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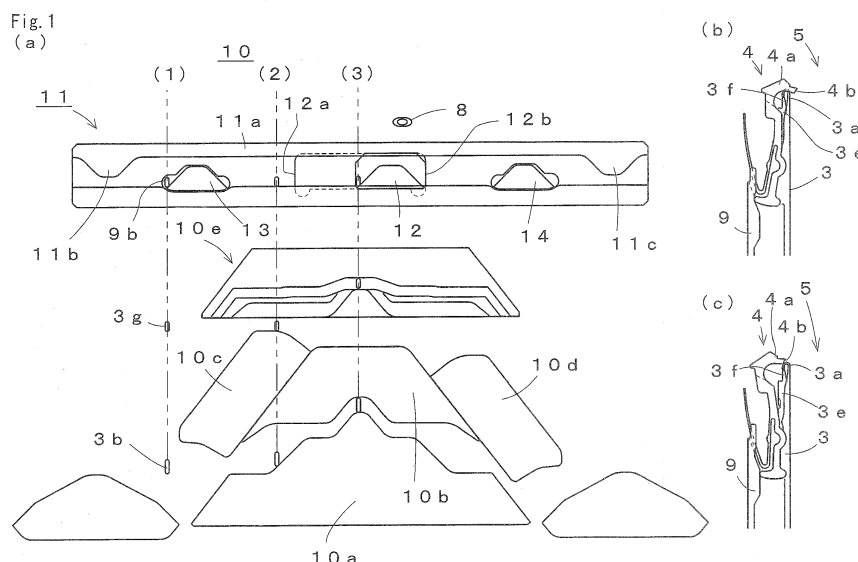
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(54) **FLATBED KNITTING MACHINE EQUIPPED WITH MOVABLE SINKER**

(57) [Problem to be solved] It is an object to provide a flatbed knitting machine equipped with movable sinkers capable of stopping the action of the movable sinker before reaching the non-acting section.

[Solution] A sinker control cam 11 sets a non-acting section in which a yarn receive part 4b of a movable sinker 4 is not made to act on a loop in a needle bed gap 5 when a knitting needle 3 is made to retreat from the needle bed gap 5 as shown in (c). When the knitting needle 3 advances to the needle bed gap 5, the sinker control cam 11 can causes the yarn receive part 4b to act on the loop

so as to prevent the loop from being raised upward and can switch the movable sinker 4 to be in a non-acting state before reaching the non-acting section. When the movable sinker 4 is switched to be in the non-acting state preceding the non-acting section, appropriate knitting can be performed in accordance with knitting conditions such as the case where a knitting yarn having low strength, which is easily broken, is used and the case where short stitches with small loop lengths are knitted excessively finely.



Description

Description

[Technical Field]

[0001] The present invention relates to a flatbed knitting machine equipped with movable sinkers which act on loops in a needle bed gap so as to prevent the loops from being raised upward together with knitting needles.

[Background Art]

[0002] Conventionally, a flatbed knitting machine is provided with at least a pair of needle beds that oppose each other in a needle bed gap interposed between the needle beds. Knitting needles that are accommodated in needle grooves on the needle beds are selectively driven by a cam system mounted on a carriage reciprocating in the lengthwise direction of the needle beds. By making hooks, provided at leading ends of the knitting needles, to advance to or retreat from the needle bed gap, it becomes possible to perform a knitting operation to form stitches with a knitting yarn, a stitch transfer operation to receive and send the stitches between the knitting needles with the needle bed gap interposed therebetween, and the like. Sinkers that are provided between the knitting needles so as to face the needle bed gap perform a stitch determination operation of forming sinker loops in the needle bed gap in corporation with the hooks forming needle loops (hereinafter, referred to as "new loop") while receiving yarn feeding in the needle bed gap and being drawn into the needle beds in formation of the stitches. As the sinkers, movable sinkers capable of causing leading end parts thereof to advance to or retreat from the needle bed gap with rocking displacement are also used (for example, see Patent Literatures 1 to 3). Each movable sinker has, on a portion of the leading end part, a part called a yarn receive part or the like that acts on the sinker loop continuous to a needle loop (hereinafter, referred to as "old loop") held on the hook so as to prevent the needle loop from being raised upward when the hook is made to advance to the needle bed gap. In the following description, the needle loop and the sinker loop of the stitch are collectively referred to as a "loop" simply.

[0003] When the movable sinkers as disclosed in Patent Literature 1 act on loops, upper portions of acting parts of the movable sinkers make contact with each other between the needle beds so as to cover the needle bed gap. In yarn feeding, when each hook is made to advance to the needle bed gap and receives supply of a knitting yarn for forming a new loop, the movable sinker is controlled so as to rock in the direction in which the leading end part thereof retreats from the needle bed gap. When the hook, that has received the supply of the knitting yarn in the needle bed gap, is drawn to the needle bed, the movable sinker is controlled so as to rock in the direction in which the leading end part thereof advances

to the needle bed gap so as to be used for the stitch determination operation.

[0004] The movable sinker as disclosed in Patent Literature 2 can press a knitted fabric down by pressing a loop downward by biasing with a spring. The pressing action of the movable sinker is once stopped before the hook is made to advance to the needle bed gap and is restarted when the hook is made to advance to the needle bed gap, so that the loop is pressed reliably. The pressing action of the movable sinker is stopped in yarn feeding, and is restarted after the yarn feeding, and stitch determination is performed.

[0005] The movable sinker as disclosed in Patent Literature 3 is used in combination with a fixed sinker that is provided on a needle bed at the side of the needle bed gap. The movable sinker performs the action to prevent the loop from being raised upward whereas the fixed sinker performs stitch determination, so that action of the movable sinker on a sinker loop is stopped in a section from yarn feeding to the stitch determination. After the stitch determination, control is finished in a state where the movable sinker acts on the loop.

[Citation List]

[Patent literature]

[0006]

Patent Literature 1: JP H02-10260 B
Patent Literature 2: JP H05-83657 B
Patent Literature 3: JP 2013-139644 A

[Summary of Invention]

[Technical Problem]

[0007] Each of the movable sinkers as disclosed in Patent Literatures 1 to 3 acts on a loop so as to prevent the loop from being raised upward when the knitting needle holding the old loop is made to advance to the needle bed gap and a non-acting section, in which the action of the movable sinker is stopped, is set while the knitting needle is made to retreat from the needle bed gap and forms a new loop from the yarn feeding to the stitch determination. However, there is a risk that yarn breakage occurs when the movable sinker is made to act on the sinker loop preceding the non-acting section depending on knitting conditions as in the case where a yarn having low strength, which is easily broken, is used as the knitting yarn, the case where a stitch is knitted excessively finely, and the like.

[0008] An object of the present invention is to provide a flatbed knitting machine equipped with movable sinkers capable of stopping to start action of the movable sinker preceding the non-acting section.

[Solution to Problem]

[0009] The present invention is a flatbed knitting machine equipped with movable sinkers, each of which advances to and retreats from a needle bed gap and is arranged between knitting needles accommodated in needle grooves, provided on needle beds in parallel, having a cam system, which is mounted on a carriage reciprocating along the needle bed, causes the knitting needles to advance to and retreat from the needle bed gap, and which includes a sinker control cam performing control such that:

when a knitting needle, holding a loop on a hook provided at a leading end of the knitting needle at the side of the needle bed gap, is made to advance to the needle bed gap, advancing the movable sinker to the needle bed gap and acting a yarn receive part provided on a leading end part of the movable sinker at the side of the needle bed gap on the loop, so as to prevent the loop from being raised upward together with the knitting needles; and when the knitting needle is made to retreat from the needle bed gap, setting a non-acting section, in which the leading end part of the movable sinker also retreats from the needle bed gap and action of the yarn receive part on the loop in the needle bed gap is stopped, characterized in that the sinker control cam includes a cam capable of switching, at a position preceding start of the non-acting section in a running direction of the carriage, whether the movable sinker keeping a state where the yarn receive part acts on the loop to the position, stops or not the action from the position to the start position of the non-acting section.

[0010] In the present invention, said sinker control cam comprises:

a section cam performing control such that the action of said yarn receive part of the movable sinker is stopped in said non-acting section; and rising and setting cams provided at positions at both of a preceding side and a following side away from the non-acting section in the running direction of said carriage as cams capable of switching whether to stop or not said action of the yarn receive part by rising and setting.

[0011] . In the present invention, said sinker control cam comprises:

rocking levers having points of support at positions close to an intermediate position between said rising and setting cams at both sides in the running direction of said carriage, supporting the rising and setting cams by arms extending from the points of support, and rocking about the points of support; springs provided on the both sides rocking levers respectively, and biasing the rocking levers such that

the rocking levers rock about the points of support, causes the rising and setting cams to rise, and said yarn receive part of the movable sinker to stop the action of the yarn receive part of the movable sinker on the loop;

a single driving source capable of switching not to stop the action of the yarn receive part on the loop by rocking the both sides rocking levers so as to cause the rising and setting cams to set against biasing by the springs; and a transmission mechanism to transmit driving force generated from the driving source to the both side rocking levers.

[0012] . In the present invention, said sinker control cam comprises a moving cam to move between said position and the non-acting section as a cam capable of switching whether to stop or not the action of the yarn receive part.

[0013] In the present invention, said movable sinker is biased by a spring such that said yarn receive part rocks in a direction of acting on said loop, said sinker control cam controls the movable sinker through a jack to advance and to retreat in an advancing/retreating direction of said knitting needle to/from said needle bed gap, and the jack drives the movable sinker in a direction orthogonal to the advancing/retreating direction so as to cause the movable sinker to rock in a direction to stop the action of the yarn receive part on the loop.

[Advantageous Effects of Invention]

[0014] According to the present invention, with a movable sinker that can prevent a loop from being raised upward together with a knitting needle when the knitting needle holding the loop on a hook is made to advance to a needle bed gap, a yarn receive part provided on a leading end part of the movable sinker acts on the loop in the needle bed gap. A sinker control cam can cause the movable sinker, which keeps a state where the yarn receive part acts on the loop, to stop the action in a non-acting section that is set when the knitting needle is made to retreat from the needle bed gap, and can switch the movable sinker to start stopping the action from a position preceding the start position of the non-acting section in a running direction of a carriage. After the yarn receive part of the movable sinker is made to act on the loop, a range in which the action of the movable sinker on the loop is stopped is switched in accordance with on knitting conditions as in a case where a knitting yarn having low strength, which is easily broken, is used, and a case where short stitches with small loop lengths are knitted excessively finely, so that appropriate knitting can be performed.

[0015] Further, according to the present invention, when a rising and setting cam at the preceding side rel-

ative to a section cam provided in the non-acting section in the running direction of the carriage switches to stop the action of the yarn receive part of the movable sinker on the loop, the yarn receive part of the movable sinker can be made into the non-acting state continuously to the non-acting section. Arising and setting cam at the following side corresponds to the preceding side when the running direction of the carriage is inverted and can switch whether to stop or not the action of the yarn receive part at the position preceding the non-acting section.

[0016] Further, according to the present invention, the sinker control cam can switch whether to stop or not the state where the yarn receive part of the movable sinker acts on the loop by causing the rising and setting cams at both sides that are supported by arms of rocking levers at both sides to rise and set by rocking of the rocking levers which are driven by a single driving source. As the driving source is single, a mechanism can be simplified.

[0017] Further, according to the present invention, the sinker control cam can switch whether to stop or not the state where the yarn receive part of the movable sinker acts on the loop by moving a position of a moving cam between a preceding position in the running direction of the carriage and the non-acting section. With this configuration, the movement position of the moving cam can be changed in accordance with knitting conditions, thereby adjusting effects of improving finish of a knitted fabric and preventing the loop from being raised upward.

[0018] Further, according to the present invention, when a jack advances and retreats so as to drive the movable sinker against a spring biasing in an acting direction such that the state where the yarn receive part of the movable sinker acts on the loop is stopped, reaction force that the jack receives from the movable sinker is orthogonal to the advancing/retreating direction. The reaction force received when the movable sinker is driven does not cause the jack to advance and retreat, so that switching to stop the state where the yarn receive part acts on the loops at the position preceding the non-acting section can keep the action-stop state to the non-acting section, thereby simplifying the configuration of the sinker control cam.

[Brief Description of Drawings]

[0019]

[Fig. 1] Figs. 1 are a front view showing a schematic cam arrangement of a cam system 10 of a flatbed knitting machine equipped with movable sinkers 4 according to Example 1 of the present invention and partial side views showing an acting state and a non-acting state of the movable sinker 4.

[Fig. 2] Figs. 2 are side views showing a structure to drive the movable sinker 4 of Figs. 1 in the acting state and the non-acting state together with a knitting needle 3.

[Fig. 3] Fig. 3 is a partial cross-sectional side view

showing a state where the movable sinker 4 acts at a position as indicated by (1) of Fig. 1(a).

[Fig. 4] Fig. 4 is a partial cross-sectional side view showing a state where the movable sinker 4 acts at a position as indicated by (2) of Fig. 1(a).

[Fig. 5] Fig. 5 is a partial cross-sectional side view showing a state where the movable sinker 4 acts at a position as indicated by (3) of Fig. 1(a).

[Fig. 6] Figs. 6 are plan views showing a structure of a sinker control cam 11 that causes the rising and setting cams 13 and 14 of Fig. 1(a) to rise and set.

[Fig. 7] Fig. 7 is a simplified view from back side showing the structure of the sinker control cam 11 that causes the rising and setting cams 13 and 14 of Fig. 1(a) to rise and set.

[Fig. 8] Fig. 8 is a front view showing schematic cam arrangement of a cam system 30 of a flatbed knitting machine equipped with movable sinkers 4 according to Example 2 of the present invention.

[Fig. 9] Fig. 9 is a partial cross-sectional side view showing a state where the movable sinker 4 acts at a position as indicated by (4) of Fig. 8.

[Description of Embodiments]

[0020] Hereinafter, with Figs. 1 to Fig. 7, and with Fig. 8 to Fig. 9, the structures and operations of a flatbed knitting machine equipped with movable sinkers 4 according to Example 1 or Example 2 of the present invention, respectively. In each example, the same reference numeral denotes corresponding part and overlapped description is omitted in some cases. Further, components that are not shown in the drawing as a description target are referred by using reference numerals as shown in other drawings in some cases.

[Example 1]

[0021] Figs. 1 show a schematic cam arrangement of a cam system 10 of a flatbed knitting machine equipped with movable sinkers 4 according to Example 1 of the present invention by Fig. 1(a), and by Figs. 1(b) and 1(c) show an acting state and a non-acting state of the movable sinker 4 respectively. As shown in Figs. 1(b) and 1(c), a knitting needle 3 is accommodated in each of needle grooves provided in parallel on a needle bed (omitted showing by a drawing). The movable sinker 4 arranged between the knitting needles 3 rocks such that a leading end part 4a thereof advances to and retreats from a needle bed gap 5. In the present example, a fixed sinker 6, which will be described later, is also provided together with the movable sinker 4. The cam system 10 that is mounted on a carriage reciprocating along the needle bed causes the knitting needle 3 to advance to and retreat from the needle bed gap 5. The following describes the case where the carriage runs leftward, and the left side in the drawing corresponds to the preceding side and the right side corresponds to the following side. When the

running direction of the carriage is rightward, the same operations are performed other than a point that the right side in the drawing corresponds to the preceding side and the left side corresponds to the following side.

[0022] The cam system 10 includes a sinker control cam 11. As shown in Fig. 1(b), when the knitting needle 3 holding a loop 7, which will be described later, on a hook 3a provided on a leading end of the knitting needle 3 at the side of the needle bed gap 5 is made to advance to the needle bed gap 5, the sinker control cam 11 causes the leading end part 4a of the movable sinker 4 to rock in a direction of advancing to the needle bed gap 5 and a yarn receive part 4b provided on the leading end part 4a acts on the loop 7 so as to prevent the loop 7 from being raised upward together with the knitting needle 3. Further, as shown in Fig. 1(c), the sinker control cam 11 sets a non-acting section in which the leading end part 4a of the movable sinker 4 also rocks in a direction of retreating from the needle bed gap 5 and action of the yarn receive part 4b on the loop 7 in the needle bed gap 5 is stopped when the knitting needle 3 is made to retreat from the needle bed gap 5 and so on.

[0023] As shown in Fig. 1(a), the cam system 10 has a needle raising cam 10a, a bridge cam 10b, and stitch cams 10c, 10d, for guiding butts 3b to drive the knitting needles 3. The knitting needle 3 is a compound needle in which a hook 3a is opened and closed by a tongue 3f of a slider 3e, and the cam system 10 has a slider cam 10e guiding a butt 3g to control the slider 3e. Further, the sinker control cam 11 includes a section cam 12 and rising and setting cams 13, 14. The section cam 12 abuts against a butt 9b provided on a sinker jack 9 intervening when the movable sinker 4 is driven, and drives the sinker jack 9 in the direction of advancing to the needle bed gap 5. A movement range of the section cam 12 is set between a left end 12a and a right end 12b as shown in the drawing. The section cam 12 moves until the end part thereof at the following side in the running direction of the carriage stops at the right end 12b of the movement range in the drawing by a reaction force that the section cam 12 receives from the butt 9b when driving the butt 9b. The section cam 12, which has moved to this position, drives the butt 9b of the sinker jack 9 along a mountain-shaped cam pattern to the side of the needle bed gap 5. The action of the movable sinker 4 on the loop 7 is stopped at the end of an ascent slope of the mountain-shaped cam pattern, so that the section cam 12 can stop the action of the yarn receive part 4b on the loop 7 before a yarn feeding position at which the hook 3a receives supply of a knitting yarn through a yarn feeder port 8, and can start the non-acting section. In the present example, when the non-acting section is started, the non-acting state of the movable sinker 4 continues even if driving by the section cam 12 is finished.

[0024] The sinker control cam 11 in the present example also includes a sinker cam 11a. The sinker cam 11a has an acting cam part 11c at a following-side position relative to the non-acting section in the running direction

of the carriage. By the acting cam part 11c, the movable sinker 4 which passes through to the following side, is made to keep a state of acting on the loop 7. An acting cam part 11b provided at the preceding side switches the movable sinker 4, that is guided from the preceding side, to be in the acting state even when the movable sinker 4 is in an action-stop state, on the other hand, keeps the acting state of the movable sinker that is guided from the preceding side in the acting state. In case, the movable sinker itself could keep the acting state by biasing with a spring, the acting cam parts 11b and 11c might not be provided.

[0025] The rising and setting cam 13 is provided so as to start driving the butt 9b from a position preceding the start of the non-acting section by the section cam 12 in the running direction of the carriage, that is, a position as indicated by (1) in Fig. 1(a). In case the rising and setting cam 13 is made to rise as shown in the drawing, the butt 9b of the sinker jack 9 is driven along the mountain-shaped cam pattern of the rising and setting cam 13 from the indicated position, then the action of the yarn receive part 4b on the loop 7 is stopped from a position at which the action of the movable sinker 4 on the loop 7 is stopped at the end of an ascent slope of the cam pattern to the start of the non-acting section. In case the rising and setting cam 13 is made to set, a state where the yarn receive part 4b of the movable sinker 4 acts on the loop is switched to last. The carriage runs in a reciprocating manner, and a rising and setting cam 14 is therefore provided also at a right-side position as the preceding side when the carriage runs rightward.

[0026] That is to say, the sinker control cam 11 has the section cam 12, which controls the movable sinker 4 such that the action of the yarn receive part 4b of the movable sinker 4 on the loop is stopped and it is made into the non-acting state in the non-acting section, and the rising and setting cams 13, 14. The rising and setting cams 13, 14 are provided at both sides as the preceding side and the following side in the running direction of the carriage, which are away from the non-acting section in which the section cam 12 controls the movable sinker 4 to be in the non-acting state.

[0027] The position at which the rising and setting cam 13 is provided could be set to a position following the acting cam part 11b and preceding the position at which the section cam 12 starts driving the movable sinker 4 to be in the non-acting state in the running direction of the carriage. In the present example, the section cam 12 starts the non-acting section before the yarn feeding position at which the knitting yarn is supplied from the yarn feeder port 8 to the hook 3a of the knitting needle 3 that has advanced to the needle bed gap 5. In case the fixed sinker 6, which will be described later, is used in combination to perform the stitch determination as in the present example, the stitch cam 10d drives a butt 3b of the knitting needle 3, and the movement range might be set such that the section cam 12 starts the non-acting section before a yarn catching position at which the hook

3a starts drawing a new loop. The position at which the rising and setting cam 13 is provided could be possible to set to precede a position at which an end part of the section cam 12 at the following side stops at the right end 12b of the movement range. In the description with references from Fig. 3 to Fig. 5, explanation will be also made for the case where the rising and setting cams 13 are provided at the position (1) and positions (2), (3). However, in case the rising and setting cams 13 would be provided at the positions (2), (3), the section cams 12 would be provided at both of the left end 12a side and the right end 12b side of the movement range without moving the section cam 12, so as to be made to set at the preceding side and to be made to rise at the following side. That is to say, in case the rising and setting cam 13 would be provided at the position (2), the section cam 12 at the preceding side in the setting state would follow the rising and setting cam 13. The position (3) corresponds to the center of the cam system 10, so that the single rising and setting cam 13 could be provided at an intermediate position between the section cam 12 in the setting state at the preceding side and the section cam 12 in the rising state at the following side. In case the action of the movable sinker 4 would be switched to be stopped at the position at which the section cam 12 at the preceding side is provided between the positions (2), (3), the section cam 12 at the preceding side could be also used as the rising and setting cam 13 without providing the rising and setting cam 13 itself.

[0028] Figs. 2 show a structure to drive the movable sinker 4 of Figs. 1 in the acting state by Fig. 2(a) and the non-acting state by Fig. 2(b) together with the knitting needle 3 in a simplified manner. A needle bed 1, which will be described later, is inclined so as to be higher at the side of the needle bed gap 5 and lower at the side farther from the needle bed gap 5. However, concerning Figs. 2 and subsequent drawings, description is made while the needle bed 1 is in a horizontal state for the convenience of explanation.

[0029] The knitting needle 3 in the present example has a needle main body 3c, which has the hook 3a on the leading end thereof at the side of the needle bed gap 5, a needle jack 3d, which has the butt 3b in the vicinity of a tail end thereof and a leading end of the needle jack 3d is connected to the vicinity of a tail end of the needle main body 3c, and the slider 3e. The movable sinker 4 has the yarn receive part 4b, which presses the loop for preventing the loop from being raised upward, and a support receive part 4c, which is provided at a rear side as the direction in which the movable sinker 4 retreats from the needle bed gap 5 so as to be spaced from the leading end part 4a. The movable sinker 4 further has a spring part 4d, which extends to the rear side from the support receive part 4c and is folded back to the side of the needle bed gap 5, and a driving part 4e, which is provided so as to be spaced from the support receive part 4c to the rear side. Although the spring part 4d is integrally formed with the movable sinker 4 in the present example, a wire

spring as a separate body might be combined. The sinker jack 9 has a driving cam part 9a and the butt 9b.

[0030] With the movement of the sinker jack 9 to the rear side as shown in Fig. 2(a), the driving cam part 9a does not press the driving part 4e of the movable sinker 4 downward. The leading end part 4a of the movable sinker 4 advances to the needle bed gap 5 by biasing by the spring part 4d, and the yarn receive part 4b is made into an acting state capable of acting on the loop. As shown in Fig. 2(b), when the sinker jack 9 is moved to the front side as the direction of advancing to the side of the needle bed gap 5, the driving cam part 9a presses the driving part 4e of the movable sinker 4 downward against the biasing by the spring part 4d. The movable sinker 4 rocks in the counterclockwise direction about the support receive part 4c as a point of support, and is made into the non-acting state where action of the yarn receive part 4a on the loop is stopped.

[0031] In the present example, when the sinker jack 9 advances to the side of the needle bed gap 5, the movable sinker 4 is driven so as to be made into the non-acting state. The spring part 4d biases the movable sinker 4 in the direction of making it into the acting state, so that the movable sinker 4 is driven so as to be made into the non-acting state against the biasing by the spring part 4d. In the non-acting state, reaction force that the driving cam part 9a of the sinker jack 9 receives from the driving part 4e of the movable sinker 4 is in the upward direction in the drawing, which is orthogonal to the advancing/retreating direction. The reaction force that the driving cam part 9a receives is orthogonal to the advancing/retreating direction of the sinker jack and does not therefore cause the sinker jack 9 to advance and retreat. The orthogonality in this case is sufficient when the angle is close to 90 degrees and a component of the reaction force in the advancing/retreating direction is adequately smaller than a component orthogonal to the advancing/retreating direction. When the rising and setting cam 13 is made to rise so as to switch the movable sinker 4 to be into the non-acting state at the preceding-side position of the non-acting section, the non-acting state can be kept to the non-acting section. In this case, the sinker control cam 11 needs not include a cam or the like for keeping the non-acting state, thereby simplifying the structure of the sinker control cam 11.

[0032] Figs. 3 to 5 show states where the movable sinker 4 acts as representatives of the positions as indicated by (1), (2), and (3) of Fig. 1(a), respectively. The needle bed 1 is shown in the horizontal state and a needle bed gap center line 5a, which extends in the vertical direction actually, is shown in an inclined manner. Grooves into which needle plates 21 are inserted are formed on a base plate 20 of the needle bed 1. The needle plates 21 are arranged on the base plate 20 at a constant interval in the direction perpendicular to a page space and the knitting needles 3 are accommodated in portions between the needle plates 21, which serve as needle grooves 2. When each needle plate 21 is inserted into the base plate

20, a wire which becomes a top tooth 22 in the vicinity of the leading end at the side of the needle bed gap 5, and a wire 23 and wires 24 and 25 for fixing the fixed sinker 6 and the needle plate 21 are inserted through the needle plate 21 in the direction perpendicular to the page space. A metal band 26 that presses an upper part of the slider 3e when the slider 3e advances to the side of the needle bed gap 5 is also provided above the movable sinker 4. The fixed sinker 6 is provided at the leading end of the needle bed 1 at the side of the needle bed gap 5, and the movable sinker 4 is required to be in the non-acting state during the stitch determination for forming a new loop. However, the position at which the rising and setting cam 13 is provided is not limited to the positions as indicated by (1), (2), and (3) of Fig. 1(a) and it might be sufficient that the position precedes the section cam 12.

[0033] In Fig. 3, the butt 3b of the needle main body 3c of the knitting needle 3 is at the position (1) of Fig. 1(a) and driving for causing the knitting needle 3 to advance to the needle bed gap 5 by the needle raising cam 10a is not started. When the rising and setting cam 13 is made to rise, the yarn receive part 4b of the movable sinker 4 is made into the non-acting state where the action on the loop 7 is stopped. To the position of (1) from the acting cam part 11b of the sinker cam 11a, the movable sinker 4 is in the acting state for the yarn receive part 4b to press the loop 7 so as to make a knitted fabric hard to float. When the rising and setting cam 13 is made to rise and driving of the butt 3g is started at the position of (1), the movable sinker 4 is switched to be in the non-acting state before the knitting needle 3 advances to the needle bed gap 5, so that a risk of yarn breakage can be reduced in the case where a knitting yarn having low strength, which is easily broken, is used, the case where short stitches with small loop lengths are knitted excessively finely, and the like.

[0034] In Fig. 4, at the position (2) of Fig. 1(a), driving of the butt 3b of the knitting needle 3 by the needle raising cam 10a causes the hook 3a to advance to the side of the needle bed gap 5. When the movable sinker 4 is made to act to the position, a preceding loop 7d formed immediately before an old loop 7a that is held on the hook 3a is retained by the needle main body 3c at a position below the hook 3a reliably. Even when the rising and setting cam 13 is made to rise, driving of the butt 3g is started at the position of (2), and the movable sinker 4 is switched to be in the non-acting state along the mountain-shaped cam pattern, the action to the position (2) can prevent the preceding loop 7d, from wrap-around, that is, moving along the outer side of a curve of the leading end of the hook 3a.

[0035] In Fig. 5, at the position (3) of Fig. 1(a), the hook 3a of the knitting needle 3 advances to the needle bed gap 5 at the most level, the old loop 7a held on the hook 3a has been cleared on the halfway from the position (2) to the position (3), and moves onto the tongue 3f of the slider 3e. In a flatbed knitting machine equipped with latch

needles as the knitting needles 3, the old loop 7a moves to a needle shank from the hook 3a while a latch is opened. When the rising and setting cam 13 is made to rise, driving of the butt 3g is started at the position (3), and the movable sinker 4 is switched to be in the non-acting state along the mountain-shape cam pattern, the action of the movable sinker 4 can clear the old loop 7a reliably while preventing it from being raised upward.

[0036] When the rising and setting cam 13 is not made to rise as the above-mentioned case, the section cam 12 provided in the non-acting section can switch the movable sinker 4 to be in the non-acting state. A section in which the rising and setting cam 13 stops the action of the movable sinker 4 preceding the non-acting section can be provided in accordance with knitting conditions as in the case where a knitting yarn having low strength, which is easily broken, is used and the case where short stitches with small loop lengths are knitted excessively finely.

[0037] Figs. 6 and Fig. 7 show a structure of a main part of the sinker control cam 11 that causes the rising and setting cams 13, 14 of Fig. 1(a) to rise and set while a bracket supporting the structure part and the other components are omitted to show. Figs. 6 show the structure when seen from the side of the needle bed gap 5 and Fig. 7 shows the structure when seen from rear side which is perpendicular to the seeing direction of Figs. 6.

[0038] The sinker control cam 11 includes rocking levers 15, 16, springs 17, 18, and a driving source 19. It should be noted that in Fig. 6(a), the springs 17, 18 are omitted to show. The rocking levers 15, 16 include points of support 15b, 16b at positions closer to an intermediate position between the rising and setting cams 13, 14 at both sides in the running direction of the carriage, support the rising and setting cams 13, 14 by arms 15a, 16a extending from the points of support 15b, 16b, and rock about the points of support 15b, 16b, respectively. As shown in Fig. 6(b), the springs 17, 18 are provided between the vicinities of the leading ends of the arms 15a, 16a of the rocking levers 15, 16 at both sides of the rising and setting cams 13, 14 and bias the rocking levers 15, 16 so that the rocking levers 15, 16 rock about the points of support 15b, 16b and causes the rising and setting cams 13, 14 to rise, and the leading end part 4a of the movable sinker 4 does not act on the loop 7. The single driving source 19 performs driving of switching the leading end part 4a of the movable sinker 4 to be made into the acting state on the loop 7 by rocking the rocking levers 15, 16 at both sides so as to cause the rising and setting cams 13, 14 to set. The driving source 19 in the present example is formed by solenoid and drives the rocking levers 15, 16 through a rocking piece 19a and a sliding plate cam 19b, which construct a transmission mechanism for transmitting output of the driving source 19.

[0039] In the present example, the rocking piece 19a rocks with output from a plunger of the solenoid as the driving source 19 and the sliding plate cam 19b moves in the right and left direction in the drawing. Driving parts

15c, 16c extending to the side of the sliding plate cam 19b from the points of support 15b, 16b are provided on the rocking levers 15, 16, respectively, and followers 15d, 16d that are provided at the leading ends thereof about against projections of a cam face 19c provided on the sliding plate cam 19b. As shown in Fig. 6(a), when the sliding plate cam 19b moves rightward in the drawing, the rocking levers 15, 16 rock in the counterclockwise direction and the clockwise direction about the points of support 15b, 16b against biasing by the springs 17, 18, respectively, and the rising and setting cams 13, 14 are made into setting states. As shown in Fig. 6(b), when the sliding plate cam 19b moves leftward in the drawing, the rocking levers 15, 16 rock in the clockwise direction and the counterclockwise direction about the points of support 15b, 16b until the follower 15d abuts against a recess of the cam face 19c by being biased by the springs 17, 18, respectively, and the rising and setting cams 13, 14 are made into rising states. One of the followers 15d, 16d might be made to abut against the recess and the other thereof might be made to abut against the projection by changing the shape of the cam face 19c, so that one of the rising and setting cams 13, 14 could be switched to rise whereas the other of them could be switched to set.

[0040] As for the rising and setting cams 13, 14, only the preceding side thereof might be made to rise in the running direction of the carriage and the following side thereof might be made to set. It should be noted that even when the state of the rising and setting cam 14 would be switched, the movable sinker 4 that has been already made into the non-acting state would not be influenced because the rising and setting cam 14 is located at the following side relative to the section cam 12. Accordingly, even when the rising and setting cams 13, 14 might be switched to rise and set at the same time, only the preceding side thereof would switch the movable sinker 4 to be in the non-acting state from the acting state and the following side thereof would not influence thereon.

[0041] The same functions can be realized with another structure in which a motor is used as the driving source 19, a rack is provided on the sliding plate cam 19b, and a pinion is attached to an output shaft of the motor so as to drive the sliding plate cam 19b, or the like. Further, when the driving source 19 might be provided on each of the rising and setting cams 13, 14, only the rising and setting cams 13, 14 at the side preceding the section cam 12 could be made to rise.

[Example 2]

[0042] Fig. 8 shows a schematic cam arrangement of a cam system 30 of a flatbed knitting machine equipped with the movable sinkers 4 according to Example 2 of the present invention. A sinker control cam 31 included in the cam system 30 does not include the section cam 12 and the rising and setting cams 13, 14 of the sinker control cam 11 in Fig. 1(a) but includes a moving cam 32. The moving cam 32 in the present example is pro-

vided with a movement mechanism capable of using a section larger than the non-acting section in which the section cam 12 is provided as the non-acting section and a driving source, and can move to a position preceding the non-acting section in the running direction of the carriage.

[0043] The non-acting section in the present example is set as a section including a yarn catching position at which the stitch cam 10d drives the butt 3b of the knitting needle 3 and drawing of the new loop by the hook 3a is started. A position that is the same as the section cam 12 in Fig. 1 may be set as the non-acting section. Representatives of positions preceding the non-acting section to which the moving cam 32 can be moved are indicated by (1), (2), (3), and (4). When the moving cam 32 might be moved to the position preceding the non-acting section, or to the non-acting section, control to stop the action of the yarn receive part 4b of the movable sinker 4 on the loop 7 could be switched. The position of the moving cam 32 could be moved, thereby adjusting effects of improving finish of a knitted fabric and preventing the loop from being raised upward in accordance with the knitting conditions such as knitting yarns to be used and stitches to be formed.

[0044] Fig. 9 shows a state where the movable sinker 4 is made to act even at the yarn feeding position, at which the knitting yarn is supplied to the hook 3a through the yarn feeder port 8, and has started retreating after advanced to the needle bed gap 5 at the position as indicated by (4) in Fig. 8. The action states of the movable sinker 4 at the positions (1), (2), and (3) in Fig. 8 are the same as those in Fig. 3, Fig. 4, and Fig. 5, respectively. The movable sinker 4 in the present example does not disturb the yarn feeding and can be therefore made to act so as to press the old loop 7a by the yarn receive part 4b also during the yarn feeding at the position in Fig. 1(a) corresponding to (4) of Fig. 8. In case the movable sinker 4 might be made to act also when the hook 3a that would have advanced to the needle bed gap 5 would be made to retreat from the needle bed gap 5 at the positions (3), (4), deviation of the old loop 7a from the tongue 3f of the slider 3e and return of the old loop 7a onto the hook 3a could be prevented. Further, in case latch needles might be used, the leading end of the latch, that would have opened when the old loop 7a would be cleared, could be prevented from interfering in the old loop 7a. However, when there might be difficulty in the yarn feeding depending on the shapes of the movable sinker 4, the movable sinker 4 should be required to be made into the non-acting state. In addition, when the movable sinker 4 might be also used for the stitch determination without providing the fixed sinker 6, the loop 7 should be pressed reliably by once making the movable sinker 4 into the non-acting state during the yarn feeding and the yarn catching, and making the movable sinker 4 into the acting state before the stitch determination.

[0045] The present invention can be applied regardless of shapes, driving methods, and presence and ab-

sence of the springs as long as the movable sinker 4 has the function to prevent the loops from being raised upward together with the knitting needles. In case the non-acting state could not be kept even by switching the movable sinker 4 to be in the non-acting state from the acting state, a cam, a stopper, or the like might be added so as to keep the non-acting state. Further, the present invention can be applied not only to stitch formation but also to stitch transfer. As the knitting needle, not only the compound needle opening and closing the hook 3a by the slider 3e but also the latch needle opening and closing the hook by the latch can be used. The invention can be applied not only to the flatbed knitting machine having two beds in which a pair of needle beds 1 form a front bed and a rear bed so as to oppose each other with the needle bed gap 5 interposed therebetween but also to a flatbed knitting machine having four beds at upper and lower two stages and a flatbed knitting machine having an auxiliary bed.

[Reference Signs List]

[0046]

3	Knitting needle	25
3a	Hook	
4	Movable sinker	
4a	Leading end part	
4b	Yarn receive part	
4c	Support receive part	30
4d	Spring part	
4e	Driving part	
5	Needle bed gap	
6	Fixed sinker	
7	Loop	35
8	Yarn feeder port	
9	Sinker jack	
9a	Driving cam part	
9b	Butt	
10, 30	Cam system	40
11, 31	Sinker control cam	
11a	Sinker cam	
11b, 11c	Acting cam part	
12	Section cam	
13, 14	Rising and setting cam	45
15, 16	Rocking lever	
17, 18	Spring	
19	Driving source	50

Claims

1. A flatbed knitting machine equipped with movable sinkers (4), each of which advances to and retreats from a needle bed gap (4) and is arranged between knitting needles (3) accommodated in needle grooves (2), provided on needle beds (1) in parallel,

having a cam system (10, 30), which is mounted on a carriage reciprocating along the needle bed (1), causes the knitting needles (3) to advance to and retreat from the needle bed gap (5), and which includes a sinker control cam (11, 31) performing control such that:

when a knitting needle (3), holding a loop (7) on a hook (3a) provided at a leading end of the knitting needle (3) at the side of the needle bed gap (5), is made to advance to the needle bed gap (5), advancing the movable sinker (4) to the needle bed gap (5) and acting a yarn receive part (4b) provided on a leading end part (4a) of the movable sinker (4) at the side of the needle bed gap (5) on the loop (7), so as to prevent the loop (7) from being raised upward together with the knitting needles (3); and

when the knitting needle (3) is made to retreat from the needle bed gap (5), setting a non-acting section, in which the leading end part (4a) of the movable sinker (4) also retreats from the needle bed gap (5) and action of the yarn receive part (4b) on the loop (7) in the needle bed gap (5) is stopped,

characterized in that the sinker control cam (11, 31) includes a cam (13, 14; 32) capable of switching, at a position preceding start of the non-acting section in a running direction of the carriage, whether the movable sinker (4) keeping a state where the yarn receive part (4b) acts on the loop (7) to the position, stops or not the action from the position to the start position of the non-acting section.

2. The flatbed knitting machine equipped with movable sinkers (4) according to Claim 1, wherein said sinker control cam (11) comprises:

a section cam (12) performing control such that the action of said yarn receive part (4b) of the movable sinker (4) is stopped in said non-acting section; and rising and setting cams (13, 14) provided at positions at both of a preceding side and a following side away from the non-acting section in the running direction of said carriage as cams capable of switching whether to stop or not said action of the yarn receive part (4b) by rising and setting.

3. The flatbed knitting machine equipped with movable sinkers (4) according to Claim 2, wherein said sinker control cam (11) comprises:

rocking levers (15, 16) having points of support (15b, 16b) at positions close to an intermediate position between said rising and setting cams (13, 14) at both sides in the running direction of

said carriage, supporting the rising and setting cams (13, 14) by arms (15a, 16a) extending from the points of support (15b, 16b), and rocking about the points of support (15b, 16b);
 springs (17, 18) provided on the both side rocking levers (15, 16) respectively, and biasing the rocking levers (15, 16) such that the rocking levers (15, 16) rock about the points of support (15b, 16b), causes the rising and setting cams (13, 14) to rise, and said yarn receive part (4b) of the movable sinker (4) to stop the action of the yarn receive part (4b) of the movable sinker (4) on the loop (7);
 a single driving source (19) capable of switching not to stop the action of the yarn receive part (4b) on the loop (7) by rocking the both side rocking levers (15, 16) so as to cause the rising and setting cams (13, 14) to set against biasing by the springs (17, 18); and
 a transmission mechanism (19a, 19b) to transmit driving force generated from the driving source (19) to the both side rocking levers (15, 16).

4. The flatbed knitting machine equipped with movable sinkers (4) according to Claim 1, wherein said sinker control cam (31) comprises a moving cam (32) to move between said position and the non-acting section as a cam capable of switching whether to stop or not the action of the yarn receive part (4b).
5. The flatbed knitting machine equipped with movable sinkers (4) according to any one of Claims 1 to 4, wherein said movable sinker (4) is biased by a spring (4d) such that said yarn receive part (4b) rocks in a direction of acting on said loop (7), said sinker control cam (11, 31) controls the movable sinker (4) through a jack (9) to advance and to retreat in an advancing/retreating direction of said knitting needle (3) to/from said needle bed gap (5), and the jack (9) drives the movable sinker (4) in a direction orthogonal to the advancing/retreating direction so as to cause the movable sinker (4) to rock in a direction to stop the action of the yarn receive part (4b) on the loop (7).

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Fig. 1
(a)

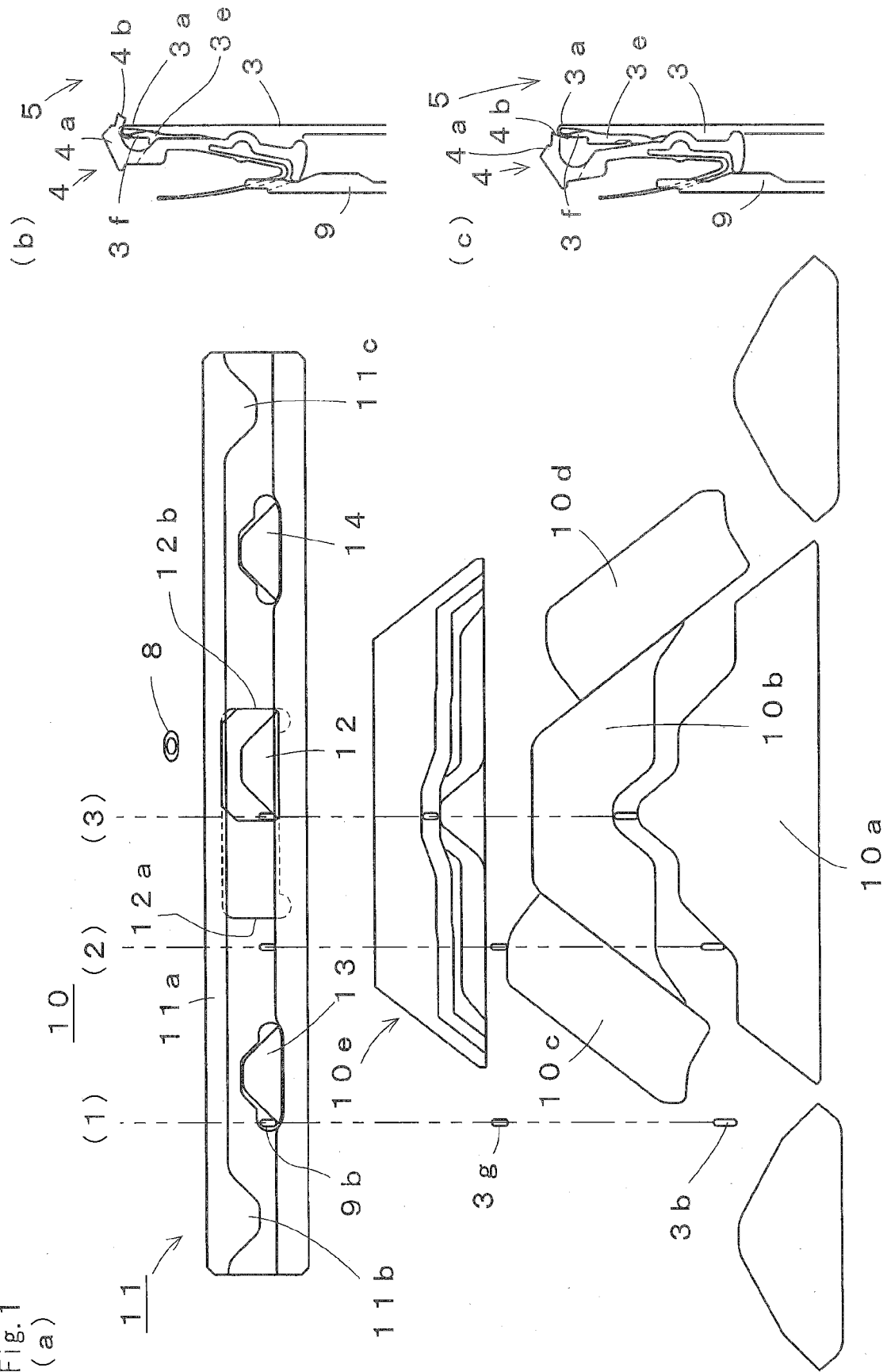
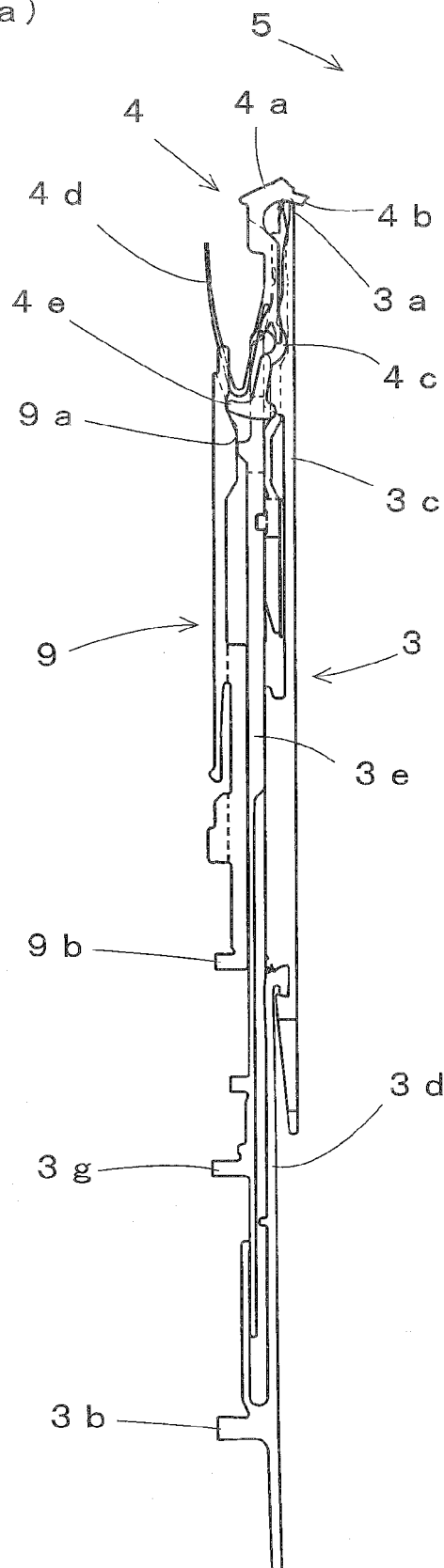


Fig. 2
(a)



(b)

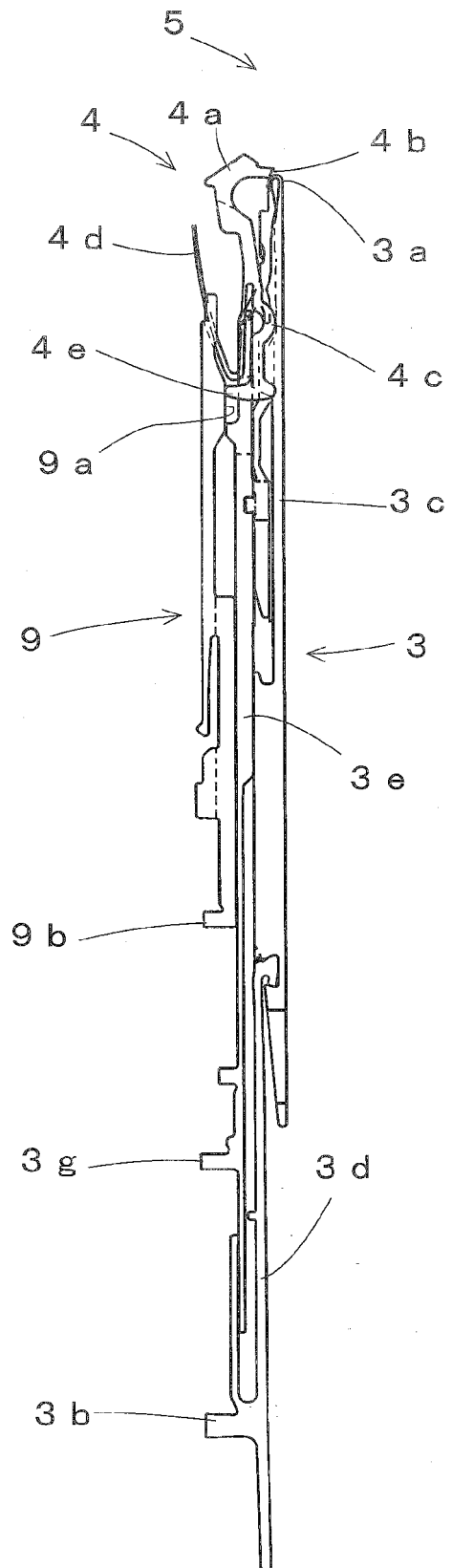
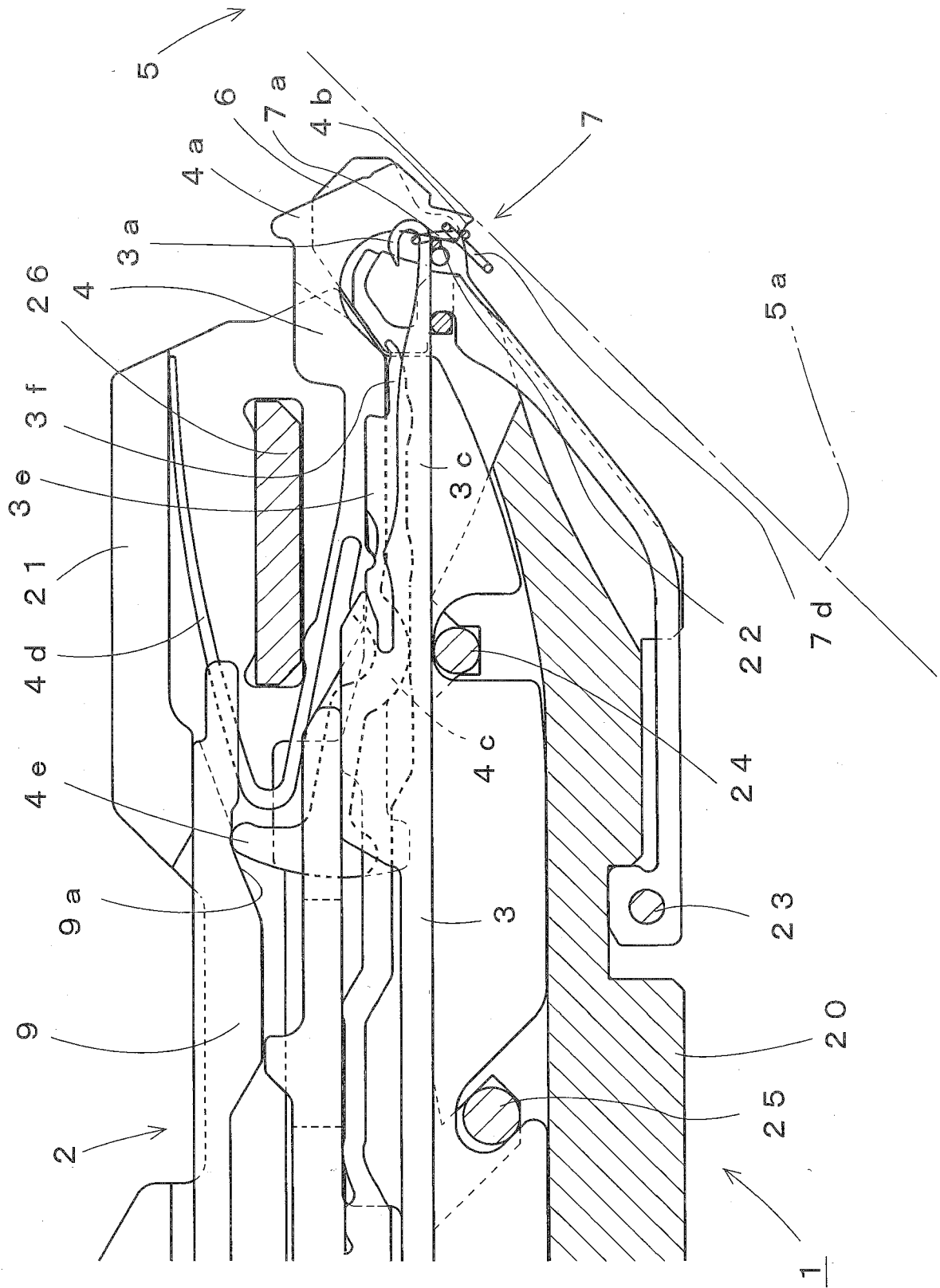
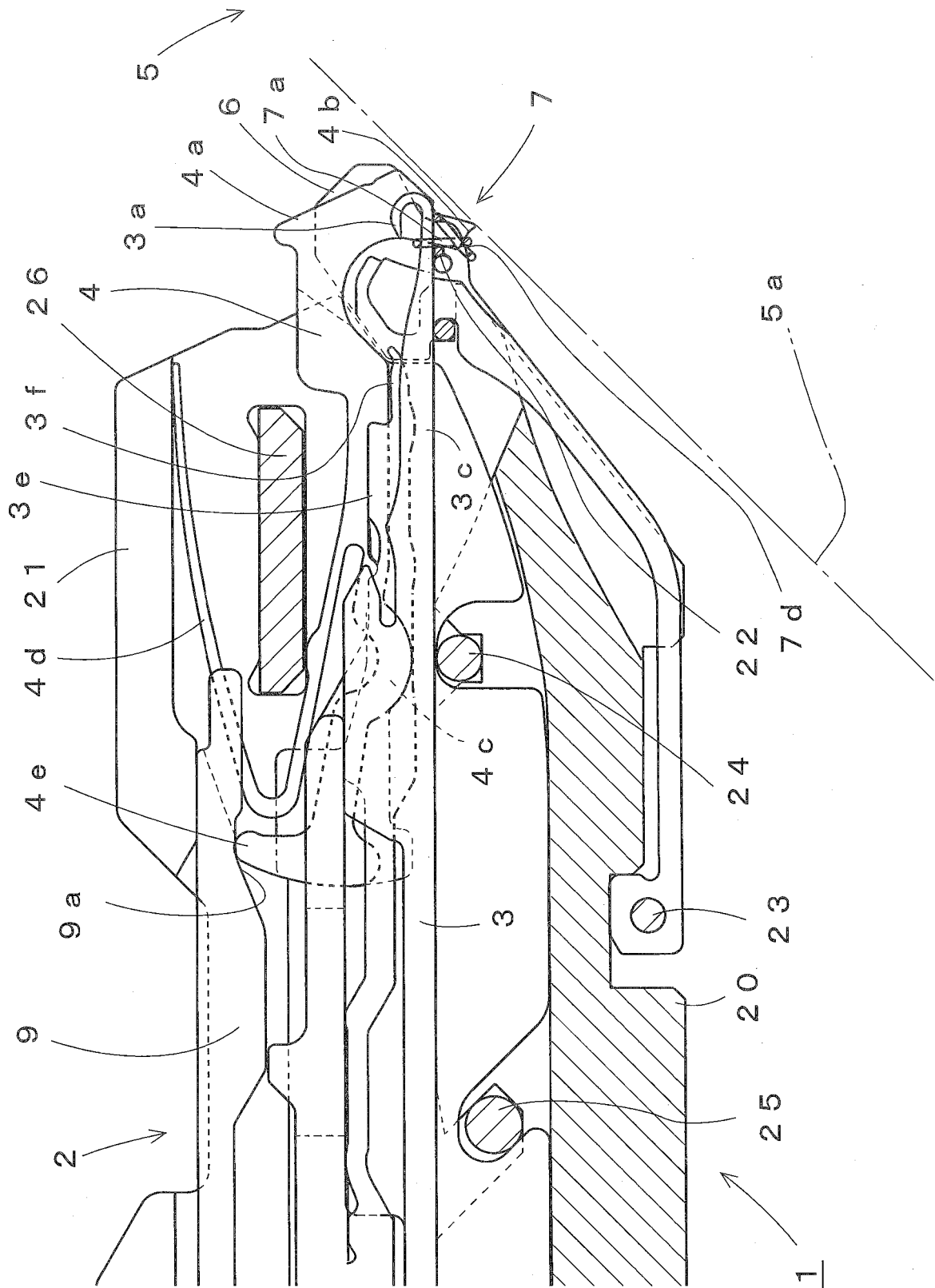


Fig. 3






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 75
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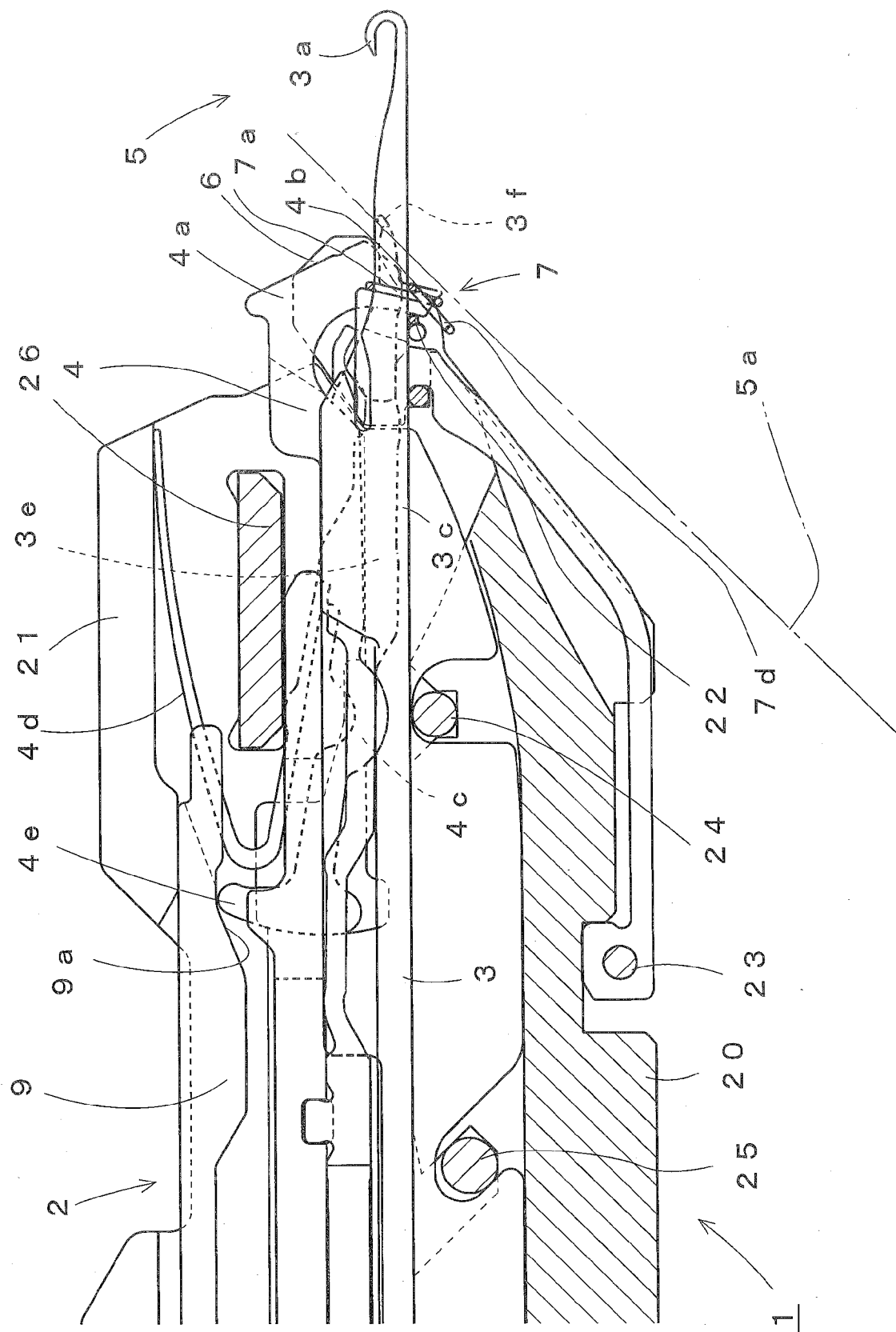
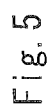
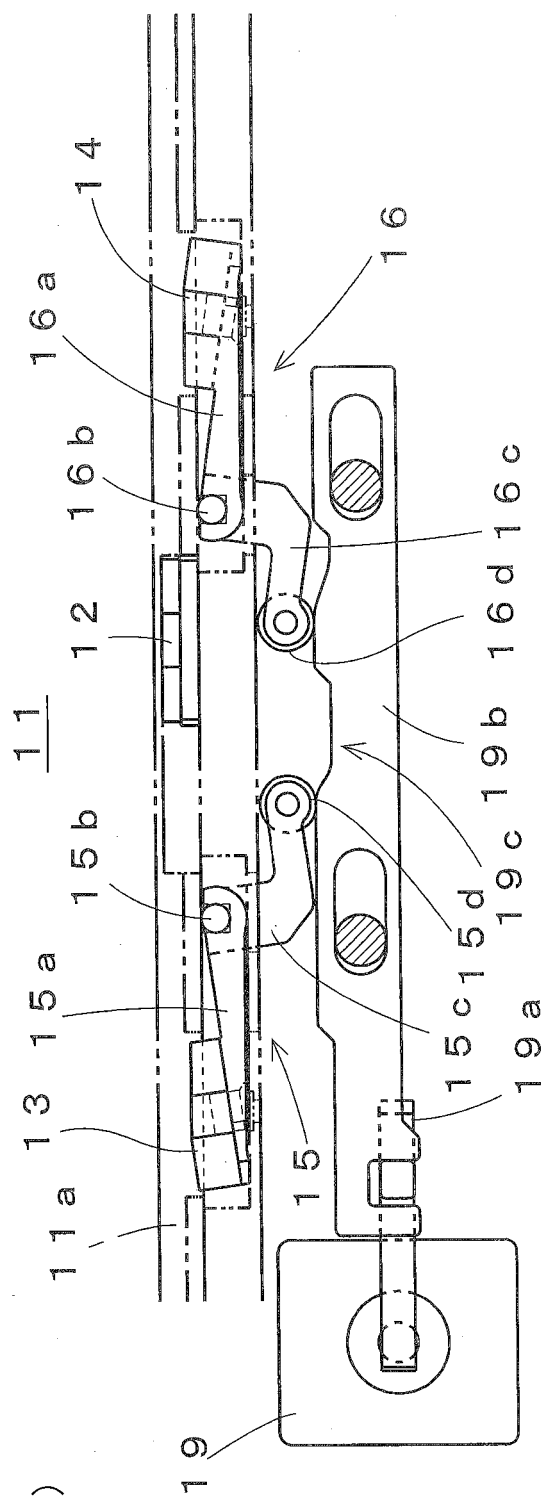


Fig. 6

(a)



(b)

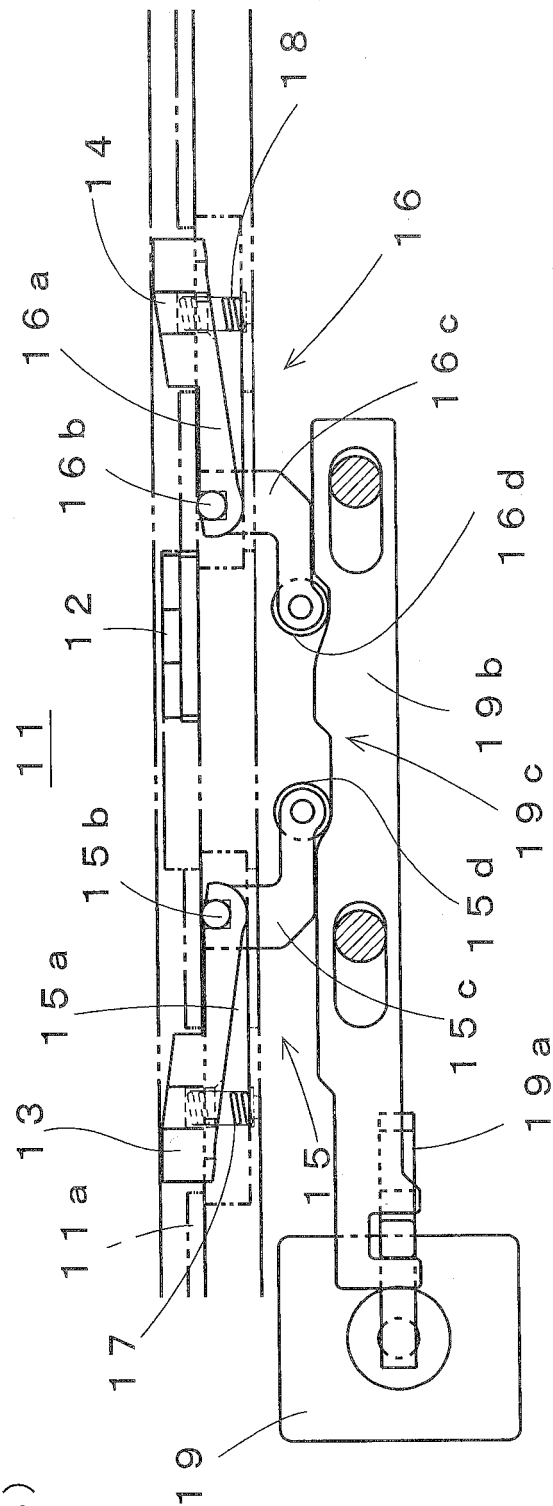


Fig. 7

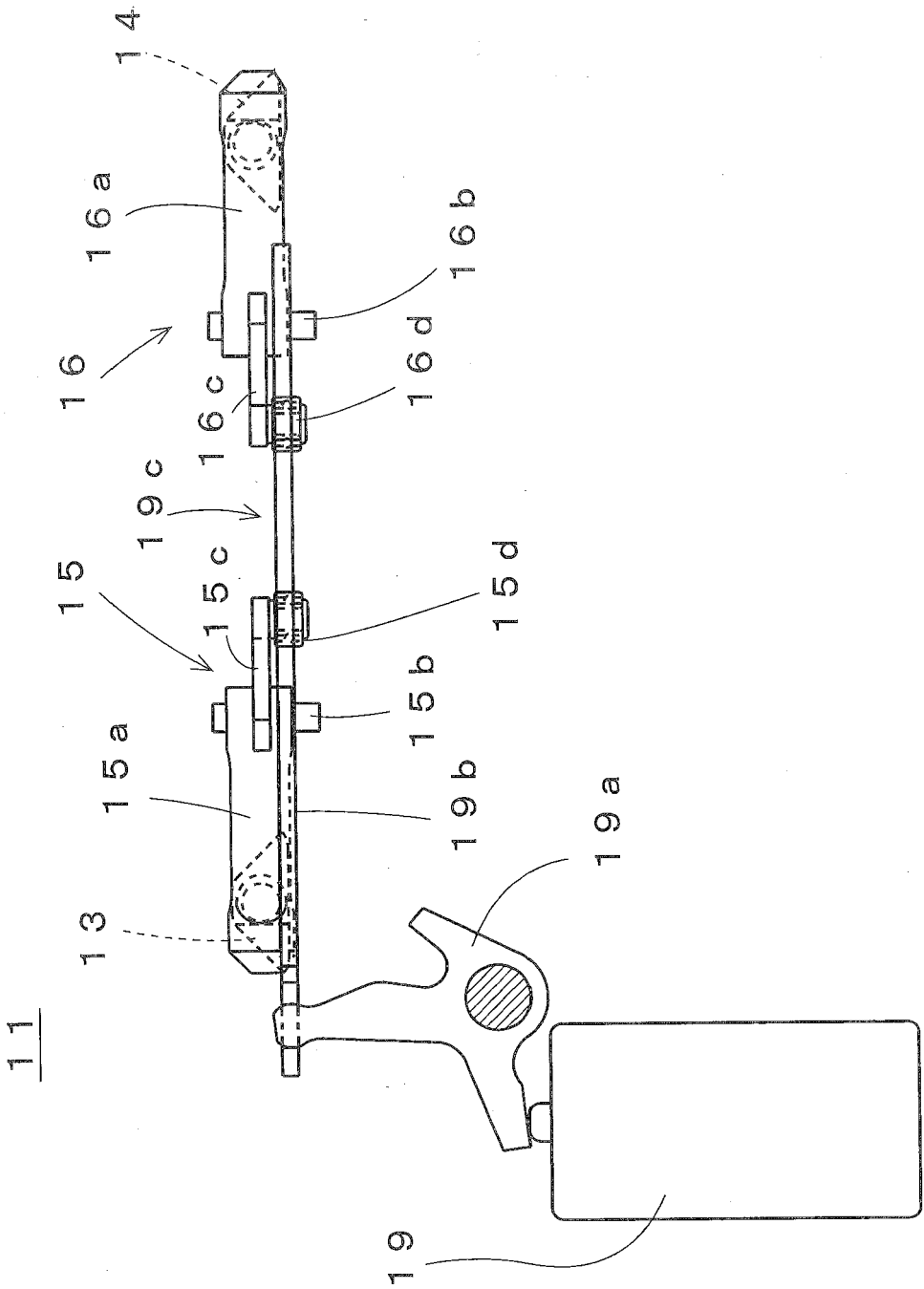


Fig. 8

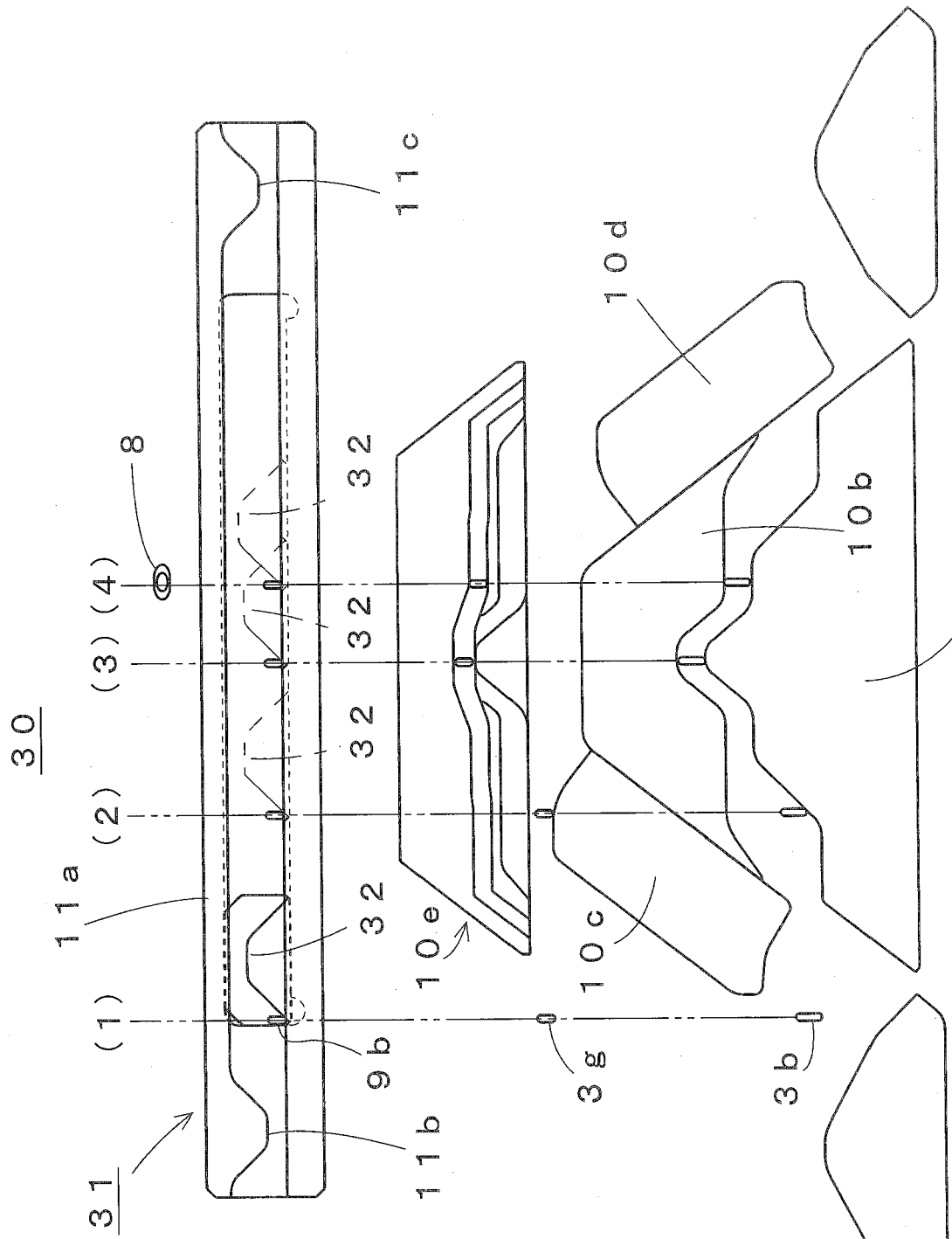
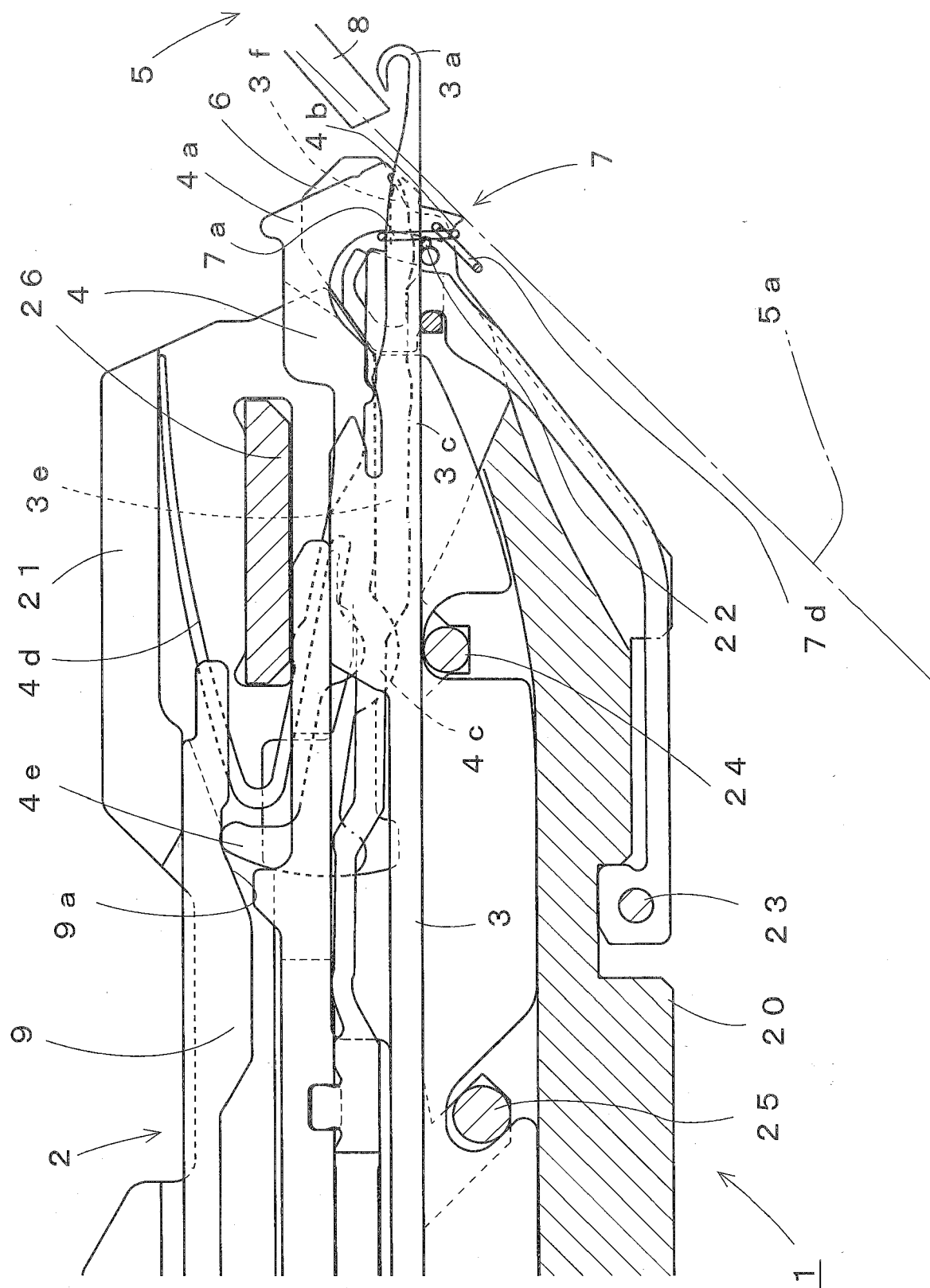


Fig. 9





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Place of search Munich		Date of completion of the search 25 May 2016	Examiner Braun, Stefanie
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