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(54) **Multilayer lining fabric with improved properties and clothes comprising same**

(57) The present invention relates to a multilayer lining fabric comprising at least two warp-knitted fabric layers of at least one polymer thread material having a weight of $\geq 100 \text{ g/m}^2$, wherein the number of weft threads per centimeter of length is larger than the number of warp threads per centimeter of width of the fabric layers,

wherein, in the plane of the layers of the fabric, the direction of warp threads of one layer is twisted with respect to the direction of warp threads of an adjacent layer by an angle α of at least 20° ; and to clothes comprising a multilayer lining fabric as defined.

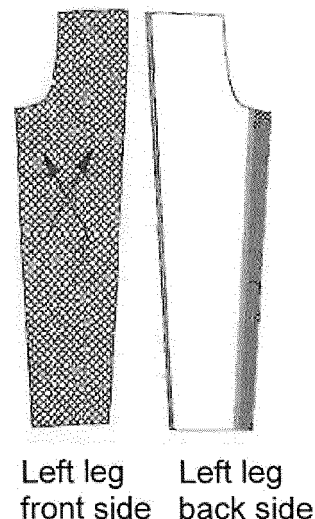
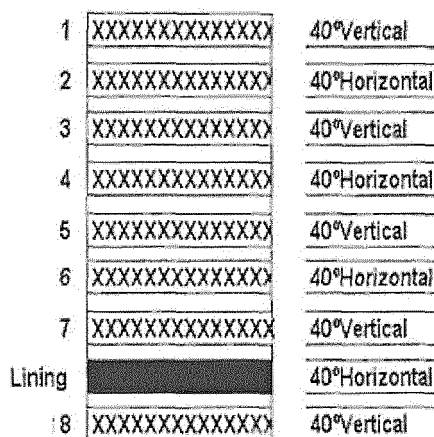


Figure 5 B

Description

[0001] The present invention relates to a multilayer lining fabric having improved properties in respect of elasticity and stretchability. Moreover, the present invention relates to a multilayer lining fabric which improves safety features of the fabric. In a further embodiment, the invention relates to clothes, in particular working clothes, comprising a multilayer lining fabric.

[0002] Lining fabrics, in particular for clothes used in a specific area as, for example, clothes worn in sports or clothes worn in a working environment, are requested to meet certain requirements concerning the wearer's comfort: Due to the fact that such clothes often need to protect the wearer against uncomfortable weather conditions (low temperature, external wetness resulting from snow or rain), they have to comprise an outer layer protecting against such conditions. On the other hand, the physical conditions of sports or working in the open air are characterized by a large extent of body movements (or movements of certain parts of the body only, e. g. the arms, the upper part of the body, the legs and/or the lower part of the body) and, in connection to that, sweating of the body.

[0003] Both of those may cause discomfort to the wearer of the clothes, if the clothes' outer (protecting) layer is cushioned with an inner lining fabric: One example of such a lining fabric is the warp-knitted fabric available on the market from the company Engtex AB, Mullsjö, Sweden, under the Trade Name "ENGTEX". The lining does allow such easy body movements to a restricted extent, only (or even prevents such movements), due to a lack of elasticity and stretchability of the lining fabric. This is particularly true for linings made of the above warp-knitted fabrics, which were placed inside the protecting layer in two or more layers one above the other, conventionally, with the warp directions of one layer parallel to those of each other lining layer.

[0004] Moreover, sweat produced by the body under sports conditions or working conditions is removed from the wearer's skin in a decelerated manner, only, or not at all. As a result, a wet lining is rubbing against the skin during the body movements, causing, in addition to discomfort to the wearer, irritation of the wearer's skin or even worse conditions like skin inflammations.

[0005] One of the specific properties of such lining fabrics placed one above the other in a plurality of layers was that such a multilayer lining fabric could be used as a protective fabric for chainsaw operators: If all layers were positioned parallel to each other (i. e. the warp direction of each layer was parallel to the warp direction of each other layer) and were well attached to each other by seams, the resulting multilayer lining fabric could prevent chainsaw operators in their working environment from injuries by their chainsaw. This was due to the fact that, after cutting through the outer protective layer of the operators' working cloth trousers, the threads of the lining layers were drawn into the chainsaw and could stop the

chainsaw's operation within a few moments, thereby preventing the operators from being injured by the motor-driven chains of the saw.

[0006] What, however, remained was the apparent lack of elasticity and stretchability of the lining fabric, which caused a non-acceptable lack of wearing comfort to the wearers of the clothes when worn in a sports or working environment.

[0007] Hence, it was an object of the present invention that the elasticity and stretchability of a multilayer lining fabric be enhanced so as to provide more comfort to the wearers provided with clothes including such multilayer lining fabric.

[0008] Moreover, it was another object of the invention that the humidity transport (resulting from sweating by the wearer) from the wearer's skin to the environment through the multilayer lining fabric be improved, thereby preventing skin irritations or even inflammations from occurring.

[0009] In addition, it was another object of the invention that the protecting properties of the multilayer lining fabric against chainsaw injuries of a chainsaw operator be improved, thereby making working accidents less probable if working clothes being provided with the multilayer lining fabric of the invention are worn in a chainsaw working environment.

[0010] Finally, it was another object of the invention that clothes comprising the multilayer lining fabric of the invention be provided, thereby allowing better wearing comfort to the wearer, for example in the case of sports clothes or working clothes and, in particular, working clothes for chainsaw operators and forest workers.

[0011] It was surprisingly found in the present invention that the above objects can be achieved altogether by a multilayer lining fabric wherein two or more layers of a warp-knitted fabric are combined to a lining fabric by a stack of said two or more warp-knitted fabric layers, the warp directions of which are twisted, from one layer to the next, by an certain angle. If a stack of such twisted lining fabrics is stitched loosely-fitting, the resulting multilayer lining fabric in a piece of clothing has a largely enhanced elasticity and may stretch during the movements of the clothes' wearer, thereby providing an improved comfort.

[0012] Moreover, it was found that working clothes comprising the multilayer lining fabric of the invention present a surprisingly better protection against chainsaw injuries due to a better blocking behavior of the chainsaw by the threads of the multilayer lining fabric: The chainsaw is, better than by prior art linings, stopped by the multilayer lining fabric of the invention not only in cases of chainsaw cuts perpendicular to the axis of the trouser legs, but also in cases of chainsaw cuts in a direction diagonal to the axis of the trouser legs: The European and National standards of the Personal Protective Equipment (PPE) requirements and of DIN (EN) 381-2 and -5 are met by the multilayer lining fabric and clothes of the present invention, and diagonal cuts standardizing newly

developed tests for the twisted direction linings of the present invention are under evaluation.

[0013] Hence, the present invention relates to a multilayer lining fabric comprising at least two warp-knitted fabric layers of at least one polymer thread material having a weight of $\geq 100 \text{ g/m}^2$ (per layer of material) wherein the number of weft threads is larger than the number of warp threads, wherein, in the plane of the layers of the fabric, the direction of warp threads of one layer is twisted with respect to the direction of warp threads of an adjacent layer by an angle α of at least 20° .

[0014] Preferred embodiments of the multilayer lining fabric of the invention are claimed in the claims dependent upon claim 1.

[0015] The present invention also relates to clothes comprising the multilayer lining fabric according to the present invention.

[0016] Preferred embodiments of the clothing are claimed in the claims dependent upon claim 9.

[0017] The invention is further explained by referring to the attached Figures. However, the subsequent description, and the Figures as well, are not intended to restrict the invention to the preferred embodiments shown or explained in detail; such description and Figures show, as examples only, preferred embodiments of the invention serving a better understanding of the principles of the invention. In the Figures:

Figure 1 shows an exemplary example of the basic pattern of warp-knitting of the prior art;

Figures 2 A and 2 B show two thread material layers side by side and in a superimposed arrangement, allowing to recognize the twist angle α of their different directions of the warp thread in the superimposed arrangement;

Figure 3 shows another example of a plurality of thread material layers side by side and in a superimposed arrangement, allowing to recognize the twist angles

α , α' etc. of their different directions of the warp thread in the superimposed arrangement;

Figure 4 shows one embodiment of the invention where a plurality (four) of thread material layers of a multilayer lining fabric M of the invention are twisted by respective angles α of $+80^\circ \pm 5^\circ$ and $-80^\circ \pm 5^\circ$; and

Figures 5 A to 5 D show specific embodiments of the stacks of multilayer lining fabrics used in manufacturing clothes in accordance with, and as explained in, the working example, wherein Figure 5 A shows an arrangement of an exemplary plurality layers for the left leg front side of working trousers for chainsaw workers, Figure 5 B shows a similar arrangement as

Figure 5 A, but for the front and back sides of working trousers for chainsaw workers; Figure 5 C shows the arrangement of a stack of a plurality of lining fabric layers included into a textile pad; and Figure 5 D shows the textile pad of Figure 5 C included into, by e. g. stitching to, a part of clothing, e. g. a portion of a pair of working trousers for a chainsaw worker.

[0018] Preferred, but exemplary (and non-restricting) embodiments of the present invention, i. e. of the multilayer lining fabric and of the clothes of the present invention, are now explained in detail by referring to the Figures.

[0019] The term "comprise", "comprises" or "comprising" as used in the present specification and claims, for example in claim 1 (multilayer lining fabric claim) or in the description of the fabric, is defined to have the meaning that said fabric of the invention may comprise (or include) (i) at least one component of the fabric following said term "comprise" or "comprises" or "comprising" or may comprise (or include) (ii) two or more components of the fabric following said term "comprise" or "comprises" or "comprising", or that (iii) further components (more specifically defined below) may also be comprised by the fabric of the invention. The same is applicable also to the clothes claims and description of the clothes of the present invention, *mutatis mutandis*.

[0020] The term "comprise", "comprises" or "comprising" as used in the present specification and claims is, however, also defined for the present invention to optionally include cases where the multilayer lining fabric of the invention mainly (or even exclusively) consists of (i) at least one component of the fabric following said term "comprise" or "comprises" or "comprising" or mainly (or even exclusively) consists of (ii) two or more components of the fabric following said term "comprise" or "comprises" or "comprising", optionally together with any necessary component a skilled person may optionally additionally include into such a fabric in order to achieve the object of the invention, or may even include cases where the component of the fabric following said term "comprise" or "comprises" or "comprising" exclusively consists of (i) at least one component named or exclusively consists of (ii) two or more components named, optionally together with any necessary component a skilled person may include into such a fabric in order to achieve the object of the invention. The same is applicable also to the clothes claims and description of the clothes of the present invention, *mutatis mutandis*.

[0021] In other words: The term "comprise" or "comprises" or "comprising" may have, in the present specification and claims, the meanings of describing, or claiming, an exhaustive or, alternatively, a non-exhaustive enumeration of elements, without that, in the former case, embodiments are excluded which, for example in subclaims of the present application and corresponding parts of the specification, claim (and describe) further features, which are beneficial or advantageous but not essential

for the present invention.

[0022] The present invention relates to a multilayer lining fabric. The term "lining fabric", as used in the present specification and claims, is defined to mean a textile material made in the form of a plurality of layers each of which consists of textile material threads. Such thread layers, in the case of the present invention, are manufactured by a process of warp-knitting. As is generally known in this technical field, the process of warp-knitting is a knitting method in which the thread zigzags along the length of the fabric and, hence, follows adjacent columns of knitting, i. e. a knitting direction which follows the length direction of the knitted textile material. In an exemplary manner, this is shown in Figure 1, wherein the arrow shows the direction of the warp thread. Such a textile material or fabric is used as a lining under a surface layer or as a protective fabric layer (e. g. of a piece of clothing) in order to generate an underlayer having specific properties.

[0023] In accordance with the present invention, the lining fabric is a multilayer lining fabric, i. e. has a number of layers of at least two: In accordance with the invention, at least two warp-knitted fabric layers of a polymeric thread material are comprised.

[0024] The number of layers is not restricted to "two" and may comprise, in preferred embodiments of the invention, 2, 3, 4, 5, 6, 7, 8 or 9 or even more warp-knitted fabric layers. There is, in the frame of the present invention, no restriction to the number of the layers of the multilayer lining fabric. An exception is the fact that a larger number of layers increases the overall weight of the multilayer lining fabric of the invention, the latter being in contrast to the object of providing a multilayer lining fabric enhancing the wearing comfort for the wearer of the fabric or of the clothes comprising said fabric, because the fabric's weight increase makes movements in the wearer's sports or working environment more cumbersome. A number of layers of ≥ 5 is preferred, and even more preferred is a number of 6, 7, 8 or 9 warp-knitted fabric layers.

[0025] The polymeric thread material may be one polymeric thread material which is identical in all layers of the multilayer lining fabric or may be two or more polymeric thread materials in different layers of the multilayer lining fabric. A skilled person may select such one (or two or even more) polymeric thread materials from a large number of materials, which are known in the art *per se*, in accordance with the specific requirements of each single case. In accordance with the invention, one single polymeric thread material for all layers of the multilayer lining fabric of the invention is preferred; this does, however, not restrict the invention to this preferred embodiment.

[0026] In accordance with the invention, the material of the (at least two) warp-knitted fabric layers is a polymer thread material. Polymers for threads which may be employed for knitting the warp-knitted fabric layers of the present invention are well-known to a skilled person and may be selected from a large number of polymer mate-

rials in accordance with the requirements of a specific case, subject to the parameters of the material. One of those parameters is, naturally, that the polymer must be capable of being made into threads which are suitable for the machine knitting process. Another criterion is the requirement that the material, in the form of a thread, must be capable of being knitted into a fabric material by a warp-knitting process.

[0027] In accordance with the invention, the polymer material, after being warp-knitted into a fabric layer has a weight of $> 100 \text{ g/m}^2$. Polymer material fabrics having a weight of $> 100 \text{ g/m}^2$ may be warp-knitted into lightweight lining fabrics having good mechanical properties, as for example excellent stretchability, light weight and good humidity-dissipating properties.

[0028] Basically there is no upper limit of the fabrics' polymer material weight, with the exception of requesting that, in view of the object to provide a light-weight material promoting the wearer's comfort, the material should not be of a too high weight. In preferred embodiments of the invention, which may be realized alone or in combination with one or several other features of the invention and which should not be construed to restrict the invention, the materials used in each fabric layer have a weight in the range of from 120 to 180 g/m^2 , preferably in a range of from 140 to 160 g/m^2 , more preferably in a range of $160 \pm 5 \text{ g/m}^2$. Exemplary (but not restricting) weights of the polymer material after being warp-knitted into a fabric layer are 132 g/m^2 or 162 g/m^2 or 114 g/m^2 or 148 g/m^2 or 171 g/m^2 , and such specific weights may be used in combination with others, while having advantageous properties for the invention. Materials having the aforementioned weight were found to be particularly suitable for the multilayer lining fabric of the present invention.

[0029] In preferred embodiments of the invention, which may be realized alone or in combination with one or several other features of the invention and which should not be construed to restrict the invention, the materials have a thickness in the range of from 0.4 to 1.0 mm, preferably within a range of from 0.6 to 0.8 mm, more preferably within a range of from 0.65 to 0.75 mm, most preferably about 0.7 mm. Materials having the afore-mentioned thickness were found to be particularly suitable for the multilayer lining fabric of the present invention.

[0030] In preferred embodiments of the invention, which may be realized alone or in combination with one or several other features of the invention and which should not be construed to restrict the invention, the polymer thread material is a polyester or polyamide. Polyesters are particularly preferred materials, since they result into multilayer lining fabrics convenient for the wearer and presenting, in addition, good safety properties, as will be shown below in detail. A skilled person is familiar with polyesters and polyamides, particularly with polyesters, as polymer thread materials known in the present field of the art and may select such polyesters from a large group thereof in accordance with the requirements

of a specific case. More preferably, the polymer thread material may be poly (ethylene terephthalate) (PET). One specific material available on the market has turned out to be a particularly suitable material, which material is available from the Company Engtex AB, Mullsjö, Sweden, under the Trade Name "ENGTEX Dyneema".

[0031] In accordance with the invention, the warp-knitting of the fabric layers was made resulting into a number of weft threads per centimeter of length of the fabric layers which is larger than the number of warp threads per centimeter of width of the fabric layers, which number ratio represents the density of knitting of the fabric layer material.

[0032] In preferred embodiments of the invention, which may be realized alone or in combination with one or several other features of the invention and which should not be construed to restrict the invention, in each layer the number of warp threads is 4.5 ± 0.5 threads/cm and/or wherein the number of weft threads is 6.5 ± 0.5 threads/cm. Fabric layers of a polymer thread material having been warp-knitted on warp-knitting machines into fabrics having thread densities in the above ranges show particularly good improvements of their properties.

[0033] In accordance with the present invention, the multilayer lining fabric comprises at least two warp-knitted fabric layers of at least one polymer thread material, which layers are superimposed one on another, and the number of warp-knitted fabric layers may be 2, 3, 4, 5, 6, 7, 8 or 9 or even more warp-knitted fabric layers, as mentioned above. In preferred embodiments of the invention, 2, 3, 4, 5, 6, 7, 8 or 9 or even more warp-knitted fabric layers, are superimposed on one another, and even more preferable is a number of 6, 7, 8 or 9 warp-knitted fabric layers, for example 7, 8 or 9 warp-knitted fabric layers, and most preferable 9 warp-knitted fabric layers which are superimposed on one another.

[0034] In preferred embodiments of the invention, which may be realized alone or in combination with one or several other features of the invention and which should not be construed to restrict the invention, the direction of warp threads of one layer, in the plane of the layers of the fabric, is twisted, with respect to the direction of warp threads of an adjacent layer, by an angle α of at least 20° . In other words: If two layers of a warp-knitted polymer thread material are formed into a stack of two thread material layers, they are not stacked one upon another in parallel (i.e. with parallel warp thread directions, as in the prior art) but are stacked in a twisted manner so that their warp thread directions are positioned at an angle α to each other of at least 20° .

[0035] This is, for example, shown in Figure 2: Two thread material layers 1, 2, each manufactured by warp-knitting are shown side by side in Figure 2 A, and they are shown in Figure 2 B in a superimposed arrangement and twisted, with respect to their warp thread directions (represented by darker lines), by an angle α of, for example, 80° .

[0036] The technical effect of the feature of a superim-

posed arrangement of the at least two (and preferably ≥ 2) warp-knitted thread material layers twisted by an angle α of at least 20° with respect to their directions of the warp threads is twofold: From a safety point of view, the blocking of the operation of a chainsaw cutting into the cloth provided with the multilayer lining fabric in a (for example) vertical or diagonal direction (of trouser legs) is in a short time range comparable to, or even better than, corresponding values of prior art clothes, but the elasticity and stretchability of the multilayer lining fabric (comprising said warp-knitted thread material layers) is enhanced considerably. Even in multilayer lining fabrics having more than the minimum two warp-knitted thread material layers (e. g. ≥ 5 or 6, 7, 8, 9 or more, for example 7, 8 or 9 warp-knitted thread material layers), the comfort for the user (particularly due to the still enhanced elasticity and stretchability) is remarkable. A motion of the legs under heavy working duty and, hence, including a lot of sweating of the wearer in trousers provided with the multilayer lining fabric is achievable without the appearance of irritations on the wearer's skin.

[0037] In addition, if a multilayer lining fabric of the above type, as it is in accordance with the present invention, is fixed in trousers of chainsaw operators, and the trousers are subjected to the standardized chainsaw cutting tests in the directions perpendicular and parallel to the trousers' legs (so-called PPE test (or in German: EU PSA-Baumuster-Prüfung)), the multilayer lining fabric is capable of blocking the chainsaw's operation better than in cases of prior art trousers provided with lining layers superimposed in parallel, with respect to their twisted directions of warp threads of the plurality of layers. Details are described below in the experimental section.

[0038] In preferred embodiments of the invention, which may be realized alone or in combination with one or several other features of the invention and which should not be construed to restrict the invention, the angle α of twist of the direction of warp threads of one layer with respect to the direction of warp threads of an adjacent layer, is at most 120° . If this upper limit value of the twist angle α is observed, the elasticity and stretchability of the multilayer lining fabric is also still enhanced. In multilayer lining fabrics having more than the minimum two warp-knitted thread material layers (e. g. having, for example, 6, 7 or 8 layers of the polymer thread material), the comfort for the user (particularly due to the enhanced elasticity and stretchability) is even better. A motion of the legs under heavy working duty and, hence, including a lot of sweating of the wearer in trousers provided with the multilayer lining fabric is achievable without the appearance of irritations or even inflammations on the wearer's skin.

[0039] Moreover, the standard tests of these multilayer lining fabrics retaining their twist of the directions of their warp threads below the above upper limit value resulted in a better blocking of the chainsaw's operation by the threads of the multilayer lining fabric.

[0040] In more preferred embodiments of the inven-

tion, which may be realized alone or in combination with one or several other features of the invention and which should not be construed to restrict the invention, the angle α of a twist of the direction of warp threads of one layer with respect to the direction of warp threads of an adjacent layer, is within a range of $50^\circ \leq \alpha \leq 110^\circ$. It is even more preferable in accordance with the present invention that the angle α of a twist of the direction of warp threads of one layer with respect to the direction of warp threads of an adjacent layer, is within a range of $60^\circ \leq \alpha \leq 100^\circ$. By retaining the twist angle in the above preferred ranges, the above properties of wearing comfort and chainsaw operation safety blocking could be further improved, compared to the prior art.

[0041] In further more preferred embodiments of the invention, which may be realized alone or in combination with one or several other features of the invention and which should not be construed to restrict the invention, the angle α of a twist of the direction of warp threads of one layer with respect to the direction of warp threads of an adjacent layer, is within a range of $70^\circ \leq \alpha \leq 90^\circ$. In mostly preferred embodiments, the angle α of twist of the direction of warp threads of one layer with respect to the direction of warp threads of an adjacent layer is within a range of $80^\circ \pm 5^\circ$. Particularly in the latter case, the elasticity and stretchability of the multilayer lining fabric is enhanced to a surprising extent. In multilayer lining fabrics having more than the minimum two warp-knitted thread material layers (e. g. having, for example, 6, 7, 8 or 9 layers of the polymer thread material), the comfort for the user (particularly due to the enhanced elasticity and stretchability) is excellent, compared to the prior art. A motion of the legs under heavy working duty and, hence, including heavy sweating of the wearer in trousers provided with the multilayer lining fabric is achievable without that irritations or even inflammations on the wearer's skin could be observed.

[0042] Moreover, the standard tests of these multilayer lining fabrics retaining their twist of the directions of their warp threads in the range of $80^\circ \pm 5^\circ$ resulted in a blocking of the chainsaw's operation by the threads of the multilayer lining fabric even exceeding the values obtained with prior art multilayer lining fabrics having a relatively parallel arrangement of their directions of the warp threads.

[0043] In further preferred embodiments of the invention, which may be realized alone or in combination with one or several other features of the invention and which should not be construed to restrict the invention, directions of warp threads of certain layers of the multilayer lining fabric M, with respect to the direction of warp threads of one of the lining layers as a reference layer, are twisted by angles α , α' , α'' which are different from each other or which are identical to each other. In other words: In superimposed arrangements of more than two (for example five) thread material layers, all twist angles α , α' , α'' , α''' (etc.) of directions of the warp threads of one layer, relative to the respective superimposed adja-

cent layer, are different from each other. The respective differences may be different in the absolute value of the angle (i. e. $|\alpha|$) or may also (or instead only) be different in view of the clockwise or counterclockwise directions. As an alternative, all warp thread direction angles α of different layers are identical to each other.

[0044] Figures 3 shows an example for the above first case where directions of warp threads of certain layers of the multilayer lining fabric M, with respect to the direction of warp threads of one of the lining layers as a reference layer, are twisted by angles α , α' , α'' which are different from each other: In accordance with Figure 3, the angles α of the twist of the direction of warp threads change from one layer couple (layers 1 $\rightarrow$ 2) of thread material to the next couple of layers, i. e. adjacent, layers 2 $\rightarrow$ 3 layers 3 $\rightarrow$ 4, of thread material in their absolute values (e. g. $\alpha = 40^\circ$; $\alpha' = 80^\circ$; $\alpha'' = 60^\circ$). In another preferred embodiment of the invention (described below with respect to Figure 4), the twist angles α of another arrangement are identical in their (absolute) values, but are varied with respect to the clockwise and counterclockwise directions (e. g. $\alpha = +80^\circ$; $\alpha' = -80^\circ$; $\alpha'' = +80^\circ$). The above values are exemplary examples only and do not restrict the invention.

[0045] In further preferred embodiments of the invention, which may be realized alone or in combination with one or several other features of the invention and which should not be construed to restrict the invention, directions of warp threads of two directly adjacent layers, with respect to the direction of warp threads of one of the lining layers as a reference layer, are twisted by the identical angle α (i. e. $|\alpha|$ is always the same), while directions of warp threads of the following two adjacent layers are parallel to those of the reference layer, and the angles α are different "only" in their clockwise or counterclockwise directions.

[0046] This case is shown in Figure 4: The reference layer of the multilayer lining fabric M has the reference numeral 1; its direction of the warp threads is represented by a darker line. The directly adjacent layer 2 of the multilayer lining fabric M has a direction of its warp threads (also represented by a darker line) which is twisted, with respect to the reference layer's (1) warp thread direction, by the angle α , e. g. by $80^\circ \pm 5^\circ$. The layer 3 directly adjacent to layer 2 of the multilayer lining fabric M has a direction of its warp threads (also represented by a darker line) which is twisted by an angle α identical to the angle α between layers 1 and 2 in its value, but having a counter-clockwise direction, e. g. $-80^\circ \pm 5^\circ$. The same is applicable to layer 4 directly adjacent to the above layer 3 of the multilayer lining fabric M; and so forth. In other words: In the preferred embodiment of the multilayer lining fabric shown in Figure 4, the layers having an odd number (e. g. 3, 5, etc.) each have directions of their warp threads (represented by darker lines) which are parallel to the reference layer's (1) warp thread direction, while the layers having an even number (e. 2, 4, 6 etc.) have directions of their warp threads (represented by darker

lines) which are in an angle α of, for example $80^\circ \pm 5^\circ$, to the warp thread directions of the odd-numbered layers (1, 3, 5 etc.).

[0047] In the latter case, a kind of "zig-zag" arrangement of the respective adjacent layers' relative twist angle α of their relative directions of the warp thread is established. Such an arrangement is highly advantageous, because the elasticity and stretchability of the multilayer lining fabric is maintained at an enhanced level, to a surprising extent. In multilayer lining fabrics having, for example, 6, 7, 8 or 9 layers of the polymer thread material, the comfort for the user (particularly due to the enhanced elasticity and stretchability) is excellent, compared to the prior art. A motion of the legs under heavy working duty and, hence, including heavy sweating by the wearer in trousers provided with the multilayer lining fabric is achievable without that irritations or even inflammations on the wearer's skin could be observed.

[0048] Moreover, the standard tests (according to the technical standard EN / DIN 381-2 and 381-5 for chain-saw trousers) of these multilayer lining fabrics retaining their twist of the directions of their warp threads in the range of $80^\circ \pm 2^\circ$ and having the above "zig-zag" configuration of their angles α of the warp thread directions, relative to the warp thread directions of the reference layer of the multilayer lining fabric, resulted in a blocking of the chainsaw's operation by the threads of the multilayer lining fabric which even exceeds the values obtained with prior art multilayer lining fabrics having a relatively parallel arrangement of their directions of the warp threads, in the chainsaw cuts in a direction perpendicular to the trouser leg axis and even more in the direction parallel to the trouser leg axis.

[0049] Further preferred embodiments of the invention, which may be realized alone or in combination with one or several other features of the invention and which should not be construed to restrict the invention are directed to multilayer lining fabrics according to the invention, wherein 2, 3, 4, 5, 6, 7, 8 or 9 layers are in an arrangement one on top of the other with their directions of warp threads of adjacent fabric layers twisted by an angle α of at least 20° and preferably at most 120° and more preferably within a range of $50^\circ \leq \alpha \leq 110^\circ$; and are fixed together loosely to form a stack of loosely fixed, e. g. loosely stitched, twisted layers.

[0050] Such a fixation of the lining fabric layers, preferably such stitching thereof, may be effected preferably at the edges of these lining fabric layers, so as to form a loosely connected, flexible stack thereof. Hence, in accordance with these preferred embodiments of the invention, such stacks of a plurality of loosely connected/fixed fabric layers are designed to form, and practically form, flexible and stretchable "pillows" comprising such a plurality of the warp-knitted material layers, wherein the relative position of the layers is not tightly fixed, but only loosely and flexibly connected. Thereby, a substantial contribution to the desired flexibility of the lining fabric can be made.

[0051] The preferred way of loose fixation known to a skilled person is seaming by loosely stitching, although the invention is not restricted to this type of loose fixation.

[0052] In a further preferred embodiment of the invention, which may be realized alone or in combination with one or several other features of the invention and which should not be construed to restrict the invention, such a stack of loosely fixed, e. g. loosely stitched, twisted layers of the lining fabric material may be included into a textile pad, and such a pad comprises a surrounding envelope and an inner stack of 2, 3, 4, 5, 6, 7, 8 or 9 loosely fixed, e. g. loosely stitched, fabric layers in an arrangement one on top of the other with their directions of warp threads of adjacent fabric layers twisted by an angle α of at least 20° .

[0053] The textile pad is defined, for the present specification and claims, to be a textile material in a sheet form and capable of forming the envelope needed for surrounding the fabric layer stack, capable of maintaining said envelope shape under the conditions of use of the pad, and capable of being fixed, by textile fixation processes as, for example, stitching, to other textile sheet materials. The material of which the pad is formed may be any material a skilled person knows for the desired purpose of surrounding the plurality of loosely fixed or loosely stitched fabric layers, and such a material may be selected by a skilled person from a number of suitable materials according to the parameters which must be observed.

[0054] In further preferred embodiments of the invention, which may be realized alone or in combination with one or several other features of the invention and which should not be construed to restrict the invention, the textile material of the pad envelope is selected from knitted or woven textile materials, which - in more preferred embodiments - will have to have, or to retain, a high elasticity. Polymer materials like polyamides and - even more preferred - polyesters are preferred materials. Polyesters are even more preferred, because they retain their elasticity, are "skin-friendly", i. e. do not undergo any changes in their mechanical properties and are capable of being treated with a "wicking" finish material capable of wicking sweat away from the skin. Particularly preferred materials are those materials known under the commercial names ELASTAN[®] or LYCRA[®].

[0055] The resulting pad comprises or includes said stack of a plurality of lining fabric layers the directions of the warp threads of which are twisted by a certain angle α as explained above, and loosely connected to a stack of textile layers, preferably by loosely stitching said layers, preferably at their edges.

[0056] Such a pad, in accordance with the invention, is required to be capable of being fixed, by any conceivable textile fixation process, to another textile material, for example to a textile material forming a piece of clothing, of which a cloth (e. g. a trouser) for sports purposes or for working purposes are two examples, only. A suitable textile fixation process may be selected by a person

skilled in this field in accordance with the requirements needed. Such a fixation process may be a step of stitching the pad to a sheet of a textile material, preferably by machine stitching the borderline or the edges of the pad to said sheet of textile material.

[0057] As a result, the sheet of textile material comprises the pad fixed (e.g. stitched, preferably machine-stitched) to the sheet, and its position on the sheet is clearly defined. On the other hand, the pad itself comprises included, and loosely connected, the flexible stack of lining textile layers, which stack, inside the envelope, provides the desired stretchability, resulting into the wearer's comfort.

[0058] In another aspect, the invention relates to clothes which comprise at least one multilayer lining fabric according to the present invention as described above in detail, as well as a shell layer. Such a shell layer may be a layer directed to the outer side of the clothes and may additionally have certain functions as, for example, a water repelling function, a safety signal colour, without restricting the invention to those functions.

[0059] Hence, with respect to the clothes of the invention, the above description of the multilayer lining fabric of the present invention can be referred to in all details, and all features of the multilayer lining fabric of the invention, i. e. one feature of the above-described features alone or several or all features of the above-described features in combination, as well as its/their objects and advantages, are also applicable to the clothes comprising such multilayer lining fabric.

[0060] The clothes of the invention may comprise at least one of the multilayer lining fabrics of the invention or may comprise two or three or even more of the multilayer lining fabrics. In a preferred embodiment of the invention, which may be realized alone or in combination with one or several other features of the invention and which should not be construed to restrict the invention, the clothes of the invention comprise one multilayer lining fabric of the above-described invention, in addition to the shell layer.

[0061] In a further preferred embodiment of the invention, which may be realized alone or in combination with one or several other features of the invention and which should not be construed to restrict the invention, the clothes of the invention comprise the multilayer lining fabric according to the invention (one multilayer lining fabric or two or even three or more multilayer lining fabrics, preferably one multilayer lining fabric) in only a part thereof. This means that the clothes comprise parts where no multilayer lining fabric of the invention is applied. One of the reasons is that the purposes of said multilayer lining fabric (in particular the safety feature of being capable of blocking a chainsaw operation cutting into said cloth) are needed to be met only in parts of the cloth.

[0062] In a further preferred embodiment of the invention, which may be realized alone or in combination with one or several other features of the invention and which should not be construed to restrict the invention, the

clothes of the invention comprising the multilayer lining fabric are selected from sports clothes and working clothes. In these preferred types of clothes, the advantages of the invention, particularly the advantages afforded by the multilayer lining fabric, can ideally be achieved: Both clothes are worn by people who have to move their bodies very much, which fact is closely connected to sweating. Hence, these wearers need clothes adapted to multi-movement types of activities and, hence, must be comfortable in their wearing properties, e. g. must provide elasticity and stretchability.

[0063] In addition, in the case of working clothes, safety aspects have to be observed. As a specific feature, the clothes of the invention, equipped with the multilayer lining fabrics of the invention, allow a blocking capability for chainsaws which surprisingly exceeds similar properties as tested in standard procedures described below in the experimental part of this description.

[0064] In a further preferred embodiment of the invention, which may be realized alone or in combination with one or several other features of the invention and which should not be construed to restrict the invention, the clothes are chainsaw protection clothes, preferably for forest workers, which surprisingly exceed all expectations not only with respect to the wearing comfort, but also with respect to the safety aspect: In chainsaw cut tests according to the EU standard EN 381-2 and 381-5, the clothes according to the invention and comprising the multilayer lining fabric of the invention achieved very good results: The preferred clothes of the invention, working trousers for forest workers, achieved good, in part even considerably better test results (more rapid stopping of the chainsaw's operation by the threads of the lining fabric layers) not only in chainsaw cuts perpendicular to the trouser leg axis, but also in chainsaw cuts in a direction diagonal to the trouser leg axis). Details thereof are described below in the experimental part of the description.

[0065] In particularly preferred embodiments of the invention, which may be realized alone or in combination with one or several other features of the invention and which should not be construed to restrict the invention, the clothes of the present invention comprise the multilayer lining fabric according to the above-described preferred embodiments of the multilayer lining fabric of the invention, wherein the loosely stitched stack of twisted layers or the textile pad of the surrounding envelope and the inner stack of 2, 3, 4, 5, 6, 7, 8 or 9 loosely fixed, preferably loosely stitched (for example along their edges) fabric layers in an arrangement one on top of the other with their directions of warp threads of adjacent fabric layers twisted by an angle α of at least 20 °, and preferably at most 120 ° and more preferably within a range of $50^\circ \leq \alpha \leq 110^\circ$, is separately stitched to the inner side of the clothes' shell layer, without additionally stitchingly fixing the twisted layers to the clothes' shell layer. As mentioned above, such multilayer lining fabric according to the invention may be applied to the whole

inner side of the clothes' shell layer or may be applied only to a part thereof.

[0066] The shell layer may be of any suitable material a skilled person knows for purposes of sports clothes, working clothes etc. and, hence, may be selected from any suitable material in accordance with the specific requirements of a single case. Typical examples of a material selected as the shell layer material is a material selected from materials having a sufficient stability, weather resistance, wicking properties and tear strength, which is essential for sports clothes and working clothes. A skilled person knows such materials for shell layers of sports and working clothes and, hence, may select such materials in accordance with the requirements of a specific case. Particularly preferred materials are polyamides and polyesters, and polyesters are even better preferred. Exemplary (albeit not restricting) materials are those known under the commercial names ELASTAN^R and LYCRA^R.

[0067] In a further preferred embodiment of the invention, which may be realized alone or in combination with one or several other features of the invention and which should not be construed to restrict the invention, the clothes of the present invention comprise advantageous and, hence, preferred embodiments, wherein a plurality of layers of the multilayer lining fabric of the above detailed description is arranged one on top of the other with their directions of warp threads of adjacent fabric layers twisted by an angle α of at least 20 ° and preferably at most 120 ° and more preferably within a range of $50^\circ \leq \alpha \leq 110^\circ$; wherein such arrangement of said plurality of layers is symmetrical to a manufacturing direction of the clothes' shell layer. Said clothes' manufacturing direction may be the lengthwise direction of knitting or weaving (i. e. the warp thread direction). In other preferred embodiments, such arrangement of said plurality of layers is symmetrical to a longitudinal axis of parts of said clothes extending in a longitudinal direction, e. g. to the longitudinal axis of the trousers' legs. In other words: The plurality of layers is arranged, with respect to the manufacturing direction or longitudinal axis direction in such a manner that angle α 's half angle ($= \alpha/2$) is located exactly on the working direction or longitudinal trouser leg axis, thereby achieving that the elasticity of the overall material (i. e. multilayer lining fabric with its plurality of layers plus shell layer) is retained on a high level, while achieving good safety standards in working clothes' safety tests (particularly the diagonal cut of the chainsaw safety test; see the experimental section below).

[0068] In a further preferred embodiment of the invention, which may be realized alone or in combination with one or several other features of the invention and which should not be construed to restrict the invention, the clothes of the invention comprising the multilayer lining fabric of the invention (as described above in all details), particularly the working trousers, may additionally comprise an additional knee protection area, affording an additional protection effect to the wearer's body when work-

ing on the knees or including movements where a touch to the knee is involved.

[0069] Such an additional knee protection area may be made in accordance with usual prior art knee protection means, but, in accordance with the invention, is preferably made of an imprintable cushioning material applied to the knee area of the trouser lag or even to both knee protection areas of both trouser legs. Such protective cushioning may be made of any material a skilled person is aware of for the desired purposes.

[0070] However, in a further preferred embodiment of the invention, which may be realized alone or in combination with one or several other features of the invention and which should not be construed to restrict the invention, the clothes of the invention comprising the multilayer lining fabric additionally comprise an additional knee protection area to which is applied, directly onto the shell material, an imprintable cushioning material made of an imprintable polymer material, wherein - even more preferably - the polymer may be selected from the group consisting of melt-printable polymers, particularly from polyurethanes. Optionally, the adherence of such a polymer material, preferably the adherence of such a polyurethane material, to the clothes' shell layer is improved by means of the application, on the area between the clothes and the additional knee protection material, of an adherence improver. A skilled person knows such adherence improving materials and may select them in accordance with the nature of the polymer and clothes' materials based on the general skill.

[0071] The additional imprintable cushioning material may be applied to the outside surface of the cloth, preferably of the working or protection trouser of the invention, in any conceivable shape. In particularly preferred embodiments of the invention, the application may comprise small spot patterns or small line patterns or small picture patterns, which may either have the same appearance (e. g. color) as the fabric sheet on which they are applied or may be different in appearance (e. g. color) so that they are silhouetted against the fabric basis. In the latter case, the manufacturer of the working clothes may show a logo or a safety sign by such an imprinted cushioning material.

[0072] In the following, the multilayer lining fabric of the present invention, as well as the clothes comprising such a multilayer lining fabric of the invention, are in more detail explained by referring to specific examples. It has to be noted that the examples are given only for allowing a better understanding of the invention and should not be construed to limit the invention to the specific examples.

Examples

[0073] Chainsaw operators' trousers subjected to the tests described below comprised an outer water protection fabric made of ELASTAN^R and an inner lining consisting of 8 warp-knitted fabric layers and an additional

lining fabric made of LYCRA[®] between layers Nos. 7 and 8 (calculated from the inner to the outer side of the lining fabric stack (see Figures 5A to 5D). In each layer, the number of warp threads was 4.5 ± 0.5 threads/cm, and the number of weft threads was 6.5 ± 0.5 threads/cm.

[0074] The direction of warp threads of warp-knitted fabric layer 2 was twisted, with respect to the direction of warp threads of layer 1, by an angle of $+80^\circ$; the direction of warp threads of warp-knitted fabric layer 3 is twisted, with respect to the direction of warp threads of layer 2, by an angle of -80° (i. e. is the same as the direction of warp threads of layer 1); the direction of warp threads of warp-knitted fabric layer 4 is twisted, with respect to the direction of warp threads of layer 3, by an angle of $+80^\circ$; the direction of warp threads of warp-knitted fabric layer 5 is twisted, with respect to the direction of warp threads of layer 4, by an angle of -80° , (i. e. is the same as the direction of warp threads of layer 1); etc. etc.. This arrangement of the layers under the water protection fabric shell layer is shown in Figure 5A, exemplarily.

[0075] The eight layers shown in Figure 5A were packed into an envelope made of ELASTAN[®] without stitching them together, and the surrounding envelope was stitched at both ends by sewing; any other stitching method instead of sewing could have been employed.

[0076] The resulting "textile pad" was applied to the left leg front side of chainsawer's working trousers. The resulting trousers were evaluated by the wearers to provide the desired elasticity and stretchability and did not cause any discomfort even under hard-sweating work conditions.

[0077] The same trousers were subjected to the EU PPE standard test by cutting on a test stand with a chainsaw cut perpendicular to the trousers' legs' axis and stopped the chainsaw under conditions identical to the usual EU PPE standard test (speed of the chains, cutting angle).

[0078] Moreover, the same trousers are being subjected to a modified test under the Industrial Standard EN 381-2 and 381-5. This standard has a test stand which is being modified for the multilayer lining fabrics due to their twisting of the warp directions in the plane of the multilayer fabric layers. First results (to be confirmed in further tests) showed that the chainsaw chain stopping by entangling the chain with the warp threads is better than the conventional multilayer fabrics having parallel directions of their warp threads, thereby surprisingly showing a better fit into safety requirements for such type of clothes, in addition to better wearing comfort for the wearers.

[0079] Working trousers made for chainsaw workers of the above materials were subjected to a 4 week long-time field test under relatively high temperature (autumn) and high humidity (rain) conditions and were found by the workers to be better adapted to the requirements and more convenient to wear under high load sweating con-

ditions (mountain forest) than all other materials available on the market: Particularly the desired elasticity and sweat-dissipating properties were found to be outstanding.

[0080] The invention was described above in detail while referring to its preferred embodiments. The reference to the preferred embodiments should, however, not be understood as a limitation of the invention. Quite to the contrary: The scope of the invention is only determined by the claims which follow.

Claims

1. Multilayer lining fabric comprising at least two warp-knitted fabric layers of at least one polymer thread material having a weight of ≥ 100 g/m², wherein the number of weft threads per centimeter of length of the fabric layers is larger than the number of warp threads per centimeter of width of the fabric layers, and wherein, in the plane of the layers of the fabric, the direction of warp threads of one layer is twisted with respect to the direction of warp threads of an adjacent layer by an angle α of at least 20° .
2. The multilayer lining fabric according to claim 1, wherein the angle α of twist of the direction of warp threads of one layer with respect to the direction of warp threads of an adjacent layer, is at most 120° ; preferably wherein the angle α of twist of the direction of warp threads of one layer with respect to the direction of warp threads of an adjacent layer, is within a range of $50^\circ \leq \alpha \leq 110^\circ$; more preferably wherein the angle α of twist of the direction of warp threads of one layer with respect to the direction of warp threads of an adjacent layer, is within a range of $60^\circ \leq \alpha \leq 100^\circ$; even more preferably wherein the angle α of twist of the direction of warp threads of one layer with respect to the direction of warp threads of an adjacent layer, is within a range of $70^\circ \leq \alpha \leq 90^\circ$; most preferably wherein the angle α of twist of the direction of warp threads of one layer with respect to the direction of warp threads of an adjacent layer, is within a range of $80^\circ \pm 5^\circ$.
3. The multilayer lining fabric according to claim 1 or claim 2, wherein, with respect to the direction of warp threads of one of the lining layers as a reference layer, directions of warp threads of other layers are twisted by angles α , α' , α'' which are different or which are identical, preferably wherein, with respect to the direction of warp threads of one of the lining layers as a reference layer, directions of warp threads of the two adjacent layers are twisted by the identical angle α , while directions of warp threads of the subsequent two adjacent layers are parallel to those of the reference layer.

4. The multilayer lining fabric according to any of the claims 1 to 3, wherein the number of the at least two warp-knitted fabric layers is 2, 3, 4, 5, 6, 7, 8 or 9; preferably wherein the number of warp-knitted fabric layers is ≥ 5 ; more preferably wherein the number of warp-knitted fabric layers is 6, 7, 8 or 9. 5
5. The multilayer lining fabric according to any of the claims 1 to 4, wherein the weight of each layer is in a range of from 120 to 180 g/m², preferably in a range of from 140 to 160 g/m², more preferably in a range of 160 ± 5 g/m²; and/or wherein, in each layer, the number of warp threads is 4.5 ± 0.5 threads/cm and/or wherein the number of weft threads is 6.5 ± 0.5 threads/cm. 10
6. The multilayer lining fabric according to any of the claims 1 to 5, wherein the polymer thread material is a polyester or polyamide or a combination thereof, preferably wherein the polymer thread material is a polyester, more preferably wherein the polymer thread material is polyethylene terephthalate (PET); and/or wherein the material thickness is within a range of from 0.4 to 1.0 mm, preferably within a range of from 0.6 to 0.8 mm, more preferably within a range of from 0.65 to 0.75 mm, most preferably about 0.7 mm. 15
7. The multilayer lining fabric according to any of the claims 1 to 6, wherein 2, 3, 4, 5, 6, 7, 8 or 9 layers are in an arrangement one on top of the other with their directions of warp threads of adjacent fabric layers twisted by an angle α of at least 20 ° and preferably at most 120 ° and more preferably within a range of $50^\circ \leq \alpha \leq 110^\circ$; and fixed together loosely, preferably seamed by loose stitching, to form a loosely fixed stack of twisted layers. 20
8. The multilayer lining fabric according to any of the claims 1 to 7, included into a textile pad comprising a surrounding envelope and an inner stack of 2, 3, 4, 5, 6, 7, 8 or 9 loosely stitched fabric layers in an arrangement one on top of the other with their directions of warp threads of adjacent fabric layers twisted by an angle α of at least 20 °. 25
9. Clothes comprising at least one multilayer lining fabric according to any of the claims 1 to 8 and a shell layer. 30
10. The clothes of claim 9 comprising the multilayer lining fabric according to any of the claims 1 to 8 in or on only a part thereof. 35
11. The clothes according to claim 9 or claim 10, wherein a plurality of layers of the multilayer lining fabric of any of the claims 1 to 8 is arranged one on top of the other with their directions of warp threads of adjacent fabric layers twisted by an angle α of at least 20 ° and preferably at most 120 ° and more preferably within α range of $50^\circ \leq \alpha \leq 110^\circ$; wherein such arrangement of said plurality of layers is symmetrical to a manufacturing direction of the clothes' shell layer, preferably wherein such arrangement of said plurality of layers is symmetrical to a longitudinal axis of parts of said clothes extending in a longitudinal direction. 40
12. The clothes of any of the claims 9 to 11, comprising the multilayer lining fabric according to claim 7 or according to claim 8, wherein the loosely stitched stack of twisted layers or the textile pad of the surrounding envelope and the inner stack of 2, 3, 4, 5, 6, 7, 8 or 9 loosely stitched fabric layers in an arrangement one on top of the other with their directions of warp threads of adjacent fabric layers twisted by an angle α of at least 20 ° is separately stitched to the inner side of the clothes' shell layer without additionally stitchingly fixing the twisted layers to the clothes. 45
13. The clothes of any of the claims 9 to 12, additionally comprising an additional knee protection area preferably made of an imprintable cushioning material, more preferably made of an imprintable polymer material selected from the group consisting of melt-printable polyurethane, optionally improved in its adherence to the clothes' shell layer by means of an adherence improver. 50
14. The clothes according to any of the claims 9 to 13, as sports clothes or working clothes. 55
15. The clothes according to any of the claims 9 to 14, as chainsaw protection clothes, preferably as chainsaw protection trousers.

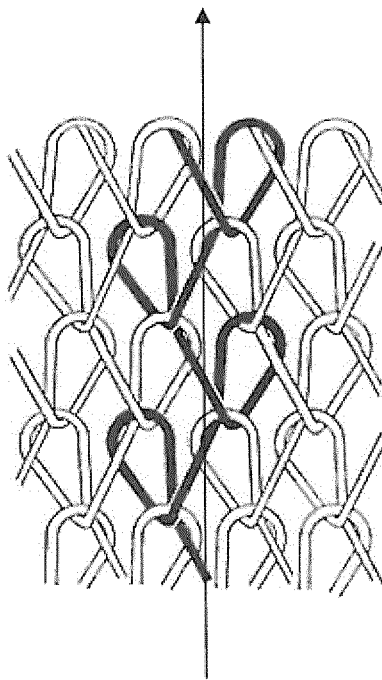
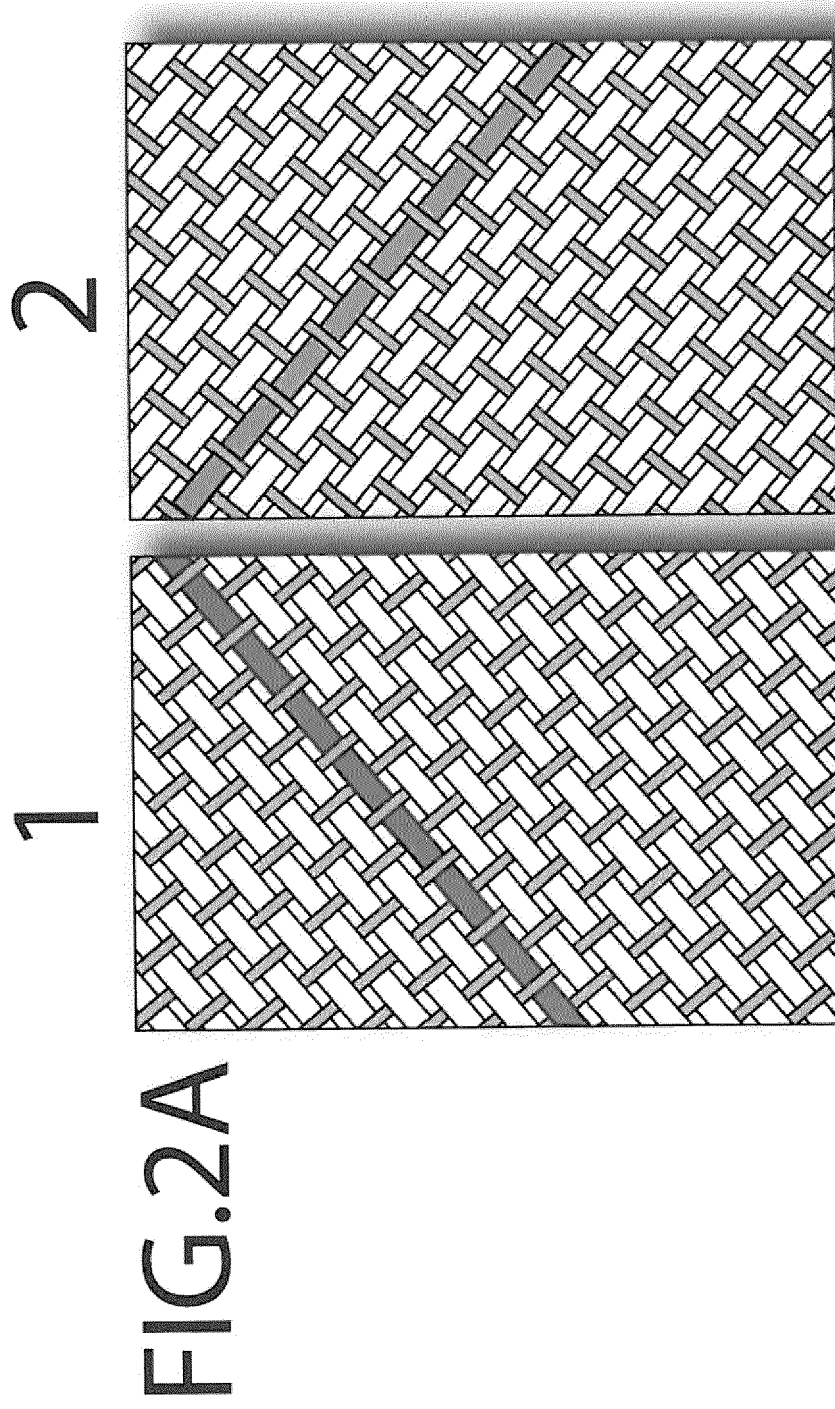


Figure 1



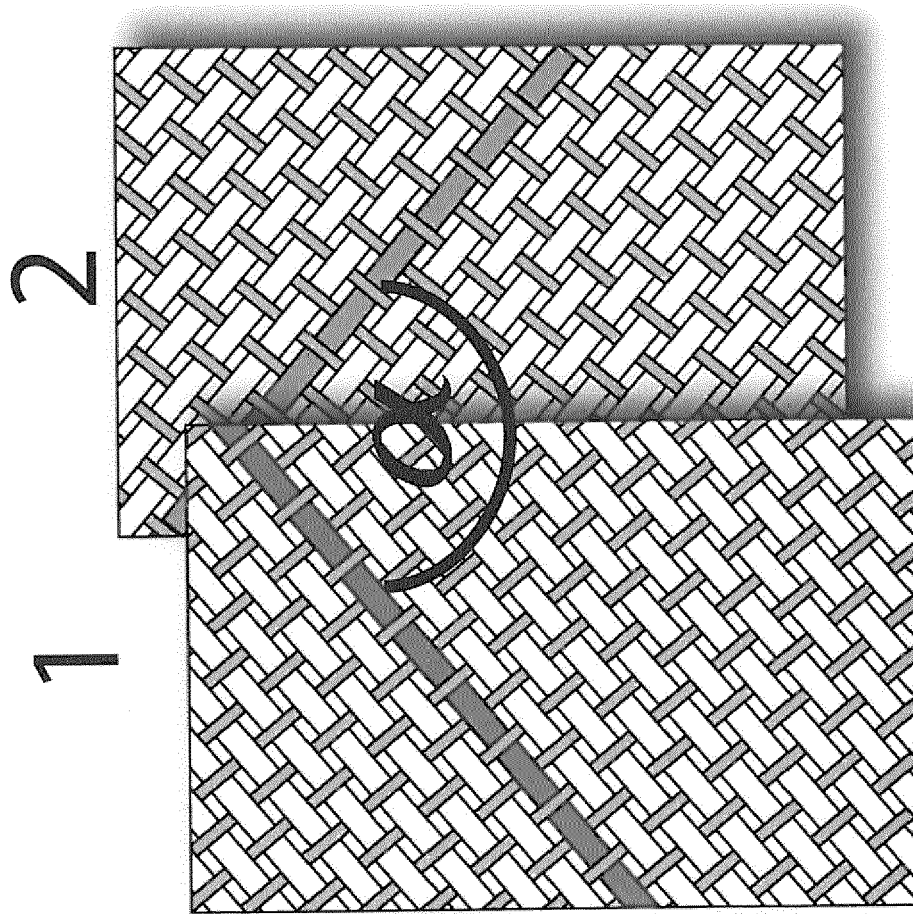
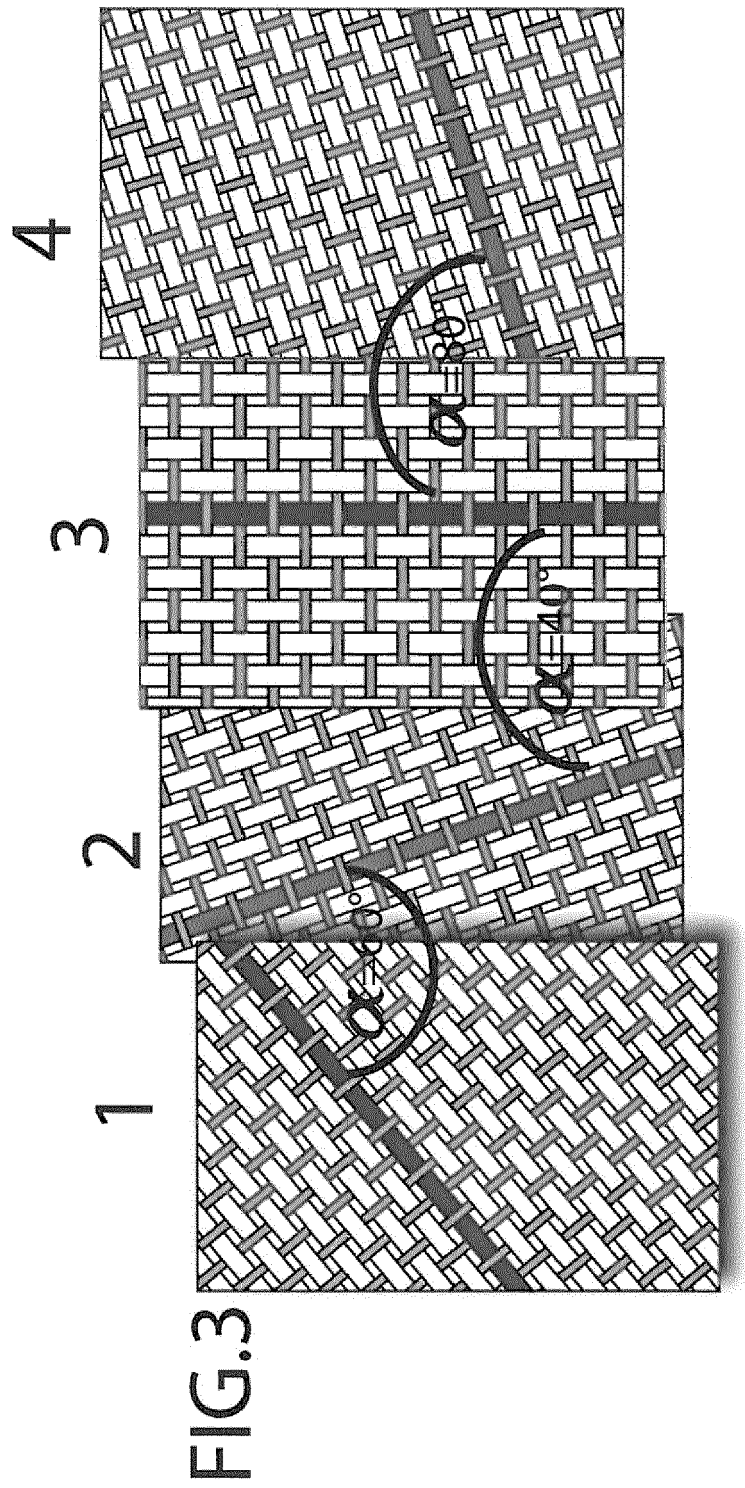


FIG. 2B



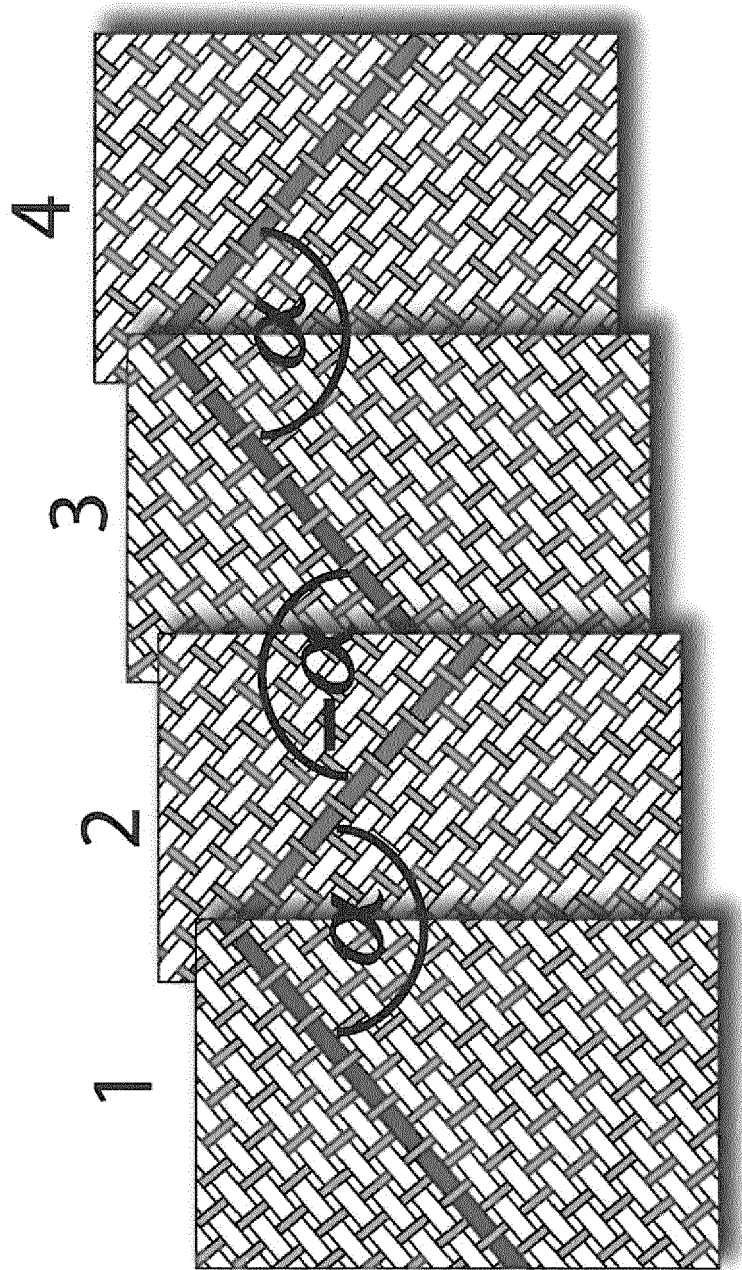
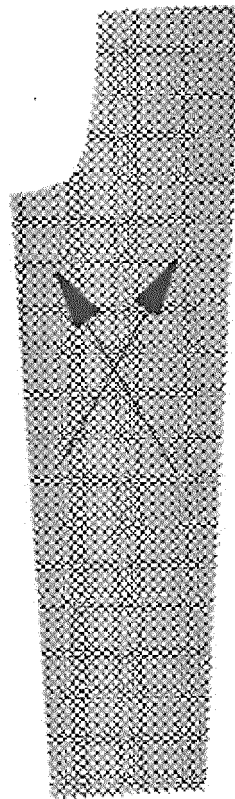


FIG. 4



8 layer in different direction:
 one layer vertical 40°
 one layer horizontal 40°
 alternating
 made of DYNEEMA

in addition lining fabric in
 between layer 7 to 8

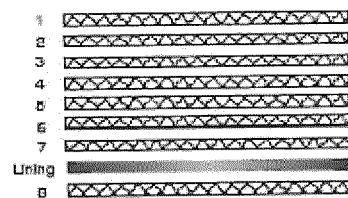


Figure 5 A

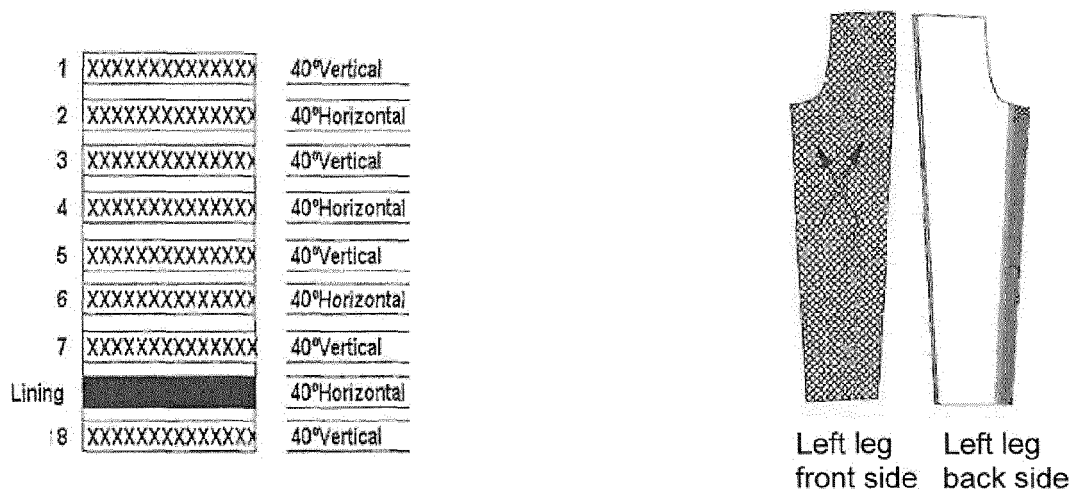


Figure 5 B

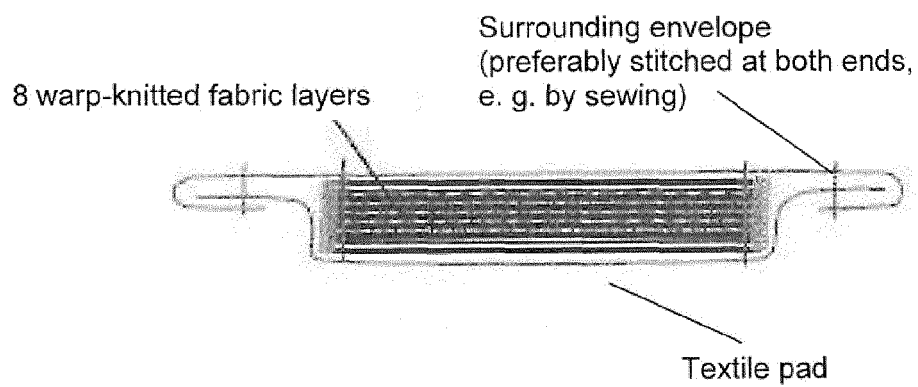


Figure 5 C

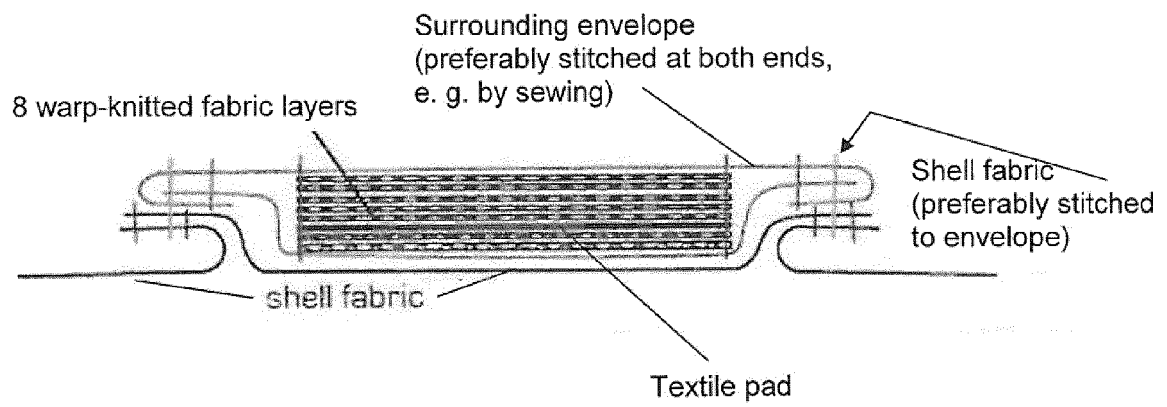


Figure 5 D



EUROPEAN SEARCH REPORT

Application Number
EP 13 18 2448

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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	DE 10 2010 041780 A1 (ROEKONA TEXTILWERK GES MIT BESCHRAENKTER HAFTUNG WIRKEREI AUSRUESTUNG) 5 April 2012 (2012-04-05) * paragraphs [0037] - [0039], [0046] - [0050], [0056]; claims 6-8, 13,14, 18; figures 3, 4, 6 *	1-15	INV. D04B21/16
A	DE 41 16 569 A1 (KUFNER TEXTILWERKE GMBH [DE]) 26 November 1992 (1992-11-26) * column 2, lines 34-68; claim 1; figures 1, 4, 6, 7; examples 1-3 *	1	
			TECHNICAL FIELDS SEARCHED (IPC)
			D04B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 6 February 2014	Examiner Sterle, Dieter
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			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 13 18 2448

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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06-02-2014

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102010041780 A1	05-04-2012	NONE	
DE 4116569 A1	26-11-1992	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82