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(54) **Compound needle for flatbed knitting machine**

(57) [Abstract]

[Problem to be solved] There is provided a compound needle for a flatbed knitting machine, which can make a slider hard to move backward owing to a pulling force to a downward of a needle bed gap, which acts on an old loop, even if a state where a tongue rises relatively is temporarily held, when the tongue is moved relatively so as to close a hook.

[Solution] A bottom portion of a tongue 6, there formed a step portion 6e between a slide contact portion 6c and an contacting portion 6d, has a shape concaved to the upper side in comparison with a conventional shape 6f. A stitch held on an upper edge 6a receives a

pulling force to a downward of a needle bed gap 8. A direction that the pulling force acts on the stitch is almost identical to a direction that the contacting portion 6d contacts a flat face 4b. Therefore, since a component force in the direction along the flat face 4b is hardly generated, a slider 5 is made hard to move backward. If the contacting portion 6d has a circular arc shape, only a component force in the direction constantly perpendicular to the flat face 4b is generated and a component force in the direction along the flat face 4b is not generated, so that the slider 5 can be made further hard to move backward.

Description

[Technical Field]

[0001] The present invention relates to a compound needle for a flatbed knitting machine, which is put in a needle groove formed on a needle bed of the flatbed knitting machine, is used for knitting a fabric and opens and closes a hook with a slider.

[Background Art]

[0002] Conventionally, in a flatbed knitting machine, a compound needle, which opens and closes a hook with a slider, has been used as a knitting needle in case miniaturization, improved productivity or the like being intended. In the compound needle, a needle body, which has the hook at a front end thereof, makes slide move in a needle groove, and a slider, which is put in a slider groove formed on the needle body, moves relatively to the needle body. The slider has a tongue at a leading end side thereof and a front end of the tongue contacts a steeple head of the hook to close the hook when an operation to form a knitted loop in which a new loop is formed on the hook. The tongue also has a function to guide an old loop held on an upper edge of the tongue such that the old loop climbs over an upper edge of the closed hook and making the old loop be knocked over. The old loop hung on the hook moves backward relatively to the hook and moves to the upper edge of the tongue when the hook advances to a needle bed gap before the hook is closed by the tongue. If a knitting yarn is fed to the hook in the needle bed gap, when the hook is pulled in to the needle bed, the knitting yarn is caught in the hook and a new loop is formed in the hook. If the front end of the tongue is made to contact the steeple head of the hook to close the hook and the needle body and the slider are further pulled in to the needle bed, the old loop is knocked over. In order to smoothly perform such operation of the tongue, a bottom face of the slider groove is formed as a cam face including a rising slope and a declining slope which move the tongue in the up-down direction in some cases (for example, see Patent Literature 1).

[Citation List]

[Patent Literature]

[0003] [Patent Literature 1] Japanese Patent No. 3886903

[Summary of Invention]

[Technical Problem]

[0004] At the time of yarn catching in which the hook is made to advance to the needle bed gap to receive yarn

feeding, the needle body is made to move forward and backward with respect to the needle bed gap while the slider is almost stopped in a state where the old loop is held on the upper edge of the tongue. When the needle body which has received the yarn feeding on the hook moves backward from the needle bed gap and gets closer to the tongue so as to close the hook, the tongue tries to rise relatively with an action by the rising slope of the slider groove and the old loop is pulled in downward in the needle bed gap. There are generated on the bottom portion of the tongue, a component force, in the direction to make the tongue contact the rising slope vertically, and a component force, in the direction to make the tongue decline along the rising slope, at a part which makes slide contact with the rising slope of the slider groove, owing to a pulling force to a downside of the needle bed gap which acts on the old loop on the upper edge. When a state where the tongue is temporarily held to rise relatively, if the component force in the direction to make the tongue decline is made larger, there arises a risk that the slider is moved backward with respect to the needle body.

[0005] The component force, in the direction to make the slider decline when the tongue rises relatively, increases in a case where the old loop are double stitches, in a case where thick knitting yarns are used, in a case where driving speeds of the needle body and the slider are made higher, or the like.

[0006] An object of the present invention is to provide a compound needle for a flatbed knitting machine which can make a slider hard to move backward owing to a pulling force, which acts on an old loop, to a downside of a needle bed gap, even if a state where a tongue ascends relatively is temporarily held, while the tongue is moved relatively so as to close a hook.

[Solution to Problem]

[0007] The present invention is a compound needle for a flatbed knitting machine, being combined a needle body which is put in a needle groove formed on a needle bed of the flatbed knitting machine in a state where the needle body is movable to slide in a front-rear direction and has a hook at a front portion, and on which a slider groove is formed rearward with respect to the hook, with a slider of which lower portion is put in the slider groove of the needle body and which has a tongue, capable of hanging a knitted loop at a front portion, and moves relatively to the needle body to open and close the hook by the tongue, and on a bottom face of the slider groove, a rising slope which makes the tongue rise such that a leading end of the tongue reaches a height at which the leading end of the tongue contacts a steeple head of the hook when the slider is made closer to the hook so as to close the hook by the tongue, and a flat face which makes the risen tongue closer to the hook at a constant height, being formed as a continuous cam face,

characterized in that

a bottom portion of the slider on which the bottom face of the slider groove acts as the cam face has:

a slide contact portion which makes slide contact with the flat face on the bottom face of the slider groove such that the tongue is made closer to the hook at the constant height when the hook is closed by the tongue, and
a contacting portion which projects from frontward of the slide contact portion to the side of the bottom face of the slider groove so as to contact the flat face in advance of the slide contact portion at a stage where the slide contact portion makes the transition from the rising slope on the bottom face of the slider groove to the flat face.

[0008] Further, in the present invention, said contacting portion on the bottom portion of the slider has a circular arc shape and makes point contact with said flat face.

[0009] Further, in the present invention, said tongue is divided into two blades and sandwiches the steeple head of said hook from both sides when the hook is closed

[Advantageous Effects of Invention]

[0010] According to the present invention, a bottom portion of a slider on which a bottom face of a slider groove acts as a cam face has a slide contact portion and a contacting portion. The slide contact portion makes slide contact with a flat face on the bottom face of the slider groove such that the tongue is made closer to the hook at a constant height when the hook is closed by the tongue. The contacting portion projects to the side of the bottom face of the slider groove from a front portion of the slide contact portion so as to abut against the flat face in advance of the slide contact portion at a stage where the slide contact portion makes a transition from a rising slope on the bottom face of the slider groove to the flat face. The contacting portion contacts the flat face on the bottom face of the slider groove in advance of the slide contact portion, so that, even if a pulling force to a downside of the needle bed gap acts on an old loop, component forces are generated in the direction along the flat face and in the direction perpendicular to the flat face. At the time of the yarn catching in which a state where the tongue relatively rises is temporarily held, if the contacting portion is made to contact the flat face, a component force is generated not in the direction that the slider is moved backward along the rising slope but in the direction along the flat face, therefore, the slider can be made hard to move backward.

[0011] Further, according to the present invention, the contacting portion on the bottom portion of the slider has a circular arc shape and makes point contact with the flat face, so that, when the contacting portion contacts the flat face on the bottom face of the slider groove, only a

component force in the direction perpendicular to the flat face can be made to be generated and a component force in the direction that the slider moves backward along the flat face can be made not to be generated.

5 [0012] Further, according to the present invention, two blades of the slider smoothly open and close the hook, even if a downward pulling force in the needle bed gap acting on the old loop is increased, the slider is made hard to move backward so that the old loop can be reliably knocked over.

[Brief Description of Drawings]

[0013]

15 [Fig. 1] Fig. 1 is a partial front view showing a schematic structure of a compound needle 1 as an embodiment of the present invention.
20 [Fig. 2] Fig. 2 is a front view showing main parts structuring the compound needle 1 of Fig. 1 and a combined state of the main parts.
25 [Fig. 3] Figs. 3 are partial front views showing operations of the compound needle 1 of Fig. 1.
[Fig. 4] Fig. 4 is a partial front view showing a state where an old loop is held on the compound needle 1 of Fig. 1.

[Description of Embodiments]

30 [0014] Hereinafter, Fig. 1 partially shows a schematic structure of a compound needle 1 used in a flatbed knitting machine as an embodiment of the present invention. Fig. 2 shows a structure of the compound needle 1 of Fig. 1 entirely and structures of main structural parts.

35 [Figs. 3] Figs. 3 shows operations of the compound needle 1 of Fig. 1. Fig. 4 shows a state in the middle of knitting a fabric with the compound needle 1 of Fig. 1.

[0015] In each drawing, the same reference numeral denotes corresponding part and repeated description is omitted in some cases. Further, parts which are not denoted with reference numerals in the drawing to be referred to but denoted with reference numerals in the drawing referred to before are described in some cases.

[0016] Further, the compound needle 1 in the drawings is illustrated in a state where the compound needle 1 is put in a needle groove formed on a needle bed of a flatbed knitting machine. However, the needle groove itself is omitted to illustrate in the drawings. The needle bed of the flatbed knitting machine is inclined upward toward a

50 [needle bed gap] located at the front side of the needle groove and downward away from the needle bed gap as shown in Fig. 4, however, the compound needle 1 in Fig. 1 to Figs. 3 is shown in a horizontal posture. In the posture, a right hand indicates a front side as the needle bed gap side and a left hand indicates a rear side away from the needle bed gap. Further, an upside in the drawings indicates a direction that the compound needle 1 floats from the needle groove and a downside in the drawings

indicates a direction that the composite needle 1 sinks in the needle groove.

[Example]

[0017] In the compound needle 1 shown in Fig. 1, a needle body 2 makes slide move in the needle groove of the needle bed in the right-and-left direction of Fig. 1. A hook 3 is provided on a front end of the needle body 2 and a guiding portion presser 2a is formed at a rearward distanced from the hook 3. A slider groove 4 is provided on a needle shank 2b including the guiding portion presser 2a at the rearward with respect to the hook 3. The slider groove 4 is opened on an upper face of the needle shank 2b. In the slider groove 4, a lower portion of a slider 5 is put in, and if the lower portion of the slider 5 makes slide move in the slider groove 4, the slider 5 can move relatively to the needle body 2. A tongue 6 is formed on a front end of the slider 5 and an old loop can be held on an upper edge 6a thereof. A fall preventing portion 6b which is made higher than the upper edge 6a is provided at a leading end of the tongue 6 so that the old loop held on the upper edge 6a does not fall.

[0018] As shown in Fig. 1, the hook 3 is opened in a state where the fall preventing portion 6b at the leading end of the tongue 6 is separated to the rearward from a steeple head 3a of the hook 3. The hook 3 is opened and closed by the tongue 6 with the relative movement of the slider 5 with respect to the needle body 2. The movement of the slider 5 with respect to the needle groove is performed through a base body 7. The slider 5 and the base body 7 combine with each other at the left side out of a range shown within the drawing. A butt provided on the base body 7 is driven by a cam so that the driving of the slider 5 is performed. Further, in the needle body 2, a butt provided on a needle jack which is combined to the needle body 2 at the left side out of a range shown in the drawing is driven with a cam so that the hook 3 is moved forward and backward with respect to a needle bed gap 8 with the movement of the needle body 2 in the needle groove. In the needle bed gap 8, needle beds at front and rear sides are opposed to each other and a center line 8a extends in the vertical direction. However, in Fig. 1, the direction that the center line 8a extends is indicated not by an up and down direction but by a diagonally right up direction.

[0019] A cam face including a rising slope 4a, a flat face 4b and a declining slope 4c is formed on a bottom face of the slider groove 4 in which the lower portion of the slider 5 is put in. The cam face guides a bottom portion of the tongue 6 and moves the tongue 6 in the up-down direction when the tongue 6 makes closer to and closes the steeple head 3a of the hook 3. If the tongue 6 closes the steeple head 3a of the hook 3, the old loop held on the upper edge 6a of the tongue 6 can be made to pass through the upper edge 3b of the hook 3 so as to be knocked over. A slide contact portion 6c, which make slide contact with the cam face, and a contacting portion

6d are provided on the bottom portion of the tongue 6. The slide contact portion 6c makes slide contact with the cam face at leftward from the rising slope 4a, that is the rising slope 4a and the flat face 4b. However, at the time of the yarn catching when yarns are fed from a yarn feeder port 9 to the hook 3 in the needle bed gap 8, as shown in Fig. 1, the slide contact portion 6c is retained in the vicinity of a portion where the slide contact portion 6c moves from the rising slope 4a to the flat face 4b and a state where the contacting portion 6d contacts the flat face 4b is temporarily held.

[0020] As shown in an upper portion of Fig. 1, on the bottom portion of the tongue 6, a step portion 6e is formed between the slide contact portion 6c and the contacting portion 6d and the step portion 6e has a shape which is concave to an upside in comparison with a conventional shape 6f. A shoulder portion 5a and a guiding portion 5b of the slider 5 are provided on the rear portion of the tongue 6. The guiding portion 5b is pressed by the guiding portion presser 2a in a state where the slider 5 is moved backward with respect to the needle-body 2 to the maximum. The shoulder portion 5a defines a backmost position at which a knitted loop held on the upper edge 6a of the tongue 6 is moved backward to the maximum.

[0021] The knitted loop held on the upper edge 6a receives a pulling force to the downside of the needle bed gap 8. At this time, the contacting portion 6d contacts the flat face 4b on the bottom portion of the tongue 6 on which the bottom face of the slider groove 4 acts as a cam face. As will be described later with reference to Fig. 4, the pulling force acting on the knitted loop acts in a downward direction in Fig. 1 and the direction that the pulling force acts is substantially identical to the direction that the contacting portion 6d contacts the flat face 4b.

Therefore, since a component force in the direction along the flat face 4b is hardly generated with the pulling force, the slider 5 is made hard to move backward. It is to be noted that even if the contacting portion 6d has a linear shape such that the contacting portion 6d makes line contact with the flat face 4b for a short distance, for example, a component force generated in the direction along the flat face 4b makes it possible to make the slider 5 hard to move backward. If the contacting portion 6d has a circular arc shape and makes point contact with the flat face 4b, only a component force in the direction constantly perpendicular to the flat face 4b is generated and a component force in the direction along the flat face 4b is not generated. Therefore, in such a case, the slider 5 can be made further hard to move backward.

[0022] Fig. 2 shows the compound needle 1 and the needle body 2, the slider 5 and the needle jack 10 as main parts of the compound needle 1 in a combined state and exploded states. The slider 5 and the base body 7 are combined to each other with a combining portion 5d and the slider 5 is moved by a driving force received on a driving butt 7b. An auxiliary butt 7c is also provided so as to be adjacent to the driving butt 7b. The needle body 2 has a combining concave 2c in the vicinity of a rear end

thereof. The needle jack 10 is bonded to the needle body 2. A tail portion of the needle jack 10 becomes an elastic leg 10a and elastically floats from a bottom face of the needle groove. A driving butt 10b is provided on the middle of the needle jack 10 and receives driving for making the needle body 2 to slide move in the needle groove. A combining convex 10c is provided on a front end of the needle jack 10. The combining convex 10c is combined to the combining concave 2c of the needle body 2 so that the needle body 2 and the needle jack 10 are combined. A combination of the base body 7 and the slider 5 can be moved relatively to the needle jack 10 and the needle body 2 which are combined to each other in this manner.

[0023] Figs. 3 shows knitting operations of the knit by moving the slider 5 relatively to the needle body 2 in the compound needle 1 of Fig. 1. Though the needle body 2 also moves with respect to the needle groove in some cases, Figs. 3 shows the operations in a state where the needle body 2 is relatively stopped and the slider 5 is relatively moved.

[0024] Fig. 3(a) shows a state where the slider 5 moves backward with respect to the needle body 2 to the maximum. In this state, the hook 3 is made into a state of advancing to the needle bed gap 8 to the maximum. The old loop hung in the hook 3 before the hook 3 is made to advance to the needle bed gap 8 moves to the tongue 6 side along the upper edge of the needle shank 2b as the needle body 2 advances to the needle bed gap 8. The fall preventing portion 6b of the tongue 6 sinks in the slider groove 4 and does not protrude from the upper edge of the needle shank 2b, so that the old loop can smoothly be moved relatively onto the upper edge 6a of the tongue 6.

[0025] Fig. 3(b) shows a state at the time of the yarn catching in which the hook 3 receives yarn feeding as shown in Fig. 1. If the slider 5 is almost stopped with respect to the needle groove, the needle body 2 is slightly moved backward with respect to the needle groove, and the hook 3 is moved backward to a yarn feeding position from the most-advanced position from the state of Fig. 3(a), the slide contact portion 6c on the bottom portion of the tongue 6 makes slide contact with the rising slope 4a so that the tongue 6 can be risen such that the upper edge 6a and the fall preventing portion 6b are located at positions higher than the upper edge of the needle shank 2b. If a state where the contacting portion 6d on the bottom portion of the tongue 6 contacts the flat face 4b is temporarily held and yarn feeding to the hook 3 is performed, even if a pulling force to the downside of the needle bed gap 8 acts on the old loop held on the upper edge 6a of the tongue 6, the slider 5 can be made hard to move backward.

[0026] Fig. 3(c) shows a state, in which the slider 5 is stopped at a position as is shown in Fig. 3(b) and the needle body 2 is moved backward with respect to the needle bed gap 8 so as to pull in the hook 3 to the needle bed. If the slide contact portion 6c on the bottom portion of the tongue 6 makes slide contact with the flat face 4b,

the abutment portion 6d is separated from the flat face 4b and does not receive an action from the cam face. The knitting yarn is caught in the hook 3.

[0027] Fig. 3(d) shows a state, in which the steeple head 3a of the hook 3 contacts the fall preventing portion 6b at the front end of the tongue 6 and the hook 3 is closed by the tongue 6. A new loop is formed in the hook 3 by pulling in the hook 3 to the needle bed side. If the hook 3 is further pulled in, the old loop held on the upper edge 6a of the tongue 6 passes through the upper edge 3b of the hook 3 and is knocked over. The declining slope 4c for making the tongue 6 decline is provided so that the fall preventing portion 6b does not hinder the movement of the old loop when the old loop is knocked over.

It is to be noted that the flat face 4b may be extended to the front end of the bottom face of the slider groove 4 without providing the declining slope 4c on the bottom face of the slider groove 4 as long as the movement of the old loop is not hindered.

[0028] It is to be noted that the slider 5 is structured to be divided into two blades which are lined in the direction perpendicular to a paper plane. A leading end side of the tongue 6 is also divided into two and the fall preventing portions 6b sandwich the steeple head 3a from both sides when the steeple head 3a of the hook 3 is closed by the leading end of the tongue 6 as shown in Fig. 3(d). When the slider 5 is divided into two blades, not only the hook 3 can be closed by the leading end of the tongue 6 as shown in Fig. 3(d) but also the two blades can be made to advance to the needle bed gap 8 beyond the hook 3 so as to perform stitch transferring. In the driving cam for performing various operations by using the slider 6 which is divided into two blades as described above, a path switching of a cam groove acting on the driving butt 7b is performed many times. If the slider 6 is moved backward in the middle of the guiding, there arises a risk that the slider 6 is guided to a different path and a malfunction is caused. If the contacting portion 6d is provided on the bottom portion of the tongue 6 so as to make the slider 6 hard to move backward, the risk of the malfunction can be reduced. Further, the slider 5 which is not divided into two blades may be used. In this case, when the state at the time of the yarn catching of the knit is temporarily held, the slider 5 can be also made hard to move backward as in the case of the above-mentioned slider 5 which is divided into two blades.

[0029] Fig. 4 shows a state at the time of the yarn catching of the knit as knitting the fabric in the vicinity of a leading end of a needle bed 11 as in Fig. 1 and Fig. 3(b).

An old loop 12 held on the upper edge 6b of the tongue 6 is continuous to a fabric 13 dropping to the downward of the needle bed gap 8. The knit fabric 13 is pulled to the downward of the needle bed gap 8 with a pulling-down device. A movable sinker 14 which pushes the old loop 12 and the fabric 13 to the downward of the needle bed gap 8 is used in some cases. The movable sinker 14 pushes the old loop 12 to the downward of the needle bed gap 8 with a yarn receiving portion 14a. A pulling

force to the downward in Fig. 4 acts on the upper edge 6a of the tongue 6 with the knitting yarns of the old loop 12. The bottom portion of the tongue 6 contacts the flat face 4b on the bottom face of the slider groove 4 at the contacting portion 6d having a circular arc shape in a point contact manner, so that a component force which moves the slider 5 backward is hardly generated on the contacting portion 6d.

[Reference Signs List]

[0030]

1 Compound needle

2 Needle body

3 Hook

3a Steeple head

4 Slider groove

4a Rising slope

4b Flat face

5 Slider

6 Tongue

6a Upper edge

6c Slide contact portion

6d Contacting portion

7 Base body

8 Needle bed gap

12 Old loop

Claims

1. A compound needle (1) for a flatbed knitting machine, being combined a needle body (2) which is put in a needle groove formed on a needle bed (11) of the flatbed knitting machine in a state where the needle body (2) is movable to slide in a front-rear direction and has a hook (3) at a front portion, and on which a slider groove (4) is formed rearward with respect to the hook (3),
with a slider (5) of which lower portion is put in the slider groove (4) of the needle body (2) and which has a tongue (6), capable of hanging a knitted loop, at a front portion and moves relatively to the needle

5 body (2) to open and close the hook (3) by the tongue (6), and

on a bottom face of the slider groove (4), a rising slope (4a) which makes the tongue (6) rise such that a leading end of the tongue (6) reaches a height at which the leading end of the tongue (6) contacts a steeple head (3a) of the hook (3) when the slider (5) is made closer to the hook (3) so as to close the hook (3) by the tongue (6), and a flat face (4b) which makes the risen tongue (6) closer to the hook (3) at a constant height, being formed as a continuous cam face, **characterized in that**

10 a bottom portion of the slider (5) on which the bottom face of the slider groove (4) acts as the cam face has:

15 a slide contact portion (6c) which makes slide contact with the flat face (4b) on the bottom face of the slider groove (4) such that the tongue (6) is made closer to the hook (3) at the constant height when the hook (3) is closed by the tongue (6), and

20 a contacting portion (6d) which projects from frontward of the slide contact portion (6c) to the side of the bottom face of the slider groove (4) so as to contact the flat face (4a) in advance of the slide contact portion (6c) at a stage where the slide contact portion (6c) makes the transition from the rising slope (4a) on the bottom face of the slider groove (4) to the flat face (4b).

2. The compound needle (1) of the flatbed knitting machine according to claim 1, **characterized in that** said contacting portion (6d) on the bottom portion of the slider (6) has a circular arc shape and makes point contact with said flat face (4b).

3. The compound needle (1) of the flatbed knitting machine according to claims 1 or 2, **characterized in that**

35 said tongue (6) is divided into two blades and sandwiches the steeple head (3a) of said hook (3) from both sides when the hook (3) is closed.

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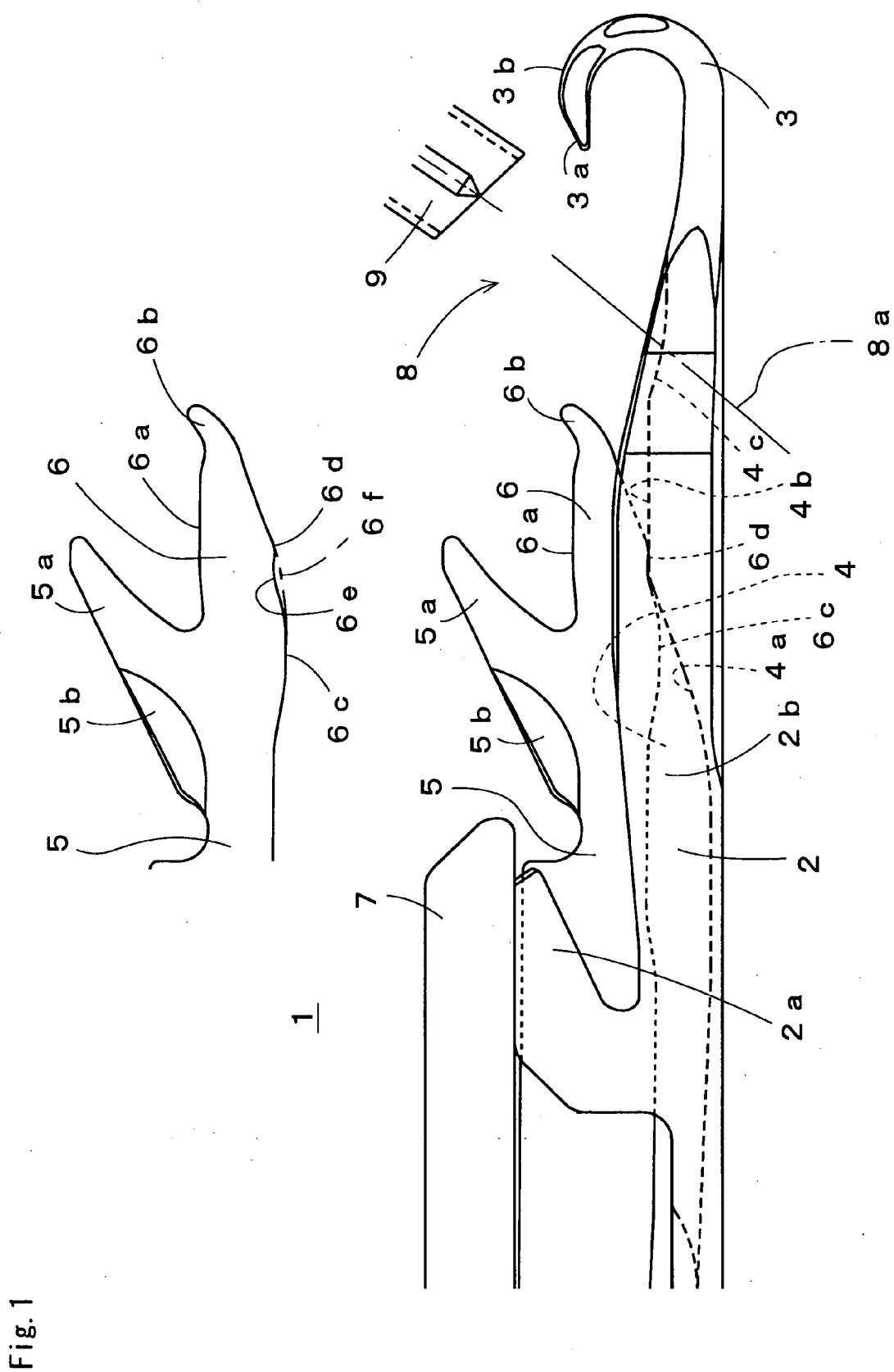


Fig. 1

Fig. 2

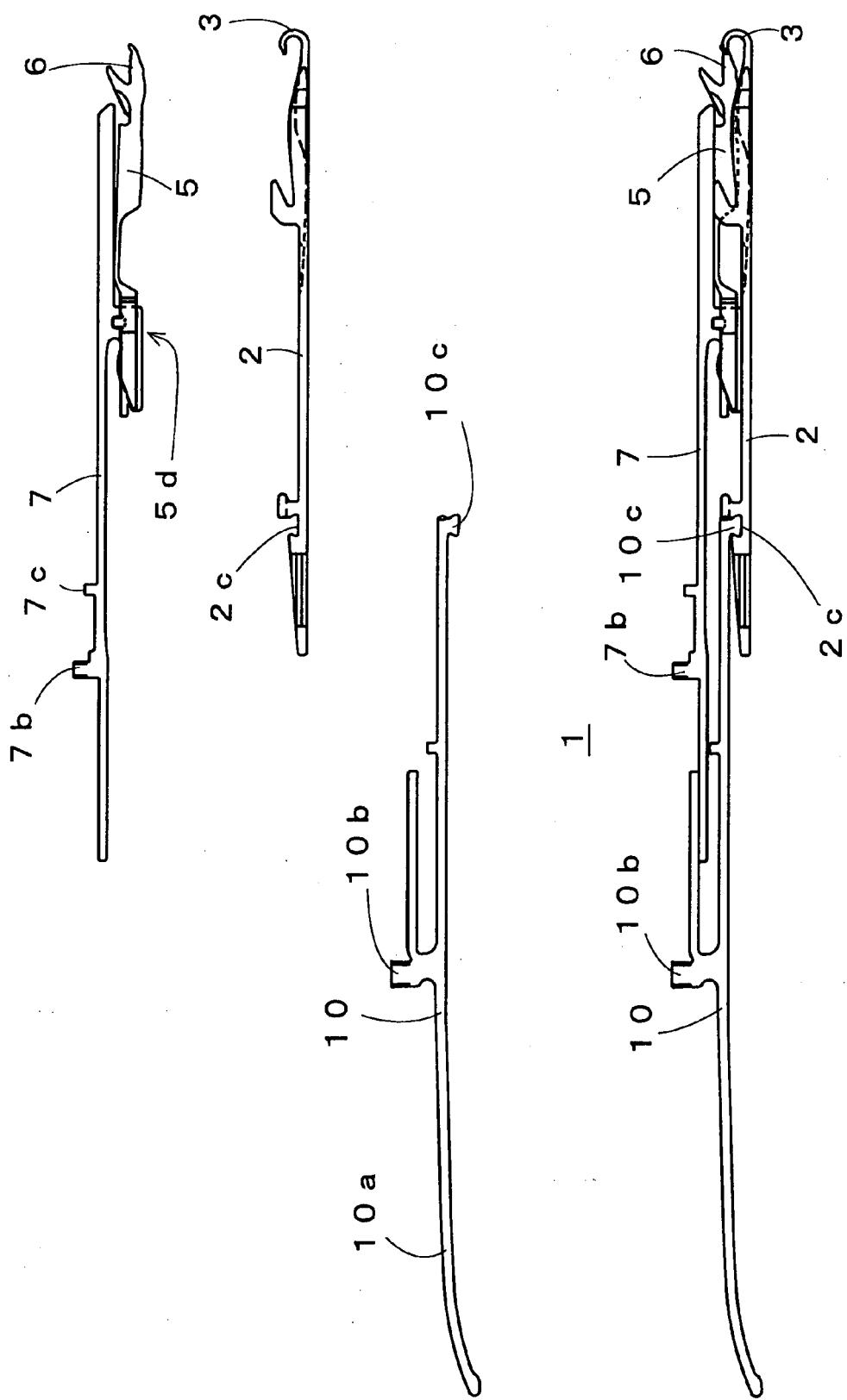
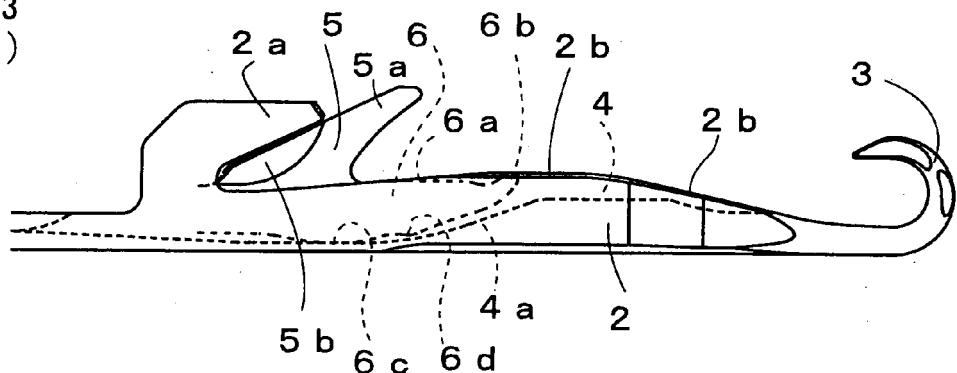
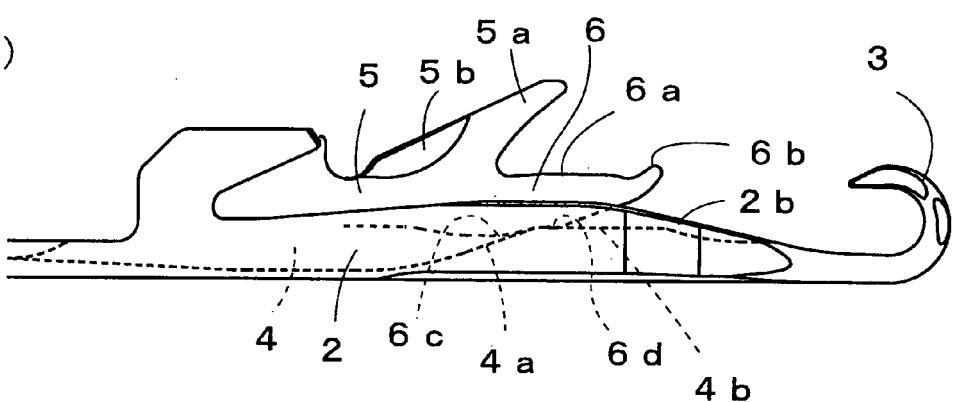


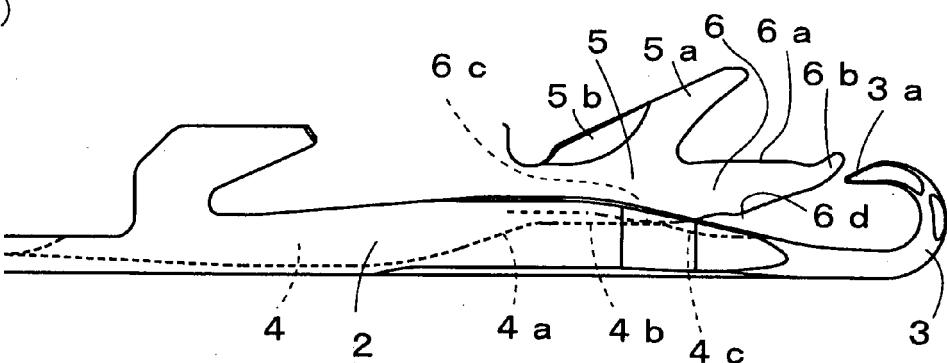
Fig. 3
(a)



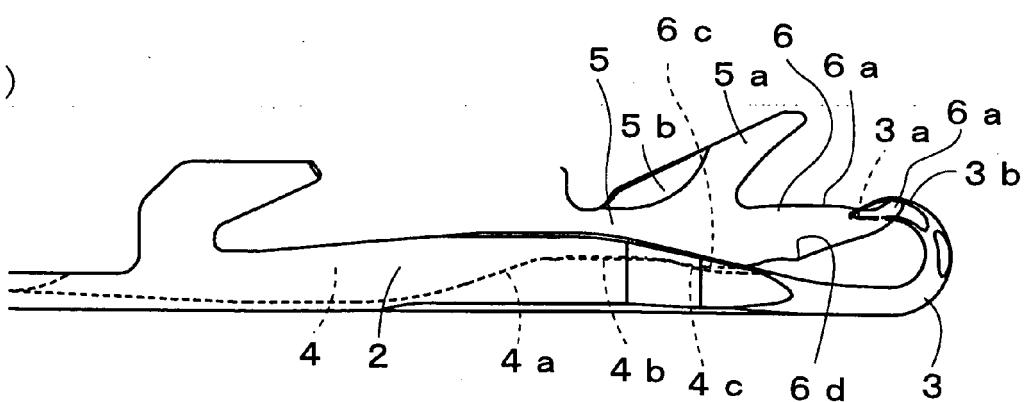
(b)



(c)



(d)



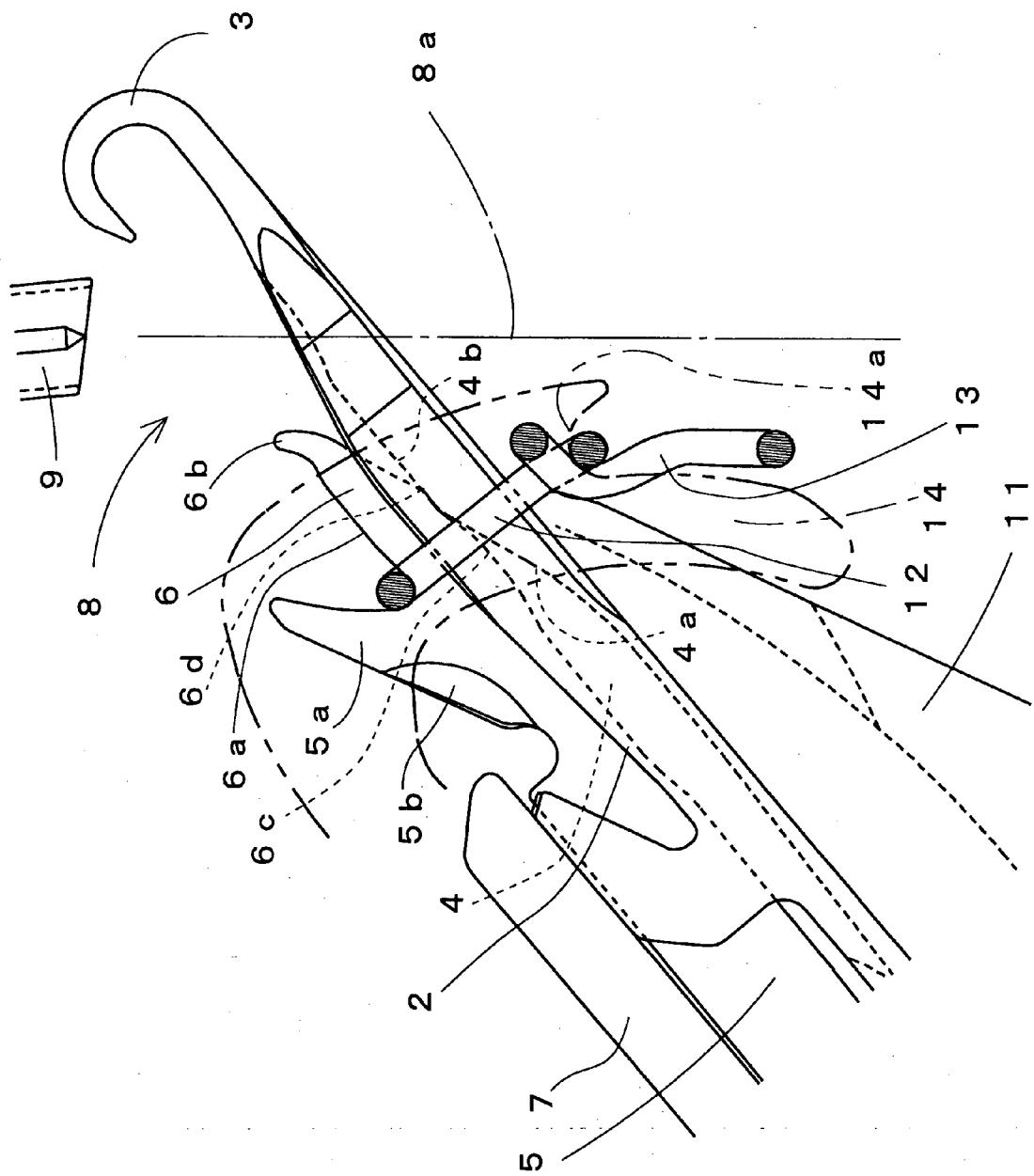


Fig. 4



EUROPEAN SEARCH REPORT

Application Number
EP 11 00 6394

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (IPC)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
X	EP 1 229 158 A1 (SHIMA SEIKI MFG [JP]) 7 August 2002 (2002-08-07) * abstract; figures 2, 4A, 4B * -----	1-3	INV. D04B35/06
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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
1	Place of search Munich	Date of completion of the search 9 December 2011	Examiner Zirkler, Stefanie
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			
T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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

EP 11 00 6394

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

09-12-2011

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 3886903 B [0003]