(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 1 995 363 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 158(3) EPC

(43) Date of publication:
26.11.2008 Bulletin 2008/48

(21) Application number: **07736914.8**

(22) Date of filing: **19.03.2007**

(51) Int Cl.:
D04B 7/26 *(2006.01)* ***D04B 1/00*** *(2006.01)*

(86) International application number:
PCT/JP2007/000257

(87) International publication number:
WO 2007/119272 (25.10.2007 Gazette 2007/43)

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR

(30) Priority: **20.03.2006 JP 2006077846**

(71) Applicant: **Shima Seiki Mfg., Ltd**
Wakayama-shi,
Wakayama 641-8511 (JP)

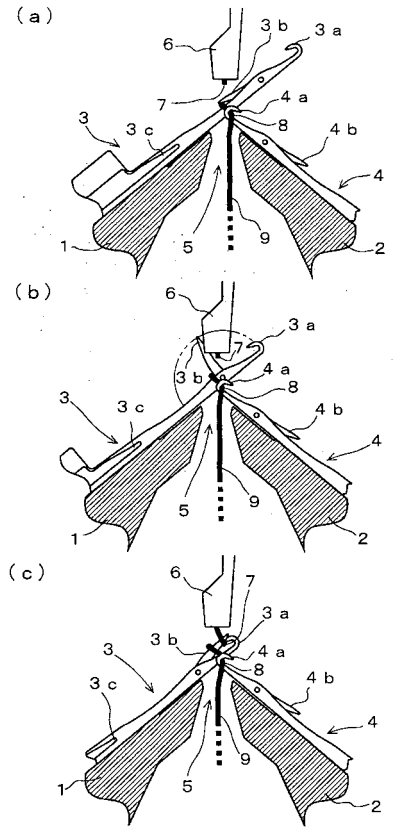
(72) Inventors:
- **NISHIKAWA, Fumihiro**
Wakayama-shi, Wakayama 641-8511 (JP)
- **YAMANISHI, Masaki**
Wakayama-shi, Wakayama 641-8511 (JP)
- **CHAN, Roger Kwok Hung**
Gladstone Park, Victoria 3043 (AU)
- **TSUBOI, Masumi**
Wakayama-shi, Wakayama 641-8511 (JP)

(74) Representative: **Geyer, Ulrich F.**
Wagner & Geyer
Patentanwälte
Gewürzmühlstrasse 5
80538 München (DE)

(54) METHOD FOR KNITTING FABRIC AND DESIGN DEVICE

(57) To capture a knitting yarn which is floating from a tip part and difficult to capture surely in the hook of a knitting needle. When a stitch loop is transferred to the knitting needle of a rear needle bed in order to increase the stitch loop formed by the knitting needle of a front needle bed, the knitting yarn is also fed to the hook of the knitting needle from a yarn carrier to form a new stitch loop. When the knitting needle is pulled in to the front needle bed side, the stitch loop remaining in the knitting needle raises a latch and displaces it to close the hook. Since the knitting yarn hanging down from the distal end of the feeder of the yarn carrier extends in the direction perpendicular to the paper surface and passes through the open/close range of the latch, the knitting yarn can be captured in the hook.

Fig. 1



EP 1 995 363 A1

Description

Technical Field

[0001] The present invention relates to a method for knitting a fabric and a design device to, in intarsia patterns, floating stitches, and the like, capture a knitting yarn in the hook of a knitting needle when the knitting yarn is let loose to avoid engagement in the knitting needle and be fed as a cross-over yarn.

Background Art

[0002] Conventionally, a flat knitting machine is used to knit fabrics including an intarsia pattern and the like by changing over a plurality of knitting yarns in the same knitting course (for example, see Patent Citation 1).
Knitting yarns used for knitting fabrics on flat knitting machines are fed to knitting needles from a yarn feeding member such as a yarn carrier, which moves along a needle bed gap in cooperation with the fabric knitting operation of the knitting needles. The intarsia pattern and the like to be knitted are in the form of being fitted in the fabric serving as a ground. Consequently, at the start portion and the end portion of the intarsia pattern and the like, yarn in and yarn out of a knitting yarn different from the ground fabric are carried out.
[0003] When the fed in knitting yarn is provided with a long distance for a cross-over yarn, which is let loose to avoid engagement in the knitting needle, the position of yarn feeding from a yarn carrier and the like floats from the needle bed gap at the end part where knitting of an intarsia pattern and the like starts, thereby making it difficult to capture the fed knitting yarn in the hook of the knitting needle. In addition, in a crossing section where the yarn becomes a cross-over yarn after yarn out, the cross-over yarn might be erroneously captured in a knitting needle that is knitting the fabric and thus be knitted into the fabric or might be entangled to the detriment of the knitting operation. The problem of floating of the cross-over yarn from the needle bed gap and difficulty in capturing in the knitting needle occurs not only in the intarsia-pattern knitting but also in fabrics of the floating stitch. In order to prevent the cross-over yarn from floating between the needle bed gap in the cross-over section and to secure that the knitting needle captures the cross-over yarn at the end of a knitting section where the cross-over yarn is used as a knitting yarn, such processing is carried out as knitting the cross-over yarn into the fabric such as by a tuck in the cross-over section, thus preventing the cross-over yarn from floating from the needle bed gap. However, knitting the cross-over yarn into the fabric by a tuck and the like requires the work of removing the knitted cross-over yarn portion in the subsequent process.
[0004] Also proposed are a yarn processing method and a knitting method that temporarily capture the knitting yarn to be a cross-over yarn with the use of knitting needles in the cross-over section and release the captured cross-over yarn after knitting of a plurality of courses (see, for example, Patent Citations 2 and 3). However, as the interval between the capturing knitting needles increases, the cross-over yarn floats from the needle bed gap. Therefore, when the cross-over section is elongated, the number of capturing knitting needles must be increased.
Also disclosed is a method for capturing the cross-over yarn such that instead of engaging the cross-over yarn in the hook of the knitting needle, the knitting needle is guided to the lower side of the hook and held (see, for example, Patent Citation 4). The requisite of this method is that the movements of the knitting needle and yarn feeding member are individually controllable, which necessitates mounting of a new cam mechanism in the flat knitting machines, by which fabrics are knitted while moving a carriage mounting therein a cam mechanism along the needle bed gap with the accompaniment of the yarn carrier.

Patent Citation 1: Japanese Examined Patent Application Publication No. S61-51061.
Patent Citation 2: Japanese Published Patent Application No. H07-310262.
Patent Citation 3: Japanese Published Patent Application No. H09-31802.
Patent Citation 4: Japanese Published Patent Application No. H09-31804

Disclosure of Invention

Technical Problem

[0005] It is an object of the present invention to provide a method for knitting a fabric and a design device which can surely capture a knitting yarn which is floating from a needle bed gap and difficult to capture in the hook of a knitting needle.

Technical Solution

[0006] The present invention provides a method for knitting a fabric on a flat knitting machine provided with at least a pair of front and rear needle beds opposed to one another across a needle bed gap, each of the needle beds being provided with a multiplicity of latch needles as knitting needles, which comprises:

carrying out a split knit of a stitch loop held in the knitting needle of the one needle bed into a knitting needle of the other needle bed; and
capturing a knitting yarn as a newly formed knitting loop in a hook of a knitting needle of the one needle bed, the knitting yarn serving as a cross-over yarn by being let loose over a distance so as to avoid engagement of the knitting yarn in knitting needles, the distance makes it difficult to capture the knitting yarn in a hook of a knitting needle which independ-

ently carrying out a stitch forming operation.

[0007] According to the present invention,
prior to the split knit, the held stitch loop is transferred to the knitting needle of the one needle bed from a fabric belonging to the other needle bed; and
after the split knit, the newly formed stitch loop is removed from the knitting needle of the one needle bed.

[0008] According to the present invention,
the knitting yarn is used for knitting an inner area of the fabric and becomes the cross-over yarn during yarn out;
the split knit is carried out in the vicinity of an end portion of the fabric; and
after the split knit, the newly formed stitch loop is removed from the knitting needle of the other needle bed after knitting of a predetermined number of courses.

[0009] According to the present invention,
the stitch loop newly formed by the split stitch is removed from the knitting needle of the one needle bed after, subsequent to the split stitch, a stitch is formed on a knitting needle different from the knitting needle used for the split stitch.

[0010] According to the present invention,
the stitch loop subjected to the split stitch into the knitting needle of the other needle bed, or a stitch loop knitted following the split stitch loop is transferred to the one needle bed side to stop ravel.

[0011] According to the present invention,
the knitting yarn is fed in such a manner that the knitting yarn becomes the cross-over yarn from a portion kitted before the plurality of courses of the fabric;
in a knitting course where the split knit is carried out, a portion where the knitting yarn crosses between the needle beds is formed in the vicinity of the end portion of the fabric; and
the crossing portion is released after the cross-over yarn is fed in and captured in the knitting needle carrying out the split knit through the crossing portion.

[0012] Furthermore, the present invention provides a design device of a fabric for creating knitting data to knit a fabric on a flat knitting machine, the flat knitting machine being provided with at least a pair of front and rear needle beds opposed to one another across a needle bed gap, each of the needle beds being provided with a multiplicity of latch needles as knitting needles, the knitting data created by the design device causing the flat knitting machine to execute a method which comprises;
carrying out a split knit of a stitch loop held in the knitting needle of the one needle bed into a knitting needle of the other needle bed; and
capturing a knitting yarn as a newly formed knitting loop in a hook of a knitting needle of the one needle bed, the knitting yarn serving as a cross-over yarn by being let loose over a distance so as to avoid engagement of the knitting yarn in knitting needles, the distance makes it difficult to capture the knitting yarn in a hook of a knitting needle which independently carrying out a stitch forming operation.

Advantageous Effects

[0013] According to the present invention, a multiplicity of latch needles are disposed on a pair of front and rear needle beds as knitting needles, and even the knitting yarn in the cross-over yarn state floating from the needle bed gap is guided inside the hook when a split stitch between the needle beds causes the stitch loop subjected to the split into an opposite needle bed to close the latch in the needle bed gap, thereby making it possible to surely capture the knitting yarn. Thus, the knitting yarn is definitely captured and knit a stable fabric.

[0014] In addition, according to the present invention, the stitch loop subjected to the split stitch is one that is transferred in advance from the needle bed to which the fabric belongs to the opposite needle bed, which makes it possible to return the transferred stitch loop to the original needle bed side as the split stitch. After the split stitch, the new stitch loop is removed from the knitting needle to which the transfer was carried out, thereby eliminating the need for processing of the stitch loop newly formed by the split stitch in a subsequent process.

[0015] In addition, according to the present invention, even in the case where the distance of the cross-over yarn is long when the yarn is out, the cross-over yarn is surely captured in the hook of the knitting needle in the vicinity of the end portion of the fabric, and in predetermined course knitting, the cross-over yarn is able to be held to prevent it from floating between the needle bed gap.

[0016] In addition, according to the present invention, the stitch loop newly formed by the split stitch is removed after a stitch loop following the split stitch is formed on a knitting needle different from the knitting needle of the stitch loop that was used for the split stitch. This makes it possible to surely capture the knitting yarn with the use of the split stitch at the time of yarn feeding, and to return the stitch loop to the fabric before transfer, whereby the stitch loop can be rendered equivalent to a stitch loop formed by a single knitting.

[0017] In addition, according to the present invention, the stitch loop follows the split stitch can be returned to the split starting side by transfer instead of being removed so as to be utilized effectively to prevent a ravel.

[0018] In addition, according to the present invention, the state in which the knitting yarn fed in a state of a cross-over yarn, which avoids engagement in the knitting needle, floats from the needle bed gap varies depending on differences in the position of a portion of the knitting yarn where the preceding knitting course finished. Before the knitting course in which the cross-over yarn is reused, a portion where the knitting yarn crosses the needle beds is formed, and therefore, the cross-over yarn is fed to the knitting needle that carries out the split stitch through the crossing portion. By forming the crossing portion in the vicinity of the end portion of the fabric, the crossing portion is rendered a starting point of yarn feeding to have a uniform condition for capturing the knitting yarn in the

hook of the knitting needle, thereby making it possible to ensure the capture.

[0019] Furthermore, according to the present invention, knitting data can be created in such a manner that when a knitting yarn not engaged in the knitting needle becomes a cross-over yarn by floating from the needle bed gap, such knitting yarn can be surely captured in the hook of the knitting needle by split stitch.

Brief Description of Drawings

[0020]

[Fig. 1] Fig. 1 is a side cross sectional view, in partial, of one embodiment of the present invention showing a state in which a knitting yarn is captured in the hook of a knitting needle with the use of a knitting operation of split stitch.

[Fig. 2] Fig. 2 is a partial plan view showing one example of a cam system 10 that carries out a knitting operation to a knitting needle 3 of a front needle bed 1, which carries out transfer by the split stitch operation shown in Fig. 1.

[Fig. 3] Fig. 3 is a partial plan view showing a state in which a knitting needle 4 of a rear needle bed 2 is made to perform a knitting operation for a stitch receiving side by the split stitch operation shown in Fig. 1 with the use of the cam system 10 of Fig. 2.

[Fig. 4] Fig. 4 is a side cross sectional view, in partial, showing a state in which the knitting needle 3 is made to perform a knitting operation of a knit with the use of the cam system 10 of Fig. 2.

[Fig. 5] Fig. 5 is a partial plan view showing a switching state of the cam system 10 when the knitting operation of a knit as shown in Fig. 4 is performed.

[Fig. 6] Fig. 6 is a simplified diagram showing an example of a fabric 9 shown in Fig. 1.

[Fig. 7] Fig. 7 is a front view schematically showing a structure of a flat knitting machine 30 that knits the fabric 9 shown in Fig. 6.

[Fig. 8] Fig. 8 is a diagram showing a state in which knitting of an X section in the wale direction is finished and knitting of Y and Z sections for the fabric 9 of Fig. 6 is carried out.

[Fig. 9] Fig. 9 shows a state in which knitting of the X section in the wale direction is finished and knitting of the Y and Z sections for the fabric 9 of Fig. 6 is carried out.

[Fig. 10] Fig. 10 shows a state in which knitting of the X section in the wale direction is finished and knitting of the Y and Z sections for the fabric 9 of Fig. 6 is carried out.

[Fig. 11] Fig. 11 is a front view showing effects of forming a crossing portion in a course 1 of Fig. 8.

[Fig. 12] Fig. 12 is a flow chart showing a schematic procedure in which a cross-over yarn is captured by an increment.

[Fig. 13] Fig. 13 is a block diagram showing a schematic structure of a design device that creates knitting data including the schematic procedure in which a crossing yarn is captured by split stitch.

Explanation of Reference

[0021]

1.	Front needle bed
2.	Rear needle bed
3 and 4.	Knitting needles
3a and 4a	Hooks
3b and 4b	Latches
5	Needle bed gap
6, 6a and 6b	Yarn carriers
8.	Stitch loop
9.	Fabric
10.	Cam system
12.	Needle raising cam
13 and 14	Stitch cams
15.	Stitch forming cam rock
16.	Stitch receiving transfer cam
17.	Transfer cam for both transfer and reception
18.	Stitch transferring cam rock
20.	Movable portion
28 and 29	End portions
30	Flat knitting machine
31	Carriage
40	Starting point
50	Design device

Best Mode for Carrying Out the Invention

[0022] Fig. 1 is one embodiment of the present invention showing a state in which a knitting yarn is captured in the hook of a knitting needle with the use of a knitting operation of split stitch. In a flat knitting machine provided with a front needle bed 1 and a rear needle bed 2, in order to execute a split stitch method as disclosed in, for example, Japanese Examined Patent Application Publication No. S62-52063, a driving mechanism of knitting needles 3 and 4 is provided that is capable of, while transferring a stitch loop formed in the preceding course between the needle beds, forming a new stitch loop also on the knitting needle on the stitch-transferring side. The front needle bed 1 and the rear needle bed 2 are opposed to one another across a needle bed gap 5, and able to advance and retire the tip sides of the knitting needles 3 and 4 back and forth with respect to the needle bed gap 5. The knitting needles 3 and 4 on their tip sides are respectively provided with hooks 3a and 4a and latches 3b and 4b. In order to transfer a stitch loop from one of the knitting needles 3 and 4 to the other in the needle bed gap 5, the knitting needle 3 at its midpoint is provided with a clip 3c. Above the needle bed gap 5, a yarn carrier 6 is movably provided in a direction perpendicular to the paper surface and feeds knitting yarn 7 through a yarn

feeding port at the distal end. When the knitting yarn 7 is fed to the hooks 3a and 4a of the knitting needles 3 and 4 in the needle bed gap 5, a stitch loop 8 is formed by the knitting operation of the knitting needles 3 and 4, and as the knitting proceeds, the stitch loop 8 parts from the knitting needles 3 and 4 to form a fabric 9 and hangs below the needle bed gap 5 by dead weight and various kinds of biasing. In an split stitch with the stitch loop 8 formed on the knitting needle 3 of the front needle bed 1, when the stitch loop 8 is transferred to the knitting needle 4 of the rear needle bed 2, a new stitch loop is also formed on the hook 3a of the knitting needle 3 from a knitting yarn 7 fed from the yarn carrier 6.

[0023] Fig. 1(a) shows a state in which after the stitch loop 8 is held at the clip 3c portion of the knitting needle 3 of the front needle bed 1 and is allowed to advance to the needle bed gap 5, the hook 4a of the knitting needle 4 of the rear needle bed 2 is allowed to go into the clip 3c portion and the stitch loop 8 is engaged in the hook 4a. When the knitting needle 3 is pulled to the front needle bed 1 side, the stitch loop 8 parts from the clip 3c and comes close to the tip of the latch 3b in an open state, since the stitch loop 8 is engaged in the hook 4a of the knitting needle 4 of the rear needle bed 2. As shown in Fig. 1(b), when the knitting needle 3 is further pulled to the front needle bed 1 side, the stitch loop 8 remaining on the knitting needle 3 raises and displaces the hook 3b in such a manner as to close the hook 3a. Although the position of the yarn carrier 6 relative to the knitting needles 3 and 4 is deviated in the direction perpendicular to the paper surface, the knitting yarn 7 hanging from the tip of the yarn feeding port extends in the direction perpendicular to the paper surface, and passes through the latch 3b open/close range. As shown in Fig. 1(c), when the latch 3b closes the hook 3a while the stitch loop 8 is passing, the knitting yarn 7 fed through the yarn feeding port of the yarn carrier 6 can be captured in the hook 3a. When the knitting needle 3 is further pulled to the front needle bed 1 side, the portion of the stitch loop 8 engaged in the knitting needle 3 comes around the tip of the knitting needle 3 along the circumferential portion of the latch 3b that is closing the hook 3a, thus parting from the knitting needle 3. The parting stitch loop 8 is engaged only in the hook 4a at the tip of the knitting needle 4 to end up as a stitch loop on the rear needle bed 2 side while being a knocked-over former loop for the stitch loop newly formed on the knitting needle 3.

[0024] Fig. 2 shows one example of a cam system 10 that carries out the knitting operation to the knitting needle 3 of the front needle bed 1, which carries out transfer by the split stitch operation shown in Fig. 1. As described later, this cam system is one of a plurality of sets mounted to the carriage along the needle bed gap 5, and is shown with the needle bed gap side upward. Hereinafter, when reference is made to "up" and "down" relative to the needle bed gap, a portion closer to the needle bed gap may be indicated as "upper" and a portion away from the needle bed gap may be indicated as "lower".

[0025] A ground board 11 of the carriage facing the needle bed is provided with a stitch forming cam rock 15 including a needle raising cam 12 and stitch cams 13 and 14, and a stitch transferring cam rock 18 including a stitch receiving transfer cam 16 and a transfer cam 17 for both transfer and reception. The stitch cams 13 and 14 can be displaced along a direction parallel to slanted cam surfaces 13a and 14a so as to adjust the stitch density. The needle raising cam 12 has a lower fixed portion 19 and an upper movable portion 20. The movable portion 20, provided with a mechanism not shown, protrudes and recedes with respect to the ground board 11 alternately with the transfer cam 17 for both transfer and reception in such a manner that when one protrudes, the other recedes. The movable portion 20 is provided with a butt guiding groove 20a. The butt guiding groove 20a is bent in a mountainous form with its center portion approaching the needle bed gap side, and links to the slope of the fixed portion 19 through a horizontal shoulder portion 20b on both sides of the groove.

[0026] The fixed portion 19 on its upper center portion is provided with the stitch receiving transfer cam 16 in a freely protruding/receding manner. The stitch receiving transfer cam 16 is symmetrical, both sides of which are inclined in such a manner that a portion closer to the center becomes deeper.

[0027] The transfer cam 17 for both transfer and reception above the needle raising cam 12 is roughly in the form of mountainous triangles with two peaks disposed side by side. On the upper edge side, the transfer cam 17 guides a knitting needle butt on the stitch transferring side, and on the lower edge side, guides a knitting needle butt on the stitch receiving side. Above the transfer cam 17 for both transfer and reception, a transfer guide cam 21 is provided, on both sides of which continue needle guide cams 22.

[0028] When the knitting needle 3 on the stitch transferring side is driven, the movable portion 20 of the needle raising cam 12 is kept in the receding state as indicated by a chain double-dashed line while the transfer cam 17 for both transfer and reception is kept in the protruding state as indicated by a solid line. The knitting needles 3 and 4 are provided with two butts for receiving driving for the knitting operation by the cam system 10, with an upper butt 23 being acted upon by the stitch transferring cam rock 18 and a lower butt 24 being acted upon by the stitch forming cam rock 15.

Assuming that the carriage provided with the cam system 10 runs leftward in the figure, the upper butt 23 and the lower butt 24 of the knitting needle 3 on the stitch transferring side move along the courses indicated by chain double-dashed lines. The positions of the upper butt 23 and the lower butt 24 corresponding to Fig. 1(a), 1(b), and 1(c) are respectively indicated by 23a, 23b, and 23c; 24a, 24b, and 24c. In addition, the position shown as the yarn carrier 6 is represented by the position at which the knitting yarn 7 from the yarn feeding port of the yarn carrier 6 is received in the hook 3a of the knitting needle 3.

[0029] Fig. 3 shows a state in which the knitting needle 4 of the rear needle bed 2 is made to perform a knitting operation for a stitch receiving side by the split stitch operation shown in Fig. 1 with the use of the cam system 10 of Fig. 2. As opposed to the cam system 10 of Fig. 1 being mounted to the carriage of the front needle bed 1, the cam system 10 of Fig. 3 is mounted to the carriage of the rear needle bed 2. Therefore, for convenience of explanation, Fig. 3 is shown to be symmetrical to Fig. 2 with the needle bed gap side down. Corresponding portions in Figs. 2 and 3 are denoted by the same numerals and overlapping explanations will be omitted in Fig. 3. However, when the knitting needle 4 on the stitch receiving side is driven, the movable portion 20 of the needle raising cam 12 is kept in the receding state as indicated by a chain double-dash line while the transfer cam 17 for both transfer and reception is kept in the protruding state as indicated by a solid line.

[0030] In addition, the knitting needle 4 is also acted upon by pressers 25, 26, and 27, though description of which is omitted in Fig. 2. The cam system 10 selects the position of the knitting needle 4 among three positions to be acted upon by one of the pressers 25, 26, and 27, as disclosed in, for example, Fig. 1 of Japanese Examined Patent Application Publication No.H02-10262. The knitting needles 3 and 4 are basically equivalent to those disclosed in Fig. 2 of Japanese Examined Patent Application Publication No.H02-10262.

[0031] The pressers 25, 26, and 27 can be individually switched into or out of action. When the knitting needle 4 is operated as the stitch receiving side, the intermediate presser 27 is switched out of action as indicated by a chain double-dashed line. When the pressers 25 and 26 are made to act upon the knitting needle 4, the lower butt 24 of the knitting needle 4 is no longer acted upon by the fixed portion 19 but is acted upon by the stitch receiving transfer cam 17 at the center to advance to the needle bed gap side. When the knitting needle 4 advances, the upper butt 23 comes in contact with the lower edge of the transfer cam 17 for both transfer and reception and descends along the guide surface formed on the lower edge. When the lower butt 24 comes in contact with the sloping cam surface 13a of the stitch cam 13, the lower butt 24 is guided in such a manner to descend along the cam surface 13a. The positions of the upper butt 23 and the lower butt 24 corresponding to Fig. 1(a), 1(b), and 1 (c) are respectively indicated by 23a, 23b, and 23c; 24a, 24b, and 24c.

[0032] Fig. 4 shows a state in which the knitting needle 3 is made to perform a knitting operation of a knit with the use of the cam system 10 of Fig. 2. In the knit, the tip of the knitting needle 3 is temporarily advanced to the needle bed gap 5 to a clear position where the stitch loop 8 retracts behind the latch 3b. The stitch loop 8 that continues into the fabric 9 stays in the vicinity of the tip of the front needle bed 1, since the fabric 9 is biased below the needle bed gap 5. Fig. 4(a) shows a state in which the knitting needle 3 that was allowed to advance into the needle bed gap 5 to the clear position is pulled back to the front needle bed 1 and is fed a knitting yarn 7 from the yarn carrier 6. As shown in Fig. 4(b), when the knitting needle 3 is pulled to the front needle bed 1 to retract from the needle bed gap 5, the stitch loop 8 starts to close the latch 3b. As shown in Fig. 4(c), when the position of the knitting yarn 7 pending from the yarn feeding port at the distal end of the yarn carrier 6 is high before the latch 3b closes the hook 3a and the stitch loop 8 parts from the tip of the knitting needle 3, then the knitting yarn 7 cannot be captured in the hook 3a for yarn catching. As described in the Patent Citation 4 in relation to its Fig. 2, after a long non-knitting section, the height of the knitting yarn 7 increases to make it difficult to carry out yarn catching by the knitting operation of a knit.

[0033] Fig. 5 shows a switching state of the cam system 10 when the knitting operation of a knit as shown in Fig. 4 is performed. When the knitting needle 3 is driven in the knitting operation of a knit, the movable portion 20 of the needle raising cam 12 is kept in the protruding state as indicated by a solid line while the transfer cam 17 for both transfer and reception is kept in the receding state as indicated by a chain double-dashed line. It should be noted that even when the knitting needle 3 is made to carry out the knitting operation for stitch transfer in the state of Fig. 2, the knitting needle 3 will form a stitch loop similar to a knit unless the opposite knitting needle 4 is made to carry out the knitting operation for stitch reception in the state of Fig. 3. The positions of the upper butt 23 and the lower butt 24 corresponding to Fig. 4(a), 4(b), and 4(c) are respectively indicated by 23a, 23b, and 23c; 24a, 24b, and 24c. In addition, the position shown as the yarn carrier 6 is represented by the position at which the knitting yarn 7 from the yarn feeding port of the yarn carrier 6 is received in the hook 3a of the knitting needle 3.

[0034] Fig. 6 shows a simplified diagram of an example of the fabric 9. In each course, in an X section in the wale direction, a pattern area 9xa of A is knitted, and in a Y section in the wale direction, a pattern area 9yb of B is knitted in a pattern area 9ya of A. In addition, in a Z section in the wale direction, only a pattern area 9za of A is knitted. In such fabric 9, processing of cross-over yarn is required at the time of yarn feeding at an edge portion 28 of the pattern area 9yb and at the time of yarn retrieval from an edge portion 29.

[0035] Fig. 7 schematically shows a structure of a flat knitting machine 30 that knits the fabric 9. The front needle bed 1 is provided with a carriage 31 mounted with a cam system capable of knitting, transfer, split stitch, and the like. The carriage 31 selectively takes yarn carriers 6a and 6b that can travel along a yarn guide rail 32 provided above the needle gap, and travels reciprocatedly in the longitudinal direction of the needle bed. It is assumed that the pattern area of A of Fig. 6 is knitted with a knitting yarn 7a fed from the yarn carrier 6a and the pattern area of B is knitted with a knitting yarn 7b fed from the yarn carrier 6b. In the flat knitting machine 30, the knitting yarns 7a and 7b are fed from cones 33a and 33b

disposed upright on a cone stand plate 33 to the yarn carriers 6a and 6b, respectively, at a substantially constant tension through a yarn tension device 34 and a yarn feeding device 35. When knitting of the fabric 9 starts, the end of the knitting yarn is grasped by a gripper 36 provided at the end portion of the needle bed. In knitting of the fabric 9 of Fig. 6, even when knitting of the X section in the wale direction starts, the end portion of the knitting yarn 7b is grasped by the gripper 36 until knitting of the edge portion 28 of the pattern area 9yb of the Y section starts. Therefore, when knitting of the edge portion 28 starts, the knitting yarn 7 fed from the yarn carrier 6b is at a high position floating from the needle gap 5. Consequently, although in the knitting operation of a knit as shown in Fig. 4 it becomes difficult to capture the knitting yarn 7 in the hook 3a, paying attention to and utilizing the split stitch operation as shown in Fig. 1 can capture the knitting yarn 7 at a high position more surely in the hook 3a.

[0036] Incidentally, the need for capturing the knitting yarn 7 at a high position in the hook 3a occurs not only in knitting of intarsia patterns but also in floating stitches, where knitting is carried out after misses to the knitting needle are continued, and in the case where knitting of an area of an independent fabric such as a pocket newly starts in a fabric. Also in these cases, utilizing the split stitch can capture the knitting yarn 7 surely in the hook 3a.

[0037] Figs. 8, 9, and 10 each show a state in which knitting of the X section in the wale direction is finished and knitting of the Y and Z sections for the fabric 9 of Fig. 6 is carried out. The numbers shown under "course" on the left side of each figure indicate relative course numbers. In the odd-number courses, the carriage runs leftward while in the even-number courses the carriage runs rightward. The symbols shown under "system" on the right side of each figure each show which cam system 10 is used when each carriage 31 mounts thereon three cam systems 10 such as those shown in Figs. 2, 3, and 5. Specifically, S1 indicates a system on the preceding side, S2 indicates an intermediate system, and S3 indicates a system on the following side. Consequently, when the carriage runs leftward, the cam system 10 on the left side is designated as S1 and the cam system 10 on the right side is designated as S3 while when the carriage runs rightward, the cam system 10 on the right side is designated as S1 and the cam system 10 on the left side is designated as S3. It should be noted that the use of the cam system is shown by way of example. In addition, as shown in Fig. 9, since the course 7 and the course 8 are repeated in a plurality of times, the numerical characters on and after the course 9 do not mean the courses on and after the 9th course relative to the course 1.

[0038] In the course 1, using the yarn carrier 6a indicated as "a" and the system S1, the last course knitting in the X section in the wale direction is carried out by the knitting yarn 7a at the front needle bed 1. Simultaneously, using the system S2, a stitch transfer is carried out from the front needle bed 1 to the rear needle bed 2 in the pattern area of A. This stitch transfer is for the purpose of forming a crossing portion in the needle bed gap 5 using the knitting yarn 7a. The position where the crossing portion is formed is preferably in the vicinity of the edge portion of the knitting width of the fabric 9. There is no need to form a new crossing portion in the case where a crossing portion is formed by a rib stitch and the like in the pattern area of A, or in the case where the fabric 9 is knitted in the form of a bag and a knitting yarn that communicates the front needle bed 1 and the rear needle bed 2 with one another exists at the edge portion.

[0039] From the course 2, the first course knitting of the Y section in the wale direction starts. The yarn carrier 6b that feeds the knitting yarn 7b stands by on the left side of the front needle bed 1 as shown in Fig. 7. However, in the case where the X section in the wale direction is already knitted and the pattern area of B is knitted in the X section, the knitting yarn 7b links not to the gripper 36 but to the edge portion of the knitted pattern area of B, from the yarn feeding port at the distal end of the yarn carrier 6b. In this state, when, using the system S3, the yarn carrier 6b indicated as "b" is took rightward, the knitting yarn 7b is fed to the edge portion 28 of Fig. 6 after being engaged in the crossing portion formed in the course 1. At the edge portion 28, split stitch is carried out. As described above, since the split stitch is used, even when the position of the knitting yarn 7b fed from the yarn carrier 6b is high, the knitting yarn 7b can be surely captured in the hook 3a of the knitting needle 3.

[0040] In the case where the configuration and specification of the yarn carrier 6 and the cam system 10 differ, it might be difficult to carry out an split stitch while taking the yarn carrier 6b by the carriage 31. In this case, by the rightward run of the carriage 31, the yarn carrier 6b is moved in advance inside the pattern area 9yb of B and stopped. Although the position of the knitting yarn 7b fed from the yarn carrier 6b at the edge portion 28 of the pattern area 9yb is heightened, it is possible to use separate knitting courses such that the yarn carrier 6b is left and the carriage 31 is moved leftward in an empty course, and then, the carriage 31 runs rightward so as to capture the knitting yarn 7b in the hook 3a by split stitch.

[0041] In the course 3, where the yarn carrier 6b runs leftward and the system S1 is used, formation of a stitch that follows the stitch loop subjected to the split stitch at the knitting needle 4 of the rear needle bed 2 is carried out at the edge portion 28, where the split stitch was carried out in the course 2, and hooking to the knitting needle 4 of the adjacent pattern area 9ya of A is carried out. The stitch loops subjected to the split stitch in the course 2 into the knitting needle 4 of the rear needle bed 2 becomes a former loop by knocking-over.

[0042] In the course 4, the yarn carrier 6b runsa rightward by the system S1, and hooking to the rear needle bed 2 is transferred to the front needle bed 1 by the system S2. By effecting a tension to the knitting yarn 7b in the opposite direction by the system S1 and carrying out a stitch transfer by the system S2 relative to the hooking,

a twisted stitch can be formed at the edge portion of the pattern area side of A of the front needle bed 1.

[0043] In the course 5, the yarn carrier 6b is advanced to the pattern area side of A by the system S1, and furthermore, a stitch transfer is carried out such that the stitch transferred to the knitting needle 4 of the rear needle bed 2 in the course 1 is returned to the knitting needle 3 of the front needle bed 1. When an split stitch is carried out to form a crossing portion, the stitch loop formed on the knitting needle 4 of the rear needle bed 2 is removed and released. This crossing portion functioned as the starting point of yarn feeding and is no longer necessary after completion of the course 2.

[0044] In the course 6, subsequent to the hooking to the edge portion of the adjacent pattern area of A, the course knitting of the pattern area of B is carried out by hauling the yarn carrier 6b by the system S1. In addition, knitting of the pattern area of A is carried out by hauling the yarn carrier 6a by the system S2. Furthermore, with the use of the system S3, the stitch loop that was subjected to the split stitch in the course 2 and is held in the knitting needle 4 of the rear needle bed 2 at the edge portion 28 of the pattern area of B is transferred to the knitting needle 3 of the front needle bed 1.

[0045] In the yarn processing from the course 2 to the course 6, ravel stopping can be carried out for the edge portion 28. Although this ravel stopping is carried out with the use of the stitch loop subjected to the split stitch, this method of ravel stopping is shown by way of example and other methods than this are possible.

[0046] When no ravel stopping is performed, the stitch loop subjected to the split stitch may be removed. Simply removing the stitch loop subjected to the split stitch eventually forms a stitch loop that is similar to one of a knit and is able to be used in the case where the position of the yarn feeding position is heightened due to yarn feeding, floating stitch, and the like. In addition, subsequent to the yarn feeding, in the same knitting course, it is possible to form a stitch loop on a knitting needle different from the knitting needle used for the split stitch and then remove the stitch loop subjected to the split stitch.

[0047] Furthermore, when the stitch loop is temporarily transferred to carry out a split stitch and a stitch loop newly formed by the split stitch is removed, then eventually this returns to the state before the stitch transfer. For example, at the time of yarn feeding to start knitting of the pattern area of B, when the stitch loop at the edge portion of the pattern area of A is transferred to carry out a split stitch, and after forming a stitch loop in the pattern area of B in the knitting course that is the same as or subsequent to the knitting course where the increment was carried out, the stitch loop newly formed by split stitch at the edge portion of the pattern area of A is removed, then the stitch loop in the pattern area of A returns to the state before the stitch transfer, thereby securing yarn feeding for knitting of the pattern area of B.

[0048] In the course 7 and the course 8, the pattern areas of A and B are knitted by repeating a required number of courses while hauling the yarn carriers 6a and 6b by systems S1 and S2.

[0049] In the course 9, where the carriage is moved leftward, the last course knitting is carried out by switching between the pattern area of A and the pattern area of B in the same course. Lastly, by the system S3, a stitch loop of the edge portion 29 of the pattern area of B is transferred from the knitting needle 3 of the front needle bed 1 to the knitting needle 4 of the rear needle bed 2.

[0050] In the course 10, by the system S1, the yarn carrier 6b is hauled and returned to the pattern area of B.

[0051] In the course 11, while hauling the yarn carrier 6b to the side of the pattern area of A by the system S1, in the pattern area of B, hooking is carried out from the edge portion 29 to the knitting needle 3 of the second front needle bed 1, and stitch formation in the knitting needle 4 of the rear needle bed 2 of the edge portion 29 is carried out.

[0052] In the course 12, by the system S1, the stitch loop formed in the knitting needle 4 of the rear needle bed 2 at the end 29 of the pattern area of B is transferred to the knitting needle 3 of the front needle bed 1. In the yarn processing from the course 9 to the course 12, ravel stopping can be carried out for the edge portion 29 where yarn retrieval is carried out. This method of ravel stopping is shown by way of example and other methods than this are of course possible.

[0053] In the course 13, using the system S1, a stitch is transferred from the knitting needle 3 of the front needle bed 1 to the knitting needle 4 of the rear needle bed 2 in the vicinity of the edge portion of the knitting width inside the pattern area of A.

[0054] In the course 14, the yarn carrier 6b is returned to the pattern area of B.

[0055] In the course 15, while moving the yarn carrier 6b outside the knitting width of the fabric 9 so that the yarn carrier 6b is further away from the position of the pattern area of B than the stitch transferred in the course 13, the stitch loop transferred in the course 13 is subjected to a split stitch to the knitting needle 3 side of the front needle bed 1. This can surely capture a cross-over yarn generated by yarn feeding from the edge portion 29 of the pattern area of B in the vicinity of the selvedge of the fabric 9 and prevent floating at the needle bed gap 5.

[0056] In the course 16, the yarn carrier 6b is returned to a position that is closer to the side of the pattern area of B than the positions of the knitting needles 3 and 4 where the split stitch was carried out.

[0057] In the course 17, where the yarn carrier 6b is hauled by the system S1, hooking to outside the knitting width of the fabric 9 is carried out. Since by the split stitch of the course 15 the cross-over yarn is surely captured in the knitting needle 4, the hooking can also be carried out surely. By the system S2, the stitch loop newly formed by the split stitch in the course 15 is removed from the knitting needle 14 of the rear needle bed 2. The removed stitch loop is absorbed as a knitting yarn for yarn retrieval that is to be hooked outside the fabric 9. In addition, the

stitch loop that is a former loop relative to the newly formed stitch loop is the stitch loop transferred in the course 13, and part of this stitch loop is engaged in the front needle bed 1 side by the split stitch in the course 15, and therefore, this stitch loop is absorbed in the stitch loop of the knitting needle 3 of the front needle bed 1, and as a result, the stitch transfer in the course 13 returns to the original in the course 17.

[0058] In the courses 18 and 19, for the Z section in the wale direction, knitting of the pattern area of A is repeated by a required number of courses. The "required courses" means that even when the hooking formed outside in the course 20 is removed at last, the cross-over yarn for yarn retrieval is pulled down from the needle bed gap 5 together with the fabric 9 and the cross-over yarn no longer floats from the needle bed gap 5.

[0059] It is noted that when, after the split stitch is carried out in the course 15, knitting is carried out by a required number of courses and then the stitch loop is removed from the knitting needle 4 of the rear needle bed 2, then the hooking in the course 17 and the removal in the course 20 need not be carried out.

[0060] Fig. 11 shows effects of forming the crossing portion in the course 1 of Fig. 8. Fig. 11(a) shows a state in which the carriage 31 hauls the yarn carrier 6a leftward in the course 1. The yarn carrier 6b, which feeds the knitting yarn 6b, waits outside the knitting width of the fabric 9. In the case where the pattern area of B is knitted prior to the fabric 9, the knitting yarn 7b is the cross-over yarn from the yarn feeding port at the distal end of the yarn carrier 6b.

[0061] Fig. 11(b) shows a state in which the carriage hauls the yarn carrier 6b rightward in the course 2 after a crossing portion is formed by a stitch transfer in the course 1 of Fig. 8. The knitting yarn 7b that is to be a cross-over yarn is fed to knit the edge portion 28 of Fig. 6 with the crossing portion serving as a starting point 40. In the case where no starting point 40 is provided, the cross-over yarn is directly fed from the edge portion of the pattern area of B knitted in advance at the time of knitting of the edge portion 28. The position of the pattern area of B knitted in advance can vary in various ways as the fabric 9 requires, such as 9b1 and 9bs etc., and therefore the knitting conditions of the edge portion 28 to which yarn feeding is carried out change accordingly. Providing the starting point 40 stabilizes the positional relation of a cross-over yarn 7b0 from the starting point 40 to the edge portion 28 even when the positions of cross-over yarns 7b1 and 7b2 vary from pattern areas 9b1 and 9b2 to the starting point 40, thereby making it possible to make the constant knitting conditions uniform.

[0062] Fig. 12 and Fig. 13 show a schematic procedure of a concept to capture the cross-over yarn by a split stitch as described above and a schematic structure of a design device that creates knitting data including the schematic procedure. As shown in Fig. 12, when the fabric 9 shown in Fig. 6 is knitted on the flat knitting machine 30 shown in Fig. 7, pattern data is input in step s1. In step s2, whether there is any section in which the knitting yarn 7 becomes a cross-over yarn is judged. When it is judged that there is a cross-over yarn, the cross-over yarn is captured by a split stitch in step s3. When it is not judged that there is a cross-over yarn in step s2, regular knitting such as a knit is carried out.

[0063] As shown in Fig. 13, a design device 50 is embodied by installing software that designs fabrics to a general-purpose computer 51. The installation may be carried out by downloading through a communication device 54 or by mounting a recording medium to an external memory device 55. This software includes a program to create knitting data that captures a cross-over yarn with the use of a split stitch in the procedure shown in Fig. 12. To the computer 51, an input device 52 such as a keyboard, digitizer, mouse, a display device 53 such as a graphic display, a communication device 54 capable of external communication through the LAN and the like, an external memory device 55 to which various recording media are able to be attached and detached, and the like are connected. An operator inputs design data to the input device 52 and designs the fabric 9 while watching the design results displayed on the display device 53. When the section to be a cross-over yarn becomes long and the operator judges that it is difficult to capture in the hooks 3a ad 4a of the knitting needles 3 and 4 by a usual knitting operation such as a knit, then the operator instructs for a split stitch. In response to this instruction, the computer 51 adds knitting data of the split stitch. The knitting data in which the split stitch is added is transmitted to the flat knitting machine 30 through the communication device 54 or input to the flat knitting machine 30 after being recorded in a recording medium such as a disk and USB memory from the external memory device 55 so as to knit the fabric 9.

Claims

1. A method for knitting a fabric on a flat knitting machine provided with at least a pair of front and rear needle beds opposed to one another across a needle bed gap, each of the needle beds being provided with a multiplicity of latch needles as knitting needles, which comprises:

carrying out a split knit of a stitch loop held in the knitting needle of the one needle bed into a knitting needle of the other needle bed; and

capturing a knitting yarn as a newly formed knitting loop in a hook of a knitting needle of the one needle bed, the knitting yarn serving as a cross-over yarn by being let loose over a distance so as to avoid engagement of the knitting yarn in knitting needles, the distance makes it difficult to capture the knitting yarn in a hook of a knitting needle which independently carrying out a stitch forming operation.

2. The method for knitting a fabric according to claim 1, wherein
prior to the split knit, the held stitch loop is transferred to the knitting needle of the one needle bed from a fabric belonging to the other needle bed; and
after the split knit, the newly formed stitch loop is removed from the knitting needle of the one needle bed.

3. The method for knitting a fabric according to claim 2, wherein
the knitting yarn is used for knitting an inner area of the fabric and becomes the cross-over yarn during yarn out;
the split knit is carried out in the vicinity of an end portion of the fabric; and
after the split knit, the newly formed stitch loop is removed from the knitting needle of the other needle bed after knitting of a predetermined number of courses.

4. The method for knitting a fabric according to claim 2, wherein
the stitch loop newly formed by the split stitch is removed from the knitting needle of the one needle bed after, subsequent to the split stitch, a stitch is formed on a knitting needle different from the knitting needle used for the split stitch.

5. The method for knitting a fabric according to claim 1, wherein
the stitch loop subjected to the split stitch into the knitting needle of the other needle bed, or a stitch loop knitted following the split stitch loop is transferred to the one needle bed side to stop ravel.

6. The method for knitting a fabric according to any one of claims 1, 2, 4, and 5, wherein
the knitting yarn is fed in such a manner that the knitting yarn becomes the cross-over yarn from a portion kitted before the plurality of courses of the fabric;
in a knitting course where the split knit is carried out, a portion where the knitting yarn crosses between the needle beds is formed in the vicinity of the end portion of the fabric; and
the crossing portion is released after the cross-over yarn is fed in and captured in the knitting needle carrying out the split knit through the crossing portion.

7. A design device of a fabric for creating knitting data to knit a fabric on a flat knitting machine, the flat knitting machine being provided with at least a pair of front and rear needle beds opposed to one another across a needle bed gap, each of the needle beds being provided with a multiplicity of latch needles as knitting needles, the knitting data created by the design device causing the flat knitting machine to execute a method which comprises;
carrying out a split knit of a stitch loop held in the knitting needle of the one needle bed into a knitting needle of the other needle bed; and
capturing a knitting yarn as a newly formed knitting loop in a hook of a knitting needle of the one needle bed, the knitting yarn serving as a cross-over yarn by being let loose over a distance so as to avoid engagement of the knitting yarn in knitting needles, the distance makes it difficult to capture the knitting yarn in a hook of a knitting needle which independently carrying out a stitch forming operation.

Fig. 1

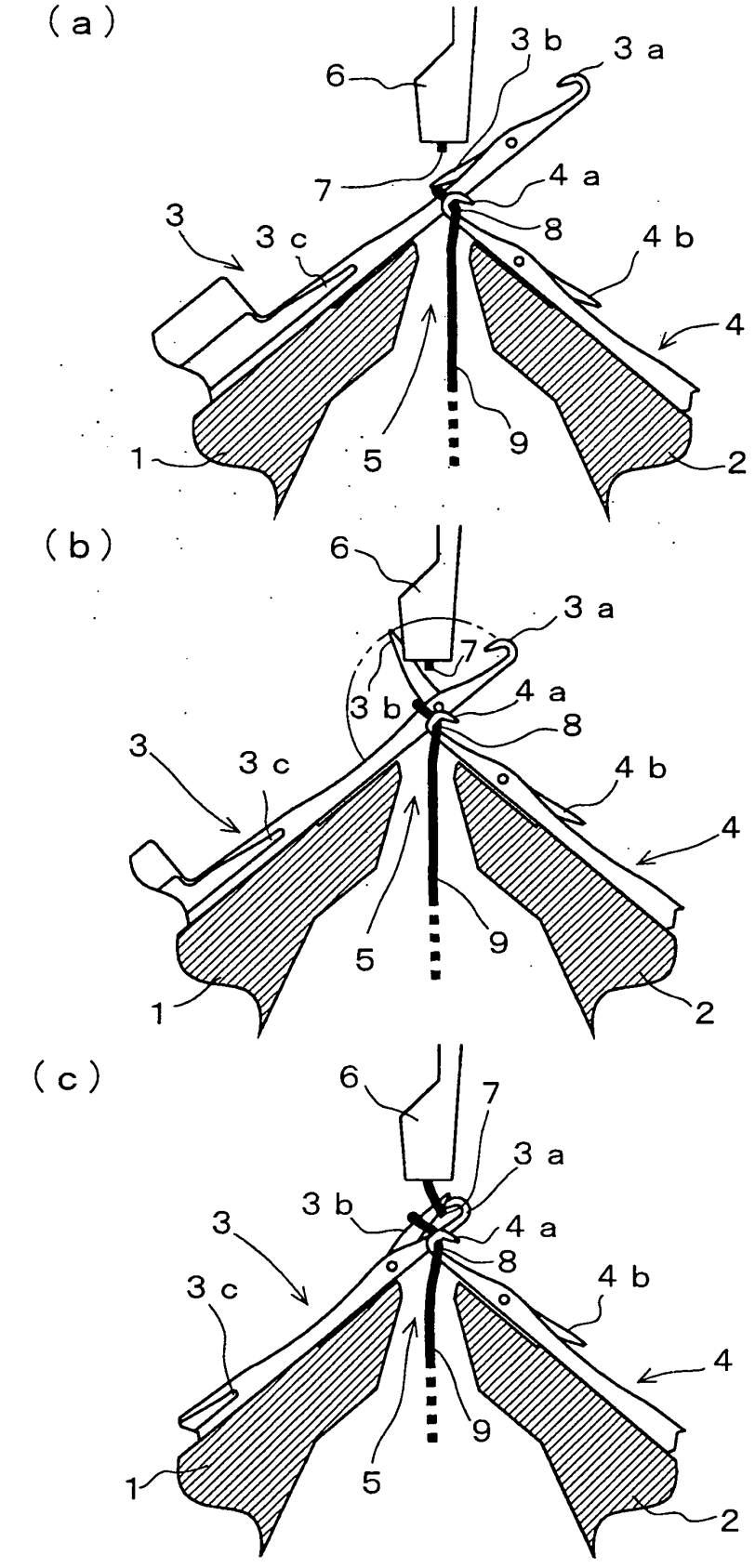

(a)
6
3b
3a
7
4a
3
3c
8
4b
4
1
5
9
2
(b)
6
3a
7
3b
4a
8
3
3c
4b
4
5
9
1
2
(c)
6
7
3a
3b
4a
3
8
4b
3c
4
9
1
5
2

Fig. 2

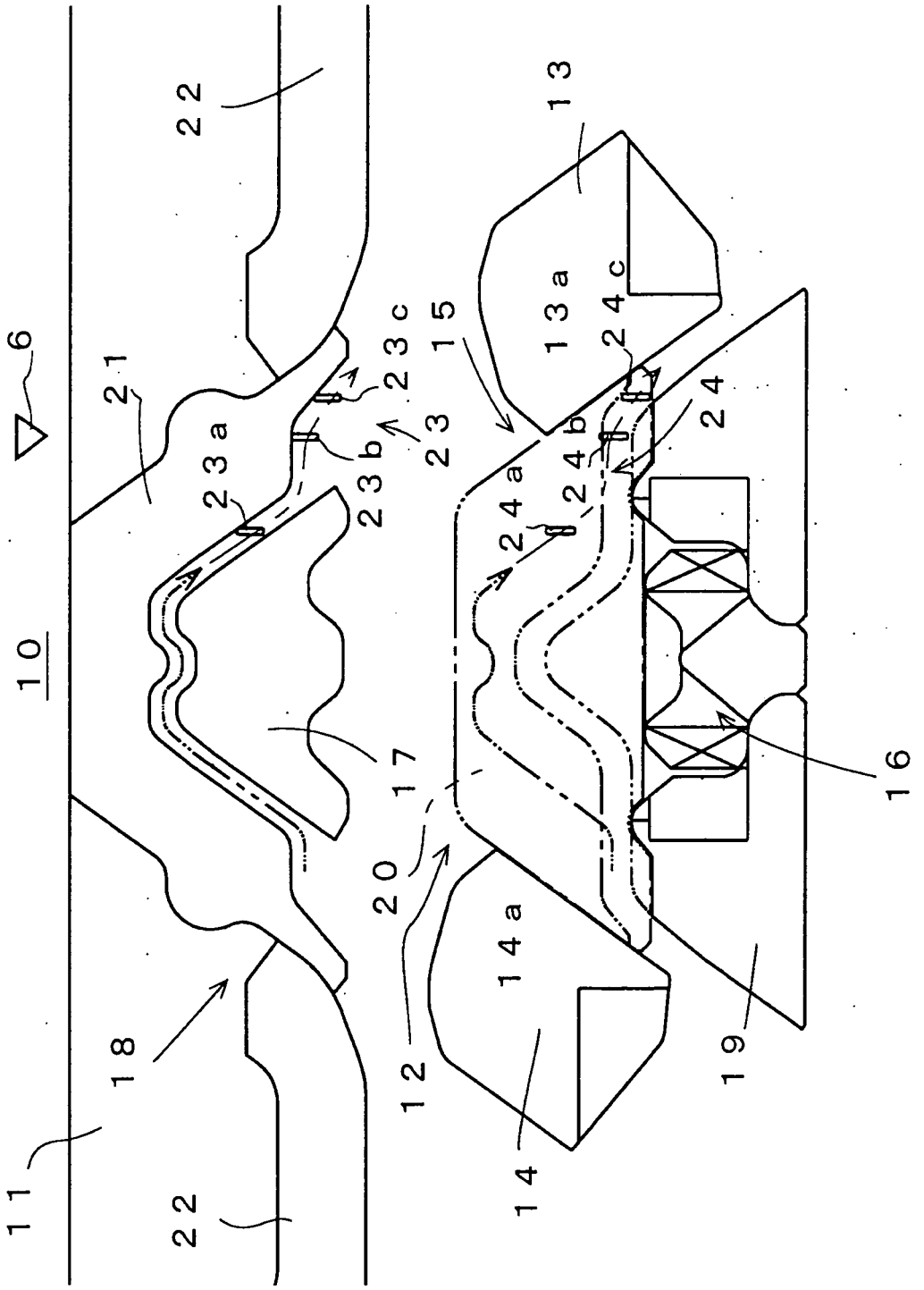

6
10
11
12
13
13a
14
14a
15
16
17
18
19
20
21
22
22
23
23a
23b
23c
24
24a
24b
24c

Fig. 3

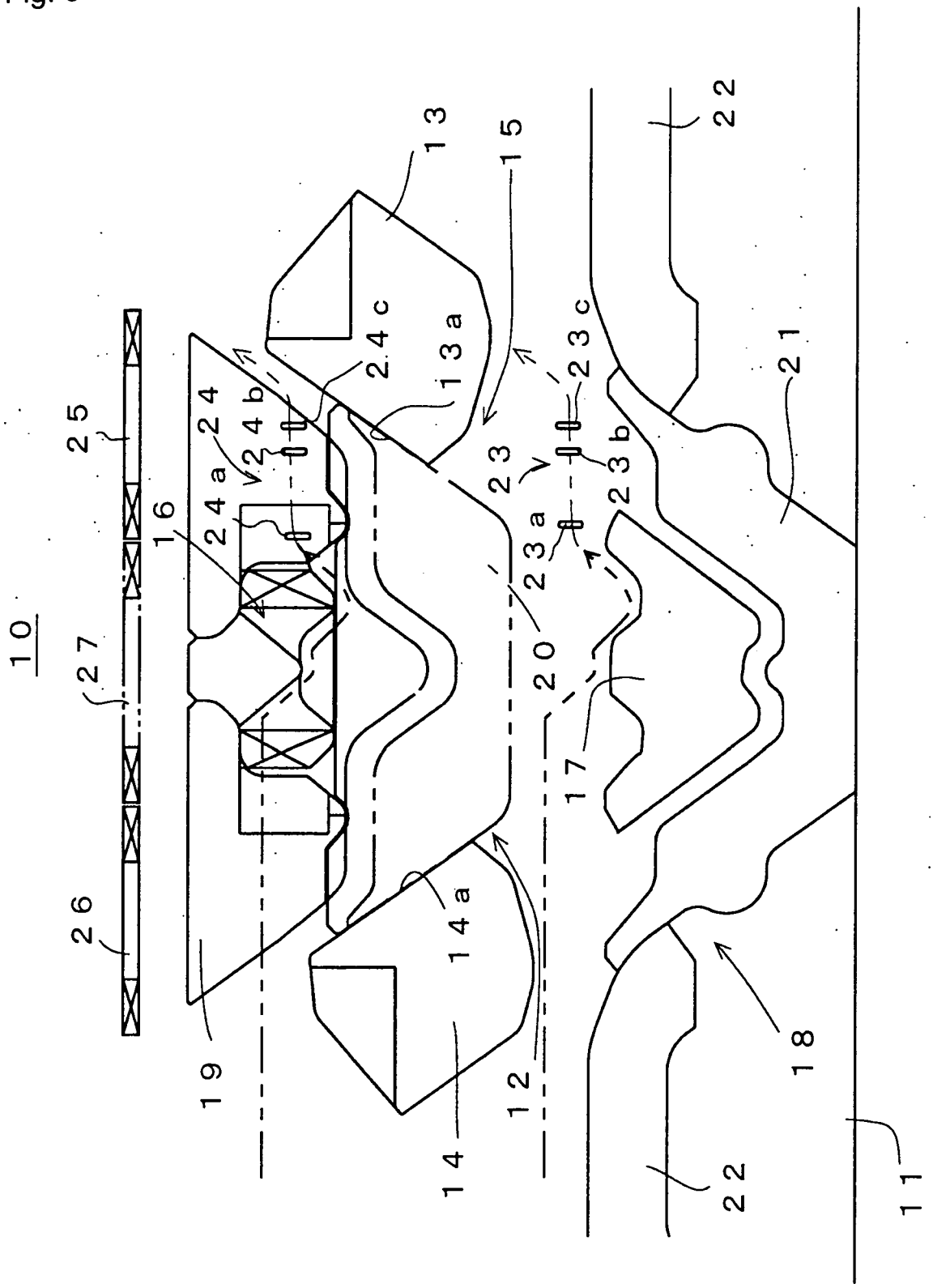

10
11
12
13
13a
14
14a
15
16
17
18
19
20
21
22
22
23
23a
23b
23c
24
24a
24b
24c
25
26
27

Fig. 4

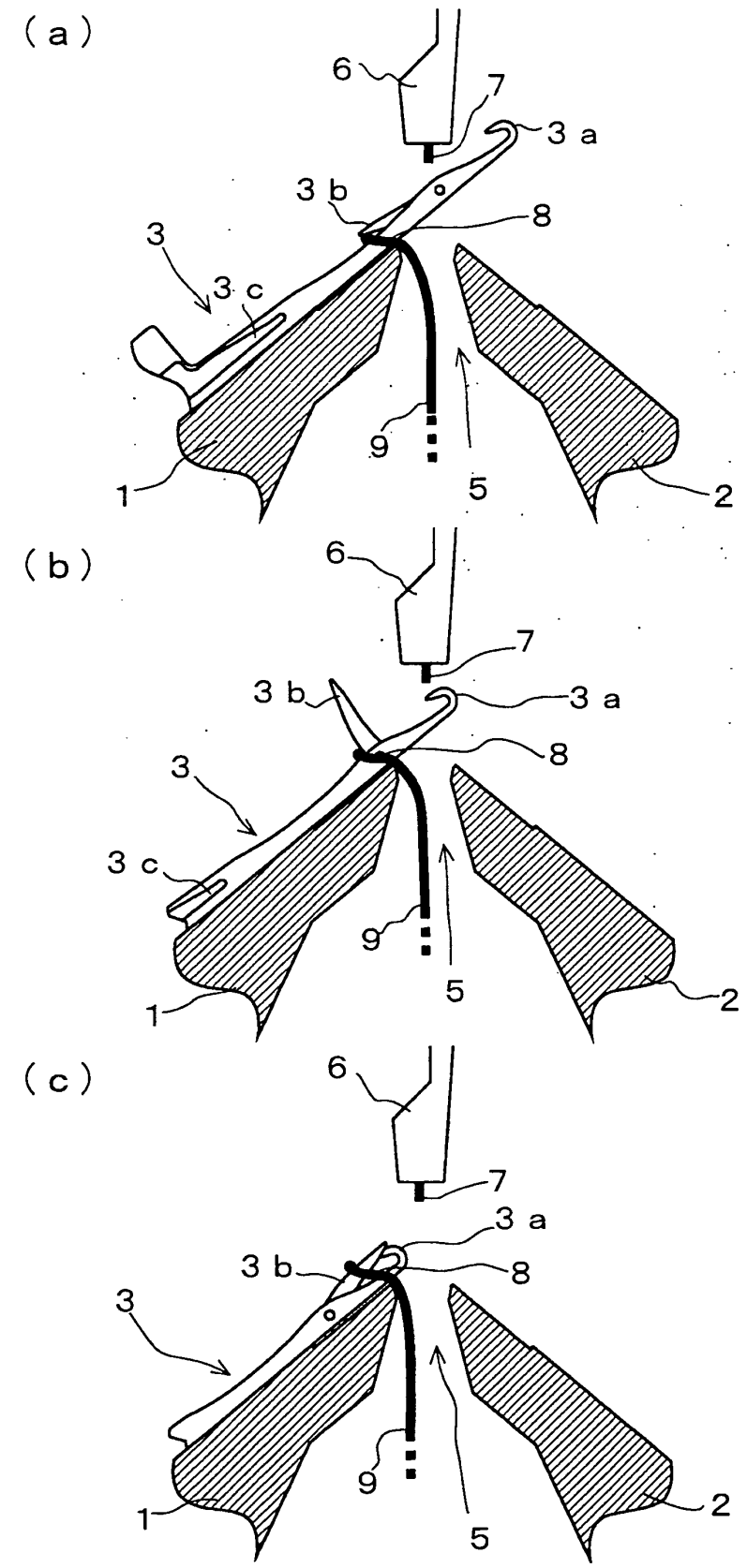


Fig. 5

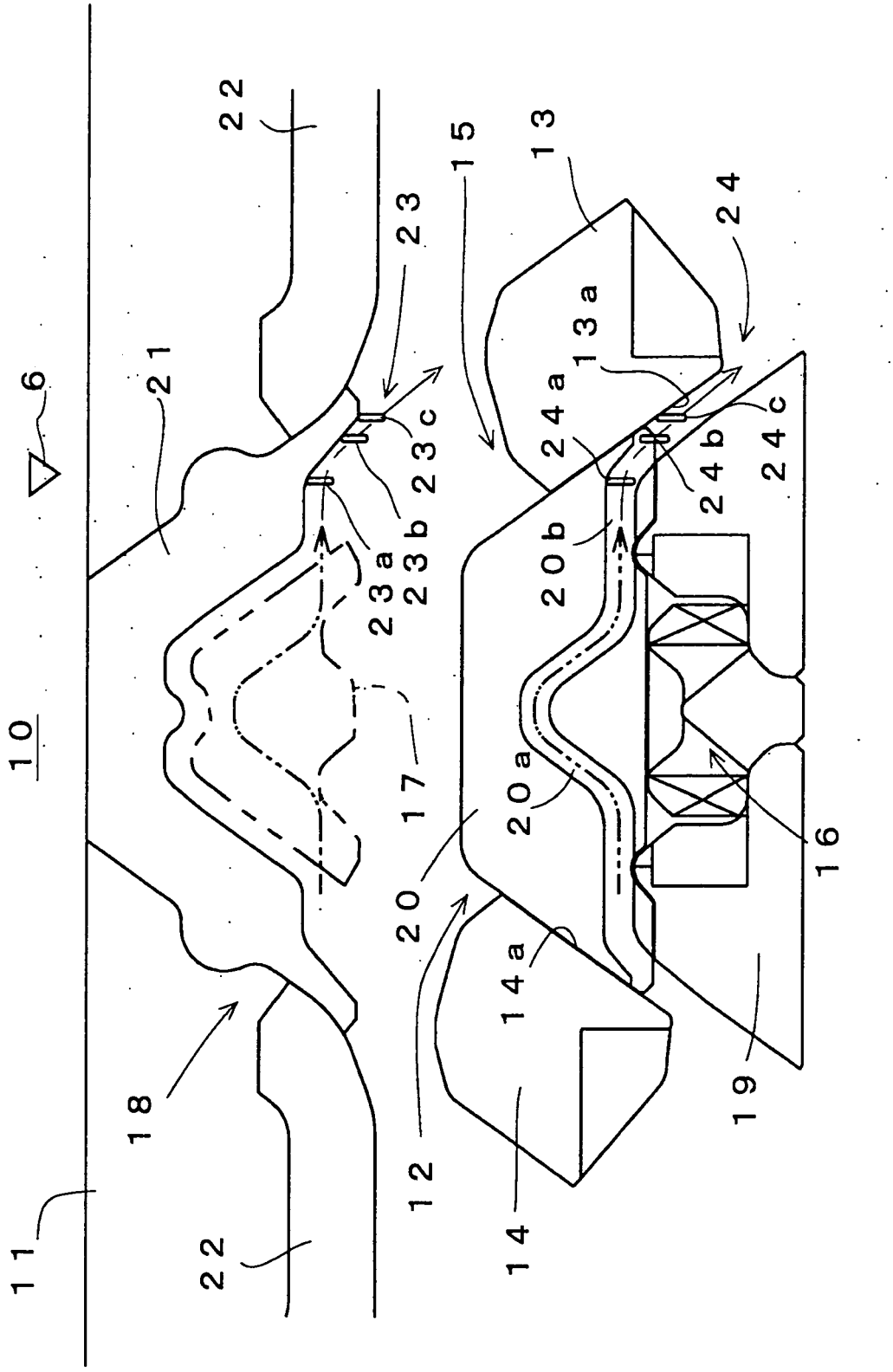

10
11
12
13
13a
14
14a
15
16
17
18
19
20
20a
20b
21
22
22
23
23a
23b
23c
24
24a
24b
24c
6

Fig. 6

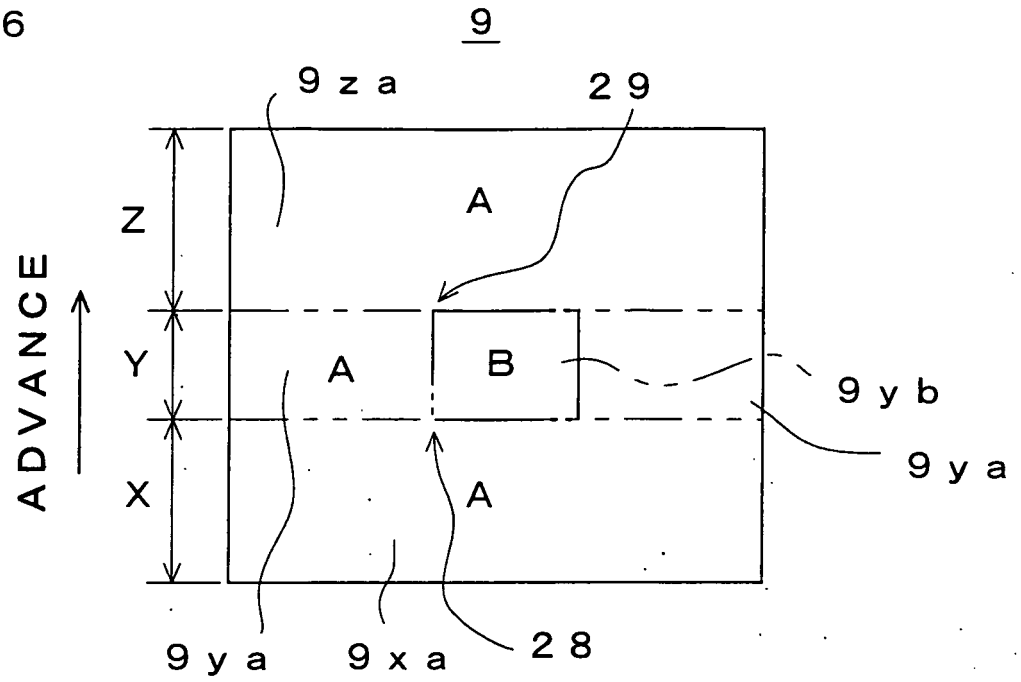


Fig. 7

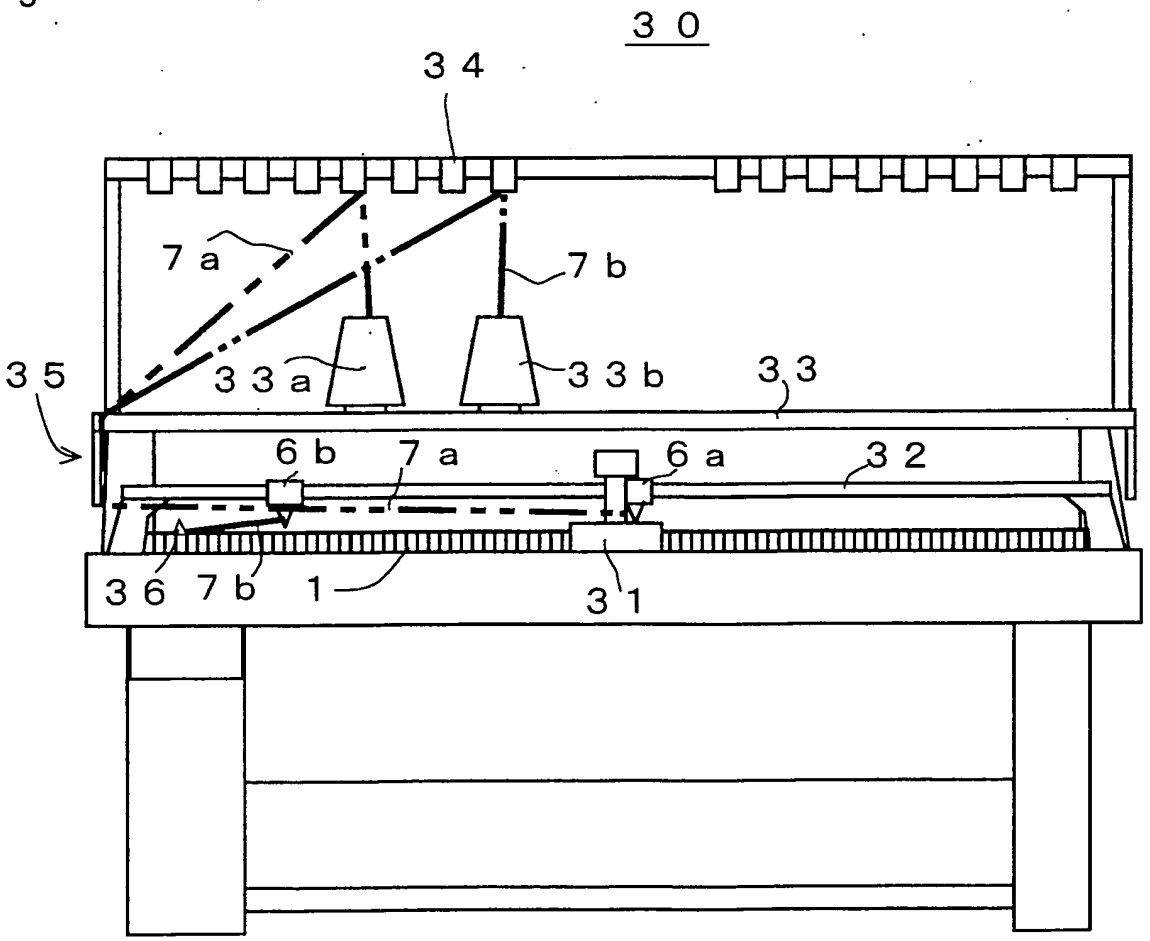


Fig. 8

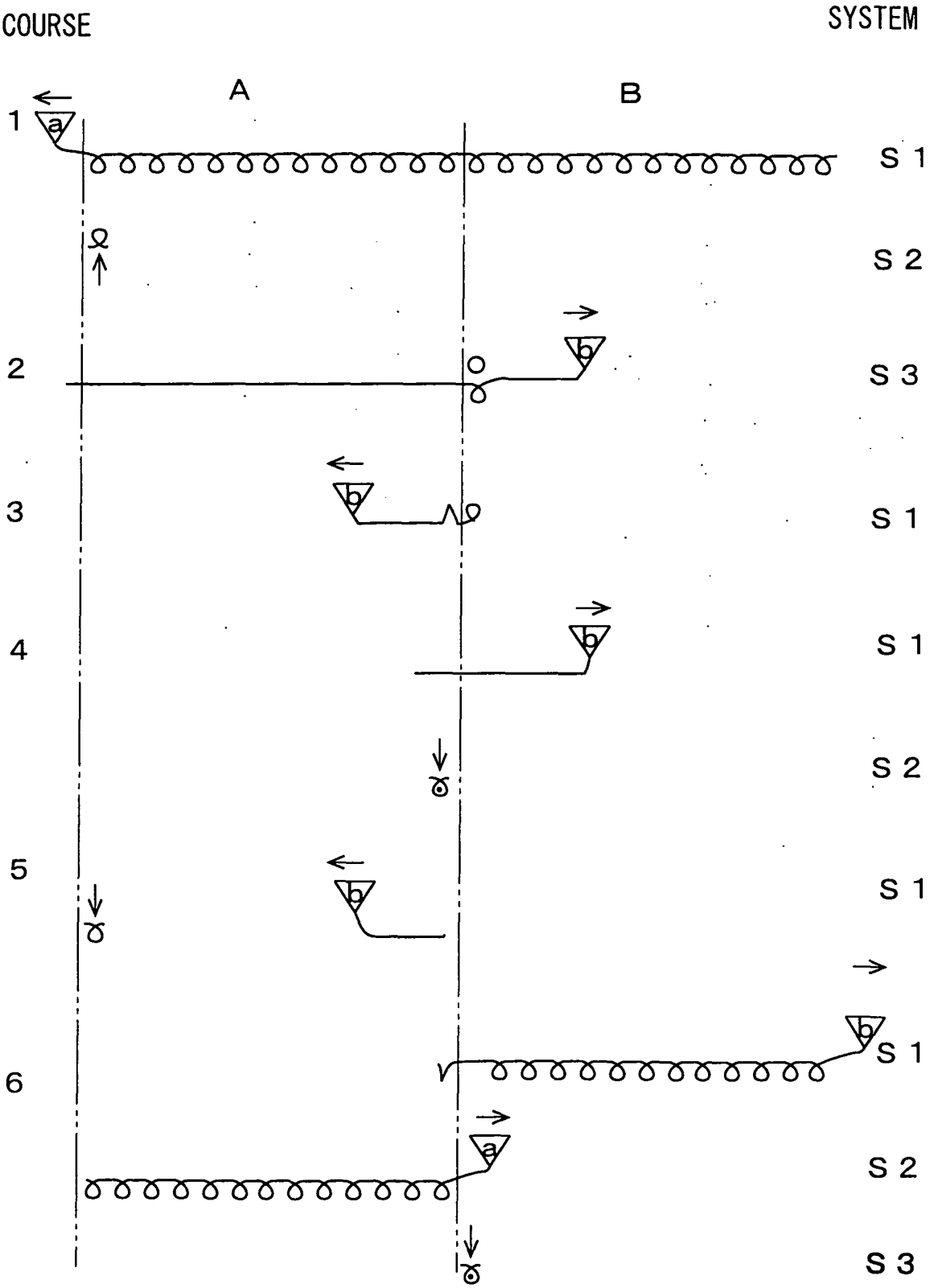


Fig. 9

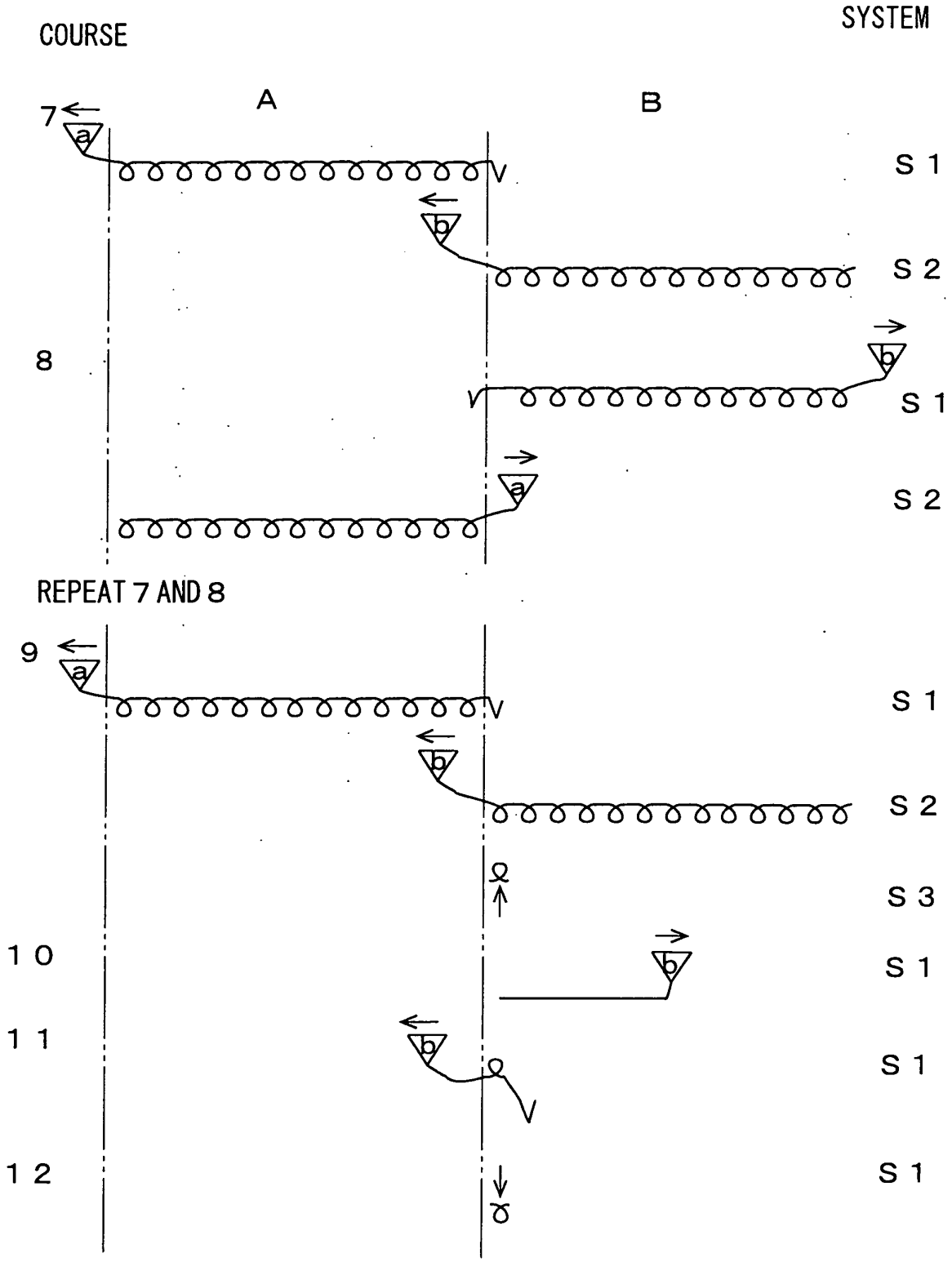

COURSE
SYSTEM
A
B
7
S 1
S 2
8
S 1
S 2
REPEAT 7 AND 8
9
S 1
S 2
S 3
10
S 1
11
S 1
12
S 1

Fig. 10

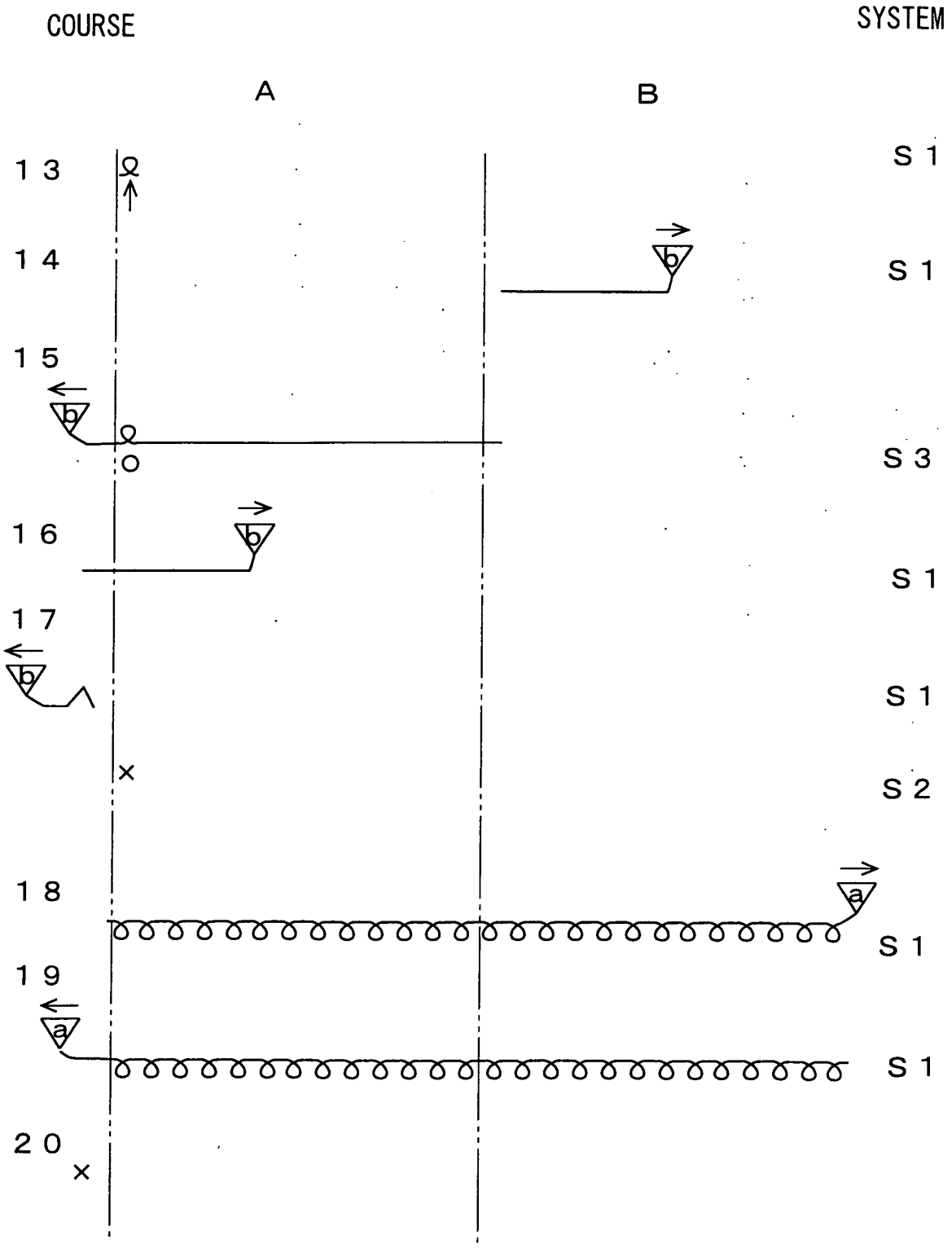

COURSE
SYSTEM
A
B
13
14
15
16
17
18
19
20
S1
S1
S3
S1
S1
S2
S1
S1
b
b
b
b
a
a
x
x

Fig. 11

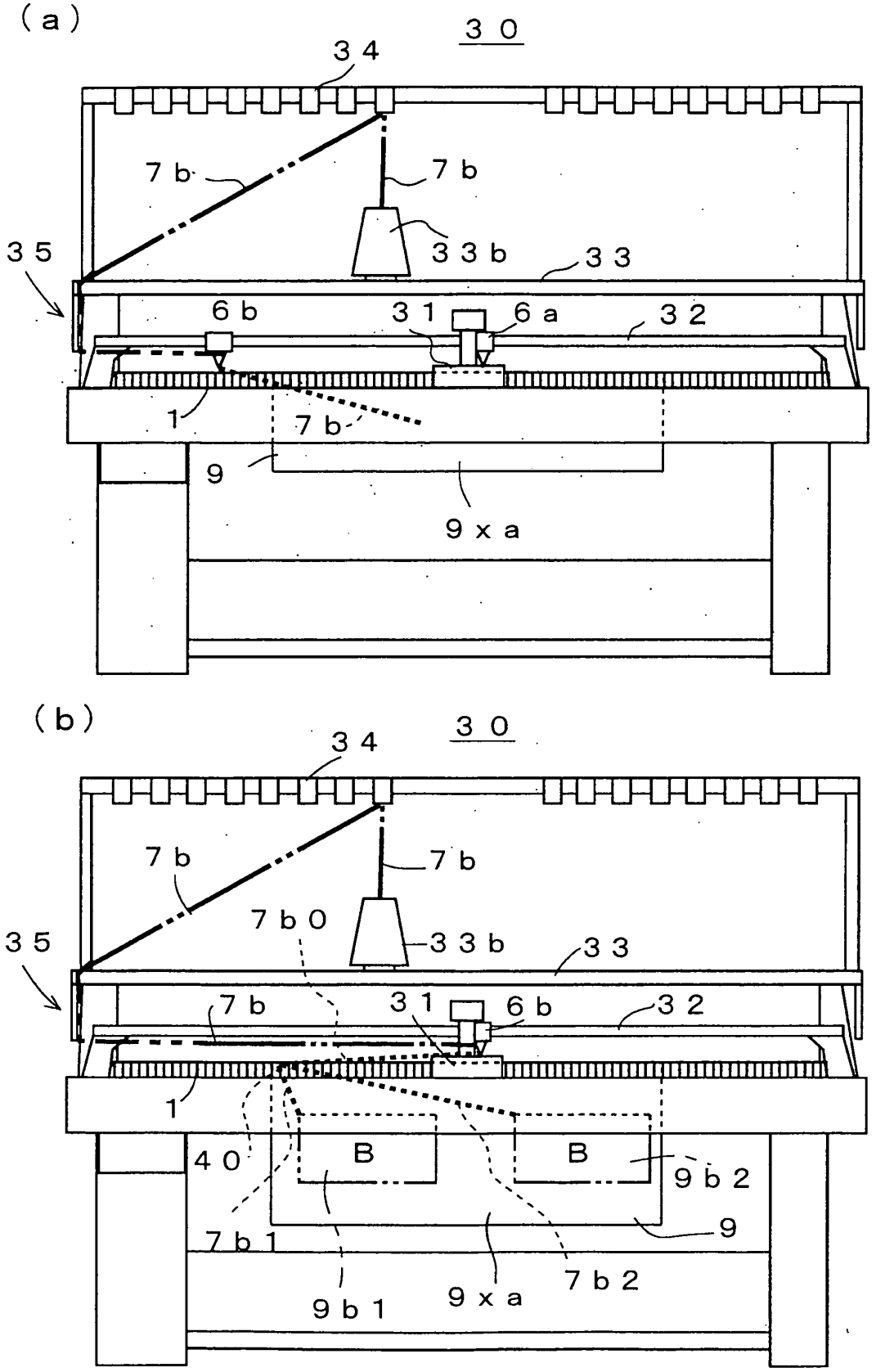

(a)
30
34
7b
7b
35
33b
33
6b
31
6a
32
1
7b
9
9xa
(b)
30
34
7b
7b
7b0
35
33b
33
7b
31
6b
32
1
40
B
B
9b2
9
7b1
7b2
9b1
9xa

Fig. 12

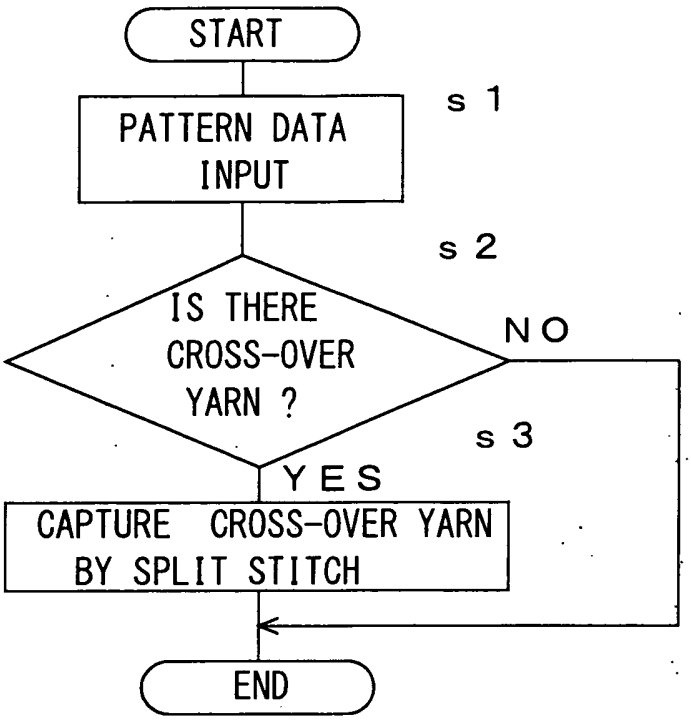
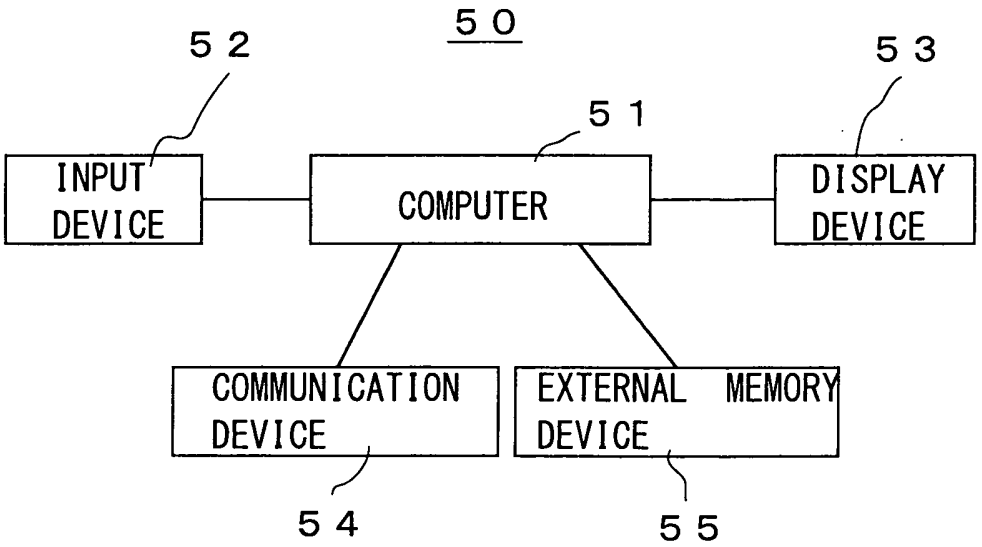

START
PATTERN DATA INPUT
s 1
s 2
IS THERE CROSS-OVER YARN ?
NO
s 3
YES
CAPTURE CROSS-OVER YARN BY SPLIT STITCH
END

Fig. 13


50
52
51
53
INPUT DEVICE
COMPUTER
DISPLAY DEVICE
COMMUNICATION DEVICE
EXTERNAL MEMORY DEVICE
54
55

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/000257

A. CLASSIFICATION OF SUBJECT MATTER
D04B7/26(2006.01)i, *D04B1/00*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
D04B1/00-1/28, 7/00-7/34

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2007
Kokai Jitsuyo Shinan Koho 1971-2007 Toroku Jitsuyo Shinan Koho 1994-2007

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	WO 2006/104062 A (Shima Seiki Mfg., Ltd.), 05 October, 2006 (05.10.06), Claim 3; page 11, lines 5 to 16 (Family: none)	1-7
A	JP 61-51061 B2 (Kabushiki Kaisha Shima Idea Center), 07 November, 1986 (07.11.86), (Family: none)	1-7
A	JP 7-310262 A (Tsudakoma Corp.), 28 November, 1995 (28.11.95), (Family: none)	1-7
A	JP 9-31802 A (Tsudakoma Corp.), 04 February, 1997 (04.02.97), (Family: none)	1-7

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
02 May, 2007 (02.05.07)	22 May, 2007 (22.05.07)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/000257

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 9-31804 A (Tsudakoma Corp.), 04 February, 1997 (04.02.97), & US 5819558 A1 & EP 754792 A1	1-7
A	JP 62-52063 B2 (Kabushiki Kaisha Shima Idea Center), 04 November, 1987 (04.11.87), (Family: none)	1-7
A	JP 2-10262 B2 (Shima Seiki Mfg., Ltd.), 07 March, 1990 (07.03.90), (Family: none)	1-7
A	JP 6-84583 B2 (Shima Seiki Mfg., Ltd.), 26 October, 1994 (26.10.94), (Family: none)	1-7
A	WO 2002/097178 A1 (Shima Seiki Mfg., Ltd.), 05 December, 2002 (05.12.02), & US 2004/0172981 A1 & EP 1403409 A1 & CN 1529776 A	1-7

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

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 S6151061 B **[0004]**
- JP H07310262 B **[0004]**
- JP H0931802 B **[0004]**
- JP H0931804 B **[0004]**
- JP S6252063 B **[0022]**
- JP H0210262 B **[0030] [0030]**