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(54) **KNITTED FABRIC AND METHOD FOR PRODUCING A KNITTED FABRIC**

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(57) **ABSTRACT**

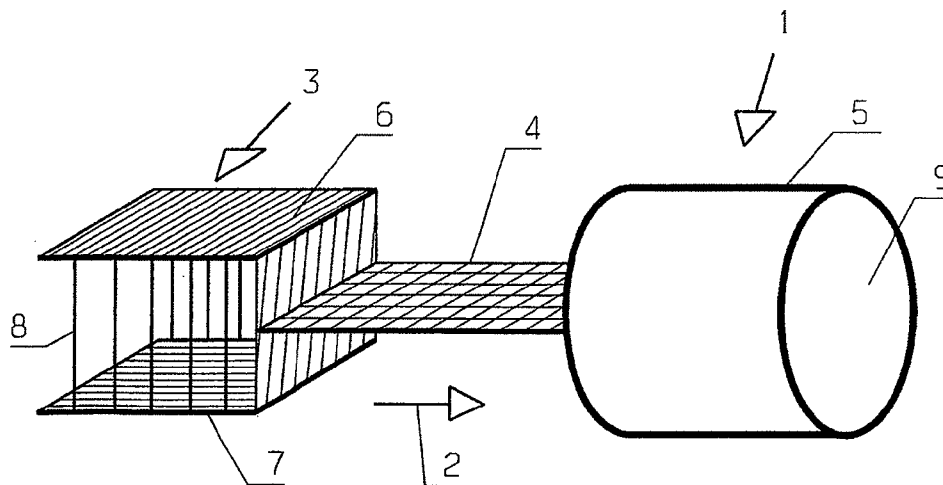
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Knitted fabric and method of forming knitted fabric. Knitted fabric includes warp threads that run in a longitudinal direction and that are connected to one another by a stitch formation, and at least three sections arranged consecutively in the longitudinal direction. The at least three sections may include at least one section formed as a spacer fabric, one section formed as a single-ply fabric and one section formed as a tubular fabric.



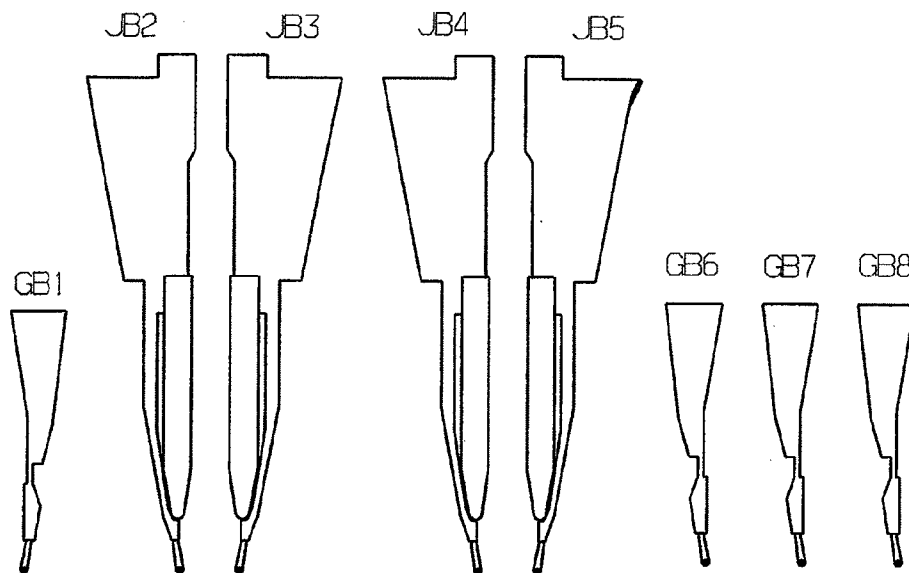


Fig: 2

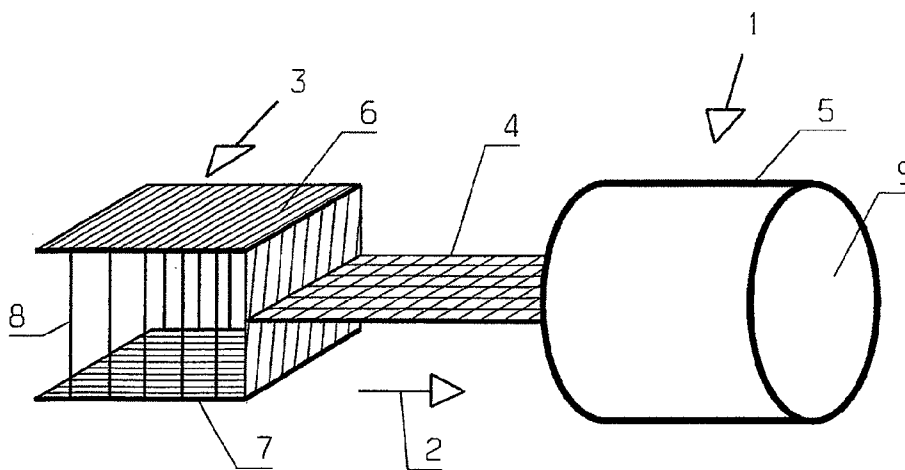


Fig: 1

KNITTED FABRIC AND METHOD FOR PRODUCING A KNITTED FABRIC

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority under 35 U.S.C. §119(a) of European Patent Application No. 15 162 489.7 filed Apr. 2, 2015, the disclosure of which is expressly incorporated by reference herein in its entirety.

BACKGROUND

[0002] 1. Field of the Invention

[0003] Embodiments of the invention relate to a knitted fabric with warp threads, running in the longitudinal direction of the knitted fabric, connected to one another by a stitch formation.

[0004] Furthermore, embodiments of the invention relate to a method for producing a knitted fabric in which two knitting needle heads and thread-feeding elements are used. The thread-feeding elements are at least partially embodied as jacquard elements.

[0005] 2. Discussion of Background Information

[0006] A knitted fabric is typically produced in such a manner that warp threads that are disposed next to one another in a warp beam arrangement are drawn off from the warp beam and guided around knitting needles by guide needles in order to form stitches. To achieve a cohesion of the warp threads to obtain a fabric, warp threads positioned adjacent to one another are stitched together during a stitch formation of this type. Depending on the type of connection used thereby, stitches can not only be formed with the most proximately adjacent warp threads, but rather also with the next closest or more distant warp threads. In any case, the warp threads always run in a longitudinal direction.

[0007] For the formation of knitted fabrics, there are pure fabrics that are referred to below as a "single-ply" fabric. There are also spacer fabrics. In the case of a spacer fabric, two covering layers are provided that are embodied as surface layers. These two covering layers are connected to one another by what are referred to as spacer threads, which are also called "pile threads". In addition, there are what are known as tubular fabrics. A tubular fabric is a knitted fabric with two layers of a surface material that are only connected to one another at their longitudinal edges. A tubular fabric can be used, for example, to form a holder, in particular a pouch or bag. Here, it is only necessary to connect the two layers of the tubular fabric at the end of a section in the longitudinal direction in order to close the holder.

[0008] A spacer fabric is often used as padding material. A spacer fabric is also often chosen where a covering that exhibits good air permeability is desired.

[0009] If the aim is to achieve multiple effects, it is normally necessary to finish individual knitted fabrics that are produced on separate knitting machines, that is, to make them the right size and then connect, e.g., sew, them to one another. This means that the production of textile objects that are to fulfill several functions is costly.

SUMMARY

[0010] Embodiments of the invention are directed to the production of textile objects having multiple functions in a simple manner.

[0011] According to embodiments, a knitted fabric of the type named at the outset includes at least one section embodied as a spacer fabric, one section embodied as a single-ply fabric and one section embodied as a tubular fabric that are arranged consecutively in the longitudinal direction.

[0012] In a knitted fabric of this type, three different fabric types are thus arranged one after another. Because these three sections are formed from the same warp threads, the three sections are connected to one another in the longitudinal direction when they leave the knitting machine. Thus, no additional work steps are necessary to connect these sections to one another. At the same time, the knitted fabric has several functions overall, since each section exhibits the desired and predetermined property. The knitted fabric with the different sections can be manufactured using ground guide bars and jacquard bars in that the jacquard bars are for example used to lay down the spacer or pile threads.

[0013] Preferably, the single-ply fabric is embodied as a one-by-one rib knitted fabric. The single-ply fabric thus comprises two covering layers positioned on top of one another which, however, are connected to one another in a planar manner, so that they ultimately form only a single layer. A one-by-one rib knitted fabric can be easily produced on a double-section knitting machine, so that the same knitting machine can be used to produce both the spacer fabric and the tubular fabric, as well as the single-ply fabric.

[0014] Preferably, the single-ply fabric is arranged between the spacer fabric and the tubular fabric. The single-ply fabric can then perform a sort of hinge function between the spacer fabric and the tubular fabric. At the same time, the single-ply fabric creates a connection between the two covering layers at an end of the tubular fabric, so that the "bottom" of a bag or pouch is formed as a result. The remaining walls (except for the cover) are formed by the tubular fabric.

[0015] Preferably, the spacer fabric has a larger extension in the longitudinal direction than the tubular fabric. The spacer fabric can thus be used to cover and pad the bag or pouch, which have been formed by the tubular fabric, not only on one side, but rather also additionally on the other side, at least in sections.

[0016] Here, it is particularly preferred that the spacer fabric has an extension in the longitudinal direction that is at least two times as large as the extension of the tubular fabric in the longitudinal direction. Both covering layers of the tubular fabric can thus be covered by the spacer fabric, so that a full padding of the tubular fabric is possible.

[0017] Preferably, the spacer fabric is arranged symmetrically to the single-ply fabric in the thickness direction. However, this symmetry is not a symmetry in the strictly mathematical sense. Instead, it is adequate if the single-ply fabric is arranged roughly in the middle of the spacer fabric in the thickness direction, that is, if between roughly 40% and 60% of the thickness of the spacer fabric protrudes past the single-ply fabric in one direction and the remaining amount of the thickness protrudes in the other direction. The knitted fabric can thus be designed relatively freely, as it is subsequently of little importance in which direction the spacer fabric is folded or bent in relation to the single-ply fabric.

[0018] Preferably, the single-ply fabric has an extension in the longitudinal direction which is at least as large as a thickness of the spacer fabric that protrudes past the single-

ply fabric. It can thus be achieved that the spacer fabric can be folded back directly onto the tubular fabric. It is thus in turn possible to achieve a padding for the tubular fabric, at least on one side of the tubular fabric.

[0019] Preferably, the single-ply fabric has an extension in the longitudinal direction that is at least as large as a thickness of the tube formed by the tubular fabric. This is also a measure for ensuring that a holder formed by the tubular fabric can be covered, and thus padded, by the spacer fabric on at least one side.

[0020] Preferably, a section with spacer fabric is arranged on one side of a section of the tubular fabric and a section with single-ply fabric is arranged on the opposite side of the tubular fabric. Thus, the spacer fabric can be folded down from the opening of the holder formed by the tubular fabric onto at least one side wall of the tubular fabric, so that it can pad the tubular fabric in this position. Particularly if a spacer fabric is also arranged at the other end of the single-ply fabric, that is, at the end of the single-ply fabric facing away from the tubular fabric, both sides of the holder formed by the tubular fabric can be covered, and thus padded, with high reliability.

[0021] Preferably, the spacer fabric comprises sections with differing thicknesses transversely to the longitudinal direction. A pattern, for example, can thus be achieved, or an eventual use of a holder that is formed by means of the tubular fabric can be accommodated. For example, the tubular fabric can be provided as a holder for a delicate object, and a larger thickness of the spacer fabric can be chosen in the locations where the delicate object requires special protection.

[0022] Embodiments of the invention are directed to a method of the type named at the outset that includes using at least four independent thread-feeding elements and controlling the jacquard elements so that they are used to form piles or to form surfaces, depending on a predetermined fabric structure.

[0023] With this method, the different fabric structures, that is, the spacer fabric, single-ply fabric and tubular fabric, can be reproduced in one knitted fabric. This occurs in a simple manner by means of the targeted selection of needles that are to form a stitch on one or both of the needle heads. If all of the needles that are to produce a stitch on the front and rear needle head are chosen, a spacer fabric is formed. If only the edges are closed, a tube is produced. If the front thread-feeding elements are woven in on the rear knitting needle head and vice versa, a one-by-one rib knitted fabric is produced.

[0024] Preferably, the jacquard elements are used to pattern at least one surface. Here, a colored thread can be used, for example, to create a structure in a multicolored textile.

[0025] It is also advantageous if jacquard elements of a single row are controlled varyingly during a stitch formation. It is thus possible to work the fabric structures not only in the direction of production, but also in the width direction of the knitted fabric. The input and sequencing of the individual repeating patterns can be achieved by a pattern control processor, for example.

[0026] Preferably, different structures are created in the width direction of the knitted fabric. Significant flexibility can thus be achieved in the production of the knitted fabric.

[0027] Embodiments are directed to a knitted fabric that includes warp threads that run in a longitudinal direction and that are connected to one another by a stitch formation, and

at least three sections arranged consecutively in the longitudinal direction. The at least three sections may include at least one section formed as a spacer fabric, one section formed as a single-ply fabric and one section formed as a tubular fabric.

[0028] In embodiments, the single-ply fabric can be formed as a one-by-one rib knitted fabric.

[0029] According to embodiments, the single-ply fabric may be arranged between the spacer fabric and the tubular fabric. The spacer fabric can have a larger extension in the longitudinal direction than the tubular fabric. Further, the spacer fabric can have an extension in the longitudinal direction that is at least two times as large as the extension of the tubular fabric in the longitudinal direction.

[0030] In accordance with other embodiments, the spacer fabric may be symmetrically arranged to the single-ply fabric in the thickness direction.

[0031] According to still other embodiments, the single-ply fabric may have an extension in the longitudinal direction which is at least as large as a thickness of the spacer fabric that protrudes past the single-ply fabric.

[0032] In other embodiments, the single-ply fabric may have an extension in the longitudinal direction which is at least as large as a thickness of a tube that is formed by the tubular fabric.

[0033] In further embodiments, the spacer fabric can be arranged on one side of the tubular fabric and the single-ply fabric is arranged on an opposite side of the tubular fabric.

[0034] According to still other embodiments, the spacer fabric may include sections with different thicknesses transversally to the longitudinal direction.

[0035] Embodiments of the invention are directed to a method for producing a knitted fabric using two knitting needle heads and thread-feeding elements at least partially embodied as jacquard elements. The method includes forming piles or surfaces, depending upon a predetermined fabric structure, by using at least four independent thread-feeding elements and controlling the jacquard elements.

[0036] In embodiments, the jacquard elements can be used to pattern at least one surface.

[0037] According to other embodiments, the jacquard elements may be controlled varyingly during a stitch formation process.

[0038] Moreover, different structures can be created in the width direction of the knitted fabric.

[0039] Embodiments of the invention are directed to a method of forming a knitted fabric. The method includes forming at least three sections consecutively in a longitudinal direction along which warp threads are arranged to run, the at least three sections can include a spacer fabric section, a single-ply fabric section and a tubular fabric section. In forming the at least three sections, the warp threads are connected to one another by a stitch formation.

[0040] In accordance with still yet other embodiments of the present invention, the spacer fabric section can include a front surface layer and a rear surface layer connected by pile threads, the single-ply fabric section can include the front surface layer and the rear surface layer, and the tubular fabric section can include the front surface layer and the rear surface layer. In a machine with plural guide bars, a first guide bar can lay down the front surface layer, a second guide bar can lay down the rear surface layer and a third guide bar can lay down the pile threads. In a machine with plural guide bars and plural jacquard bars, a first guide bar

can lay down the front surface layer, a second guide bar can lay down the rear surface layer and the plural jacquard bars can lay down the pile threads. Moreover, in a machine with at least two needle beds and plural independent thread-feeding elements, the at least two needle beds can form the front and rear surface layer and the plural independent thread-feeding elements can form the pile layers. The plural independent thread-feeding elements may include at least four jacquard bars.

[0041] Other exemplary embodiments and advantages of the present invention may be ascertained by reviewing the present disclosure and the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0042] The present invention is further described in the detailed description which follows, in reference to the noted plurality of drawings by way of non-limiting examples of exemplary embodiments of the present invention, in which like reference numerals represent similar parts throughout the several views of the drawings, and wherein:

[0043] FIG. 1 shows a schematic illustration of a knitted fabric; and

[0044] FIG. 2 shows a schematic illustration of a guide bar configuration for producing the knitted fabric according to FIG. 1.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0045] The particulars shown herein are by way of example and for purposes of illustrative discussion of the embodiments of the present invention only and are presented in the cause of providing what is believed to be the most useful and readily understood description of the principles and conceptual aspects of the present invention. In this regard, no attempt is made to show structural details of the present invention in more detail than is necessary for the fundamental understanding of the present invention, the description taken with the drawings making apparent to those skilled in the art how the several forms of the present invention may be embodied in practice.

[0046] FIG. 1 shows a knitted fabric 1 in a highly schematized form. The illustration is not to scale.

[0047] Knitted fabric 1 is formed in that multiple warp threads running in longitudinal direction 2 are connected to one another by stitches.

[0048] Knitted fabric 1 includes a, e.g., one, section embodied as a spacer fabric 3, a, e.g., one, section embodied as a single-ply fabric 4 and a, e.g., one, section embodied as a tubular fabric 5 arranged consecutively in longitudinal direction 2.

[0049] Single-ply fabric 4 is embodied as a one-by-one rib knitted fabric. Further, single-ply fabric 4 is arranged between spacer fabric 3 and tubular fabric 5.

[0050] The three sections, that is, spacer fabric 3, single-ply fabric 4 and tubular fabric 5, are formed by continuous warp threads, i.e., no additional measures are used for these three sections be joined together.

[0051] To produce a knitted fabric 1 of this type, a guide bar arrangement such as illustrated schematically in FIG. 2 can be used.

[0052] For example, a guide bar GB1 lays down a front surface layer 6. Guide bars GB7 and GB8 lay down threads for a rear surface layer 7. A guide bar GB6 lays down pile

threads 8, which can also be referred to “spacer threads,” as shown in FIG. 1. Furthermore, four jacquard bars JB2, JB3, JB4 and JB5 are provided which can be controlled so that they either subject a warp thread to a stitch formation or remove a warp thread from stitch formation during a stitch formation process.

[0053] Instead of guide bar GB6, jacquard bars JB2-JB5 can also be used to lay down the pile threads 8.

[0054] To create two surface layers 6, 7, a double-section warp knitting machine is used, that is, a warp knitting machine with two needle beds for knitting needles.

[0055] Single-ply fabric 4 is embodied as what is referred to as a “simplex” fabric. A single-ply fabric 4 of this type comprises the two surface layers 6, 7 which, however, bear directly against one another and are also connected to one another during the stitch formation processes. The two layers 6, 7 are therefore closely and inextricably connected.

[0056] The tubular fabric 5 is essentially also composed of the two surface layers 6, 7, which are only directly connected to one another at the longitudinal edges running in the longitudinal direction 2.

[0057] Knitted fabric 1 with the three different fabric sections (or types) can thus be produced based upon knitting technology with a machine having two needle beds and at least four independent thread-feeding elements. In an exemplary embodiment, the thread-feeding elements are, at least in the case of the jacquard bars JB2-JB5, based on a piezo jacquard technology. The arrangement of the jacquard elements is thereby chosen such that the jacquard bars JB2-JB5 can be used both for forming piles and for patterning surfaces. The different sections with pile (spacer thread 3), simplex (single-ply fabric 4) and tube (tubular fabric 5) can thus be reproduced in a single product.

[0058] The knitted fabric illustrated can then be further processed for a number of textile products. This will be described below on the basis of a holder for a delicate object, for example a mobile phone.

[0059] Tubular fabric 5 forms a holder with an open front side 9, through which the telephone can be inserted.

[0060] Single-ply fabric 4, which in a manner of speaking closes the holder at the bottom end, connects to tubular fabric 5 so that the inserted telephone is not able to fall out in a downward direction. Spacer fabric 3 can be folded over onto tubular fabric 5 to pad the outside of tubular fabric 5. In this embodiment, it is preferred that spacer fabric 3 has a greater extension in the longitudinal direction 2 than tubular fabric 5. This extension can even be at least twice as large as the extension of tubular fabric 5 in longitudinal direction 2. It is thus possible to have spacer fabric 3 run along one side of tubular fabric 5 and, after a folding-over of spacer fabric 3, to fold it back down on the other side of tubular fabric 5. Spacer fabric 3 then also closes the opening of a front side 9. The holder that is formed by tubular fabric 5 is then automatically padded on all sides, since spacer fabric 3 with pile threads 8 is capable of absorbing certain impacts and pressures.

[0061] Single-ply fabric 4 is arranged roughly in the middle of spacer fabric 3, that is, spacer fabric 3 is arranged symmetrically to single-ply fabric 4 in the thickness direction. In this case, however, it is sufficient if single-ply fabric 4 is arranged within a range of 40% to 60% of the thickness of spacer fabric 3. The thickness is the distance between front surface layer 6 and rear surface layer 7.

[0062] In another embodiment not illustrated, single-ply fabric 4 can also connect to spacer fabric 3 in such a manner that single-ply fabric 4 is the continuation of one of the two surface layers 6, 7.

[0063] Single-ply fabric 4 preferably forms not only the bottom closure of the pouch or bag that is formed by tubular fabric 5, but rather also forms a type of hinge. Accordingly, it is beneficial if single-ply layer 4 has an extension in longitudinal direction 2 that is at least as large as a thickness of spacer fabric 3 that protrudes past single-ply fabric 4. It is thus ensured that spacer fabric 3 can be folded over onto tubular fabric 5 without any problems occurring.

[0064] If it is known how “thick” the filled holder formed by tubular fabric 5 is, which is normally the case if a holder of this type is finished for a specific product, then it is also beneficial if single-ply fabric 4 has an extension in longitudinal direction 2 that is at least as large as a thickness of the tube formed by tubular fabric 5. In this case, it is also ensured that spacer fabric 3 can be folded over all the way to the long side of tubular fabric 5 by single-ply fabric 4.

[0065] Spacer fabric 3 can have different thicknesses transversally to longitudinal direction 2. In this case, spacer fabric 3 and the accompanying padding effect can be adapted to the object that is to be accommodated in tubular fabric 5 if tubular fabric 5 is used for a bag or pouch. For example, a greater thickness of spacer fabric 3 can be provided in particularly delicate regions of the object to allow these sections to be better protected.

[0066] The illustrated arrangement of spacer fabric 3, single-ply fabric 4 and tubular fabric 5 is shown merely by way of example. It can also be provided that a section with spacer fabric 3 is arranged on one side of a section with tubular fabric 5 and a section with single-ply fabric 4 is arranged on the opposite side of tubular fabric 5. In the latter case, a section with spacer fabric 3 can also be connected to the section with single-ply fabric 4, for example, to cover both sides of tubular fabric 5 with shorter sections of spacer fabric 3.

[0067] Thus, a knitted fabric with three different functions or properties can be produced without the need for a complicated retooling or finishing of the knitted fabric. This minimizes the finishing effort drastically and at the same time results in a decrease in production costs. The risk of defects during production is also reduced.

[0068] The thinner one-by-one rib passages can be easily draped. The surfaces of the individual structures can be freely designed. Patterns can be integrated for functional zones with air permeability and for breathable regions with appropriate reinforcements, or the surface can be used for styling the knitted fabric with colors and shapes. The arrangement of the warp weaving machine used permits any desired number of needles or thread-feeding elements necessary for the different regions. In this manner, different structures can be worked not only in the direction of production, but also in the width direction of the knitted fabric. The input and sequencing of the individual repeating patterns can be achieved by a pattern control processor, for example.

[0069] In addition to the holders described above, shoes, articles of clothing, backpacks, jackets, seating furniture and mattress materials, packaging, etc. can be produced.

[0070] It is noted that the foregoing examples have been provided merely for the purpose of explanation and are in no way to be construed as limiting of the present invention.

While the present invention has been described with reference to an exemplary embodiment, it is understood that the words which have been used herein are words of description and illustration, rather than words of limitation. Changes may be made, within the purview of the appended claims, as presently stated and as amended, without departing from the scope and spirit of the present invention in its aspects. Although the present invention has been described herein with reference to particular means, materials and embodiments, the present invention is not intended to be limited to the particulars disclosed herein; rather, the present invention extends to all functionally equivalent structures, methods and uses, such as are within the scope of the appended claims.

What is claimed:

1. A knitted fabric comprising:

warp threads that run in a longitudinal direction and that are connected to one another by a stitch formation; and at least three sections arranged consecutively in the longitudinal direction,

wherein the at least three sections comprise at least one section formed as a spacer fabric, one section formed as a single-ply fabric and one section formed as a tubular fabric.

2. The knitted fabric according to claim 1, wherein the single-ply fabric is formed as a one-by-one rib knitted fabric.

3. The knitted fabric according to claim 1, wherein the single-ply fabric is arranged between the spacer fabric and the tubular fabric.

4. The knitted fabric according to claim 3, wherein the spacer fabric has a larger extension in the longitudinal direction than the tubular fabric.

5. The knitted fabric according to claim 4, wherein the spacer fabric has an extension in the longitudinal direction that is at least two times as large as the extension of the tubular fabric in the longitudinal direction.

6. The knitted fabric according to claim 1, wherein the spacer fabric is symmetrically arranged to the single-ply fabric in the thickness direction.

7. The knitted fabric according to claim 1, wherein the single-ply fabric has an extension in the longitudinal direction which is at least as large as a thickness of the spacer fabric that protrudes past the single-ply fabric.

8. The knitted fabric according to claim 1, wherein the single-ply fabric has an extension in the longitudinal direction which is at least as large as a thickness of a tube that is formed by the tubular fabric.

9. The knitted fabric according to claim 1, wherein the spacer fabric is arranged on one side of the tubular fabric and the single-ply fabric is arranged on an opposite side of the tubular fabric.

10. The knitted fabric according to claim 1, wherein the spacer fabric comprises sections with different thicknesses transversally to the longitudinal direction.

11. A method for producing a knitted fabric using two knitting needle heads and thread-feeding elements at least partially embodied as jacquard elements, comprising:

forming piles or surfaces, depending upon a predetermined fabric structure, by using at least four independent thread-feeding elements and controlling the jacquard elements.

12. The method according to claim 11, wherein the jacquard elements are used to pattern at least one surface.

13. The method according to claim **11**, wherein the jacquard elements are controlled varyingly during a stitch formation process.

14. The method according to claim **13**, wherein different structures are created in the width direction of the knitted fabric.

15. A method of forming a knitted fabric comprising: forming at least three sections consecutively in a longitudinal direction along which warp threads are arranged to run, the at least three sections comprising a spacer fabric section, a single-ply fabric section and a tubular fabric section,

wherein, in forming the at least three sections, the warp threads are connected to one another by a stitch formation.

16. The method according to claim **15**, wherein the spacer fabric section comprises a front surface layer and a rear surface layer connected by pile threads, wherein the single-ply fabric section comprises the front surface layer and the rear surface layer, and the tubular fabric section comprises the front surface layer and the rear surface layer.

17. The method according to claim **16**, wherein, in a machine with plural guide bars, a first guide bar lays down the front surface layer, a second guide bar lays down the rear surface layer and a third guide bar lays down the pile threads.

18. The method according to claim **16**, wherein, in a machine with plural guide bars and plural jacquard bars, a first guide bar lays down the front surface layer, a second guide bar lays down the rear surface layer and the plural jacquard bars lays down the pile threads.

19. The method according to claim **16**, wherein, in a machine with at least two needle beds and plural independent thread-feeding elements, the at least two needle beds form the front and rear surface layer and the plural independent thread-feeding elements form the pile layers.

20. The method according to claim **19**, wherein the plural independent thread-feeding elements comprise at least four jacquard bars.

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