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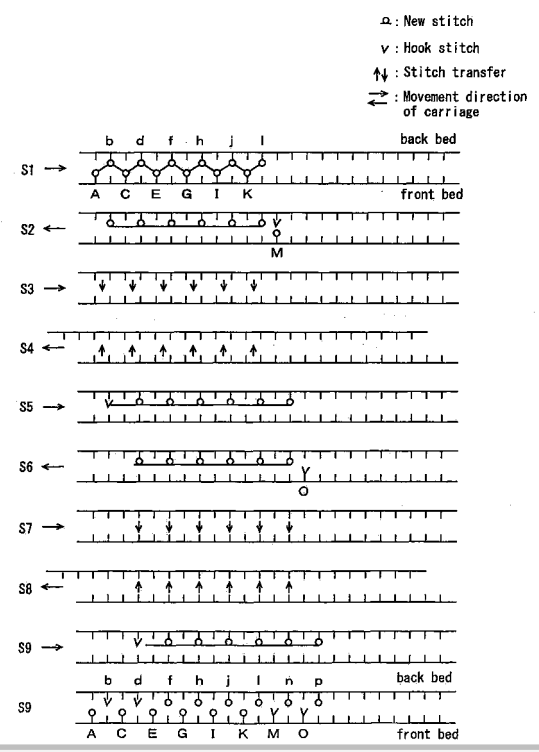
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(54) **THREE-DIMENSIONAL KNITTING METHOD, AND THREE-DIMENSIONAL ARTICLE KNITTED BY THE METHOD**

(57) A bottom face 8 is knitted, starting from a rib course 6, and meanwhile sides 10, 12 are moved relatively horizontally to form sides 14, 16 which are constituted by hook stitches. Four side faces of a three-dimensional article 40 are knitted by the sides 10, 12 and wales connected to the sides 14, 16 which are constituted by the hook stitches. Then, an upper face 30 is knitted and joined to stitches of sides 34, 35, and stitches of a side 32 is subjected to bind-off, whereby the three-dimensional article 40 is obtained. A three-dimensional knitted fabric having a bottom face can be seamlessly knitted.

FIG. 1



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Description

[0001] The present invention relates to knitting of a three-dimensional article having a bottom face and side face, and particularly to knitting of the bottom face of the three-dimensional article.

[0002] Patent Document 1 (Japanese Patent Application Laid-open No. 2007-16351) proposes a method of seamlessly knitting a three-dimensional article having four side faces and an upper face. According to Patent Document 1, first, the four side faces of the three-dimensional article are knitted into a cylinder, and then one of the sides of the upper face is knitted and joined with both sides thereof during knitting. Finally, the side of the upper face that has been knitted and a side opposite to the upper face are subjected to bind-off, to complete a three-dimensional article. In this case, two opposing sides of the upper face may be knitted first and then subjected to bind-off at the central part of the upper face.

[0003] Patent Document 2 (WO2004/020719) discloses a method of knitting a glove, where five finger pouches for a thumb to a little finger are joined together with gussets. The glove is completed by, for example, joining a finger pouch for the little finger with three cylinders for three fingers of an index finger to an annular finger that are joined with gussets, to obtain a cylinder for the four fingers, and then joining a finger pouch for the thumb to these cylinders to obtain a cylinder for the five fingers. The last cylinder is continuously knitted to obtain a rib part of a wrist, whereby the glove is completed.

[0004] A variety of knitted fabrics can be obtained when a bottom face of the three-dimensional article described in Patent Document 1 can be knitted seamlessly. For example, a seamless cube or square pyramid can be obtained. Moreover, a cylindrical knitted fabric with a closed bottom face can be knitted, which can be formed into, for example, a finger pouch for a glove or a sock. A three-dimensional article with a bottom face can be utilized not only in such a finger pouch, but also in various commodities, such as footwear, a slipper, and small pouches such as a bag, a wallet, and a spectacle case.

Patent Document 1: Japanese Patent Application Laid-open No. 2007-16351
Patent Document 2: WO2004/020719

[0005] An object of the present invention is to allow seamless knitting to be performed on a bottom face of a three-dimensional article, and to provide a glove, a sock, a bag or other article obtained by seamlessly knitting the bottom face.

[0006] In a method of the present invention for knitting a three-dimensional article in use of a flat-knitting machine having a first needle bed and a second needle bed facing each other in a longitudinal direction, the method of the present invention is characterized in having:

a: a step of providing the first needle bed with a first

stitch row and providing the second needle bed with a second stitch row, in a manner that the first stitch row and the second stitch row face each other;

b: a step of knitting a plurality of stitch rows, each having the first stitch row and a wale formed continuously therein, up to a third stitch row, in order to knit a knitted fabric of a bottom face of a three-dimensional article, and providing a fifth stitch row and a sixth stitch row between the third stitch row and the second stitch row or a fourth stitch row having the second stitch row and a wale formed continuously therein; and

c: a step of knitting a side face of the three-dimensional article into a cylinder, with the second and third stitch rows, the fifth and sixth stitch rows, or the third to sixth stitch rows being used as a bottom side of the three-dimensional article.

[0007] In the step b, it is preferred that each stitch row having the first stitch row and wale formed continuously therein be moved to the right or left on the first needle bed so as to be away from the second stitch row, that an empty needle, which is generated on the first needle bed by moving each stitch row, be provided with a first hook stitch row so as to face the second stitch row, thereby obtaining the fifth stitch row, and that a second hook stitch row be provided to a needle on the second needle bed facing the third stitch row as a result of moving each stitch row, to obtain the sixth stitch row. Note that "a hook stitch" in this specification is a stitch made by hooking with an empty needle.

[0008] In the step b, it is preferred that the stitch row, which has the second stitch row and wale formed continuously therein, be knitted up to the fourth stitch row, that the stitch row, which has the second stitch row and wale formed continuously therein, be moved to the other side of the right and left on the second needle bed, so as to be away from the third stitch row, that a row of hook stitches be provided to an empty needle generated on the second needle bed as a result of the movement so that the row of hook stitches faces the third stitch row, thereby obtaining a part of the sixth stitch row, and that a row of hook stitches be provided to a needle on the first needle bed facing the fourth stitch row as a result of the movement, thereby obtaining a part of the fifth stitch row. Note that a stitch row subsequent to the second stitch row may be the fourth stitch row.

[0009] Preferably, in the step c, as the bottom sides of the three-dimensional article, the second and third stitch rows and the fifth and sixth stitch rows are obtained, without knitting the fourth stitch row in the step b described above.

[0010] The present invention also aims to provide a three-dimensional article that has a pouch constituted by a bottom face knitted fabric, and a cylindrical side face knitted fabric constituted by a stitch of a side of the bottom face and a stitch having continuous wales.

[0011] Preferably, the pouch has five pouches of a

thumb pouch, index finger pouch, middle finger pouch, annular finger pouch, and little finger pouch, wherein a wale of the thumb pouch, a wale of the index finger pouch, a wale of the middle finger pouch, and a wale of the annular finger pouch are connected respectively to the wale of the index finger pouch, the wale of the middle finger pouch, the wale of the annular finger pouch, and a wale of the little finger pouch at web parts between fingers, to form a cylindrical knitted fabric.

More preferably, each of the wales is configured by a plurality of wales, and the wale of the thumb pouch, the wale of the index finger pouch, the wale of the middle finger pouch, and the wale of the annular finger pouch are connected respectively to the wale of the index finger pouch, the wale of the middle finger pouch, the wale of the annular finger pouch, and the wale of the little finger pouch, by the respective gussets at the web parts between fingers.

[0012] It is more preferred that the pouch configure footwear.

It is more preferred that the pouch configure a bag.

[0013] The followings can be exemplified by showing the associations with embodiments. Note that stitches simply described as "stitches" in this specification may include "hook stitches," and a bottom face means a surface that is knitted first when knitting a three-dimensional article from the bottom to the top.

First needle bed	Rear needle bed
Second needle bed	Front needle bed
First stitch row	Stitches b to 1
Second stitch row	Stitches A to K
Third stitch row	Stitches j to t
Fifth stitch row	Hook stitches b to h
Sixth stitch row	Hook stitches M to S

[0014] In the present invention, a three-dimensional article with a closed bottom face can be seamlessly knitted easily. This three-dimensional article can be utilized as a glove, a sock with toes and the like since the bottom face fits the fingertips. Moreover, this three-dimensional article can be utilized as a bag or footwear.

[0015]

Fig. 1 is a diagram showing a knitting procedure for knitting a bottom face of a three-dimensional article in an embodiment;

Fig. 2 is a diagram showing a knitting procedure following the procedure shown in Fig. 1;

Fig. 3 is a modification in which the bottom face is knitted starting from a central part thereof to each side, showing a procedure following the procedure shown in Fig. 1;

Fig. 4 is a diagram schematically showing how four side faces and an upper face are knitted after knitting the bottom face of the three-dimensional article in

the embodiment;

Fig. 5 is a diagram showing a modification in which the central part of the bottom face is knitted bi-directionally;

Fig. 6 is a diagram showing a modification in which the upper face is knitted bi-directionally and bound-off at the central part;

Fig. 7 is a diagram showing a modification of a square pyramid;

Fig. 8 is a perspective view schematically showing footwear to be knitted in the embodiment;

Fig. 9 is a diagram schematically showing a slipper to be knitted in the embodiment;

Fig. 10 is a diagram schematically showing a process of producing a bag in the embodiment;

Fig. 11 is a diagram schematically showing a procedure for knitting a glove in the embodiment; and

Fig. 12 is a diagram in which the glove knitted in the embodiment is viewed from the finger side.

[0016]

2	Front needle bed
4	Rear needle bed
25 6	Rib course
8	Bottom face knitted fabric
10, 12	Side configured by stitches
14, 16	Side configured by hook stitches
18 to 24	Side obtained during knitting
30 26 to 29	Side faces
30	Upper face
32	Stitch row
33 to 35	Sides of upper face
36	Stitch row
35 37,38	Rows of unjointed stitches
40	Three-dimensional article
42	Stitch start line
44	Bind-off line
70	Square pyramid article
40 71 to 74	Side faces
80	Footwear
81	Stitch start line
82	Bottom face
83 to 86	Side faces
45 87	Surface
88	Heel
90	Slipper
91	Stitch start line
92	Bottom face
50 93 to 96	Side faces
100	Bag
101	Stitch start line
102	Cylindrical knitted fabric
103	Bottom face
55 104 to 107	Side faces
108	Upper face
109	Bind-off line
111 to 115	Bottom faces

116 to 123	Sides
131 to 135	Finger pouches
141 to 144	Gussets
146 to 148	Cylinders
150	Glove

[0017] The best mode for carrying out the present invention is described hereinafter, but the present invention is not limited thereto.

[0018] Figs. 1 to 14 show an embodiment and its modification. Figs. 1 and 2 schematically show a procedure for knitting a bottom face of a three-dimensional article. In the embodiment, a flat-knitting machine with two beds is used, wherein one of the needle beds is capable of racking freely in a horizontal direction with respect to the other needle bed so as to allow stitch transfer to be performed freely between the needle beds. Instead of the flat-knitting machine with two beds, a flat-knitting machine with four beds or a flat-knitting machine having two needle beds and two transfer jack beds may be used.

[0019] Step 1 of Fig. 1 shows a state in which knitting is started, wherein a stitch row of a rib to be started is supported by A to 1 needles. Next, in Step 2, a carriage, not shown, is moved from, for example, the right to the left of a needle bed to form a hook stitch on a needle M and knit one course on the rear needle bed side. The stitch row on the rear needle bed side is shifted by two pitches to the right by means of racking in Step 3 and Step 4, and then one course is knitted by the rear needle bed in Step 5 to form a hook stitch at a needle b which becomes an empty needle.

[0020] In Step 6, a hook stitch is formed at a needle O of the front needle bed, and one course of stitch row is knitted on the rear needle bed. In Step 7 and Step 8 the stitch row of the rear needle bed is shifted by two pitches to the right. In Step 9, a hook stitch is formed in an empty needle d formed on the rear needle bed, to knit one course. As shown in the lowest part of Fig. 1, the stitch row supported by the needles A to K of the front needle bed at the beginning of knitting is not moved, and four courses are knitted on the rear needle bed side, hence the stitch row is moved by four pitches from b to 1 to f to p. On the front needle bed, two hook stitches are formed in the needles M, O so as to face the stitches of the needles n, p formed on the rear needle bed, and two hook stitches are formed in the two empty needles b, d that are generated on the rear needle bed.

[0021] Fig. 2 shows a knitting procedure subsequent to Step 9. This knitting procedure is a repetition of the knitting procedures carried out in Steps 2 to 9, wherein one hook stitch is formed on the front needle bed side in Step 10, and one course of knitted fabric is knitted on the bottom face. In Step 11 and Step 12 the stitch row on the rear needle bed side is moved by two pitches to the right. In Step 13 a hook stitch is formed in an empty needle f formed as a result of stitch transfer, and one course of knitted fabric is knitted in the rear needle bed. In Steps 14 to 17, knitting performed in Steps 10 to 13 is repeated

one more times.

[0022] In Step 17 the stitch row A to K on the front needle bed is not moved, but the stitch row on the rear needle bed is moved from j to t, and a row of hook stitches is formed in b to j of the rear needle bed and M to S of the front needle bed. The stitch row of A to K on the front needle bed, the stitch row of j to t on the rear needle bed, the row of hook stitches b to h on the rear needle bed, and the row of hook stitches M to S on the front needle bed constitute four sides of the bottom face knitted fabric of the three-dimensional article. Here, the bottom face knitted fabric is a rectangular having a stitch ratio between the long side and the short side is 3:2. A square bottom face or a bottom face having a hook stitch row longer than a stitch row of a knit can be configured by the number of times that the knitting step of Steps 10 to 13 is repeated.

[0023] In Step 17, the row of stitches A to K is a second stitch row, the row of stitches j to t a third stitch row, the row of hook stitches b to h a fifth stitch row, and the row of hook stitches M to S a sixth stitch row. The third stitch row j to t is moved from the original position (b to 1) to the right on the rear needle bed, while the fifth stitch row is positioned to face the second stitch row, and the sixth stitch row is positioned to face the third stitch row.

[0024] In knitting shown in Figs. 1 to 2, the stitch rows are not formed on the front needle bed but on the rear needle bed only. However, from the state of Step 1 shown in Fig. 1, the stitch rows can be formed on both the front needle bed and the rear needle bed, and a position to start knitting can be disposed in a central part of the bottom face by moving the stitch row on the front needle bed side and the stitch row on the rear needle bed side to the opposite side in the horizontal direction.

[0025] Such an example is shown in Fig. 3. Before carrying out each step shown in Fig. 3, the stitch row on the rear needle bed is moved to the right-hand side of the diagram by means of Steps 1 to 9 shown in Fig. 1. In Steps 31 to 39 shown in Fig. 3, the stitch row A to K on the front needle bed side is moved to the left-hand side of the diagram. The detail of each step is obtained by changing the knitting procedures shown in Figs. 1 and 2. For example, one course of stitch row is knitted on the front needle bed side in Step 31, then one hook stitch is formed on the rear needle bed side in Step 32, and one course is knitted on the front needle bed side. Next, in Steps 33 and 34, the stitch row on the front needle bed is moved by two pitches to the left, and in Step 35 one hook stitch is formed in an empty needle generated as a result of the movement, to knit one course on the front needle bed side. By repeating the procedure described above (Steps 36 to 39), the stitch row on the front needle bed side can be moved to the left-hand side of the diagram while knitting the bottom face.

[0026] Fig. 4 schematically shows how a three-dimensional article 40 is knitted. Reference numeral 2 represents the front needle bed and 4 the rear needle bed. In response to Step 1 shown in Fig. 1, one course of rib

course 6 is knitted, and knitting of a stitch row on the rear needle bed 4 is repeated as shown in Steps 2 to 17 of Figs. 1 and 2. As a result, a knitted fabric 8 of the bottom face is formed, a side 10 configured by a plurality of stitches is formed on the front needle bed 2, and a side 12 configured by a plurality of stitches is similarly formed on the rear needle bed. The side 10 is a remaining stitch row of the rib course 6, while the side 12 is a new stitch row that is knitted in a step of knitting the knitted fabric 8. In relation to the side 10, the side 12 is moved on the rear needle bed 4 to the right-hand side of the diagram. A side 16 configured by hook stitches is formed in an empty needle resulted from the movement, and a side 14 configured by hook stitches is formed so as to face the side 12. The number of stitches of the side 14 matches that of the side 16.

[0027] Four side faces of the three-dimensional article 40 are knitted on the sides 10, 14, 12 and 16 respectively. Note that a hatching or other line in each diagram indicates a connection between stitches. Reference numerals 18 to 24 represent sides obtained during knitting. Once knitting of an appropriate number of courses of the four side faces is finished, a three-dimensional article with an opened upper face (the face surrounded by the four sides 18, 22, 20 and 24) is obtained as shown in the lower left part of Fig. 4. Reference numerals 26 to 29 represent four side faces of the three-dimensional article. After knitting the four side faces of the three-dimensional article, for example, an upper face 30 is knitted on the front needle bed 2, and stitches of the sides 34, 35 on the upper face are joined one by one, each time when knitting two courses of the upper face 30. As a result, the widths of unjoined stitch rows 37, 38 are reduced gradually. When joining the sides 34, 35, the stitch row 37 is joined to the stitch row 36 side, and the stitch row 38 is joined to the stitch row 36 side. As a result, the stitch row 36 and the stitch row 32 face each other, and once the formation of the stitches on the upper face 30 is completed, the stitch row 36 and the stitch row 32 are overlapped and subjected to bind-off to complete the three-dimensional article 40.

[0028] In the three-dimensional article 40 shown in Fig. 4, the knitted fabric of the bottom face is knitted on the rear needle bed side as shown in Figs. 1 and 2, but the knitted fabric of the bottom face may be knitted in both the front and rear needle beds as shown in Fig. 3. Such an example is shown in Fig. 5. Reference numeral 42 represents a stitch start line that is located in, for example, a central part of the bottom face, from which knitting of the knitted fabric of the bottom face is started in both front and rear directions, as shown by the arrow. Subsequently, the four side faces are knitted as with the manner shown in Fig. 4, to knit and bind-off the upper face 30.

[0029] Various methods according to Patent Document 1 are known for bind-off the upper face. For example, as shown in Fig. 6, a bind-off line 44 may be provided in the central part of the upper face, and knitting may be started from both the front and rear directions in the di-

agram of the upper face to perform bind-off on the central part of the upper face.

[0030] In Figs. 4 to 6, a cubical or rectangular solid article is knitted, but an article in the shape of a square pyramid can be knitted. Such an example is shown in Fig. 7. Reference numeral 70 represents a square pyramid article, and a square or rectangular bottom face 8 is knitted. When engaged with the needle beds 2, 4, the bottom face 8 is in the shape of a diamond or parallelogram. Next, four side faces 71 to 74 are knitted into cylinders, the width of each cylinder is gradually reduced during the knitting step, and the apex of the square pyramid is subjected to bind-off, whereby the article 70 shown on the right-hand side of Fig. 7 is obtained.

[0031] Figs. 8 to 12 show a specific application example of the three-dimensional article, wherein the white arrow in each diagram indicates the direction of knitting. Fig. 8 shows seamlessly knitted footwear 80. Reference numeral 81 represents a stitch start line. For example, a bottom face 82 is knitted on the toe side, and then side faces 83 to 86 are knitted into cylinders. A surface 87 and other three surfaces are knitted individually in the middle of the cylinders. A surface 85 is knitted to have more stitch courses than surfaces 84, 86, to knit a heel 88, and then the surface 85 is joined with the surfaces 84, 86, whereby the footwear 80 is obtained. In Fig. 8, the toe side is provided with the stitch start line 81 and the bottom face 82, but the surface 85, for example, may be knitted as the bottom face.

[0032] Fig. 9 shows a seamlessly knitted slipper 90, which has a simplified structure of the footwear 80 shown in Fig. 8. Here, for example, a bottom face 92 is knitted starting from a stitch start line 91, and side faces 93 to 96 are knitted into cylinders. Along the way, knitting of the side faces 93, 94, 96 is ended, and only the side face 95 is continuously knitted, whereby the slipper 90 is obtained.

[0033] Fig. 10 shows an example of knitting a two-tiered bag 100. For example, a stitch start line 101 is knitted, and a cylindrical knitted fabric 102 is obtained. Next, a bottom face 103 is knitted. Here, both the front and rear needle beds are used to start knitting a central part of the bottom face 103. Subsequently, four side faces 104 to 107 are knitted to obtain an upper face 108, which is subjected to bind-off at a bind-off line 109 in the central part. Next, for example, the structure shown on the right-hand side of Fig. 10 is obtained by folding the knitted fabric 102 such that the side face 107 is brought inside the bag, whereby the cylindrical knitted fabric 102 becomes a bag cover. The process up to this point can be carried out seamlessly. The doubly overlapped knitted fabrics are adhered together according to need, and buttons and the like are attached by stitching, adhering, or performing other processing. Note that knitting can be carried out in an opposite direction from the position of the bind-off line 109 in the middle to the position of the bind-off line 101.

[0034] Obtaining the bag 100 as an article having a

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