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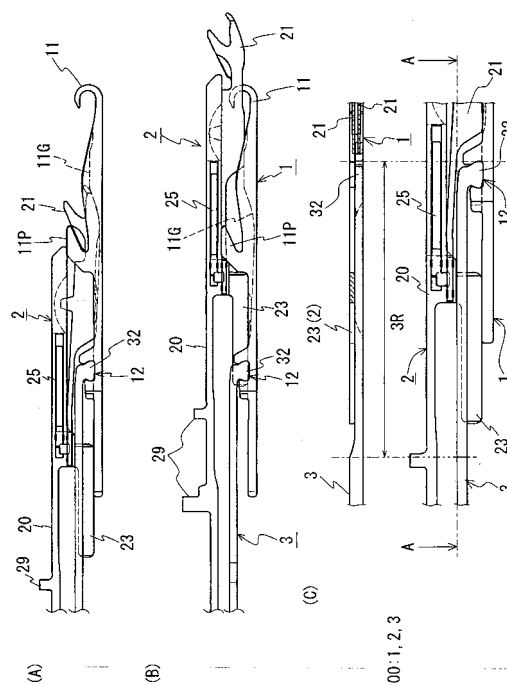
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(54) **COMPLEX NEEDLE, WEFT KNITTING MACHINE**

(57) To provide a compound needle in which the entire length is shortened. A compound needle 100 includes a needle main body 1, a slider 2, and a needle jack 3. The needle main body 1 includes a needle jack engagement portion 12 that is formed locally thin, and an arm-slidably-contacting surface 13 having a width in parallel to the needle jack engagement portion 12 in a thickness direction of the needle main body 1. The slider 2 includes a slider plate 21 arranged in a slider base body 20, and a thin slider arm 23 that slidably contacts the arm-slidably-contacting surface 13 of the needle main body 1. The needle jack 3 includes a distal end engagement portion 32, which is formed in a distal end region 3R formed to a thickness smaller than or equal to a thickness of the needle jack engagement portion 12 and engages the needle jack engagement portion 12.

Fig. 2



Description

TECHNICAL FIELD

[0001] The present invention relates to a compound needle having a configuration of opening and closing a hook arranged at a distal end of a needle main body with a slider, and a flat knitting machine equipped with the compound needle.

BACKGROUND ART

[0002] The flat knitting machine is a machine that knits a knitted fabric by moving knitting needles arranged in a great number of needle grooves arranged in parallel in a needle bed with a cam system arranged in a carriage, which reciprocates along a longitudinal direction of the needle bed (direction orthogonal to the needle groove). A compound needle that opens and closes the hook of the needle main body with the slider is known as a knitting needle used in such a flat knitting machine (see e.g., Patent Documents 1 and 2).

[0003] Fig. 3 is a schematic view of a needle main body 101, a slider 102, and a needle jack 103 of the members configuring the compound needle, and Fig. 4 is a schematic view of a compound needle 200 in which each member 101, 102, 103 are combined, where (A) shows a state in which the slider 102 is withdrawn the most with respect to the needle main body 101, and (B) shows a state in which the slider 102 is advanced the most with respect to the needle main body 101.

[0004] The needle main body 101 is a linear long member having a hook 111, which is arranged at the distal end of the body to hold a knitting yarn, and a needle jack engagement portion (hereinafter referred to as NJ engagement portion) 112, which is arranged on a back end side of the body. A distal end engagement portion 132 of a needle jack (hereinafter referred to as NJ) 103 engages the NJ engagement portion 112. Thus, when the cam system acts on a butt 139 of the NJ 103, the needle main body 101 is advanced and withdrawn along the needle groove with the NJ 103.

[0005] The slider 102 is a long member that advances and withdraws along the needle groove when the cam system acts on a butt 129 arranged therein, and is a member that opens and closes the hook 111 with two slider plates 121 arranged on the distal end side. When the slider 102 and the needle main body 101 relatively slide, a slider arm 123 of the slider 102 and an arm-slidably-contacting surface 113 of the needle main body 101 slidably contact each other so that the members 101, 102 do not chatter in an up and down direction. The arm-slidably-contacting surface 113 is formed between a projection 111P that projects out at the upper surface of the needle main body 101, and a projection 112A that forms the NJ engagement portion 112.

PRIOR ART DOCUMENT

PATENT DOCUMENT

5 **[0006]**

[Patent Document 1] JP 4-066941 B
[Patent Document 2] JP 2946323 B2

10 DISCLOSURE OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0007] In recent years, there are demands for miniaturization and weight saving of the flat knitting machine equipped with the compound needle having the above configuration. To respond to such demands, it is considered effective to shorten the entire length of the compound needle to realize miniaturization and weight saving of the flat knitting machine. Since the entire length of the compound needle is a factor that determines the length of the needle groove, the needle bed can be miniaturized if the compound needle can be shortened, and as a result, the flat knitting machine can be made smaller and lighter.

25 **[0008]** In light of the foregoing, it is one object of the present invention to provide a compound needle in which the entire length is shortened, and a flat knitting machine equipped with the compound needle.

30 MEANS FOR SOLVING THE PROBLEMS

[0009] The inventors of the present invention reviewed the factors that the entire length of the compound needle 200 is long, and focused on the fact that the engagement position of the NJ 103 with respect to the needle main body 101 is distant from the hook 111 to ensure the slide length of the slider 102. The engagement position is distant from the hook 111 because the projection or the like that inhibits the relative slide of the arm-slidably-contacting surface 113 and the slider arm 123 cannot be arranged on the arm-slidably-contacting surface 113, and the NJ engagement portion 112 inevitably needs to be arranged on the further back end side of the needle main body 101 than the arm-slidably-contacting surface 113.

45 The inventors of the present invention changed the way of thinking and reached the idea of arranging the arm-slidably-contacting surface and the needle jack engagement portion in the needle main body in parallel in the thickness direction of the needle groove. The inventors thus came to complete the compound needle of the present invention and the flat knitting machine described below.

[0010] A compound needle of the present invention is a compound needle arranged in a needle groove formed in a needle bed of a flat knitting machine, the compound needle including a needle main body, which includes a hook for holding a knitting yarn, a slider, which is slidably combined with respect to the needle main body and which

opens and closes the hook, and a needle jack, which engages the needle main body and advances and withdraws the needle main body in a direction along the needle groove. The slider includes a slider base body, a slider plate, which is arranged in the slider base body to open and close the hook, and a slider arm, which is arranged at an intermediate portion of the slider base body and formed thin with respect to a thickness of the slider base body. The needle main body includes a needle jack engagement portion that is formed locally thin, and an arm-slidably-contacting surface, which is a surface having a width in parallel to the needle jack engagement portion in a thickness direction of the needle main body and to which the slider arm is brought into slidable contact. The needle jack includes a distal end engagement portion, which is formed in a distal end region formed to a thickness of smaller than or equal to a thickness of the needle jack engagement portion and engages the needle jack engagement portion.

[0011] According to one aspect of the compound needle of the present invention, the slider preferably includes a slide-resistance generating portion formed on the same side as the needle jack engagement portion of the needle main body on a distal end side of the slider arm in the slider base body. The slide-resistance generating portion is configured to apply a slide resistance between the needle groove and the slider when the slider is slid along the needle groove.

[0012] A flat knitting machine of the present invention is a flat knitting machine in which at least a pair of needle beds including a plurality of needle grooves is arranged facing each other, the flat knitting machine including the compound needle of the present invention described above in the needle grooves.

EFFECTS OF THE INVENTION

[0013] In the compound needle of the present invention, since the arm-slidably-contacting surface and the needle jack engagement portion of the needle main body are arranged in parallel in a width direction of the needle groove, the position where the needle jack engages the needle main body becomes closer to the hook compared to the prior art and the entire length of the needle main body can also be shortened. Therefore, the compound needle of the present invention is shorter and lighter than the conventional compound needle. As a result, the needle groove in which the compound needle is to be arranged can be shortened, whereby the needle bed can be made smaller and lighter, and the cost can be reduced with space saving and lighter weight of the flat knitting machine and reduction in material.

[0014] The slide resistance can be generated between the slider and the side wall of the needle groove by forming the slide-resistance generating portion in the slider, so that the accuracy of the stopping position of the slider can be enhanced. The slide-resistance generating portion is not arranged on the slider arm and pushes the

slider to the needle groove on the side opposite to the side where the needle jack is arranged, so that the slider arm is not strongly pushed against the distal end of the needle jack and the needle jack engagement portion of the needle main body. As a result, the advancing and withdrawing operation of the slider, and the advancing and withdrawing operation of the needle jack and the needle main body become smoother.

[0015] The flat knitting machine equipped with the compound needle of the present invention is smaller and lighter than the prior art. The length along the needle groove of the needle bed becomes shorter in accordance with the shortened compound needle, and the carriage that operates the compound needle also becomes compact.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

Fig. 1 is a schematic view of a needle main body, a slider, and a needle jack arranged in a compound needle according to the embodiment. The figures shown near each member are a partial top view of the needle main body, a partial bottom view of the slider, and a partial top view of the needle jack.

Figs. 2A to 2C are schematic views showing a state in which each member of Fig. 1 is assembled into the compound needle, where Fig. 2A is a view showing a state in which the slider is withdrawn the most with respect to the needle main body, Fig. 2B is a view showing a state in which the slider is advanced the most with respect to the needle main body, and Fig. 2C is a partially enlarged view of the compound needle in the state of (A) and a perspective view of a cross-section taken along line A-A of the partially enlarged view.

Fig. 3 is a schematic view of a needle main body, a slider, and a needle jack arranged in a conventional compound needle.

Figs. 4A and 4B are schematic views showing a state in which each member of Fig. 3 is assembled into the compound needle, where Fig. 4A is a view showing a state in which the slider is withdrawn the most with respect to the needle main body, and Fig. 4B is a view showing a state in which the slider is advanced the most with respect to the needle main body.

MODE FOR CARRYING OUT THE INVENTION

[0017] An embodiment of a compound needle of the present invention will be hereinafter described based on Figs. 1 and 2. Compared to a conventional compound needle 200 shown in Figs. 3 and 4, a compound needle 100 of the present invention differs in the configuration of a needle main body 1, a slider 2, and a needle jack (hereinafter referred to as NJ) 3 arranged in the compound needle 100. Due to the difference in the configu-

rations, an entire length of the compound needle 100 is greatly shortened compared to the conventional compound needle 200 although a slide length of the slider 2 in the compound needle 100 is the same as that in the conventional compound needle 200. Only the members 1, 2, 3 in the compound needle 100 will be described below.

[0018] Similar to the prior art, the needle main body 1 is a linear long member having a hook 11, which is arranged at a distal end to hold a knitting yarn, a needle jack engagement portion (hereinafter referred to as NJ engagement portion) 12, which is arranged at a back end, and an arm-slidably-contacting surface 13, to which a slider arm 23 of the slider 2, to be described, makes slidable contact. The difference between the needle main body 1 and the needle main body 101 of the conventional compound needle 200 lies in that the arm-slidably-contacting surface 13 and the NJ engagement portion 12 are arranged in parallel in a thickness direction of the needle main body 1.

[0019] The arm-slidably-contacting surface 13 and the NJ engagement portion 12 can be arranged in parallel in the thickness direction of the needle main body 1 because the thickness of the needle main body 1 in a region 1R from a projection 11P of the needle main body 1 to the back end of the needle main body 1 is divided into two regions and the NJ engagement portion 12 is arranged in one of the regions (see the top view of the needle main body in Fig. 1). That is, the NJ engagement portion 12 is formed by projections 12A, 12B that project out to the upper side of the needle main body 1, but such projections 12A, 12B are arranged solely on the side of one side wall of a needle groove and have a thinner thickness than the width of the needle groove. The arm-slidably-contacting surface 13 is formed by an upper surface of the needle main body 1 in the other region where the NJ engagement portion 12 is not arranged of the two regions obtained by dividing the region 1R in the thickness direction of the needle main body 1.

[0020] As described above, the thickness (thickness substantially the same as the width of the needle groove) of the needle main body 1 in the region 1R is shared by the width of the arm-slidably-contacting surface 13 and the thicknesses of the projections 12A, 12B of the NJ engagement portion 12, so that the arm-slidably-contacting surface 13 and the NJ engagement portion 12 can be arranged in parallel in the thickness direction of the needle main body 1. As a result, the position of the back end of the needle main body 1 can be brought closer to the hook 11, so that the length of the needle main body 1 can be shortened by approximately 40% of the prior art.

[0021] Similar to the prior art, the slider 2 includes a slider base 20, two slider plates 21 mounted to the slider base 20, a schematically L-shaped slider arm 23 arranged at an intermediate portion of the slider base 20, and a butt 29 on which a cam system arranged in the carriage acts. The two slider plates 21 are arranged in slider grooves 11G, 11G of the needle main body 1 to be

able to sandwich the hook 11 in between.

[0022] The difference between the slider 2 of the present embodiment and the conventional slider is that the slider arm 23 to be brought into slidable contact with the arm-slidably-contacting surface 13 is formed thin with change in design of the needle main body 1. As shown in the bottom view of the slider of Fig. 1, the slider arm 23 is thinner than the thickness of the slider base body 20 (substantially the same thickness as the width of the needle groove) and is arranged solely on the side of the arm-slidably-contacting portion 13 of the needle main body 1 when the slider 2 and the needle main body 1 are combined (see also Fig. 2C). Thus, the slider arm 23 slidably contacts the arm-slidably-contacting portion 13 at the upper side of the arm-slidably-contacting portion 13 arranged on the bottom side in a depth direction of the needle groove.

[0023] The slide length of the slider 2 with respect to the needle main body 1 is defined in the following manner.

First, as shown in Fig. 2A, when the slider 2 is withdrawn with respect to the needle main body 1, the butt 29 on the left side of the slider 2 and a stopping protrusion 39Q (rod-shaped protrusion extending in a longitudinal direction of the NJ3 from the root of the butt 39) of the NJ3 shown in Fig. 1 are brought into contact thus inhibiting the slider 2 from withdrawing in excess. On the other hand, as shown in Fig. 2B, when the slider 2 is advanced with respect to the needle main body 1, the slider arm 23 of the slider 2 and the projection 11P of the needle main body 1 are brought into contact thus inhibiting the slider 2 from advancing in excess.

[0024] The slider 2 includes a plate spring shaped slide-resistance generating portion 25 on a side surface on the distal end side of the slider arm 23 in the slider body 20, the side surface being on the opposite side of the slider arm 23 in the thickness direction of the slider base body 20. The slide-resistance generating portion 25 makes contact with one side wall of the needle groove when the slider 2 is arranged in the needle groove, thus pushing the slider base body 20 against the other side wall of the needle groove, generating slide resistance between the slider 2 and the needle groove, and enhancing the accuracy of the stopping position of the slider 2 in the needle groove.

[0025] The basic shape of the NJ3 is practically the same as the conventional article, and the NJ3 includes a distal end engagement portion 32 that engages the NJ engagement portion 12 of the needle main body 1, and a butt 39 on which the cam system arranged in the carriage acts, similar to the prior art. However, the thickness of a distal end region 3R of a predetermined length including the distal end engagement portion 32 becomes thin with change in design of the needle main body 1 and the slider 2. The thin thickness portion is arranged solely on the side of the NJ engagement portion 12 of the needle main body 1 when the NJ3 and the needle main body 1 are combined.

[0026] When the needle main body 1, the slider 2, and

the NJ3 are combined, the slider arm 23 and the distal end region 3R of the NJ3 are arranged in parallel in the thickness direction of the needle groove, as shown in a perspective view taken along line A-A of Fig. 2C. Thus, the position where the NJ3 engages the needle main body 1 becomes closer to the hook 11 compared to the prior art, and hence the entire length of the compound needle 100 is greatly shortened from the prior art. When the needle main body 1 and the slider 2 are relatively slid, of course, the slider arm 23 does not interfere with the distal end region 3R of the NJ3 or the NJ engagement portion 12 of the needle main body 1, and thus the relative slide length of the needle main body 1 and the slider 2 is the same as the conventional compound needle 200 and does not become shorter than the compound needle 200.

[0027] When the entire length of the compound needle 100 is shortened as described above, the length of the needle groove can be shortened by such an amount. As a result, the needle bed can be miniaturized and made lighter, and furthermore, the carriage that travels on the needle groove can be miniaturized and made lighter thus achieving great space saving and lighter weight of the flat knitting machine. Higher speed and improvement in acceleration/deceleration performance of the carriage can also be expected with reduction in the weight of the carriage.

[0028] In the configuration of the present embodiment, lighter weight of the compound needle 100 can also be achieved since the entire length of the needle main body 1 is shortened with the arrangement in which the NJ engagement portion 12 is brought closer to the hook 11 in the needle main body 1. The compound needle 100 may be arranged in units of thousands in the flat knitting machine, and thus the weight of the entire flat knitting machine can be greatly reduced if the weight of the compound needle 100 can be reduced. Furthermore, if the weight of the compound needle 100 can be reduced, the load that advances and withdraws the compound needle 100 in the needle groove also becomes smaller, and thus the output of the motor for travelling the carriage can be replaced with a low output motor and the power consumption can be reduced.

[0029] Furthermore, in the configuration of the present embodiment, the slide-resistance generating portion 25 for generating the slide resistance between the slider 2 and the needle groove is arranged on the same side as the NJ3 in the thickness direction of the needle groove, and thus the slider 2 is pushed in the direction away from the NJ3. Thus, an excessively large friction force does not act between the slider 2 and the NJ3, and the advancing and withdrawing operations of the slider 2 along the needle groove as well as the advancing and withdrawing operation of the NJ3 and the needle main body 1 along the needle groove become smoother.

[0030] The embodiment of the present invention is not limited to the embodiment described above, and may be appropriately changed within a scope not deviating from

the gist of the invention. For instance, a compound needle in which one slider plate is attached to the slider may be adopted, or a compound needle in which the slider base body and the slider plate are a complete integrated body may be adopted.

DESCRIPTION OF REFERENCE NUMERALS

[0031]

100, 200 compound needle
 1, 101 needle main body
 1R region
 11, 111 hook
 11G slider groove
 11P, 111P projection
 12, 112 needle jack engagement portion (NJ engagement portion)
 12A, 12B, 112A projection
 13, 113 arm-slidably-contacting surface
 2, 102 slider
 20 slider base body
 21, 121 slider plate
 23, 123 slider arm
 25 slide-resistance generating portion
 29, 129 butt
 3, 103 needle jack
 3R distal end region
 32, 132 distal end engagement portion
 39, 139 butt
 39Q stopping protrusion

Claims

1. A compound needle arranged in a needle groove formed in a needle bed of a flat knitting machine, the compound needle including a needle main body, which includes a hook for holding a knitting yarn, a slider, which is slidably combined with respect to the needle main body and which opens and closes the hook, and a needle jack, which engages the needle main body and advances and withdraws the needle main body in a direction along the needle groove, **characterized in that** the slider includes, a slider base body, a slider plate, which is arranged in the slider base body to open and close the hook, and a slider arm, which is arranged at an intermediate portion of the slider base body and formed thin with respect to a thickness of the slider base body; the needle main body includes, a needle jack engagement portion that is formed locally thin, and an arm-slidably-contacting surface, which is a surface having a width in parallel to the needle jack engagement portion in a thickness direction of the nee-

the main body and to which the slider arm is brought into slidable contact; and the needle jack includes a distal end engagement portion, which is formed in a distal end region formed to a thickness of smaller than or equal to a thickness of the needle jack engagement portion and engages the needle jack engagement portion.

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2. The compound needle according to claim 1, **characterized in that**

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the slider includes a slide-resistance generating portion formed on the same side as the needle jack engagement portion of the needle main body on a distal end side of the slider arm in the slider base body; and the slide-resistance generating portion is configured to apply a slide resistance between the needle groove and the slider when the slider is slid along the needle groove.

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3. A flat knitting machine in which at least a pair of needle beds including a plurality of needle grooves is arranged facing each other, the flat knitting machine comprising the compound needle according to claim 1 or 2 in the needle grooves.

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Fig. 1

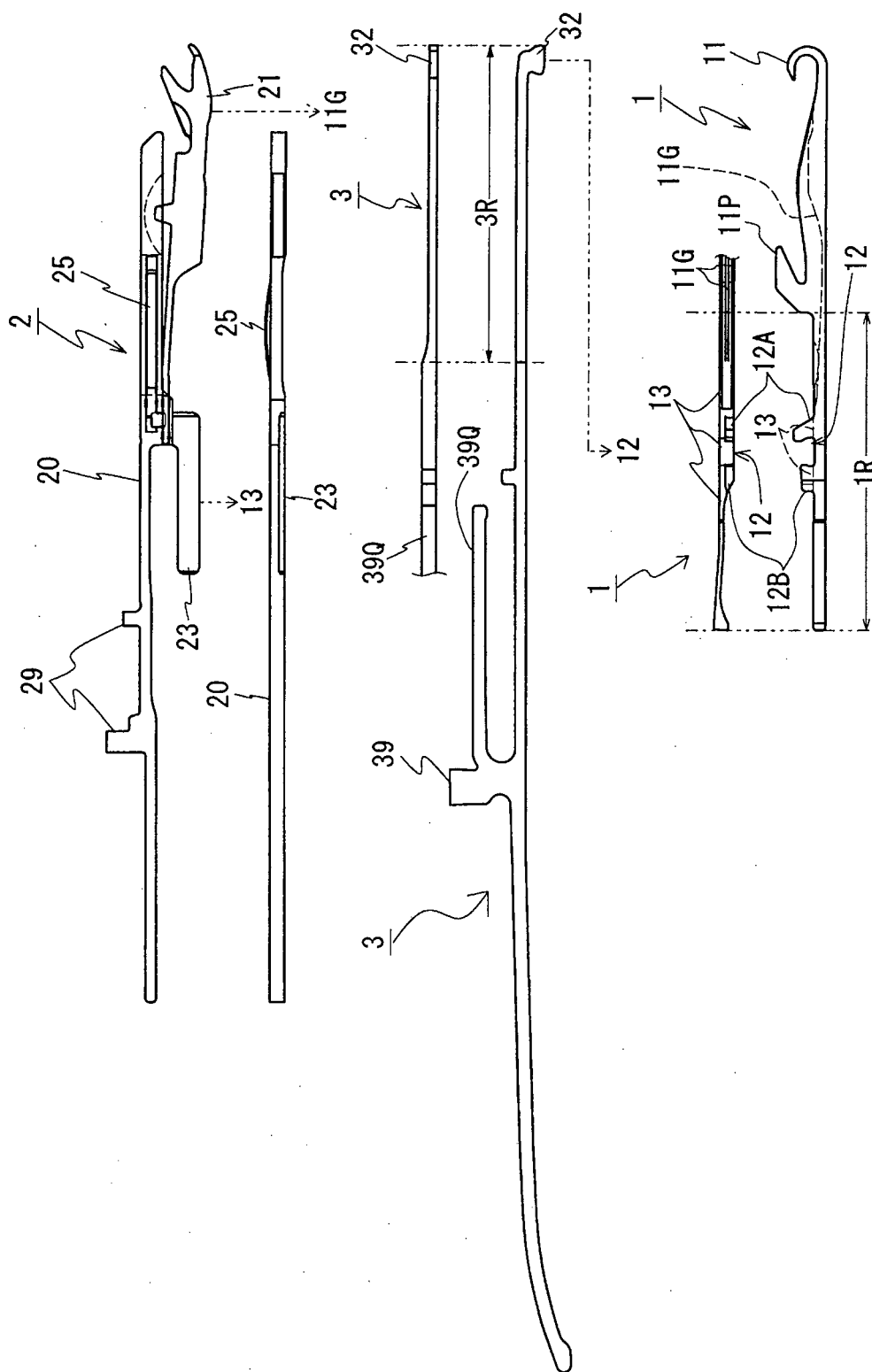
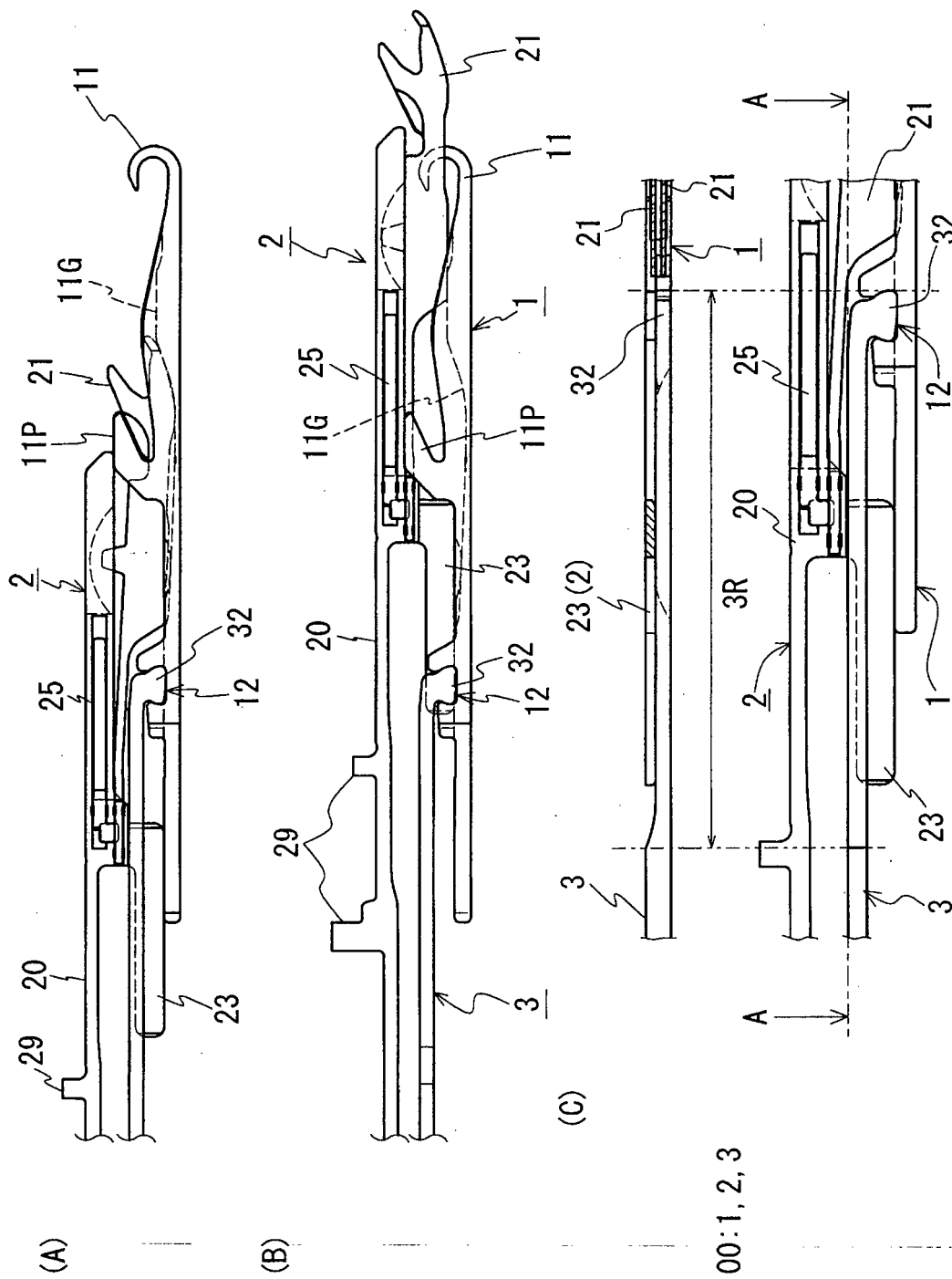


Fig. 2



100:1, 2, 3

Fig. 3

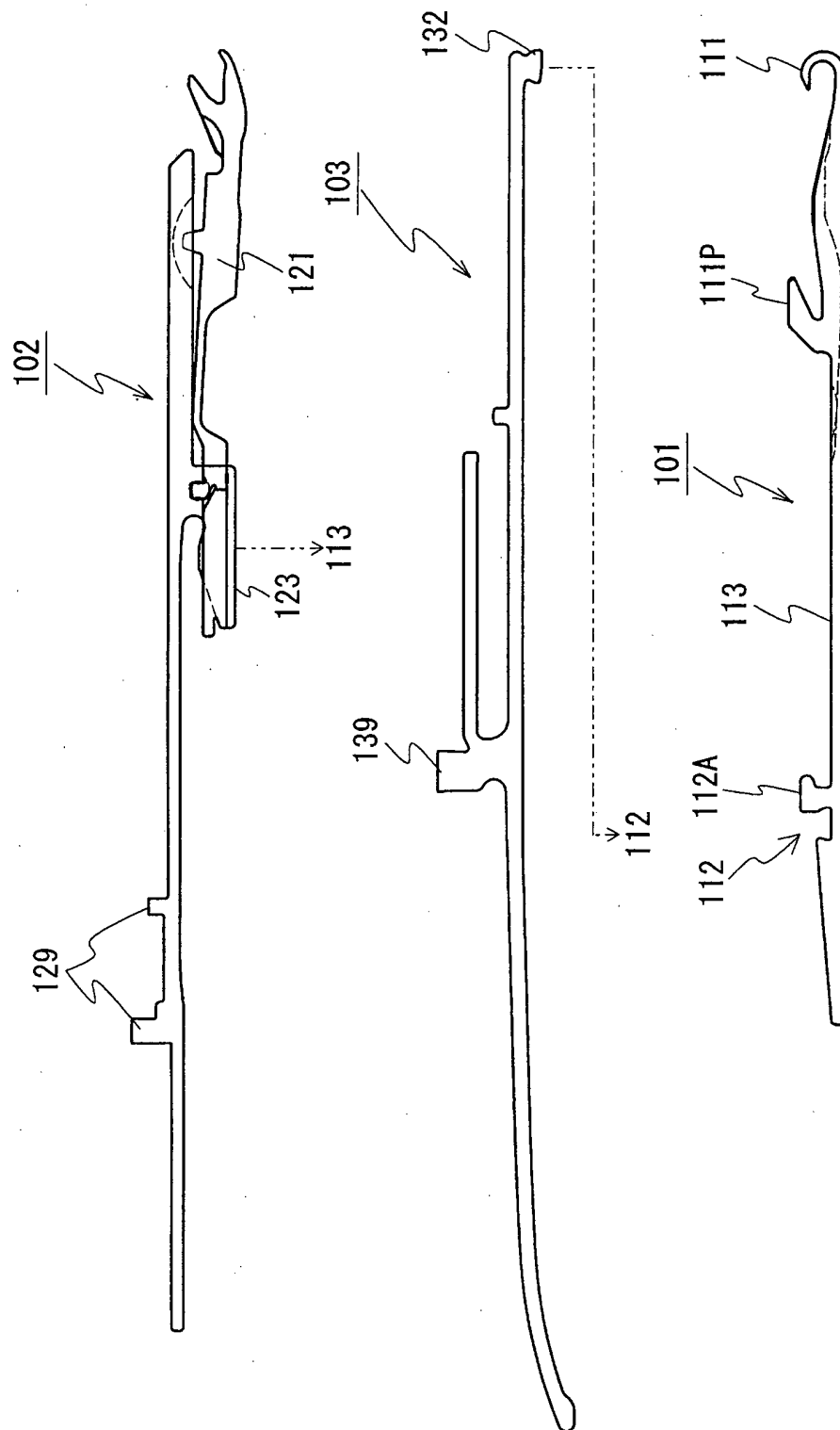
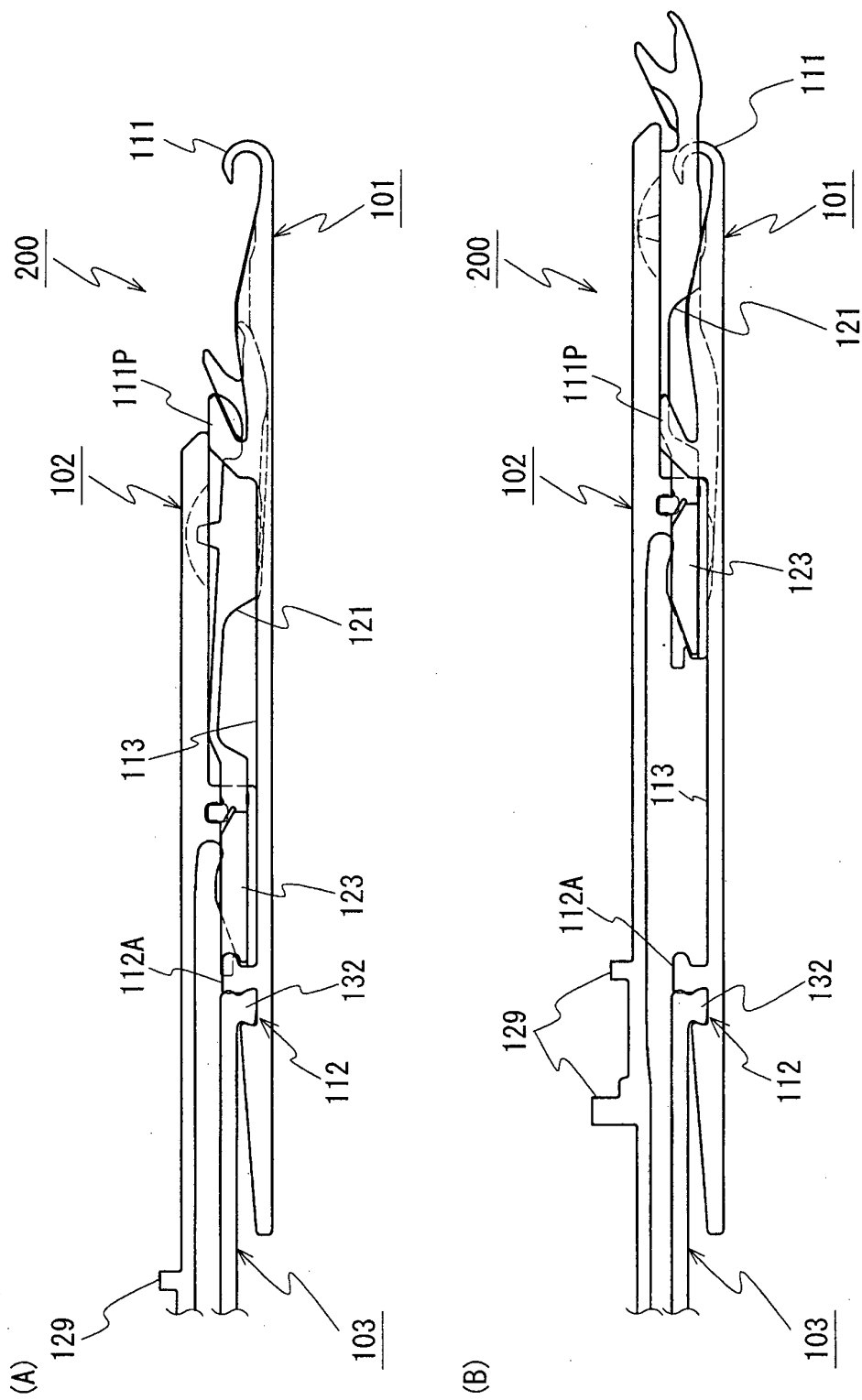


Fig. 4



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2010/055452

A. CLASSIFICATION OF SUBJECT MATTER

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)

D04B35/02-35/08

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.
X Y	JP 2946323 B2 (Shima Seiki Mfg., Ltd.), 06 September 1999 (06.09.1999), paragraphs [0027] to [0034]; fig. 11, 12 (Family: none)	1 2, 3
Y	JP 3-104970 A (Shima Seiki Mfg., Ltd.), 01 May 1991 (01.05.1991), entire text; all drawings (Family: none)	2, 3
Y	JP 4237821 B1 (Shima Seiki Mfg., Ltd.), 11 March 2009 (11.03.2009), paragraph [0018]; fig. 1, 3 (Family: none)	3

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

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Date of the actual completion of the international search
07 May, 2010 (07.05.10)Date of mailing of the international search report
18 May, 2010 (18.05.10)Name and mailing address of the ISA/
Japanese Patent Office

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2010/055452

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 4-66941 B2 (Shima Seiki Mfg., Ltd.), 26 October 1992 (26.10.1992), entire text; all drawings & GB 2237035 A & IT 1242058 A	1-3
A	JP 2000-328409 A (Shima Seiki Mfg., Ltd.), 28 November 2000 (28.11.2000), entire text; all drawings & US 6389848 B1 & EP 1203838 A1 & WO 2000/071796 A1 & DE 60018760 T & CN 1351684 A	1-3

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REFERENCES CITED IN THE DESCRIPTION

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- JP 2946323 B [0006]