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(54) **FLAT KNITTING MACHINE**

(57) Provided is a flat knitting machine capable of inhibiting the feeder tip from moving out of the region where the feeder tip can feed yarn to the target position that is on the side of the needle bed gap, the target position being a position where a knitting needle takes hold of the yarn, when the feeder tip is moved up or down. In a flat knitting machine (100) including needle beds (110); a yarn passage rail (130) that installed above the needle beds (110); a yarn feeder (1) including a feeder tip (23a) for supplying knitting yarn to a knitting needle (111); and a feeder tip position adjusting elongated hole (24a) and a screw (40) for adjusting the yarn-feeding height of the feeder tip (23a), the yarn feeder (1) includes: a feeder rod (20) to which the feeder tip (23a) is provided; a raising bias unit guiding groove (11) that guides the feeder rod (20) in a guide direction inclined with respect to the vertical direction; and feeder tip side guides (31) and carrier base side guide (32) that convert a moving direction of the feeder tip (23a) to a direction bringing the moving direction of the feeder tip (23a) closer to the vertical direction than the guide direction, in response to a change in the height of the feeder tip (23a), at least within a height range where the feeder tip (23a) is allowed to feed the yarn a position at which the yarn is taken hold of.

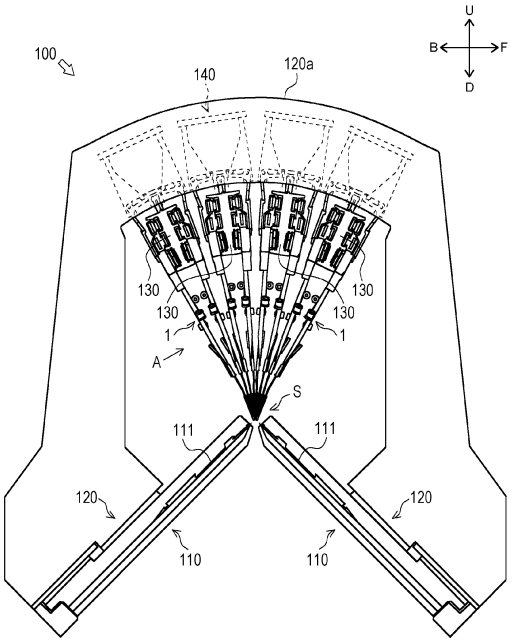


FIG. 1

EP 4 455 379 A1

Description

Technical Field

[0001] The disclosure relates to a technique for a flat knitting machine that includes a yarn feeder.

Background Art

[0002] Conventionally, techniques of a flat knitting machine including a yarn feeder are known. One example of such a technique is disclosed in Patent Literature 1.

[0003] Patent Literature 1 describes a flat knitting machine including a yarn carrier (yarn feeder). The yarn carrier includes a feeder rod that can be moved up or down, and a feeder rod guide that guides the movement of the feeder rod. The bottom end of the feeder rod has a feeder tip through which the yarn is fed to a knitting needle. The feeder rod is lowered for the operation of feeding yarn, and is raised to evacuate the yarn feeder portion from the needle bed gap to standby. The feeder rod includes a rod the bottom end of which is provided with the feeder tip, and a raising bias unit provided above the rod. The rod and the raising bias unit are coupled to each other with a screw passed through an elongated hole provided to the rod.

[0004] With this structure, by changing the position where the screw is fastened inside the elongated hole, it is possible to adjust a yarn-feeding height at which the feeder tip feeds yarn, in the manner suitable for the knitting conditions. As a specific example, the position of the feeder tip may be set lower in a case where knitted is a fabric including a section with a series of misses (floating jacquard).

Citation List

Patent Literature

[0005] Patent Literature 1: JP 3044370 B

Summary of Invention

Technical Problem

[0006] In the technique described in Patent Literature 1, as the feeder tip is moved up or down, the position of the feeder tip may shift toward the side of the front or rear needle bed, and the feeder tip may move out of the region where the feeder tip can feed yarn to a target position that is on the side of the needle bed gap. The target position herein is a position where a corresponding knitting needle takes hold of the yarn.

[0007] The disclosure has been made in view of the issue described above, and an object to be addressed by the disclosure is to provide a flat knitting machine capable of inhibiting the feeder tip from moving out of the region where the feeder tip can feed yarn to the target position that is on the side of the needle bed gap, the target position being a position where a knitting needle takes hold of the yarn, as the feeder tip is moved up or down.

Solution to Problem

[0008] The problem to be addressed by the disclosure has been described above. The solution to the problem will now be explained.

[0009] That is, a flat knitting machine according to the disclosure includes: at least two needle beds that face each other with a needle bed gap therebetween, and each of which has knitting needles arranged side by side in a longitudinal direction; a yarn passage rail that is installed above the needle beds; a carrier base that is provided movably along the yarn passage rail; a yarn feeder that is provided as a part of a path for feeding knitting yarn to the knitting needles, the yarn feeder including the carrier base and a feeder tip for feeding the knitting yarn to a knitting needle; and feeder tip height adjusting means for adjusting a yarn-feeding height of the feeder tip, in which the yarn feeder includes: a feeder rod to which the feeder tip is provided; converting means that converts a direction in which the feeder tip is moved; a feeder rod guide that is supported by the carrier base and that supports the converting means; and guiding means for guiding the feeder rod in a guide direction that is inclined with respect to a vertical direction, in which the converting means is included in the feeder rod and the feeder rod guide, and converts the direction in which the feeder tip is moved, to a direction bringing the feeder tip closer to the vertical direction than the guide direction, in response to a change in a height of the feeder tip, at least within a height range where the feeder tip is allowed to feed the yarn to a position at which the yarn is taken hold of.

[0010] With such a configuration, as the feeder tip is moved up or down, the feeder tip is moved closer to the vertical direction with respect to the guide direction guided by the guiding means. Therefore, it is possible to inhibit the feeder tip from moving out of the region where the feeder tip can feed yarn to the target position that is on the side of the needle bed gap, the target position being a position where a knitting needle takes hold of the yarn.

[0011] The feeder rod is provided with a yarn feeder portion that is provided with the feeder tip, and the converting means includes: a feeder tip side guide runner provided to any one of the yarn feeder portion or the feeder rod guide, on a side closer to the feeder tip; a carrier base side guide runner provided to any one of the yarn feeder portion or the feeder rod guide, on a side closer to the carrier base; a feeder tip side guide provided to the other one of the yarn feeder portion and the feeder rod guide, on the side closer to the feeder tip, and adapted to guide the feeder tip side guide runner along a trajectory in parallel with the guide direction; and a carrier base side guide provided to the other one of the yarn feeder portion and the feeder rod guide, on the side closer to

the carrier base, and adapted to guide the carrier base side guide runner in a direction inclined with respect to the guide direction, being inclined toward a side on which an upper end of the yarn feeder portion moves away from the needle bed gap in a front-back direction.

[0012] With such a configuration, it is possible to reduce bulkiness of the yarn feeder in the thickness direction in the area near the needle bed gap where a plurality of yarn feeder are provided densely. Therefore, space saving can be achieved.

[0013] The feeder rod may include: a rod that is guided in the guide direction by the guiding means, and that is moved up and down by being actuated by an up-down actuating mechanism; and a yarn feeder portion that is connected to the rod and that is provided with the feeder tip.

[0014] With such a configuration, by evacuating the yarn feeder portion of the standby yarn feeder away from the needle bed gap, it is possible to prevent collision of the yarn feeder portion of the travelling yarn feeder with the yarn feeder portion of the standby yarn feeder.

[0015] The yarn feeder portion may be a member separate from the rod, and may be connected to the rod in such a manner that the feeder tip is movable in a direction different from the guide direction of the feeder rod, and in a direction in which the position of the feeder tip in the front-back direction change with respect to the rod.

[0016] With such a configuration, it is possible to reduce the load imposed on the feeder rod as the yarn feeder portion moves with respect to the rod.

[0017] The feeder rod may include a coupler disposed between the rod and the yarn feeder portion, and coupling the rod and the yarn feeder portion, and the coupler may be fixed and connected to the rod at a position below the yarn passage rail in such a manner that the feeder tip height adjusting means can adjust an up-down position with respect to the rod.

[0018] With such a configuration, the height of the coupler with respect to the rod can be adjusted by avoiding the yarn passage rail, so that the yarn-feeding height of the feeder tip can be easily adjusted.

[0019] The guiding means may be provided to the carrier base, and the yarn passage rails may be provided radially with respect to the center between the needle beds that are on a front side and a back side in a side view.

[0020] With such a configuration, it is possible to make use of an effect achieved by the radial arrangement of the yarn passage rails, the effect being that that the width in the front-back direction can be made smaller than that in the case where the yarn passage rails are disposed horizontally.

Advantageous Effects of Invention

[0021] As an advantageous effect according to the disclosure, it is possible to inhibit the feeder tip from moving out of the region where the feeder tip can feed yarn to the target position, which is on the side of the needle bed gap, as the feeder tip is moved up or down, the target position being where a knitting needle takes hold of the yarn.

Brief Description of Drawings

[0022]

FIG. 1 is a side view illustrating a flat knitting machine according to a first embodiment of the disclosure;
FIG. 2 is a schematic of a yarn passage rail and a yarn feeder, in a view along arrow A in FIG. 1;
FIG. 3 is a side view of a yarn feeder;
FIG. 4A is a front view illustrating a yarn feeder portion; FIG. 4B is a side view illustrating the yarn feeder portion;
FIG. 5 is a cross-sectional view taken along line C-C in FIG. 2;
FIG. 6 is an enlarged side sectional view illustrating the yarn feeder having the feeder tip raised;
FIG. 7 is an enlarged side sectional view of a yarn feeder included in a flat knitting machine according to a second embodiment of the disclosure;
FIG. 8 is an enlarged side sectional view of the yarn feeder having the feeder tip raised, in the second embodiment;
FIG. 9 is an enlarged side sectional view of a yarn feeder included in a flat knitting machine according to a third embodiment of the disclosure; and
FIG. 10 is an enlarged side sectional view of the yarn feeder having the feeder tip raised, in the third embodiment.

Description of Embodiments

[0023] In the following description, the directions indicated by arrows U, D, F, B, L, and R in the drawings are defined as an upward direction, a downward direction, a frontward direction, a backward direction, a leftward direction, and a rightward direction, respectively.

[0024] As illustrated in FIGS. 1 and 2, a flat knitting machine 100 according to a first embodiment of the disclosure mainly include needle beds 110, carriages 120, yarn passage rails 130, and up-down actuating mechanisms 140.

[0025] The needle beds 110 are disposed facing each other, with a needle bed gap S therebetween, in the front-back direction. The front and rear needle beds 110 are disposed in an inverted V shape in side view, with each of the needle beds 110 positioned diagonally upwards toward the center between the needle beds 110 in the front-back direction (in the direction facing each other). Each of the needle beds 110 is provided with a large number of knitting needles 111 that are arranged in the longitudinal direction (left-right direction) of the needle bed 110.

[0026] The carriage 120 is disposed as a pair, on the front and rear sides, respectively, in a manner facing the

front and rear needle beds 110, respectively, from above. The front and rear carriages 120 are connected to each other via a gate arm 120a disposed in a manner straddling over the plurality of yarn passage rails 130. The carriages 120 are enabled to reciprocate in the longitudinal direction of the needle beds 110 by a servo motor (not illustrated). Each of the carriages 120 is provided with a needle selecting mechanism (not illustrated) and a cam mechanism (not illustrated) for causing the knitting needles 111 on the needle beds 110 to selectively operate.

[0027] A plurality of the yarn passage rails 130 stretch above the needle beds 110, and are disposed in a manner extending along the longitudinal direction of the needle beds 110. The yarn passage rails 130 are arranged radially with respect to the center between the front and rear needle beds 110 in side view. The "center between the front and rear needle beds 110" herein means the position where the yarn is fed, in side view. On the front and rear surfaces of each of the yarn passage rails 130, yarn feeders 1 for feeding knitting yarn are supported, respectively, in a manner movable along the yarn passage rail 130, as a part of a path for feeding the knitting yarn to the knitting needle 111. The knitting yarn from a yarn package (not illustrated) is fed to the yarn feeders 1 via an appropriate yarn feed path.

[0028] Each of the up-down actuating mechanisms 140 includes a cam plate 141 provided above the corresponding yarn feeder 1, and enabled to push down the feeder rod 20 of the yarn feeder 1. The feeder rod 20 is lowered by causing the cam plate 141 to operate. The up-down actuating mechanism 140 also includes a spring 142 that is inserted onto the raising bias unit 21, which will be described later, and applies an upward biasing force to the feeder rod 20. The up-down actuating mechanism 140 is thus enabled to raise the feeder rod 20, with the spring 142.

[0029] A configuration of the yarn feeder 1 will now be described with reference to FIGS. 2 to 6. Among the plurality of yarn feeders 1, FIGS. 2, 3, 5, and 6 illustrate the rearmost yarn feeder 1.

[0030] The yarn feeder 1 is enabled to travel along the yarn passage rail 130, in the longitudinal direction of the yarn passage rail 130, by being provided with travelling rollers 1a. With a belt fixed to the yarn feeder 1, the yarn feeder 1 is enabled to travel by causing a motor to drive the belt. The yarn feeder 1 may also be configured to travel by being pulled by the carriage 120.

[0031] Each of the yarn feeders 1 includes a carrier base 10, a feeder rod 20, and a feeder rod guide 30.

[0032] The carrier base 10 illustrated in FIGS. 2 and 3 is for supporting the feeder rod 20 and the feeder rod guide 30, which will be described later. The carrier base 10 is provided as an upper part of the yarn feeder 1. As illustrated in FIG. 2, the carrier base 10 is provided with a raising bias unit guiding groove 11, which is an example of the guiding means according to the disclosure. The raising bias unit guiding groove 11 is provided at the center of the carrier base 10, being the center in the left-right direction, in a manner extending in the up-down direction, and is enabled to guide the raising bias unit 21 of the feeder rod 20, which will be described later.

[0033] The feeder rod 20 is moved up or down to prevent collisions of the feeder tips 23a for feeding the knitting yarn to the knitting needles 111. The feeder rod 20 is supported on the carrier base 10, and the feeder rods 20 of the respective yarn feeders 1 are provided radially with respect to the center between the front and rear needle beds 110 in side view. Each of the feeder rods 20 includes the raising bias unit 21, the rod 22, the yarn feeder portion 23, and a coupling plate 24.

[0034] The raising bias unit 21 illustrated in FIGS. 2 and 3 is provided to an upper part of the feeder rod 20. The spring 142 of the up-down actuating mechanism 140 is inserted onto and attached to the raising bias unit 21. The raising bias unit 21 thus receives the upward biasing force of the spring 142. At the same time, the raising bias unit 21 is pressed downwards by the cam plate 141, which is of the up-down actuating mechanism 140, via a press-down portion 21a provided to an upper part of the raising bias unit 21. The raising bias unit 21 extends in a direction in which the raising bias unit guiding groove 11 extends, and is actuated by the up-down actuating mechanism 140 to move up or down by being guided along the raising bias unit guiding groove 11.

[0035] The rod 22 illustrated in FIGS. 2 and 3 is provided under the raising bias unit 21, and provided in a manner extending linearly in the direction in which the raising bias unit 21 extends. The rod 22 is connected to the raising bias unit 21, and is actuated by the up-down actuating mechanism 140 to move up or down together with the raising bias unit 21. A protrusion 22a protruding backwards is provided to a lower part of the rod 22.

[0036] The yarn feeder portion 23 is disposed below the rod 22, and the feeder tip 23a is provided to the bottom end of the yarn feeder portion 23. The position where the feeder tip 23a is disposed is not limited to the bottom end of the yarn feeder portion 23. The yarn feeder portion 23 is a member separate from the rod 22, and is connected to the rod 22 via the coupling plate 24, which will be described later. By connecting the yarn feeder portion 23 and the rod 22 via the coupling plate 24, the yarn feeder portion 23 is connected movably to the rod 22. When the yarn feeder portion 23 is moved with respect to the rod 22, the feeder tip 23a moves in a direction in which the position of the feeder tip 23a with respect to the rod 22 in the front-back direction changes, in a direction different from the guide direction in which the feeder rod 20 is moved up or down by the up-down actuating mechanism 140 by being guided along the raising bias unit guiding groove 11. The yarn feeder portion 23 has a feeder tip side guide runner 23b and a carrier base side guide runner 23c.

[0037] The feeder tip side guide runner 23b illustrated in FIGS. 2, 4, and 5 is guided along feeder tip side guiding grooves 31a, which will be described later. The feeder

tip side guide runner 23b is provided in a middle portion of the yarn feeder portion 23 in the vertical direction, in a manner protruding toward the left and the right, at a position above the feeder tip 23a. The feeder tip side guide runner 23b has a rectangular or a rhombus shape with its two opposing corners chamfered, in side view, so that the yarn feeder portion 23 is permitted to move in a direction different from the guide direction in which the rod 22 is guided by the raising bias unit guiding groove 11. The feeder tip side guide runner 23b may also have a circular shape or an elliptical shape in side view.

[0038] The carrier base side guide runner 23c illustrated in FIGS. 2, 4, and 5 is guided along carrier base side guiding grooves 32a, which will be described later. The carrier base side guide runner 23c has a shape protruding toward the left and the right sides from the top end of the yarn feeder portion 23, at a position higher than the feeder tip side guide runner 23b. The carrier base side guide runner 23c has a rectangular shape or a rhombus shape with its two opposing corners chamfered, in side view. The carrier base side guide runner 23c may also have a circular shape or an elliptical shape in side view.

[0039] The coupling plate 24 is disposed between the rod 22 and the yarn feeder portion 23, and couples the rod 22 and the yarn feeder portion 23. The coupling plate 24 includes a feeder tip position adjusting elongated hole 24a and a bottom end connector 24b.

[0040] The feeder tip position adjusting elongated hole 24a illustrated in FIG. 2 is an example of the feeder tip height adjusting means according to the disclosure, and is provided in a manner penetrating the coupling plate 24 in the thickness direction, and in a manner extending in the longitudinal direction of the coupling plate 24. The feeder tip position adjusting elongated hole 24a is provided to an upper part of the coupling plate 24. Into this feeder tip position adjusting elongated hole 24a, the protrusion 22a of the rod 22 is inserted from the front side. With the protrusion 22a inserted into the feeder tip position adjusting elongated hole 24a, the left-right position of the coupling plate 24 with respect to the rod 22 is restricted. A screw 40 is then inserted into the feeder tip position adjusting elongated hole 24a from the back, at a position lower than the yarn passage rail 130. The screw 40 is then screwed into a female screw hole (not illustrated) provided to a lower part of the rod 22. In this manner, the coupling plate 24 is fixed to the rod 22, in an upper part of the coupling plate 24.

[0041] The bottom end connector 24b illustrated in FIG. 2 is provided to the bottom end of the coupling plate 24, and is engaged with an engagement hole 23d (see FIGS. 4A and 4B) provided to the yarn feeder portion 23. The coupling plate 24 is thus connected to the yarn feeder portion 23 via the lower part of the coupling plate 24 in such a manner that the yarn feeder portion 23 is movable in a direction in which the position of the yarn feeder portion 23 in the front-back direction changes.

[0042] The feeder rod guide 30 is provided in front of the feeder rod 20, and is for guiding the feeder rod 20. The feeder rod guide 30 has its upper end portion supported by the carrier base 10. The feeder rod guide 30 includes feeder tip side guides 31 and a carrier base side guide 32.

[0043] The feeder tip side guides 31 and the feeder tip side guide runner 23b are an example of converting means according to the disclosure. The feeder tip side guides 31 are provided to the left and right sides of the bottom end of the feeder rod guide 30, respectively. The feeder tip side guides 31 extend in parallel with the path along which the rod 22 is advanced and evacuated. As illustrated in FIG. 5, each of the feeder tip side guides 31 has a feeder tip side guiding groove 31a. The feeder tip side guiding grooves 31a are provided in a manner recessed outwards on the left and right sides of the feeder rod guide 30, respectively, and each of feeder tip side guiding grooves 31a has openings on the top end and the bottom end of the feeder tip side guide 31, respectively. The feeder tip side guide runner 23b is housed in the feeder tip side guides 31.

[0044] The carrier base side guide 32 and the carrier base side guide runner 23c are one example of the converting means according to the disclosure. The carrier base side guides 32 are provided at a position higher than the feeder tip side guides 31.

[0045] The carrier base side guide 32 is provided in a manner extending in a direction different from the trajectory along which the rod 22 is advanced and evacuated by the up-down actuating mechanism 140. More specifically, as illustrated in FIGS. 3, 5, and 6, the carrier base side guide 32 is provided in a manner extending in a direction closer to the horizontal direction than the guide direction in which the rod 22 is guided by the raising bias unit guiding groove 11.

[0046] As illustrated in FIGS. 5 and 6, the carrier base side guide 32 has a carrier base side guiding groove 32a. The carrier base side guiding groove 32a has an opening on the bottom end of the carrier base side guide 32, and extends in parallel with the direction in which the carrier base side guide 32 extends. The carrier base side guide runner 23c is housed in the carrier base side guiding grooves 32a. With this configuration, when the height of the feeder tip 23a is to be moved up, the carrier base side guide runner 23c is guided along the carrier base side guide 32 in a direction inclined toward the side on which the upper end of the yarn feeder portion 23 moves away from the needle bed gap S in the front-back direction than the longitudinal direction of the rod 22.

[0047] In the yarn feeder 1 having the configuration described above, by having the yarn feeder portion 23 guided by the feeder tip side guides 31 and the carrier base side guide 32 of the feeder rod guide 30, the yarn feeder portion 23 is movably connected to the rod 22 in a direction in which the position of the yarn feeder portion 23 with respect to the rod 22 in the front-back direction changes, in a direction different from the guide direction in which the rod 22 is guided by the raising bias unit guiding groove 11.

[0048] More specifically, the feeder tip side guide 31 and the carrier base side guide 32 convert, at least within a yarn feedable range, the moving direction of the feeder tip 23a to a direction bringing the moving direction of the feeder tip 23a closer to the vertical direction, than the guide direction in which the rod 22 is guided by the raising bias unit guiding groove 11, in response to a change in the height of the feeder tip 23a, having been changed by the up-down actuating mechanism 140, or by a change in the position where the screw 40 is fastened in the feeder tip position adjusting elongated hole 24a in the longitudinal direction. The "yarn feedable range" herein means a range of heights at which the feeder tip 23a can be feed yarn to a position at which the yarn is taken hold of.

[0049] A way in which the feeder rod 20 is advanced and evacuated with respect to the needle bed gap S will be described below with reference to FIGS. 1 and 2. When the yarn feeder 1 performs a yarn-feeding operation, the cam plate 141 presses down the press-down portion 21a provided to the upper part of the raising bias unit 21, and the raising bias unit 21 is caused to lower, against the biasing force of the spring 142, by being guided along the raising bias unit guiding groove 11. As the raising bias unit 21 is lowered, the rod 22 is lowered, and the feeder tip 23a of the yarn feeder portion 23 goes into the needle bed gap S. By causing the feeder tip 23a to go into the needle bed gap S, the yarn feeder portion 23 is enabled to feed the knitting yarn to the knitting needle 111.

[0050] While the yarn feeder 1 is to be put to standby, the cam plate 141 releases the pressing force on the press-down portion 21a. Once the cam plate 141 releases the pressing force on the press-down portion 21a, the feeder rod 20 is raised by the biasing force of the spring 142, and the yarn feeder portion 23 is evacuated from the needle bed gap S. By causing the feeder tip 23a of the yarn feeder 1 not feeding yarn to evacuate from the needle bed gap S, it is possible to alleviate the collision of the yarn feeder portion 23 of the yarn feeder 1 feeding yarn with the yarn feeder portion 23 of the yarn feeder 1 not feeding yarn.

[0051] The way in which the height of the feeder tip 23a is adjusted will now be described. In the yarn feeder 1, the yarn-feeding height of the feeder tip 23a can be adjusted, depending on the knitting condition. When the height of the feeder tip 23a is to be adjusted, the position where the screw 40 is fastened in the longitudinal direction of the feeder tip position adjusting elongated hole 24a is adjusted, to adjust the up-down position of the coupling plate 24 with respect to the rod 22. By adjusting the up-down position of the coupling plate 24 with respect to the rod 22, the height of the feeder tip 23a can be adjusted.

[0052] The rod 22 and the coupling plate 24 are fastened by the screw 40 below the yarn passage rail 130. Hence, it is possible to adjust the height of the coupling plate 24 with respect to the rod 22 by avoiding the yarn passage rail 130. Therefore, it is possible to adjust the yarn-feeding height of the feeder tip 23a, easily.

[0053] If the yarn feeder portion 23 is moved in the same direction as the guide direction in which the rod 22 is guided by the raising bias unit guiding groove 11 in order to adjust the yarn-feeding height of the feeder tip 23a in a manner suitable for the knitting condition, the feeder tip 23a becomes displaced from a center plane between the front and rear needle beds 110. As a result, when the feeder tip 23a is moved up or down, the feeder tip 23a may move out of the region where the feeder tip 23a can feed yarn to the target position that is on the side of the needle bed gap S, the target position being a position where a knitting needle takes hold of the yarn.

[0054] Furthermore, for plating knitting in which the knitting yarns of two yarn feeders 1 are knitted simultaneously by advancing and evacuating the feeder rods 20 with respect to the needle bed gap S, it becomes possible to set the position of the feeder tip 23a higher for yarn feeder 1 for plating, which is kept delayed from the ordinary yarn feeder 1, so that the knitting can be carried out with the main yarn and the plating yarn at difference heights. In this manner, when the feeder tip 23a is moved up or down by an advancing or evacuating movement of the feeder rod 20, too, the feeder tip 23a may move in a direction separating from the region where the feeder tip 23a can feed yarn to the target position that is on the side of the needle bed gap S.

[0055] Therefore, in the flat knitting machine 100 according to the present embodiment, the configurations such as the feeder tip side guide 31 and the carrier base side guide 32 serve to suppress the displacement of the feeder tip 23a in the front-back direction, accompanying the up or down movement of as the feeder tip 23a. An operation of the yarn feeder portion 23 when the feeder tip 23a is moved upwards for the yarn-feeding operation will now be described with reference mainly to FIGS. 5 and 6. FIG. 5 illustrates a configuration before the feeder tip 23a is raised. FIG. 6 illustrates a configuration after the feeder tip 23a is raised from the configuration illustrated in FIG. 5.

[0056] When the up-down actuating mechanism 140 rises the rod 22, the yarn feeder portion 23 also moves upwards while being guided by the feeder rod guide 30. Furthermore, when the position of coupling plate 24 with respect to the rod 22 is shifted upwards by shifting the feeder tip position adjusting elongated hole 24a upwards with respect to the screw 40, the yarn feeder portion 23 also moves upwards while being guided by the feeder rod guide 30.

[0057] More specifically, the yarn feeder portion 23 is raised from the position illustrated in FIG. 5 to the position illustrated in FIG. 6, for example, while the feeder tip side guide runner 23b is guided along the feeder tip side guiding grooves 31a of the feeder tip side guide 31, and while the carrier base side guide runner 23c of the yarn feeder portion 23 is guided along the carrier base side guiding groove 32a of the carrier base side guide 32. When the

feeder tip side guide runner 23b is guided along the feeder tip side guiding grooves 31a on the feeder tip side guide 31, the feeder tip side guide runner 23b follows a trajectory in parallel with the trajectory of the rod 22 actuated by the up-down actuating mechanism 140. By contrast, the carrier base side guiding groove 32a of the carrier base side guide 32 is configured in such a manner that the carrier base side guide runner 23c is guided in a direction inclined with respect to the longitudinal direction of the rod 22, being inclined toward the side on which the upper end of the carrier base side guiding groove 32a moves away from the needle bed gap S in the front-back direction. Therefore, as the yarn feeder portion 23 is moved upwards, the inclination of the yarn feeder portion 23 changes in the direction becoming closer to the horizontal direction.

[0058] When the inclination of the yarn feeder portion 23 changes in a direction becoming closer to the horizontal direction, the feeder tip 23a moves substantially in the vertical direction, without becoming displaced to the side of the rear needle bed 110 in the front-back direction. In this manner, the feeder tip 23a can be raised while suppressing the displacement of the feeder tip 23a in the front-back direction, with respect to the center plane P between the front and rear needle beds 110. The center plane P herein is a vertical plane passing through the center between the front and rear needle beds 110 in the front-back direction. In the same manner, the feeder tip 23a can be lowered from the position illustrated in FIG. 5 to the position illustrated in FIGS. 4A and 4B, for example, while suppressing the displacement of the feeder tip 23a in the front-back direction, with respect to the center plane P between the front and rear needle beds 110.

[0059] In the manner described above, it is possible to suppress the displacement of the feeder tip 23a from the center plane P between the front and rear needle beds 110, when the feeder tip 23a is moved up or down. Therefore, it is possible to suppress a movement of the feeder tip 23a in a direction separating from the region where the feeder tip can feed yarn to the target position that is on the side of the needle bed gap S, when the feeder tip 23a is moved up or down.

[0060] A flat knitting machine 100 according to a second embodiment of the disclosure will be described below with reference to FIGS. 7 and 8. The same components as those of the first embodiment are denoted by the same reference numerals, and descriptions thereof will be omitted.

[0061] The flat knitting machine 100 according to the second embodiment is different from the flat knitting machine 100 according to the first embodiment in that the feeder rod guide 30 includes a carrier base side guide 33, instead of the carrier base side guide 32.

[0062] In the same manner as the carrier base side guide 32, a lower part of the carrier base side guide 33 extends in a direction becoming closer to the horizontal direction than the guide direction in which the rod 22 is guided by the raising bias unit guiding groove 11. An upper part of the carrier base side guide 33 is bent in a manner extending in a direction becoming nearer to the vertical direction than the direction in which the lower part of the carrier base side guide 33 extends, at a position at which the height of the feeder tip 23a is brought above the yarn feedable range. The carrier base side guide 33 has a carrier base side guiding groove 33a having a shape corresponding to the carrier base side guide 33. The carrier base side guide runner 23c is housed in the carrier base side guiding grooves 33a.

[0063] When the rod 22 is raised by the up-down actuating mechanism 140, or when the feeder tip position adjusting elongated hole 24a is shifted upwards with respect to the screw 40, the yarn feeder portion 23 rises from the position illustrated in FIG. 7 to the position illustrated in FIG. 8, for example, while the feeder tip side guide runner 23b is guided along the feeder tip side guiding groove 31a of the feeder tip side guide 31, and the carrier base side guide runner 23c of the yarn feeder portion 23 is guided along the carrier base side guiding groove 33a of the carrier base side guide 33. With the carrier base side guides 33, the feeder tip 23a moves vertically within the yarn feedable range. By contrast, when the feeder tip 23a is raised while the feeder tip 23a is above the yarn feedable range, more specifically, when the carrier base side guide runner 23c is at a position higher than the bent part of the carrier base side guide 33, the feeder tip 23a moves in a direction separating from the needle bed gap S in the front-back direction. Therefore, collisions between the yarn feeder portions 23 can be further suppressed.

[0064] A flat knitting machine 100 according to a third embodiment of the disclosure will be described below with reference to FIGS. 9 and 10. The same components as those of the first embodiment are denoted by the same reference numerals, and descriptions thereof will be omitted.

[0065] The flat knitting machine 100 according to the third embodiment is different from the flat knitting machine 100 according to the first embodiment in that the feeder rod 20 includes an elastically deforming portion 24A, instead of the coupling plate 24; the yarn feeder portion 23 has a protrusion 23e; and the feeder rod guide 30 has an elongated guide hole 34, instead of the feeder tip side guide 31 and the carrier base side guide 32.

[0066] The elastically deforming portion 24A that is elastically deformable is provided between the rod 22 and the yarn feeder portion 23. The rod 22, the yarn feeder portion 23, and the elastically deforming portion 24A are integrally formed. A protrusion 23e protruding in the left-right direction is formed on an upper part of the yarn feeder portion 23.

[0067] The elongated guide hole 34 of the feeder rod guide 30 extends in a direction closer to the vertical direction than the guide direction in which the rod 22 is guided by the raising bias unit guiding groove 11. The protrusion 23e is inserted into the elongated guide hole 34.

[0068] When the rod 22 is raised by the up-down actuating mechanism 140, the protrusion 23e moves from the bottom end of the elongated guide hole 34 to the upper end thereof, by being guided along the elongated guide hole 34. With this, the yarn feeder portion 23 is raised from the position illustrated in FIG. 9 to the position illustrated in FIG. 10, for example. By guiding the protrusion 23e along the elongated guide hole 34, and with the elastic force of the elastically deforming portion 24A, the inclination of the yarn feeder portion 23 is changed in a direction closer to the horizontal direction, as the yarn feeder portion 23 is moved upwards. Within the yarn feedable range, the feeder tip 23a moves in a vertical direction, as the protrusion 23e is guided along the elongated guide hole 34.

[0069] Because there is no coupling plate 24 in the third embodiment, the feeder tip position adjusting elongated hole 24a is provided to a member provided between the upper part and the lower part of the rod 22. The height of the feeder tip 23a can be adjusted by adjusting the height of the lower part of the rod 22 with respect to the height of the upper part of the rod 22.

[0070] As described above, in each of the embodiments, it is possible to move the feeder tip 23a up or down while suppressing the displacement of the feeder tip 23a from the center plane P between the front and rear needle beds 110, in the front-back direction. The center plane P herein is a vertical plane passing through the center between the front and rear needle beds 110 in the front-back direction. It is therefore possible to suppress the movement of the feeder tip 23a in a direction separating from the region where the feeder tip can feed yarn to the target position that is on the side of the needle bed gap S, as the feeder tip 23a is moved up or down.

[0071] Although each of the embodiments of the disclosure has been described above, the disclosure is not limited to the embodiments described above, and appropriate modifications may be made within the scope of the technical idea of the invention described in the claims.

[0072] For example, the converting means including the feeder tip side guide 31, the feeder tip side guide runner 23b, the carrier base side guide 32, and the carrier base side guide runner 23c are applicable, regardless of how the yarn passage rails 130 are disposed. The yarn passage rails 130 are not limited to those arranged radially with respect to the center between the front and rear needle beds 110 in side view, and may also be those arranged horizontally, as described in FIGS. 4(b) and 4(c) of EP 3115491 Al, for example. In the case where the yarn passage rails 130 are provided in this manner, while the feeder rods 20 move up or down in the vertical directions, each of the feeder rods 20 has a bent portion bent toward the needle bed gap S so that the yarn feeder portion 23 of each feeder rod 20 can feed the yarn thereto. The converting means including the feeder tip side guide 31, the feeder tip side guide runner 23b, the carrier base side guide 32, and the carrier base side guide runner 23c is also applicable to the case where the feeder tip height adjusting means, such as the feeder tip position adjusting elongated hole 24a, is provided to a portion lower than the bent portion. In this case, the yarn feeder portion 23 is advanced or evacuated along this portion below the bent portion, following the guiding means.

[0073] Furthermore, the direction in which the feeder tip 23a is moved by the converting means including the feeder tip side guide 31, the feeder tip side guide runner 23b, the carrier base side guide 32, and the carrier base side guide runner 23c does not need to be exactly the vertical direction, and the direction may be a direction closer to the vertical direction than the guide direction in which the rod 22 is guided by the raising bias unit guiding groove 11.

[0074] In addition, the up-down actuating mechanism 140 is not limited to the one that uses the cam plate 141 to move the feeder rod 20 up or down, and may be one that uses an actuating lever to move the feeder rod 20 up or down, or one that uses a rack and pinion to move the feeder rod 20 up or down, as described in JP 2012 -524842 W, for example.

[0075] The feeder tip height adjusting means for adjusting the height of the feeder tip 23a at the time of feeding yarn has been described to adjust the height of the feeder tip 23a at the time of feeding yarn by changing the position where the screw 40 is fastened, in the longitudinal direction of the feeder tip position adjusting elongated hole 24a. However, the feeder tip height adjusting means may also use a motor to adjust the height of the cam plate 141, as disclosed in CN 210711959 U, for example, to adjust the yarn-feeding height of the feeder tip 23a.

[0076] The flat knitting machine 100 is not necessarily required to be provided with the up-down actuating mechanism 140 for moving the feeder rod 20 up or down. In such a configuration, the yarn feeder portion 23 is not necessarily required to be connected to the rod 22, and the yarn feeder portion 23 may be connected to the feeder rod guide 30.

[0077] In the first embodiment, the feeder rod 20 is provided with the runners (the feeder tip side guide runner 23b and the carrier base side guide runner 23c), and the feeder rod guide 30 is provided with the guiding grooves (the feeder tip side guiding groove 31a and the carrier base side guiding groove 33a). However, it is also possible for the feeder rod guide 30 to be provided with the runners, and the feeder rod 20 may be provided with the guiding grooves. In such a configuration, the guiding grooves may be provided on the side surfaces of the yarn feeder portion 23.

Reference Signs List

[0078]

1	yarn feeder
10	carrier base
20	feeder rod

22	rod
23	yarn feeder portion
23a	feeder tip
23b	feeder tip side guide runner
23c	carrier base side guide runner
24	coupler
24a	feeder tip position adjusting elongated hole
30	feeder rod guide
31	feeder tip side guide
32, 33	carrier base side guide
34	elongated guide hole
40	screw
100	flat knitting machine
110	needle bed
111	knitting needle
130	yarn passage rail

Claims

1. A flat knitting machine (100), comprising:

at least two needle beds (110) that face each other with a needle bed gap (S) therebetween, and each of which has knitting needles (111) arranged side by side in a longitudinal direction;
a yarn passage rail (130) that is installed above the needle beds (110);
a carrier base (10) that is provided movably along the yarn passage rail (130);
a yarn feeder (1) that is provided as a part of a path for feeding knitting yarn to the knitting needles (111), the yarn feeder (1) including the carrier base (10) and a feeder tip (23a) for feeding the knitting yarn to the knitting needles (111); and
feeder tip height adjusting means (24a, 40) for adjusting a yarn-feeding height of the feeder tip (23a), the flat knitting machine (100) being **characterized in that**:

the yarn feeder (1) includes:

a feeder rod (20) to which the feeder tip (23a) is provided;
converting means (23b, 23c, 31, 32, 33, 34) for converting a direction in which the feeder tip (23a) is moved;
a feeder rod guide (30) that is supported by the carrier base (10) and that supports the converting means (23b, 23c, 31, 32, 33, 34); and
guiding means (11) for guiding the feeder rod (20) in a guide direction that is inclined with respect to a vertical direction,

the converting means (23b, 23c, 31, 32, 33, 34) is included in the feeder rod (20) and the feeder rod guide (30), and converts the direction in which the feeder tip (23a) is moved, to a direction bringing the feeder tip (23a) closer to the vertical direction than the guide direction, in response to a change in a height of the feeder tip (23a), at least within a height range where the feeder tip (23a) is allowed to feed the yarn to a position at which the yarn is taken hold of.

2. The flat knitting machine (100) according to claim 1, **characterized in that**:

the feeder rod (20) is provided with a yarn feeder portion (23) that is provided with the feeder tip (23a), and
the converting means (23b, 23c, 31, 32, 33, 34) includes:

a feeder tip side guide runner (23b) provided to any one of the yarn feeder portion (23) or the feeder rod guide (30), on a side closer to the feeder tip (23a);
a carrier base side guide runner (23c) provided to any one of the yarn feeder portion (23) or the feeder rod guide (30), on a side closer to the carrier base (10);
a feeder tip side guide (31) provided to the other one of the yarn feeder portion (23) and the feeder rod guide (30), on the side closer to the feeder tip (23a), and adapted to guide the feeder tip side guide runner (23b) along a trajectory in parallel with the guide direction; and
a carrier base side guide (32, 33) provided to the other one of the yarn feeder portion (23) and the feeder rod guide (30), on the side closer to the carrier base (10), and adapted to guide the carrier base side guide runner (23c) in a direction inclined with respect to the guide direction, being inclined toward a side on which an upper end of the yarn feeder portion (23) moves away from the needle bed gap (S) in a front-back direction.

3. The flat knitting machine (100) according to claim 1, **characterized in that** the feeder rod (20) includes:

a rod (22) that is guided in the guide direction by the guiding means (11), and that is moved up and down by being actuated by an up-down actuating mechanism (140); and
a yarn feeder portion (23) that is connected to the rod (22) and that is provided with the feeder tip (23a).

4. The flat knitting machine (100) according to claim 3, **characterized in that** the yarn feeder portion (23) is a member separate from the rod (22), and the feeder tip (23a) is connected to the rod (22) in a manner movable in a direction different from the guide direction of the feeder rod (20), and in a direction in which the position of the feeder tip (23a) with respect to the rod (22) changes in the front-back direction.

5. The flat knitting machine (100) according to claim 3 or 4, **characterized in that**

the feeder rod (20) includes a coupler (24) disposed between the rod (22) and the yarn feeder portion (23), and coupling the rod (22) and the yarn feeder portion (23), and
the coupler (24) is fixed and connected to the rod (22) at a position below the yarn passage rail (130) in such a manner that the feeder tip height adjusting means (24a, 40) can adjust an up-down position with respect to the rod (22).

6. The flat knitting machine (100) according to claim 3 or 4, **characterized in that**

the guiding means (11) is provided to the carrier base (10), and
the yarn passage rail (130) is provided radially with respect to the center between the needle beds (110) that are on a front side and a back side in a side view.

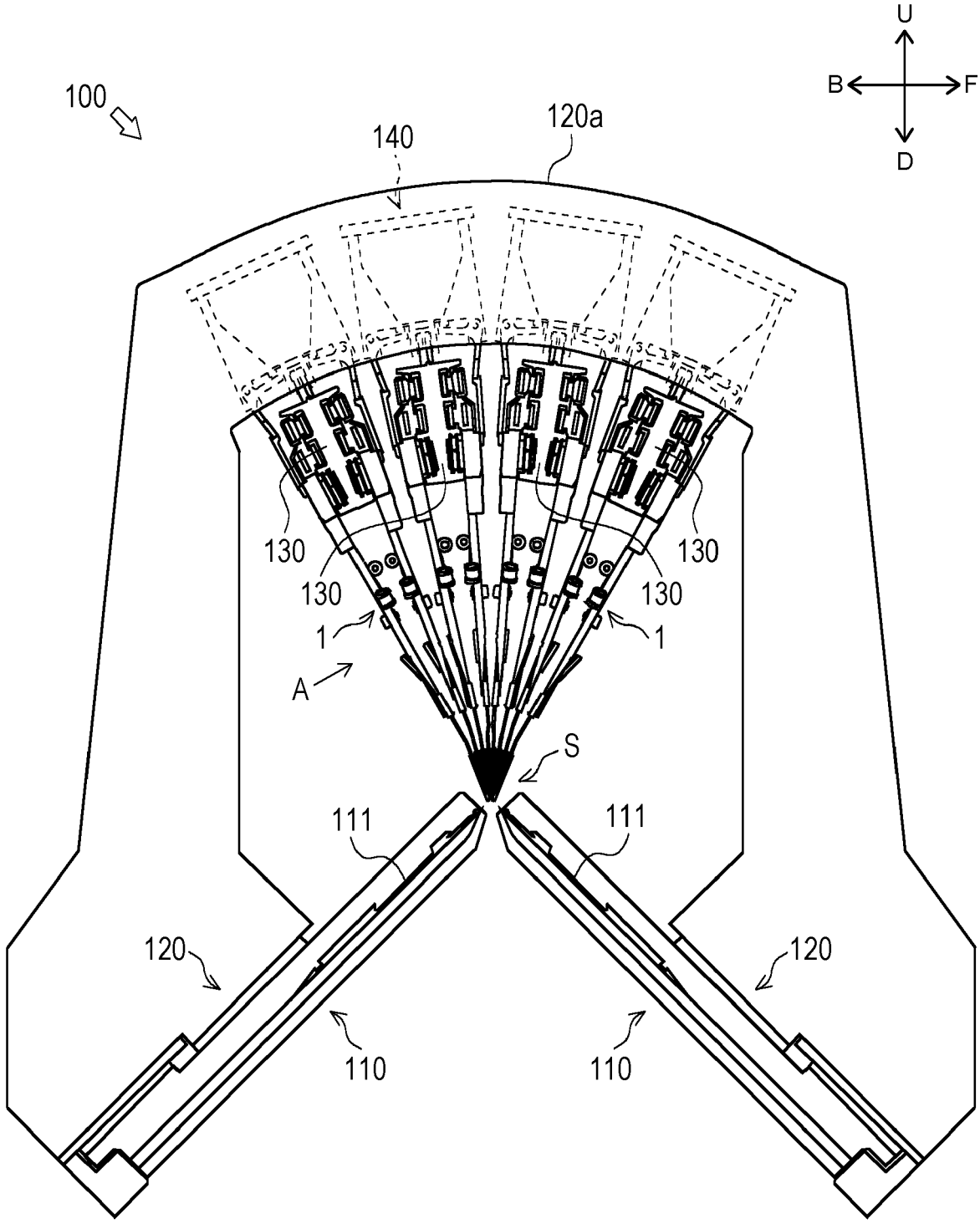
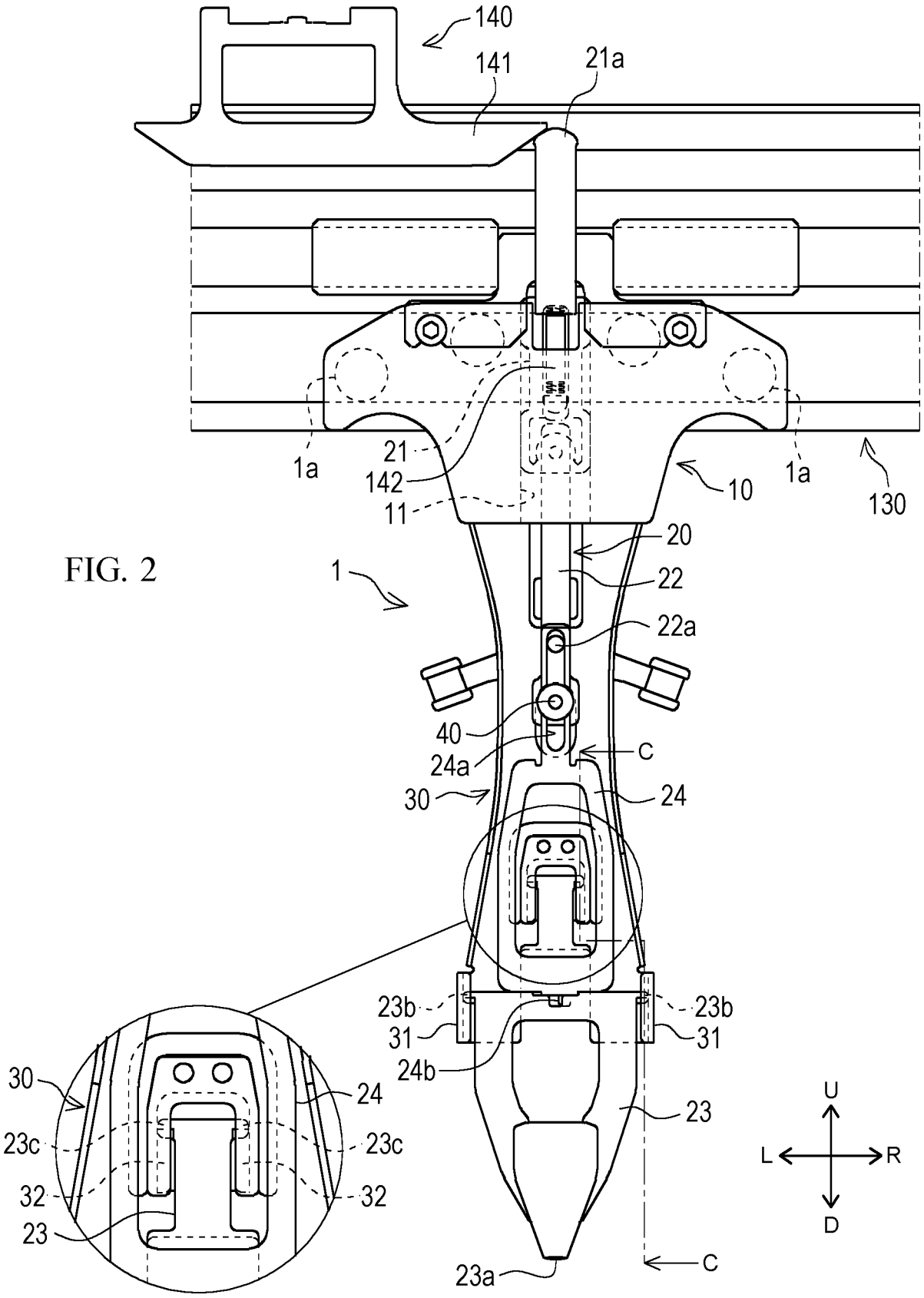


FIG. 1

FIG. 2


140
141
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1a
21
142
11
10
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130
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22a
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C
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23b
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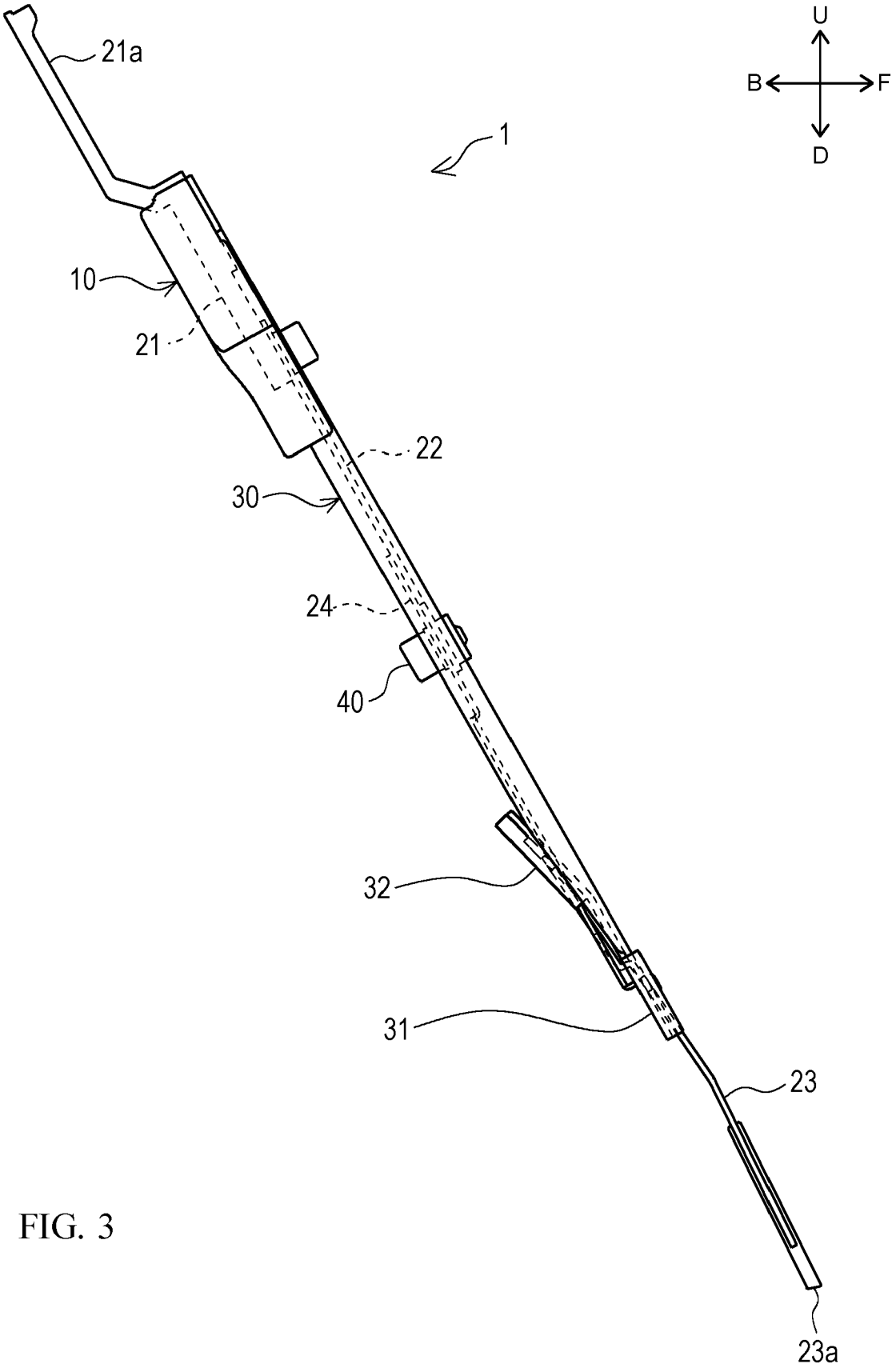


FIG. 3

FIG. 4A

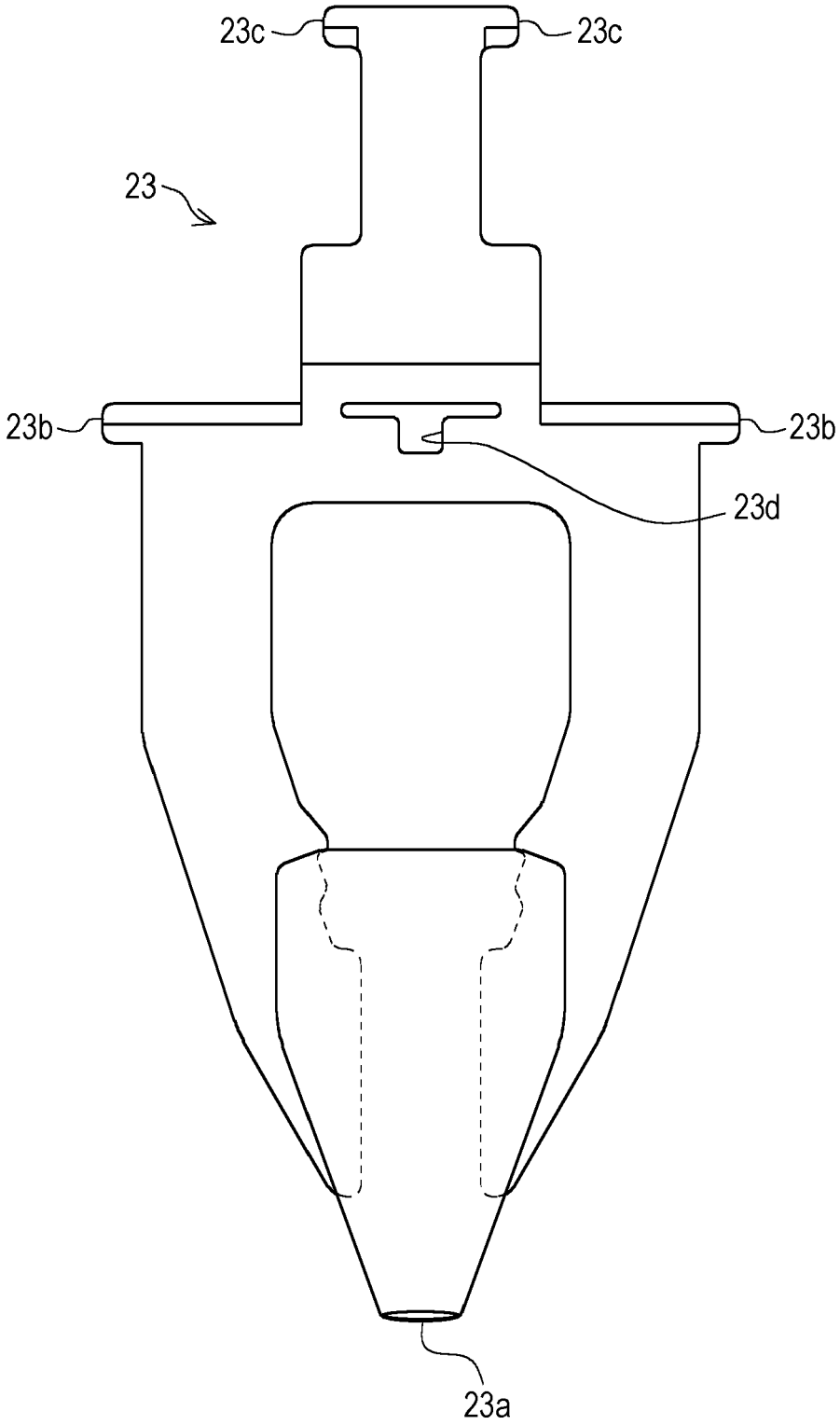
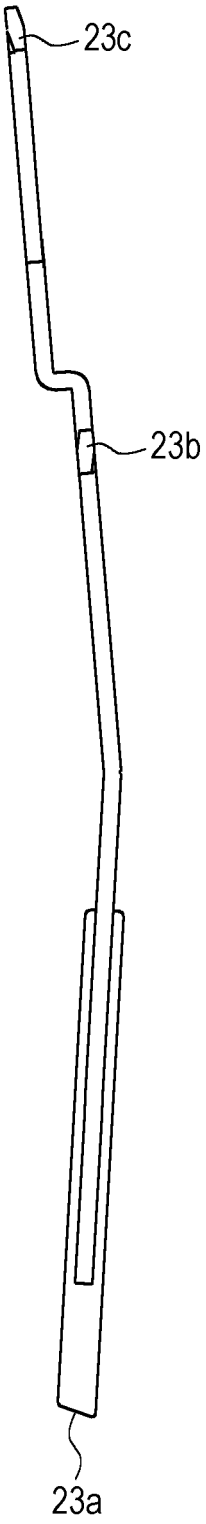


FIG. 4B



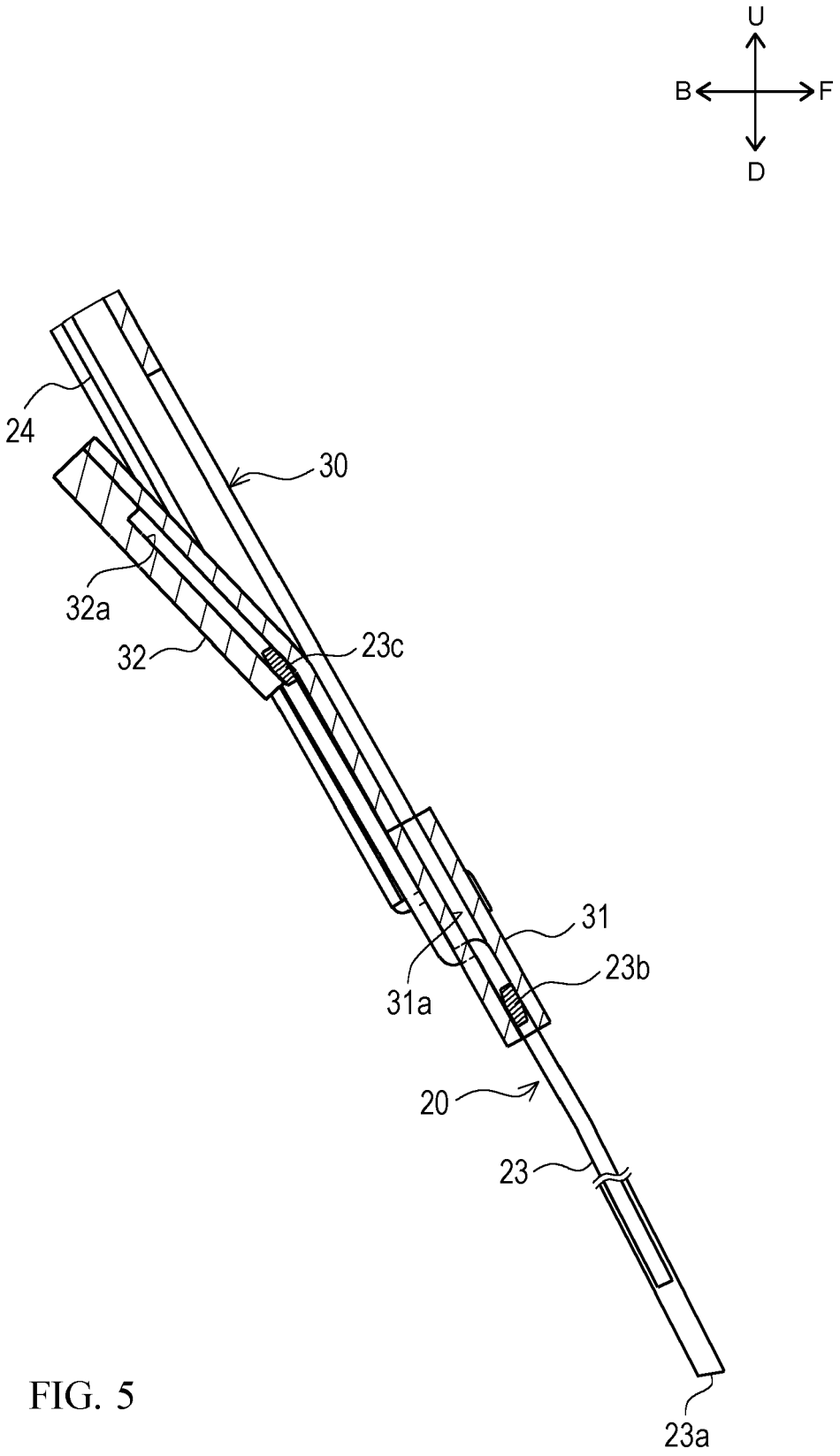


FIG. 5

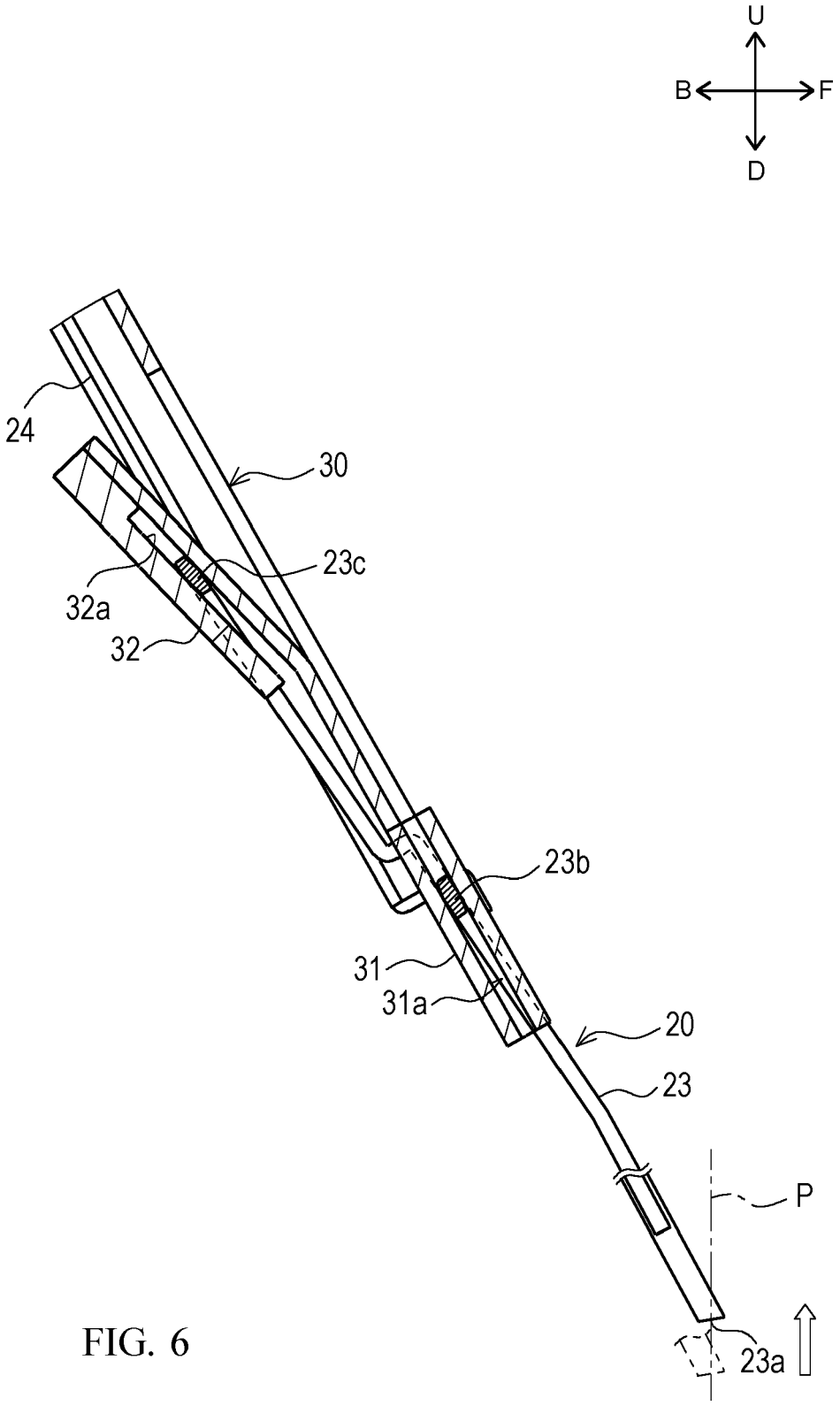


FIG. 6

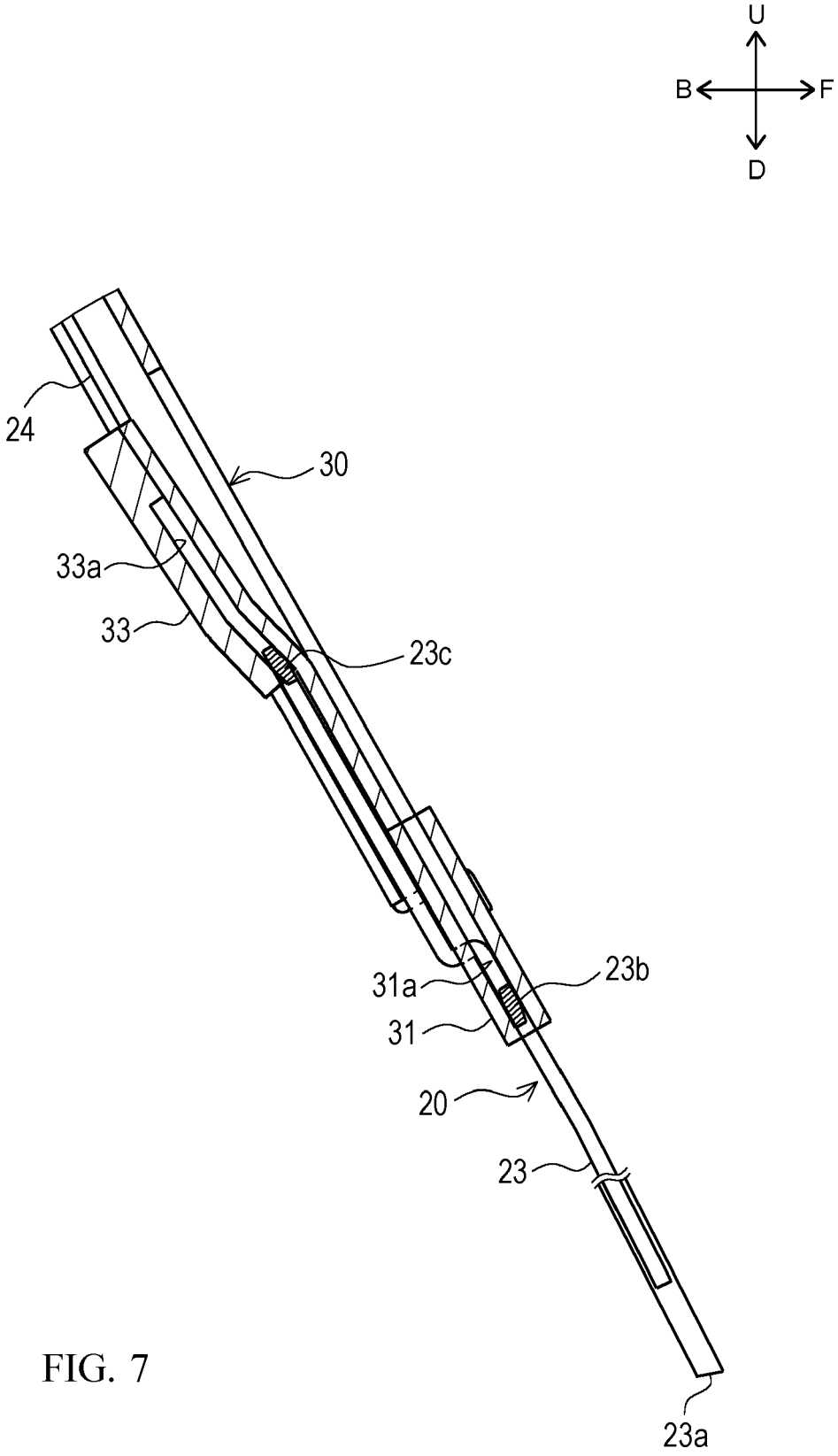


FIG. 7

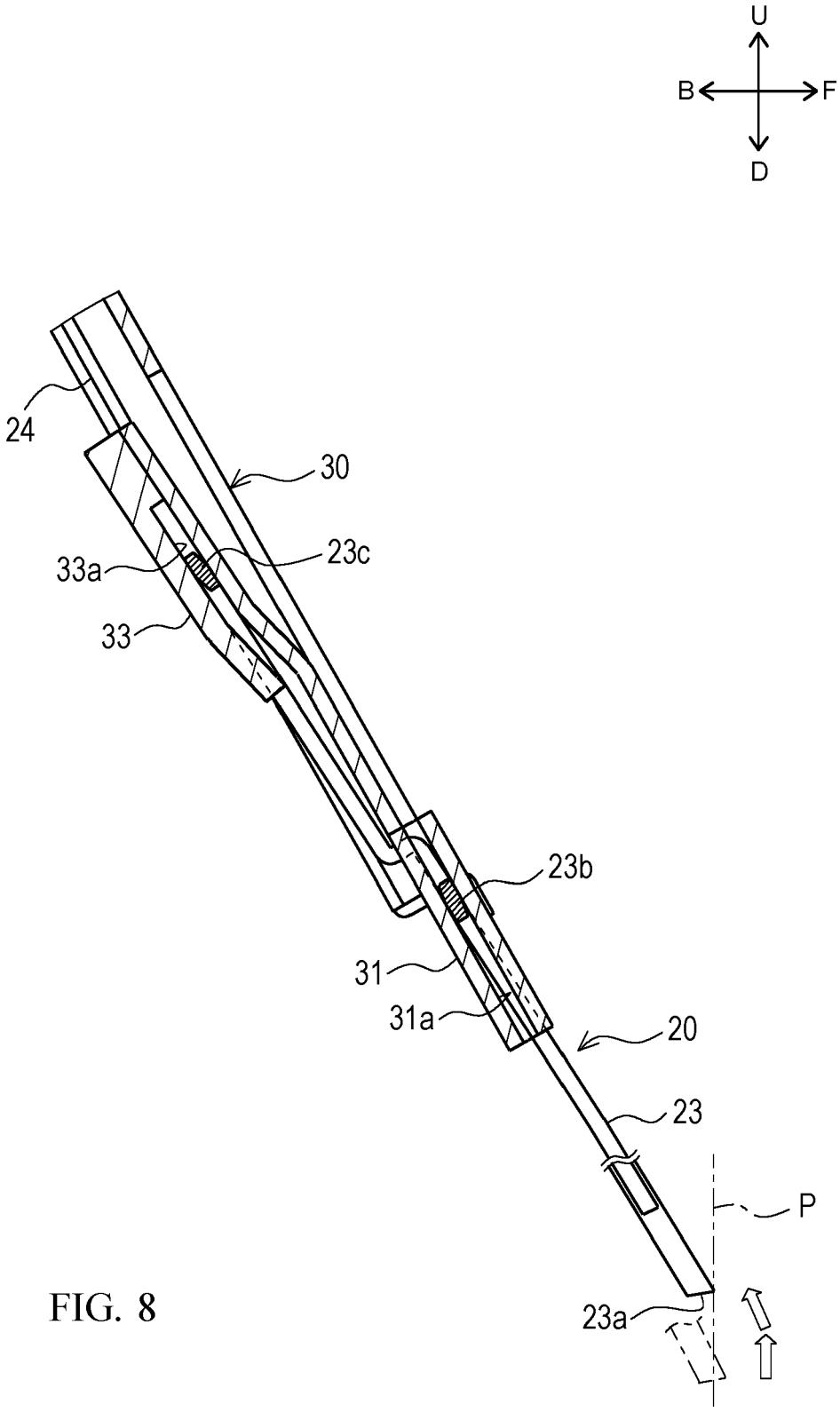


FIG. 8

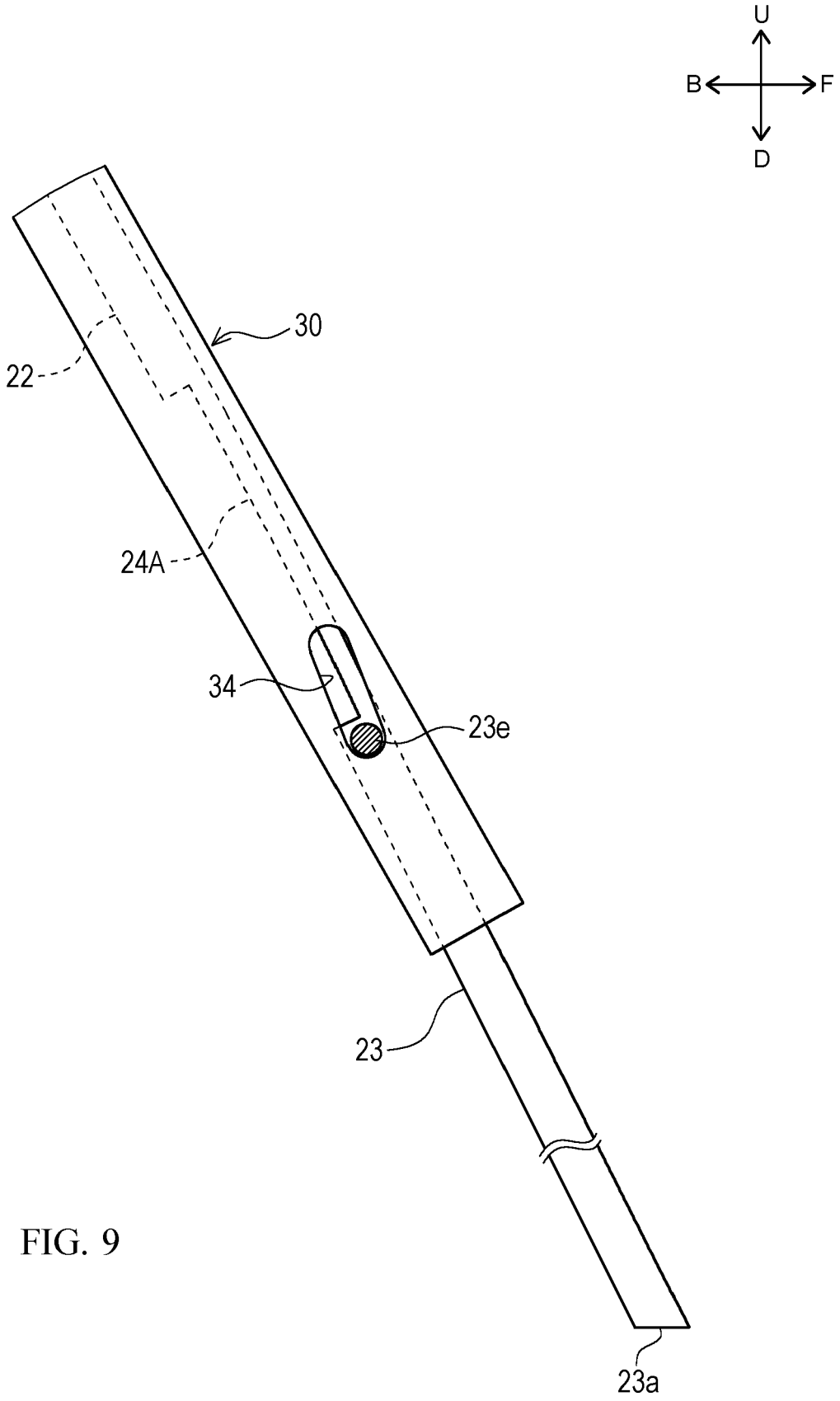


FIG. 9

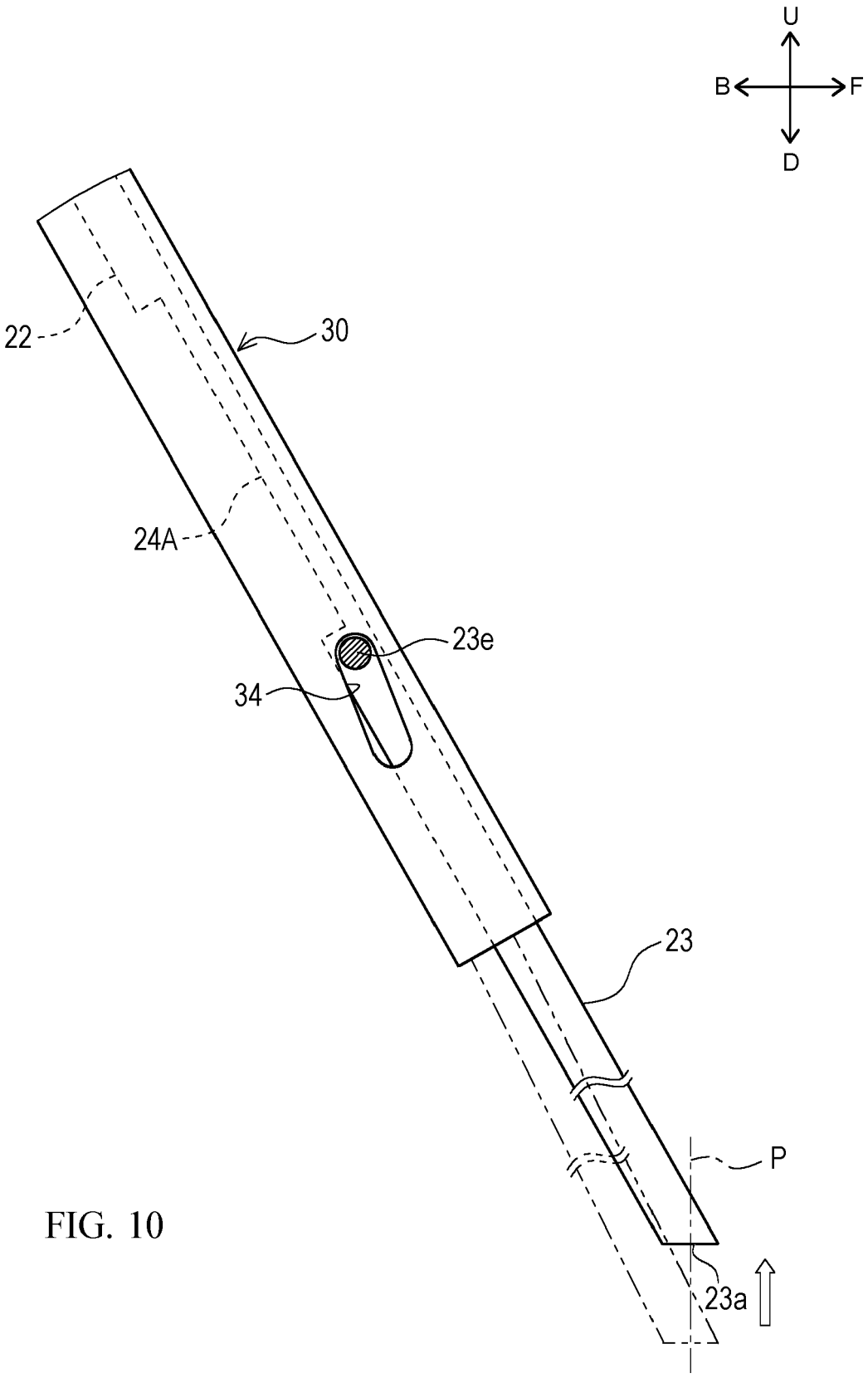


FIG. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 24 17 1573

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	16 May 2024	Wendl, Helen

CATEGORY OF CITED DOCUMENTS

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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