



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
17.04.2013 Bulletin 2013/16

(51) Int Cl.:
D04B 1/10 (2006.01)

(21) Application number: **12006854.9**

(22) Date of filing: **02.10.2012**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **03.10.2011 JP 2011219501**

(71) Applicant: **SHIMA SEIKI MFG. LTD.**
Wakayama-shi
Wakayama 641-8511 (JP)

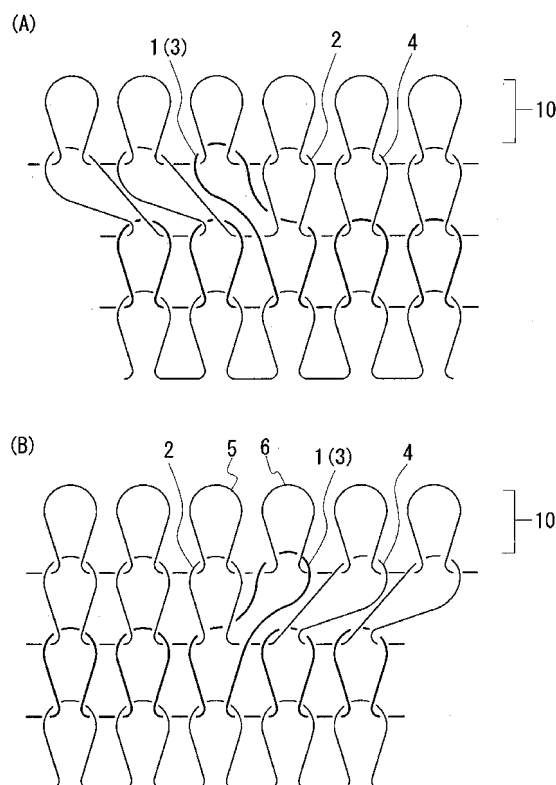
(72) Inventors:
• **Okamoto, Kazuyoshi**
Wakayama-shi
Wakayama, 641-8511 (JP)
• **Yamada, Hisao**
Wakayama-shi
Wakayama, 641-8511 (JP)

(74) Representative: **Wagner, Karl H.**
Wagner & Geyer
Gewürzmühlstrasse 5
80538 Munich (DE)

(54) **Method of knitting a knitted fabric**

(57) To provide a knitting method of a knitted fabric in which the knitting yarn does not wind around the widening stitch even if the widening stitch is formed by split knitting using the flat knitting machine equipped with the latch needles. Assuming a direction toward a side, on which a transfer clip arranged at a side surface of the latch needles lined in parallel on the one needle bed FB is present, is a first direction RS and an opposite direction is a second direction LS, the method includes moving a yarn feeder 8 in the first direction RS and performing split knitting on a target stitch 1 (step α). The yarn feeder 8 is moved in the second direction LS to a position beyond a position of the widening stitch 3, which is the target stitch 1 transferred to the other needle bed BB by the split knitting of the step α (step β). The widening stitch 3 is transferred to an empty needle in the one needle bed FB (step γ). The yarn feeder 8 is moved in the first direction RS to a position beyond the position of the widening stitch 3 transferred in the step γ (step δ). A new stitch 4 is formed on the first direction RS side of the widening stitch 3 at the same time as or after the step δ (step ϵ).

Fig. 2



Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a knitting method of a knitted fabric for forming a widening stitch by split knitting using a flat knitting machine equipped with latch needles.

Description of the Related Art

[0002] A knitting method of a knitted fabric for forming a widening stitch by split knitting using a flat knitting machine in which a plurality of latch needles are lined in parallel on at least a front and a back needle bed is conventionally known (see e.g., patent document 1). In the split knitting, while transferring a stitch (target stitch) held on one of the front or back needle bed to the latch needle of the other opposing needle bed, a new knitting yarn is fed to form a new stitch, which is pulled out from the target stitch, on the latch needle of the one needle bed (latch needle on which the transferred target stitch is originally held). After the split knitting, the target stitch is inserted within a knitting width of the knitted fabric as a widening stitch.

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0003] [Patent Document 1] Japanese Unexamined Patent Publication No. 4-73245

SUMMARY OF THE INVENTION

[0004] However, in the knitting method of the knitted fabric for forming a widening stitch by split knitting using the flat knitting machine equipped with the latch needles, the knitting yarn of the new stitch may wind around the root of the target stitch, which becomes the widening stitch, and disfigure the knitted fabric.

[0005] The latch needle includes a transfer clip at one side surface, and is structured to transfer stitches between opposing needle beds through the clip (see e.g., Figs. 1 to 3 in Japanese Unexamined Patent Publication No. 2009-161873, etc.). Thus, the hooks of the latch needles of the opposing needle beds are slightly shifted against each other in a longitudinal direction of the needle beds. This shift causes the knitting yarn of the new stitch to wind around the root of the target stitch.

[0006] Fig. 3A is a loop diagram of the vicinity of a widening stitch 3 of when the widening stitch 3 (originally target stitch 1) is inserted toward the left side within the knitting width of the knitted fabric, and Fig. 3B is a loop diagram of the vicinity of the widening stitch 3 of when the widening stitch 3 is inserted toward the right side with-

in the knitting width of the knitted fabric. As shown in Figs. 3A and 3B, when split knitting is carried out using the flat knitting machine equipped with the latch needles, the knitting yarn of a new stitch 2 winds around the root of the widening stitch 3. Furthermore, comparing Figs. 3A and 3B, the arrangement state of the stitches and the knitting yarn is not symmetrical. Thus, if the knitting width of the knitted fabric is symmetrically increased with a center line of the knitted fabric in between, the appearance near the right and left widening stitches 3 may differ.

[0007] In light of the foregoing, it is an object of the present invention to provide a knitting method of a knitted fabric in which the knitting yarn does not wind around the widening stitch even if the widening stitch is formed by split knitting using the flat knitting machine equipped with the latch needles.

[0008] The present invention is a knitting method of a knitted fabric using a flat knitting machine, which includes at least a front and a back needle bed and a yarn feeder for supplying a knitting yarn to a plurality of latch needles lined in parallel on the needle beds and in which stitches are transferable between the front and back needle beds, for forming a widening stitch by split knitting and inserting the widening stitch within a knitting width of the knitted fabric, the split knitting including forming a new stitch following a target stitch, which is a stitch held on one needle bed, while transferring the target stitch to the latch needle of the other needle bed. The knitting method of the knitted fabric of the present invention performs the following steps α to ε assuming a direction toward a side, on which a transfer clip arranged at a side surface of the latch needles lined in parallel on the one needle bed is present, in a longitudinal direction of the one needle bed is a first direction, and an opposite direction is a second direction.

[Step α] Move the yarn feeder in the first direction and perform the split knitting on the target stitch.

[Step β] Move the yarn feeder in the second direction to a position beyond a position of the widening stitch, which is the target stitch transferred to the other needle bed by the split knitting of the step α .

[Step γ] Transfer the widening stitch to an empty needle in the one needle bed.

[Step δ] Move the yarn feeder in the first direction to a position beyond the position of the widening stitch transferred in the step γ .

[Step ε] Form a new stitch on the first direction side of the widening stitch at the same time as or after the step 5.

[0009] According to one aspect of the knitting method of the knitted fabric of the present invention, when forming two widening stitches that form a pair at distant positions in the longitudinal direction of the one needle bed, the one widening stitch and the other widening stitch are preferably inserted within the knitting width of the knitted fabric so that an inserting direction of the one widening stitch and an inserting direction of the other widening stitch are opposite directions to each other.

[0010] According to another aspect of the knitting method of the knitted fabric of the present invention, the

steps α to ε are repeated continuously. In this case, step ε is carried out at the same time as the step δ , and furthermore, $n-1^{\text{th}}$ step δ (include step ε) also serves as n^{th} step α . That is, step $\alpha \rightarrow \text{step } \beta \rightarrow \text{step } \gamma \rightarrow \text{step } \delta (= \text{step } \alpha) \rightarrow \text{step } \beta \rightarrow \text{step } \gamma \rightarrow \text{step } \delta (= \text{step } \alpha) \dots$

[0011] According to the knitting method of the knitted fabric of the present invention, the knitting yarn winding around the widening stitch can be raveled by carrying out the step β to the step ε before knitting the next stitch after performing split knitting to form the widening stitch similar to the prior art in the step α . As a result, the knitting yarn of the new stitch 2 does not wind around the root of the widening stitch 3, as shown in Figs. 2A and 2B of the embodiment, to be described later. Thus, in the knitting method of the knitted fabric of the present invention, the moving direction of the yarn feeder of when carrying out split knitting is very important. Specifically, if the yarn feeder is moved in the second direction (i.e., direction toward a side on which the transfer clip is not present) to carry out split knitting in the step α , the winding of the knitting yarn of the new stitch 2 around the widening stitch 3 cannot be resolved even if the step β to the step ε are carried out.

[0012] In the knitting method of the knitted fabric of the present invention, even if two widening stitches that form a left-right pair are formed and the respective inserting directions are directions opposite to each other, the state of the widening stitches and the stitches in the vicinity thereof can be symmetric (see Figs. 2A and 2B). In the prior art, on the other hand, the symmetrical widening stitches cannot be formed by split knitting using the latch needles, as shown in Figs. 3A and 3B.

[0013] The gaugeless knitting of changing from the half gauge knitting to the full gauge knitting can be carried out in the middle of the knitting of the knitted fabric by continuously repeating the step α to the step ε in the knitting method of the knitted fabric of the present invention (see second embodiment).

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

Fig. 1 is a knitting step diagram showing knitting steps according to a knitting method of a knitted fabric of the present invention using a flat knitting machine equipped with latch needles;

Fig. 2A is a loop diagram of the vicinity of a widening stitch, which is formed according to the knitting method of the knitted fabric of the present invention, of when the widening stitch is inserted toward the left side within the knitting width of the knitted fabric, and Fig. 2B is a loop diagram of the vicinity of the widening stitch of when the widening stitch is inserted toward the right side within the knitting width of the knitted fabric; and

Fig. 3A is a loop diagram of the vicinity of a widening stitch, which is formed according to a knitting method

of a knitted fabric of the prior art, of when the widening stitch is inserted toward the left side within the knitting width of the knitted fabric, and Fig. 3B is a loop diagram of the vicinity of the widening stitch of when the widening stitch is inserted toward the right side within the knitting width of the knitted fabric.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015] Embodiments of the present invention will be hereinafter described based on the drawings. The knitting described in the embodiments explains a knitting example that uses a two-bed flat knitting machine equipped with a front needle bed (hereinafter referred to as FB) and a back needle bed (hereinafter referred to as BB) extending in a transverse direction and disposed opposite to each other in a cross direction. The knitting needles arranged in the flat knitting machine are latch needles having a transfer clip at a side surface of the knitting needles. The flat knitting machine to use may be a four-bed flat knitting machine. The knitted fabric to knit may be a tubular knitted fabric or a single layer knitted fabric, which knitted fabrics can be knitted in either of a full gauge state or a half gauge state.

<First Embodiment>

[0016] In the present embodiment, an example of performing split knitting on a stitch held on the FB to form a widening stitch according to the knitting method of the knitted fabric of the present invention will be described based on a knitting step diagram shown in Fig. 1 (in the present embodiment, half gauge knitting is carried out from the start to the end of the knitting). In the knitting step diagram of Fig. 1, "S + number" on the left column indicates the number of the knitting step, an arrow in a left and right direction in the right column indicates the moving direction of a yarn feeder 8, an arrow in the left and right direction with "K" indicates carrying out knitting with the movement of the yarn feeder 8. A black dot in the middle column showing the actual knitting state indicates the hook of the latch needle arranged on each needle bed, A to L indicate the positions of the latch needles of the FB, a to l indicate the positions of the latch needles of the BB, and the arrow indicates the direction of transfer. In the middle column, the area where the knitting operation is actually carried out in each knitting step is indicated with a thick line, and the stitch held on the latch needle is indicated with a thin line.

[0017] First, S1 shows a state in which the yarn feeder 8 is moved in a left direction in a plane of drawing, and stitches are formed on the latch needles K, I, G, E, C of the FB. In the subsequent knitting steps, the yarn feeder 8 is moved from such state in the right direction in the plane of drawing to form a widening stitch. The latch needles lined on the FB of the present embodiment include a transfer clip at the side surface on the right side in the

plane of drawing. The direction (right direction in the plane of drawing) toward the right side where the transfer clip is present is thus referred to as "first direction RS", and the opposite direction is referred to as "second direction LS".

[0018] In S2, a new stitch following the stitches held on the latch needles C, E of the FB is formed and split knitting is performed on the stitch (target stitch 1) held on the latch needle G of the FB while moving the yarn feeder 8 in the first direction RS. The split knitting includes transferring the target stitch 1 held on the latch needle G of the FB in S1 to the latch needle g of the BB, and forming a new stitch 2 pulled out from the target stitch 1 on the latch needle G of the FB. The target stitch 1 transferred from the latch needle G of the FB in S1 to the latch needle g of the BB is hereinafter referred to as a widening stitch 3.

[0019] In S3, the stitches held on the latch needles C, E of the FB are transferred to the latch needles c, e of the BB. S3 merely makes the subsequent knitting steps efficient, and may not be carried out.

[0020] In S4, the yarn feeder 8 is moved in the second direction LS to a position beyond the position of the widening stitch 3 transferred to the latch needle g of the BB in S2 (correspond to step β of the present invention).

[0021] In S5, the widening stitch 3 formed in S2 is transferred to the latch needle H of the FB (correspond to step γ of the present invention). The needle to which the widening stitch 3 is transferred is not particularly limited as long as it is the latch needle of the FB.

[0022] In S6, the yarn feeder 8 is moved in the first direction RS to a position beyond the position of the widening stitch 3 transferred to the latch needle H of the FB in S5 (correspond to step δ of the present invention). In the present embodiment, when moving the yarn feeder 8 in the first direction RS, a new stitch following the stitches held on the latch needles I, K of the FB is formed (correspond to step ε of the present invention). A state in which the winding of the knitting yarn around the widening stitch 3 is resolved is fixed by forming a new stitch 4 on the latch needle I of the FB. The knitting corresponding to the step ε may be carried out separate from the movement of the yarn feeder 8 corresponding to the step δ .

[0023] The widening stitch 3 is transferred from the latch needle H of the FB to the latch needle g of the BB in S7, and the stitches held on the latch needles c, e, g of the BB (stitch of the latch needle g is the widening stitch 3) are transferred to the latch needles A, C, E of the FB in S8.

[0024] A loop diagram of the vicinity of the widening stitch 3 formed based on the knitting steps described above is shown in Fig. 2A. In Fig. 2A, a state in which a knitting course 10 following in a wale direction of a stitch row held on the FB in S8 of Fig. 1 is formed is shown.

[0025] As apparent with reference to Fig. 2A, the knitting yarn of the new stitch 2 does not wind around the root of the widening stitch 3 if the widening stitch 3 is formed by split knitting according to the knitting step of

the present embodiment, and thus the vicinity of the widening stitch 3 has a satisfactory appearance (see prior art diagram of Fig. 3A for comparison).

[0026] In Fig. 2A, the widening stitch 3 is inserted toward the left side within the knitting width, but the widening stitch 3 may be inserted toward the right side of the knitting width, in which case the state shown in the loop diagram of Fig. 2B is obtained. Comparing Figs. 2A and 2B, it can be seen that the arrangement state of the widening stitch 3 and the knitting yarn of the vicinity thereof is in a symmetric relationship. Therefore, the vicinity of the widening stitches 3, 3 is symmetric when the widening stitch 3 shown in Fig. 2A and the widening stitch 3 shown in Fig. 2B are formed at distant positions in the longitudinal direction of the FB, and hence satisfactory appearance is realized.

<Second embodiment>

[0027] In the present embodiment, a gaugeless knitting of changing from the half gauge knitting to the full gauge knitting in the middle of the knitting of the knitted fabric by carrying out the knitting method of the knitted fabric of the present invention will be described. In the first embodiment, an empty needle is provided to be in the half gauge state in which the latch needle is used every other times before the widening stitch 3 is formed (see S1 of Fig. 1), and such half gauge state is maintained even after the widening stitch 3 is formed (see S8 of Fig. 1). On the other hand, the widening stitch 3 may be moved to the empty needle of the FB to be in the full gauge state after the widening stitch 3 is formed. For instance, after forming the widening stitch 3 in S2 of Fig. 1, S4 to S6 are carried out without carrying out S3. As a result, the widening stitch 3 is inserted to the position of the latch needle H of the FB, and the number of stitches in the knitting width direction of the knitted fabric can be increased without changing the width at which the knitted fabric is held in the needle bed. In this case, when knitting the next knitting course (knitting course 10 at the very top in Fig. 2B) after inserting the widening stitch 3 within the knitting width of the knitted fabric, if the stitch 5 is miss knitted at the position of the new stitch 2, the stitch 2 and the stitch 6 can be branched from the widening stitch 3 without being overlapped and hence the appearance at the vicinity of the widening stitch 3 can be improved.

[0028] The step α to step ε in the knitting method of the knitted fabric of the present invention may be continuously carried out. For instance, carry out split knitting on the stitch of the latch needle C in S1 of Fig. 1 (step α) → move the yarn feeder 8 in S4 (step β) → transfer the widening stitch 3 in S5 (step γ) → carry out split knitting on the stitch of the latch needle E (step α : also serves as the first steps δ , ε), ... are repeated. Accordingly, the gaugeless knitting of changing from the half gauge knitting to the full gauge knitting in the middle of the knitting of the knitted fabric can be carried out continuously in the course direction. Furthermore, the boundary portion

of the half gauge knitted portion and the full gauge knitted portion in the finished knitted fabric can be beautifully finished.

[0029] The yarn feeder of the flat knitting machine may be a type that is taken with the carriage, or may be self-propelled type.

ing direction of the other widening stitch (3) are opposite directions to each other.

3. The knitting method of the knitted fabric according to claim 1, **characterized in that** the step α to the step ε are repeated continuously.

Claims

1. A knitting method of a knitted fabric using a flat knitting machine, which includes at least a front and a back needle bed and a yarn feeder (8) for supplying a knitting yarn to a plurality of latch needles lined in parallel on the needle beds and in which stitches are transferrable between the front and back needle beds, for forming a widening stitch by split knitting and inserting the widening stitch within a knitting width of the knitted fabric, the split knitting including forming a new stitch (2) following a target stitch (1), which is a stitch held on one needle bed (FB), while transferring the target stitch (1) to the latch needle of the other needle bed (BB); the knitting method **characterized in that** assuming a direction toward a side, on which a transfer clip arranged at a side surface of the latch needles lined in parallel on the one needle bed (FB) is present, in a longitudinal direction of the one needle bed (FB) is a first direction (RS), and an opposite direction is a second direction (LS), the method comprises:
 - step α of moving the yarn feeder (8) in the first direction (RS) and performing the split knitting on the target stitch (1);
 - step β of moving the yarn feeder (8) in the second direction (LS) to a position beyond a position of the widening stitch (3), which is the target stitch (1) transferred to the other needle bed (BB) by the split knitting of the step α ;
 - step γ of transferring the widening stitch (3) to an empty needle in the one needle bed (FB);
 - step δ of moving the yarn feeder (8) in the first direction (RS) to a position beyond the position of the widening stitch (3) transferred in the step γ ; and
 - step ε of forming a new stitch (4) on the first direction (RS) side of the widening stitch (3) at the same time as or after the step δ .
2. The knitting method of the knitted fabric according to claim 1, **characterized in that** when forming two widening stitches (3, 3) that form a pair at distant positions in the longitudinal direction of the one needle bed (FB), the one widening stitch (3) and the other widening stitch (3) are inserted within the knitting width of the knitted fabric so that an inserting direction of the one widening stitch (3) and an insert-

Fig. 1

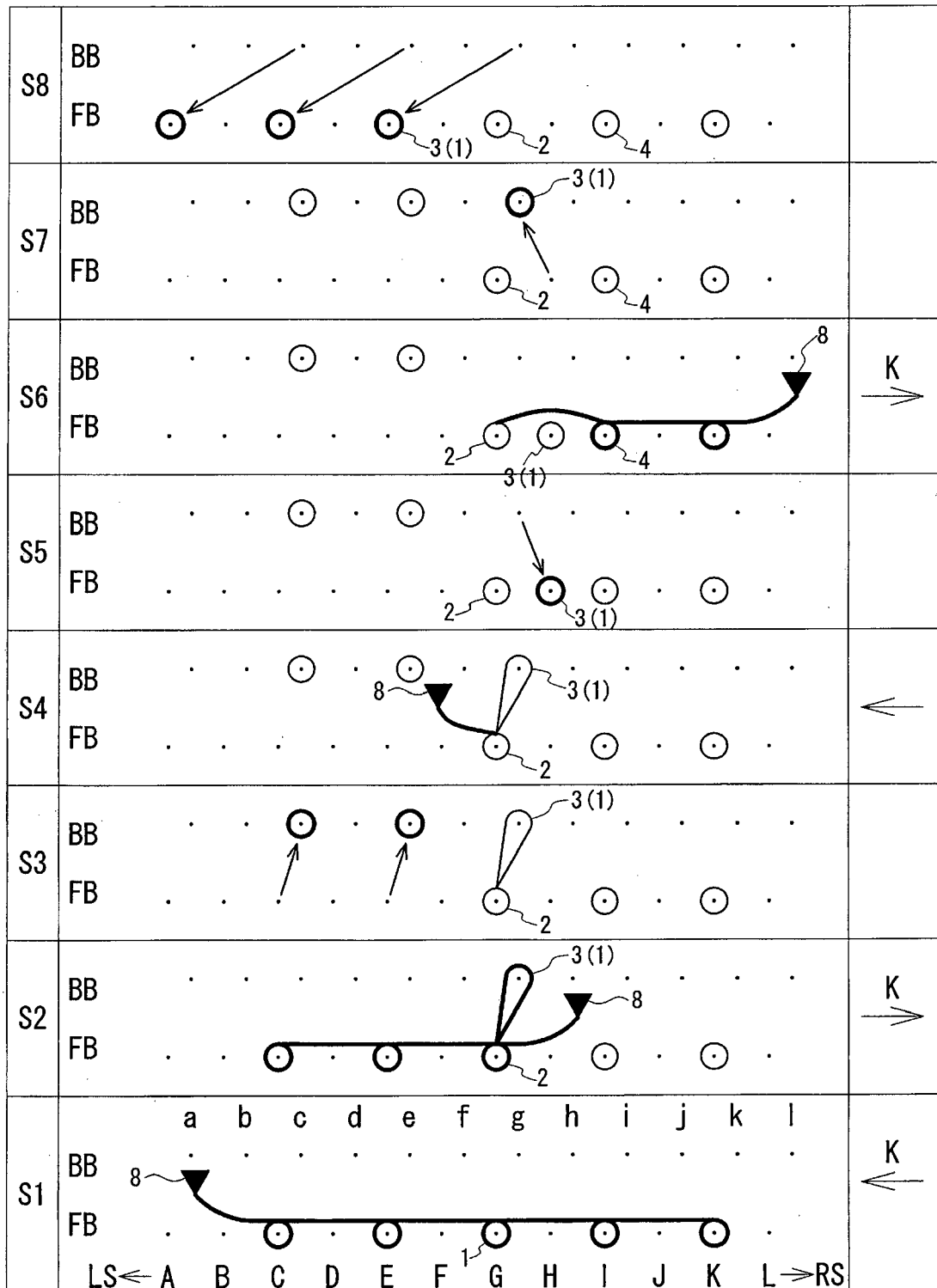


Fig. 2

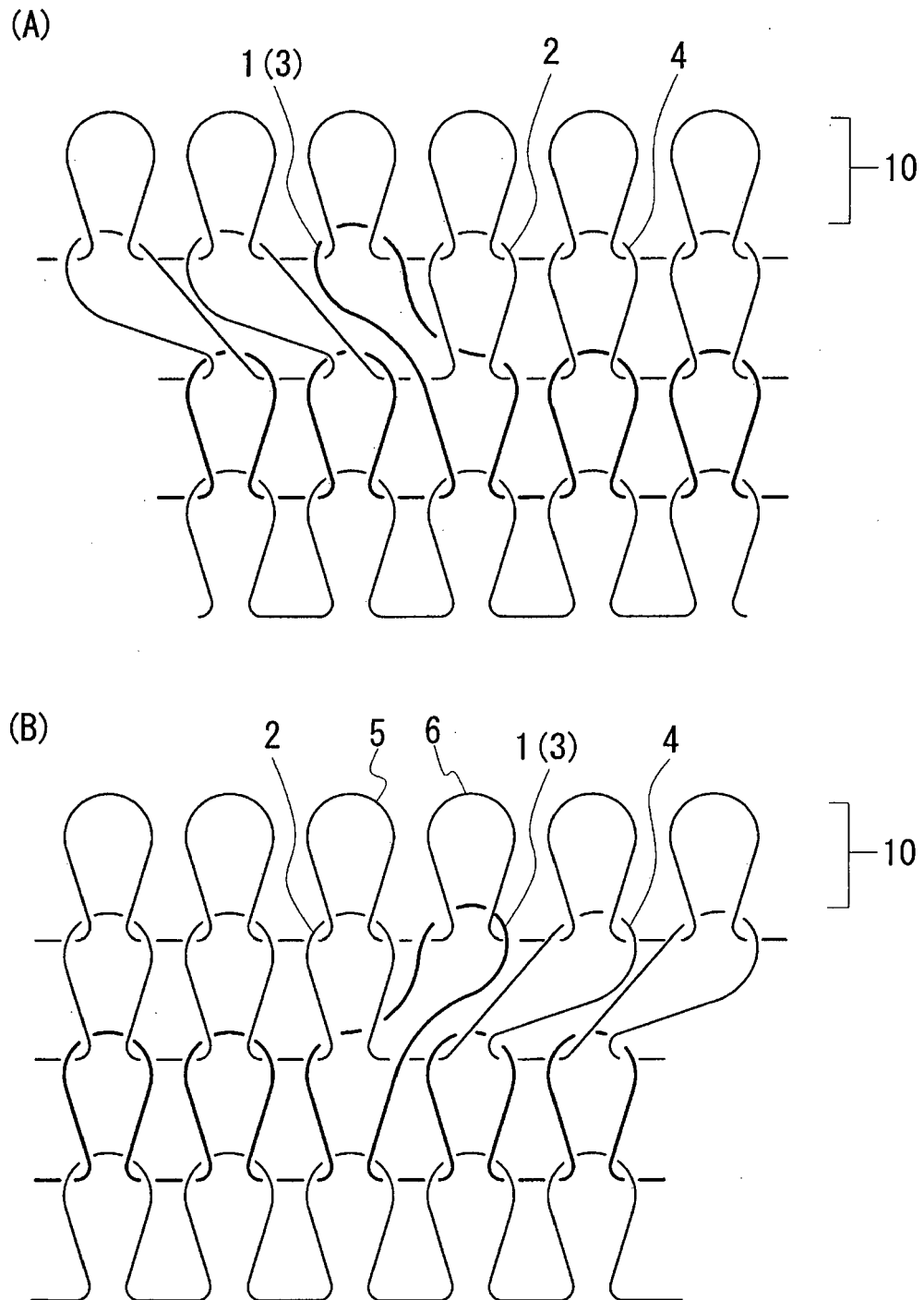
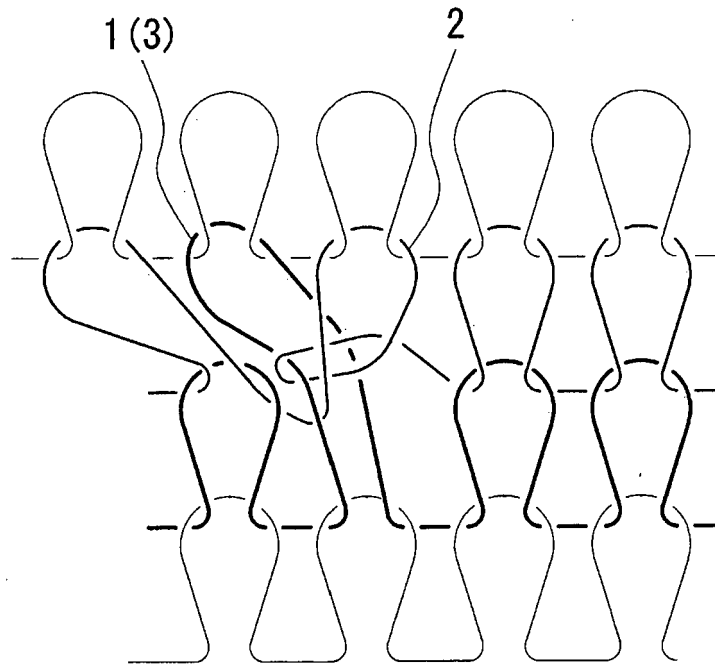
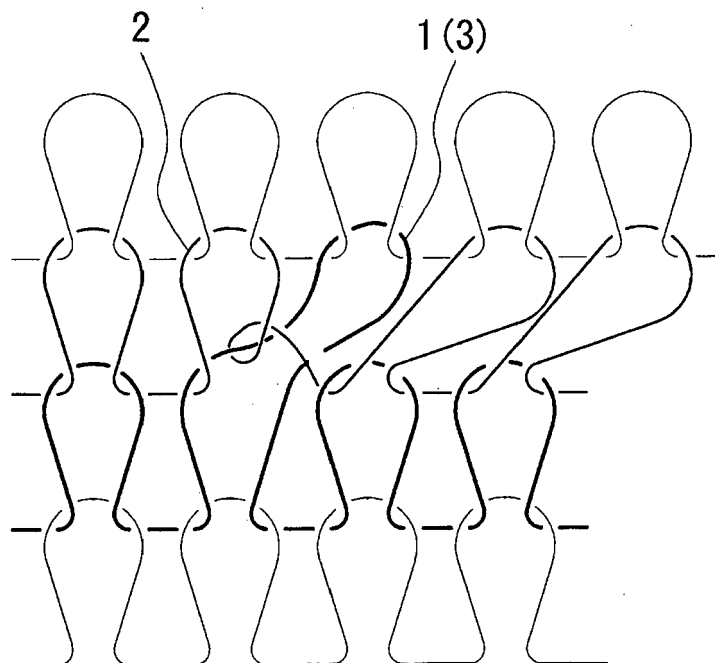


Fig. 3

(A)



(B)





EUROPEAN SEARCH REPORT

Application Number
EP 12 00 6854

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 0 490 694 A1 (SHIMA SEIKI MFG [JP]) 17 June 1992 (1992-06-17) * page 4, line 3 - page 5, line 50; figures 1-4 *	1-3	INV. D04B1/10
A	US 6 308 536 B2 (ROELL FRIEDRICH [DE]) 30 October 2001 (2001-10-30) * column 4, lines 13-49; figures 1,10 *	1-3	
A,D	EP 0 466 439 A2 (SHIMA SEIKI MFG [JP]) 15 January 1992 (1992-01-15) * column 3, lines 12-29; figure 3 *	1-3	
			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 14 March 2013	Examiner Wendl, Helen
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			

 1
EPO FORM 1503 03.82 (P04C01)

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

EP 12 00 6854

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

14-03-2013

Patent document cited in search report		Publication date		Patent family member(s)	Publication date
EP 0490694	A1	17-06-1992	DE	69121857 D1	10-10-1996
			DE	69121857 T2	23-01-1997
			EP	0490694 A1	17-06-1992
			ES	2091304 T3	01-11-1996
			JP	2538421 B2	25-09-1996
			JP	4214448 A	05-08-1992
			US	5417088 A	23-05-1995

US 6308536	B2	30-10-2001	DE	19616003 A1	23-10-1997
			EP	0904439 A1	31-03-1999
			EP	1069221 A2	17-01-2001
			EP	1074647 A2	07-02-2001
			EP	1074648 A2	07-02-2001
			EP	1074649 A2	07-02-2001
			EP	1074650 A2	07-02-2001
			JP	2001501259 A	30-01-2001
			US	6116057 A	12-09-2000
			US	6233976 B1	22-05-2001
			US	2001001925 A1	31-05-2001
			WO	9740220 A1	30-10-1997

EP 0466439	A2	15-01-1992	DE	69112929 D1	19-10-1995
			DE	69112929 T2	08-02-1996
			EP	0466439 A2	15-01-1992
			ES	2077803 T3	01-12-1995
			JP	4073245 A	09-03-1992

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 4073245 A [0003]
- JP 2009161873 A [0005]