yarns 31 on the back of the fabric and over portions 41 extending over one warp yarn 31 on the front of the fabric. Thereby, it can be ensured that the weft yarns 33 appear only seldom on the front thereby avoiding disturbing the glittering appearance of the front side. At the same time, the under portions 39 of the weft yarns on the backside can be designed to extend droopy to increase the soft touch of the fabric on the backside.

[0110] Figure 11 shows an alternative embodiment in which the weft yarns 33 are composite yarns 1 and the warp yarns 31 are not composite yarns. As in figure 10, the warp yarns 31 and weft yarns 33 in figure 11 are both woven with a 3/1 repeat unit. In figure 11, the sight facing the viewer shall be the front of the fabric. Thus, contrary to figure 10, figure 11 illustrates an embodiment, in which the front is visually dominated by composite weft yarns 1/33 within the meaning of the invention. This can be achieved by weaving the fabric in that the over portions 41 of the weft yarns 33 extend over three warp yarns 31 on the front of the fabric while the under portions 39 extend over one warp yarn 31 on the back of the fabric. Respectively, in figure 11, the over portions 37 of the warp yarns 31 extend over one weft yarn 33 on the front of the fabric while the under portions 35 of the warp yarns 31 extend over three weft yarns 33 on the back of the fabric. The fabric 11 being illustrated in figure 11 shall represent a fabric with weft dominated front while the fabric being illustrated in figure 10 shall represent a fabric with warp dominated front.

[0111] Figure 12 shows an embodiment with identical weaving structure as figure 11 being modified in that, in addition to the weft yarns 33, the warp yarns 31 are composite yarns 1 within the meaning of the invention. With such embodiment, a fabric with a front and a back having a remarkable glittering effect can be provided.

[0112] The black lines in the composite yarns 1 in figures 10 to 12 shall represent the fibers of the fibrous strand only partially covers the flat filament, which shall be illustrated by the white surfaces between the black lines.

[0113] The features disclosed in the above description, the figures and the claims might be significant for the realization of the invention in its different embodiments individually as in any combination.

Reference signs:

[0114]

1	Composite yarn
3	Flat filament
5	Fibrous strand
7	Filament core
5 9	Support filament
11	Woven fabric
13	Spool
15	Merging unit
17	Spool
10 19	Drafting unit
21	Rolls
23	Common twist axis
25	Longitudinal axis of flat filament
27	Longitudinal axis of support filament
15 29	Edge of flat filament
31	Warp yarns
33	Weft yarns
35	Under portion of warp yarn
37	Over portions of warp yarn
20 39	Under portion of weft yarn
41	Over portions of weft yarn
43	staple fibers
45	filaments
47	roll with recess
25 49	shaft
C	Cross section of flat filament
T	Thickness of cross section of flat filament
W	Width of cross section of flat filament
30 R	Radial direction
L	Longitudinal axis
U	Circumferential direction

35 Claims

1. A composite yarn (1), comprising:

- a fibrous strand (5); and
- at least one flat filament (3) having a cross-section (C) with a thickness (T) and a width (W) of at least three times the thickness (T).

2. The composite yarn (1) according to claim 1, wherein the at least one flat filament (3) comprises a polymer, in particular a polymer with polar monomer units, wherein the polymer is preferably selected from the group consisting of

- a synthetic polymer, preferably a polyester, more preferably a polyethyleneterephthalate, and/or
- a polysaccharide, particularly preferred a cellulose or derivatives thereof, more preferably a cellulose hydrate.

3. The composite yarn (1) according to claim 1 or 2, wherein the at least one flat filament comprises a

metallic layer, in particular an aluminum layer, and at least one polymer layer, in particular at least one polymer layer on each side of the metallic layer.

4. The composite yarn (1) according to one of the preceding claims, wherein the at least one flat filament (3) has a root mean square roughness of less than less than 0,5 μm , more preferably of less than 0,3 μm , even more preferably of less than 0,15 μm , most preferably of less than 0,1 or less than 0,06 μm .

5. The composite yarn (1) according to one of the preceding claims, further comprising at least one support filament (9),

- wherein the at least one support filament (9) is wrapped around the at least one flat filament (3), or

- wherein the at least one flat filament (3) is wrapped around the at least one support filament (9), or

- wherein the at least one support filament (9) and the at least one flat filament (3) are twisted around each other.

6. The composite yarn (1) according to one of the preceding claims, wherein

- the fibrous strand (5) has a count between 100 to 1000 dtex, preferably 200 to 800 dtex, more preferably 250 to 700 dtex, most preferably 300 to 600 dtex,

- the fibrous strand (5) comprises a plurality of fibers having an individual fiber count between 0,1 and 10 dtex, preferably between 0,5 and 5 dtex, more preferably between 1 and 3 dtex, most preferably between 1,3 and 2,3 dtex, and/or

- the fibrous strand (5) comprises between 50 and 600, preferably between 100 and 450, more preferably between 150 and 400, most preferably between 200 and 300 fibers, in particular in a cross section of the composite yarn.

7. The composite yarn (1) according to one of the preceding claims, wherein the fibrous strand comprises cotton fibers, in particular in a weight content of at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 95%, 98%, 99% or 100%.

8. The composite yarn (1) according to one of the preceding claims, wherein the fibrous strand (3) covers the at least one flat filament at least partially, preferably wherein the fibrous strand and the at least one flat filament are spun, in particular ring spun or core spun, into the composite yarn (1).

9. The composite yarn (1) according to one of the pre-

ceding claims, further comprising

- a filament core (7), in particular comprising an elastic filament and/or an inelastic filament, in particular wherein the fibrous strand (5) and/or the at least one flat filament (3) partially cover the filament core (7), in particular are spun around the filament core (7).

10. The composite yarn (1) according to one of the preceding claims, wherein the composite yarn (1) comprises the at least one flat filament (3), in particular the at least one flat filament (3) and the at least one support filament (9) according to claim 5, in a weight content between 5 and 35 %, and/or the fibrous strand (5), in particular the fibrous strand (5) and the filament core (7) according to claim 9, in a weight content between 95 and 65 %.

11. A fabric, in particular a woven fabric (11), a non-woven fabric or a knitted fabric, comprising at least one composite yarn (1) according to one of the preceding claims.

12. A woven fabric (11), comprising:

- a front and a back; and

- a plurality of weft yarns (33) and a plurality of warp yarns (31),

wherein the warp yarns (31) bypass weft yarns (33) at their front side to define over portions (37) and at their back side to define under portions (35), and

wherein the weft yarns (33) bypass warp yarns (31) at their front side to define over portions (41) and at their back side to define under portions (39), and

wherein at least a part of the warp yarns (31) and/or of the weft yarns (33) are composite yarns (1) according to one of the claims 1 to 10, in particular wherein only the warp yarns (31) or only the weft yarns (35) comprise composite yarns (1) according to one of the claims 1 to 10.

13. The woven fabric (11) according to claim 11, wherein the total amount of yarns bypassed by over portions of the composite yarns is larger than the total amount of yarns bypassed by under portions of the composite yarns, in particular wherein the composite yarns are woven according to a repeat unit selected from one or more of the repeat units of 2/1, 3/1, 3/2, 4/1, 4/2 or 4/3, in particular wherein the first digit represents the number of yarns bypassed by the over portion (37, 41) and the second digit represents the number of yarns bypassed by the under portions (35, 39).

14. The woven fabric (11) according to one of the claims 11 to 13, wherein at least a part of the warp yarns (31) and/or of the weft yarns (33) comprise frontside yarns and backside yarns, wherein the backside yarns are free from flat filaments, in particular free from composite yarns according to one of the claims 1 to 10, and wherein the frontside yarns comprise, in particular consist of, the composite yarns according to one of the claims 1 to 10, in particular wherein
- the under portion of the backside yarns comprise loop portions and/or wherein
 - the backside yarns and the composite yarns (1) are both warp yarns (31) and/or both weft yarns (33) and/or wherein
 - the backside yarns are alternated with the front-side yarns.
15. The woven fabric (11) according to claim 14, wherein the backside yarns have a lower yarn count than the composite yarns (1) and/or wherein the backside yarns are undyed and/or wherein the composite yarns (1) are dyed, in particular with a vat dye, a sulfur dye and/or a reactive dye, preferably with indigo.

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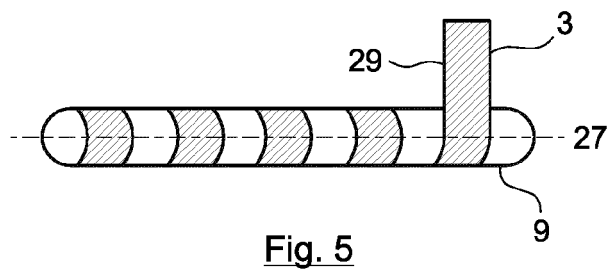
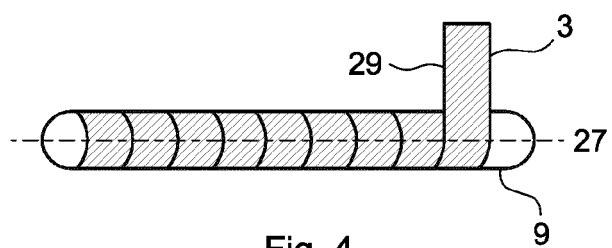
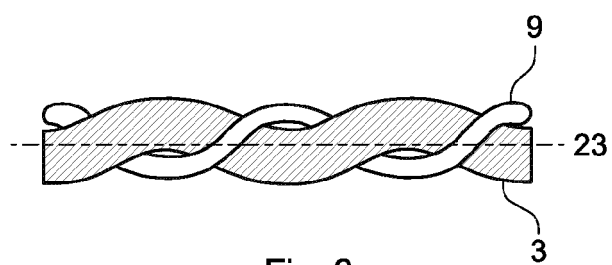
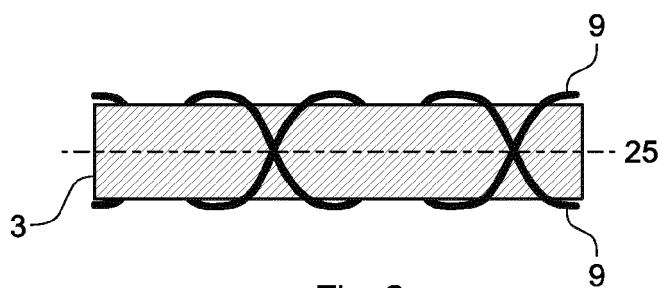
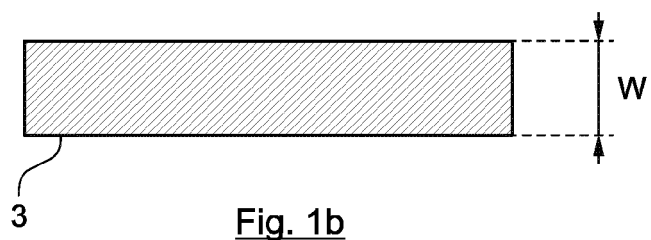
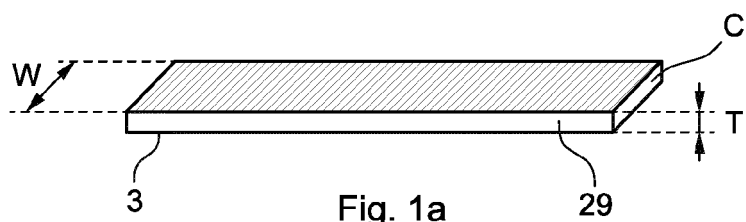
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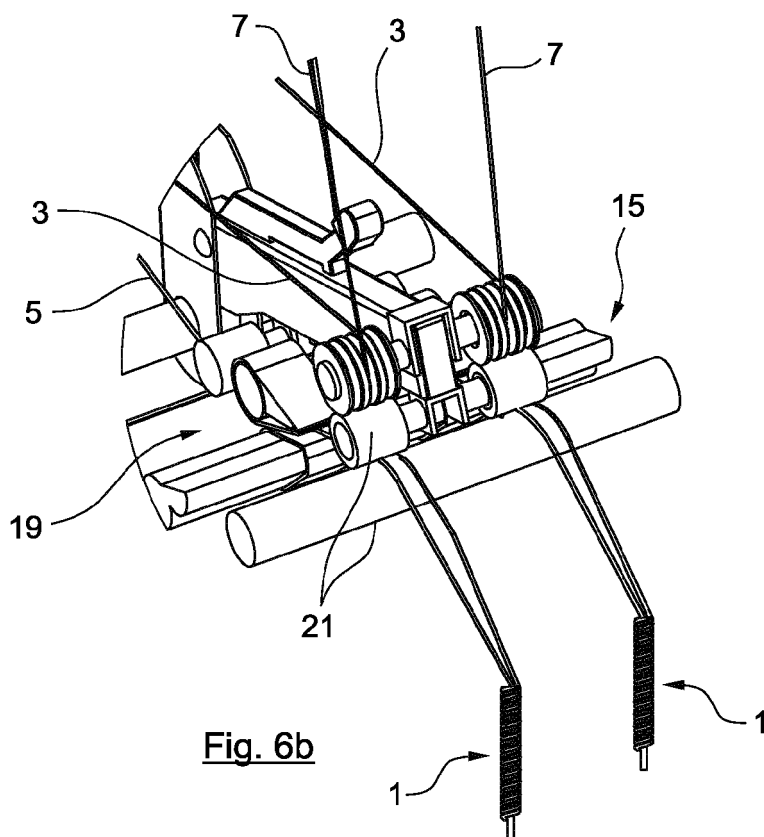
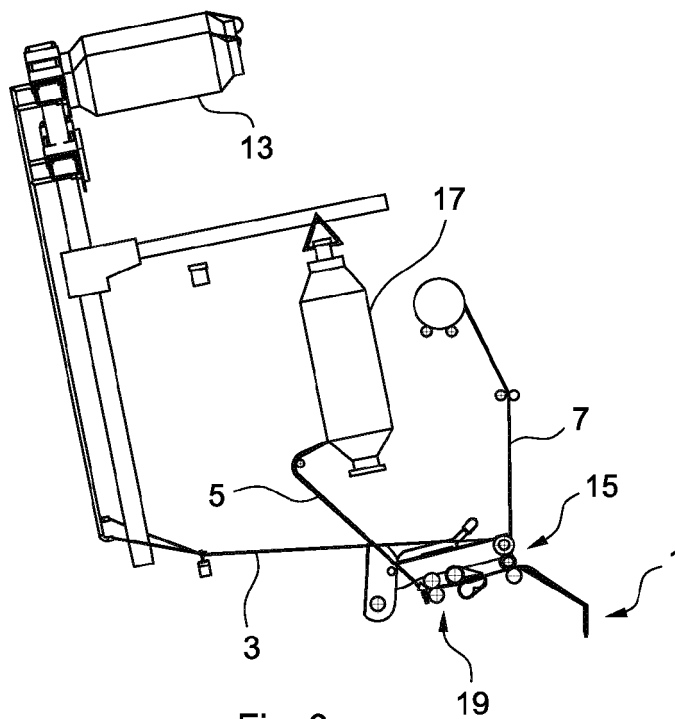
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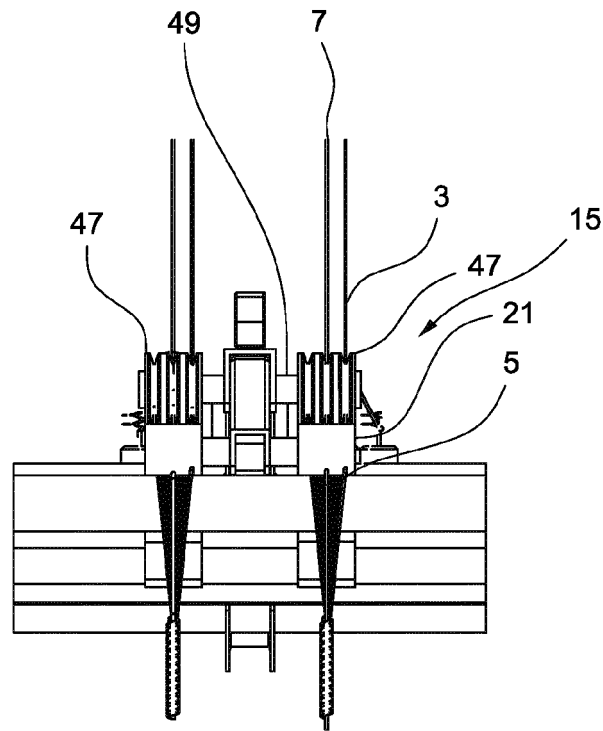


Fig. 6c

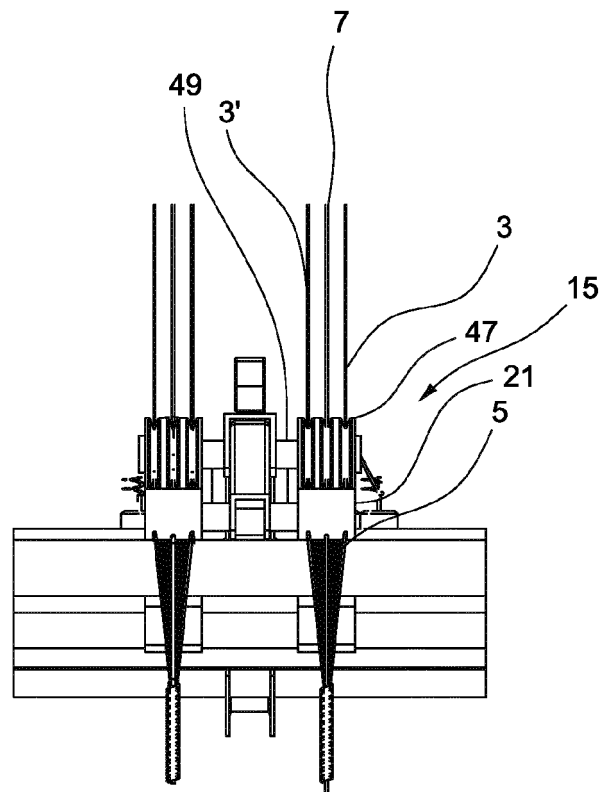


Fig. 7

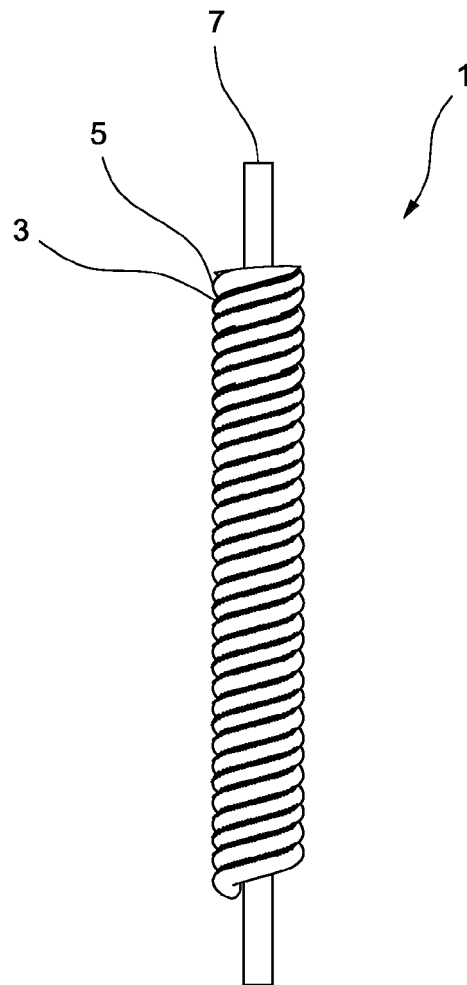


Fig. 8a

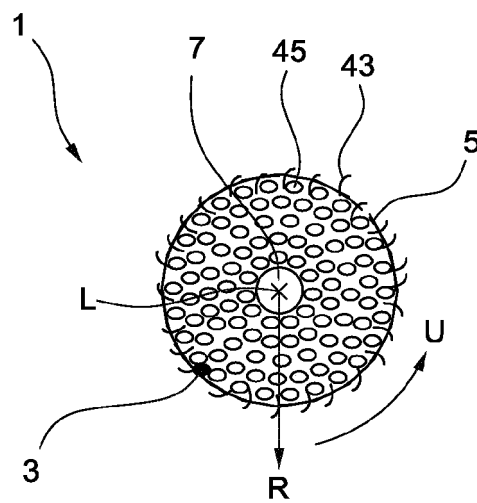


Fig. 8b

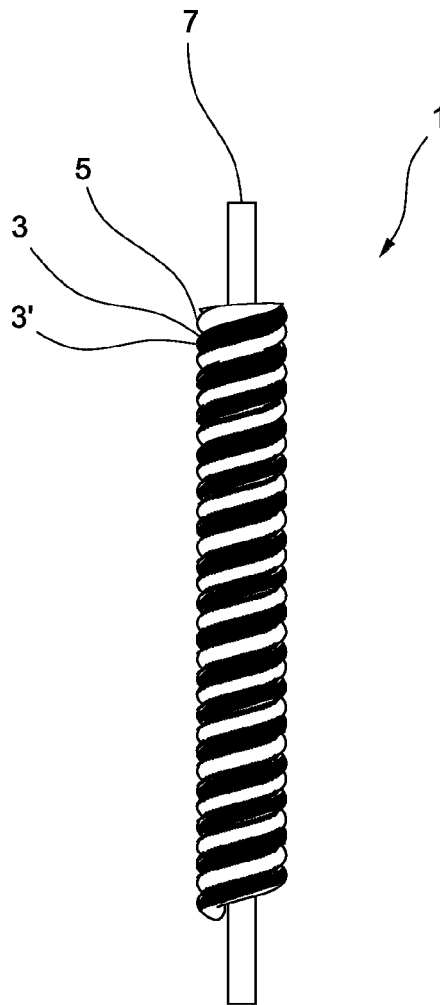


Fig. 9a

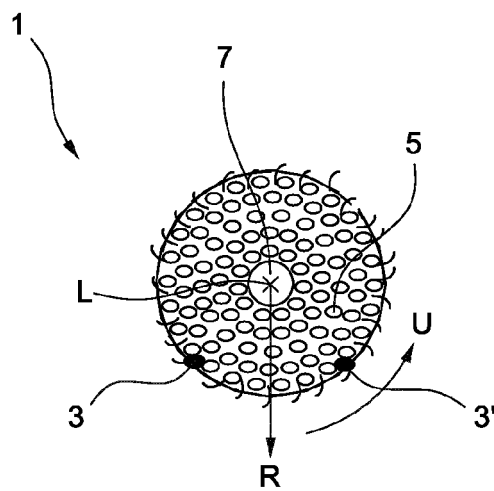


Fig. 9b

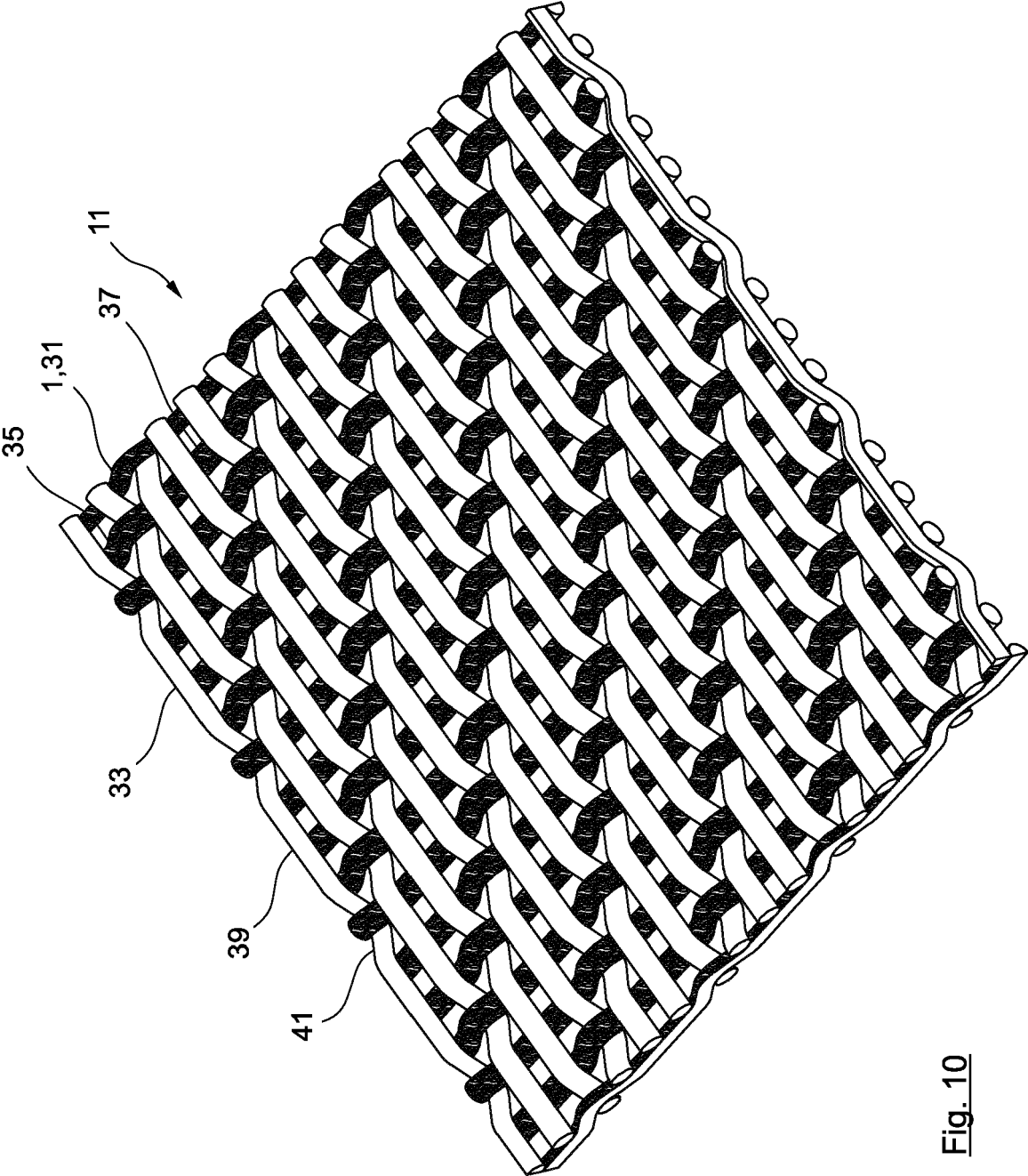


Fig. 10

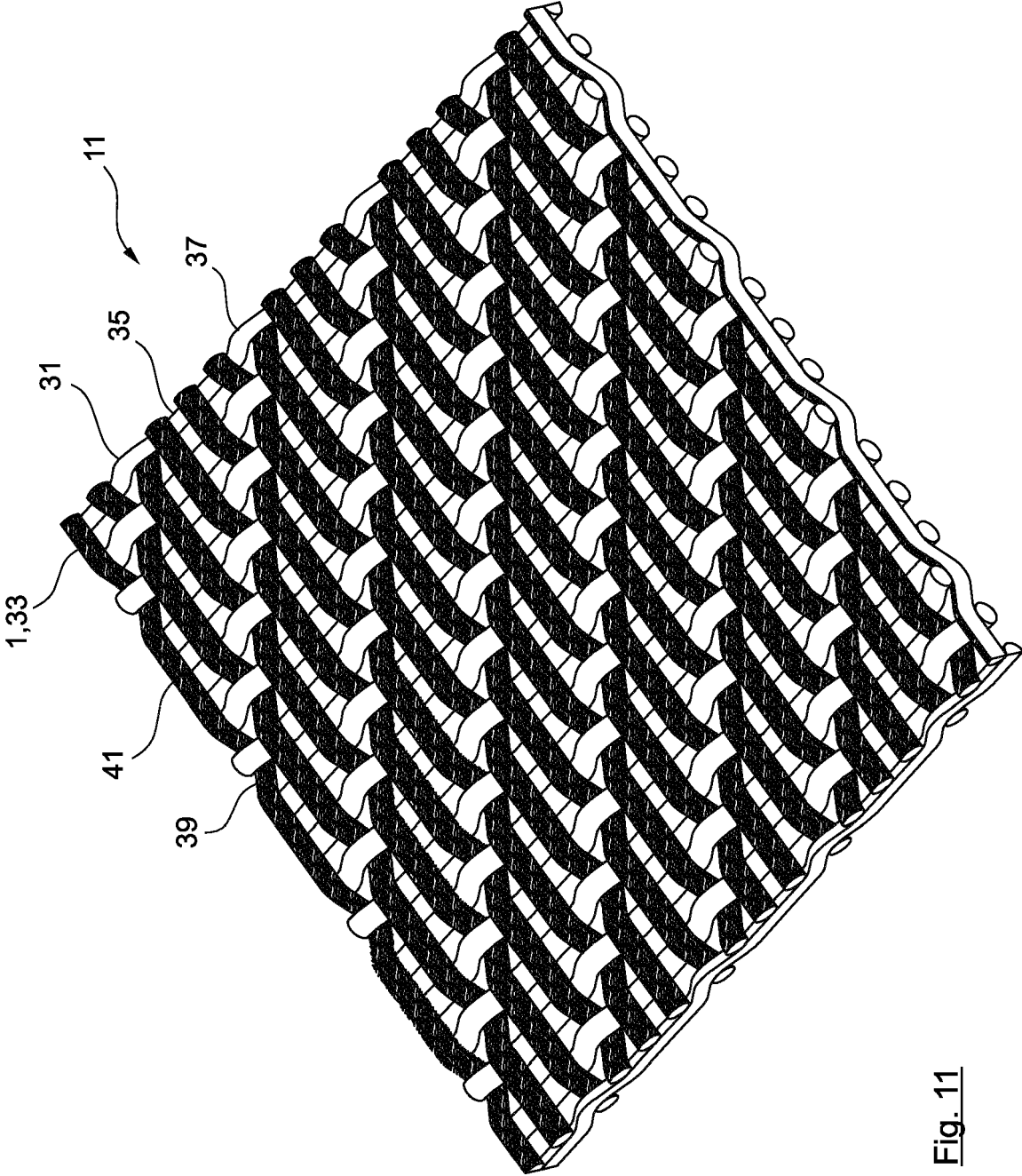


Fig. 11

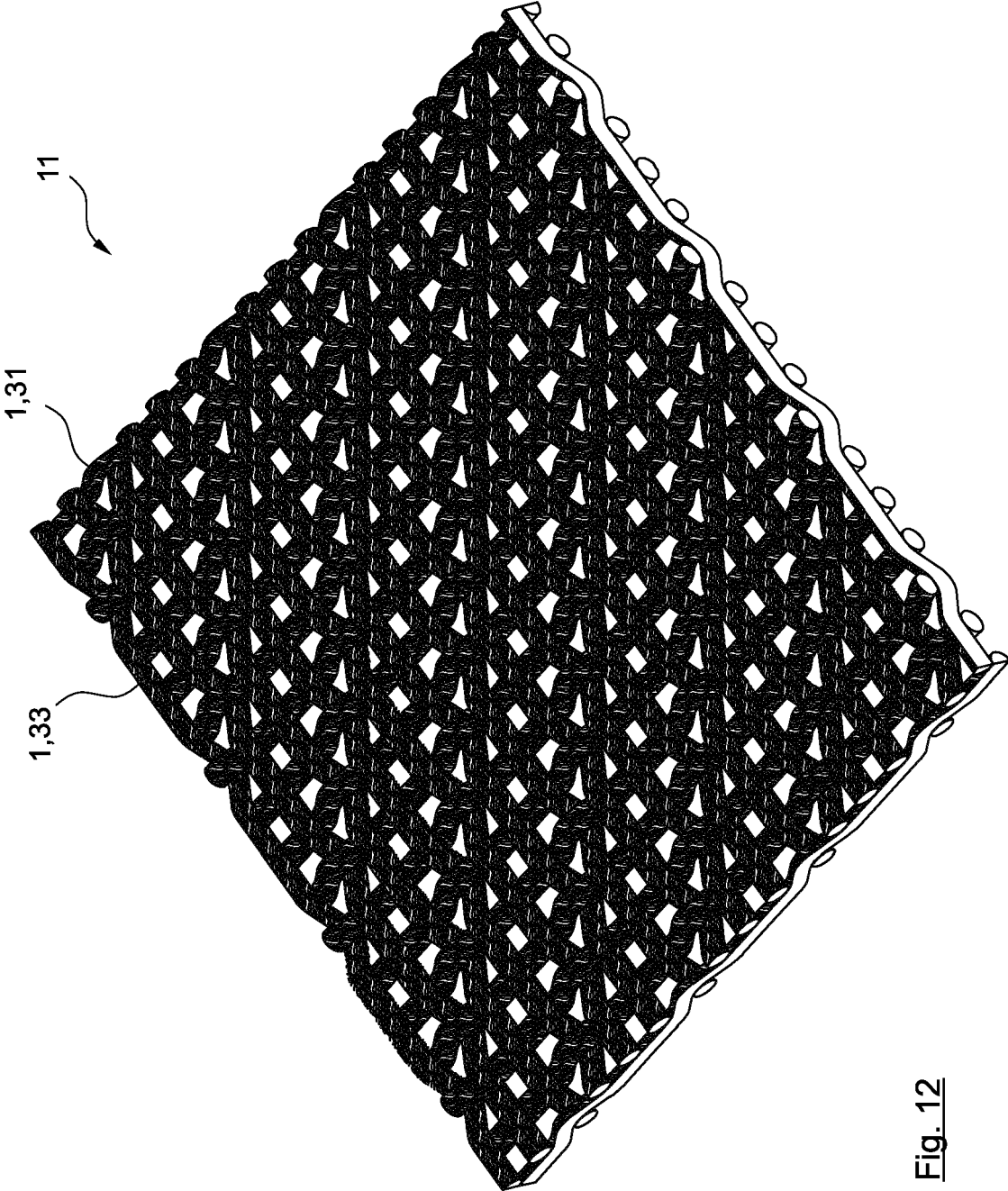


Fig. 12



EUROPEAN SEARCH REPORT

Application Number

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2 607 185 A (LEO SILVERMAN) 19 August 1952 (1952-08-19) * column 1, line 1 - line 14 * * column 2, line 56 - column 4, line 27; figures 1,4-5 *	1-3, 5, 7, 8, 11, 12	INV. D02G3/34 D02G3/06 D03D15/553 D03D15/37
X	WO 2011/089976 A1 (REIKO KK [JP]; SAIUCHI KIIYOKAZU [JP] ET AL.) 28 July 2011 (2011-07-28) * paragraph [0001] * * paragraph [0017] - paragraph [0018] * * paragraph [0025] - paragraph [0037]; figures 1-2 * * paragraph [0054] - paragraph [0057] *	1-3, 5-8, 10-12	
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CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

**ANNEX TO THE EUROPEAN SEARCH REPORT
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