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(54) **METHOD TO PRODUCE CUT RESISTANT FABRIC AND CUT RESISTANT FABRIC**

VERFAHREN ZUR HERSTELLUNG EINES SCHNITTFESTEN GEWEBES UND SCHNITTFESTES GEWEBE

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Description

Technical field

[0001] The invention pertains to the technical field of protective cut resistant, stab resistant and puncture resistant fabric. The invention also pertains to the technical field of manufacturing said cut resistant, stab resistant and puncture resistant fabric.

Background

[0002] There are many different types of fabrics designed to protect the human body from a range of external forces, particularly direct physical or mechanical forces. Many fabrics of the prior art have been developed for specific purposes, such as protecting soldiers, fire fighters or police during the course of their work. These fabrics have been designed to provide protection against projectiles such as bullets, sharp weapons such as knives, or impact such as a blow from a baton. Fabrics developed for these types of purposes are typically very thick and heavy.

[0003] For example, as described in US patent 5,008,959, light-weight body armor is made of woven or non-woven fabric composed of filaments of very high molecular weight polymers. Bullets impacting on body armor generally do not have sufficient energy and force to break a significant number of the filaments which make up the armor fabric. The impact can elongate, distort and deform the fabric, but doing so they expends and dissipates energy so that there is insufficient energy to penetrate the fabric. Aramid polymer filaments and yarns, sold under the trademark Kevlar®, and a polyethylene material, commercially referred to as Spectra® have been extensively used in these types of fabrics. Kevlar® is a trade mark of DuPont Corporation; Spectra® is a trade mark of Honeywell.

[0004] For example, Kevlar or Dyneema® (DSM) fabric used as inserts in trousers for motorcyclists weighs more than 450g/m^2, and Kevlar bullet proof vests are very thick. Many of the fabrics of the prior art have a limited life span as they are sensitive to UV light and the colors of high performance fiber products are limited mostly to yellow, white and black, because they are unable to be dyed and cannot receive a printed logo or other advertising indicia. Furthermore, the fabrics of the prior art have significant drawbacks in terms of moisture management, weight, wicking, heat transfer management. These fiber products are generally not stretchable, due to which they limit the freedom of movement of the wearer. This also limits the ability to be integrated into garments without detracting from the look, feel and comfort for the everyday user.

[0005] US patent 5,210,877 describes outwear garments for cyclists that substantially protect the wearer from cuts and grazing in the event of a fall or a crash. The outwear comprises protective fabric panels containing abrasion and cut resistant high performance yarn of ultra-high molecular weight polyethylene fiber of approximately 215 denier, such as Spectra® in combination with Lycra® or other yarns.

[0006] WO 2010/026387 describes a protective fabric has a two layer flat-knit structure with opposite facing layers. One facing layer is made from a first high performance yarn, such as aramid and the second facing layer comprises a second high performance yarn, such as ultra-high molecular weight polyethylene.

[0007] US 5 087 499 describes garments made from fibers such as KEVLAR® and designed to deter penetration of objects are subjected to an additional brushing step to enhance the fibers' abilities to prevent penetration of sharp needle-like penetrating objects. The fibers may also be coated with an abrasive material to further engage and deflect penetrating objects.

[0008] There is still a need for new protective fabrics that do not detract from the wearer's comfort or freedom to move during sporting activities.

Summary of the invention

[0009] The present invention provides a method for manufacturing a cut, stab and puncture resistant fabric comprising:

- supplying a first yarn, a second yarn and a third yarn to a knitting machine for forming a fabric, wherein said first yarn is polyester or polyamide yarn with a thickness of 75-250 dtex, wherein said second yarn is polyethylene yarn with a thickness of 100-250 dtex and wherein said third yarn is elastane yarn with a thickness of 33-100 dtex,
- forming the cut-resistant fabric from the first yarn, the second yarn and the third yarn supplied as a fine rib pique knit, and
- finishing the cut-resistant fabric in a heat treatment step for stabilizing the cut resistant fabric, wherein the cut resistant fabric comprises a side with predominantly polyethylene loops which forms a polyethylene side and a side with predominantly polyester or polyamide loops which forms a polyester or polyamide side.

[0010] Fine pique knit results in a side which comprises the majority of polyethylene loops and a side which comprises the majority of polyester or polyamide loops. The polyester or polyamide side is generally considered more comfortable. The polyethylene side comprises the protective, cut-resistant polyethylene yarns. This allows the fabric to advantageously be processed and treated further using conventional methods which cannot be used in combination with many protective fabrics in the prior art. For example, the polyester or polyamide side can be brushed significantly increasing wearer's comfort, without significantly brushing the protective polyethylene yarns which would drastically decrease the cut resistance of the fabric.

[0011] This also includes coloring treatments, which can be advantageously directed at the polyester or polyamide side. Furthermore, the yarns employed within this method are colorable through conventional processing unlike many of the materials used in protective garments known in the arts.

[0012] In a second aspect, the present invention relates to a cut, stab and puncture resistant fabric, which comprises :

- a first yarn, being polyester or polyamide yarn with a thickness of 75-250 dtex,
- a second yarn, being polyethylene yarn with a thickness of 100-250 dtex,
- a third yarn, being elastane yarn with a thickness of 33-100 dtex,
- fine rib pique loops formed from said first yarn, said second yarn and said third yarn forming a fine rib pique knit, wherein the cut resistant fabric comprises a side with predominantly polyethylene loops which forms a polyethylene side and a side with predominantly polyester loops which forms a polyester side.

[0013] The cut resistant fabric according to the present invention shows a very good balance between high cut resistance and high comfort. This allows the fabric to be used in a wide range of garments and applications. Furthermore, the fabric has two different sides, one of which can be optimized for comfort rather than mechanical properties such as cut resistance. The fine rib pique knit makes the fabric stretch sufficiently while maintaining strength. The fabric has a technical look and touch. In a third aspect, the invention relates to garments which comprise a fabric produced by the method of the first aspect or a fabric according to the second aspect.

[0014] These garments are both comfortable and thoroughly cut resistant, stab resistant and puncture resistant. Furthermore, the garment can be advantageously processed using known techniques specifically to improve its desired use due to the distinct polyester or polyamide and polyethylene side.

Description of figures

[0015] **Figure 1** shows a schematic of a fine rib pique knit according to the present invention.

Detailed description of the invention

[0016] The present invention concerns a method to produce cut-resistant fabric. The invention particularly concerns a method to produce cut-resistant fabric which can be further processed through conventional means. The invention also concerns cut-resistant fabric which is comfortable and lightweight. The invention also concerns cut-resistant garments which are comfortable and lightweight. The invention particularly concerns cut-resistant fabric and garments which can be used, possibly after post-treatments, in a wide range of applications.

[0017] Unless otherwise defined, all terms used in disclosing the invention, including technical and scientific terms, have the meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. By means of further guidance, term definitions are included to better appreciate the teaching of the present invention.

[0018] As used herein, the following terms have the following meanings:

"A", "an", and "the" as used herein refers to both singular and plural referents unless the context clearly dictates otherwise. By way of example, "a compartment" refers to one or more than one compartment.

[0019] "About" as used herein referring to a measurable value such as a parameter, an amount, a temporal duration, and the like, is meant to encompass variations of +/-20% or less, preferably +/-10% or less, more preferably +/-5% or less, even more preferably +/-1% or less, and still more preferably +/-0.1% or less of and from the specified value, in so far such variations are appropriate to perform in the disclosed invention. However, it is to be understood that the value to which the modifier "about" refers is itself also specifically disclosed.

[0020] "Comprise", "comprising", and "comprises" and "comprised of" as used herein are synonymous with "include", "including", "includes" or "contain", "containing", "contains" and are inclusive or open-ended terms that specifies the presence of what follows e.g. component and do not exclude or preclude the presence of additional, non-recited components, features, element, members, steps, known in the art or disclosed therein.

[0021] The recitation of numerical ranges by endpoints includes all numbers and fractions subsumed within that range, as well as the recited endpoints.

[0022] In this application, polyethene yarn can also be referred to as polyethylene yarn.

[0023] The expression "% by weight", "weight percent", "%wt" or "wt%", here and throughout the description unless otherwise defined, refers to the relative weight of the respective component based on the overall weight of the formulation.

[0024] The "basis weight" or "grammage" is the areal density of a fabric product, that is, its mass per unit of area. In this text the basis weight is expressed in grams per square meter (g/m^2).

[0025] In this text, "yarn thickness" is expressed as linear density, particularly in direct units. For example, tex gives the weight in grams of one kilometer of yarn and dtex gives the weight in decigrams of one kilometer of yarn. An indirect method fixes the weight and gives the length of yarn created.

[0026] The technical meaning of the terms pique knitwear and fine rib knitwear and their design are known to one skilled in the art. From the standpoint of one skilled in the art they therefore require no separate definition. The corresponding design is also known to one skilled in the art. A practical example of a fine rib pique knit is

shown in Fig 1.

Method

[0027] In a first aspect, the invention provides a method for manufacturing a cut resistant fabric comprising :

- supplying a first yarn, a second yarn and a third yarn to a knitting machine for forming a fabric, wherein said first yarn is polyester or polyamide yarn with a thickness of 75-250 dtex, wherein said second yarn is polyethylene yarn with a thickness of 100-250 dtex and wherein said third yarn is elastane yarn with a thickness of 33-100 dtex,
- forming the cut-resistant fabric from the first yarn, the second yarn and the third yarn supplied as a fine rib pique knit, and
- finishing the cut-resistant fabric in a heat treatment step for stabilizing the cut resistant fabric, wherein the cut resistant fabric comprises a side with predominantly polyethylene loops which forms a polyethylene side and a side with predominantly polyester loops which forms a polyester side.

[0028] The first yarn is polyester yarn, with a thickness of 75-250 dtex, preferably 125-180 dtex, more preferably 130-160 dtex, most preferably about 140 dtex. The first, polyester yarn is advantageously polyamide 6,6 yarn. These yarns are generally known and are readily available on the market. Furthermore processing techniques for these yarns are well known. Polyester or polyamide is generally considered more comfortable than polyethylene. Polyethylene has better mechanical properties, particularly for cut-resistance, stab-resistance and puncture-resistance.

[0029] The fine rib pique knit as described by the invention leads to a fabric side which predominantly comprises polyester or polyamide loops, and a fabric side which predominantly comprises polyethylene loops. The fabric side which comprises predominantly polyester or polyamide loops is consequently soft and comfortable to touch. The fabric side which comprises predominantly polyethylene loops has a technical optic and touch and good mechanical properties. This is advantageous as it allows further treatments, processing and finishing of the fabric based on which side should be affected. Furthermore, many conventional processes can be used for polyester, polyamide or polyethylene, which can often not be used for protective gear using both. This includes extensive brushing and dying for many protective fabrics and yarns.

[0030] The second yarn is polyethylene yarn, with a thickness of 100-250 dtex, preferably 180-220 dtex, more preferably 200-220 dtex, most preferably about 220 dtex. The polyethylene yarn is preferably ultra-high molecular weight poly ethylene (UHMWPE). The ultra-high molecular weight poly ethylene preferably has a molecular mass higher than 1.000.000 gram / mol, more preferably a molecular mass higher than 1.200.000 gram / mol, most preferably a molecular mass higher than 1.400.000 gram / mol.

[0031] The third yarn is elastane yarn, with a thickness of 33-100 dtex, preferably 60-78 dtex, more preferably 70-78 dtex, most preferably about 78 dtex.

[0032] Advantageously, the filament count of ultra-high molecular weight polyethylene (UHMWPE), yarn ranges between 25 and 200. Thus, ultra-high molecular weight polyethylene (UHMWPE), yarn has an adequately great number of individual filaments to provide cut resistance, stab resistance and puncture resistance. According to the invention the method comprises a fine rib pique knitting method. In another aspect of the invention, the invention relates to a cut resistant textile which is double-bed knitwear in the form of a fine rib pique knit. Fig 1 shows knitwear in the fashion of a double-bed knit with in the form of a fine rib pique knit or fine rib pique knit weave. Fig. 1 shows double-bed knitwear with tuck loops according to eight rows 1, 2, 3, 4, 5, 6, 7 and 8. Here the needles are denoted 9 and the loops 10. The polyester or polyamide yarn is denoted as 11, the polyethylene yarn is denoted as 12 and the elastane yarn is denoted as 13. Each uneven row 1, 3, 5 and 7 comprises a polyethylene yarn 12. Each even row 2, 4, 6 and 8 comprises an polyester or polyamide yarn 11. Each fourth row 4 and 8 also comprises an elastane yarn 13. Knitwear has an elastic stretchiness with elastic rebound. The loops ensure rebound of the textile layer after elastic rebound to the initial position after elastic elongation. The elastane yarn 13, which is highly stretchable, is knit along with the polyester or polyamide yarn 11. This allows the incorporation of the elastane yarn 9 into the knit fabric and forms the fine rib pique hybrid. This is advantageous as highly elastic yarns such as elastane are difficult to knit.

[0033] In a preferred embodiment, the cut-resistant fabric is subjected to brushing after heat treatment. The function served by providing brushed loops is to provide a greater comfort to the user. Brushing, which is a known procedure, employing a rotary wire brush, breaks the continuous filaments of the yarns, which form the loops. This means that the top surface is defined by filament ends, in addition to the curved filaments, which are not broken in the brushing process. Brushed surfaces have a very soft feel and minimize user discomfort.

[0034] In a further, preferred embodiment, only the polyester side of the fabric is brushed. Breaking the filaments of the yarns improves comfort but reduces their strength, stiffness and cut-resistance. It is preferred to only brush the side which contacts with the wearer's skin, which is preferably the polyester side. This allows the stiff, protective polyethylene yarns to comprise more unbroken filaments. This results in a cut resistant fabric which can be used in garments for both its good cut resistance and its wearing comfort.

[0035] One of the advantages of the method of producing cut resistant textile of the present invention is that, it is capable of being brushed by conventional techniques

to provide this comfort feature. These conventional techniques do not provide the desired result in many textiles known in the prior art.

[0036] Brushing is not an accurate procedure in the sense that there is a measurable parameter to indicate the extent of which filaments or fracture, or filament ends are created. It is, nonetheless, an accepted measure in the industry to a fabric as being "lightly" brushed, "medium" brushed or "heavily" brushed to progressively indicate the brushing action. The preferred degree of brushing is a "medium" brushed surface of the loops of the top portion. This provides a satisfactory comfort factor, without adversely affecting the cut resistant function of the fabric. This is to point out that it is undesirable for the brushing to create a great a number of filament ends, as this reduces the yarn strength and cut resistance of the fabric.

[0037] A circular knitting machine provided with 20 to 32 needles per inch in the machine cycle is advantageously used for manufacturing the fabric. Sufficiently densely placed needles enable a dense structure to the fabric.

[0038] The temperature of the heat treatment step preferably ranges between 60°C and 140°C. Thus, the temperature is sufficiently high to provide fabric shrinkage, yet suitably low to ensure that synthetic yarns of the fabric will not begin to deform, in which case the fabric becomes rigid and "paper-like". In other words, the temperature is sufficiently low to prevent the fabric from "burning". The fabric can be finished in a washing step before the heat treatment step. With the washing step, it is possible to remove any impurities in the fabric thus achieving an end product of higher quality. At the same time, the washing temperature partly thermally stabilizes the fabric, interlocking the first, second and third yarn. Thus, the fabric is dimensionally stable in use and does not notably stretch during washes.

[0039] Preferably, the fabric shrinkage is lower than 15% after the heat treatment, more preferably the fabric shrinkage is lower than 10% after the heat treatment, most preferably the fabric shrinkage is about 5% after the heat treatment. This means that when washing a product made from the fabric, no significant shrinkage nor stretching takes place, which is important regarding the usability of the product.

[0040] A particular advantage of the present invention is the creation of double-bed knitwear with a side or face of the fabric which comprises predominantly polyester or polyamide loops, further called "polyester or polyamide side". This side is preferably used as "inside", which is the side which touches the wearer's skin when used in garments and clothing.

[0041] The opposite side then comprises predominantly polyethylene loops, further called "polyethylene side". This side has a technical look and touch, and is primarily protective. It provides the fabric with its cut resistant, stab resistant and puncture resistant properties.

[0042] Having two faces to the fabric which are thoroughly interlocked allows the use of conventional surface treatments which often cannot be used on protective fabric. It also allows the use of surface treatments to be targeted to a side. As such, a surface treatment can be restricted to the side to optimize the benefits and minimize the resources required for said treatments. Examples of such treatments are brushing, hydrophilic treatments, antibacterial treatments and so forth.

[0043] In a preferred embodiment, the cut resistant fabric is subjected to a hydrophilic treatment. This is advantageous for the breathability of the fabric. Furthermore, this can be advantageous for further (surface) treatments of the fabric, particularly with polar and / or waterborne substances, including suspensions and emulsions. In a further preferred embodiment, the hydrophilic treatment is applied to the polyethylene side of the fabric. This is advantageous as polyethylene, particularly UHMWPE is generally lipophilic and hydrophobic. In another preferred embodiment, the hydrophilic treatment is applied to the polyester or polyamide side of the fabric. This allows easier processing of the hydrophilic treatment.

[0044] In another preferred embodiment, the cut resistant fabric is subjected to an antibacterial treatment. Polymer-based yarns, fabric and garment is regularly used in food and medical industries. Further antibacterial treatments improve fabric for use in these areas as well as similar industries. In a further preferred embodiment, the antibacterial treatment is applied to the polyethylene side of the fabric. This is advantageous to prevent bacteria of attaching to the fabric from the outside, as the polyethylene is the protective side. In another preferred embodiment, the antibacterial treatment is applied to the polyester or polyamide side of the fabric. The polyester side is generally easier to apply treatments to. Furthermore, this provides antibacterial properties directly on the side of the fabric which comes into contact with the wearer.

Fabric

[0045] In a second aspect, the present invention relates to a cut, stabbing and puncture resistant fabric, which comprises :

- a first yarn, being polyester or polyamide yarn with a thickness of 75-250 dtex,
- a second yarn, being polyethylene yarn with a thickness of 100-250 dtex,
- a third yarn, being elastane yarn with a thickness of 33-100 dtex,
- fine rib pique loops formed from said first yarn, said second yarn and said third yarn forming a fine rib pique knit, wherein the cut resistant fabric comprises a side with predominantly polyethylene loops which forms a polyethylene side and a side with predominantly polyester loops which forms a polyester side.

[0046] Advantageously, the abrasion resistance, cut resistance and tear resistance values of the fabric are

each at least 2 according to the EN388 standard. More preferably, the abrasion resistance, cut resistance and tear resistance values of the fabric are each at least 3 according to the EN388 standard. Then the fabric can be used in a versatile manner for various applications.

[0047] According to an embodiment, the fabric has 15 to 40, preferably 25 to 30 loops per inch. An adequately great number of loops in a certain unit area directly correlates with the cut resistance level, with the fabric being extremely dense, yet simultaneously stretchy. The weight of the fabric prior to heat treatment and shrinkage after knitting is preferably 200-350 g/m^2. The weight of a fabric according to the invention after heat treatment may range between 300 and 460 g/m^2, preferably between 350 and 460 g/m^2, more preferably between 400 and 460 g/m^2, more preferably about 420 g/m^2. This makes the fabric lightweight compared to many protective and cut resistant fabrics known in the prior art. Application possibilities of products that are made from a thin fabric are wide, since a thin fabric does not disturb the wearer, it is stretchy and properly fits on the wearer.

[0048] In an embodiment, the maximum stretch of the fabric is 50%, generally between 35% and 65%, most preferably between 45% and 55%. This is the maximum stretch of the fabric in a warp direction.

[0049] In an embodiment, the maximum stretch of the fabric is 50%, generally between 35% and 65%, most preferably between 45% and 55%. This is the maximum stretch of the fabric in a weft direction.

[0050] In another embodiment, the stretch comfortable during use is 15%, generally between 10% and 25%, most preferably between 12% and 20%. Here, "comfortable" stretch is determined by the maximum compressibility specified in standards. Excessive tightness causes physiological harm.

[0051] In a preferred embodiment, the fabric according the second aspect has a cut resistance value of at least 2 according to DIN EN 388 : 2017. In another preferred embodiment, the fabric has a cut resistance value of level B according to ISO 13997. Preferably, the fabric has a cut a cut resistance value of at least 2 according to DIN EN 388 : 2017 and a cut resistance value of level B according to ISO 13997.

[0052] In a more preferred embodiment, the fabric according the second aspect has a cut resistance value of at least 3 according to DIN EN 388 : 2017. In another more preferred embodiment, the fabric has a cut resistance value of level B-C according to ISO 13997. Most preferably, the fabric has a cut resistance value of at least 3 according to DIN EN 388 : 2017 and a cut resistance value of level B-C according to ISO 13997.

Garment

[0053] In another aspect of embodiments described herein there is provided a garment comprising the cut-resistant fabric of the present invention.

[0054] The fabric system of the present invention is suitable for use in various garments including sporting garments and garments for other motion related activities, children's clothing and clothing for the elderly who may need protection from friction.

[0055] When compared with fabric systems of the prior art, the fabric system of the present invention is up to 30 times stronger and provides superior wearer protection against damage from friction, cuts, scrapes, grazes resulting from motion related activity. The fabric system of the present invention is also breathable, has sufficient elasticity to provide a comfortable fit and exhibits 'wicking' qualities to cool the wearer's body.

[0056] The fabric system must be sufficiently flexible, pliable and resilient to readily conform to the contours of the wearer's body, or a portion of their body, that is intended to be protected by the fabric system. It is particularly important that the fabric is sufficiently flexible, pliable and resilient to be made into a garment which can substantially envelop the upper torso or lower torso or limbs of a wearer. The fabric system of the present invention is also softer and smoother than many fabrics of the prior art.

[0057] Preferably the fabric system of the present system is incorporated into a garment in a position where it can protect the parts of a wearer that are sensitive or most at risk from damage. For example, it may be used in the sleeves and in one or more back panels of a cyclist's jersey to provide protection to the rider's arms, elbows, and back if they fall from their bicycle at speed onto a hard or rough surface. Typically, as the cyclist hits and slides along the surface, the fabric system will disperse heat and reduce the likelihood of burning. Furthermore the fabric system of the present invention is up to 30 times stronger than similar systems of the prior art and protects the cyclist from cuts, grazes and small stones being embedded in the skin.

[0058] In yet a further aspect of embodiments described herein there is provided a garment comprising two or more, preferably multiple panels, wherein at least one panel comprising the fabric system of the present invention.

[0059] The fabric system of the present invention can be used for construction of an entire garment, or just parts, such as individual panels. The fabric system of the present invention can be manufactured to provide any desired fabric weight (typically measured in g.m'2 and referred to as GSM levels). Hence, the fabric system of the present invention can have a GSM level tailored to provide consistency when it is integrated with other fabrics in a garment.

[0060] For example, conventional cycling shorts (knicks) generally have a four, six, or eight panel construction, elastic ribbing around the bottom of the leg cuffs and the waist, and additional padding (termed a 'chamois') in the region of the buttocks and crotch. Preferably the shorts include two panels, each respectively extending from the waist to a leg cuff that are made of the fabric system of the present invention in order to protect the

wearer's hip and buttocks from grazing.

[0061] Advantageously, the protective fabric according to the present invention can be used in a broad range of garment products. This range of garment products further increases when the fabric is subjected to post-treatments suited to optimize the fabric for its intended use within a garment. The range of garment products includes, without limiting the scope of the invention, sports gear such as for speed skating, short track, ski and snowboarding, sailing, speedboating and other protective gear used in sports. Furthermore, it also has use within protective gear in various industries including meat and food processing, policing, military, firefighting and first-responders.

[0062] When used as a garment, the fabric system of the present invention provides advantages including:

- reducing damage to human tissue when a wearer comes into contact with a hard or tough surface;
- providing improved dispersion of heat when a wearer contacts a surface at speed;
- providing high resistance to tearing or ripping when a wearer contacts a surface;
- improving protection against injury without significant adverse effect on the aerodynamics or weight of the garment;
- maintaining the positive qualities of sporting clothing including breathability and not restricting movement;
- having a wide range of applications, from elite athletes to children in playgrounds; and
- reducing injury generally, with concomitant reduction in time away from the sport/ training and medical costs.

[0063] The invention is further described by the following non-limiting examples which further illustrate exemplary embodiments of the invention, which is limited by the appended claims.

Examples

Examples 1

[0064] A fabric was knit on a 30" knitting machine. Three yarns were used : a 220 dtex high-modulus polyethylene yarn, a 70/1 polyester yarn and a 78 dtex elastane yarn. The fabric was created as a fine rib pique hybrid. The resulting fabric had a raw weight of 285 g/m^2.

[0065] The fabric is prepared for finishing through washing and heat treatment, using a discontinuous alternating jet beam. The heat treatment involves stretching the yarn at 20°C to 2 g/l tensile stress. The temperature is increased to 60°C at 2°C per minute. At this temperature increase, the yarns remain stretched for 60 minutes. After one hour, the temperature cools from 60°C to 30°C at 1.5°C per minute. The tensile stress is then removed from the yarn. The yarn is rinsed (warm) and 2% softener is added at 30°C.

[0066] The fabric is further dried at 100°C in a tumbling motion. The fabric is then placed on a stenter frame, at 100°C with a speed of 10 m/min and an overfeed of 18%. The finished fabric has a specific finished weight of 420 g/m^2. The fabric, particularly on the polyethylene side, is cut resistant, stab resistant and puncture resistant.

Example 2

[0067] A fabric according to example 1 was knit with a raw weight of 285 g/m^2. The fabric was washed, heat treated and dried as in example 1. The dried fabric was then treated with hydrophilic and antibacterial treatments using 30g/l Tubingal GSI, 30g/l Arristan CPU and 1g/l I Sys AG.

Example 3

[0068] The finished fabric as in example 1 was further finished with a roughening / napping finishing step.

Claims

1. Method for manufacturing a cut resistant fabric comprising :

   - supplying a first yarn (11), a second yarn (12) and a third yarn (13) to a knitting machine for forming a fabric, wherein said first yarn is polyester or polyamide yarn with a thickness of 75-250 dtex, wherein said second yarn is polyethylene yarn with a thickness of 100-250 dtex and wherein said third yarn is elastane yarn with a thickness of 33-100 dtex,
   - forming the cut-resistant fabric from the first yarn, the second yarn and the third yarn supplied as a fine rib pique knit, and
   - finishing the cut-resistant fabric in a heat treatment step for stabilizing the cut resistant fabric, wherein the cut resistant fabric comprises a side with predominantly polyethylene loops (10) which forms a polyethylene side and a side with predominantly polyester or polyamide loops (10) which forms a polyester or polyamide side.

2. Method for manufacturing a cut resistant fabric according to claim 1, wherein the cut resistant fabric is subjected to brushing.

3. Method for manufacturing a cut resistant fabric according to claim 1, wherein the polyester or polyamide side of said cut resistant fabric is subjected to brushing.

4. Method for manufacturing a cut resistant fabric according to any of claims 1-3 using ultra-high-molecular-weight polyethylene (UHMWPE), yarn with a

thickness of 100-250 dtex as said second yarn.

5. Method for manufacturing a cut resistant fabric according to any of claims 1-4, wherein the cut resistant fabric is subjected to a hydrophilic treatment.

6. Method for manufacturing a cut resistant fabric according to any of claims 1-5, wherein the cut resistant fabric is subjected to an antibacterial treatment.

7. Method for manufacturing a cut resistant fabric according to any of claims 1-6, wherein the temperature of said heat treatment step ranges from 80°C to 100°C.

8. Cut resistant fabric, which comprises :

- a first yarn, being polyester or polyamide yarn with a thickness of 75-250 dtex,
- a second yarn, being polyethylene yarn with a thickness of 100-250 dtex,
- a third yarn, being elastane yarn with a thickness of 33-100 dtex,
- fine rib pique loops formed from said first yarn, said second yarn and said third yarn forming a fine rib pique knit, wherein the cut resistant fabric comprises a side with predominantly polyethylene loops which forms a polyethylene side and a side with predominantly polyester loops which forms a polyester side.

9. Cut resistant fabric according to claim 8, produced according to any of claims 1-7.

10. Cut resistant fabric according to any of claims 8-9, wherein the cut resistant fabric has been subjected to brushing.

11. Cut resistant fabric according to claim 8-10, wherein the polyester or polyamide side of said cut resistant fabric has been subjected to brushing.

12. Cut resistant fabric according to any of claims 8-11, wherein the basis weight of the fabric may range between 300 and 500 g/m^2.

13. Garment comprising the cut resistant fabric produced according to the method of any of claims 1-7 or the cut resistant fabric according to any of the claims 8-12.

Patentansprüche

1. Verfahren zur Herstellung einer Schnittschutztextilie, Folgendes umfassend:

- Einführen eines ersten Garns (11), eines zweiten Garns (12) und eines dritten Garns (13) in eine Wirkmaschine zum Bilden einer Textilie, wobei das erste Garn Polyester- oder Polyamidgarn mit einer Dicke von 75 bis 250 dtex ist, wobei das zweite Garn Polyethylengarn mit einer Dicke von 100 bis 250 dtex ist und wobei das dritte Garn Elastangarn mit einer Dicke von 33 bis 100 dtex ist,
- Bilden der Schnittschutztextilie aus dem eingeführten ersten Garn, dem eingeführten zweiten Garn und dem eingeführten dritten Garn als Feinripp-Piqué-Wirkware und
- Endbehandeln der Schnittschutztextilie in einem Wärmebehandlungsschritt, um die Schnittschutztextilie zu stabilisieren,

wobei die Schnittschutztextilie eine Seite mit vorwiegend Polyethylenschlaufen (10) umfasst, die eine Polyethylenseite bildet, und eine Seite mit vorwiegend Polyeser- oder Polyamidschlaufen (10), die eine Polyester- oder Polyamidseite bildet.

2. Verfahren zur Herstellung einer Schnittschutztextilie nach Anspruch 1, wobei die Schnittschutztextilie einem Bürsten unterzogen wird.

3. Verfahren zur Herstellung einer Schnittschutztextilie nach Anspruch 1, wobei die Polyester- oder Polyamidseite der Schnittschutztextilie einem Bürsten unterzogen wird.

4. Verfahren zur Herstellung einer Schnittschutztextilie nach einem der Ansprüche 1 bis 3, das ultrahochmolekulares Polyethylen(UHMWPE)-Garn mit einer Dicke von 100 bis 250 dtex als das zweite Garn verwendet.

5. Verfahren zur Herstellung einer Schnittschutztextilie nach einem der Ansprüche 1 bis 4, wobei die Schnittschutztextilie einer hydrophilen Behandlung unterzogen wird.

6. Verfahren zur Herstellung einer Schnittschutztextilie nach einem der Ansprüche 1 bis 5, wobei die Schnittschutztextilie einer antimikrobiellen Behandlung unterzogen wird.

7. Verfahren zur Herstellung einer Schnittschutztextilie nach einem der Ansprüche 1 bis 6, wobei die Temperatur des Wärmebehandlungsschritts im Bereich von 80 °C bis 100 °C liegt.

8. Schnittschutztextilie, die Folgendes umfasst:

- ein erstes Garn, das Polyester- oder Polyamidgarn mit einer Dicke von 75 bis 250 dtex ist,
- ein zweites Garn, das Polyethylengarn mit einer Dicke von 100 bis 250 dtex ist

- ein drittes Garn, das Elastangarn mit einer Dicke von 33 bis 100 dtex ist,
- Feinripp-Piqué-Schlaufen, die aus dem ersten Garn, dem zweiten Garn und dem dritten Garn gebildet sind, was eine Feinripp-Piqué-Wirkware bildet, wobei die Schnittschutztextilie eine Seite mit vorwiegend Polyethylenschlaufen umfasst, die eine Polyethylenseite bildet, und eine Seite mit vorwiegend Polyesterschlaufen, die eine Polyesterseite bildet.

9. Schnittschutztextilie nach Anspruch 8, erzeugt nach einem der Ansprüche 1 bis 7.

10. Schnittschutztextilie nach einem der Ansprüche 8 bis 9, wobei die Schnittschutztextilie einem Bürsten unterzogen wird.

11. Schnittschutztextilie nach einem der Ansprüche 8 bis 10, wobei die Polyester- oder Polyamidseite der Schnittschutztextilie einem Bürsten unterzogen wird.

12. Schnittschutztextilie nach einem der Ansprüche 8 bis 11, wobei das Flächengewicht der Textilie im Bereich zwischen 300 und 500 g/m^2 liegen kann.

13. Kleidungsstück, umfassend die Schnittschutztextilie, die gemäß dem Verfahren nach einem der Ansprüche 1 bis 7 erzeugt wurde, oder die Schnittschutztextilie nach einem der Ansprüche 8 bis 12.

Revendications

1. Procédé de fabrication d'un tissu résistant aux coupures comprenant :

- la fourniture d'un premier fil (11), d'un deuxième fil (12) et d'un troisième fil (13) à une machine à tricoter pour former un tissu, dans lequel ledit premier fil est un fil de polyester ou de polyamide ayant une épaisseur de 75 à 250 dtex, dans lequel ledit deuxième fil est un fil de polyéthylène ayant une épaisseur de 100 à 250 dtex et dans lequel ledit troisième fil est un fil d'élastane ayant une épaisseur de 33 à 100 dtex,
- la formation du tissu résistant aux coupures à partir du premier fil, du deuxième fil et du troisième fil fournis sous la forme d'un tricot piqué à côtes fines, et
- le finissage du tissu résistant aux coupures dans une étape de traitement thermique pour stabiliser le tissu résistant aux coupures,

dans lequel le tissu résistant aux coupures comprend un côté présentant principalement des boucles de polyéthylène (10) qui forme un côté polyéthylène et un côté présentant principalement des boucles de polyester ou de polyamide (10) qui forme un côté polyester ou polyamide.

2. Procédé de fabrication d'un tissu résistant aux coupures selon la revendication 1, dans lequel le tissu résistant aux coupures est soumis à un brossage.

3. Procédé de fabrication d'un tissu résistant aux coupures selon la revendication 1, dans lequel le côté polyester ou polyamide dudit tissu résistant aux coupures est soumis à un brossage.

4. Procédé de fabrication d'un tissu résistant aux coupures selon l'une quelconque des revendications 1 à 3 utilisant un fil de polyéthylène de poids moléculaire très élevé (UHMWPE) ayant une épaisseur de 100 à 250 dtex en tant que ledit deuxième fil.

5. Procédé de fabrication d'un tissu résistant aux coupures selon l'une quelconque des revendications 1 à 4, dans lequel le tissu résistant aux coupures est soumis à un traitement hydrophile.

6. Procédé de fabrication d'un tissu résistant aux coupures selon l'une quelconque des revendications 1 à 5, dans lequel le tissu résistant aux coupures est soumis à un traitement antibactérien.

7. Procédé de fabrication d'un tissu résistant aux coupures selon l'une quelconque des revendications 1 à 6, dans lequel la température de ladite étape de traitement thermique se situe dans une plage de 80 °C à 100 °C.

8. Tissu résistant aux coupures, qui comprend :

- un premier fil, étant un fil de polyester ou de polyamide ayant une épaisseur de 75 à 250 dtex,
- un deuxième fil, étant un fil de polyéthylène ayant une épaisseur de 100 à 250 dtex,
- un troisième fil, étant un fil d'élastane ayant une épaisseur de 33 à 100 dtex,
- des boucles de piqué à côtes fines formées à partir dudit premier fil, dudit deuxième fil et dudit troisième fil formant un tricot piqué à côtes fines, dans lequel le tissu résistant aux coupures comprend un côté présentant principalement des boucles de polyéthylène qui forme un côté polyéthylène et un côté présentant principalement des boucles de polyester qui forme un côté polyester.

9. Tissu résistant aux coupures selon la revendication 8, produit selon l'une quelconque des revendications 1 à 7.

10. Tissu résistant aux coupures selon l'une quelconque des revendications 8 et 9, dans lequel le tissu résistant aux coupures a été soumis à un brossage.

11. Tissu résistant aux coupures selon une revendication 8 à 10, dans lequel le côté polyester ou polyamide dudit tissu résistant aux coupures a été soumis à un brossage.

12. Tissu résistant aux coupures selon l'une quelconque des revendications 8 à 11, dans lequel la masse surfacique du tissu peut se situer dans une plage entre 300 et 500 g/m^2.

13. Vêtement comprenant le tissu résistant aux coupures produit selon le procédé selon l'une quelconque des revendications 1 à 7 ou le tissu résistant aux coupures selon l'une quelconque des revendications 8 à 12.

FIGURES

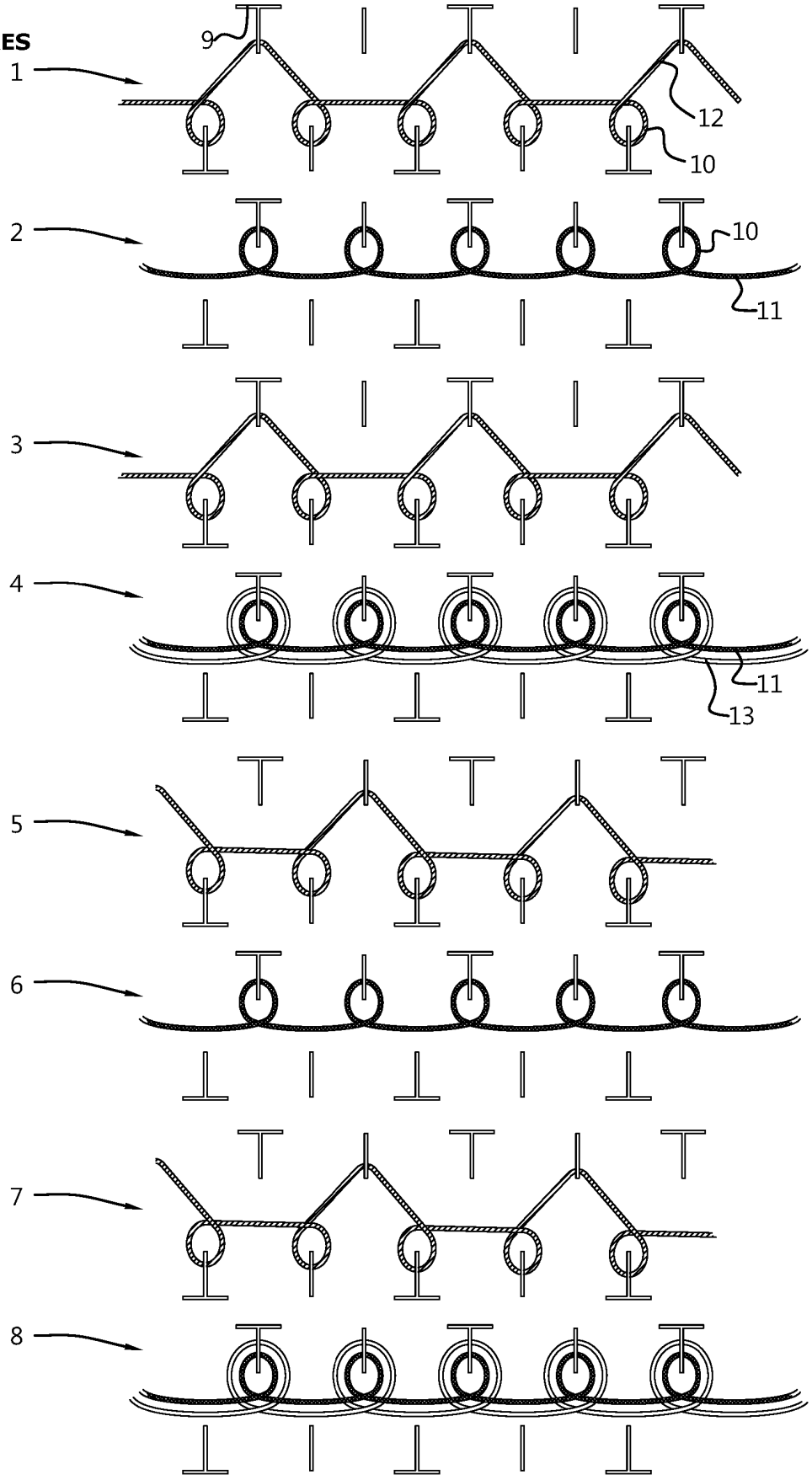

FIG. 1

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 5008959 A **[0003]**
- US 5210877 A **[0005]**
- WO 2010026387 A **[0006]**
- US 5087499 A **[0007]**