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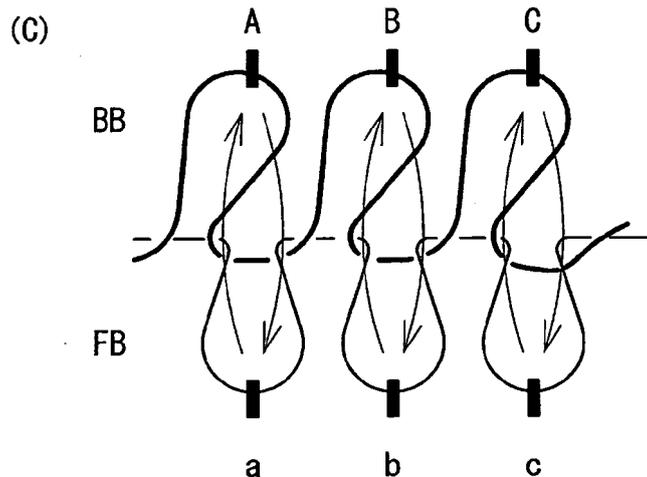
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(54) **Set-up method of knitted fabric and knitted fabric**

(57) A set-up method of a knitted fabric capable of knitting a set-up portion by split knitting using a flat knitting machine equipped with a compound needle including a needle main body and a slider with two blades is provided. The split knitting of forming new stitches a to c on knitting needles of an BB following target stitches A to C

configuring a base course formed on one needle bed (BB) and transferring the target stitches A to C to the knitting needles of the other needle bed (FB) is carried out. The target stitches A to C are transferred from the knitting needles of the FB to the knitting needles of the BB, and the new stitches a to c are transferred from the knitting needles of the BB to the knitting needles of the FB.



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a set-up method of a knitted fabric for knitting a set-up portion of a knitted fabric using a flat knitting machine equipped with a compound needle including a needle main body and a slider with two blades, and a knitted fabric knitted by applying the set-up method.

Description of the Related Art

[0002] A method of setting up a knitted fabric using a flat knitting machine including at least a front and a back needle bed is conventionally known. The simplest set-up method is a method of knitting a set-up portion of a knitted fabric by alternately feeding a knitting yarn to the front and back needle beds. However, in such a method, a cross-over yarn crossed between the front and back needle beds tends to become long, and hence the set-up portion may seem loose. To overcome such a problem, knitting the set-up portion using split knitting has been proposed (refer to Patent Document 1, for example).

[0003] When knitting the set-up portion using the split knitting, a base course to become a base is first knitted on one of the front and back needle beds. While transferring a stitch (target stitch) of the base course to a knitting needle of the other needle bed, a new knitting yarn is fed to form a new stitch on a knitting needle of the one needle bed (knitting needle on which the target stitch to be transferred is originally held) so as to be pulled out from the relevant stitch (target stitch). This is carried out from one end side towards the other end side in a knitting width direction. The set-up portion knitted in such a manner is the set-up portion in which sinker loops of the stitches held on the front and back needle beds are intertwined with each other, as shown in Fig. 4. At the set-up portion, the yarn length connecting the stitches does not become unnecessarily long, and thus a tight set-up portion can be made.

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0004]

[Patent Document 1] Japanese Unexamined Patent Publication No. 4-73245

SUMMARY OF THE INVENTION

[0005] The set-up method using the split knitting described in Patent Document 1, however, is a method that

is effective if the knitting needle of the flat knitting machine is a latch needle, and is a method that is inappropriate if the knitting needle of the flat knitting machine is a compound needle including a needle main body and a slider with two blades that open and close a hook of the needle main body (refer to Japanese Patent No. 2917146, for example). If the set-up method of Patent Document 1 is performed with the flat knitting machine equipped with the compound needle, the stitch of the base course and the new stitch do not intertwine, as shown in Fig. 5, and hence the set-up portion same as that in Fig. 4 cannot be knitted. Needless to say, the set-up portion same as that in Fig. 4 merely cannot be formed with the compound needle according to the procedure same as that in Patent Document 1, but this does not mean that the knitted fabric cannot be set up with the compound needle.

[0006] The above problem arises as the structure for transferring the stitches between the opposing needle beds differs between the latch needle and the compound needle including the slider with two blades. In the case of the latch needle, a clip on the side surface of the latch needle is used to transfer the stitch and hence the latch needles of the opposing needle beds are slightly shifted against each other in a longitudinal direction of the needle beds. In the case of the compound needle including the slider with two blades, on the other hand, the stitch held at a tongue at the distal end on a needle bed gap side of the blade is taken with the hook of the opposing compound needle and thus the hooks of the compound needles of the opposing needle beds are not shifted against each other in the longitudinal direction of the needle beds.

[0007] A completely new idea is desired to knit the set-up portion formed by intertwining a knitting yarn for connecting the stitches held on the front needle bed with a knitting yarn for connecting the stitches held on the back needle bed with a flat knitting machine using the compound needle having a structure different from the latch needle as described above.

[0008] The present invention has been devised in view of the above problem, and an object thereof is to provide a set-up method of a knitted fabric capable of knitting a set-up portion by the split knitting using a flat knitting machine equipped with compound needles, each including a needle main body and a slider with two blades, and a knitted fabric including the set-up portion knitted by applying the method.

[0009] A set-up method of a knitted fabric according to the present invention is a set-up method of a knitted fabric, using a flat knitting machine including at least a front and a back needle bed between which stitches can be transferred, for knitting a set-up portion of a knitted fabric by split knitting of forming new stitches following target stitches configuring a base course formed on either one of the front and back needle beds on knitting needles of the one needle bed while transferring the target stitches to knitting needles of the other needle bed. Then, in the set-up method of the knitted fabric according to the present invention, the target stitches are transferred from

the knitting needles of the other needle bed to the knitting needles of the one needle bed, and the new stitches are transferred from the knitting needles of the one needle bed to the knitting needles of the other needle bed to interchange held positions of the target stitches and the new stitches in an opposing direction of the needle beds from held positions at the beginning of formation, the target stitches and the new stitches with interchanged held positions forming the set-up portion. The knitting needles of the needle beds in the flat knitting machine used in the set-up method of the knitted fabric of the present invention are compound needles, each including a needle main body and a slider with two blades.

[0010] An outline of the set-up method of the knitted fabric according to the present invention will be briefly described with reference to Figs. 1A to 1C. A short line in Figs. 1A to 1C indicates a knitting needle of a front needle bed (hereinafter referred to as FB) or a back needle bed (hereinafter referred to as BB).

[0011] First, Fig. 1A shows a state in which the stitches (target stitches A to C) of the base course formed following the stitches formed with a draw thread shown with a dotted line are held on the knitting needles of the BB. When the split knitting is carried out with respect to the target stitches A to C, the target stitches A to C are moved to the knitting needles of the FB and the new stitches a to c are held on the knitting needles of the BB (see Fig. 1B). In this state, the split knitting is carried out using the compound needle, and thus the knitting yarn of the target stitches A to C and the knitting yarn of the new stitches a to c are not intertwined. In the set-up method of the knitted fabric according to the present invention, therefore, the target stitches A to C are transferred from the FB to the BB, and the new stitches a to c are transferred from the BB to the FB (see Fig. 1C). The knitting yarn of the target stitches A to C and the knitting yarn of the new stitches a to c are intertwined, as shown in Fig. 1C, by this interchanging of the held positions of the target stitches A to C and the new stitches a to c in the opposing direction of the FB and the BB.

[0012] According to one aspect of the set-up method of the knitted fabric of the present invention, the held positions of the target stitches and the new stitches are preferably interchanged after forming all the new stitches.

[0013] According to one aspect of the set-up method of the knitted fabric of the present invention, the flat knitting machine is preferably a four-bed flat knitting machine including additional opposing front and back needle beds above the opposing front and back needle beds; and when the base course is full-gauge knitted, interchanging of the held positions of the odd-numbered target stitches and new stitches counting from one end side in a longitudinal direction of the needle beds, and interchanging of the held positions of the even-numbered target stitches and new stitches counting from the one end side are preferably carried out separately. The full-gauge knitted base course is the base course knitted in a state an empty needle is not provided between the adjacent target stitch-

es in the base course.

[0014] When interchanging the held positions of the target stitch and the new stitch, the interchanging is preferably carried out according to the following steps α to δ if the interchanging of the odd-numbered stitches and the interchanging of the even-numbered stitches are to be carried out separately. As a premise for the steps α to δ , assume either one of a stitch group comprising the target stitches or a stitch group comprising the new stitches as a first stitch group, and the other as a second stitch group.

[Step α] transferring the $4n+1^{\text{th}}$ ($4n+2^{\text{th}}$) stitches of the first stitch group to the upper needle bed facing the needle bed on which the stitches are held, and transferring the $4n+3^{\text{th}}$ ($4n+4^{\text{th}}$) stitches of the second stitch group to the upper needle bed facing the needle bed on which the stitches are held.

[Step β] transferring the $4n+3^{\text{th}}$ ($4n+4^{\text{th}}$) stitches of the first stitch group and the $4n+1^{\text{th}}$ ($4n+2^{\text{th}}$) stitches of the second stitch group to the upper needle bed on the same side as the needle bed on which the stitches are held through empty needles formed by the step α .

[Step γ] transferring the stitches transferred in the step α to the empty needles formed by the step β through the empty needles formed by the step α .

[Step δ] transferring the stitches transferred in the step P to the empty needles formed by the step α .

[0015] An outline of the set-up method of the knitted fabric according to the present invention including the steps α to δ will be briefly described with reference to Figs. 2A to 2D. In Figs. 2A to 2D, FD refers to a lower front needle bed, BD refers to a lower back needle bed, FU refers to an upper front needle bed, and BU refers to an upper back needle bed. In the description using Figs. 2A to 2D, the new stitches a to c are assumed as a first stitch group, the target stitches A to C are assumed as a second stitch group, and only the movement of the first ($4n+1$; $n=0$) new stitch a and target stitch A from the left side in the plane of drawing will be illustratively described.

[0016] First, in the step α shown in Fig. 2A, the new stitch a held on the BD is transferred to the FU, which is the upper needle bed facing the BD. Then, in step P shown in Fig. 2B, the target stitch A held on the FD is transferred to the FU, which is the upper needle bed on the same side as the FD, through the empty needle of the BD formed by the step α . In the step γ shown in Fig. 2C, the new stitch a transferred to the FU is transferred to the empty needle of the FD formed by the step P through the empty needle of the BD formed by the step α . Lastly, in the step δ shown in Fig. 2D, the target stitch A transferred to the FU is transferred to the empty needle of the BD formed by the step α . Although not illustrated in Figs. 2A to 2D, the $4n+3^{\text{th}}$ stitches (third stitches C, c from the left side in the plane of drawing) defined in the steps α to δ are to make a movement line symmetric with the movement of the stitches A, a with a dotted line, which is a boundary of the front and back needle beds, in between.

[0017] A knitted fabric according to the present invention is a knitted fabric including a set-up portion knitted using a flat knitting machine including at least a front and a back needle bed in which a plurality of compound needles, each including a needle main body and a slider with two blades, is arranged in rows, and between which stitches can be transferred. The set-up portion of the knitted fabric of the present invention is knitted by the set-up method of the knitted fabric according to the present invention.

[0018] According to the set-up method of the knitted fabric of the present invention, the knitted fabric of the present invention including a set-up portion knitted by the split knitting can be knitted even with a flat knitting machine equipped with compound needles each including a slider with two blades. This is because the knitting yarn of the target stitch and the knitting yarn of the new stitch knitted with the compound needles, which do not intertwine under normal circumstances, can be intertwined by interchanging the held positions of the target stitch and the new stitch.

[0019] The knitting efficiency can be enhanced by forming all the new stitches at once in the set-up method of the knitted fabric of the present invention than by repeating the formation of one or a few new stitches and the interchanging of the held positions of the target stitch and the new stitch.

[0020] Furthermore, the knitting efficiency can be enhanced, as shown in the embodiment described later, by separately carrying out the interchanging of the held positions of the odd-numbered stitches and the interchanging of the held positions of the even-numbered stitches in the set-up method of the knitted fabric of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

Figs. 1A to 1C are explanatory views describing the concept of a set-up method of a knitted fabric of the present invention described in claim 1;

Figs. 2A to 2D are explanatory views describing the concept of a set-up method of a knitted fabric of the present invention described in claim 4;

Fig. 3 is a knitting step diagram showing the knitting steps according to the set-up method of the knitted fabric of a first embodiment using a flat knitting machine equipped with a compound needle;

Fig. 4 is a loop diagram of a set-up portion knitted with a conventional split knitting method using a flat knitting machine equipped with a latch needle; and

Fig. 5 is a loop diagram of a set-up portion knitted with a conventional split knitting method using a flat knitting machine equipped with a compound needle.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0022] Embodiments of the present invention will be hereinafter described with reference to the drawings. For the knitting described in the embodiments, a description will be given of a knitting example using a four-bed flat knitting machine including a lower front needle bed (FD) and a lower back needle bed (BD) extending in a transverse direction and disposed opposite to each other in a cross direction, and an upper front needle bed (FU) and an upper back needle bed (BU) arranged above the FD and the BD and provided with a great number of compound needles in rows at the same pitch as the lower needle beds. This flat knitting machine enables transfer of stitches between the front and back needle beds, and the BD and the BU arranged in the flat knitting machine can be racked in the transverse direction. In the currently commercially available flat knitting machine, stitches can be transferred between the FD and the BD, between the FD and the BU, and between the BD and the FU, but the stitches cannot be transferred between the FD and the FU, between the BD and the BU, and between the FU and the BU.

<First embodiment>

[0023] In a first embodiment, an example in which the set-up method of the present invention is applied when forming stitches with a knitting yarn, which is a draw thread, on the BB as stitches of a terminating portion of waste knitting that facilitates the knitting, and thereafter, setting up a knitted fabric following such stitches formed with the draw thread will be described with reference to Fig. 3.

[0024] In the knitting step diagram of Fig. 3, only a part of the needle bed is shown, and the number of stitches is shown to be less than the number used in the actual knitting for the sake of convenience of explanation. "Alphabet + number" in the left column of Fig. 3 indicates the number of the knitting step, and an arrow in the right column indicates how many pitches (P) to rack the back needle bed (BD, BU) from the previous step in the direction of the arrow. The middle column in Fig. 3 indicates the operation actually performed in each knitting step, where a white circle in the middle column indicates a target stitch, a black circle indicates a new stitch, and an arrow indicates a direction of transfer.

[0025] S1 shows a state in which target stitches A to H of a base course are formed on the knitting needles of the BD following the stitches formed with the draw thread. The split knitting is carried out from such a state.

[0026] In S2, a new knitting yarn is fed to form new stitches a to h on the knitting needles of the BD while transferring the target stitches A to H held on the knitting needles of the BD to the knitting needles of the opposing FD. The knitting efficiency is enhanced by forming all the new stitches a to h at once. In the present embodiment,

a stitch group comprising the new stitches a to h is referred to as a first stitch group, and a stitch group comprising the target stitches A to H is referred to as a second stitch group.

[0027] In S3 to S8, the held positions in the opposing direction of the needle beds (up and down direction in the plane of drawing) of odd-numbered ($4n+1$, $4n+3$; n is a natural number including 0) target stitches A, C, E, G and new stitches a, c, e, g counting from the leftward direction in the plane of drawing are interchanged.

[0028] In S3, the back needle bed is racked by one pitch in the leftward direction in the plane of drawing, and then the first ($4n+1$; $n=0$) new stitch a and the fifth ($4n+1$; $n=1$) new stitch e are transferred from the BD to the FU. At the same time as this transfer, in S3, the third ($4n+3$; $n=0$) target stitch C and the seventh ($4n+3$; $n=1$) target stitch G are transferred from the FD to the BU.

[0029] In S4, the back needle bed is racked by one pitch in the rightward direction in the plane of drawing, and then the third ($4n+3$; $n=0$) new stitch c and the seventh ($4n+3$; $n=1$) new stitch g held on the BD are transferred to the empty needles of the FD formed in S3. At the same time as this transfer, in S4, the first ($4n+1$; $n=0$) target stitch A and the fifth ($4n+1$; $n=1$) target stitch E held on the FD are transferred to the empty needles of the BD formed in S3.

[0030] Furthermore, in S5, the back needle bed is racked by one pitch in the rightward direction in the plane of drawing, and then the new stitches c, g transferred in S4 are transferred from the FD to the BU and the target stitches A, E transferred in S4 are transferred from the BD to the FU. The BU to which the new stitches c, g are transferred is the upper needle bed on the same side as the BD on which the new stitches c, g were held in S2. The FU to which the target stitches A, E are transferred is the upper needle bed on the same side as the FD on which the target stitches A, E were held in S2.

[0031] In S6, the back needle bed is racked by two pitches in the leftward direction in the plane of drawing, and then the new stitches a, e held on the FU are transferred to the empty needles of the BD formed in S5 and the target stitches C, G held on the BU are transferred to the empty needles of the FD formed in S5.

[0032] Furthermore, in S7, the back needle bed is racked by one pitch in the rightward direction in the plane of drawing, and then the new stitches a, e transferred to the BD in S6 are transferred to the empty needles of the FD formed in S4, and the target stitches C, G transferred to the FD in S6 are transferred to the empty needles of the BD formed in S4.

[0033] Lastly, in S8, the back needle bed is racked by one pitch in the rightward direction in the plane of drawing, and then the new stitches c, g transferred to the BU in S5 are transferred to the empty needles of the FD formed in S3 and the target stitches A, E transferred to the FU in S5 are transferred to the empty needles of the BD formed in S3. At the time point S8 is finished, the held positions in the opposing direction of the needle beds of

the odd-numbered target stitches A, C, E, G and new stitches a, c, e, g from the left side in the plane of drawing are interchanged.

[0034] Subsequently, the held positions in the opposing direction of the needle beds of the even-numbered ($4n+2$, $4n+4$) target stitches B, D, F, H and new stitches b, d, f, h from the left side in the plane of drawing are interchanged based on the idea similar to S3 to S8.

[0035] According to the knitting steps described above, the set-up portion in which the knitting yarn of the target stitches A to C and the knitting yarn of the new stitches a to c are intertwined can be formed, as shown in Fig. 1C.

<Modified embodiment>

[0036] A part of the first embodiment can be changed. For instance, the odd numbered-stitches may be interchanged after interchanging the even-numbered stitches first. The target stitches A to H may be defined as the first stitch group and the new stitches a to h may be defined as the second stitch group. In this case, the back needle bed is first racked by one pitch in the rightward direction in the plane of drawing, and then the target stitches A, E are transferred from the FD to the BU and the new stitches c, g are transferred from the BD to the FU, in place of S3 of Fig. 3. Subsequently, the held positions are interchanged based on the idea similar to the first embodiment.

[0037] The flat knitting machine to use may be a two-bed flat knitting machine. In this case, a half gauge knitting in which an empty needle is provided between adjacent stitches is carried out to interchange the held positions of the target stitch and the new stitch.

Claims

1. A set-up method of a knitted fabric for knitting a set-up portion of a knitted fabric, using a flat knitting machine including at least a front and a back needle bed between which stitches can be transferred, by split knitting of forming new stitches (a to h) following target stitches (A to H), which target stitches are configuring a base course formed on either one of the front and back needle beds, on knitting needles of the one needle bed while transferring the target stitches (A to H) to knitting needles of the other needle bed, **characterized in that:**

the knitting needles of the needle beds are compound needles each including a needle main body and a slider with two blades, the target stitches (A to H) are transferred from the knitting needles of the other needle bed to the knitting needles of the one needle bed, and the new stitches (a to h) are transferred from the knitting needles of the one needle bed to the knitting needles of the other needle bed to inter-

- change held positions of the target stitches (A to H) and the new stitches (a to h) in an opposing direction of the needle beds from held positions at the beginning of formation, the target stitches (A to H) and the new stitches (a to h) with interchanged held positions forming the set-up portion.
2. The set-up method of the knitted fabric according to claim 1, **characterized in that** the held positions of the target stitches (A to H) and the new stitches (a to h) are interchanged after forming all the new stitches (a to h).
3. The set-up method of the knitted fabric according to claim 1 or 2, **characterized in that** the flat knitting machine is a four-bed flat knitting machine including additional opposing front and back needle beds above the opposing front and back needle beds; and
when the base course is full-gauge knitted, interchanging of the held positions of the odd-numbered target stitches (A, C, E, G) and new stitches (a, c, e, g) counting from one end side in a longitudinal direction of the needle beds, and interchanging of the held positions of the even-numbered target stitches (B, D, F, H) and new stitches (b, d, f, h) counting from the one end side are carried out separately.
4. The set-up method of the knitted fabric according to claim 3, **characterized in that** assuming either one of a stitch group comprising the target stitches or a stitch group comprising the new stitches as a first stitch group, and the other as a second stitch group, in the interchanging of the held positions of the odd-numbered target stitches (A, C, E, G) and new stitches (a, c, e, g),
step α of transferring the $4n+1^{\text{th}}$ stitches (a, e) of the first stitch group to the upper needle bed facing the needle bed on which the stitches (a, e) are held, and transferring the $4n+3^{\text{th}}$ stitches (C, G) of the second stitch group to the upper needle bed facing the needle bed on which the stitches (C, G) are held,
step β of transferring the $4n+3^{\text{th}}$ stitches (c, g) of the first stitch group and the $4n+1^{\text{th}}$ stitches (A, E) of the second stitch group to the upper needle bed on the same side as the needle bed on which the stitches (c, g; A, E) are held through an empty needle formed by the step α ,
step γ of transferring the stitches (a, e; C, G) transferred in the step α to the empty needles formed by the step P through empty needles formed by the step α , and
step δ of transferring the stitches (c, g; A, E) transferred in the step β to the empty needles formed by the step α are performed;
- in the interchanging of the held stitches of the even-numbered target stitches and new stitches, the steps α to δ are carried out with $4n+1$ of the steps α to δ read as $4n+2$, and $4n+3$ read as $4n+4$; and n is a natural number including 0.
5. A knitted fabric including a set-up portion knitted using a flat knitting machine including at least a front and a back needle bed in which a plurality of compound needles, each including a needle main body and a slider with two blades, is arranged in rows, and between which stitches can be transferred; **characterized in that** the set-up portion is knitted by the set-up method of the knitted fabric according to any one of claims 1 to 4.

Fig. 1

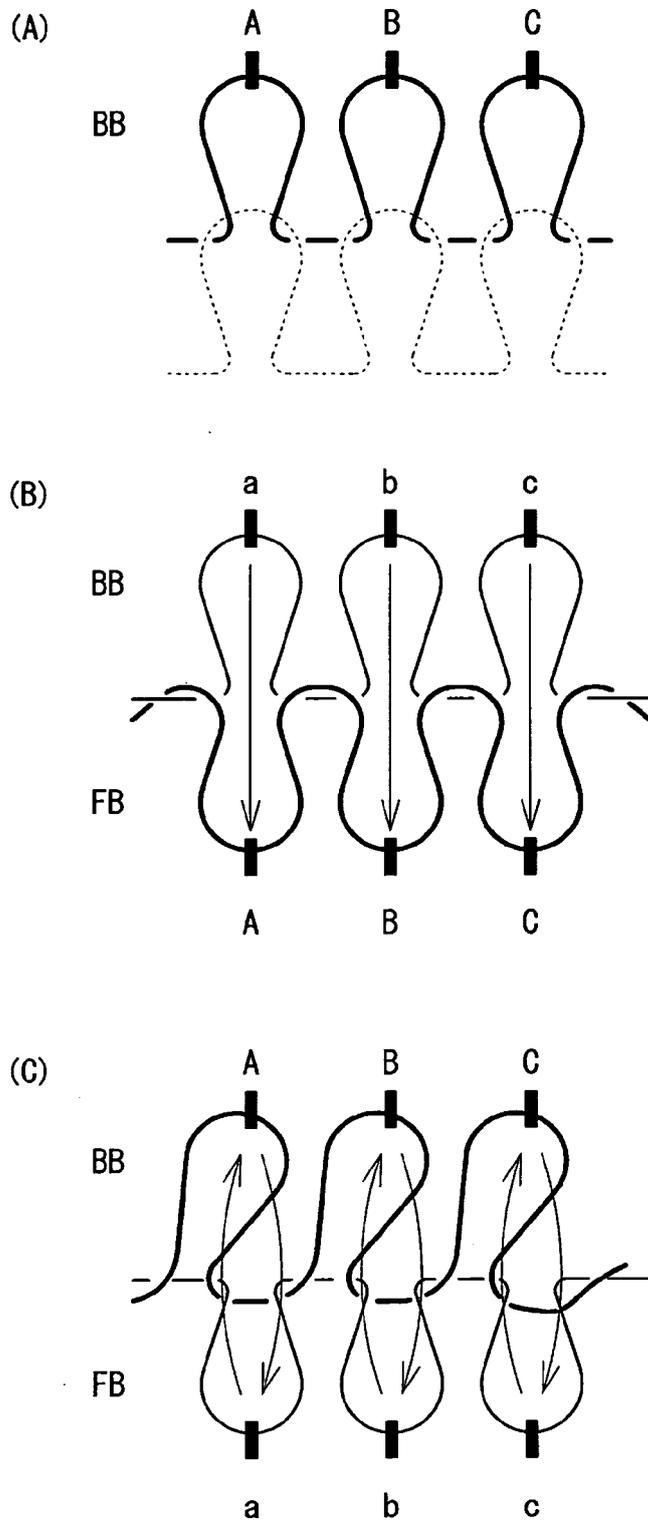


Fig. 2

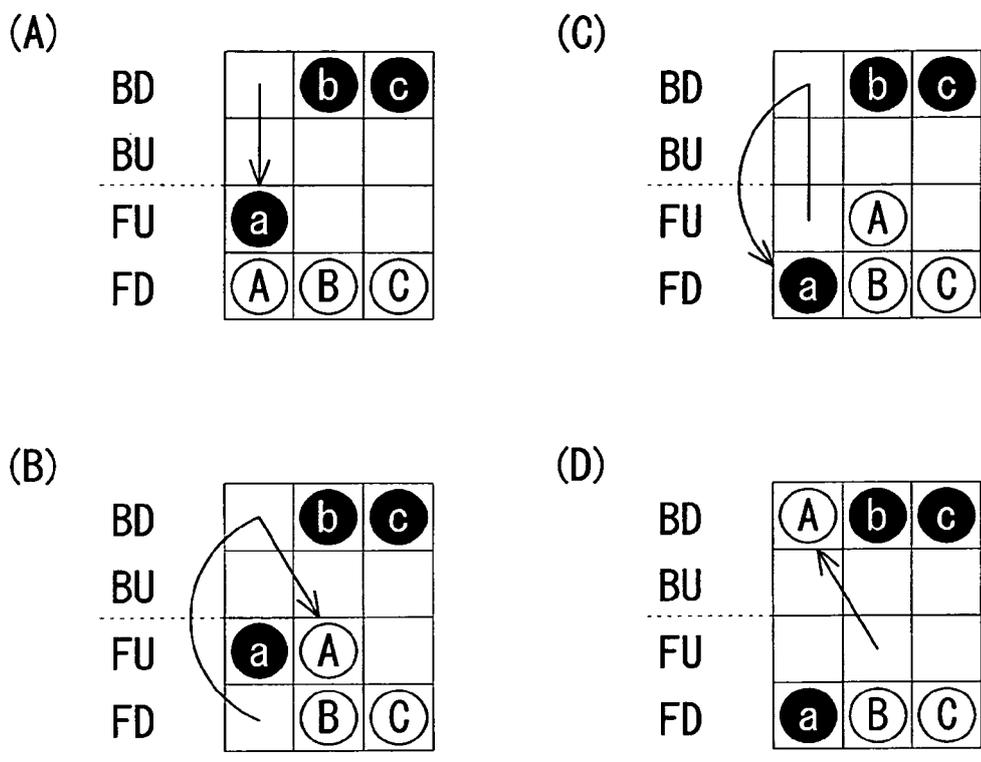


Fig. 3

S8	BD BU FU FD		$\xrightarrow{1P}$
S7	BD BU FU FD		$\xrightarrow{1P}$
S6	BD BU FU FD		$\xleftarrow{2P}$
S5	BD BU FU FD		$\xrightarrow{1P}$
S4	BD BU FU FD		$\xrightarrow{1P}$
S3	BD BU FU FD		$\xleftarrow{1P}$
S2	BD BU FU FD		
S1	BD BU FU FD		

Fig. 4

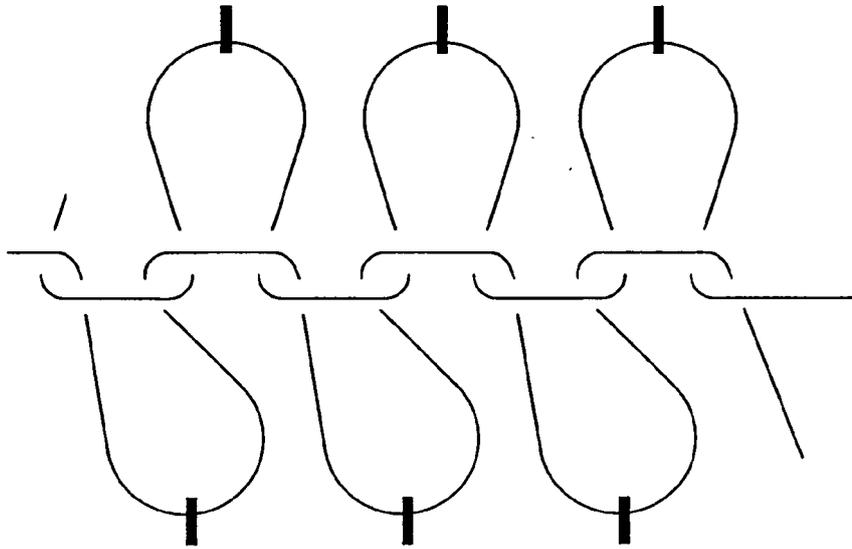
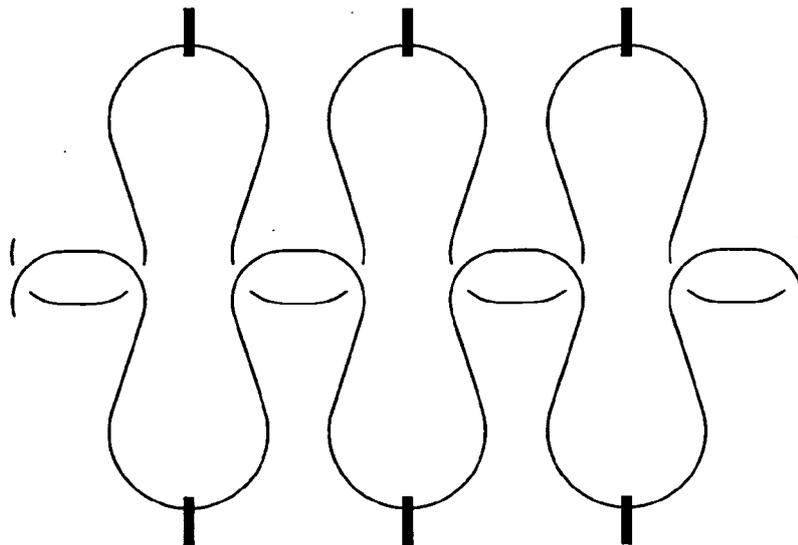


Fig. 5





EUROPEAN SEARCH REPORT

Application Number
EP 12 00 4877

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	EP 2 327 818 A1 (SHIMA SEIKI MFG [JP]) 1 June 2011 (2011-06-01)	5	INV. D04B1/10
A	* paragraphs [0019], [0020]; claim 2; figure 2 *	1-4	ADD. D04B7/22

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A,P	* paragraphs [0006] - [0008], [0012]; claim 4 *	1-4	

			TECHNICAL FIELDS SEARCHED (IPC)
			D04B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 6 December 2012	Examiner Sterle, Dieter
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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06-12-2012

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

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