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(54) **KNOTTER DEVICE**

(57) There is provided a knotter device capable of tying a sheet bend knot stably.

A yarn joining unit 20 includes a yarn guide 23 configured to guide an old yarn 2b in a direction different from the direction in which the old yarn 2b extends; a knitting needle 21 configured to hook the old yarn 2b and to twist the old yarn 2b to form a twisted stitch 4, to hook another part of the old yarn 2b guided by the yarn guide 23, to form a stitch 5 by passing the other part through the twisted stitch 4 to one side, and to pass the new yarn 2a guided by the yarn guide lever 14 through the stitch 5; a hook 22 around which the old yarn 2b is wound when the knitting needle 21 forms the stitch 5 and that is operable to unwind the old yarn, and a tensioner 27 and a yarn guide lever 14 configured to increase the tension of the old yarn 2b so that the stitch 5 having the new yarn 2a passed is passed through the twisted stitch 4, to the other side.

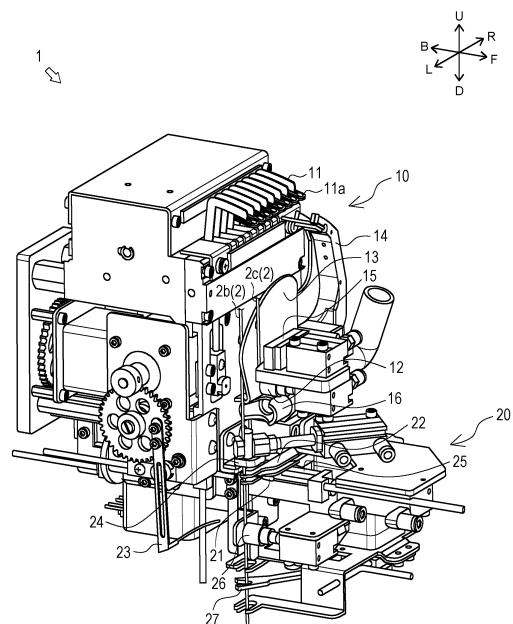


Fig. 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to a technique for a knotter device including a yarn selecting unit and a yarn joining unit.

BACKGROUND ART

[0002] Conventionally, techniques related to a knotter device including a yarn selecting unit and a yarn joining unit have been publicly known. By using a knotter device, the yarn currently being used can be switched to another yarn having a different color, for example.

[0003] Patent Literature 1 discloses a yarn knotting device configured to tie a terminating end resultant of cutting a first yarn for which an operation has been completed, and a starting end of a second yarn for the next operation. The yarn knotting device mentioned above forms a stitch by rotating a knitting needle, with the action of the latch, without using a yarn guide in the process of forming a stitch with respect to a twisted stitch, and therefore, there has been a problem in terms of stability in forming the stitch.

CITATION LIST

PATENT LITERATURE

[0004] Patent Literature 1: JP 2002-35460 A

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0005] The present invention has been made in view of the circumstance described above, and an object of the present invention is to provide a knotter device capable of tying a sheet bend knot stably.

SOLUTION TO PROBLEM

[0006] The problem to be addressed by the disclosure has been mentioned above, and solutions to the problem will now be explained.

[0007] That is, a knotter device according to the present invention is a knotter device including a yarn selecting unit and a yarn joining unit, in which the yarn selecting unit includes a guide lever configured to guide a new yarn fed from a yarn source to the yarn joining unit, and the yarn joining unit includes: a guide configured to guide an old yarn in a direction different from a direction in which the old yarn stretches; a knitting needle configured to hook and to twist the old yarn to form a twisted stitch, to hook another part of the old yarn guided by the guide, to form a stitch by passing the other part through the twisted stitch to one side, and to pass the new yarn guided by the

guide lever through the stitch; a hook around which the old yarn is wound when the knitting needle forms the stitch and that is operable to unwind the old yarn; and a tension applying unit configured to increase tension of the old yarn so as to pass the stitch having the new yarn passed therethrough to another side.

[0008] With such a configuration, the sheet bend knot can be tied stably.

[0009] A relative timing of unwinding the old yarn around the hook and increasing the tension of the old yarn by the tension applying section can be set to any timing.

[0010] With such a configuration, it is possible to suppress breakage and knotting failures of yarns.

[0011] The hook may be enabled to change the timing of unwinding the old yarn.

[0012] With such a configuration, yarns can be knotted more appropriately, in a manner suitable for the yarn.

[0013] Furthermore, the hook includes a pair of hook-shaped members on which the old yarn is placeable, and the knitting needle is enabled to advance into and to retract from a space between the pair of hook-shaped members, and is enabled to be rotated about an axis.

[0014] With such a configuration, a twisted stitch and a stitch following the twisted stitch can be formed stably.

[0015] Furthermore, the guide is configured to guide a downstream part of the old yarn, the downstream part being downstream of the hook, to a position facing the knitting needle across the hook.

[0016] With such a configuration, the process for forming a stitch following a twisted stitch can be performed more stably.

[0017] The knotter device further includes: a holder configured to hold the old yarn at a position upstream of the stitch, after the new yarn is passed through the stitch; and a cutter configured to cut an unnecessary part of the new yarn and the old yarn while the old yarn is being held by the holder, and the tension applying unit is configured to increase a tension of the old yarn after the old yarn is cut by the cutter.

[0018] With such a configuration, the old yarn and the new yarn can be knotted efficiently.

[0019] The tension applying unit includes the guide.

[0020] With such a configuration, the guide plays a plurality of roles, so that a simple configuration can be achieved.

[0021] The knitting needle is configured to form a multi-twisted stitch.

[0022] With such a configuration, loosening of the yarn knot can be suppressed.

ADVANTAGEOUS EFFECTS OF INVENTION

[0023] As an advantageous effect of the present invention, the sheet bend knot can be tied stably.

BRIEF DESCRIPTION OF DRAWINGS

[0024]

Fig. 1 is an upper left perspective view showing a knotter device according to a first embodiment of the present invention.

Fig. 2(a) is a schematic front view showing the knotter device, and Fig. 2(b) is a schematic left side view showing a configuration after the knotter device has selected a yarn to join.

Fig. 3(a) is a schematic front view showing a configuration in which a yarn guide lever having hooked the selected yarn is guiding the selected yarn rearwards, and Fig. 3(b) is a schematic front view showing a configuration in which the yarn guide lever having hooked a yarn currently in use is guiding the yarn currently in use to the front side of the separator.

Fig. 4 is a left front perspective view showing a yarn joining unit.

Fig. 5(a) is a schematic cross-sectional plan view showing a knitting needle, a hook, and a yarn guide included in the yarn joining unit, and Fig. 5(b) is a schematic left side view showing the knitting needle, the hook, and the yarn guide included in the yarn joining unit.

Fig. 6 is a block diagram showing a configuration of the knotter device.

Fig. 7 is a flowchart showing a process of joining yarns.

Fig. 8(a) is a schematic cross-sectional plan view showing a configuration after the hook has hooked the old yarn, and Fig. 8(b) is a schematic cross-sectional plan view showing a configuration after the old yarn wound around the hook is unwound.

Fig. 9(a) is a schematic cross-sectional left side view showing a configuration after the hook has hooked the old yarn, and Fig. 9(b) is a schematic cross-sectional left side view showing a configuration after the yarn guide has formed a buffer on the old yarn.

Fig. 9(c) is a schematic left sectional view showing a configuration after the knitting needle has gone into the space between an upper hook and a lower hook.

Fig. 10(a) is a schematic cross-sectional left side view showing a configuration after the knitting needle has retracted from the space between the upper hook and the lower hook to drag the old yarn rearwards, Fig. 10(b) is a schematic cross-sectional left side view showing a configuration after a twisted stitch has been formed with the old yarn, and Fig. 10(c) schematic cross-sectional left side view showing a configuration after the knitting needle has hooked a part of the buffer formed on the old yarn.

Fig. 11(a) is a schematic cross-sectional left side view showing a configuration after a stitch is formed with the old yarn, and Fig. 11(b) is a schematic left sectional view showing a configuration in which the old yarn is wound around a hook portion of the lower

hook.

Fig. 12(a) is a schematic cross-sectional left side view showing a configuration after the new yarn has been dragged to the front side of the hook, and Fig. 12(b) is a schematic left sectional view showing a configuration after the new yarn is pulled into the stitch.

Fig. 13(a) is a schematic cross-sectional left side view showing a configuration after the new yarn and the old yarn are cut by a cutter, and Fig. 13(b) is a schematic left sectional view showing a configuration in which the new yarn has come off from the knitting needle.

Fig. 14(a) is a schematic cross-sectional left side view showing a configuration after the new yarn has been pulled out to the front side of the twisted stitch. Fig. 14(b) is a schematic cross-sectional left side view showing a configuration after the old yarn and the new yarn have been joined.

Fig. 15(a) is a schematic cross-sectional left side view showing a configuration after a twisted stitch has been formed with the old yarn, Fig. 15(b) is a schematic left sectional view showing a configuration in which the knitting needle has entered the space between the upper hook and the lower hook, and Fig. 15(c) is a schematic left sectional view showing a configuration after the knitting needle has been half-rotated within the space between the upper hook and the lower hook.

Fig. 16(a) is a schematic cross-sectional left side view showing a configuration after the knitting needle has moved forwards. Fig. 16(b) is a schematic cross-sectional left side view showing a configuration in which the old yarn is hooked onto the knitting needle while the knitting needle is being rotated. Fig. 16(c) is a schematic left side sectional view showing a configuration after a double twisted stitch has been formed.

DESCRIPTION OF EMBODIMENT

[0025] In the following description, directions indicated by the arrows U, D, F, B, L, and R in the drawings are defined as an upward direction, a downward direction, a frontward direction, a rearward direction, a leftward direction, and a rightward direction, respectively. In the drawings, some components are omitted as appropriate, for the simplicity of the drawing.

[0026] The knotter device 1 is configured to tie a yarn 2 currently being used in a knitting machine, with a new yarn 2 wound on a yarn cone that is a yarn source, into a sheet bend knot. The knotter device 1 is disposed between the yarn source and the knitting machine. More specifically, the yarn source is disposed above the knotter device 1, and the knitting machine is disposed below the knotter device 1. The yarn 2 is fed downwards to the knotter device 1 from above. Hereinafter, the upstream in the direction in which the yarn is fed will be referred to as

"upstream", and the downstream in the direction in which the yarn is fed will be referred to as "downstream". The knitter device 1 includes a yarn selecting unit 10, a yarn joining unit 20, and a controller 30.

[0027] The yarn selecting unit 10 shown in Figs. 1, 2(a), 6, and the like is configured to guide the yarn 2 selected from a plurality of yarns 2 fed from the yarn sources, to the yarn joining unit 20. The yarn selecting unit 10 mainly includes yarn selecting plates 11, a yarn holder 12, a separator 13, a yarn guide lever 14, a first yarn pressor 15, and a suction 16.

[0028] The yarn selecting plates 11 are enabled to select one yarn 2 from a plurality of yarns 2 fed from the yarn source. The yarn selecting plate 11 can select two or more yarns 2 from the plurality of yarns 2 fed from the yarn sources at the same time. Hereinafter, the yarn 2 selected by the yarn selecting plate 11 will be referred to as "new yarn 2a". The yarn 2 currently being used in the knitting machine will be referred to as "old yarn 2b", and the yarn 2 other than the old yarn 2b and the new yarn 2a will be referred to as a "standby yarn 2c". The yarn selecting plate 11 is disposed in plurality, with their plate surfaces facing in the left-right directions. The plurality of yarn selecting plates 11 are disposed side by side in the left-right direction. The yarn selecting plate 11 is provided rockably in the front-back direction, by solenoids that are provided respectively. The yarn 2 is inserted into a ring 11a provided at a distal end of the yarn selecting plate 11.

[0029] The yarn holder 12 is provided downstream of the yarn selecting plate 11. The yarn holder 12 is displaceable between a holding position for holding the yarn 2, and a retracted position not holding the yarn 2. The yarn holder 12 is configured displaceable by air pressure, for example. The yarn holder 12 at the holding position can hold proximity of the tip ends of the plurality of respective yarns 2 at the same time. More specifically, the yarn holder 12 can hold a plurality of yarns 2 at the same time, but not the old yarn 2b.

[0030] The separator 13 is disposed between the yarn selecting plates 11 and the yarn holder 12 in the yarn-feeding direction. The separator 13 has a plate-like shape, with its plate surfaces facing the front-rear directions. The separator 13 is capable of separating the old yarn 2b from the standby yarn 2c. Specifically, the old yarn 2b is guided behind the separator 13, downwards. The standby yarn 2 is passed through the ring 11a provided on the distal end of the yarn selecting plate 11, passed in front of the separator 13, and is held by the yarn holder 12.

[0031] The yarn guide lever 14 is enabled to guide the new yarn 2a selected by the yarn selecting plate 11, into the yarn joining unit 20. The yarn guide lever 14 is disposed rotatably about an axis extending in the front-back direction. The yarn guide lever 14 is driven by a motor, for example. As shown in Fig. 3(a), the yarn guide lever 14 can catch the new yarn 2a, on its distal end 14a, while swinging. A side surface projection 14b is disposed in the middle of the yarn guide lever 14. As shown in Fig. 3(a),

the yarn guide lever 14 can catch the old yarn 2b, on the side surface projection 14b, while swinging.

[0032] The first yarn pressor 15 is disposed upstream of the yarn holder 12, on the front side of the separator 13.

The first yarn pressor 15 is displaceable between a pressing position for pressing the yarn 2 so as not to move, and a retracted position not pressing the yarn 2. The first yarn pressor 15 is configured displaceable by air pressure, for example. The first yarn pressor 15 at the pressing position can press proximity of the tip ends of the yarns other than the new yarn 2a, that is, the old yarn 2b and the standby yarn 2c.

[0033] The suction 16 is disposed downstream of the yarn holder 12. The suction 16 is enabled to suction and to hold the tip end of the yarn 2. The suction 16 is also enabled to remove the yarn waste generated in the yarn joining process, by suctioning.

[0034] When one yarn selecting plate 11 is selected by the yarn selecting unit 10 having the configuration described above, the selected yarn selecting plate 11 is swung and pulls the new yarn 2a, which is the yarn 2 passed through the ring 11a of the yarn selecting plate 11, rearwards, as shown in Fig. 2(b). From this positioning, the yarn guide lever 14 is swung in the counterclockwise direction in front view, and the new yarn 2a having been pulled rearwards becomes hooked onto the distal end of the yarn guide lever 14, and the old yarn 2b becomes hooked onto the side surface projection 14b, as shown in Fig. 3(a). As the yarn guide lever 14 is then further swung in the counterclockwise direction in front view, the new yarn 2a is guided behind the separator 13, and the old yarn 2b is guided in front of the separator 13, as shown in Fig. 3(b). In the manner described above, the yarn selecting unit 10 can select one new yarn 2a from a plurality of yarns 2 fed from the yarn source, and guide the selected new yarn 2a to the yarn joining unit 20.

[0035] The yarn joining unit 20 shown in Figs. 1, 4 to 6, and the like ties the new yarn 2a selected by the yarn selecting unit 10 and the old yarn 2b, into a sheet bend knot. The yarn joining unit 20 is disposed downstream of the yarn selecting unit 10. The yarn joining unit 20 mainly includes a knitting needle 21, a hook 22, a yarn guide 23, a cutter 24, a second yarn pressor 25, a third yarn pressor 26, and a tensioner 27.

[0036] The knitting needle 21 shown in Figs. 1, 4, and 5 is for forming a stitch in the process of joining the yarns. As the knitting needle 21, a latch needle is used, for example. The longitudinal direction of the knitting needle 21 aligned in the front-back direction. The knitting needle 21 is disposed movably in the front-back direction. The knitting needle 21 is provided rotatably about an axis extending in the front-back direction. As shown in Fig. 5(a), a hook portion 21a capable of hooking the old yarn 2b and the new yarn 2a is provided to the front end of the knitting needle 21. The hook portion 21a has a hook-like shape.

[0037] The hook 22 shown in Figs. 1, 4, and 5 linearly supports the old yarn 2b. When the knitting needle 21

forms a stitch, the old yarn 2b is wound around the hook 22. The hook 22 is disposed on the front side of the knitting needle 21. The hook 22 is provided movably in the left-right direction. The hook 22 includes a pair of hook-shaped members on which the old yarn 2b are placeable. Hereinafter, an upper hook-shaped member will be referred to as an upper hook 22a, and a lower hook-shaped member will be referred to as a lower hook 22b. The upper hook 22a and the lower hook 22b are disposed with a space therebetween in the up-down direction. The upper hook 22a is disposed above the knitting needle 21. The lower hook 22b is disposed below the knitting needle 21. Each of the upper hook 22a and the lower hook 22b has a main body 28 and a hook portion 29.

[0038] The longitudinal direction of the main body 28 is aligned in the left-right direction. The hook portion 29 is provided to a left end of the main body 28. The hook portion 29 has a hook-like shape bending rearwards and rightwards from the left end of the main body 28. The upper hook 22a and the lower hook 22b are enabled to hook the old yarn 2b onto their hook portions 29.

[0039] With such a configuration of the hook 22, the knitting needle 21 is enabled to advance into and to retract from the space between the upper hook 22a and the lower hook 22b, by moving back and forth.

[0040] The yarn guide 23 shown in Figs. 1, 4, and 5 is capable of guiding the old yarn 2b in a direction different from the direction in which the old yarn 2b extends. The yarn guide 23 has a substantially L shape. More specifically, the yarn guide 23 includes a first portion 23a having its longitudinal direction aligned in a substantially up-down direction, and a second portion 23b extending rightwards from the bottom end of the first portion 23a. A top end of the first portion 23a is fixed to a gear 23A that is rotatable about an axis extending in the left-right direction. The first portion 23a is positioned on the left side of the knitting needle 21 and the hook 22. The second portion 23b is provided in a manner extending further rightwards than the old yarn 2b. The yarn guide 23 can apply tension to the old yarn 2b by swinging.

[0041] The cutter 24 shown in Figs. 1 and 4 cuts unnecessary portions of the new yarn 2a and the old yarn 2b while the old yarn 2b is held by the second yarn pressor 25, which will be described later. The cutter 24 is disposed upstream of the hook 22, and is enabled to cut a part of the new yarn 2a and the old yarn 2b, upstream of a knot between the new yarn 2a and the old yarn 2b. The cutter 24 is displaceable between a cutting position for cutting the new yarn 2a and the old yarn 2b, and a retracted position not enabled to cut the old yarn 2b and the new yarn 2a.

[0042] The second yarn pressor 25 shown in Figs. 1 and 4 is configured to press the old yarn 2b. The second yarn pressor 25 is disposed downstream of the cutter 24. The second yarn pressor 25 is disposed upstream of the knitting needle 21 and the hook 22. The second yarn pressor 25 is displaceable between a pressing position

for pressing the yarn 2 so as not to move, and a retracted position not pressing the yarn 2. The second yarn pressor 25 is configured displaceable by air pressure, for example. The second yarn pressor 25 at the pressing position can press a part of the old yarn 2b, on the upstream of the knot. Figs. 1 and 4 show the cutter 24 as being positioned at the cutting position, and the second yarn pressor 25 as being positioned at the retracted position; however, in practice, when the second yarn pressor 25 is at the pressing position, the cutter 24 is positioned at the cutting position.

[0043] The third yarn pressor 26 shown in Figs. 1 and 4 is configured to press the old yarn 2b. The third yarn pressor 26 is disposed downstream of the second yarn pressor 25. The third yarn pressor 26 is disposed downstream of the knitting needle 21 and the hook 22. The third yarn pressor 26 is displaceable between a pressing position for pressing the yarn 2 so as not to move, and a retracted position not pressing the yarn 2. The third yarn pressor 26 is configured displaceable by air pressure, for example. The third yarn pressor 26 at the pressing position can press a part of the old yarn 2b, on the downstream side of the knot.

[0044] The tensioner 27 applies tension to the old yarn 2b. The tensioner 27 is provided displaceable between a biasing position for applying tension to the old yarn 2b, with the biasing force of a spring, and a retracted position not applying tension to the old yarn 2b.

[0045] The controller 30 shown in Fig. 6 is configured to control the operations of the yarn selecting unit 10 and the yarn joining unit 20. The controller 30 includes a storage unit such as a RAM, a ROM, and an HDD, and an arithmetic processing unit such as a CPU. The controller 30 can control the timing of the operations of the members included in the yarn selecting unit 10 and the yarn joining unit 20, as appropriate. The controller 30 can cause the members to move in cooperation with the knitting machine, and to join the yarns based on knitting data of the knitting machine, for example.

[0046] Operations of the members of the knotter device 1 during an operation of joining the yarns will now be described with reference to Figs. 7 to 14.

[0047] To begin with, in step S1 shown in Fig. 7, the old yarn 2b is hooked onto the hook 22. Specifically, as shown in Fig. 8(a), the hook 22 is moved rightwards. As a result, as shown in Fig. 9(a), the old yarn 2b is hooked onto the hook portions 29 of the hook 22.

[0048] Next, in step S2, a twisted stitch 4 is formed with the old yarn 2b. Specifically, as shown in Fig. 9(b), by causing the yarn guide 23 to swing, a downstream part of the old yarn 2b, being downstream of the hook 22, is dragged forwards. In this manner, a bend of the old yarn 2b is formed in front of the knitting needle 21. Hereinafter, the bent portion of the old yarn 2b will be referred to as a buffer 3. The buffer 3 extends from below the lower hook 22b toward the front side of the knitting needle 21, and then is bent downwards again toward the third yarn pressor 26.

[0049] The hook 22 is then moved rightwards to pull the old yarn 2b further rightwards. The knitting needle 21 is then moved forwards, as shown in Fig. 9(c), and goes into the space between the upper hook 22a and the lower hook 22b. The hook 22 is then moved leftwards, and the knitting needle 21 is moved back and retracted from the space between the upper hook 22a and the lower hook 22b, as shown in Fig. 10(a), so that the old yarn 2b is hooked and dragged rearwards. The old yarn 2b is then twisted, as shown in Fig. 10(b), by half-rotating the knitting needle 21, and a loop-shaped twisted stitch 4 is formed thereby.

[0050] In step S3, a stitch 5 is formed with the old yarn 2b. Specifically, as shown in Fig. 10(c), the knitting needle 21 is moved forwards, and the hook portion 21a hooks a part of the buffer 3 of the old yarn 2b. Next, as shown in Fig. 11(a), the knitting needle 21 is moved rearwards and retracted from the space between the upper hook 22a and the lower hook 22b, and the old yarn 2b is passed through the twisted stitch 4. In this manner, the stitch 5 is formed. At this time, the old yarn 2b is wound around the main body 28 of the lower hook 22b in the beginning. As the hook 22 is moved slightly rightwards, and the knitting needle 21 pulls the old yarn 2b rearwards, the old yarn 2b becomes wound around the hook portion 29 of the lower hook 22b, as shown in Fig. 11(b).

[0051] The yarn guide 23 is then swung in the direction opposite to the arrow shown in Fig. 5(b), and goes back to the original position. The second yarn pressor 25 is then displaced to the pressing position, to press an upstream part of the old yarn 2b, being upstream of the hook 22.

[0052] Next, in step S4, the new yarn 2a is pulled into the stitch 5. Specifically, after the knitting needle 21 is moved forwards, as shown in Fig. 12(a), the yarn guide lever 14 of the yarn selecting unit 10 is swung as shown in Figs. 3(a) and 3(b), so that the new yarn 2a is dragged to the front side of the hook 22. Next, as shown in Fig. 12(b), the knitting needle 21 is moved rearwards, with the new yarn 2a hooked on the hook portion 21a, to pass the new yarn 2a through the stitch 5. The yarn guide lever 14 is then returned to the original position shown in Fig. 2(a).

[0053] In step S5, the old yarn 2b wound around the hook 22 is then unwound. Specifically, as shown in Fig. 8(b), by moving the hook 22 leftwards, the wound portion of the old yarn 2b is released from the lower hook 22b.

[0054] Next, in step S6, tension is applied to the old yarn 2b and the new yarn 2a. Specifically, when the cutter 24 is displaced to the cutting position, the cutter 24 cuts a part of the new yarn 2a and the old yarn 2b above the hook 22, as shown in Fig. 13(a), and the cutter having cut the yarns is displaced to the retracted position. The knitting needle 21 is then moved rearwards to pull the new yarn 2a hooked on the hook portion 21a rearwards, thereby pulling the cut end of the new yarn 2a toward the stitch 5. As the knitting needle 21 is further moved rearwards, the cut end of the new yarn 2a is passed through the stitch 5 toward the rear side, and the new yarn 2a is released from the hook portion 21a of the knitting needle 21, as shown in

Fig. 13(b).

[0055] The old yarn 2b is then pulled downstream by the tension of the tensioner 27, with an upstream part of the old yarn 2b, being upstream of the hook 22, is pressed down by the second yarn pressor 25. As a result, as shown in Fig. 14(a), the stitch 5 and the new yarn 2a having passed through the stitch 5 are pulled out of the twisted stitch 4, toward the front side of the twisted stitch 4. The third yarn pressor 26 is then displaced to the pressing position to press a downstream part of the old yarn 2b, being downstream of the hook 22. Then, as the yarn guide 23 is rotated and hooks the old yarn 2b, as shown in Fig. 5(b), to apply a tension to the old yarn 2b and the new yarn 2a, in the direction in which the knot is tightened, as shown in Fig. 14(b). Furthermore, by causing the third yarn pressor 26 to displace to the retracted position, and by causing the tensioner 27 or the like to apply tension to the old yarn 2b, a sheet bend knot is completed, with the old yarn 2b and the new yarn 2a joined to each other.

[0056] As described above, in the knotter device 1 according to the present embodiment, it is possible to achieve a knot smaller than a reef knot by using a sheet bend knot to join the old yarn 2b and the new yarn 2a. Therefore, the knot resists less when the yarn is knitted using the knitting machine. Furthermore, unlike a splicer connecting the ends of the yarns by untwisting the fibers and splicing fibers, even in a case where the old yarn 2b and the new yarn 2a have different colors, it is possible to suppress smearing of the yarns at the knot.

[0057] In a case where the new yarn 2a is a stretchable yarn such as an elastic yarn, another pressing member, not shown, is used to press a part of the new yarn 2a indicated by a two-dot chain line circle in Figs. 12(b) to 14(a) (e.g., a part near the stitch 5, and between the stitch 5 and the distal end 14a of the yarn guide lever 14) while the cutter 24 cuts the yarns by and the knitting needle 21 pulls the new yarn 2a. In this manner, when the new yarn 2a is cut with the cutter 24, the new yarn 2a, with the tension having applied thereto released, can be suppressed from coming off of the knot. The pressing force of the pressing member is released after the knot is tightened by the yarn guide 23.

[0058] In the knotter device 1 according to the present embodiment, the members included in the yarn selecting unit 10 and the yarn joining unit 20 operate independently, without mechanically interoperating with one another. Therefore, the controller 30 can control the timing of the operations of the members of the yarn selecting unit 10 and the yarn joining unit 20 independently.

[0059] Therefore, the relative timing for releasing the old yarn 2b wound around the hook 22, and the timing for causing the tensioner 27 and the yarn guide lever 14 to increase the tension on the old yarn 2b can be set to any timing, in the manner suitable for the vulnerability and the degree of friction on the surfaces of the old yarn 2b and the new yarn 2a.

[0060] For example, in a case where the surfaces of the

old yarn 2b and the new yarn 2a are relatively rough, it might not be possible for the stitch 5 through which the new yarn 2a has been passed to pass through the twisted stitch 4 to the rear side, and it might not be possible to form a knot successfully. In order to prevent such a problem, the timing for releasing the old yarn 2b wound around the lower hook 22b may be delayed. For example, it is possible to keep the old yarn 2b wound on the lower hook 22b for a while, while tension is being applied to the old yarn 2b and the new yarn 2a. In this manner, the twisted stitch 4 can be kept large even while the stitch 5 having the new yarn 2a passed therethrough is being pulled out to the front side of the twisted stitch 4. Therefore, it is possible to pass the stitch 5 having the new yarn 2a passed therethrough easily through the twisted stitch 4.

[0061] By contrast, in a case where the surfaces of the old yarn 2b and the new yarn 2a are relatively slippery, the stitch 5 having the new yarn 2a passed therethrough may be pulled too far toward the front side of the twisted stitch 4, and the twisted stitch 4 may become reversed and the new yarn 2a may become entangled with the old yarn 2b. In order to prevent such a problem, the timing for releasing the old yarn 2b wound around the lower hook 22b may be advanced. For example, the old yarn 2b wound around the lower hook 22b may be unwound between Figs. 12(a) and 12(b), that is, before the new yarn 2a is pulled into the stitch 5. Because the size of the twisted stitch 4 is reduced, the stitch 5 having the new yarn 2a passed therethrough can be suppressed from being pulled too far behind the twisted stitch 4.

[0062] In the manner described above, it is possible to set the timing for releasing the old yarn 2b wound around the hook 22 to any timing with respect to the timing for increasing the tension being applied on the old yarn 2b by the tensioner 27 and the yarn guide 23. Therefore, it is possible to prevent the yarn from breaking, and to suppress defects in the knot.

[0063] Although an embodiment of the disclosure has been described above, the disclosure is not limited to the embodiment described above, and modifications may be made as appropriate, within the scope of the technical idea of the invention defined in the claims.

[0064] For example, in the present embodiment, the knitting needle 21 forms the twisted stitch 4 as a single stitch, but the twisted stitch 4 may be formed as multi-twisted stitch. A method of forming such a multi-twisted stitch 4 will now be described.

[0065] As shown in Fig. 15(a), the old yarn 2b is twisted by half-rotating the knitting needle 21, to form a looped twisted stitch 4. Next, as shown in Fig. 15(b), the knitting needle 21 is moved forwards within a range in which the latch does not come out of the twisted stitch 4, and goes into the space between the upper hook 22a and the lower hook 22b.

[0066] Next, as shown in Fig. 15(c), the knitting needle 21 is half-rotated within the space between the upper hook 22a and the lower hook 22b. Next, as shown in Fig.

16(a), the knitting needle 21 is moved back.

[0067] Next, as shown in Fig. 16(b), the knitting needle 21 is rotated in the same direction as before. The knitting needle 21 hooks the old yarn 2b on the hook portion 21a while being rotated. By half-rotating the knitting needle 21 from the position shown in Fig. 16(a), the old yarn 2b is wound twice around the knitting needle 21, as shown in Fig. 16(c). In the manner described above, it is possible to a double-twisted stitch 4.

[0068] In this manner, it is possible to reduce the risk of the knot between the old yarn 2b and the new yarn 2a becoming untied. By repeating the steps shown in Figs. 15 and 16, the twisted stitch 4 may be tripled or more.

15 INDUSTRIAL APPLICABILITY

[0069] The present invention is applicable to a knitter device including a yarn selecting unit and a yarn joining unit.

20 REFERENCE SIGNS LIST

[0070]

- 25 1: Knitter device
- 10: Yarn selecting unit
- 14: Yarn guide lever
- 20: Yarn joining unit
- 21: Knitting needle
- 30 22: Hook
- 23: Yarn guide
- 24: Cutter
- 25: Second yarn pressor
- 26: Third yarn pressor
- 35 27: Tensioner

Claims

- 40 1. A knitter device comprising a yarn selecting unit and a yarn joining unit, wherein

the yarn selecting unit includes a guide lever configured to guide a new yarn fed from a yarn source to the yarn joining unit, and the yarn joining unit includes a guide configured to guide an old yarn in a direction different from a direction in which the old yarn stretches,

a knitting needle configured to hook and to twist the old yarn to form a twisted stitch, to hook another part of the old yarn guided by the guide, to form a stitch by passing the other part through the twisted stitch to one side, and to pass the new yarn guided by the guide lever through the stitch,

a hook around which the old yarn is wound when the knitting needle forms the stitch and that is

- operable to unwind the old yarn, and a tension applying unit configured to increase tension of the old yarn so that the stitch having the new yarn passed through the stitch is passed through the twisted stitch to another side. 5
2. The knotter device according to claim 1, wherein relative timings for unwinding the old yarn wound around the hook and for increasing the tension of the old yarn by the tension applying unit are settable to any timings. 10
3. The knotter device according to claim 1 or 2, wherein the hook is enabled to change a timing for unwinding the old yarn wound around the hook. 15
4. The knotter device according to any one of claims 1 to 3, wherein
- the hook includes a pair of hook-shaped members on which the old yarn is placeable, and the knitting needle is enabled to advance into and to retract from a space between the pair of hook-shaped members, and is enabled to be rotated about an axis. 20
25
5. The knotter device according to any one of claims 1 to 4, wherein the guide is configured to guide a downstream part of the old yarn, the downstream part being downstream of the hook, to a position facing the knitting needle across the hook. 30
6. The knotter device according to any one of claims 1 to 5, further comprising: 35
- a holder configured to hold the old yarn at a position upstream of the stitch, after the new yarn is passed through the stitch; and a cutter configured to cut an unnecessary part of the new yarn and the old yarn while the old yarn is being held by the holder, wherein the tension applying unit is configured to increase a tension of the old yarn after the old yarn is cut by the cutter. 40
45
7. The knotter device according to any one of claims 1 to 6, wherein the tension applying unit includes the guide.
8. The knotter device according to any one of claims 1 to 7, wherein the knitting needle forms a multi-twisted stitch. 50

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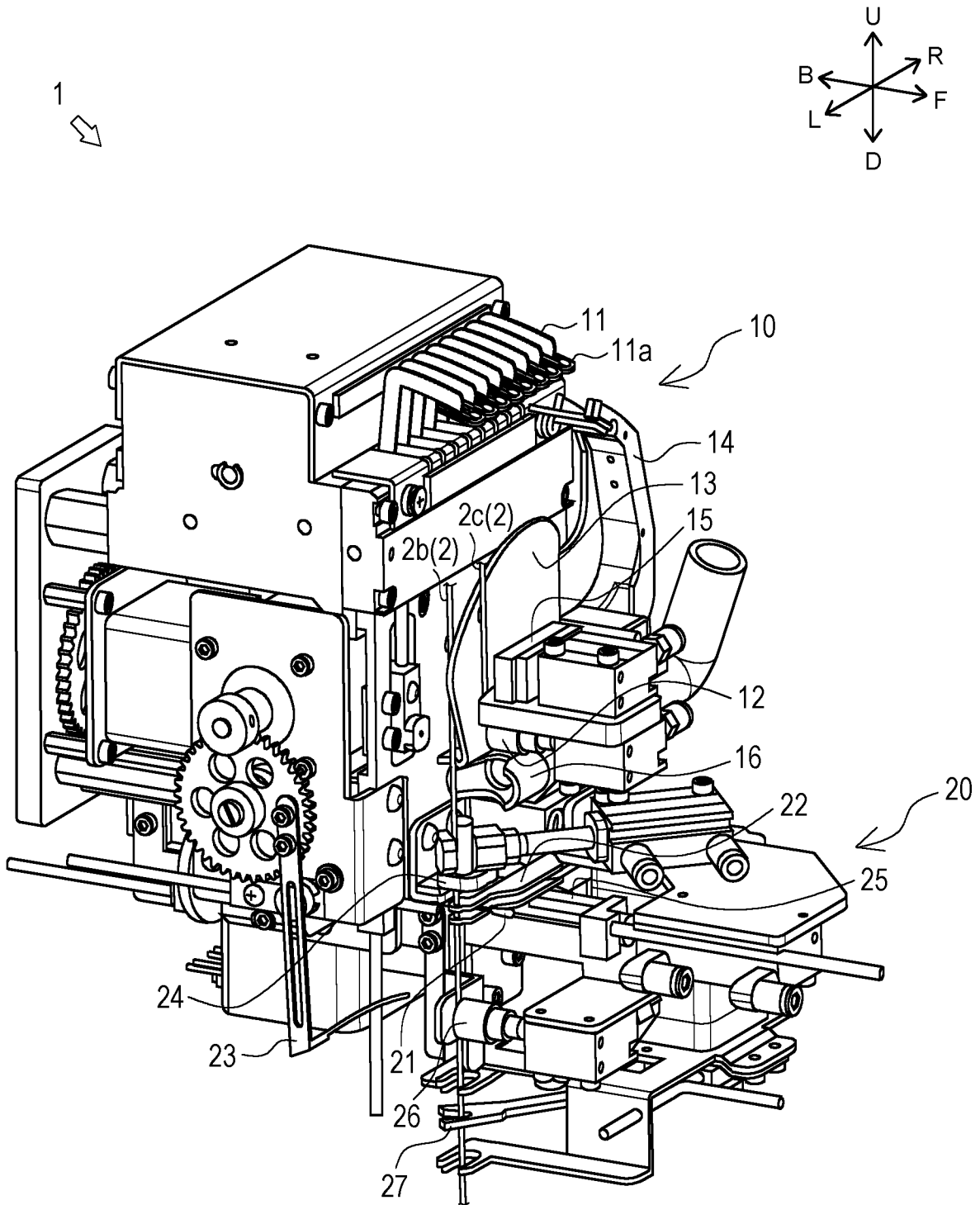


Fig. 1

Fig. 2(a)

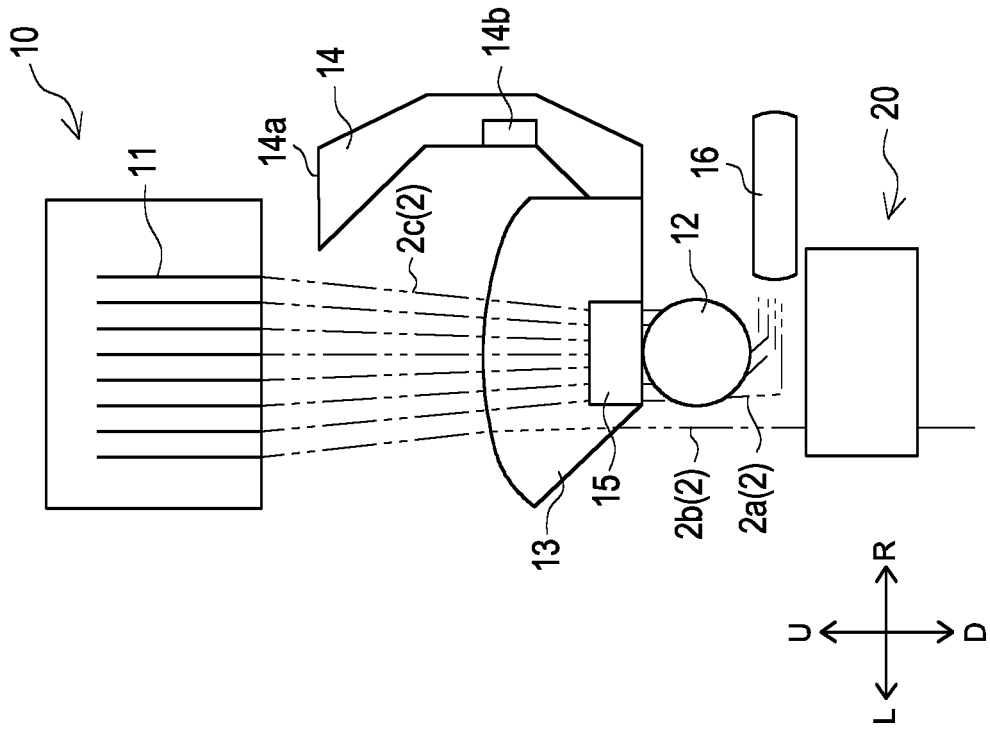


Fig. 2(b)

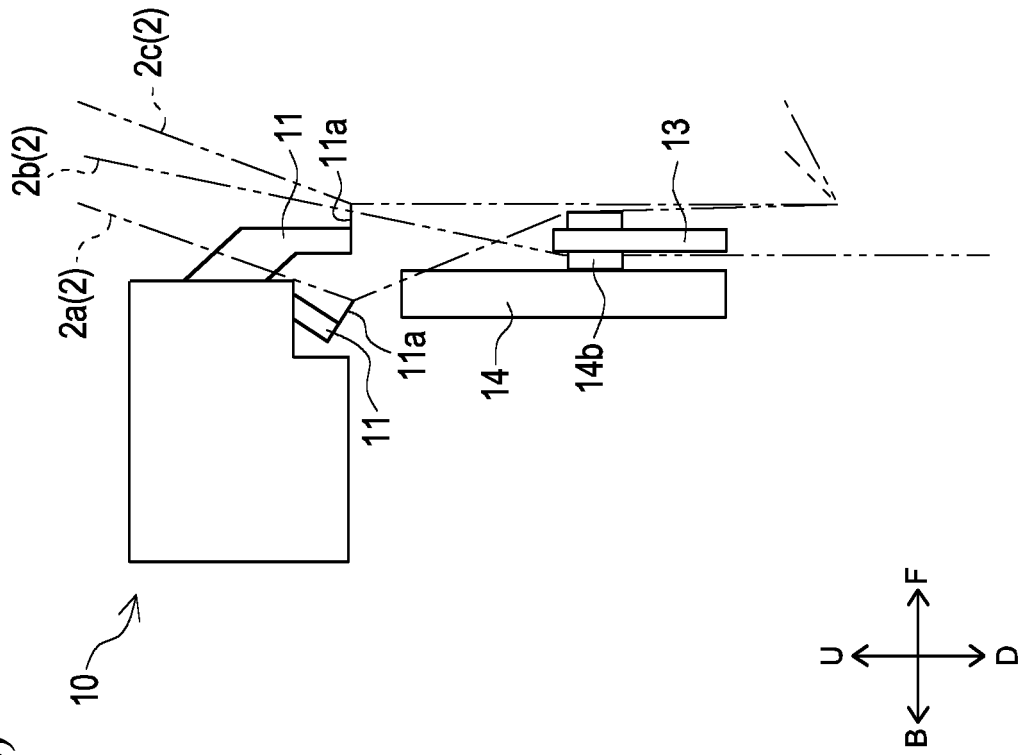


Fig. 3(a)

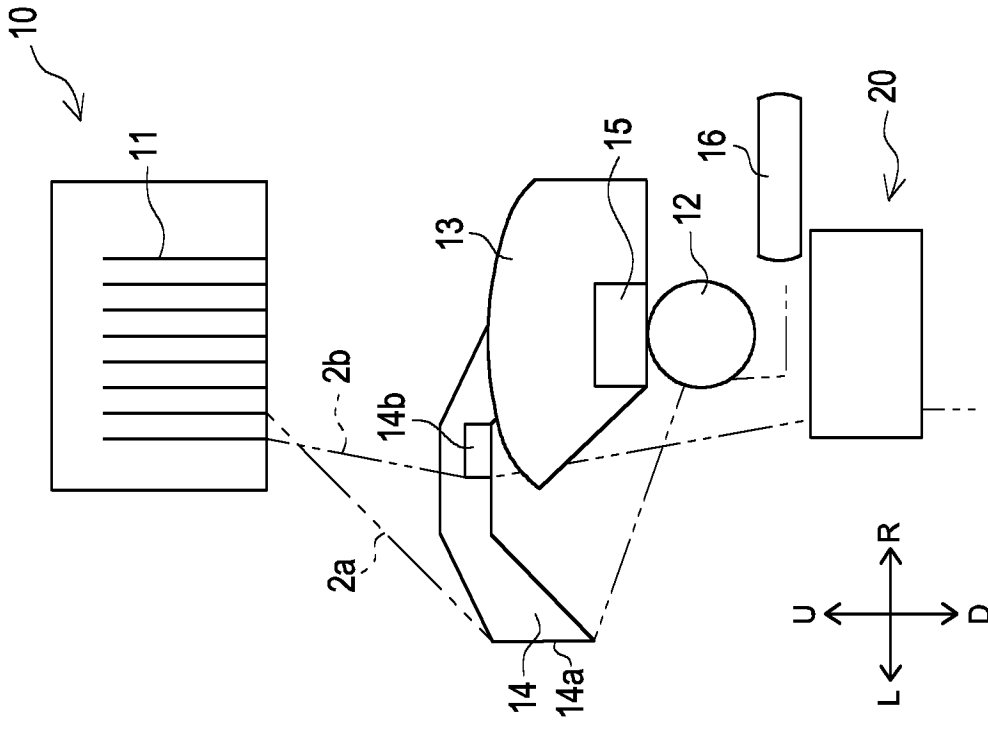
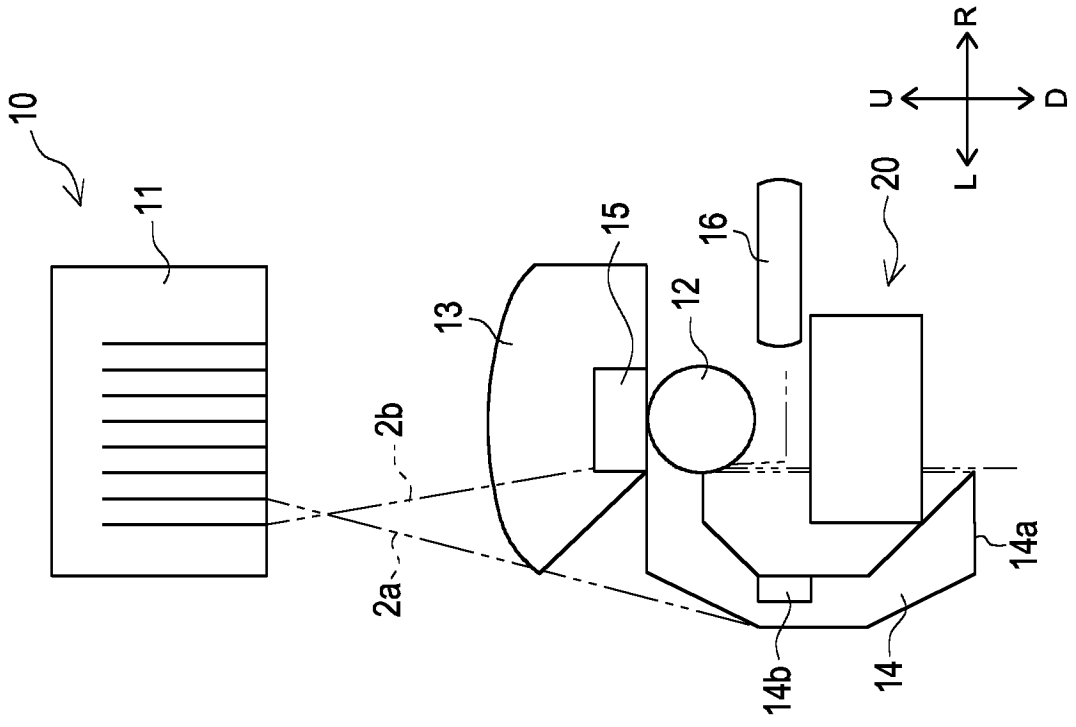


Fig. 3(b)



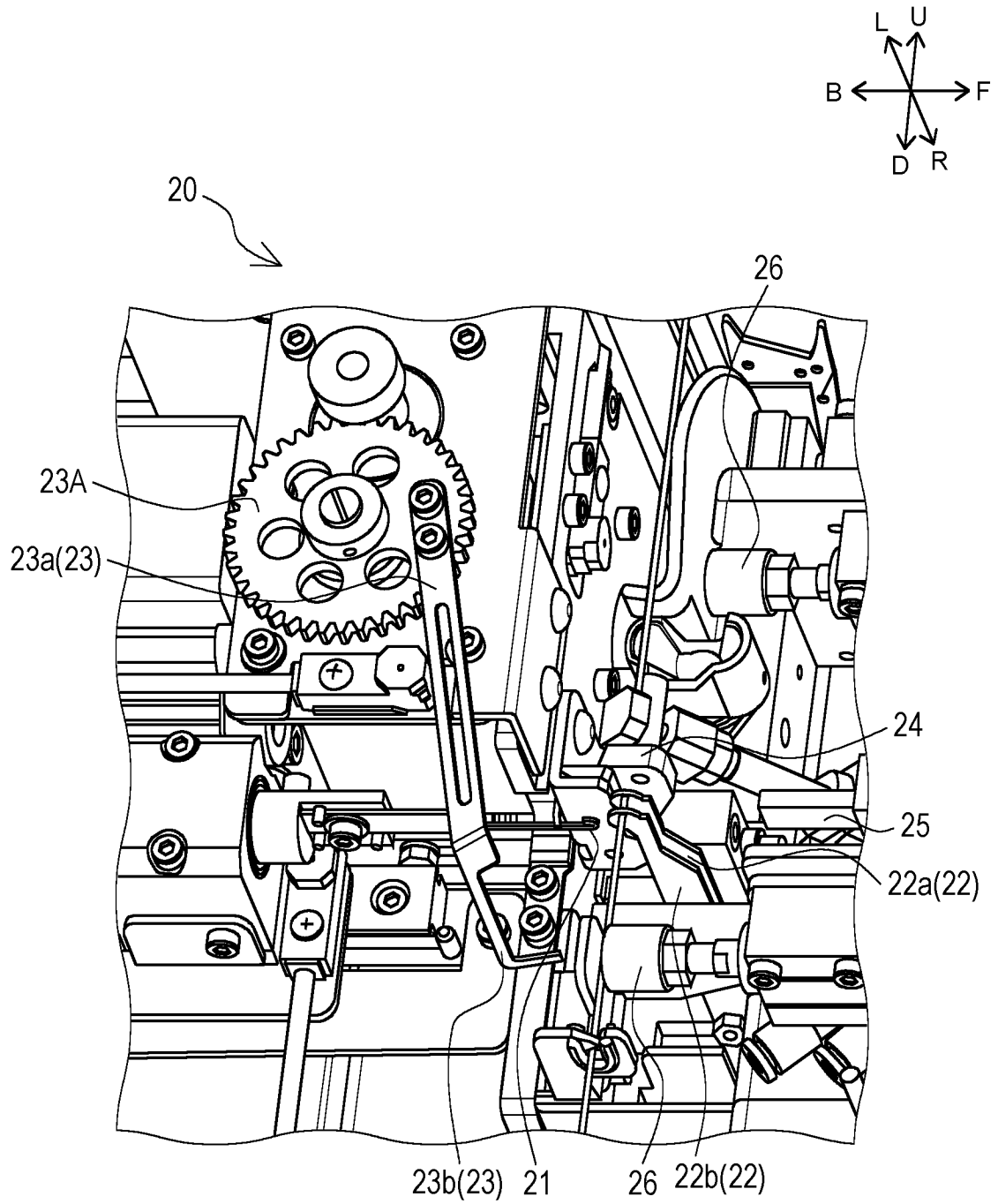


Fig. 4

Fig. 5(a)

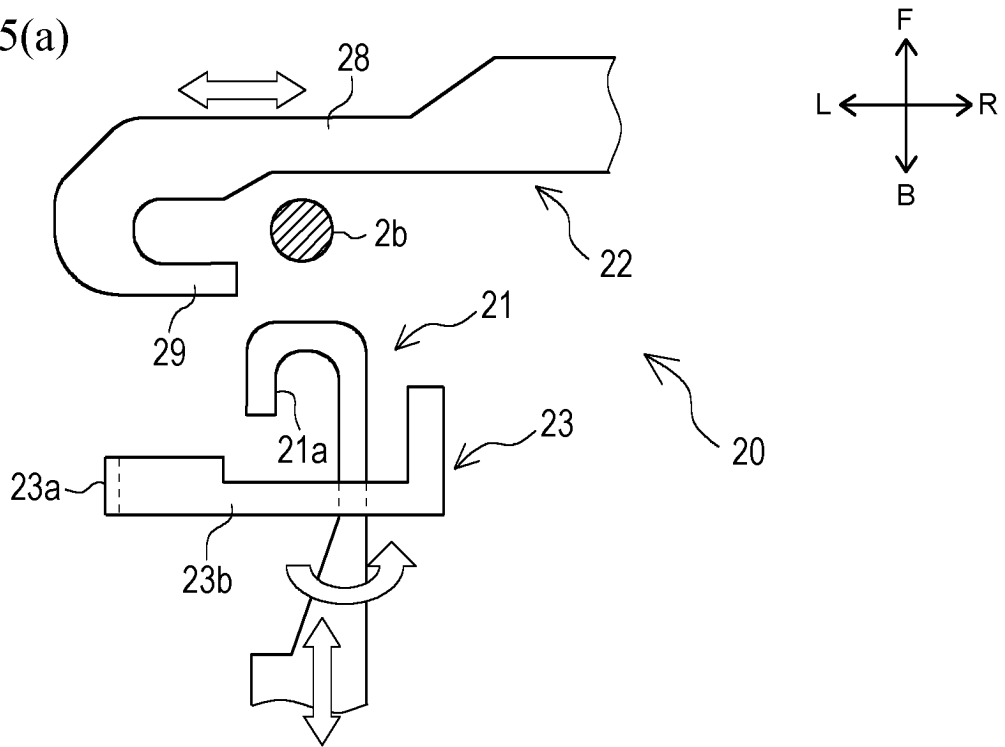
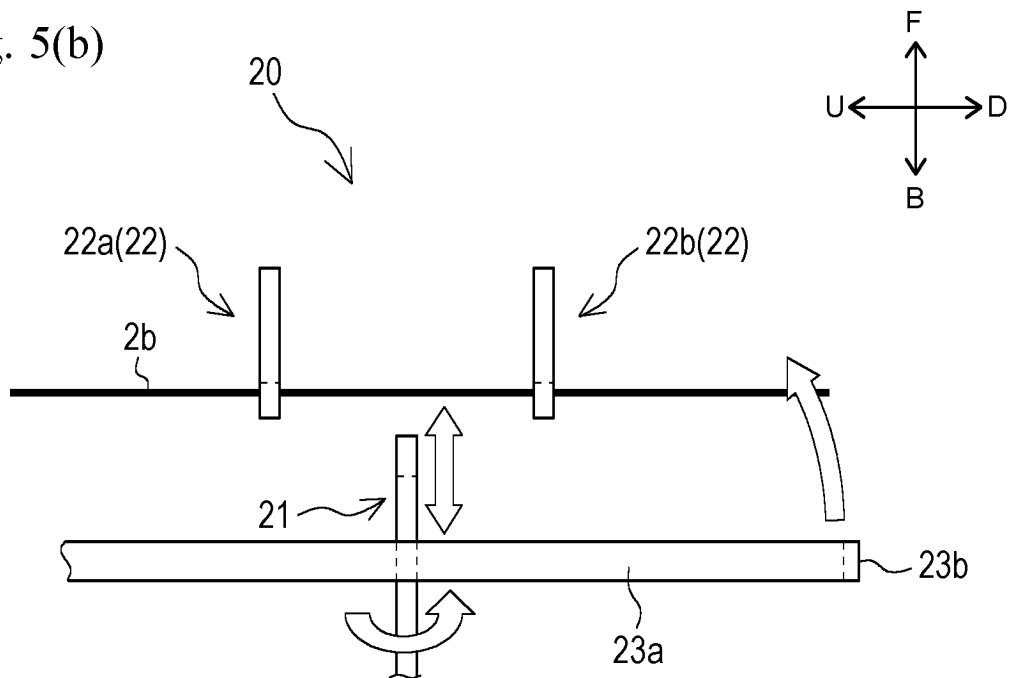


Fig. 5(b)



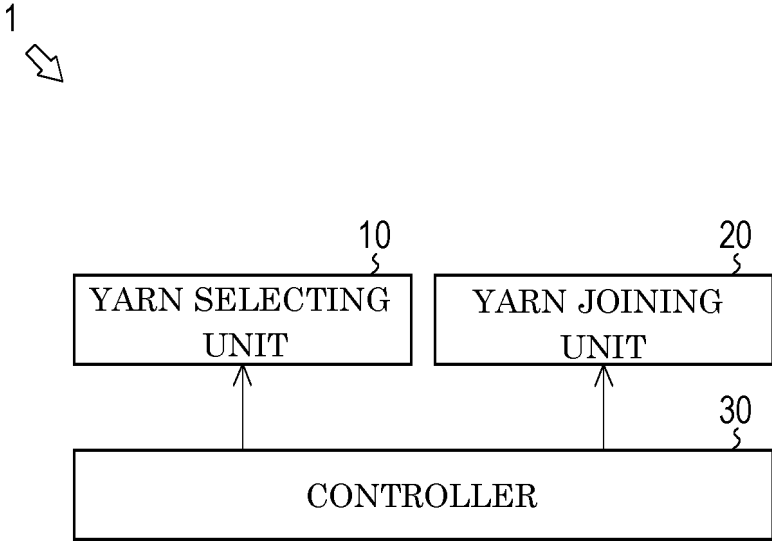


Fig. 6

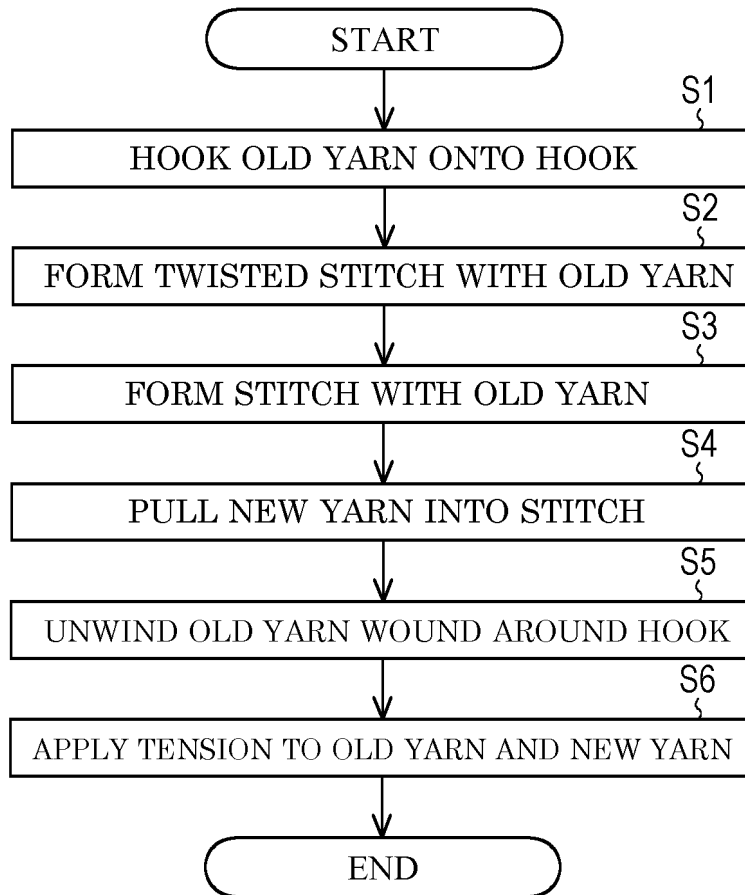


Fig. 7

Fig. 8(a)

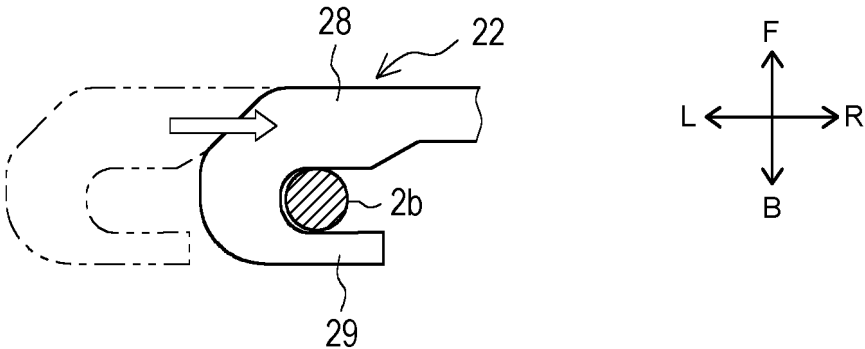


Fig. 8(b)

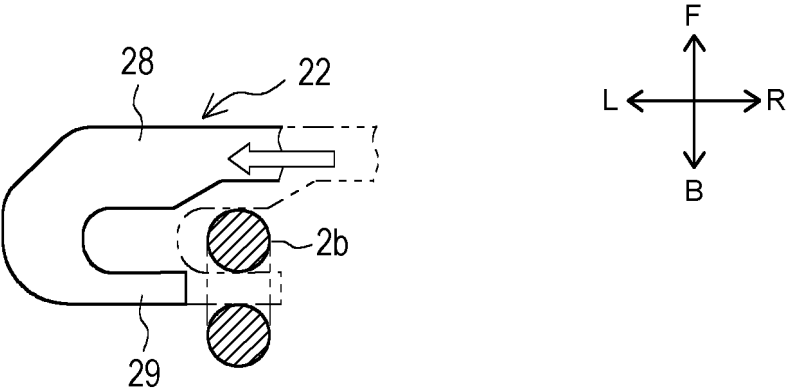


Fig. 9(a)

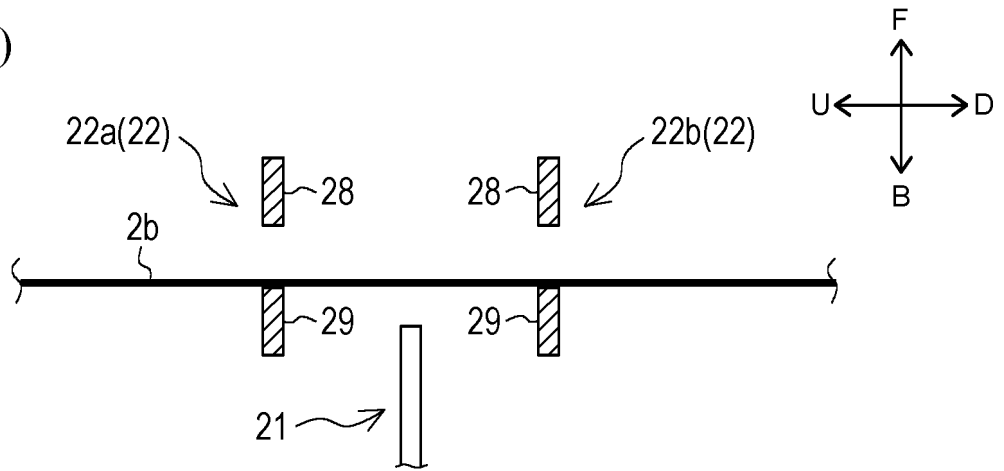


Fig. 9(b)

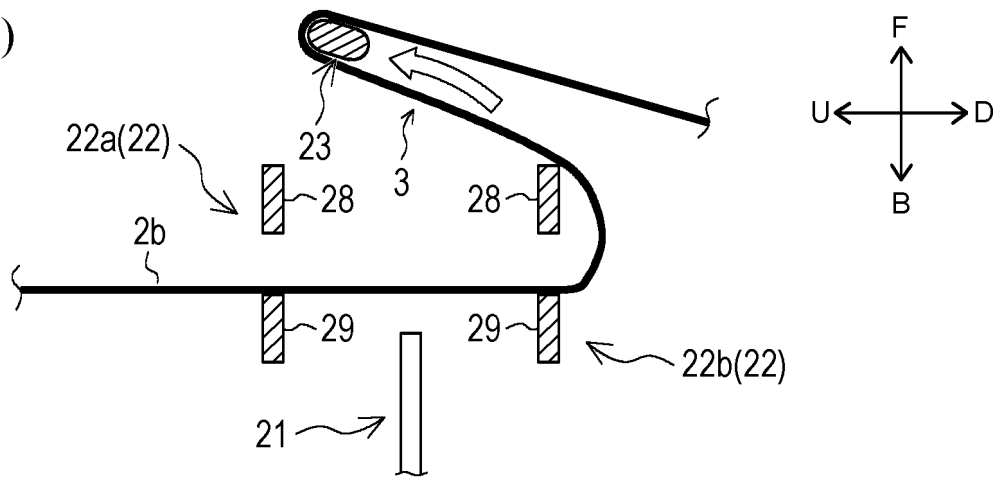


Fig. 9(c)

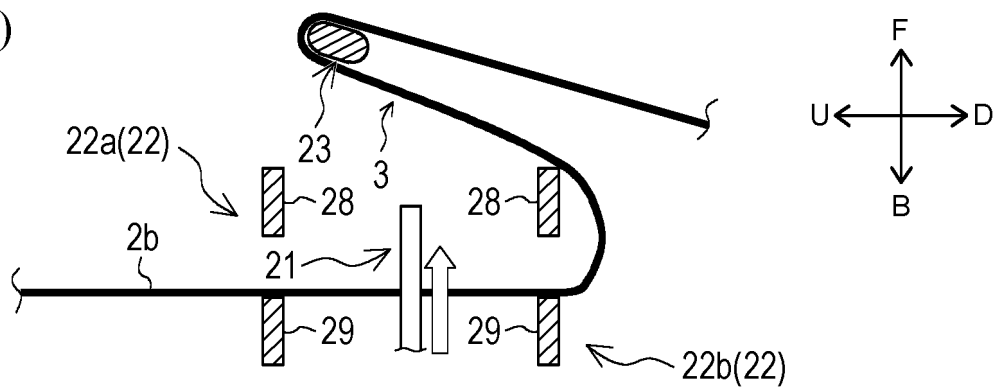


Fig. 10(a)

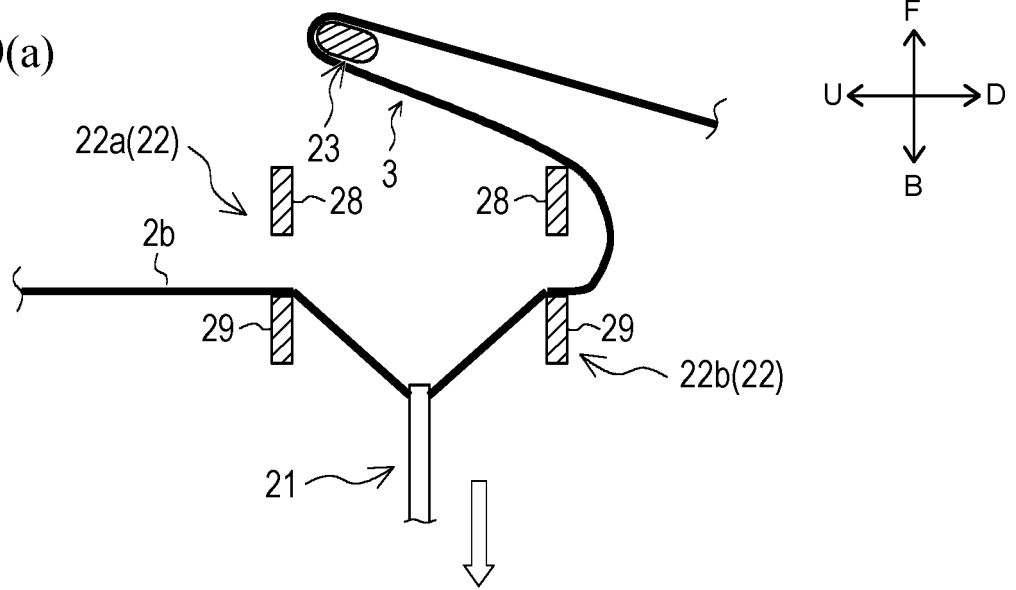


Fig. 10(b)

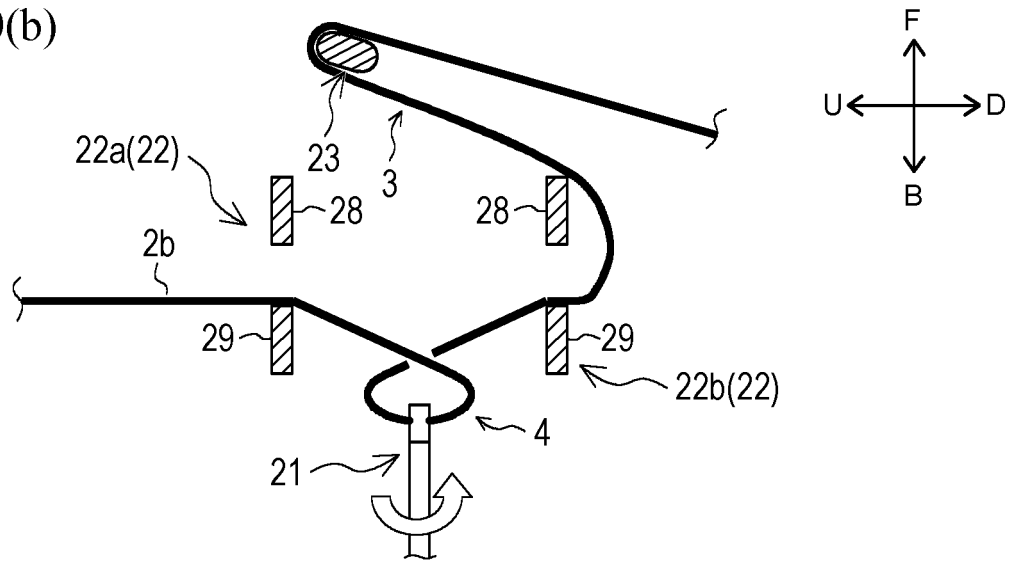


Fig. 10(c)

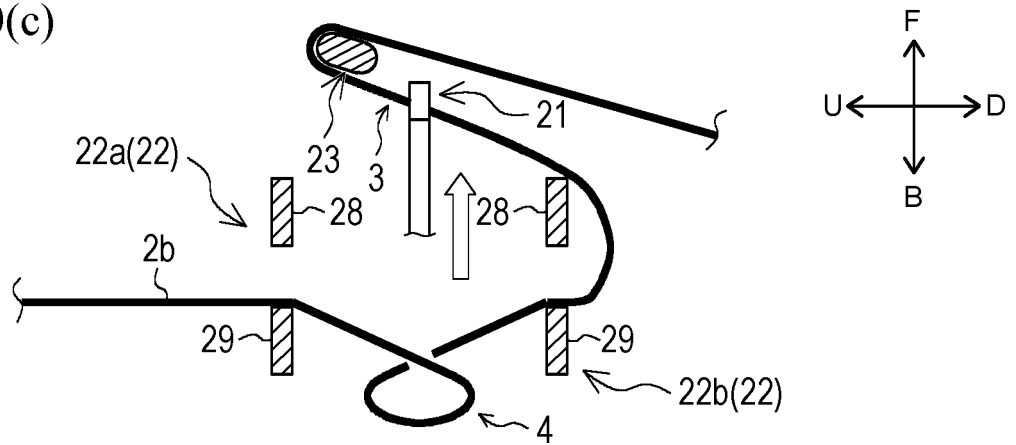


Fig. 11(a)

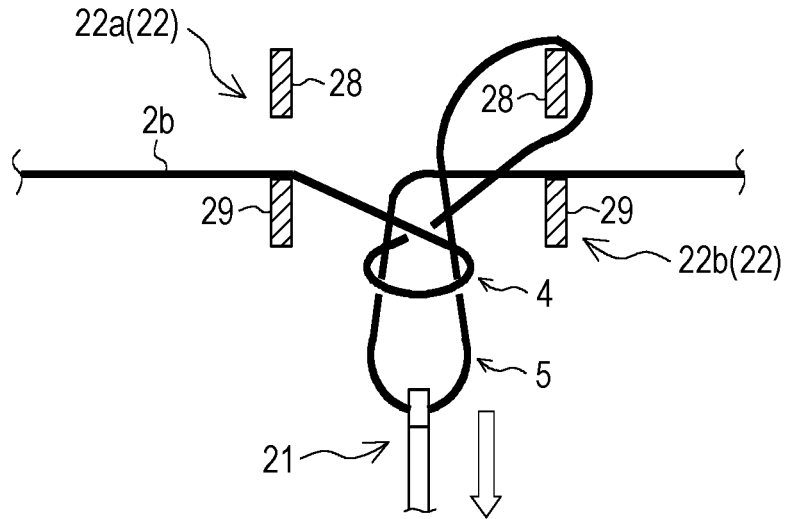


Fig. 11(b)

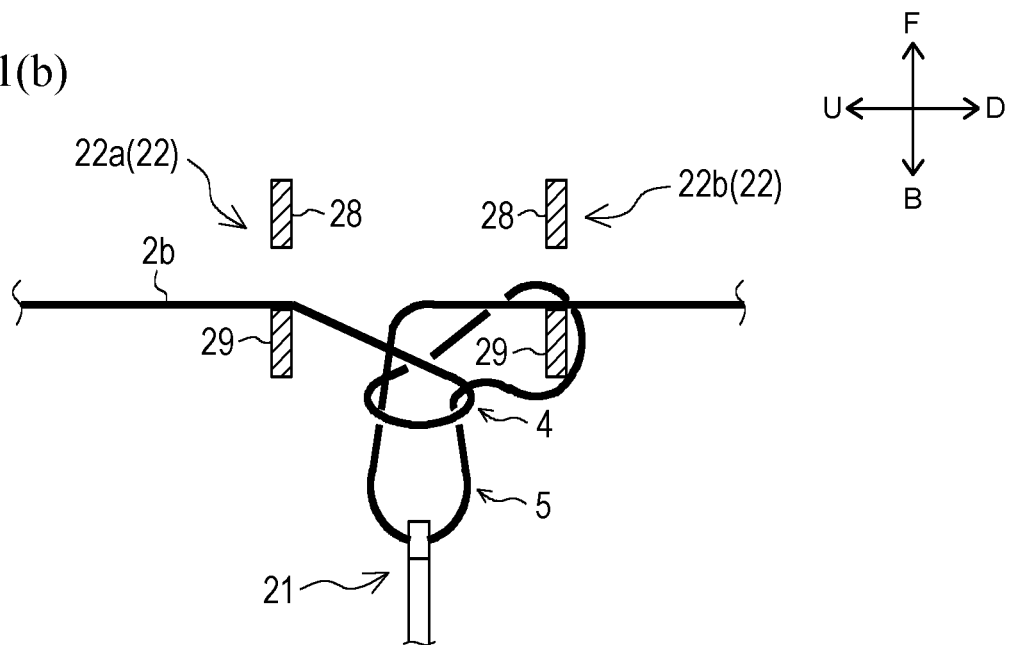


Fig. 12(a)

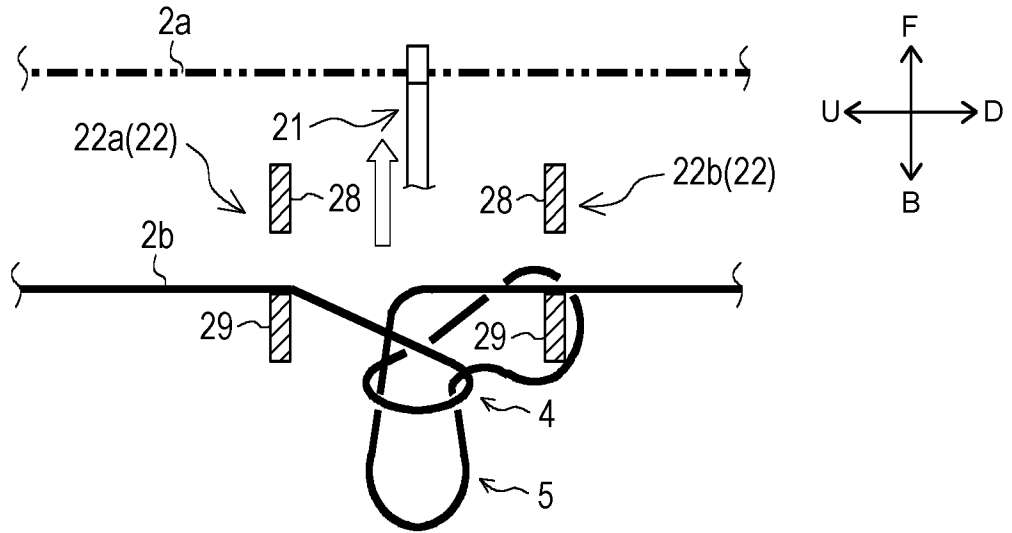


Fig. 12(b)

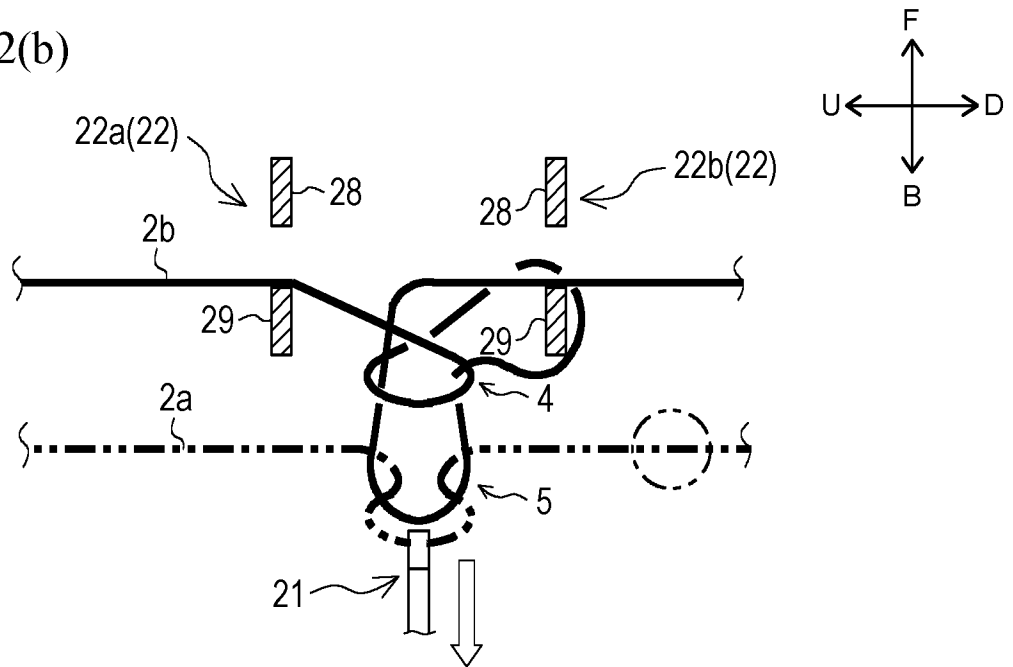


Fig. 13(a)

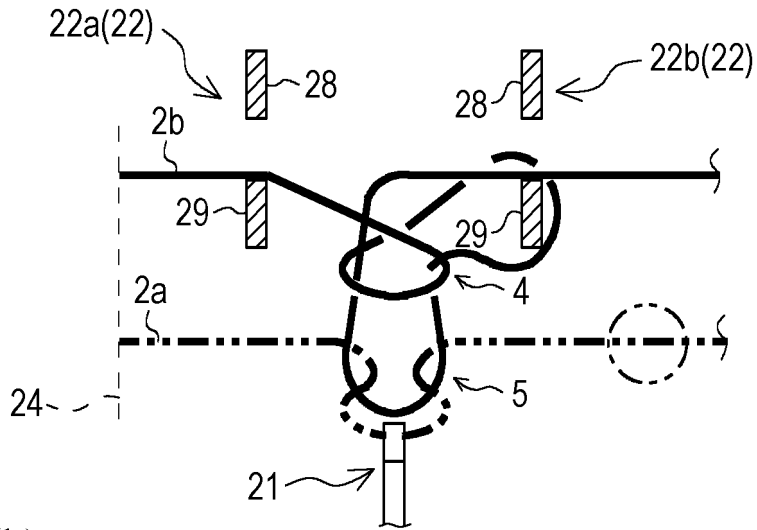


Fig. 13(b)

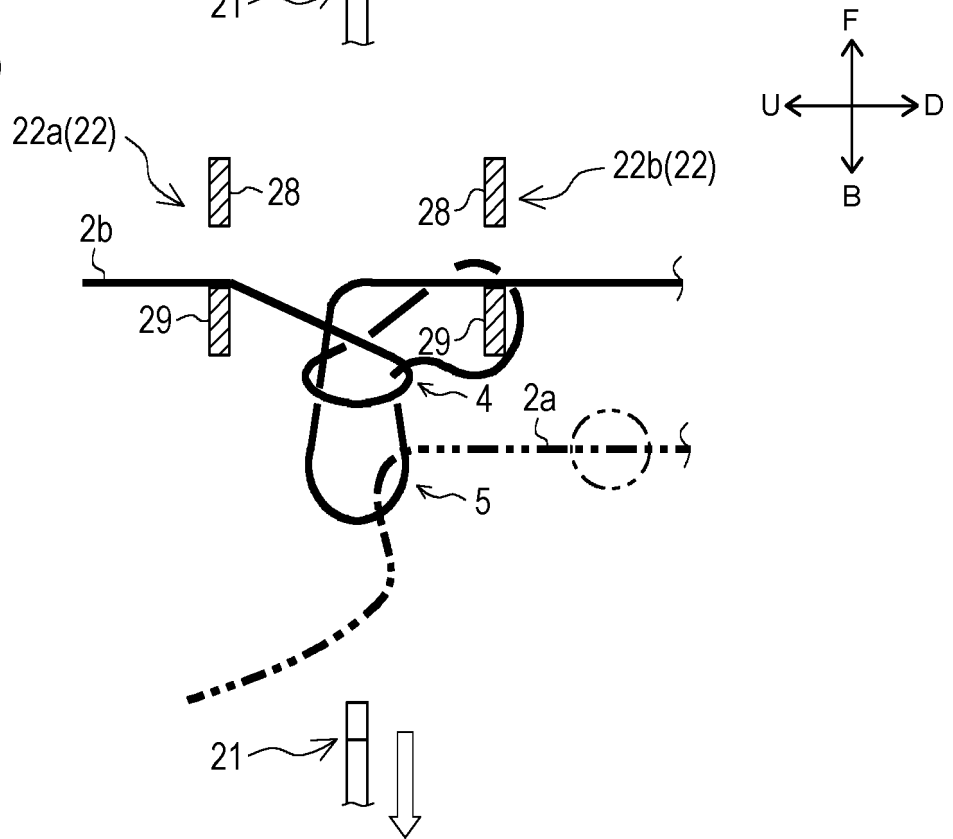


Fig. 14(a)

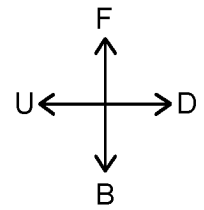
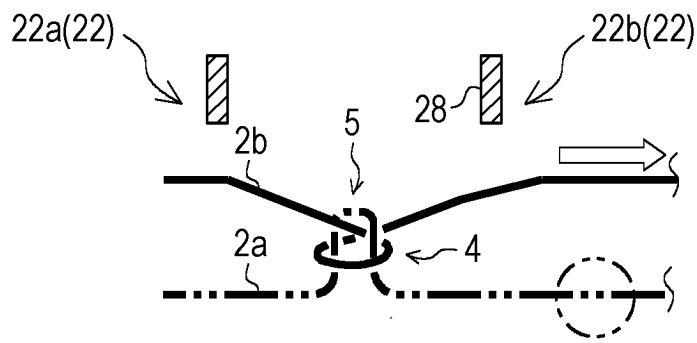


Fig. 14(b)

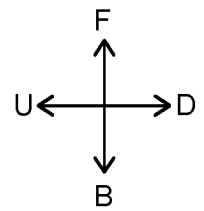
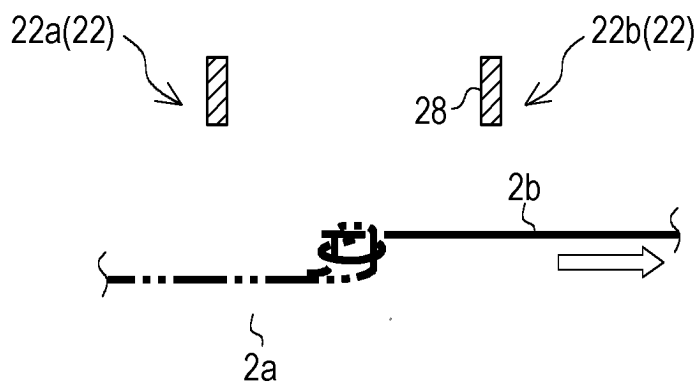


Fig. 15(a)

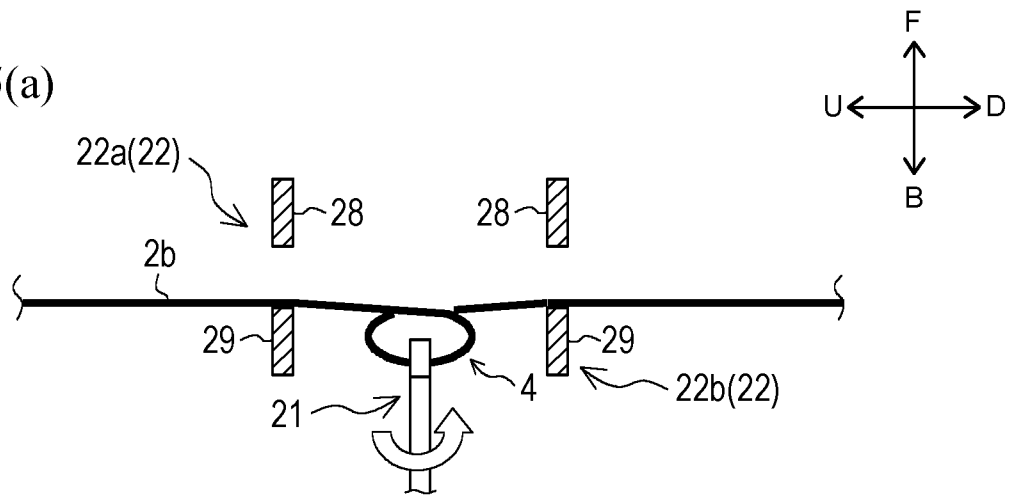


Fig. 15(b)

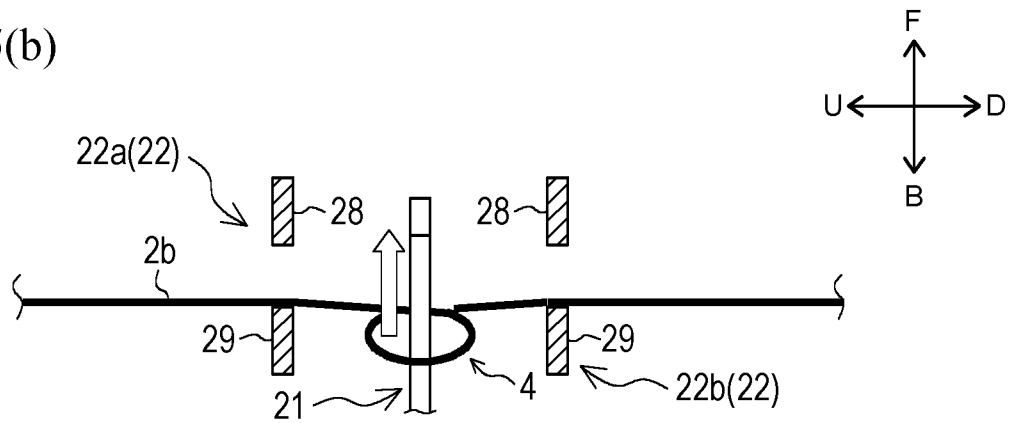


Fig. 15(c)

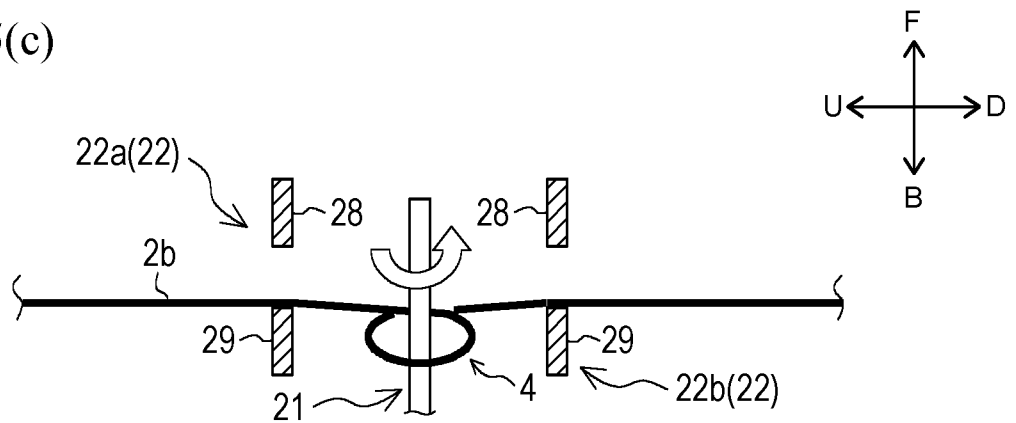


Fig. 16(a)

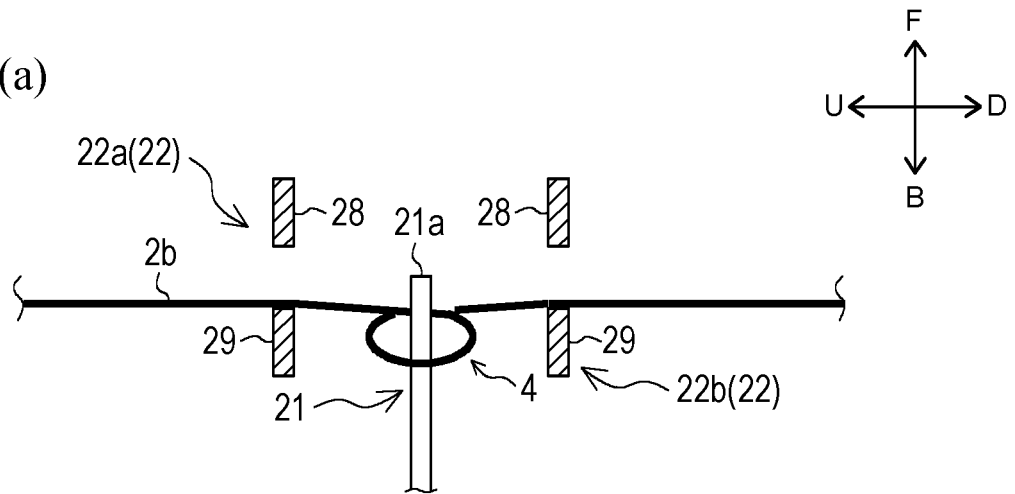


Fig. 16(b)

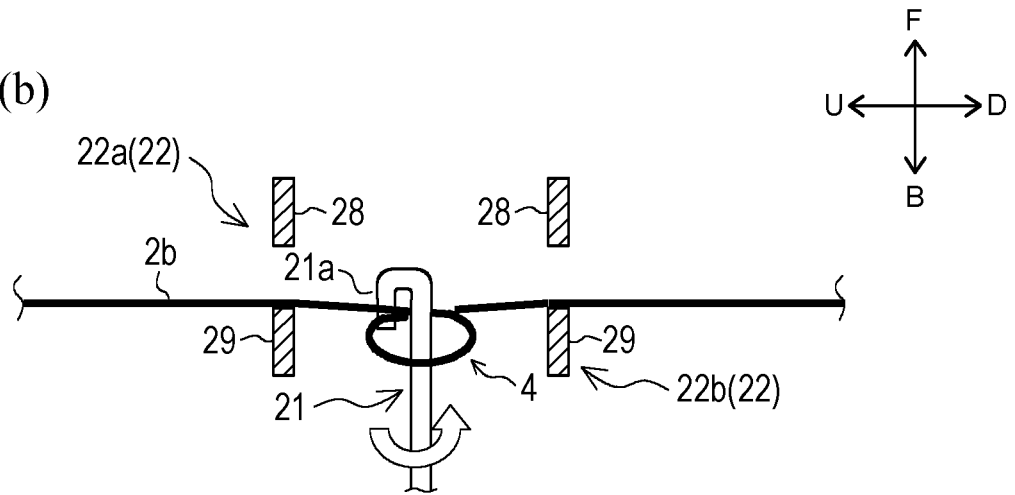
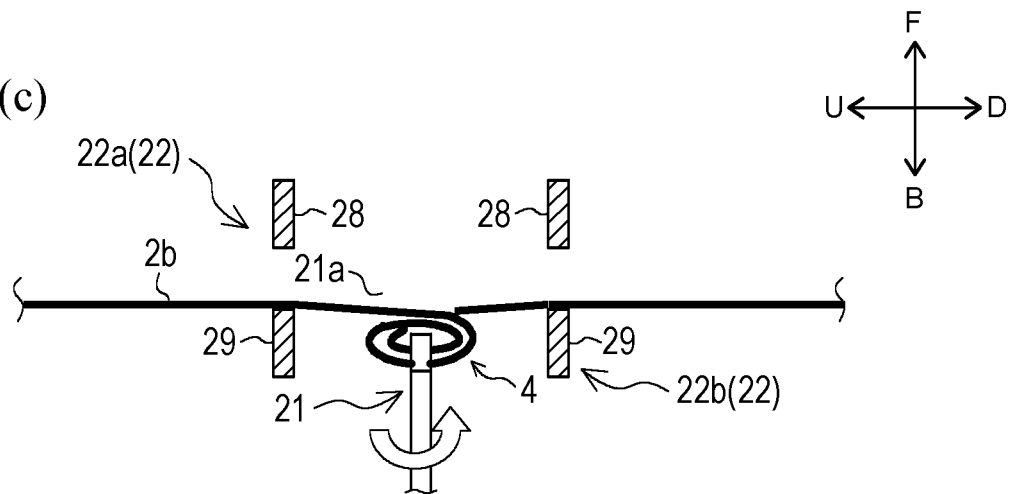


Fig. 16(c)



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2023/006520

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A. CLASSIFICATION OF SUBJECT MATTER		
<i>B65H 69/04</i> (2006.01); <i>D01H 15/00</i> (2006.01); FI: B65H69/04; D01H15/00 A		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) B65H69/04; D01H15/00		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Published examined utility model applications of Japan 1922-1996 Published unexamined utility model applications of Japan 1971-2023 Registered utility model specifications of Japan 1996-2023 Published registered utility model applications of Japan 1994-2023		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2007-106548 A (SHIMA SEIKI MFG LTD) 26 April 2007 (2007-04-26) paragraphs [0021]-[0044], fig. 1-15	1-8
A	JP 2002-35460 A (BROTHER IND LTD) 05 February 2002 (2002-02-05) paragraphs [0031]-[0081], fig. 1-47	1-8
A	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 101717/1991 (Laid-open No. 42264/1993) (JUKI CORP.) 08 June 1993 (1993-06-08), paragraphs [0007]-[0014], fig. 1-9	1-8
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 25 April 2023		Date of mailing of the international search report 16 May 2023
Name and mailing address of the ISA/JP Japan Patent Office (ISA/JP) 3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915 Japan		Authorized officer Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2023/006520

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Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2007-106548 A	26 April 2007	(Family: none)	
JP 2002-35460 A	05 February 2002	US 2002/0035954 A1 paragraphs [0149]-[0199], fig. 1-47	
JP 5-42264 U1	08 June 1993	(Family: none)	

REFERENCES CITED IN THE DESCRIPTION

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