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(54) **DOUBLE LAYER KNITTED ELEMENT COMPRISING FUNCTIONAL TUCKED-IN YARNS, SHOE UPPER AND SHOE COMPRISING THE SAME**

(57) The present invention relates to a double layer knitted element, in particular for a sports article, comprising a first layer (100) comprising a first yarn (110), and a second layer (200) comprising a second yarn (210), and a third yarn (310) arranged at least in part between the first and second layer (100, 200), wherein the third yarn (310) is attached to at least one of the first and second layer (100, 200) by a plurality of tuck stitches, wherein there is at least one miss stitch between two successive tuck stitches of the third yarn (310).

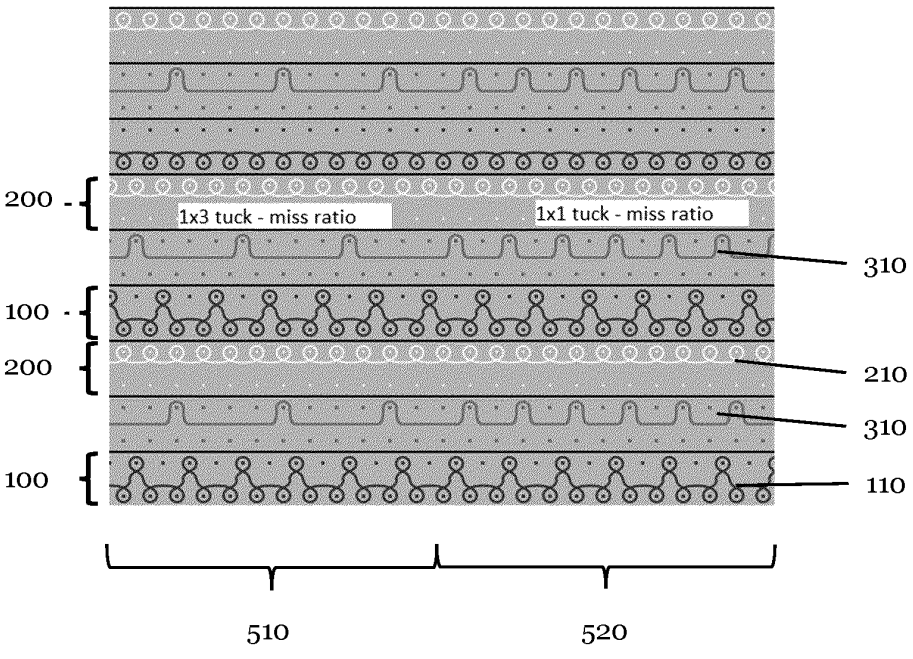

Fig. 8

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Description

1. Field of the invention

[0001] The present invention relates to a double knitted element, in particular a sports article, and to a method of manufacturing such a double knitted element.

2. Prior art

[0002] In order to provide a knitted element with desired functional properties such as stiffness, stretch, recovery or compression properties through knitting, there exists various manufacturing methods.

[0003] In particular, stiffness is usually achieved by plating a melting yarn together with a base yarn (e.g. polyester) or just mixing melting yarns with the base yarn into the same yarn feeder. Another possibility to achieve stiffness is provided by knitting thermoplastic polyurethane (TPU) yarns or by knitting hybrid yarns, which represent a mixture of polyester and melting yarn. Furthermore, stretch, recovery or compression properties are usually achieved by in-laying covered elastic yarns, by plating or mixing spandex yarns together with the base yarn (e.g. natural fiber, artificial, synthetic) directly into the feeder or by knitting covered elastic yarns.

[0004] Tucked-in yarns are usually used on a single layer knit base, for example in fleece fabrics. In these fabrics, the yarns that are too thick for regular knitting and are thus inserted into the fabric by tucking. Furthermore, an elastic yarn may be used as inlay or even in a tuck-float structure for sock knitting, but this use is only known for a single jersey or a single knit layer.

[0005] Thus, the present invention deals with various problems to be solved.

[0006] When using plating or mixing to achieve stiffness, the melting yarn follows the same knitting sequence as the base yarn. Further, the amount of melting yarn is difficult to control as it depends on the knitting structure. In addition, if the melting yarn is only needed on one side of the fabric, then the knitting sequence needs to be modified accordingly, which results in a different visual appearance or property of the fabric. When the melting yarn is mixed together with the base yarn it is impossible to control which of the two yarns will show up on the surface of the fabric. Plating the melting yarn can improve this shortcoming, but it is usually difficult or time consuming to set it up on the knitting machine. In particular, plating is usually difficult to adjust on the knitting machine.

[0007] When using elastic yarns to achieve stretch, recovery or compression as in-laid yarns, there is always a risk of pulling out the elastic yarn because it is not connected to the fabric. In particular, the in-laid yarn is just a long float inside the double layer knit.

[0008] Therefore, the problem to be solved by the present invention is to provide a knit fabric and a respective manufacturing method to achieve enhanced functional properties in the knit fabric. In particular, there is a need to create functional properties in the knit independently of the knitting sequence, to avoid the possibility of pulling out the in-laid threads, to keep the appearance of the fabric as it is, but with added functional properties, and/or to activate the melting yarn at targeted locations of the knit fabric.

[0009] US 2017/ 0 029 989 A1 relates to textile constructions formed with fusible filaments. In particular, the document is directed to a textile construct wherein thermoplastic yarns or fibers are melted to form a fused film on one side or layer of the construct while another side or layer is maintained in a discrete knitted structure. The fused film may provide a membrane side or layer that has desired attributes, such as one or more of waterproofness, water resistance, wind resistance, and breathability.

[0010] Further prior art can be found in DE 10 2017 223 746 A1, DE 10 2013 207 163 A1 and DE 20 2006 020 794 U1.

3. Summary of the invention

[0011] The invention is defined by the independent claims.

[0012] According to a first aspect, the above problem is solved by a double layer knitted element, in particular for a sports article. The double layer knitted element comprises a first layer comprising a first yarn, a second layer comprising a second yarn and a third yarn arranged at least in part between the first and second layer, wherein the third yarn is attached to at least one of the first and second layer by a plurality of tuck stitches, wherein there is at least one miss stitch between two successive tuck stitches of the third yarn.

[0013] In general, the third yarn is locked to the fabric because of the tucks. Compared to the tucked-in third yarn of the present invention, inlay strands are free floating inside the double layer fabric and could be removed from the knitted fabric if pulled.

[0014] The third yarn is independent of the main knitting structure and does not influence it, but further enhances the properties of the knit. In fact, the tuck stitches that are visible on the surface of one of the knitted layers are minimalistic so they do not significantly affect the surface finish of that knitted layer. In addition, as the third yarn is sandwiched in between the two layers, additional protection of the third yarn is provided. This means that yarns that would fail testing (abrasion, color migration etc.) could be still tucked in and provide extra function to a double layer knitted element.

[0015] The third yarn of the double knitted element may comprise a functional yarn. The use of a functional yarn as the third yarn allows to create functional properties in the knit independent of the knitting sequence.

[0016] The first yarn of the first layer and the second yarn of the second layer may be a same type of yarn but it can also be two different types of yarns.

[0017] The functional yarn may be at least one of a melting yarn, thermoplastic polyurethane, TPU, yarn, water repellent yarn, volume/puff yarn, natural fiber yarn (e.g. wool and cotton), cellulose yarn, hybrid yarn, antimicrobial (anti-bacterial) yarn like copper, zinc, silver, elastic yarn, conductive yarn, or at least one of a yarn with at least one of a heat resistance, UV protecting, heat retaining, moisture absorbent, water resistance, chemical resistance, flame resistance, moisture wicking capability, or at least one of a yarn with a compression, shrinkability, cushioning, conductive, insulation, durability property.

[0018] Advantageously, by using a functional yarn as the third yarn, the double layer knitted element can be provided with different properties, depending on the functionality of the yarn. For example, stretch, recovery or compression properties of the double layer knitted element can be influenced by using an elastic yarn as a functional yarn. On the other hand, stiffness can be achieved by using melting yarn, TPU yarn or hybrid yarn as a functional yarn. For example, melting or TPU functional yarns can be used to stiffen the heel and toe cap areas of an upper, wherein elastic functional yarns can be used to create stretch or recovery in the instep area or in the collar of a fabric. In general, using elastomeric material generates reinforced areas after an application of heat.

[0019] An additional advantage is given by the fact, that the use of plating or mixing the functional yarn with the base yarn into the yarn feeder or the use of in-laid functional yarns is not necessary.

[0020] The third yarn may be attached to only one of the first and second layer by tuck stitches in the respective layer.

[0021] When the third yarn is attached to only one of the first or second layer by using tuck stitches, the third yarn is not visible at the respective other layer. Thus, the appearance of the top of the one layer is kept as it is, wherein desired functional properties are provided by the third yarn. Further, the tuck stitches that are visible on the surface of one of the knitted layers are minimalistic, so they do not significantly affect the surface finish of that knitted layer. In fact, the third yarn is more or less independent of the main knitting structure and does not influence it. Rather, the tuck stitches that are visible on the surface of one of the knitted layers are minimalistic, so they do not significantly affect the surface finish of that knitted layer, at the same time the surface finish of the other knitted layer is completely unaffected.

[0022] In addition, if a melting yarn is provided between the first and second layer and attached only to one layer, it is possible to activate the melting yarn only on the inner side of one of the two layers. For example, if the melting yarn is connected (tucked) to the back side layer, after thermal activation, the melting yarn will be absorbed mostly by the back side layer, but the external side of the front layer may not show any traces of the melting yarn. Thus, further post processes can be applied to the top side of the fabric, without using / reactivating the melted yarn.

[0023] The third yarn may be attached to at least one of the first and the second layer by immediately successive tuck stitches.

[0024] A ratio between the number of tuck stitches and the number of miss stitches may be variable within a course or a row.

[0025] In particular, the amount of support in a respective area of the double layer knitted element, can be engineered by the tuck-miss ratio. More tucks close to one another will add more yarn in the respective area. Changing the tuck-miss ratio of the third yarn in different areas can provide different stretch or stiffness properties. In contrast to that, an inlay strand would have the same property along its width.

[0026] The ratio between the number of tuck stitches and the number of miss stitches can be at least one of 1:1, 1:2, or 1:3. One miss stitch means one needle is skipped in the needle bed and the third yarn is floated over that one needle between two tuck stitches. Thus, a tuck-miss ratio of 1:2 for example means that two needles are skipped and the third yarn is floated over that two needles between two tuck stitches.

[0027] In general, the support of a double layer knitted element can be engineered by the tuck-miss ratio. More tucks close one to another provides a higher amount of the third yarn. Thus, a tuck-miss ratio of 1:1 provides a higher support than 1:2, wherein 1:2 provides a higher support than 1:3 and so on.

[0028] A distance between two successive tuck stitches may be less than 2.54 cm.

[0029] In general, 2.54 cm of a needle bed of a knitting machine corresponds to 14 needles on a gauge 14 machine or 7 needles on a gauge 7 machine, wherein the gauge of a knitting machine corresponds to the number of needles in 2.54 cm (one inch). For safety reasons, floats are usually kept shorter than 2.54 cm. If the floats are longer, there is the risk that the needles are not catching the yarn.

[0030] The first yarn of the first layer may be attached to the second layer, and/or the second yarn of the second layer may be attached to the first layer by tuck or loop stitches.

[0031] The third yarn may be knitted at least twice in between two knitting rows. In other words, there are at least two courses of the third yarn knitted in between two knitting rows.

[0032] Thus, an increased support may be provided by keeping the same tuck-miss ratio but knitting the third yarn multiple times in between two knitting rows. For example, knitting the third yarn several times between two knitting rows can be used to increase the stiffness in a particular area of a fabric (for example in the heel of an upper).

[0033] The third yarn may be partially knitted in between two knitting rows.

[0034] Partially knitting allows that the third yarn is pro-

vided in a different amount in different areas of the double layer knitting element. In particular, when the third yarn is partially knitted multiple times in between two knitting rows. Thus, different support may be provided in different areas, depending on the amount of the third yarn. Thus, the provided support of a certain area or zone can be engineered by keeping the same tuck-miss ratio but partially knitting the third yarn one or multiple times in a certain area.

[0035] Further, partially knitting the third yarn is technically easier compared to an inlay strand. The reason is that the third yarn is connected by tuck to the fabric and it will not jump out when the knitting direction is changed.

[0036] The thickness of the third yarn may vary within the knitted element.

[0037] By varying the thickness of the third yarn, the support of the double layer knitted element can also be influenced,

[0038] The third yarn may be provided in repetitive structures, jacquard structures or in spacer-based structures.

[0039] Thus, structures like repetitive structures, jacquard structures or spacer-based structures may be engineered by using a functional yarn, wherein the appearance of at least one layer of the structures remains the same.

[0040] The element may be manufactured by intarsia, interlock, plating, inverted plating, and/or inlay techniques.

[0041] Thus, various double-layer elements with different structures and functional properties can be provided by the present invention.

[0042] A further aspect of the present invention is directed to an upper for a shoe, in particular a sports shoe, comprising a double layer knitted element as described herein.

[0043] A further aspect of the present invention is directed to a shoe, in particular a sports shoe, comprising an upper as described herein, i.e. with a knitted element according to the invention, and a sole attached to the upper.

[0044] Thus, an upper or a shoe are provided, which comprise the previously described beneficial properties of the double layer knitted element.

[0045] According to another aspect of the invention, a method of manufacturing a double layer knitted element in accordance with one of the previous aspects is provided. In particular, the method comprises the steps of providing a first layer comprising a first yarn, providing a second layer comprising a second yarn and arranging a third yarn at least in part between the first and second layer, wherein the third yarn is attached to at least one of the first and second layer by a plurality of tuck stitches, wherein there is at least one miss stitch between two successive tuck stitches of the third yarn.

4. Brief description of the drawings

[0046] In the following, aspects of the present invention will be explained in more detail with reference to the accompanying figures. These figures show:

Figs. 1A-C:	Knitting scheme for a double layer knitted element with two layers and a third tucked-in yarn;
Fig. 2:	Knitting scheme for a double layer knitted element with two layers and a third tucked-in yarn knitted twice in between two knitting rows;
Figs. 3A-B:	Knitting scheme for a double layer knitted element with two layers and a third tucked-in yarn with a different ratio between the number of tuck stitches and the number of miss stitches;
Fig. 4:	Knitting scheme for a double layer knitted element with a third tucked-in yarn knitted twice in between two knitting rows;
Fig. 5:	Knitting scheme for a double layer knitted element with jacquard structures and a third tucked-in yarn;
Fig. 6A-C:	Knitting scheme for a double layer knitted element using different knitting techniques;
Fig. 7:	Knitting scheme for a double layer knitted element with a spacer and a third tucked-in yarn;
Fig. 8:	Knitting scheme for a double layer knitted element and a third tucked-in yarn with a varying ratio between the number of tuck stitches and the number of miss stitches within the same course;
Fig. 9:	Knitting scheme for a double layer knitted element and a partially tucked-in third yarn;
Figs. 10A-B:	Knitting scheme and section of a double layer knitted element and a tucked-in third yarn using Intarsia knitting technique; and
Fig. 11:	Flow diagram illustrating a method of manufacturing a double layer knitted element of the present invention.

5. Detailed description of preferred embodiments

[0047] In the following, embodiments and variations of the present invention are described in more detail referring to a double layer knitted element, in particular for a sports article. However, the present invention can also be used otherwise, e.g. the invention can be used for a shoe upper, clothing or accessories where various functional properties like stiffness, elasticity, stretch, recovery or compression without influencing the appearance are required.

[0048] The use of a third tucked-in yarn enables that a double knitted element comprises desired functional properties while it still has an uninfluenced outward appearance. The various functional properties comprise stiffness, elasticity, stretch, recovery or compression, for example. The techniques used in order to achieve such properties or functions will be described in the following.

[0049] The described techniques include suitable knitting techniques comprising different combinations of the number of tuck and miss stitches of the third yarn, as well as the selection of fibers and yarns. These and other techniques will be explained in the following, before embodiments of shoe uppers will be described in which these techniques are applied.

[0050] Figs. 1A-C show knitting schemes of a double layer knitted structure, wherein the dots represent the needle positions of a knitting machine in a knitting row. In particular, the knitting scheme of Figs. 1A-C comprises two lines of needles provided within a row.

[0051] Fig. 1A illustrates a first layer 100 (e.g. the front layer) comprising a first yarn 110, a second layer 200 (e.g. the back layer) comprising a second yarn 210, and a third yarn 310 arranged at least in part between the first layer 100 and the second 200 layer, wherein the third yarn 310 is attached to the second 200 layer by a plurality of tuck stitches 311. In alternative embodiments, the third yarn 310 may be attached to the first layer 100 by a plurality of tuck stitches. As illustrated in Fig. 1A there is at least one miss stitch 312 between two successive tuck stitches 311 of the third yarn. In this embodiment, the ratio between the number of tuck stitches and the number of miss stitches, which corresponds to the tuck-miss ratio, is 1:1.

[0052] In general, the main double layer knit structure is independent of the tucked-in yarn. The tucked-in yarn is an addition to the existing structure and is sandwiched in between the two layers.

[0053] Further, Fig. 1A illustrates that the third yarn 310 is only attached to the second layer 200 by immediately successive tuck stitches 311, wherein the third yarn 310 is not attached to the first layer 100.

[0054] In a specific embodiment, when using melt or TPU yarns as the third yarn 310, stiffness can be applied to only one of the two layers.

[0055] In another embodiment stiffness is achieved within the fabric without affecting its external appearance.

[0056] In an embodiment of the invention, the first 110 and second 210 yarns maybe different.

[0057] In another embodiment, the first 110 and second 210 yarns may be equal.

[0058] In the embodiment illustrated in Fig. 1A, the first layer 100 is connected to the second layer 200 by tuck stitches.

[0059] Fig. 1B illustrates a section of a front layer 100 of an exemplary double knitted element comprising a first yarn 110, wherein Fig. 1C illustrates a section of a back layer 200 comprising a second yarn 210. In Figs. 1B and 1C, a melting yarn 310 is connected (tucked) to the back layer 200. In particular, the melting yarn 310 is absorbed mostly by the back layer 200 (a bit also by the inner side of the front layer 100) after thermal activation. The external side of the front layer 100 does not present melting yarn 310, as shown in Fig. 1B. Thus, further post processes can be applied to the front side of the fabric, without using or reactivating the melted yarn 310 underneath the front layer 100. As shown in the example of Fig. 1C the first yarn 110 of the front layer 100 may be attached to the back layer 200 by tuck or loop stitches.

[0060] In general, the third yarn is locked to the fabric because of the tucks. Compared to the tucked-in third yarn of the present invention, inlay strands would be free floating inside the double layer fabric and could be removed from the knitted fabric if pulled.

[0061] Further, in various embodiments of the present invention, the third yarn may comprise a functional yarn.

[0062] In some embodiments, the functional yarn can be at least one of a melting yarn, thermoplastic polyurethane, TPU, yarn, water repellent yarn, volume/puff yarn, natural fiber yarn (e.g. wool and cotton), cellulose yarn, hybrid yarn, anti-microbial (anti-bacterial) yarn like copper, zinc, silver, elastic yarn, conductive yarn, or at least one of a yarn with at least one of a heat resistance, UV protecting, heat retaining, moisture absorbent, water resistance, chemical resistance, flame resistance, moisture wicking capability, or at least one of a yarn with a compression, shrinkability, cushioning, conductive, insulation, durability property.

[0063] In particular, applications of knitting a conductive yarn could be heating certain parts of the upper or for transferring electricity to led lights in the upper or tooling, wherein wool yarns can heat up the upper and cotton yarns can absorb moisture.

[0064] Fig. 2 shows an exemplary embodiment wherein the third yarn 310a can be tucked in the first layer 100, i.e. on the front stitches from row 110, in a first knitting step and the third yarn 310b can be tucked in the second layer 200, i.e. on the back stitches from the previous row 210, not shown here, in a second knitting step by immediately successive tuck stitches.

[0065] Figs. 3A and 3B illustrate knitting schemes, having different ratios between the number of tuck stitches and the number of miss stitches of the third yarn 310. As illustrated in Fig. 3A, there are two miss stitches 312 between two successive tuck stitches 311 of the third yarn 310, wherein the ratio between the number of tuck stitch-

es 311 and the number of miss stitches 312 is 1:2. Fig. 3B shows a knitting scheme, with three miss stitches 312 between two successive tuck stitches 311 of the third yarn 310, wherein the ratio between the number of tuck stitches 311 and the number of miss stitches 312 is 1:3.

[0066] In general, the support (with respect to stiffness or stretch properties) of a double layer knitted element can be engineered by the tuck-miss ratio. More tucks close one to another provide a higher amount of the third yarn 310. Thus, a tuck-miss ratio of 1:1 provides a higher support than 1:2, wherein 1:2 provides a higher support compared to 1:3 and so on.

[0067] In a specific embodiment, not shown here, a distance between two successive tuck stitches may be less than 2.54 cm (one inch). In particular, 2.54 cm of the needle bed of a knitting machine corresponds to 14 needles on a gauge 14 machine or 7 needles on a gauge 7 machine, wherein the gauge of a knitting machine corresponds to the number of needles in 2.54 cm which corresponds to 1 inch. For safety reasons, floats are usually kept shorter than 2.54 cm. If the floats are longer, there is the risk that the needles are not catching the yarn.

[0068] Further, Figs. 3A and 3B provide examples, wherein the first layer 100 is attached to the second layer 200 by loop stitches. In the embodiments of Figs. 3A and 3B, the third yarn 310 is only attached to the second layer 200 by immediately successive tuck stitches 311 to the second layer 200, i.e. there are no tuck stitches of the third yarn 310 in the first layer 100.

[0069] In other embodiments, the third yarn is attached to at least one of the first and the second layer by tuck stitches. For example, the third yarn 310 may be tucked to the first layer 100 and the second layer 200. In other embodiments, the third yarn may be tucked to only the first layer by immediately successive tuck stitches.

[0070] Fig. 4 illustrates another embodiment, wherein the third yarn 310 is knitted at least twice in between two knitting rows. In this embodiment, there are at least two courses of the third yarn 310 knitted in between two knitting rows. In particular, the third yarn 310 is knitted in a first knitting sequence 301 (for example tuck-miss going to right) and in a second knitting sequence 302 (miss-tuck going to the left), which increases the support of the third yarn 310 on the double layer knitted element.

[0071] Knitting the third yarn 310 several times in between two knitting rows can be used for example to increase the stiffness of a fabric.

[0072] The amount of support can also be engineered by using finer or thicker yarns (150 den to 900 den). For a melt yarn even 2,000 den and for sock knit even more is possible. In particular, higher denier means thicker yarns.

[0073] Fig. 4 provides an example, wherein the first layer 100 is attached to the second layer 200 by loop stitches.

[0074] In the embodiment of Fig. 4, the third yarn 310 is only attached to the second layer 200 by immediately successive tuck stitches 311 to the second layer 200 and not to the first layer.

[0075] In another embodiment, not explicitly shown here, the third yarn 310 maybe tucked only to the first layer 100, or tucked to the first layer 100 and the second layer 200 by using tuck stitches.

[0076] In general, the third yarn is independent of and can be combined with all double knit structures. That means that the structure can stay the same, but with function (stretch / stiffness / conductive yarn) being applied in various places of the upper.

[0077] In some embodiments, the third yarn can be inserted in repetitive structures as shown in Figs. 1 - 4 or in jacquard structures, as shown in Fig. 5.

[0078] In further embodiments, the tucked-in third yarn may be combined with knitting techniques such as partial knitting, intarsia (zone knitting), plating, inverted plating, devore, inlay etc.

[0079] Some additional knitting structures using a functional third yarn 310 are shown in Figs. 6A-C. Fig. 6C, for example, illustrates an interlock structure with a third yarn.

[0080] In other embodiments, the third yarn can also be inserted in spacer-based structures, as shown in Fig. 7. In Fig. 7, a spacer layer 400 and the third yarn 310 are alternately knitted in between two knitting rows of the first layer 100 and the second 200 layer.

[0081] Fig. 8 illustrates an embodiment of the invention, wherein the ratio between the number of tuck stitches and the number of miss stitches is variable within a course or a row. In particular, the amount of support in different portions (510, 520) within the same row of the knitting element, can be engineered by the tuck-miss ratio. In particular, the example of Fig. 8 presents a first portion (510) with a tuck-miss ratio of 1:3 and a second portion (520) with a tuck-miss ratio of 1:1. More tucks close to one another one will add more yarn in that specific portion.

[0082] A variation of the tuck-miss ratio of the third yarn in different areas can provide different stretch or stiffness properties in the respective areas. In contrast to that, an inlay strand has the same property along its width.

[0083] In some embodiments, the ratio between the number of tuck stitches and the number of miss stitches can be at least one of 1:1, 1:2, or 1:3.

[0084] Fig. 9 illustrates an embodiment, wherein the third yarn 310 is partially knitted in a certain portion of a knitting row. In Fig. 9, the third yarn 310 is provided once in a first portion 530, wherein the third yarn is provided multiple (e.g. three) times in another portion 540.

[0085] Partially knitting of the third yarn as shown in Fig. 9 can provide different support by keeping the same tuck-miss ratio but knitting different amounts of the third yarn 310 in a certain portion of the knitting row or area of the double layer element.

[0086] Further, partially knitting the third yarn is technically easier compared to an inlay strand. The reason is that the third yarn is connected by tuck to the fabric and it will not jump out when the knitting direction is

changed.

[0087] Figs. 10A-B illustrate an embodiment with an efficient placement of a third yarn 310 in a double-knitted element by using Intarsia knitting. In general, special zones can be engineered on the knitted element to have special properties through intarsia. In the specific embodiment of Fig. 10A the third yarn 310 is knitted, in a double-Jersey knit, multiple times in immediately successive courses in a portion of the knitted element between the front 100 and back layers 200. In addition, the third yarn 310 is attached to the first 100 and the second 200 layer by alternating tuck-miss stitches.

[0088] In a specific embodiment, a third yarn 310 with an elastomer material may be used to generate reinforced areas after the application of heat. Besides elastomer, other polymer based yarns can also be used that provide a reinforcing effect on application of heat, pressure or other treatments. Further, due to the knitting method, no pre-twisting of materials is needed and manual labour is reduced and high-performance upper materials can be created.

[0089] Fig. 10B shows a section of a double-knitted element by using Intarsia knitting, in a double-Jersey knit, wherein the third yarn 310 is attached to the first 100 and the second 200 layer by alternating tuck-miss stitches. By using tuck-stiches of the third yarn 310 to both layers, the third yarn 310 is visible in both layers (e.g. first layer 100 of Fig. 10B).

[0090] In a further embodiment, an upper for a shoe, in particular a sports shoe, may be provided, which comprises a double layer knitted element according to the present invention.

[0091] In addition, a shoe, in particular a sports shoe, may comprise an upper, which comprises a double layer knitted element of the present invention and a sole, which is attached to the upper.

[0092] Fig. 11 shows a flow diagram illustrating a method of manufacturing a double layer knitted element according to the present invention and as described in more detail above. In step 1110, a first layer comprising a first yarn is provided. In step 1120, a second layer comprising a second yarn is provided. In step 1130, a third yarn is at least in part arranged between the first and second layer, wherein the third yarn is attached to at least one of the first and second layer by a plurality of tuck stitches, wherein there is at least one miss stitch between two successive tuck stitches of the third yarn.

[0093] In the following, further embodiments are described to facilitate the understanding of the invention:

1. Double layer knitted element, in particular for a sports article, comprising:

a. a first layer comprising a first yarn; and

b. a second layer comprising a second yarn; and

c. a third yarn arranged at least in part between the first and second layer, wherein the third yarn is attached to at least one of the first and second layer by a plurality of tuck stitches, wherein there is at least one miss stitch between two successive tuck stitches of the third yarn.

2. Double layer knitted element of embodiment 1, wherein the third yarn comprises a functional yarn.

3. Double layer knitted element of embodiment 2, wherein the functional yarn is at least one of a melting yarn, thermoplastic polyurethane, TPU, yarn, water repellent yarn, volume/puff yarn, natural fiber yarn, cellulose yarn, hybrid yarn, anti-microbial yarn like copper, zinc, silver, elastic yarn, conductive yarn, or at least one of a yarn with a at least one of a heat resistance, UV protecting, moisture absorbent, water resistance heat retaining, chemical resistance, flame resistance, moisture wicking capability, or at least one of a yarn with a compression, shrinkability, cushioning, conductive, insulation, durability property.

4. Double layer knitted element of one of the previous embodiments, wherein the third yarn is attached to only one of the first and second layer by tuck stitches in the respective layer.

5. Double layer knitted element of one of the previous embodiments, wherein the third yarn is attached to at least one of the first and the second layer by immediately successive tuck stitches.

6. Double layer knitted element of one of the previous embodiments, wherein a ratio between the number of tuck stitches and the number of miss stitches is variable within a course or a row.

7. Double layer knitted element of one of the previous embodiments, wherein the ratio between the number of tuck stitches and the number of miss stitches is at least one of 1:1, 1:2, or 1:3.

8. Double layer knitted element of one of the previous embodiments, wherein a distance between two successive tuck stitches is less than 2.54 cm.

9. Double layer knitted element of one of the previous embodiments, wherein the first yarn of the first layer is attached to the second layer, and/or the second yarn of the second layer is attached to the first layer by tuck or loop stitches.

10. Double layer knitted element of one of the previous embodiments, wherein the third yarn is knitted at least twice in between two knitting rows.

11. Double layer knitted element of one of the pre-

vious embodiments, wherein the third yarn is partially knitted in a certain portion of the knitting row.

12. Double layer knitted element of one of the previous embodiments, wherein the thickness of the third yarn varies within the knitted element.

13. Double layer knitted element of one of the previous embodiments, wherein the tucked-in third yarn is provided in repetitive structures, jacquard structures or in spacer-based structures.

14. Double layer knitted element of one of the previous embodiments, wherein the element is manufactured by intarsia, interlock, plating, inverted plating, and/or inlay techniques.

15. Upper for a shoe, in particular a sports shoe, comprising a double layer knitted element of one of the preceding embodiments.

16. Shoe, in particular a sports shoe, comprising:

a. an upper of embodiment 15; and
b. a sole attached to the upper.

17. Method of manufacturing a double layer knitted element in accordance with one of embodiments 1 through 14, the method comprising the steps of:

a. providing a first layer comprising a first yarn; and

b. providing a second layer comprising a second yarn; and

c. arranging a third yarn at least in part between the first and second layer, wherein the third yarn is attached to at least one of the first and second layer by a plurality of tuck stitches, wherein there is at least one miss stitch between two successive tuck stitches of the third yarn.

Claims

1. Double layer knitted element, in particular for a sports article, comprising:

a. a first layer (100) comprising a first yarn (110); and
b. a second layer (200) comprising a second yarn (210); and
c. a third yarn (310, 310a, 310b) arranged at least in part between the first and second layer, wherein the third yarn is attached to at least one of the first and second layer by a plurality of tuck stitches (311), wherein there is at least one miss stitch (312) between two successive tuck stitches of the third yarn.

2. Double layer knitted element of claim 1, wherein the third yarn comprises a functional yarn; in particular wherein the functional yarn is at least one of a melting yarn, thermoplastic polyurethane, TPU, yarn, water repellent yarn, volume/puff yarn, natural fiber yarn, cellulose yarn, hybrid yarn, anti-microbial yarn like copper, zinc, silver, elastic yarn, conductive yarn, or at least one of a yarn with a at least one of a heat resistance, UV protecting, moisture absorbent, water resistance heat retaining, chemical resistance, flame resistance, moisture wicking capability, or at least one of a yarn with a compression, shrinkability, cushioning, conductive, insulation, durability property.

3. Double layer knitted element of one of the previous claims, wherein the third yarn is attached to only one of the first and second layer by tuck stitches in the respective layer.

4. Double layer knitted element of one of the previous claims, wherein the third yarn is attached to at least one of the first and the second layer by immediately successive tuck stitches.

5. Double layer knitted element of one of the previous claims, wherein a ratio between the number of tuck stitches and the number of miss stitches is variable within a course or a row; and/or
wherein the ratio between the number of tuck stitches and the number of miss stitches is at least one of 1:1, 1:2, or 1:3.

6. Double layer knitted element of one of the previous claims, wherein a distance between two successive tuck stitches is less than 2.54 cm.

7. Double layer knitted element of one of the previous claims, wherein the first yarn of the first layer is attached to the second layer, and/or the second yarn of the second layer is attached to the first layer by tuck or loop stitches.

8. Double layer knitted element of one of the previous claims, wherein the third yarn is knitted at least twice in between two knitting rows.

9. Double layer knitted element of one of the previous claims, wherein the third yarn is partially knitted in a certain portion (510, 520, 530, 540) of the knitting row.

10. Double layer knitted element of one of the previous claims, wherein the thickness of the third yarn varies within the knitted element.

11. Double layer knitted element of one of the previous claims, wherein the tucked-in third yarn is provided in repetitive structures, jacquard structures or in spacer-based structures (400).

12. Double layer knitted element of one of the previous claims, wherein the element is manufactured by intarsia, interlock, plating, inverted plating, and/or inlay techniques.

13. Upper for a shoe, in particular a sports shoe, comprising a double layer knitted element of one of the preceding claims.

14. Shoe, in particular a sports shoe, comprising:

a. an upper of claim 13; and
b. a sole attached to the upper.

15. Method of manufacturing a double layer knitted element in accordance with one of claims 1 through 12, the method comprising the steps of:

a. providing (1110) a first layer comprising a first yarn; and
b. providing (1120) a second layer comprising a second yarn; and
c. arranging (1130) a third yarn at least in part between the first and second layer, wherein the third yarn is attached to at least one of the first and second layer by a plurality of tuck stitches, wherein there is at least one miss stitch between two successive tuck stitches of the third yarn.

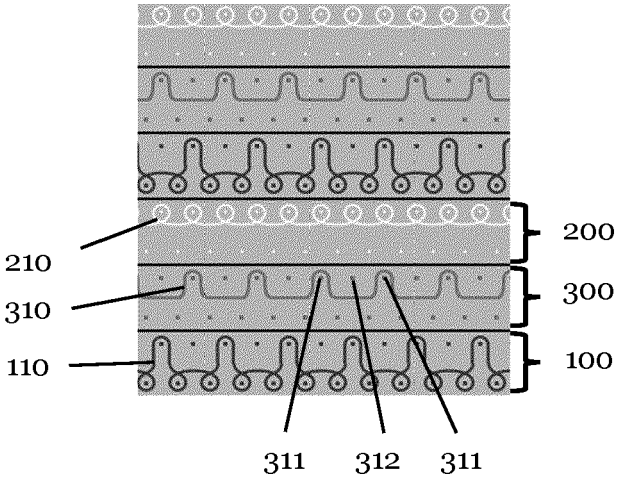

Fig. 1A

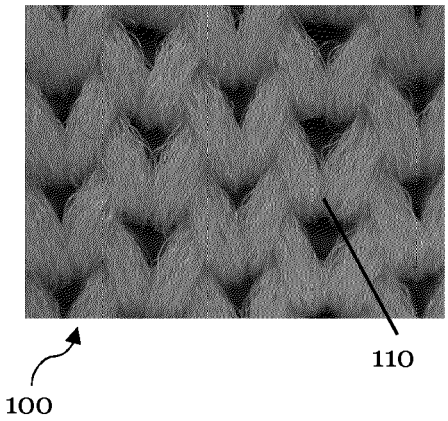

Fig. 1B

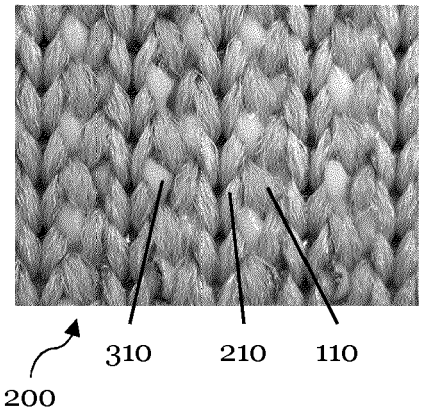

Fig. 1C

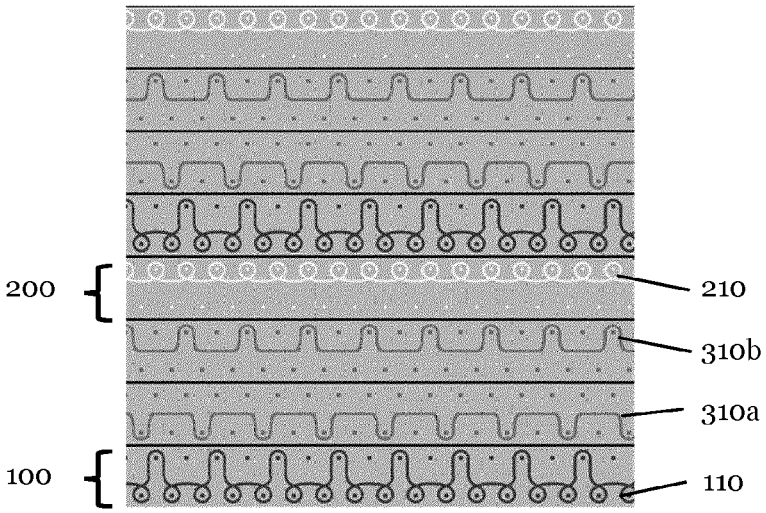

Fig. 2

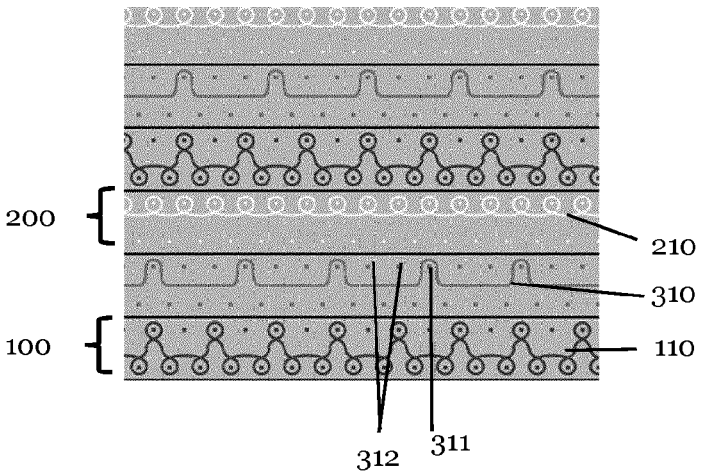

Fig. 3A

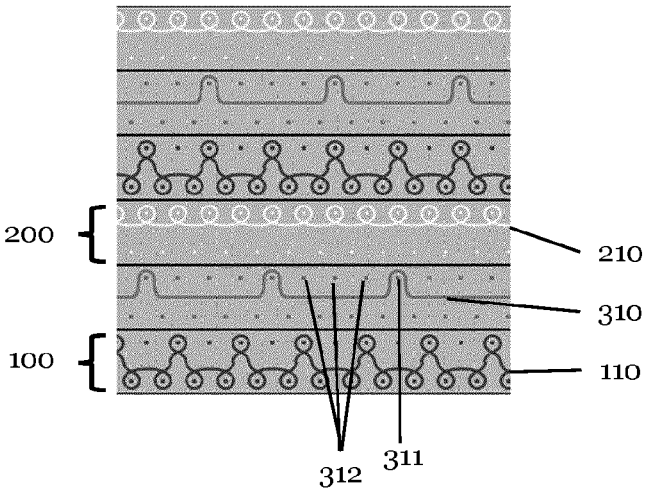

Fig. 3B

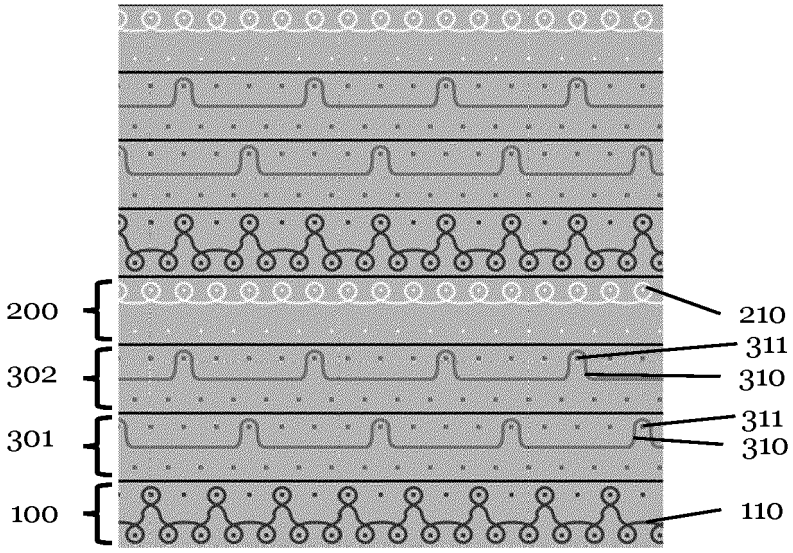

Fig. 4

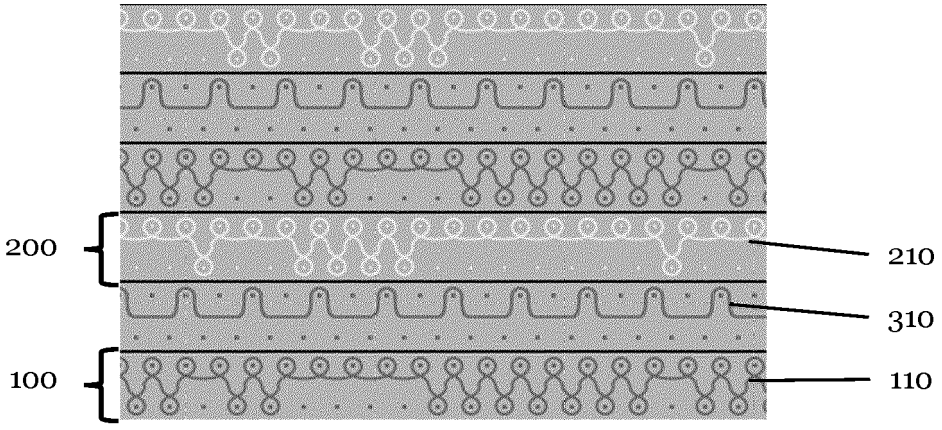

Fig. 5

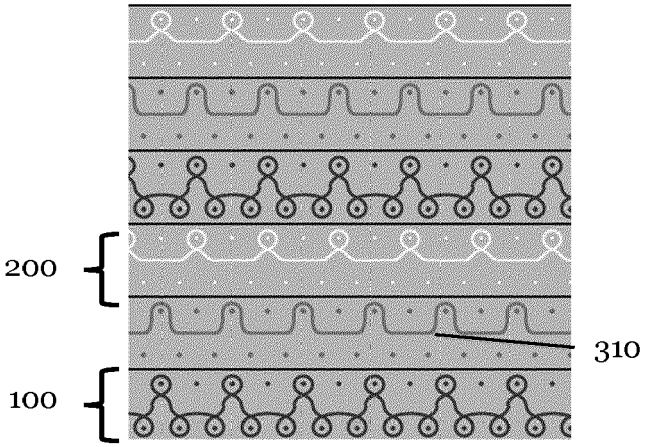

Fig. 6A

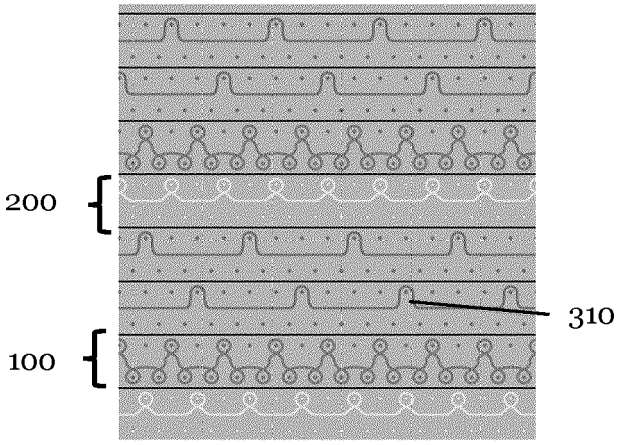

Fig. 6B

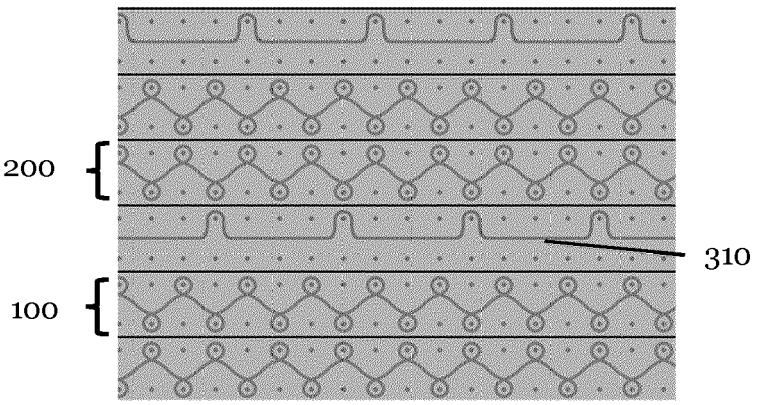

Fig. 6C

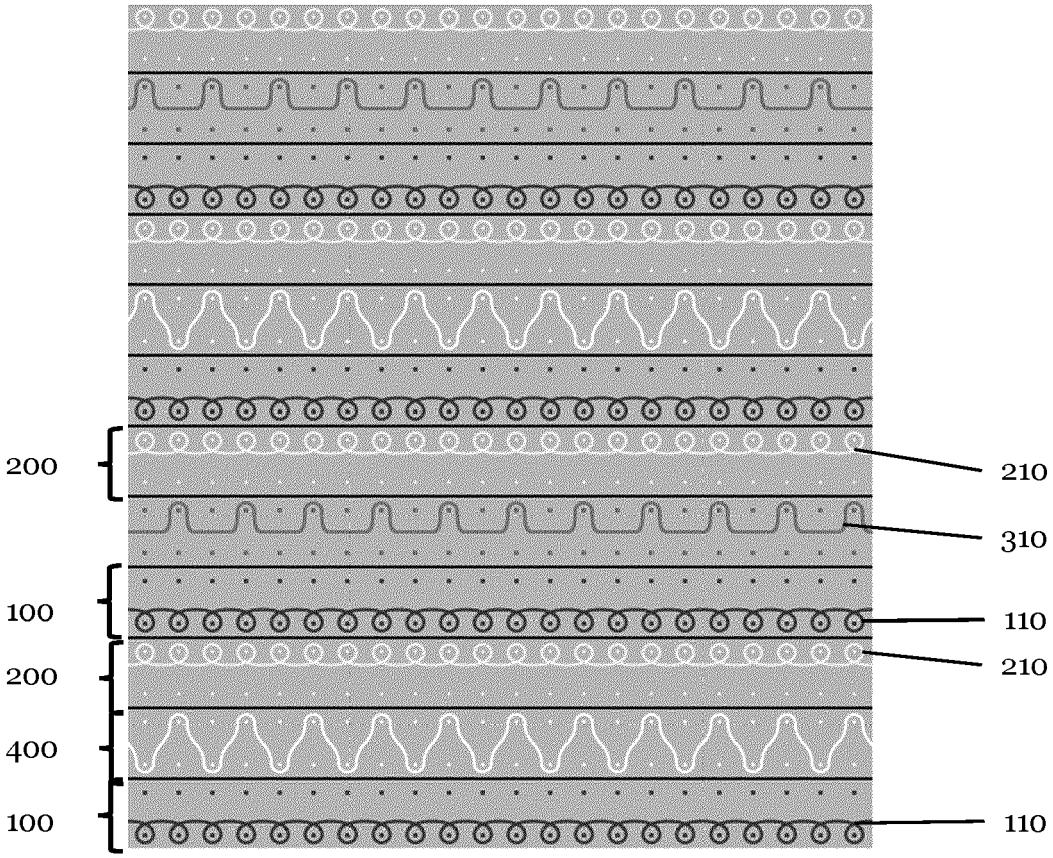

Fig. 7

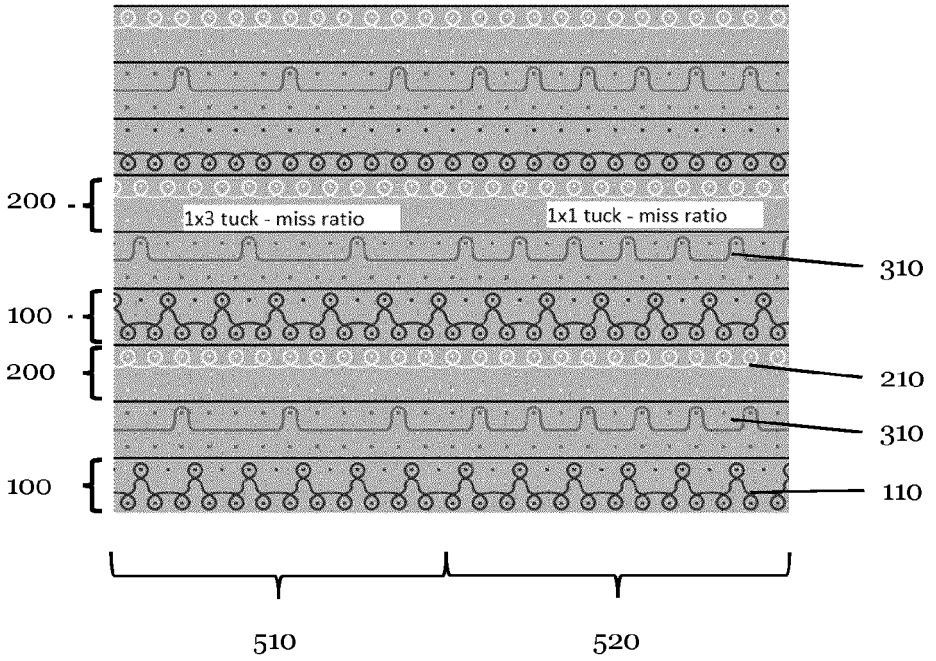
200
1x3 tuck - miss ratio
1x1 tuck - miss ratio
310
100
200
210
310
100
110
510
520

Fig. 8

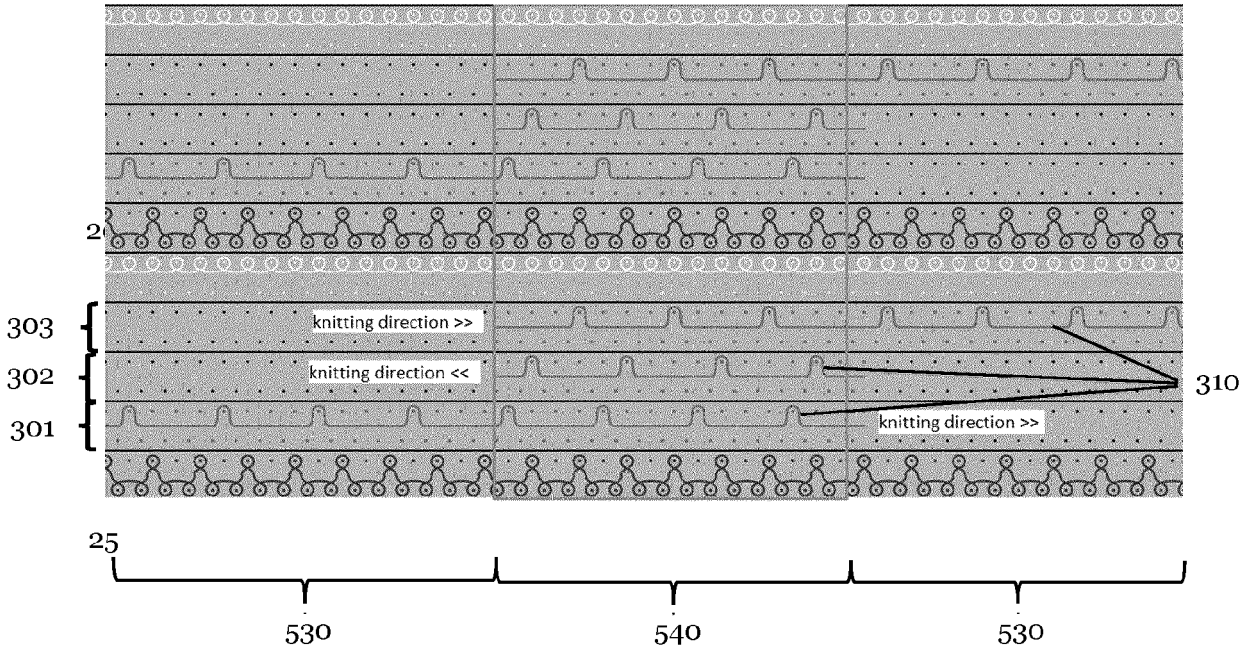
2
303
knitting direction >>
302
knitting direction <<
310
301
knitting direction >>
25
530
540
530

Fig. 9

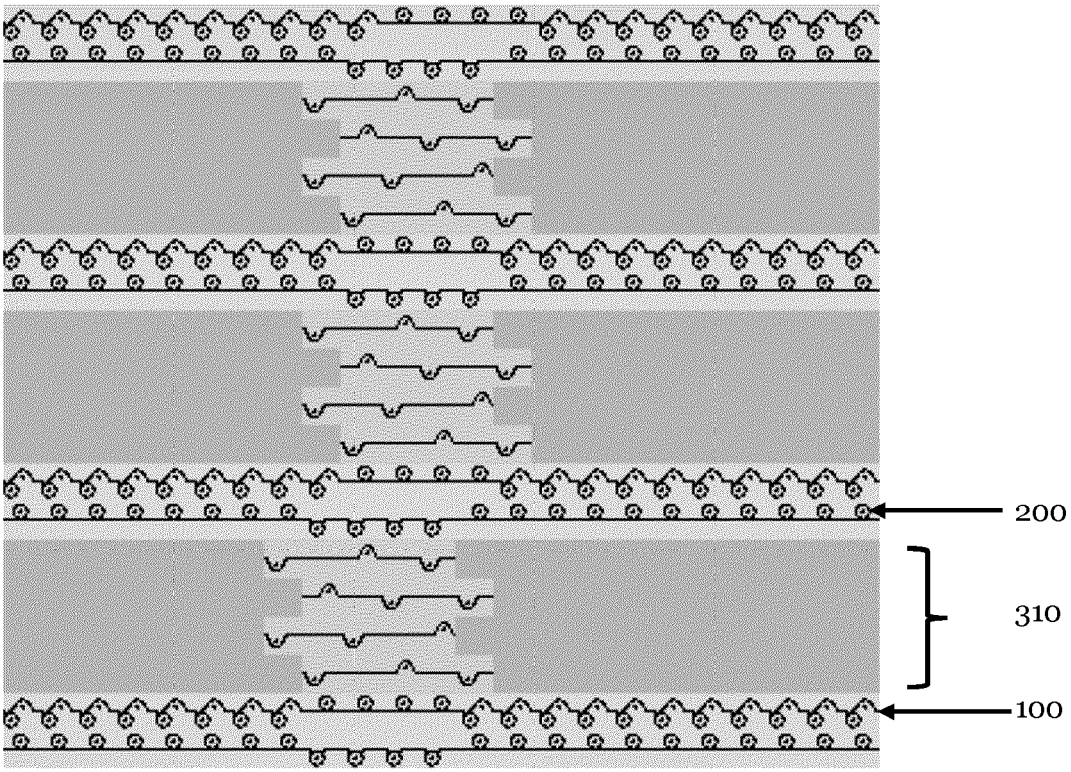

Fig. 10A

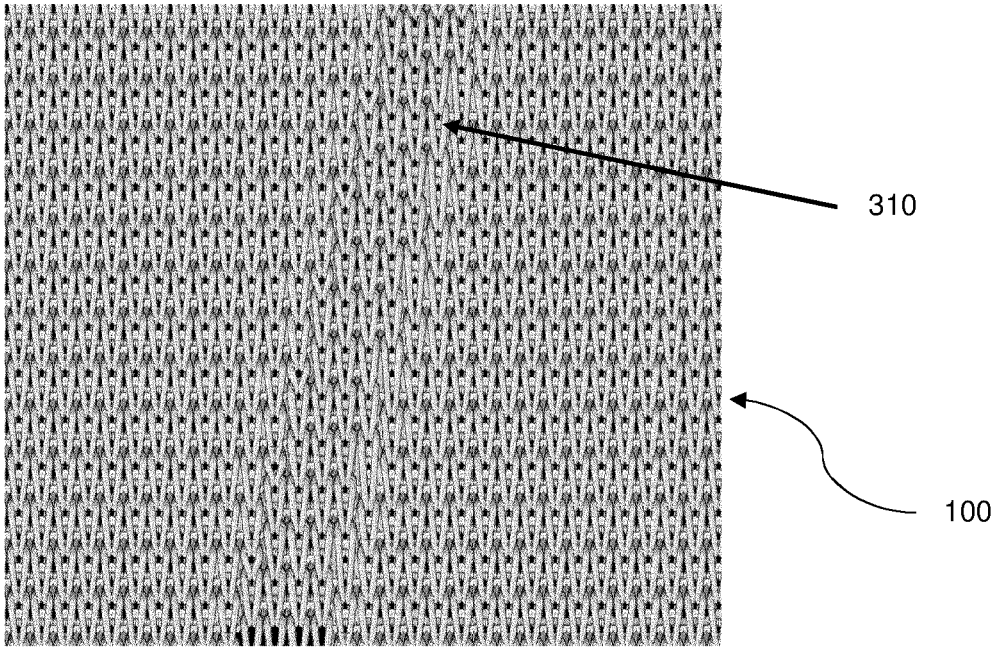

Fig. 10B

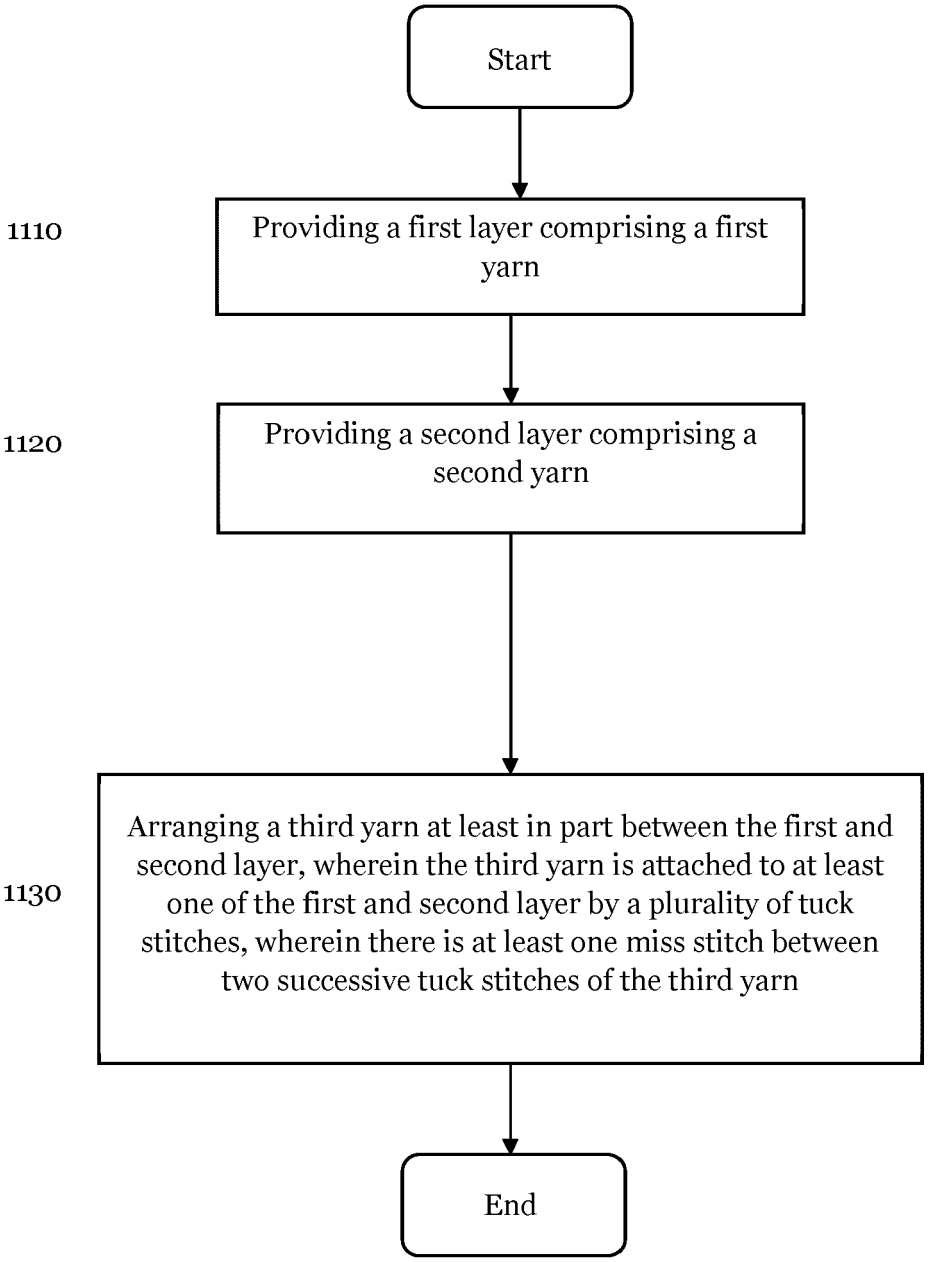
Start
1110
Providing a first layer comprising a first yarn
1120
Providing a second layer comprising a second yarn
1130
Arranging a third yarn at least in part between the first and second layer, wherein the third yarn is attached to at least one of the first and second layer by a plurality of tuck stitches, wherein there is at least one miss stitch between two successive tuck stitches of the third yarn
End

Fig. 11

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EUROPEAN SEARCH REPORT

Application Number
EP 21 20 8263

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 A	DE 10 2016 005593 A1 (ULMER STRICKDESIGN GMBH [DE]) 16 November 2017 (2017-11-16) * paragraphs [0007] - [0014], [0019], [0021], [0033] - [0042]; claims 1, 3, 4, 10, 11; figures 2-4 *	1-13,15 14	INV. D04B1/12 ADD. A43B1/04
X	WO 2015/011148 A1 (VISIOTEX GMBH [DE]) 29 January 2015 (2015-01-29) * page 2, line 32 - page 4, line 3; claims 1, 8, 12, 13 * * page 6, line 18 - page 7, line 25 * * page 9, lines 1-20; figure 1 * * page 11, line 27 - page 12, line 13; figure 3e *	1,2,4-6, 8-15	
X A	WO 2020/081133 A1 (NIKE INNOVATE CV [US]; NIKE INC [US]) 23 April 2020 (2020-04-23) * paragraphs [0013] - [0014], [0032] - [0059]; claims 6, 7, 16-18, 20; figures 1-7B *	1,2,4-15 3	
X	WO 2019/197319 A1 (BASF SE [DE]) 17 October 2019 (2019-10-17) * page 14, line 5 - page 16, line 18; claims 1, 3, 5, 7; figures 1-6 *	1,2,4-6, 8,9,11, 12,15	TECHNICAL FIELDS SEARCHED (IPC) D04B A43B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	30 March 2022	Sterle, Dieter

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30-03-2022

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