



(12) **EUROPEAN PATENT APPLICATION**  
published in accordance with Art. 153(4) EPC

(43) Date of publication:  
**30.11.2011 Bulletin 2011/48**

(51) Int Cl.:  
**D04B 7/00 (2006.01) D04B 35/06 (2006.01)**

(21) Application number: **09834370.0**

(86) International application number:  
**PCT/JP2009/006980**

(22) Date of filing: **17.12.2009**

(87) International publication number:  
**WO 2010/073558 (01.07.2010 Gazette 2010/26)**

(84) Designated Contracting States:  
**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 SE SI SK SM TR**

• **SHIMASAKI, Yoshinori**  
Wakayama-shi  
Wakayama 641-8511 (JP)  
• **YAMAUCHI, Satoshi**  
Wakayama-shi  
Wakayama 641-8511 (JP)

(30) Priority: **27.12.2008 JP 2008335577**

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

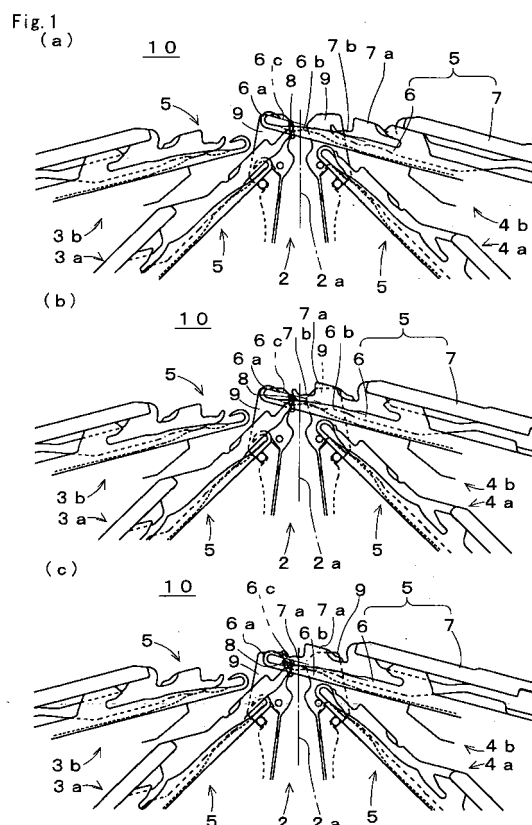
(74) Representative: **Wagner, Karl H.**  
Wagner & Geyer  
Gewürzmühlstrasse 5  
80538 München (DE)

(72) Inventors:  
• **GOTO, Masanori**  
Wakayama-shi  
Wakayama 641-8511 (JP)

(54) **WEFT KNITTING MACHINE AND STITCH TRANSFER METHOD FOR SAME**

(57) It is an object of the present invention to provide a flatbed knitting machine and a stitch transferring method thereof in which stitch transferring failures such as stitch drop or split of a knitted loop are prevented from occurring and stable stitch transferring can be performed.

In a flatbed knitting machine 10, as shown in (a), a slider 7 of a compound needle 5 at a stitch receiving side is made to start to advance to a needle bed gap 2 before a tip of a hook 6a which is pulled in reaches to a knitted loop 8. As shown in (b), bottoms of tips of tongues 7b are advanced to the knitted loop 8. If the tongues 7b are advanced further, the bottoms of the tips of the tongues 7b are warped upward along the knitted loop 8 as shown in (c). The knitted loop 8 is pushed so as to sink to a needle shank 6b side beyond a downward trajectory 6c of the tip of the hook 6a. When the hook 6a is closed by the tongues 7b, if the tips of the tongues 7b are made to float once with respect to the needle shank 6b, and then, sink, the knitted loop 8 can be reliably sunk and caught in the hook 6a even if the knitted loop 8 floats.



## Description

### Technical Field

[0001] The present invention relates to a flatbed knitting machine being provided with compound needles as knitting needles, and a stitch transferring method in the flatbed knitting machine, with respect to each compound needle a head portion of a slider for opening and closing a hook is separated into two blades which are capable of advancing to a needle bed gap beyond an upper edge of the hook.

### Background Art

[0002] Conventionally, as knitting needles for a flatbed knitting machine, a technique of performing stitch transferring by utilizing sliders of compound needles is known, with respect to each compound needle a head portion of the slider for opening and closing a hook is separated into two blades which are capable of advancing to a needle bed gap beyond an upper edge of the hook (for example, see Patent Citation 1). Steps called tongues are formed on tips of the blades. In the flatbed knitting machine described in Patent Citation 1, a pair of needle beds at the front and rear sides are provided so as to sandwich the needle bed gap and the compound needles are selectively driven by cams mounted on carriages which runs back and forth on the needle beds so as to perform a knitting operation and a stitch transferring operation. In Fig. 12 in Patent Citation 1, a cam arrangement for guiding butts provided on needle bodies of the compound needles and the sliders so as to perform the stitch transferring operation is illustrated together with a butt passing trajectory. At the time of the stitch transferring, a compound needle of the stitch transferring side holds a knitted loop by the tongues which are made to advance to the needle bed gap beyond the upper edge of the hook. Further, a technique to prevent a held knitted loop dropping from tips of tongues by once enlarging and then narrowing a space between tips of the tongues and a needle shank of the needle body when a hook is closed in order to smoothly perform knockover in a state where a slider closes an opening at a tip side of the hook with the tips of the tongues has been known (for example, see Patent Citation 2).

[0003] In each drawing from Fig. 13 to Fig. 20 of Patent Citation 1, operation states of the compound needles corresponding to primary positions on the passing trajectory in Fig. 12 are illustrated as side views of the needle beds. In particular, in Fig. 16, a state where the slider at the stitch transferring side is made to advance to the needle bed gap beyond the hook and the knitted loop is held by the tongues formed on the head portion of the slider is illustrated. As illustrated with 6-b in Fig. 6, blades at the tip of the slider bifurcate to both sides of the hook and a space between tips of the blades expand. In Fig. 17 and Fig. 18, states where the hook at the stitch receiving side

is made to enter between the blades are illustrated. In Fig. 19, a state where the slider at the stitch transferring side is pulled in and the knitted loop is put over the needle shank of the needle body at the stitch receiving side is illustrated. In Fig. 20, a state where the hook at the stitch receiving side is pulled in and the knitted loop is received in the opening at the tip side of the hook, that is, in the hook.

[0004] The stitch transferring operation in the flatbed knitting machine is performed when a structure pattern is knitted or when number of knitted loops is increased or decreased. When knit fabrics knitted on the front and the rear needle beds are connected at both sides of knitting width so as to be knitted into a tubular form, in particular, when rib knitting including front stitches and back stitches or the like is performed, formation of the knitted loop and the stitch transferring are alternately performed. Therefore, in such case, frequency of the stitch transferring is increased. If half gauge knitting is performed, tubular knit fabrics can be knitted by the rib knitting even with one pair of needle beds at the front side and the rear side. When a four-bed type flatbed knitting machine, which is provided with two stage needle beds of upper and lower at both sides of the needle bed gap, is used, the tubular knit fabrics can be knitted by the rib knitting with all needle knitting. In the four-bed type flatbed knitting machine, the front stitches are knitted on the needle beds at the lower stage and the back stitches are knitted on the needle beds at the upper stage. On one needle bed at the lower stage, a knitting needle for knitting the front stitch and a knitting needle for holding the back stitch knitted on the needle bed at the upper stage opposed to the needle bed at the lower stage are alternately arranged. The stitch transferring is performed between the knitting and the holding of the back stitch.

[0005] Figs. 3 illustrate a state where the stitch transferring is performed from the lower stage side to the upper stage side in the four-bed type flatbed knitting machine partially in a simplified manner. In Figs. 3, an operation corresponding to Fig. 19 in Patent Citation 1 is divided into three stages of (a), (b), and (c) in order to compare with an embodiment of the invention, which will be described with reference to Figs. 1 later. A flatbed knitting machine 1 includes a front lower needle bed 3a and a front upper needle bed 3b at the front side and a rear lower needle bed 4a and a rear upper needle bed 4b at the rear side while sandwiching a needle bed gap 2 therebetween. Each needle bed is inclined such that the needle bed is made higher toward the needle bed gap 2 and is made lower as is away from the needle bed gap 2. The front lower needle bed 3a and the front upper needle bed 3b are arranged so as to be plane-symmetrical to the rear lower needle bed 4a and the rear upper needle bed 4b with respect to a center face 2a of the needle bed gap 2. In this description, directions that a knitting needle is moved on each needle bed are described as an upward corresponding to the direction of advancing to the needle bed gap 2 and as a downward corresponding to the di-

rection of pulling in to a needle bed.

[0006] Each knitting needle is accommodated in a needle groove provided on each needle bed and the head portion of the knitting needle moves forward and backward with respect to the needle bed gap 2. In this description, in each needle groove, displacement of a direction that a knitting needle is away from a bottom is expressed as floats and displacement of a direction that a knitting needle moves toward a bottom is expressed as sinks. The compound needle 5 as disclosed in Patent Citation 1 or Patent Citation 2 is used as each knitting needle. A compound needle 5 includes a needle body 6 and a slider 7. A hook 6a is formed on the head portion of the needle body 6 so as to correspond to a tip of a needle shank 6b. The hook 6a is curved into a bent form and a tip thereof is folded to the side of the needle shank 6b. A portion between the tip of the hook 6a and the needle shank 6b opens. When the hook 6a is pulled in, the tip of the hook 6a passes on a downward trajectory 6c.

[0007] The slider 7 is accommodated in a groove provided on the needle shank 6b of the needle body 6 and is movable relatively with respect to the needle body 6. A tip of the slider 7 is separated into two blades 7a, a tongue 7b is formed on a head portion of each separated blade. The tongues 7b can close the opening between the tip of the hook 6a and the needle shank 6b. When the front lower needle bed 3a serves as the stitch transferring side and the rear upper needle bed 4b serves as the stitch receiving side, a knitted loop 8 is held on the tongues 7b of the stitch transferring side and advances to the needle bed gap 2 beyond the upper edge of the hook 6a while expanding to both sides. Further, sinkers 9 are provided between the knitting needles at both sides of the needle bed gap 2. If the hook 6a of the stitch receiving side enters between the blades 7a of the stitch transferring side, the slider 7 of the stitch transferring side is pulled in. The knitted loop 8 is come off from the tongues 7b of the slider 7 and is retained in the vicinity of the upper edges of the sinkers 9. If the hook 6a of the stitch receiving side is pulled in, the knitted loop 8 can be caught in the hook 6a and received.

Patent Citation 1: Japanese Patent No. 3085657

Patent Citation 2: Japanese Patent No. 3886903

## Disclosure of the Invention

### Technical Problem

[0008] In the stitch transferring using the conventional compound needle 5, the slider 7 of the stitch receiving side stays in a state where the slider 7 does not advance to the needle bed gap 2 from the rear upper needle bed 4b. Only the needle body 6 is pulled in with a state where the hook 6a is opened. The knitted loop 8 which is transferred from the stitch transferring side is caught in the middle when the hook 6a of the stitch receiving side is pulled in. The knitted loop 8 caught by the hook 6a of the

stitch receiving side is come off from the upper edges of the tongues 7b of the stitch transferring side and is retained in the vicinity of the upper edges of the sinkers 9. In a state where the knitted loop 8 is held on the upper edges of the tongues 7b of the stitch transferring side, a force for expanding the knitted loop 8 is applied to knitting yarns. If the knitted loop 8 is come off from the upper edges of the tongues 7 of the stitch transferring side, a force, for dragging down the knit fabrics, or the like is applied to the knitted loop 8. If the knitting yarns have sufficient stretching property and smoothness, the size of the knitted loop 8 becomes smaller than that in a state where the knitted loop 8 is put over the tongues 7b at the stitch transferring side. If the knitted loop 8 becomes smaller, the knitted loop 8 is easily caught in the hook 6a when the hook 6a of the stitch receiving side is pulled in to the rear upper needle bed 4b.

[0009] In cases where desirable smoothness of the knitting yarns is not obtained, a desirable stretching property thereof is not obtained, a force of dragging down the knit fabrics is not sufficiently applied, and so on, there is a possibility that the knitted loop 8 does not become smaller and is made into a state of floating in the vicinity of the upper edges of the sinkers 9. As the case where the force of dragging down the knit fabrics is not sufficiently applied, there exists a case where the number of knitted loops is increased to make the knitting width larger or a case where the flechage knitting is performed. When the knitted loop 8 to be knitted as the back stitch on the rear upper needle bed 4b is stitch-transferred from the front lower needle bed 3a to the rear upper needle bed 4b, the knitted loop 8 easily floats in the direction away from the hook 6a at the stitch receiving side as a property of the knitted loop 8 itself.

[0010] When the knitted loop 8 is in the floating state, there arises a risk that the knitted loop 8 touches the downward trajectory 6c of the tip of the hook 6a of the stitch receiving side or the knitted loop 8 floats beyond the downward trajectory 6c. If the knitted loop 8 floats beyond the downward trajectory 6c of the tip of the hook 6a, the knitted loop 8 cannot be caught in the hook 6a and stitch drop in which the knitted loop 8 is come off to the needle bed gap 2 is caused. If the knitted loop 8 touches the downward trajectory 6c, there arises a risk that the knitting yarns forming the knitted loop 8 are split by the tip of the hook 6a.

[0011] An object of the present invention is to provide a flatbed knitting machine in which stitch transferring failures such as stitch drop or split of a knitted loop are prevented from occurring and stable stitch transferring can be performed and a stitch transferring method in the flatbed knitting machine.

### Technical Solution

[0012] The present invention is a flatbed knitting machine, provided with needle beds which are arranged so as to be opposed to each other with respect to a needle

bed gap, each needle bed equipped with compound needles arranged in parallel as knitting needles, each compound needle having a needle body and a slider, the needle body has a hook at a head portion, the slider relatively moves with respect to the needle body so as to open and close an opening at a tip side of the hook, the head portion of the slider is separated into two blades which are capable of advancing to the needle bed gap beyond an upper edge of the hook so as to sandwich the hook from both sides, a tongue is formed on a head portion of each blade, at a stitch transferring side a knitted loop is held between the tongues which advance to the needle bed gap beyond the upper edge of the hook and open mutually, at a stitch receiving side the hook of the needle body which is advanced to the needle bed gap is made to enter between the tongues of the stitch transferring side, and then is pulled in, so that the knitted loop is received in the opening of the hook at the stitch receiving side to perform stitch transfer, comprising:

hook advancing means for making the hook of the stitch receiving side advance to the needle bed gap and enter between the tongues of the stitch transferring side, and

tongue advancing means for making the slider of the stitch receiving side advance to the needle bed gap, until the knitted loop is sunk by bottoms of tips of the tongues to the side of a needle shank of the needle body beyond a declining trajectory of the tip of the hook before the hook of the stitch receiving side is pulled in and reaches to the knitted loop held between the tongues of the stitch transferring side.

**[0013]** Further, in the present invention, on said slider of the stitch receiving side, when the tips of said tongues move relatively with respect to said needle body so as to close the opening of the tip side of said hook, a space between the needle shank of the needle body of the stitch receiving side and the tips of the tongues is once enlarged, and then, narrowed.

**[0014]** Further, in the present invention, said compound needle is driven by a cam mounted on a carriage which runs back and forth along each needle bed, and the cam has said hook advancing means and said tongue advancing means as driving paths.

**[0015]** Further, in the present invention, said needle bed is a type of upper and lower two stages at least one side of said needle bed gap, and said hook advancing means and said tongue advancing means make the compound needle which is arranged in parallel on the upper stage needle bed operate as the stitch receiving side to receive the knitted loop which is transferred from the opposed needle bed at the lower stage side.

**[0016]** Furthermore the present invention is a stitch transferring method in a flatbed knitting machine, provided with needle beds which are arranged so as to be opposed to each other with respect to a needle bed gap,

each needle bed equipped with compound needles arranged in parallel as knitting needles, each compound needle having a needle body and a slider, the needle body has a hook at a head portion, the slider relatively moves with respect to the needle body so as to open and close an opening at a tip side of the hook, the head portion of the slider is separated into two blades which are capable of advancing to the needle bed gap beyond an upper edge of the hook so as to sandwich the hook from both sides, a tongue is formed on a head portion of each blade, at a stitch transferring side a knitted loop is held between the tongues which advance to the needle bed gap beyond the upper edge of the hook and open mutually, at a stitch receiving side the hook of the needle body which is advanced to the needle bed gap is made to enter between the tongues of the stitch transferring side, and then is pulled in, so that the knitted loop is received in the opening of the hook at the stitch receiving side to perform stitch transfer, wherein

after making the hook of the stitch receiving side advance to the needle bed gap and enter between the tongues of the stitch transferring side, and before the hook of the stitch receiving side is pulled in and reaches to a knitted loop held between the tongues,

advancing the slider of the stitch receiving side to the needle bed gap and sinking the knitted loop by bottoms of tips of the tongues to the side of a needle shank of the needle body beyond a declining trajectory of the tip of the hook.

### Advantageous Effects

**[0017]** According to the present invention, at the stitch transferring side, the knitted loop is held between the tongues which advance to the needle bed gap beyond the upper edge of the hook at the head portion of the needle body and between which a space is opened. At the stitch receiving side, the hook advancing means makes the hook of the needle body enter between the tongues of the stitch transferring side. The tongue advancing means makes the knitted loop sink by bottoms of the tips of the tongues before the hook of the stitch receiving side is pulled in and the tip of the hook reaches to the knitted loop held between the tongues at the stitch transferring side. The knitted loop can be sunk to the needle shank side of the needle body beyond at least a downward trajectory of the tip of the hook, so that, even if the knitted loop floats in a state where the hook is made to enter between the tongues of the stitch transferring side, stitch transferring failures such as stitch drop or split of a knitted loop are prevented from occurring and stable stitch transferring can be performed.

**[0018]** Further, according to the present invention, on the slider of the stitch receiving side, when the tips of the tongues move relatively with respect to the needle body so as to close the opening at the tip side of the hook, a space between the needle shank of the needle body and the tips of the tongues is once enlarged, and then, nar-

rowed. Since the bottoms of the tips of the tongues float and sink with respect to the needle shank, the knitted loop in a state of floating from the needle shank can be pressed down to the needle shank side. Since the floating of the knitted loop can be eliminated, when the hook is pulled in to the needle bed of the stitch receiving side, the knitted loop can be reliably caught in the opening at the tip side of the hook.

**[0019]** Further, according to the present invention, driving paths provided on a cam mounted on a carriage are made to operate as the hook advancing means and the tongue advancing means so that stability of stitch transferring can be improved.

**[0020]** Further, according to the present invention, when back stitches hung at a lower stage needle bed are transferred to an upper stage needle bed at which the back stitches are knitted and to which the lower stage needle bed is opposed interleaving the needle bed gap, the back stitches which easily float are pushed by the tips of the tongues and are caught in the hooks of the stitch receiving side so that stable stitch transferring can be performed.

**[0021]** Further, according to the present invention, the knitted loop held between the tongues of the stitch transferring side is sunk to the needle shank side of the needle body beyond the downward trajectory of the tip of the hook of the stitch receiving side by the bottoms of the tips of the tongues of the slider of the stitch receiving side. If the knitted loop floats from the needle shank, the knitted loop is reliably caught in the opening of the tip of the descending hook so that stable stitch transferring can be performed.

## Brief Description of Drawings

### [0022]

[Fig. 1] Figs. 1 are side cross-sectional views simply illustrating a characteristic operation in the middle of stitch transferring from a lower stage needle bed side to an upper stage needle bed side in a four-bed type of a flatbed knitting machine 10 as an embodiment of the present invention.

[Fig. 2] Fig. 2 is a cam arrangement view of a stitch transferring cam 11 used in the flatbed knitting machine 10 in Fig. 1.

[Fig. 3] Figs. 3 are side cross-sectional views simply illustrating a state where stitch transferring from the lower stage side to the upper stage side in a conventional four-bed type of a flatbed knitting machine 1.

## Best Mode for Carrying Out the Invention

**[0023]** Figs. 1 illustrate a characteristic operation in the middle of stitch transferring from a lower stage side needle bed to an upper stage side needle bed in a four-bed type of a flatbed knitting machine 10 as an embodiment

of the present invention. Figs. 1(a), 1(b) and 1(c) correspond to Figs. 3(a), 3(b) and 3(c), respectively. In the following description, the same reference numerals as those in a flatbed knitting machine 1 denote components in the flatbed knitting machine 10, which correspond to components in the flatbed knitting machine 1 and description which might be overlapped is skipped.

**[0024]** In the flatbed knitting machine 10, a slider 7 of a compound needle 5 on a rear upper needle bed 4b of a stitch receiving side is made to advance to a needle bed gap 2 before a hook 6a is pulled in. In Fig. 1(a), tongues 7b are started to advance, and in Fig. 1(b), bottoms of tips of the tongues 7b reach to a position of a knitted loop 8. The tips of the tongues 7b are curved in the direction away from the bottom. If the tongues 7b are made to advance further, the bottoms of the tips of the tongues 7b are warped upward along the knitted loop 8 as shown in Fig. 1(c). The knitted loop 8 is pushed such that a needle loop portion between sinkers 9 sinks in the direction into the hook 6a, that is, to the side of a needle shank 6b beyond a downward trajectory 6c of a tip of the hook 6a while sinker loops retained on upper edges of the sinkers 9 serve as swing support points.

**[0025]** In Fig. 1(c), the hook 6a is also pulled in to the direction of the rear upper needle bed 4b and the hook 6a is closed by the tips of the tongues 7b. If the hook 6a is pulled in to the rear upper needle bed 4b after the hook 6a is closed in such a manner, the knitted loop 8 caught in the hook 6a can be reliably received. When the hook 6a is closed by the tips of the tongues 7b, a space between the tip of the tongue and a needle shank of a needle body can be also enlarged once, and then, narrowed as described in Patent Citation 2. When the knitted loop 8 is pushed by the bottoms of the tips of the tongues 7b, the tips of the tongues 7b are made to float from the needle shank 6b once, and then sink, so that, even if the knitted loop 8 floats, the knitted loop 8 is sunk reliably so as to be caught in the hook 6a.

**[0026]** Fig. 2 shows schematic cam arrangement of a stitch transferring cam 11 mounted on a carriage provided on each needle bed in the flatbed knitting machine 10 in Fig. 1. The compound needle 5 of a front lower needle bed 3a is driven by a front lower cam 13 and the compound needle 5 of the rear upper needle bed 4b is driven by a rear upper cam 14. A cam which drives the knitting needle 5 of the rear lower needle bed 4a and a cam which drives the knitting needle 5 of the front upper needle bed 3b are equivalent to the front lower cam 13 and the rear upper cam 14, respectively. The stitch transferring cam 11 is symmetrical with respect to a center line 11a such that an equivalent operation is performed even if a traveling direction of the carriage is inversed. In the following description, a leading side with respect to the center line 11a is expressed as an anterior half and a following side with respect to the center line 11a is expressed as a posterior half in the traveling direction.

**[0027]** In Fig. 2, a path 16 and a path 17 on which butts of the needle body 6 of the knitting needle 5 and the slider

7 are guided are shown when the knitted loop is transferred from the knitting needle 5 of the front lower needle bed 3a to the knitting needle 5 of the rear upper needle bed 4b at the left line of the carriage. Thus, the front lower needle bed 3a serves as the stitch transferring side and the rear upper needle bed 4b serves as the stitch receiving side based on a needle selection result to a select jack as shown by a path 18. The select jack is connected to the side of each knitting needle away from the needle bed gap 2 with respect to the needle body. If a butt protruding in the direction of floating from the needle groove is pressurized by a presser group 19, the select jack sinks the butt of the needle body 6 in the needle groove.

**[0028]** The front lower cam 13 includes a needle operation cam 20 and a slider operation cam 21. On the needle operation cam 20, a stitch transferring side hook advancing path 20a and a stitch receiving side hook advancing path 20b are provided. On the slider operation cam 21, a stitch transferring side tongue advancing path 21a and a stitch receiving side tongue advancing path 21b are provided. The stitch transferring side and the stitch receiving side are switched by selecting the path 18 of the butt of the select jack based on the needle selection result for each knitting needle. As shown in Fig. 2, when the front lower cam 13 serves as the stitch transferring side, the needle at an H position is selected and the butt of the select jack passes through a path on which pressers 22a, 22b are provided. If the presser 22a at the anterior half is set to be non-active and the presser 22b at the posterior half is set to be active, the butt of the needle body 6 is guided by the stitch transferring side hook advancing path 20a at the anterior half so as to make the hook 6a advance to the needle bed gap 2. At the anterior half, the slider 7 slightly advances to the side of the needle bed gap 2 with the advancement of the needle body 6 to the needle bed gap 2. Further, the butt of the slider 7 is guided by the stitch receiving side tongue advancing path 21a at the posterior half so that the tongues 7b advance to the needle bed gap 2. The butt of the needle body 6 descends after passing through a top of the stitch transferring side hook advancing path 20a and the hook 6a is drawn to the front lower needle bed 3a. The butt of the select jack sinks upon the reception of the action by the presser 22b at the posterior half, so that the butt of the needle body 6 does not advance to the needle bed gap 2 at the posterior half.

**[0029]** If the needle is selected such that the select jack is at an A position, the butt of the select jack passes through a path on which pressers 23a, 23b, 23c, 23d are provided. If the pressers 23a, 23b at the anterior half are set to be active, and the pressers 23c, 23d at the posterior half are set to be non-active, the butt of the needle body 6 does not pass through the stitch transferring side hook advancing path 20a at the anterior half but passes through the stitch receiving side hook advancing path 20b at the posterior half. The butt of the slider 7 slightly advances to the side of the needle bed gap 2 on the stitch receiving side tongue advancing path 21b at the posterior

half.

**[0030]** If the needle is selected such that the select jack is at a B position, the butt of the select jack passes through a path on which a presser 24 is provided. The presser 24 protrudes all the time and the needle body 6 and the slider 7 do not advance to the needle bed gap 2 and do not perform operations relating to the stitch transferring. It is to be noted that positions of the butt of the needle body 6 corresponding to Figs. 1(a), 1(b) and 1(c) are shown by 26a, 26b, and 26c, respectively and positions of the butt of the slider 7 are shown by 27a, 27b, and 27c, respectively.

**[0031]** The rear upper cam 14 includes a needle operation cam 30 and a slider operation cam 31. On the needle operation cam 30, a stitch receiving side hook advancing path 30a and a stitch transferring side hook advancing path 30b are provided. On the slider operation cam 31, a stitch receiving side tongue advancing path 31a and a stitch transferring side tongue advancing path 31b are provided. The stitch receiving side and the stitch transferring side are switched by selecting the path 18 of the butt of the select jack based on the needle selection result for each knitting needle. As shown in Fig. 2, when the rear upper cam 14 serves as the stitch receiving side, the needle at the H position is selected and the butt of the select jack passes through a path on which pressers 32a, 32b are provided. If the presser 32a at the anterior half is set to be active and the presser 32b at the posterior half is set to be non-active, the butt of the needle body 6 is guided by the stitch receiving side hook advancing path 30a at the posterior half so as to make the hook 6a advance to the needle bed gap 2. Further, the butt of the slider 7 is guided by the stitch receiving side tongue advancing path 31a at the posterior half so that the tongues 7b advance to the needle bed gap 2, so that operations as shown in Figs. 1(a), 1(b) and 1(c) can be performed.

**[0032]** If the needle is selected such that the select jack is at an A position, the butt of the select jack passes through a path on which presser 33a, 33b are provided. If the presser 33a at the anterior half is set to be non-active, and the presser 33b at the posterior half is set to be active, the butt of the needle body 6 passes through the stitch transferring side hook advancing path 30b at the anterior half so as to advance to the needle bed gap 2 and does not advance to the needle bed gap 2 at the posterior half. The butt of the slider 7 passes through the stitch transferring side tongue advancing path 31b so as to advance to the needle bed gap 2 with the advancement of the needle body 6 at the anterior half, and passes through the stitch receiving side tongue advancing path 31a so as to advance to the needle bed gap 2 at the posterior half. At the stitch transferring side, the tongues 7b are not needed to be made to advance to the needle bed gap 2 but the path is commonly used. The tongues 7b can be made so as not to advance to the needle bed gap 2 at the stitch transferring side by switching the path. However, the structure of the slider operation cam 31 can be made simpler in a case where such switching of

the path is not performed.

**[0033]** If the needle is selected such that the select jack is at a B position, the butt of the select jack passes through a path on which a presser 34 is provided. The presser 34 protrudes all the time, so that the needle body 6 and the slider 7, do not advance to the needle bed gap 2 and do not perform operations relating to the stitch transferring. It is to be noted that positions of the butt of the needle body 6 corresponding to Figs. 1(a), 1(b) and 1(c) are shown by 36a, 36b, and 36c respectively, and positions of the butt of the slider 7 corresponding to Figs. 1(a), 1(b) and 1(c) are illustrated by 37a, 37b, and 37c respectively.

**[0034]** In the stitch transferring to which the present invention is applied, the hook 6a of the stitch receiving side is slightly pulled in, is closed by the tongues 7b advancing to the needle bed gap 2, and then, is pulled in to the rear upper needle bed 4b, but a structure, in which the hook 6a is not pulled in until the hook 6a is closed and only the tongues 7b are made to advance, might be employed. Further a structure, in which the tongues 7b are made to advance to a position so as to press down the knitted loop 8 and are retained then only the hook 6a is descended, might be employed.

**[0035]** The flatbed knitting machine 10 in Figs. 1 is a four-bed type machine and the present invention is applied to stitch transferring from a lower stage side needle bed to an upper stage side needle bed, which is opposed to the lower stage side needle bed interleaving the needle bed gap 2. However, the present invention can be realized in other cases within a range without departing from a scope of the present invention. For example, the present invention can be applied to stitch transferring from the upper stage side needle bed to the lower stage side needle bed and stitch transferring between the lower stage side needle beds in the four bed type machine. Further, the present invention can be applied to stitch transferring between the needle beds in a two bed type machine. The knitting needle is driven by the stitch transferring cam 11, however, the present invention can be also applied in the same manner with a combined cam including both functions of stitch transferring and knitting by switching the path. Further, with the stitch transferring cam 11, the same stitch transferring can be performed in both running directions of the carriage, but it is needless to say that the stitch transferring may be performed in a specific direction. Further, the knitting needle is not limited to be driven by the cam and may be provided with an individual driving actuator on the needle body 6 and the slider 7, for example.

#### Explanation of Reference

##### [0036]

- 2 Needle bed gap
- 3a Front lower needle bed
- 3b Front upper needle bed

- 4a Rear lower needle bed
- 4b Rear upper needle bed
- 5 Compound needle
- 6 Needle body
- 5 6a Hook
- 6b Needle shank
- 7 Slider
- 7a Blade
- 7b Tongue
- 10 8 Knitted loop
- 10 Flatbed knitting machine
- 11 Stitch transferring cam
- 20, 30 Needle operation cam
- 21, 31 Slider operation cam
- 15 30a Stitch receiving side hook advancing path
- 31a Stitch receiving side tongue advancing path

#### Claims

- 20 1. A flatbed knitting machine, provided with needle beds which are arranged so as to be opposed to each other with respect to a needle bed gap, each needle bed equipped with compound needles arranged in parallel as knitting needles, each compound needle having a needle body and a slider, the needle body has a hook at a head portion, the slider relatively moves with respect to the needle body so as to open and close an opening at a tip side of the hook, the head portion of the slider is separated into two blades which are capable of advancing to the needle bed gap beyond an upper edge of the hook so as to sandwich the hook from both sides, a tongue is formed on a head portion of each blade, at a stitch transferring side a knitted loop is held between the tongues which advance to the needle bed gap beyond the upper edge of the hook and open mutually, at a stitch receiving side the hook of the needle body which is advanced to the needle bed gap is made to enter between the tongues of the stitch transferring side, and then is pulled in, so that the knitted loop is received in the opening of the hook of the stitch receiving side to perform stitch transfer, comprising:

- 45 hook advancing means for making the hook of the stitch receiving side advance to the needle bed gap and enter between the tongues of the stitch transferring side, and
- 50 tongue advancing means for making the slider of the stitch receiving side advance to the needle bed gap, until the knitted loop is sunk by bottoms of tips of the tongues to the side of a needle shank of the needle body beyond a declining trajectory of the tip of the hook before the hook of the stitch receiving side is pulled in and reaches to the knitted loop held between the tongues of the stitch transferring side.

2. The flatbed knitting machine according to claim 1, wherein  
on said slider of the stitch receiving side, when the tips of said tongues move relatively with respect to said needle body so as to close the opening of the tip side of said hook, a space between the needle shank of the needle body of the stitch receiving side and the tips of the tongues is once enlarged, and then, narrowed.
3. The flatbed knitting machine according to claims 1 or 2, wherein  
said compound needle is driven by a cam mounted on a carriage which runs back and forth along each needle bed, and  
the cam has said hook advancing means and said tongue advancing means as driving paths.
4. The flatbed knitting machine according to any one of claims 1 to 3, wherein  
said needle bed is a type of upper and lower two stages at least one side of said needle bed gap, and said hook advancing means and said tongue advancing means make the compound needle which is arranged in parallel on the upper stage needle bed operate as the stitch receiving side to receive the knitted loop which is transferred from the opposed needle bed at the lower stage side.
5. A stitch transferring method in a flatbed knitting machine, provided with needle beds which are arranged so as to be opposed to each other with respect to a needle bed gap, each needle bed equipped with compound needles arranged in parallel as knitting needles, each compound needle having a needle body and a slider, the needle body has a hook at a head portion, the slider relatively moves with respect to the needle body so as to open and close an opening at a tip side of the hook, the head portion of the slider is separated into two blades which are capable of advancing to the needle bed gap beyond an upper edge of the hook so as to sandwich the hook from both sides, a tongue is formed on a head portion of each blade, at a stitch transferring side a knitted loop is held between the tongues which advance to the needle bed gap beyond the upper edge of the hook and open mutually, at a stitch receiving side the hook of the needle body which is advanced to the needle bed gap is made to enter between the tongues of the stitch transferring side, and then is pulled in, so that the knitted loop is received in the opening of the hook at the stitch receiving side to perform stitch transfer, wherein  
after making the hook of the stitch receiving side advance to the needle bed gap and enter between the tongues of the stitch transferring side, and before the hook of the stitch receiving side is pulled in and reaches to a knitted loop held between the tongues,

advancing the slider of the stitch receiving side to the needle bed gap and sinking the knitted loop by bottoms of tips of the tongues to the side of a needle shank of the needle body beyond a declining trajectory of the tip of the hook.

Fig. 1  
(a)

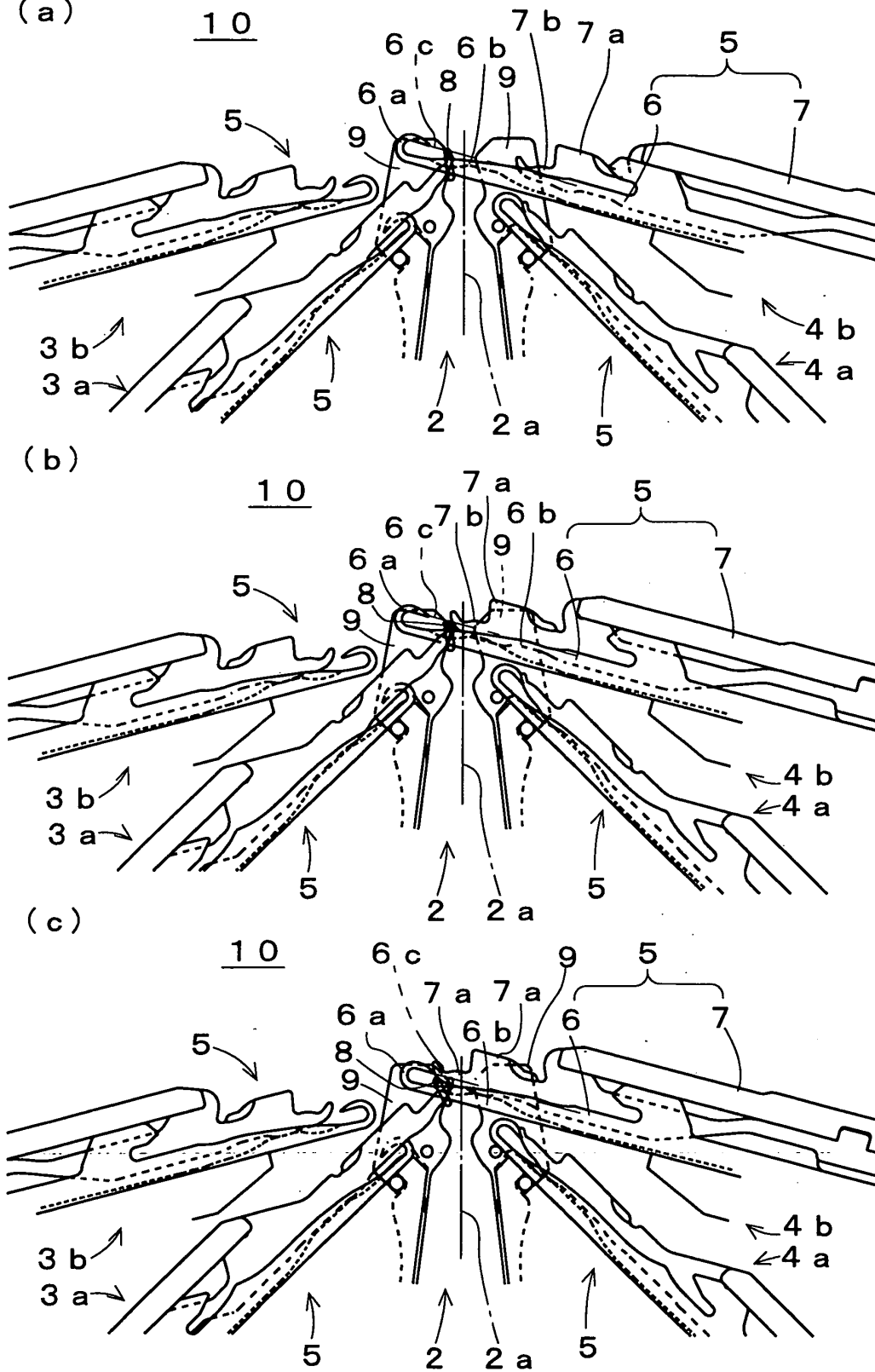


Fig. 2  
10

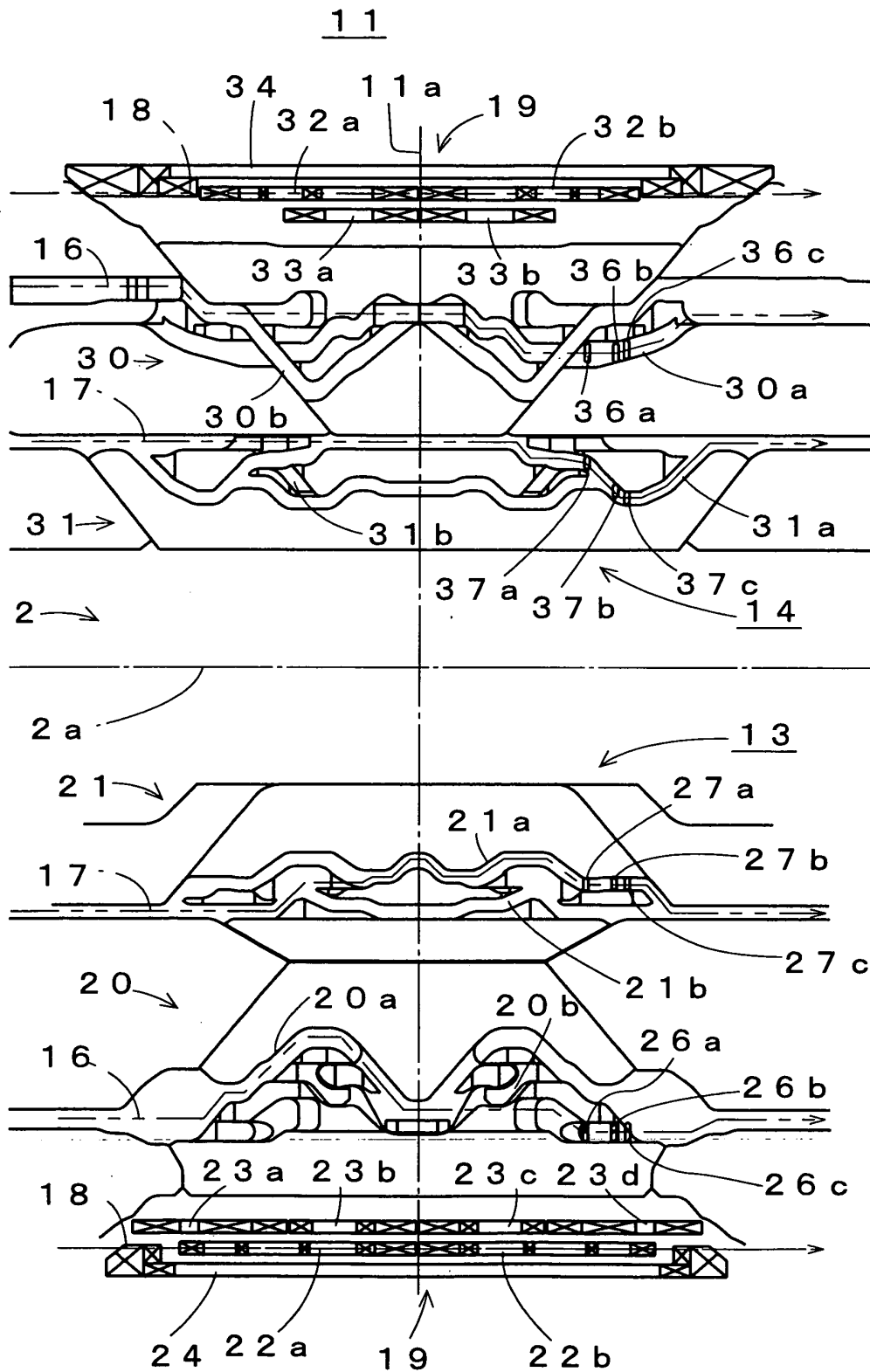
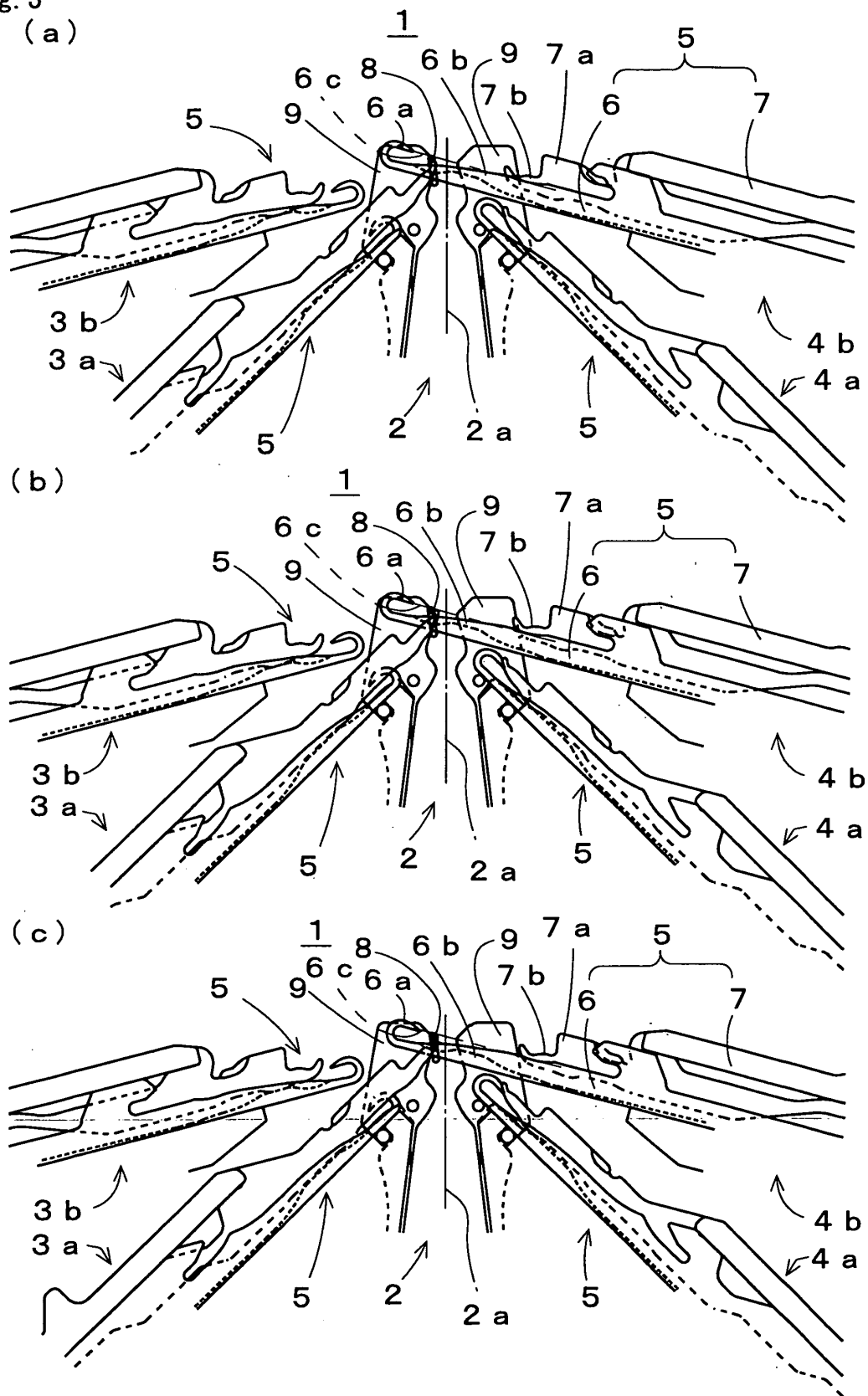


Fig. 3  
(a)



## INTERNATIONAL SEARCH REPORT

|                                                    |
|----------------------------------------------------|
| International application No.<br>PCT/JP2009/006980 |
|----------------------------------------------------|

## A. CLASSIFICATION OF SUBJECT MATTER

D04B7/00(2006.01) i, D04B35/06(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)

D04B7/00, D04B35/06

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 | 1996-2010 |
| Kokai Jitsuyo Shinan Koho | 1971-2010 | Toroku Jitsuyo Shinan Koho | 1994-2010 |

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. |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| A         | JP 3085657 B2 (Shima Seiki Mfg., Ltd.),<br>11 September 2000 (11.09.2000),<br>entire text; all drawings<br>& US 5992183 A & EP 896078 A2<br>& DE 69814259 D | 1-5                   |
| A         | JP 3886903 B2 (Shima Seiki Mfg., Ltd.),<br>28 February 2007 (28.02.2007),<br>entire text; all drawings<br>(Family: none)                                    | 1-5                   |

☒ 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

"I" 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

"&amp;" document member of the same patent family

Date of the actual completion of the international search  
08 January, 2010 (08.01.10)Date of mailing of the international search report  
19 January, 2010 (19.01.10)Name and mailing address of the ISA/  
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.  
PCT/JP2009/006980

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                                                                    | Relevant to claim No. |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| A         | WO 02/016684 A1 (Shima Seiki Mfg., Ltd.),<br>28 February 2002 (28.02.2002),<br>entire text; all drawings<br>& JP 3886900 B2 & US 2003/0159473 A1<br>& EP 1325973 A1 & DE 60132795 D<br>& AU 7872601 A & TW 548358 B<br>& CN 1454269 A | 1-5                   |
| A         | WO 2007/037285 A1 (Shima Seiki Mfg., Ltd.),<br>05 April 2007 (05.04.2007),<br>entire text; all drawings<br>& EP 1942216 A1 & CN 101278086 A                                                                                           | 1-5                   |
| A         | JP 2005-113352 A (Shima Seiki Mfg., Ltd.),<br>28 April 2005 (28.04.2005),<br>entire text; all drawings<br>& US 2007/0051138 A1 & EP 1672106 A1<br>& WO 2005/035852 A1 & KR 10-2006-0096480 A<br>& CN 1867716 A                        | 1-5                   |

Form PCT/ISA/210 (continuation of second sheet) (April 2007)

**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 3085657 B [0007]
- JP 3886903 B [0007]