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(72) Inventor: **GOTO, Masanori**
Wakayama-shi
Wakayama 641-8511 (JP)

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(74) Representative: **Carstens, Dirk Wilhelm**
WAGNER & GEYER
Gewürzmühlstrasse 5
80538 München (DE)

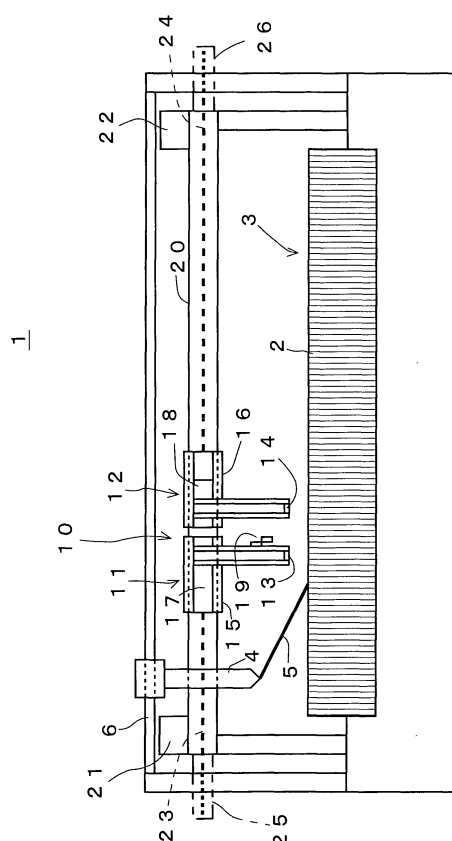
(71) Applicant: **Shima Seiki Mfg., Ltd**
Wakayama-shi
Wakayama 641-8511 (JP)

(54) **YARN END TREATING DEVICE FOR FLAT KNITTING MACHINE**

(57) To provide an edge yarn processing apparatus for a flatbed knitting machine which can operate a cutter by a gripper unit side alone provided with the cutter without using rotation of a slide guiding member.

A first gripper 11 and a second gripper 12 have a first gripping part 13 and a second gripping part 14, respectively, which can grip knitting yarn 5 at the one end. Operation of the first gripping part 13 and the second gripping part 14 are conducted, respectively, on the basis of relative movement of a first grooved cam member 17 and a second grooved cam member 18 to a first holder 15 and a second holder 16. With the first gripper 11, a cutter 19 is also provided, and the operation of the cutter 19 is also conducted on the basis of the relative movement of the first grooved cam member 17 to the first holder 15, together with the first gripping part 13. Consequently, change-over between knitting yarn holding state and operation of the cutter 19 can be carried out without rotating the track 20.

[Fig. 1]



Description**Technical Field**

5 [0001] The present invention relates to an edge yarn processing apparatus for a flatbed knitting machine that can capture or cut a knitting yarn that extends from a knitting needle to a yarn feeding member while a fabric is knitted with the flatbed knitting machine.

Background Art

10 [0002] Conventionally, a flatbed knitting machine, which is equipped with needle beds in front and in rear, has been used for applications to knit a fabric in tubular shape which is made by connecting both ends of the knitting width between needle beds. However, even in the tubular fabric, when a plurality of tubular fabrics are combined such as gloves or the like, an edge yarn processing apparatus is used together (for example, see Patent Citations 1 and 2). In the case of
15 gloves, a plurality of finger bags and barrels are knitted as tubular fabrics, respectively. In particular, when the fabric is begun to be knitted from the fingertip, the finger bags are knitted one by one. When knitting of one finger bag is finished, the knitted fabric of the finger bag is hung over knitting needles to temporarily discontinue knitting, then a next finger bag is begun to be knitted. After the next finger bag starts to be knitted with using the knitting yarn extending from the finger bag, for which knitting is discontinued, to the yarn feeding member, a cross-over-yarn comes into being. It takes
20 a lot of trouble to process the cross-over-yarn after the glove is knitted and the knitted fabric is removed from the flatbed knitting machine. It could save trouble that the cross-over-yarn might be captured to be cut during knit operation by an edge yarn processing apparatus, which carries out procedures such as inserting the cut yarn edge into the tubular fabric being knitted or the like.

25 [0003] In Patent Citation 1, there disclosed is a structure in which a slide guiding member, along which a unit having a gripper and a cutter runs, is rotated to drive the gripper and the cutter. In Patent Citation 2, a cutter is equipped to one of the two independently movable gripper units and a slide guiding member is rotated to drive the gripper only. The cutter is driven by the use of a cam installed to the other gripper unit. Consequently, even if the cutter is equipped to one gripper unit, the cutter operation depends on the other gripper unit.

30 Patent Citation 1: Japanese Published patent application No. H08-325901
Patent Citation 2: Japanese Published patent application No. 2005-89933

Disclosure of the Invention**Technical Problem**

35 [0004] In the edge yarn procedure of Patent Citation 1, rotation of the same slide guiding member is utilized for driving the gripper and driving the cutter. In order to hold knitting yarn by the gripper, spring bias is used. The slide guiding member has a key groove formed on a circular cross sectional surface in order to definitely take out the driving force.
40 A reactive force, caused by spring bias to hold knitting yarn, might increase sliding resistance in the key groove when the gripper unit runs and might result to lose durability and stability.

[0005] In the edge yarn procedure of Patent Citation 2, it is unable to operate the cutter by the gripper unit side alone, to which the cutter is equipped, and a harmonized operation with the other gripper unit is necessary.

45 [0006] It is an object of the present invention to provide an edge yarn processing apparatus for a flatbed knitting machine that can operate a cutter independently by a gripper unit side alone to which the cutter is equipped without using rotation of a slide guiding member.

Technical Solution

50 [0007] The present invention is an edge yarn processing apparatus for a flatbed knitting machine, including two grippers consist of a first gripper and a second gripper, the two grippers are independently movable on a track built along needle beds of the flatbed knitting machine, each gripper respectively having a gripping part which advances to and retreats from a knitting area where a fabric is knitted with knitting yarn fed to the knitting needles that advance from needle beds, the grippers being able to simultaneously capture and grip the knitting yarn by the gripping parts when the distance
55 between grippers comes close to a predetermined range, and a cutter equipped to the first gripper for cutting the knitting yarn, comprising:

a first cam member mounted to the first gripper, being relatively movable in a direction along the track;

a first cam mechanism mounted to the first gripper, changing over an advancing or retreating state in which the gripping part advances to or retreats from the knitting area, and cutting state of the cutter, working with the relative movement of the first cam member;

a second cam member mounted to the second gripper, being relatively movable in a direction along the track; and
 a second cam mechanism mounted to the second gripper, changing over an advancing or reversing state in which the gripping part advances to or retreat from the knitting area, working with the relative movement of the second cam member.

[0008] In the present invention, said first cam mechanism and said second cam mechanism advance to said knitting area with knitting yarn gripped by said gripping parts, and can change over to said state in which the knitting yarn is not gripped or at least can reduce the gripping force under the advancing state.

[0009] In the present invention, said first cam mechanism and said second cam mechanism guide said gripping part respectively, to advance to or to retreat from said knitting area in a predetermined linear route so as to prevent the gripping part from interfering with members used for knitting of the fabric.

[0010] In the present invention, said track is built linearly in parallel to the longitudinal direction of said the needle beds, and further comprising:

four racks, each rack connected to one of the first gripper, the second gripper, the first cam member, and the second cam member, being able to independently slide to move along the track; and

four drive mechanisms placed on an end area of the track for driving each rack to slide along the track by pinions engaged with teeth of each rack.

[0011] In the present invention, said first cam member individually having a gripper cam groove for changing over to advance or to retreat the gripping part of said first gripper to or from said knitting area, and a cutting cam groove for changing over cutting condition of said cutter;

the gripper cam groove, formed in a shape that retreats the gripping part from the knitting area in the intermediate section and advancing the gripping part to the knitting area in sections on both sides;

the cutting cam groove, having a shape that opens and closes the cutter symmetrically to the relative moving direction of the first cam member to the first gripper in the intermediate section of the gripper cam groove where the gripping part evacuates from the knitting area; and

said second cam member having a gripper cam groove, formed in a shape, the intermediate section of which retreats the gripping part from the knitting area and both side sections of which advances the gripping part to the knitting area.

Advantageous Effects

[0012] According to the present invention, a first gripper and a second gripper are independently movable on a track built along needle beds of a flatbed knitting machine. Operations of the gripping parts of the first gripper and the second gripper are carried out to work with the relative movement of the first cam member and the second cam member to the first cam mechanism and the second cam mechanism mounted to the first gripper and the second gripper, respectively. Furthermore, the first gripper is equipped with a cutter that cuts knitting yarn and is able to change over the cutter cutting state in accordance with the relative movement in the direction along the track between the first cam mechanism and the first cam member. When the first gripper and the second gripper are brought close to a predetermined area, the knitting yarn can be simultaneously captured and gripped by the gripping parts of both grippers. Since the knitting yarn gripped by the first gripper and the second gripper can be cut and separated by relatively moving the first cam member and operating the cutter, the track is not rotated but is used as a slide guiding member only that guides the movement, and then, the cutter is able to be operated by the first gripper alone.

[0013] According to the present invention, in the event that the first cam mechanism and the second cam mechanism are advanced to the knitting area with the knitting yarn gripped by the gripping parts and the cam mechanisms can be changed over to the state with the knitting yarn un-gripped, operation of inserting the edge yarn into the knitting area and separating it can be conducted unfaillingly. Or if the gripping force can be reduced, the edge yarn can be pulled out from the gripping parts, for example, while moving.

[0014] According to the present invention, because the first cam mechanism and the second cam mechanism advance the gripping parts to the knitting area or retreat the gripping parts from the knitting area in a predetermined linear route so as to prevent them from interfering with knitting members used for knitting the fabric, such as knitting needles, sinkers, and the like, each cam mechanism need not to conduct any three-dimensional advance and retreat operations and the structure is able to be simplified.

[0015] According to the present invention, the first gripper, the second gripper, the first cam member, and the second cam member are connected to one ends of four racks which can independently slide to move along the linear track and

can be independently moved them by four drive mechanisms that are placed on an end area of the track and that drive each rack respectively to slide along the track by pinions engaged with teeth of each rack.

[0016] According to the present invention, for example, when a finger bag of a glove is knitted, operations to capture and cut the cross-over-yarn and to insert the edge yarn into the fabric and to release the edge yarn can be carried out smoothly in both directions.

Brief Description of Drawings

[0017]

[Fig. 1] Fig. 1 is a front view showing a concisely schematic structure of an edge yarn processing apparatus 10 of a flatbed knitting machine as one embodiment of the present invention.

[Fig. 2] Figs. 2 are a plan view, a front view, and a right side view showing a structure of a first gripper 11 of Fig. 1.

[Fig. 3] Figs. 3 are a plan view and a front view showing a structure of a second gripper 12 of Fig. 1.

[Fig. 4] Figs. 4 are front views showing operation that a knitting yarn 5 is gripped by a hook member 31 and a holding member 32 of a first gripping part 13 shown in Figs. 2.

[Fig. 5] Fig. 5 is a graph showing an example of height change of the hook members 31, 41 and the holding members 32, 42 associated with operation of the edge yarn processing apparatus 10 of Fig. 1.

[Fig. 6] Figs. 6 are side cross-sectional views showing structures related to a track 20 of Fig. 1.

[Fig. 7] Figs. 7 are a plan view, a front view, and a right side view showing a structure of a first holder 15 of Fig. 1.

[Fig. 8] Figs. 8 are a plan view, a front view, and a right side view showing a structure of a first guiding member 33 mounted to a guiding member fixing portion 15d of the first holder 15 of Figs. 7.

[Fig. 9] Figs. 9 are a plan view and a front view showing a structure of a second holder 16 of Fig. 1.

[Fig. 10] Figs. 10 are a plan view and a front view showing a structure of a second guiding member 43 mounted to a mounting part for guiding member 16d of the second holder 16 of Figs. 9.

[Fig. 11] Figs. 11 are a plan view, a front view, and a right side view showing a structure of a first grooved cam member 17 of Fig. 1.

[Fig. 12] Figs. 12 are a plan view and a front view showing a structure of a second grooved cam member 18 of Fig. 1.

[Fig. 13] Figs. 13 are a plan view, a front view, and a right side view of the hook member 31 and a plan view and front view of the hook member 41 of Figs. 2.

[Fig. 14] Figs. 14 are a plan view, a front view, and a right side view of the holding member 32 and a plan view and a front view of the holding member 42 of Figs. 2.

[Fig. 15] Figs. 15 are a plan view, a front view, and a right side view showing a structure of a cutter 19 of Fig. 1.

[Fig. 16] Figs. 16 are a plan view and a front view showing a structure of levers 34, 55 of Figs. 2 and a lever 44 of Figs. 3, respectively.

[Fig. 17] Figs. 17 are a plan view, a front view, and a right side view showing a structure of a covering plate 38 of Figs. 2 and a plan view and a front view showing a structure of a covering plate 48 of Figs. 3.

[Fig. 18] Figs. 18 are a plan view and a front view showing a structure of a spacer 58 of Figs. 3.

[Fig. 19] Figs. 19 are a plan view, a front view, and a right side view showing a structure of connection members 39a, 49a of Figs. 2 and Figs. 3.

[Fig. 20] Figs. 20 are a plan view and a front view showing a structure of driving members 27a, 27b of Figs. 2 and Figs. 6.

[Fig. 21] Fig. 21 is a front view showing a state in which the first gripper 11 and the second gripper 12 of Fig. 1 are in an inserting position.

[Fig. 22] Fig. 22 is a partial cross-sectional view of a needle bed gap 3 showing a state in which the first gripper 11 and the second gripper 12 of Fig. 1 are in the inserting position.

[Fig. 23] Fig. 23 is a front view showing a state in which the first gripper 11 and the second gripper 12 of Fig. 1 are in an intermediate position.

[Fig. 24] Fig. 24 is a front view showing a state in which the first gripper 11 and the second gripper 12 of Fig. 1 are in a waiting position.

[Fig. 25] Fig. 25 is a partial cross-sectional view of the needle bed gap 3 showing a state in which the first gripper 11 and the second gripper 12 of Fig. 1 are in the waiting position.

[Fig. 26] Fig. 26 is a front view showing a state in which the first gripper 11 and the second gripper 12 of Fig. 1 are in the intermediate position.

[Fig. 27] Fig. 27 is a front view showing a state in which the first gripper 11 and the second gripper 12 of Fig. 1 are in the inserting position.

[Fig. 28] Fig. 28 is a front view showing a knitting yarn cutting state by the cutter 19 of Fig. 1.

[Fig. 29] Fig. 29 is a side view showing the knitting yarn cutting state by the cutter 19 of Fig. 1.

[Fig. 30] Figs. 30 are a plan view, a front view, and a right side view showing a structure of a first gripper 111 used

for an edge yarn processing apparatus as another embodiment of the present invention.

[Fig. 31] Figs. 31 are a plan view and a front view showing a structure of a second gripper 112 used for the edge yarn processing apparatus device as the other embodiment of the present invention.

5 Explanation of Reference

[0018]

1.	Flatbed knitting machine
10 2.	Needle bed
3.	Needle bed gap
4.	Yarn feeding member
10.	Edge yarn processing apparatus
11, 111.	First gripper
15 12, 112.	Second gripper
13, 113.	First gripping part
14, 114.	Second gripping part
15, 115.	First holder
16, 116.	Second holder
20 17, 117.	First grooved cam member
18, 118.	Second grooved cam member
19, 119.	Cutter
20.	Track
21,22.	Driving part
25 23, 23a, 23b, 24, 24a, 24b.	Rack
25, 25a, 25b, 26.	Guide
31, 41, 121, 141.	Hook member
32, 42, 132, 142.	Holding member
34,44,55,134,144.	Lever
30 38, 48, 138, 148	Covering plate
50	Cutter member
51	Upper blade
52	Lower blade

35 Best Mode for Carrying Out the Invention

[0019] Fig. 1 shows a concisely schematic structure of one embodiment of the present invention. A flatbed knitting machine 1 feeds knitting yarn 5 from a yarn feeding member 4 to knitting needles for knitting a fabric while the needles advance to a needle bed gap 3 in which front and rear needle beds 2 facing each other. On the needle bed 2, a large number of knitting needles are placed side by side, and a carriage, whose illustration is omitted, selectively drives knitting needles while the carriage is running back and forth along the needle bed 2 and knits a fabric while taking a yarn feeding member 4 along. The yarn feeding member 4 runs along yarn feeder rails 6 built above the needle bed gap 3. When knitting of a finger bag of a glove, or the like is temporarily finished and right before knitting for a next finger bag starts, a knitting yarn 5 crosses over from the knitting needle at the end of the knitted finger bag to the yarn feeding member 4.

[0020] An edge yarn processing apparatus 10 according to the present embodiment is provided to capture and cut the knitting yarn 5 in such state, and thereby to process the edge yarn generated. The edge yarn processing apparatus 10 includes two gripper units, namely, a first gripper 11 and a second gripper 12. The first gripper 11 and the second gripper 12 have a first gripping part 13 and a second gripping part 14, which can grip the knitting yarn 5 at the head ends, respectively. The operations of the first gripping part 13 and the second gripping part 14 are carried out, respectively, on the basis of relative movements of a first grooved cam member 17 and a second grooved cam member 18 with respect to a first holder 15 and a second holder 16. To the first gripper 11, a cutter 19 is also equipped, and the operation of the cutter 19 is carried out together with the first gripping part 13 on the basis of relative movement of the first grooved cam member 17 with respect to the first holder 15. Incidentally, the first gripper 11 and the second gripper 12 basically have a commonality of operation and structure, at least, with respect to the first gripping part 13 and the second gripping part 14.

[0021] The first holder 15 and the first grooved cam member 17 of the first gripper 11, and the second holder 16 and the second grooved cam member 18 of the second gripper 12, are movable, respectively, along a track 20 linearly built above the needle bed gap 3. On both end area of the track 20, driving parts 21,22 which drive the first holder 15 and

the first grooved cam member 17, as well as the second holder 16 and the second grooved cam member 18 are placed, respectively. In the edge yarn processing apparatus 10 of the present embodiment, head ends of racks 23,24 are connected to driven parts, which are moved by pushing and pulling while pinions of the driving parts 21,22 are engaged with teeth of the racks 23,24. For example, racks made of synthetic resin are used for the racks 23,24, and the one ends thereof are housed in bended guides 25,26 utilizing the flexibility. Racks are bent with the side with teeth inside. In the event that a band-shape surface to which teeth are disposed upright in racks 23,24 is parallel to the paper surface, the direction in which guides 25,26 are bent is an in-plane perpendicular to the paper surface, and for example, the guides are bent to the rear side. Incidentally, as shown from the structure in the vicinity of the needle bed gap 3 such as one in Fig. 22 described later, the direction in which the first gripping part 13 and the second gripping part 14 advance and retreat to and from the needle bed gap 3 inclines with respect to the direction of the yarn feeding member 4, such as a yarn feeder. The yarn feeding member 4 droops downward from above the needle bed gap 3 nearly in the vertical direction. Consequently, the direction in which the first gripping part 13 and the second gripping part 14 advance and retreat to and from the needle bed gap 3 inclines with respect to the vertical direction, and the band-shape surface of racks 23,24 is parallel to the advancing and retreating direction and inclines in the same manner.

[0022] For example, two racks are used as each rack 23, 24 respectively. The first holder 15 and the first grooved cam member 17 as well as the second holder 16 and the second grooved cam member 18 are driven by two pieces each of driving parts 21,22, respectively, that is, by a total of four driving parts. In this way, movement of the first gripper 11 and the second gripper 12 as well as change-over of operation between the first gripping part 13 and the second gripping part 14 can be activated independently. By bringing the first gripper 11 and the second gripper 12 close to a predetermined range and relatively moving the first grooved cam member 17 and the second grooved cam member 18, the first gripping part 13 and the second gripping part 14 are operated to simultaneously capture and grip the knitting yarn 5. In addition, in the first gripper 11, change-over of operations of the first gripping part 13 and operation of the cutter 19 can be conducted independently, except the operations of capturing and gripping of the knitting yarn 5, which are conducted together with the second gripper 12.

[0023] Figs. 2 show a structure of the first gripper 11. Fig. 2(a) shows a state of the first gripper 11 as a plan view, Fig. 2(b) shows the state as a front view, and Fig. 2(c) shows the state as a right side view, respectively. The first gripper 11 has the first holder 15 supported by the track 20 and movable in the lateral direction of Fig. 1 sliding along the track 20. The first holder 15 is connected, for example, to the one end part of a rack 23a on the upper step side. To the first holder 15, the first grooved cam member 17 is housed, and is able to move relatively in the lateral direction of the drawing. The first grooved cam member 17 is also connected, for example, to the one end part of a rack 23b on the lower step side. To the connection parts at the one ends of racks 23a,23b, driving members 27a,27b are mounted, respectively.

[0024] The first gripping part 13 is formed with the head end of a hook member 31 and the head end of a holding member 32. The hook member 31 and the holding member 32 are guided by a first guiding member 33 to move in the vertical direction of the drawing.

[0025] A lever 34 has an intermediate roller slotted into a gripper cam groove 17a of the first grooved cam member 17 and a base end is rotatably supported by a supporting point 36. The head end of the lever 34 is connected to the hook member 31 via a connecting part 37, and moves the hook member 31 up and down with the guide of the gripper cam groove 17a to a roller 35. The hook member 31 and holding member 32 as well as the driving part of the cutter 19 are housed in a gripper guiding part 33b and a cutter guiding part 33c of the first guiding member 33 shown in Fig. 8. The gripper guiding part 33b and the cutter guiding part 33c serve as a guiding groove of the first holder 15. The hook member 31 and the holding member 32 housed in the gripper guiding part 33b and the cutter guiding part 33c are prevented from dropping in the direction perpendicular to the paper surface by a covering plate 38 that covers the surface side. In the covering plate 38, a stopping part 38a that prevents the holding member 32 from lowering is also formed. Between the first guiding member 33 of the first holder 15 and the first grooved cam member 17 and racks 23a,23b, connecting members 39a,39b which fit to driving members 27a,27b mounted to the one ends of racks 23a,23b and which receive the driving force are installed, respectively, to achieve mechanical connections. Incidentally, in the first grooved cam member 17, a cutter cam groove 17b is also formed. To the cutter cam groove 17b, a roller 56 mounted at the middle of the lever 55 is slotted in. When the first grooved cam member 17 moves relatively to the first holder 15, the first grooved cam member 17 displaces the lever 55 to rock via the roller 56. The rocking displacement of the lever 55 can move the cutter member 50 vertically via a connecting part 57 on a free edge part side and can drive the cutter 19. The vertical movement of the cutter member 55 takes place at the V-letter shape section formed in the cutter cam groove 17b.

[0026] Figs. 3 show a structure of the second gripper 12. Fig. 3(a) shows a state of the second gripper 12 as a plan view and Fig. 3(b) shows the state as a front view, respectively. The second gripper 12 has a second holder 16 supported by the track 20 of Fig. 1 and moved in the lateral direction of Fig. 1 sliding along the track 20. The second holder 16 is subject to drive from one end of a rack 24a via a connecting member 49a. To the second holder 16, a second grooved cam member 18 is housed, and is relatively movable in the lateral direction of the drawing. The second grooved cam member 18 is also subject to drive from one end of a rack 24b via a connecting member 49b.

[0027] The second gripping part 14 is formed with a head end of a hook member 41 and a head end of a holding member 42. The hook member 41 and the holding member 42 are guided by a second guiding member 43 to move in the vertical direction of the drawing.

[0028] A lever 44 has an intermediate roller 45 slotted in the gripper cam groove 18a of the second grooved cam member 18 and a base end rotatably supported by a supporting point 46. The head end of the lever 44 is connected to the hook member 41 via a connecting part 47 and moves up and down the hook member 41 to follow the roller 45 guided by the gripper cam groove 18a. The hook member 41 and the holding member 42 are housed in a guiding part for gripping part 43b of the second guiding member 43 shown in Fig. 10 and are prevented from dropping in the direction perpendicular to paper surface by the covering plate 48 that covers the surface side. On the covering plate 48, a stopping part 48a that prevents the holding member 42 from lowering is also formed. To the second guiding member 43 of the second holder 16 and the second grooved cam member 18, connecting members 49a and 49b are installed, respectively, and same as Figs. 2, they achieve mechanical connections with respect to the rack 24. As described later, the lever 44 and the hook member 41 form the connecting part 47, and a spacer 58 is inserted between the hook member 41 as well as the lever 44 and the second guiding member 43.

[0029] Figs. 4 show states in which the knitting yarn 5 is gripped by the hook member 31 and the holding member 32 of the first gripping part 13 shown in Figs. 2. Fig. 4(a) shows the state in which the knitting yarn 5 is captured by the hook part 31a at the head end of the hook member 31. A holding part 32a at the head end of the holding member 32 is formed with a plate spring which pinches the hook part 31a from both sides. Under a state in which the holding part 32a of the holding member 32 pinches only a portion above the hook part 31a of the hook member 31, the hook member 31 and the holding member 32 do not completely operate simultaneously, and therefore the range in which only the hook member 31 moves up and down increases. As shown in Fig. 4(b), pulling up the hook member 31 with respect to the holding member 32 to pinch the hook part 31a by the holding part 32a can grip the knitting yarn 5. Under a state in which the knitting yarn 5 is gripped by the hook part 31a and the holding part 32a, the hook member 31 and the holding member 32 move simultaneously as if the holding member 32 follows the hook member 31 by a pinching force. In the hook member 31, a concave part 31b is formed to drive the up and down movement. To the holding member 32, as described later with respect to Fig. 21, an arm part 32b, which comes in contact with a stopping part 43a of the second guiding member 43 to stop lowering, is formed.

[0030] Fig. 5 shows an example of changes in heights of hook parts 31a, 41a of hook members 31, 41 in association with the operation of the edge yarn processing apparatus 10 in full lines and changes in heights of holding parts 32a, 42a of holding members 32, 42 in dashed lines. Before the time instant t_0 , the first gripper 11 and the second gripper 12 are moved from a waiting state at a remote location outside the knitting width of the fabric being knitted to a location of coming close to the knit end, and a state in which they come in contact with each other as shown in Fig. 24 described later is achieved. As shown in full lines, when hook members 31, 41 are lowered from time instant t_0 to time instant t_1 , holding members 32, 42 descend partway as shown in dashed lines. This is because arm parts 32b, 42b of holding members 32, 42 come into contact with the stopping part 43a of the second guiding member 43 and the stopping part 33a of the first guiding member 33, respectively, to prevent them from descending. From time instant t_1 to time instant t_2 , with a spacing between hook parts 31a, 41a and holding parts 32a, 42a held distant, the yarn feeding member 4 is moved, and the first gripper 11 and the second gripper 12 pass through so that the knitting yarn 5 as a cross-over-yarn passes between hook parts 31a, 41a and holding parts 32a, 42a. On the way to raise hook members 31, 41 from time instant t_2 , the knitting yarn 5 is captured by hook parts 31a, 41a as shown in Fig. 4(a). Further the hook members 31, 41 are raised then the hook parts 31a, 41a reach the height where holding parts 32a, 42a are stopping. The knitting yarn 5 is gripped between hook parts 31a, 41a and holding parts 32a, 42a as shown in Fig. 4(b). When hook parts 31a, 41a and holding parts 32a, 42a which grip the knitting yarn 5 finish ascending at time instant t_3 , the cutter 19 is operated to cut the knitting yarn 5.

[0031] After cutting the knitting yarn 5, the first gripper 11 and the second gripper 12 are moved independently from each other. For example, if an edge yarn is gripped by the first gripper 11 at one side near to the yarn feeding member 4, the first gripper 11 is set in a waiting state being away from the knitted fabric. The gripping part 14 of the second gripper 12, which is to grip the edge yarn at the other side near to the knitted fabric, moves to a position within the knitting width of the knitted fabric such as a finger bag or the like, before time instant t_4 . When the hook member 41 begins to descend at time instant t_4 , the holding member 42 also follows to descend until the arm part 42b comes into contact with the stopping part 48a of the covering plate 48. Since the holding member 42 is held back on the way of descending, if the hook member 41 could be inserted within a finger bag or the like by time instant t_5 , it would occur either gripping of the knitting yarn 5 by the gripping part 14 would dissolve or at least the gripping force would decrease. If the gripping part 14 could be moved sideways by time instant t_6 , it would enable to break away the knitting yarn 5 from the gripping part 14 and to insert the knitting yarn within the finger bag or the like. If the hook member 41 could be raised to the height for waiting from time instant t_6 to time instant t_7 , on the way the holding member 42 would ascend together.

[0032] Incidentally, as a method for capturing the knitting yarn 5, it is possible to allow the knitting yarn 5 to cross over from the knitt end of knitted fabric to the yarn feeding member 4 in advance. If the hook members 31, 41 might be raised

after the first gripper 11 and the second gripper 12 with lowering hook parts 31a,41a might be entered from one side of the knitting yarn 5 which might be in the state of cross over yarn, the knitting yarn 5 could be captured and gripped.

[0033] In the flatbed knitting machine 1 according to the first embodiment, as shown in Fig. 2 and Fig. 3, in the first grooved cam member 17, the gripper cam groove 17a and the cutter cam groove 17b are separated. Sections that lowers the hook member 31 in the gripper cam groove 17a are formed on both sides of the section that operates the cutter 19 with the cutter cam groove 17b. This can make operation of the first gripper 11 and operation of the cutter 19 free of directionality and enables the operating direction to be freely chosen. For example, with respect to the first holder 15, when the first grooved cam member 17 moves relatively to the left side, and when it moves relatively to the right side, the process of edge yarn including cutting the knitting yarn 5 from gripping and releasing the gripped knitting yarn 5 can be smoothly carried out. Furthermore, because the gripper cam groove 17a and the cutter cam groove 17b of the first grooved cam member 17 and the gripper cam groove 18a of the second grooved cam member 18 have nearly bilaterally symmetrical shapes, they can be operated without causing a performance difference caused by the direction.

[0034] Figs. 6 show structures relating to the track 20 of Fig. 1. Fig. 6(a) shows a structure of the track 20 itself. The track 20 has a track member 20a, with head end side serving as a guide 25, fixed to a supporting block 20c by a plurality of bolts 20b installed with certain intervals. Fig. 6(b) shows a state in which the first holder 15 is supported by the track 20. The second holder 16 is supported in the same manner. As shown in Fig. 6(b), in the first holder 15, the first guiding member 33 is driven by a driving member 27a mounted to the head end of a rack 23a which is housed in the track member 20a via a connecting member 39a. In the track member 20a, a rack 23b for driving the first grooved cam member 17 is also housed. The guide 25 portion of the track member 20a and the portion fixed by the bolts 20b or the like, may be divided and assembled. The supporting block 20c is connected to the base substrate of the flatbed knitting machine 1 of Fig. 1.

[0035] As shown in Fig. 6(c), in one end part of the track 20, the driving part 21 is installed. The driving part 22 shown in Fig. 1 is installed to the other end part of the track 20 in the same manner. In the driving part 21, a motor 60 is disposed. The motor 60 is mounted to the opening side of the guide 25 which houses racks 23a,23b by a bracket 62 in such a manner that an output shaft 61 faces teeth of racks 23a,23b. At the head end of the output shaft 61, either one of pinion 63a or pinion 63b is installed and engaged with teeth of racks 23a,23b. By installing two each of this kind of motor 60 and pinions 63a,63b and driving racks 23a,23b, respectively, the first holder 15 and the first grooved cam member 17 can be moved along the track 20 from the end part of the track 20. Since the first grooved cam member 17 is housed in the first holder 15, moving the first holder 15 and the first grooved cam member 17 equivalently brings the first grooved cam member 17 to the stationary state with respect to the first holder 15. In the event that a difference is generated between the movements of the first holder 15 and the first grooved cam member 17, the first grooved cam member 17 moves relatively to the first holder 15. The movements of the second holder 16 and the second grooved cam member 18 are carried out in the same manner.

[0036] Fig. 6(d) shows sensors 65a,65b installed at the end part of the rack 20. Sensors 65a,65b detect approach of the end parts of the first holder 15 and the first grooved cam member 17 of, for example, the first gripper 11. When signals are outputted to indicate that the first holder 15 and the first grooved cam member 17 are approaching to locations of sensors 65a,65b, it is possible to confirm that the first gripper 11 is in the reference state. Using a stepping motor for the motor 60 shown in Fig. 6(c) or computing the rotation rate by a rotary encoder can identify the drive rate of racks 23a,23b by pinions 63a,63b and can find out the location of the first holder 15 and the first grooved cam member 17 with the end part set as a reference. For the second gripper 12, too, the location is able to be found out as is the case of the first gripper 11.

[0037] Figs. 7 show a structure of the first holder 15. Fig. 7(a) shows a state as a plan view, Fig. 7(b) shows the state as a front view, and Fig. 7(c) shows the state as a right side view, respectively. To the first holder 15, a grooved cam storage part 15a and a lever storage part 15b are formed parallel to the moving direction. On the surface side, a boss 15c is formed. On the side where the second holder 16 exists, a mounting part for guiding member 15d is formed and an elongated opening hole 15e is formed on the lower part of the drawing.

[0038] Fig. 8 shows a structure of the first guiding member 33 mounted to the guide mounting part 15d of the first holder 15. Fig. 8(a) shows a state as a plan view, Fig. 8(b) shows the state as a front view, and Fig. 8(c) shows the state as a right side view, respectively. To the direction where the second holder 16 exists in a state in which the first guiding member 33 is mounted to the guide mounting part 15d of the first holder 15, a stopper arm 33a protrudes. On the surface of the first guiding member 33, a guiding part for gripping part 33b, which guides the hook member 31 and the holding member 32 in the vertical direction of the drawing, and a cutter guiding part 33c, which carries out a guide to operate the cutter 19, are mounted. For operation of the cutter 19, a cutter operation restricting part 33d is also formed.

[0039] Figs. 9 show a structure of the second holder 16. Fig. 9(a) shows a state as a plan view and Fig. 9(b) shows the state as a front view, respectively. In the second holder 16, a grooved cam storage part 16a and a lever storage part 16b are formed parallel to the moving direction. On the surface side, a boss 16c is formed. In the side where the first holder 15 exists, a guide mounting part 16d is formed, and an elongated opening hole 16e is formed.

[0040] Figs. 10 show a structure of the second guiding member 43 mounted to the guide mounting part 16d of the

second holder 16. Fig. 10(a) shows a state as a plan view and Fig. 10(b) shows the state as a front view, respectively. In the direction where the first holder 15 exists in the state in which the second guiding member 43 is mounted to the guide mounting part 16d of the second holder 16, the stopper arm 43a protrudes. On the surface of the second guiding member 43, the gripper guiding part 43b is mounted to guide the hook member 41 and the holding member 42 in the vertical direction.

[0041] Figs. 11 show a structure of the first grooved cam member 17. Fig. 11(a) shows a state as a plan view, Fig. 11(b) shows the state as a front view, and Fig. 11(c) shows the state as a right side view, respectively. To the first grooved cam member 17, the connecting member 39b is connected at the bottom. The connecting member 39b is exposed to the outside from an elongated opening hole 15e with the first grooved cam member 17 housed in the grooved cam storage part 15a of the first holder 15. On the surface of the first grooved cam member 17, the gripper cam groove 17a is formed on the lower step side, and the cutter cam groove 17b is formed on the upper step side. The cutter cam groove 17b is formed in such a manner as to operate the cutter in the waiting section in the gripper cam groove 17a. The gripper cam groove 17a and the cutter cam groove 17b are totally formed in bilaterally symmetric like shape.

[0042] Figs. 12 show a structure of the second grooved cam member 18. Fig. 12(a) shows a state as a plan view and Fig. 12(b) shows the state as a front view, respectively. To the second grooved cam member 18, the connecting member 49b is also connected at the bottom. The connecting member 49b is exposed to the outside from the elongated opening hole 16e with the second grooved cam member 18 housed in the storage part for grooved cam member 16a of the second holder 16. On the surface of the second grooved cam member 18, the gripper cam groove 18a is formed. The gripper cam groove 18a is totally formed in bilaterally symmetric like shape.

[0043] Figs. 13 show structures of the hook member 31 and the hook member 41. Figs. 13(a), 13(b), and 13(c) show a state of the hook member 31 as a plan view, a front view, and a right side view, respectively. Figs. 13(d) and 13(e) show the hook member 41 as a plan view and a front view, respectively. On the lower end of the hook members 31, 41, hook parts 31a, 41a are formed. In the middle between the top and the bottom of the hook members 31, 41, concave parts 31b, 41b are formed so as to protrude to the side in order to construct connecting parts 37, 47 shown in Figs. 2 and Figs. 3, respectively.

[0044] Figs. 14 show structures of the holding member 32 and the holding member 42. Figs. 14(a), 14(b), and 14(c) show a state of the holding member 32 as a plan view, a front view, and a right side view, respectively. Figs. 14(d) and 14(e) show the holding member 42 as a plan view and a front view, respectively. The shape of the holding member 42 is symmetrical to the holding member 32 except arm parts 32b, 42b, and the state of the holding member 42 as a left side view is same as Fig. 14(d).

[0045] At the lower end of the holding members 32, 42, holding parts 32a, 42a are formed as two plate springs. At the position a little upwards from the midpoint between top and bottom of the holding members 32, 42, arm parts 32b, 42b are formed so as to protrude to the side. The arm parts 32b, 42b are so formed as to be able to contact with the stopping arm 43a of the second guiding member 43 and stopping arm 33a of the first guiding member 33 shown in Figs. 10 and Figs. 8, respectively. Incidentally, the arm parts 32b, 42b are also able to contact with the stopping parts 38a, 48a of the covering plates 38, 48.

[0046] Figs. 15 show a structure of the cutter 19. Fig. 15(a) shows a structure of the cutter member 50 as a plan view, and Figs. 15(b) and 15(c) show the structure of the cutter 19 as a front view and a right side view, respectively. The cutter 19 is constructed by connecting an upper blade 51 and a lower blade 52 to the lower end of the cutter member 50 at the supporting point 53. A pressure contacting state of the upper blade 51 and the lower blade 52 at the supporting point 53 is adjusted by the suppress strength of the spring 54. The lower end of the cutter member 50 is connected to the upper part of the lower blade 52. The upper blade 51 has an arm 51a extending from the supporting point 53 in the lateral direction. The arm 51a is used by being inserted in the cutter operation restricting part 33d of the first guiding member 33 shown in Figs. 8.

[0047] Figs. 16 show structures of levers 34, 55, and 44. Fig. 16(a) and Fig. 16(b) show a structure of the lever 34 as a plan view and a front view, respectively. Fig. 16(c) and Fig. 16(d) show a structure of the lever 55 as a plan view and a front view, respectively. Fig. 16(e) and Fig. 16(f) show a structure of the lever 44 as a plan view and a front view, respectively. In the middle of the levers 34, 55, and 44, rollers 35, 56, and 45 are installed, respectively. The base end side of the lever 34 and the lever 55 are connected to the common supporting point 36. On the free edge side of the levers 34 and 55, a convex part 34a and a concave part 55a which serve as connecting part 37, 57 are formed, respectively. The lever 44 is connected to a supporting point 46 on the base end side and has a convex part 44a that serves as connecting part 47 on the free edge side.

[0048] Figs. 17 show a structure of the covering plates 38, 48. Figs. 17(a), 17(b), and 17(c) show the structure of the covering plate 38 as a plan view, a front view, and a right side view, respectively. Figs. 17(d) and 17(e) show the structure of the covering plate 48 as a plan view and a front view, respectively. In the covering plates 38, 48, stopping parts 38a, 48a are formed at the bottom, and arm parts 32b, 42b of the holding members 32, 42 shown in Figs. 14 are connectable thereto. Above the stopper arms 38a, 48a, protrusions 38b, 48b similar to stopping parts 38a, 48a are formed, respectively, to restrict the ascending position of arm parts 32b, 42b of holding members 32, 42.

[0049] Figs. 18 show a structure of a spacer 58 shown in Figs. 3. Figs. 18(a) and 18(b) show a state as a plan view and a front view, respectively. On the second gripper 12 side, no structure such as a lever 55 that drives cutter or the like is installed, and therefore, a spacer 58 of thickness equivalent to that of the lever 55 is inserted.

[0050] Figs. 19 show structures of connection members 39a,49a shown in Figs. 2 and Figs. 3. Figs. 19(a), 19(b), and 19(c) show a state as a plan view, a front view and a right side view, respectively. The connecting members 39b, 49b are of the same shape but used the shape upside down.

[0051] Figs. 20 show a structure of driving members 27a,27b shown in Figs. 2, Figs. 6, or the like. Figs. 20(a) and 20(b) show the structure as a plan view and a front view, respectively. The driving members 27a, 27b have teeth that fit to the teeth of surfaces of racks 23a,23b;24a,24b, and are mounted to the vicinity of the head ends of the racks 23a, 23b;24a,24b with bolts. On connecting members 39a,39b;49a,49b, U-letter shape concaves as shown in Fig. 19(b) are formed and driving members 27a,27b fit to the concaves and transmit driving force from the racks 23a, 23b;24a,24b to the connecting members 39a,39b;49a,49b.

[0052] Hereinafter, Fig. 21 to Fig. 29 show typical operations of the edge yarn processing apparatus 10 with a state in which the first grooved cam member 17 and the second grooved cam member 18 are driven to move with respect to the first holder 15 and the second holder 16, while the holders are stopping. Incidentally, for the convenience of explanation, description of the guide mounting parts 15d,16d and description of the spacer 58 are omitted in the first holder 15 and the second holder 16. In addition, the front view shows the state in which the covering plates 38,48 are removed. The side cross-sectional view shows additionally simplified structure of the needle bed 2 in the flatbed knitting machine 1.

[0053] Fig. 21 and Fig. 22 show a state in which the first gripper 11 and the second gripper 12 descend the hook members 31,41 of the first gripping part 13 and the second gripping part 14 and insert them into the knitting area. Fig. 21 shows the state as a partial cross-sectional front view of the needle bed gap 3 and Fig. 22 shows the state as a right side view, respectively. Rollers 35,45 are located in insertion positions on the lower step side of the gripper cam groove 17a,18a, and therefore, rockingly displace levers 34,44 in such a manner as to lower the free edge side and push down the hook members 31,41 to the lower end via connecting parts 37,47. The inserting state is able to be independently achieved by the first gripper 11 and the second gripper 12, respectively, and the close contact condition between the first gripper 11 and the second gripper 12 shown in Fig. 21 is not necessary and the distance between them may be separated.

[0054] Under a closely contacting state between the first gripper 11 and the second gripper 12 as shown in Fig. 21, lowering of arms 32b,42b of holding members 32,42 can be prevented, respectively, by the stopping parts 43a of the second guiding member 43 and the stopping part 33a of the first guiding member 33. As a result, holding members 32,42 stay at the upper part and only hook members 31,41 advance to the needle bed gap 3, and thereby capturing or the like of knitting yarn 5 is able to be easily carried out.

[0055] Fig. 22 shows the operating condition at the needle bed gap 3 in the inclined manner. In the actual flatbed knitting machine 1, for example, the direction in which the yarn feeding member 4 extends comes close to the perpendicular direction, but for convenience of description, the moving direction of the hook member 31 and holding member 32 is shown in the vertical direction. In the needle bed gap 3, a hook 70a and a slider 71a of a knitting needle belongs to the front needle bed advance, and a hook 70b and a slider 71b of a knitting needle belongs to the rear needle bed advance, then they drag the knitting yarn fed from the yarn feeding member 4 and form a knitted loop. For a knitting needle, a composite needle that opens and closes hooks 70a,70b with sliders 71a,71b is shown, but a latch needle that opens and closes hooks 70a,70b by a latch may be used, too. In the needle bed gap 3, movable sinkers 72a,72b are provided in such a manner that they advance and retreat from the front and rear needle beds. In addition, a stitch presser 73 for pressing knitted fabric is inserted in the needle bed gap 3.

[0056] Hereinafter, in Fig. 25 and Fig. 29 together with Fig. 22, a state of the first gripper 11 is shown as a right side view. Although the illustration is omitted, except the structure relating to the cutter 19, the second gripper 12 operates in the same manner as portions corresponding to the first gripper 11.

[0057] Fig. 23 shows a state in which rollers 35,45 are located in an inclined sections of the gripper cam groove 17a of the first grooved cam member 17 and the gripper cam groove 18a of the second grooved cam member 18. The inclined sections of the gripper cam grooves 17a,18a are formed on the way between the waiting position and the insertion position. The free edge portions of the levers 34,44 installed with rollers 35,45, ascend, and hook members 31,41 ascend as compared to the insertion position shown in Fig. 21. When hook parts 31a,41a of the hook members 31,41 ascend to the position of the head end of holding parts 32a,42a of waiting holding members 32,42, holding members 32,42 ascend together with the hook members 31,41.

[0058] Fig. 24 and Fig. 25 show a yarn gripping state in which the first gripper 11 and the second gripper 12 are raised from the needle bed gap 3 to the waiting position. Fig. 24 shows a partial cross-sectional view of the needle bed gap 3 and Fig. 25 show a right side view thereof, respectively. As shown in Fig. 24, in the waiting position, rollers 35,45 are located at a section on the upper step side, which is the midpoint between the gripper cam groove 17a of the first groove cam member 17 and the gripper cam groove 18a of the second groove cam member 18, and a section on the lower step side corresponding to the insertion position is installed on both sides. The section corresponding to the waiting

position of the gripper cam groove 17a of the first grooved cam member 17 is installed being extended, and in this section, the cutter cam groove 17b has a shape that changes into a V-letter shape. When a roller 56 passes the bottom end of the V-letter shape section, the cutter 19 cuts the knitting yarn 5 by vertical movement of the cutter member 51 associated with the rocking displacement of the lever 55.

[0059] Fig. 26 shows a state of rollers 35,45 which are located in the inclined section corresponding to the intermediate position between the insertion position on the lower step side and the waiting position on the upper step side of the gripper cam grooves 17a,18a. However, in Fig. 23, the inclined section comes on the right side of the cam groove of the upper step side that corresponds to the waiting position of gripper cam grooves 17a,18a, whereas in Fig. 26, the inclined section comes on the left side. Allowing the rollers to move with the waiting position in-between from the intermediate position of Fig. 23 to the intermediate position of Fig. 26 can operate the cutter 19 in the waiting position on the halfway.

[0060] Fig. 27 shows a state in which hook members 31,41 are located at the insertion position similar to that of Fig. 21. However, the positions of rollers 35,45 are the insertion positions corresponding to the right-side inclined section of the groove on an upper step side corresponding to the waiting position, whereas in Fig. 27, it is the insertion position corresponding to the left-side inclined section. The right end of the first grooved cam member 17 intrudes into the second guiding member 43 side but no interference occurs since the second grooved cam member 18 has moved rightwards.

[0061] As described above, in the first gripping part 13 and the second gripping part 14, hook parts 31a,41a depart from holding parts 32a,43a and advance to the lower side of the needle bed gap 3. As shown in Fig. 4(a), if the yarn feeding member 4 moves to stretch the knitting yarn over hook parts 31a,41a and then, the hook parts 31a,41a are raised from the needle bed gap 3, the knitting yarn is able to be gripped by hook parts 31a,41a and to be pulled up to the position of holding parts 32a,42a, and to be captured. The holding members 32,42 have their arm parts 32b,42b come in contact with the stopping part 43a of the second guiding member 43 of the counterpart and with the stopping part 33a of the first guiding member 33, respectively, to be prevented from lowering, and the holding parts 32a,42a stay on the upper position than the head end of the yarn feeding member 4. Incidentally, in order to bring arm parts 32b,42b in contact with stopping parts 43a,33a, as shown in Fig. 21, the first guiding member 33 of the first gripper 11 and the second guiding member 43 of the second gripper 12 must be brought close to each other.

[0062] As shown in Fig. 22 and Fig. 25, hook members 31,41 and holding members 32,42 move along a linear route in the needle bed gap 3. The first gripper 11 and the second gripper 12 are installed to provide angles in such a manner that hook members 31,41 would not interfere with the yarn feeding member 4, stitch presser 64, or the like in the movement in this kind of linear route.

[0063] Fig. 28 and Fig. 29 show a state in which the cutter 19 is operated to cut the knitting yarn gripped by the first gripper 11 and the second gripper 12 in the motion following yarn grasping at the insertion position shown in Fig. 21 and Fig. 27. Fig. 28 shows the state as a front view and Fig. 29 shows the state as a right side view, respectively. In order to operate the cutter 19, the first grooved cam member 17 is moved horizontally with respect to the first holder 15 and the roller 56 installed to the lever 55 that drives the cutter member 50 must be guided to the bottom end of the V-letter shape section of the cutter cam groove 17b in the range where the roller 35 is located at the waiting position on the upper step side of the gripper cam groove 17a. This kind of first grooved cam member 17 is able to be driven independently on the first gripper 11 side but when the second gripper 12 comes close, the head end of the first grooved cam member 17 moving rightwards could come in contact with the second grooved cam member 18 and interfere with it. As shown in Fig. 27, cooperatively ascending the hook member 41 of the second gripping part 14 enables the second grooved cam member 18 to evacuate on the right side of the second holder 16. Because the lateral length of the second grooved cam member 18 is shorter than the second holder 16, a space on the left side can be made by evacuating the second grooved cam member 18 to the right side. Consequently, the head end of the first grooved cam member 17 is able to intrude into the second holder 16 side.

[0064] As shown in Fig. 29, the arm 51a extending from the upper cutter blade 51 of the cutter 19 is inserted in the cutter operation restricting portion 33d of the first guiding member 33 and is restricted in the vertical range of the cutter operation restricting portion 33d. Consequently, by pressing the cutter member 50 via the lever 55 shown in Fig. 28, the lower cutter blade 52 lowers together with the cutter member 50, while the upper cutter blade 51 rotates around the descending supporting point 53 in the direction to close the opening formed with the lower cutter blade 52. As a result, the angle between the upper cutter blade 51 and the lower cutter blade 52 closes and the cutter 19 carries out operation to cut the knitting yarn as scissors. In addition, by pulling up the cutter member 50 from the state to close the upper cutter blade 51 and the lower cutter blade 52, the upper cutter blade 51 rotates around the ascending supporting point 53 in the direction to open the angle formed with the lower cutter blade 52. As a result, in the cutter 19, an opening between the upper cutter blade 51 and the lower cutter blade 52 is expanded.

[0065] Expanding the distance between the first gripper 11 and the second gripper 12 enables the first gripper 11 and the second gripper 12 to independently operate, respectively. In the solo operation, the first gripping part 13 and the second gripping part 14 are allowed to advance into the needle bed gap 3, respectively, then gripping of the knitting yarn 5 by the first gripping part 13 and the second gripping part 14 can be released, too. When hook members 31,41

independently descend, the holding members 32,42 descend until the arm parts 32b,42b come in contact with the stopping parts 38a,48a of the covering plates 38,48. The hook members 31,41 can continue lowering slightly more. As a result, in the first gripping part 11 and the second gripping part 12, gripping of the knitting yarn 5 can be loosened. By advancing the first gripping part 13 and the second gripping part 14 into the needle bed gap 3 with the knitting yarn 5 gripped by the first gripping part 13 and the second gripping part 14, gripping can be loosened and released. By further moving the first gripper 11 and the second gripper 12 under gripping loosened condition, the gripped knitting yarn 5 can be withdrawn from hook parts 31a,41a of the hook members 31,41 and from the holding parts 32a,42a of the holding members 32,42.

[0066] The operation similar to that shown in Fig. 20 of the Patent Citation 2 can be carried out by the first gripper 11 and the second gripper 12 of the present invention, too. When knitting of one finger bag of a glove finishes and knitting of a next finger bag starts, the knitting yarn, extending from the knitting yarn of the needle bed holding the knitted finger bag to the yarn feeding member 4, crosses over on the hook parts 31a,41a which are in the yarn grasping state shown in Fig. 21 and Fig. 22 of the present invention and the hook parts 31a,41a ascend, so that the knitting yarn can be captured and gripped between the hook parts and the holding parts 32a,42a. The knitting yarn 5 with both ends gripped by the first gripper 11 and the second gripper 12 in the ascending state can be cut by operating the cutter 19 as shown in Fig. 28 and Fig. 29. Setting of the first gripper 11 to the yarn feeding member 4 side and the second gripper 12 to the finger bag side brings about the state in which the yarn end extending from the finger bag is gripped by the second gripper 12 and the head end of the knitting yarn 5 extending from the yarn feeding member 4 is gripped by the first gripper 11. The yarn end gripped by the second gripper 12 can be inserted into the finger bag by moving the second gripper 12 to the knitted finger bag side and further moving the second gripper 12 by loosening the gripping of the yarn end. It is possible to carry out an operation such that the first gripper 11 grips the yarn end until a next finger bag is knitted to a certain extent, after the finger bag is knitted to a certain extent, the first gripper moves into the finger bag and loosens the gripping, and then further moves to insert the yarn end into the finger bag. Under knitting states except the start of knitting or the end of knitting, the first gripper 11 and the second gripper 12 may be stopped at the outside the region where a fabric is knitted so that the first gripper 11 and the second gripper 12 maintain the waiting position shown in Fig. 24 and Fig. 25.

[0067] In the foregoing explanation, both the first gripper 11 and the second gripper 12 are driven, respectively, by the driving parts 21,22 placed on both end sides of the track 20, but the driving parts 21,22 may be placed collectively on one end side of the track 20. In addition, the first grooved cam member 17 and the second grooved cam member 18 may have driving parts mounted to the first gripper 11 and the second gripper 12 and may be moved relatively. Furthermore, the driving parts for moving may be mounted to the first gripper 11 and the second gripper 12 to achieve a self-propelled system.

[0068] Fig. 30 and Fig. 31 show a structure of a first gripper 111 and a second gripper 112 used for an edge yarn processing apparatus as a second embodiment of the present invention, respectively. The edge yarn processing apparatus carries out operation basically same as that of the edge yarn processing apparatus 10 shown in Fig. 21 through Fig. 29 in the flatbed knitting machine 1 shown in Fig. 1.

[0069] Figs. 30(a), 30(b), and 30(c) show a state of the first gripper 111 as a plan view, a front view, and a right side view, respectively. The first gripper 111 has a first holder 115 supported by a track 20 of Fig. 1 and movable in the lateral direction of the drawing to slide along the track 20. The first holder 115 is connected to one end part of a rack 23a by a rack connecting part 115a. In the first holder 115, the first grooved cam member 117 is housed and is relatively movable in the lateral direction of the drawing. The first grooved cam member 117 has also a rack connecting part 117a and is connected to one end of a rack 23b.

[0070] A first gripping part 113 is formed at the head end of a hook member 131 and the head end of a holding member 132. The hook member 131 and the holding member 132 are connected by a spring 133 in order to secure a bias in the direction to close the first gripping part 131. The structure of the gripping part formed with the hook member 131 and the holding member 132 is equivalent to that shown in Fig. 21 of Patent Citation 2.

[0071] A lever 134 has an intermediate roller 135 fit into a gripper cam groove 117b of the first grooved cam member 117 and the base end rotatably supported by a supporting point 136. The head end of the lever 134 is connected to the hook member 131 via a connecting part 137, and moves the hook member 131 up and down guided by a cam groove 117b to the roller 135. The hook member 131 and holding member 132 as well as the driving part of the cutter 119 are housed in a guiding groove of the first holder 115, and are prevented by the covering plate 138 from dropping in the direction perpendicular to the paper surface. Together with the lower side covering plate 138 shown in the drawing, an upper side covering plate is used, but illustration is omitted in Fig. 30. Between a rack connecting part 115a of the first holder 115 and a rack connecting part 117a of the first cam member 117 and the racks 23a,23b, connecting members 139a,139b are installed, respectively, and achieve mechanical connections.

[0072] The operation of a cutter 119 is carried out in the manner equivalent to that of the cutter 19 shown in Fig. 21 through Fig. 29. However, the cam groove 117b of the first grooved cam member 117 is shared with vertical drive of the hook member 131. That is, on the cam groove 117b, a roller 155 directly driving the cutter 119 slotted in the right side

section from the section to which the roller 135 slotted in.

[0073] Figs. 31(a) and 31(b) show a state of a second gripper 112 as a plan view and a front view, respectively. The second gripper 112 has a second holder 116 supported by the track 20 of Fig. 1 and movable in the lateral direction of the drawing to slide relative to the track 20. The second holder 116 is connected to one end of a rack 24a by a rack connecting part 116a. In the second holder 116, a second grooved cam member 118 is housed, and is relatively movable in the lateral direction of the drawing. The second grooved cam member 118 also has a rack connecting part 118a and is connected to one end of the rack 24b.

[0074] A second gripping part 114 is formed at the head end of a hook member 141 and the head end of a holding member 142. The hook member 141 and the holding member 142 are connected by a spring 143 and in order to secure a bias in the direction to close the second gripping part 114. The structure of the second gripping part 114 is equivalent to that of the first gripping part 113.

[0075] A lever 144 has an intermediate roller 145 fitted to a cam groove 118b of the second grooved cam member 118, and the base end rotatably supported by a supporting point 146. The head end of the lever 144 is connected to the hook member 141 via a connecting part 147 and moves the hook member 11 up and down guided by the cam groove 118b to the roller 145. Between a rack connecting parts 116a, 118a of the second holder 116 and of the second cam member 118, and racks 24a, 24b, connecting members 149a, 149b are installed, respectively, and achieve mechanical connections.

[0076] In the second embodiment, as shown in Fig. 30, the cam groove 117b of the first grooved cam member 117 is divided into the right and left inclined portions of the V-letter shape section and carry out both vertical drive of the hook member 131 and operation of the cutter 119, and therefore, downsizing is possible. However, there is no degree of freedom in the directionality of operation. A series of operations from gripping to cutting of the knitting yarn 5 are conducted by moving the first grooved cam member 117 rightwards with respect to the first holder 115 from the state in which the roller 135 is located at the lower end of the V-letter shape section. By moving the first grooved cam member 117 rightwards, the knitting yarn 5 is gripped while the hook member 131 is ascending, and is cut by guiding the roller 155 to the V-letter shape section.

Claims

1. An edge yarn processing apparatus for a flatbed knitting machine, including two grippers consist of a first gripper and a second gripper, the two grippers are independently movable on a track built along needle beds of the flatbed knitting machine, each gripper respectively having a gripping part which advances to and retreats from a knitting area where a fabric is knitted with knitting yarn fed to the knitting needles that advance from needle beds, the grippers being able to simultaneously capture and grip the knitting yarn by the gripping parts when the distance between grippers comes close to a predetermined range, and a cutter equipped to the first gripper for cutting the knitting yarn, comprising:

a first cam member mounted to the first gripper, being relatively movable in a direction along the track;
a first cam mechanism mounted to the first gripper, changing over an advancing or retreating state in which the gripping part advances to or retreats from the knitting area, and cutting state of the cutter, working with the relative movement of the first cam member;
a second cam member mounted to the second gripper, being relatively movable in a direction along the track; and
a second cam mechanism mounted to the second gripper, changing over an advancing or reversing state in which the gripping part advances to or retreat from the knitting area, working with the relative movement of the second cam member.

2. The edge yarn processing apparatus for the flatbed knitting machine according to claim 1, wherein said first cam mechanism and said second cam mechanism advance to said knitting area with knitting yarn gripped by said gripping parts, and can change over to said state in which the knitting yarn is not gripped or at least can reduce the gripping force under the advancing state.

3. The edge yarn processing apparatus for the flatbed knitting machine according to claim 1 or claim 2, wherein said first cam mechanism and said second cam mechanism guide said gripping part respectively, to advance to or to retreat from said knitting area in a predetermined linear route so as to prevent the gripping part from interfering with members used for knitting of the fabric.

4. The edge yarn processing apparatus for the flatbed knitting machine according to any one of claims 1 - 3, wherein said track is built linearly in parallel to the longitudinal direction of said the needle beds, and further comprising:

four racks, each rack connected to one of the first gripper, the second gripper, the first cam member, and the second cam member, being able to independently slide to move along the track; and
four drive mechanisms placed on an end area of the track for driving each rack to slide along the track by pinions engaged with teeth of each rack.

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5. The edge yarn processing apparatus for the flatbed knitting machine according to any one of claims 1 - 4, wherein said first cam member individually having a gripper cam groove for changing over to advance or to retreat the gripping part of said first gripper to or from said knitting area, and a cutting cam groove for changing over cutting condition of said cutter;
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- the gripper cam groove, formed in a shape that retreats the gripping part from the knitting area in the intermediate section and advancing the gripping part to the knitting area in sections on both sides;
- the cutting cam groove, having a shape that opens and closes the cutter symmetrically to the relative moving direction of the first cam member to the first gripper in the intermediate section of the gripper cam groove where the gripping part evacuates from the knitting area; and
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- said second cam member having a gripper cam groove, formed in a shape, the intermediate section of which retreats the gripping part from the knitting area and both side sections of which advances the gripping part to the knitting area.

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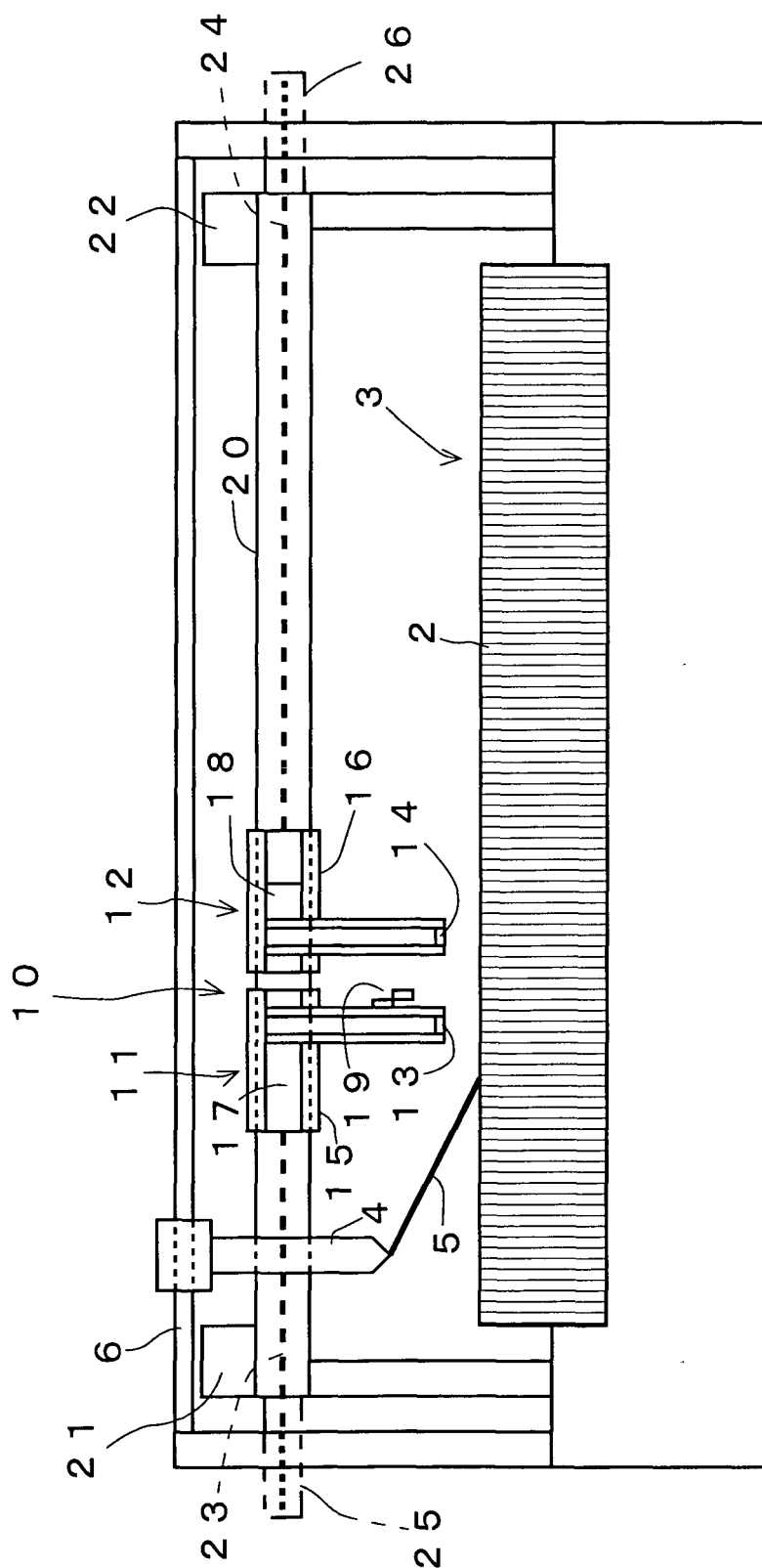
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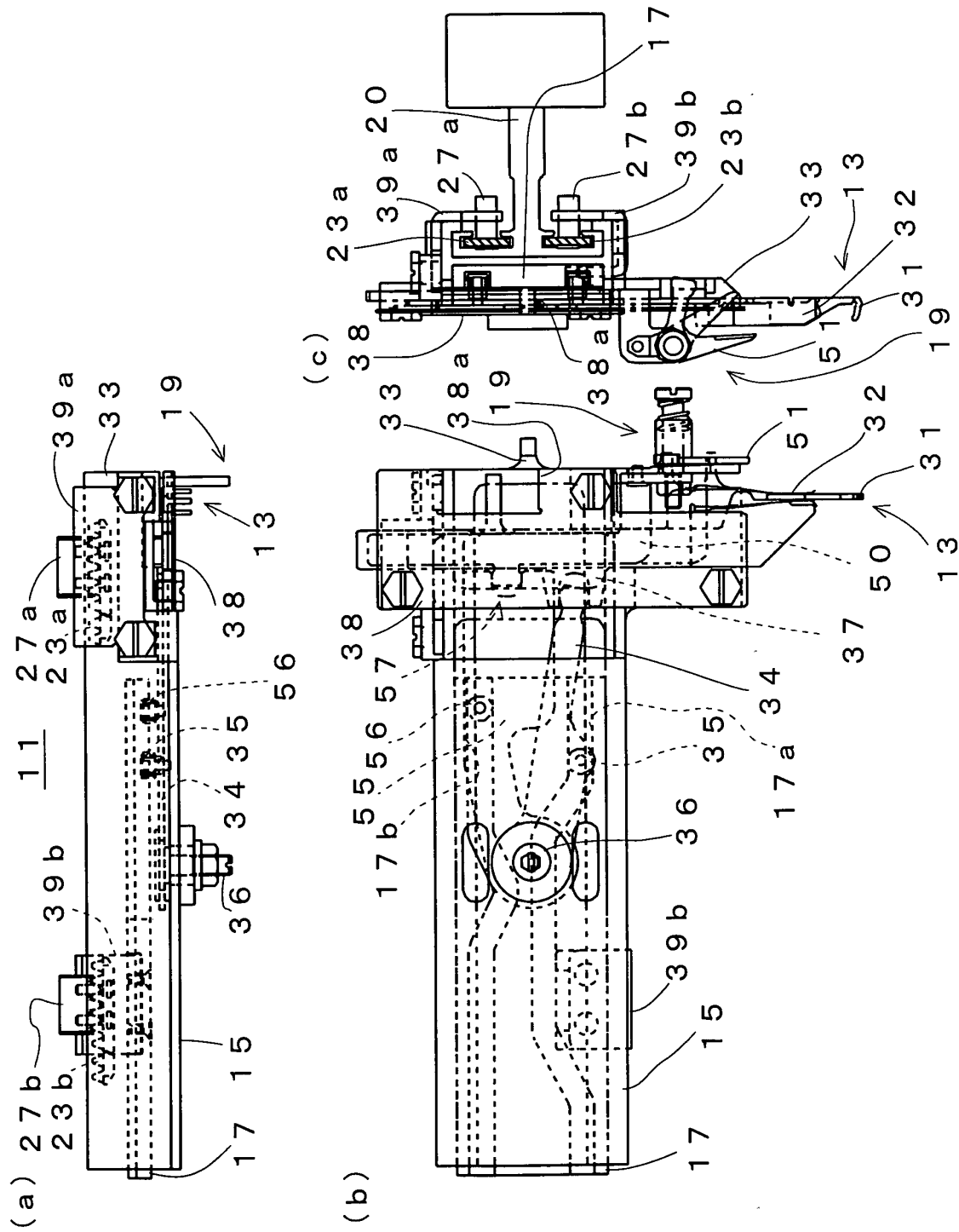
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[Fig. 1]

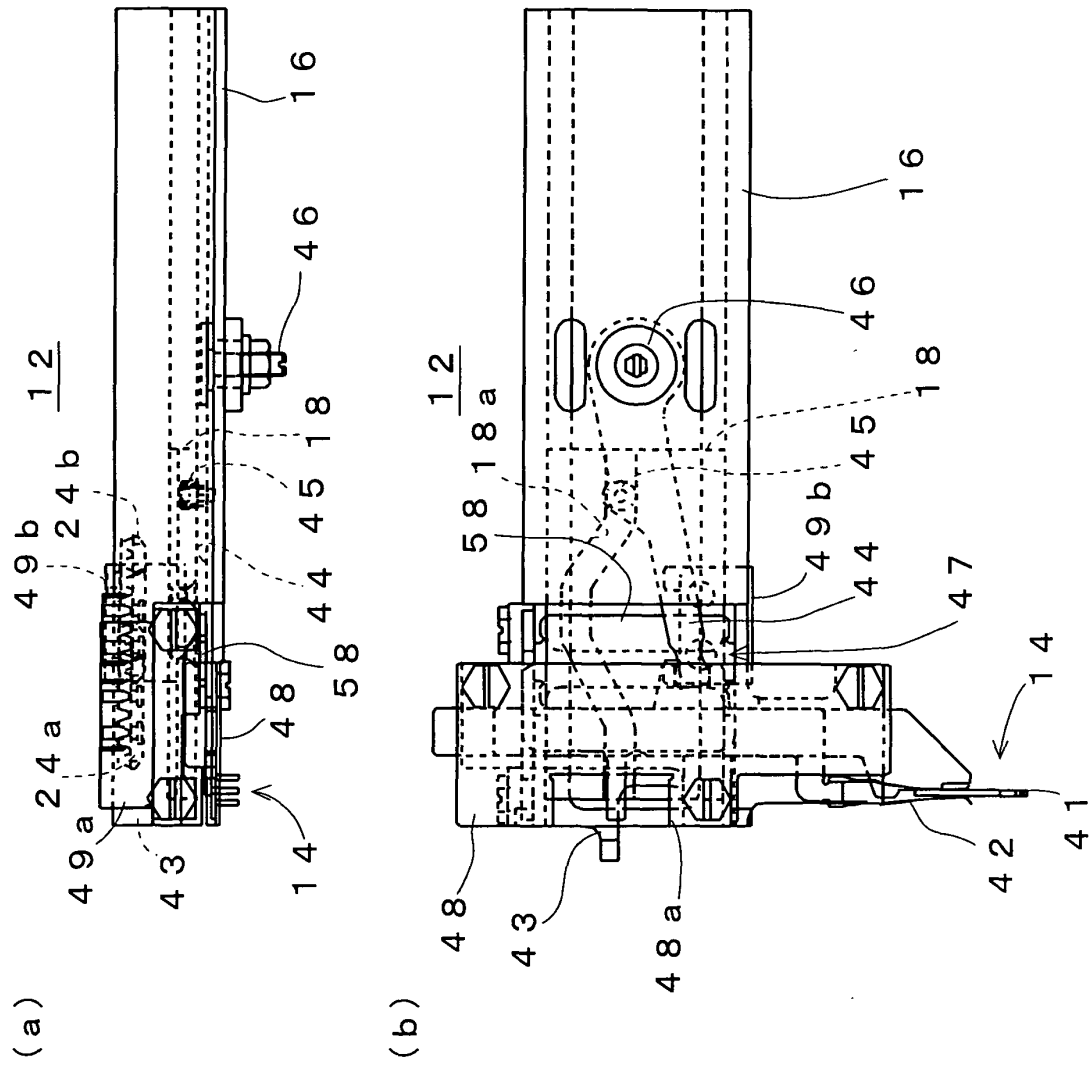
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[Fig. 2]

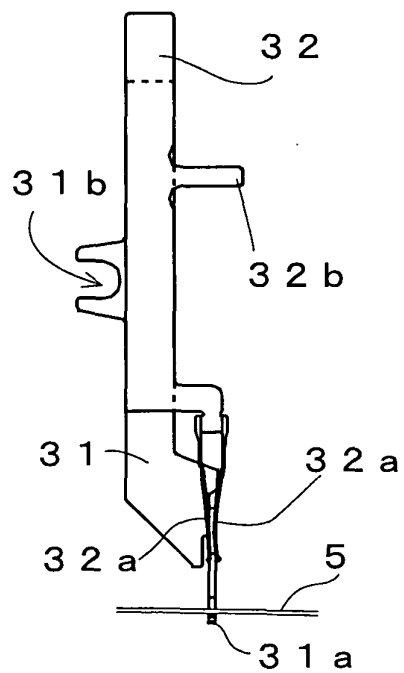


[Fig. 3]

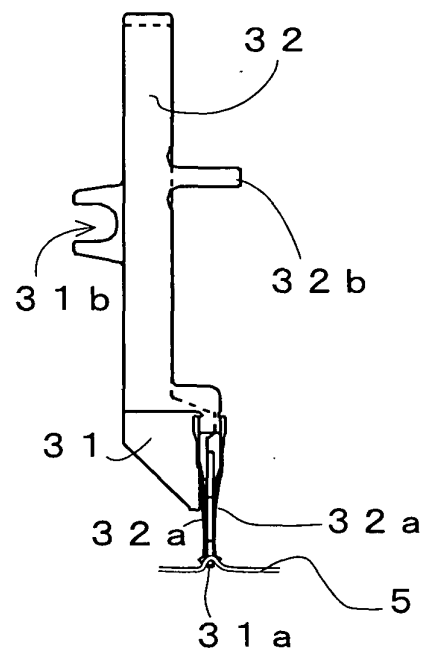


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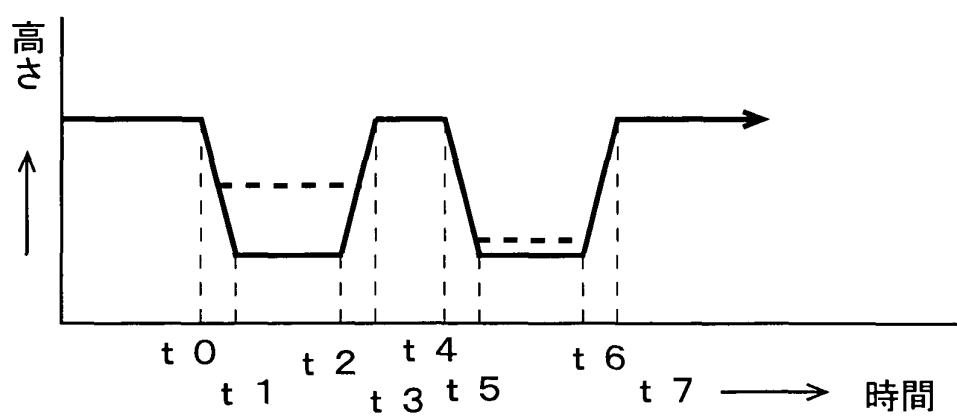
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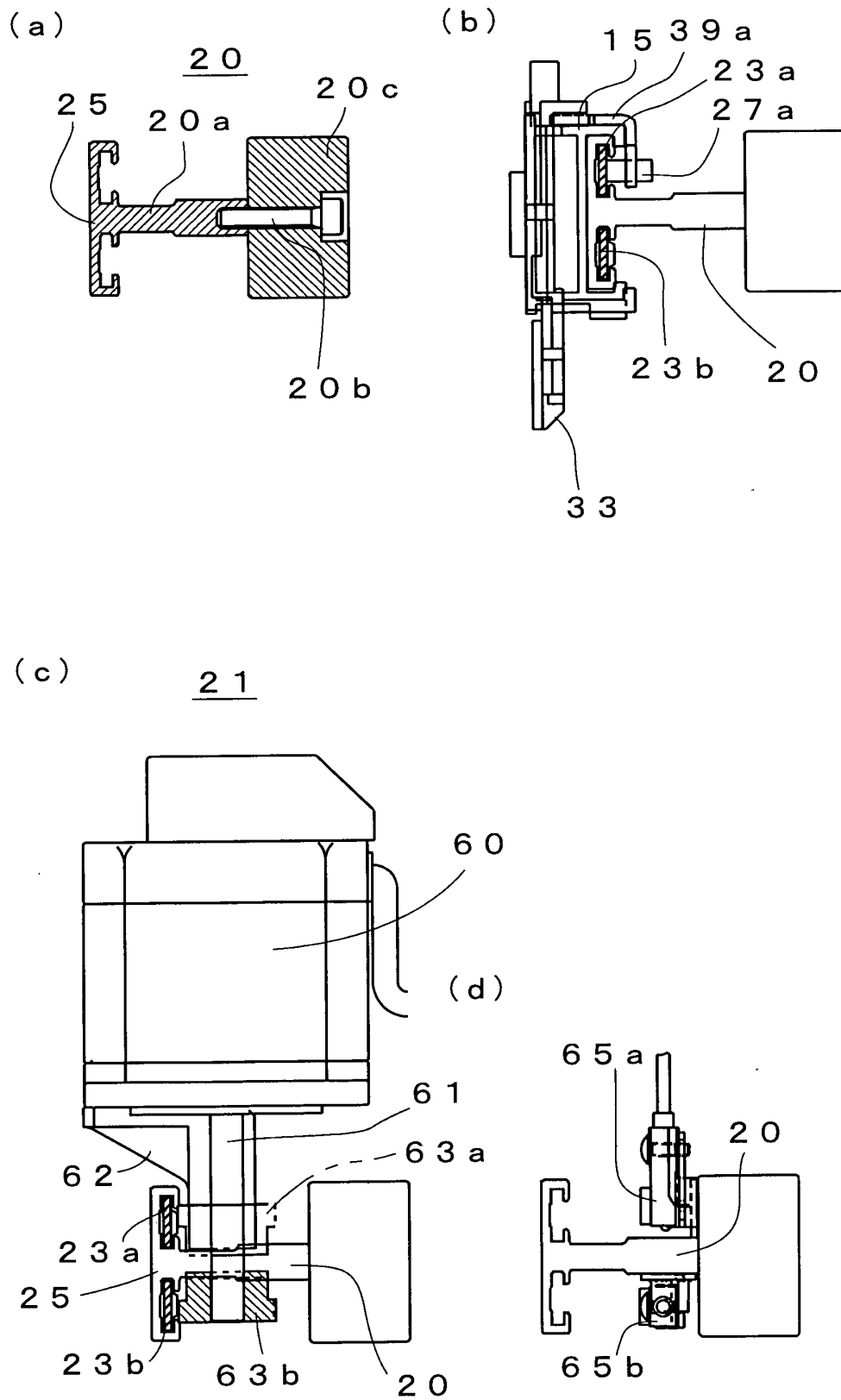
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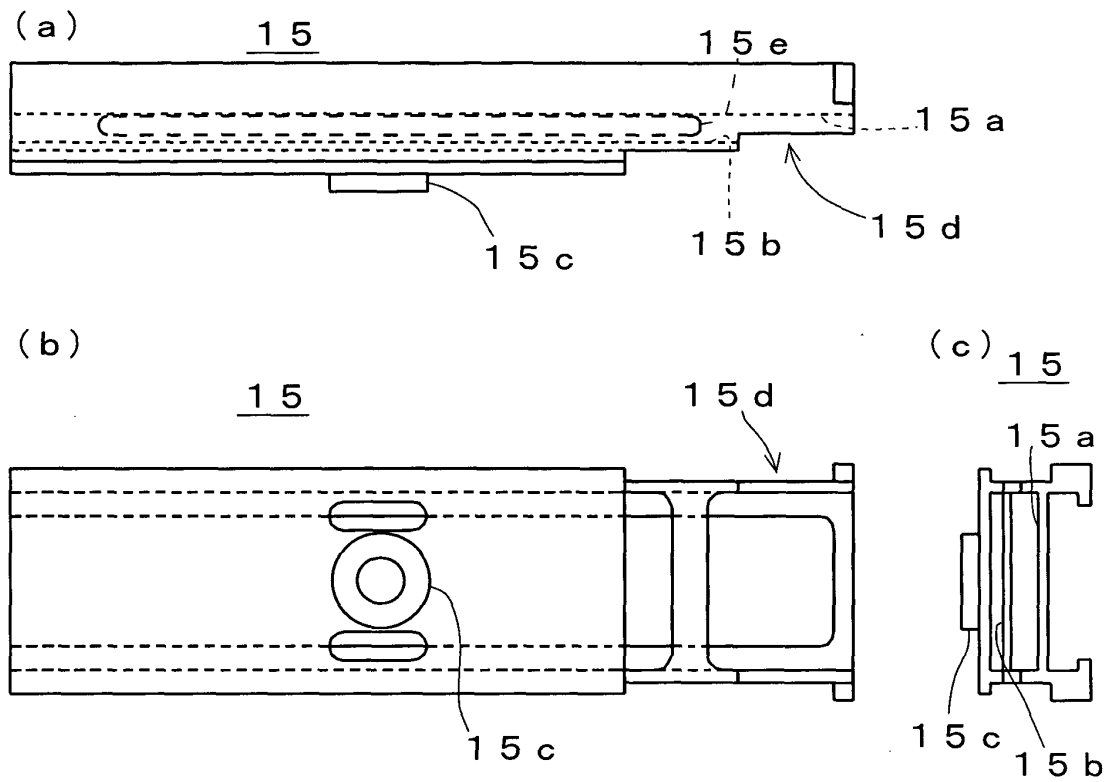
[Fig. 5]



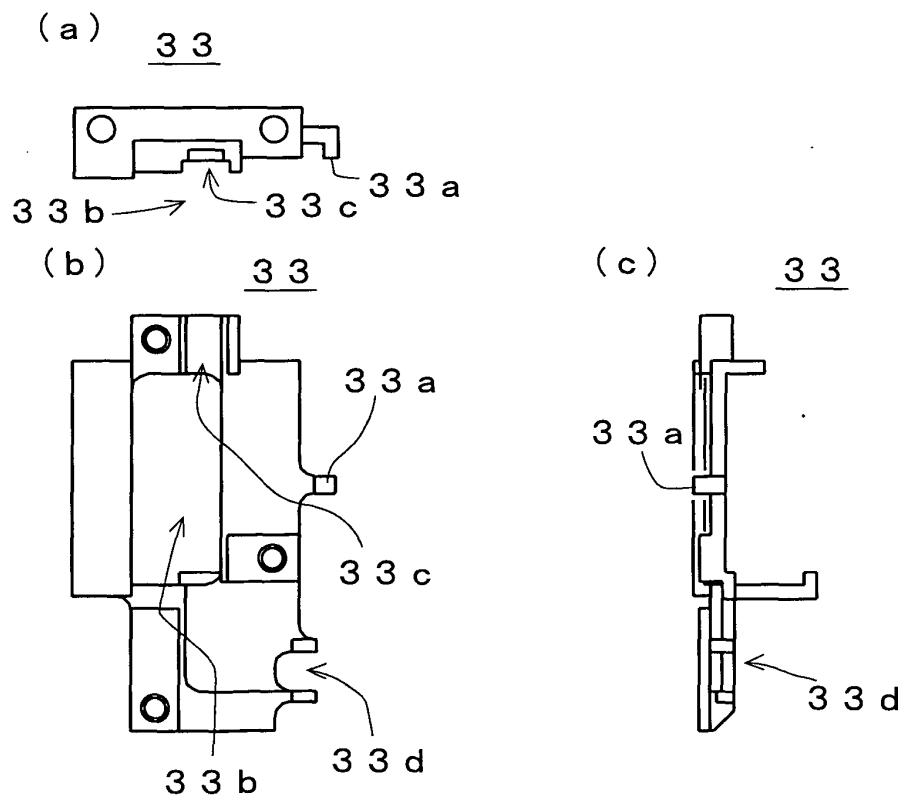
[Fig. 6]



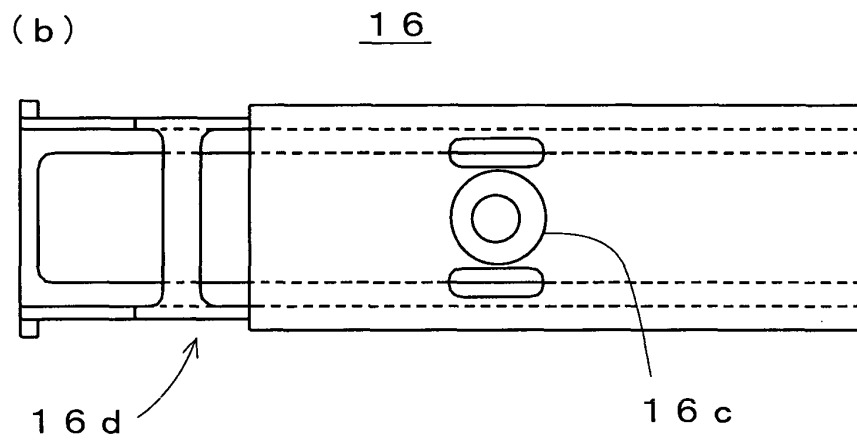
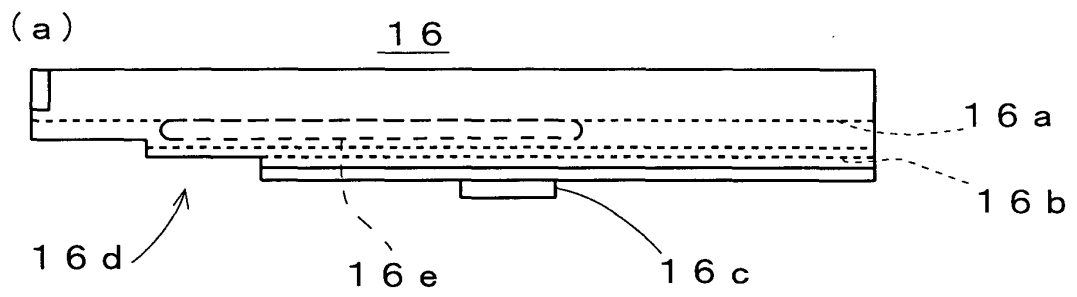
[Fig. 7]



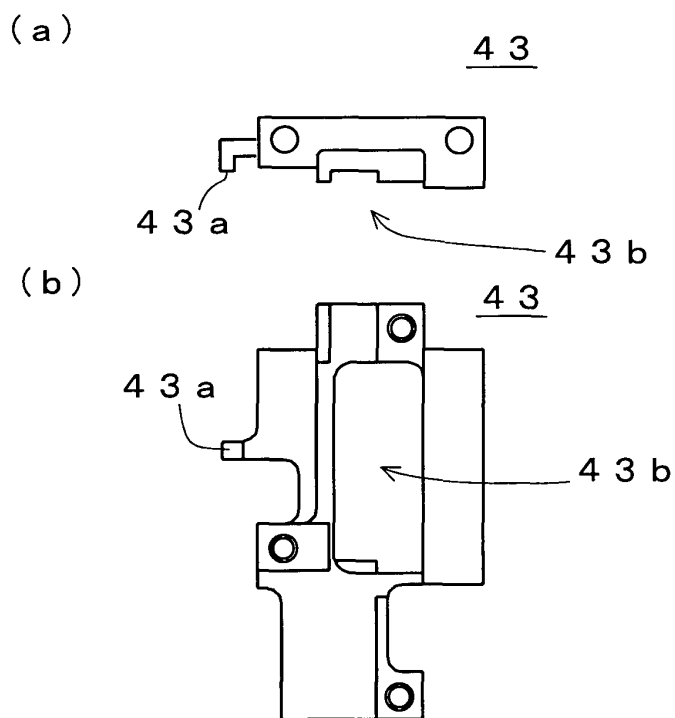
[Fig. 8]



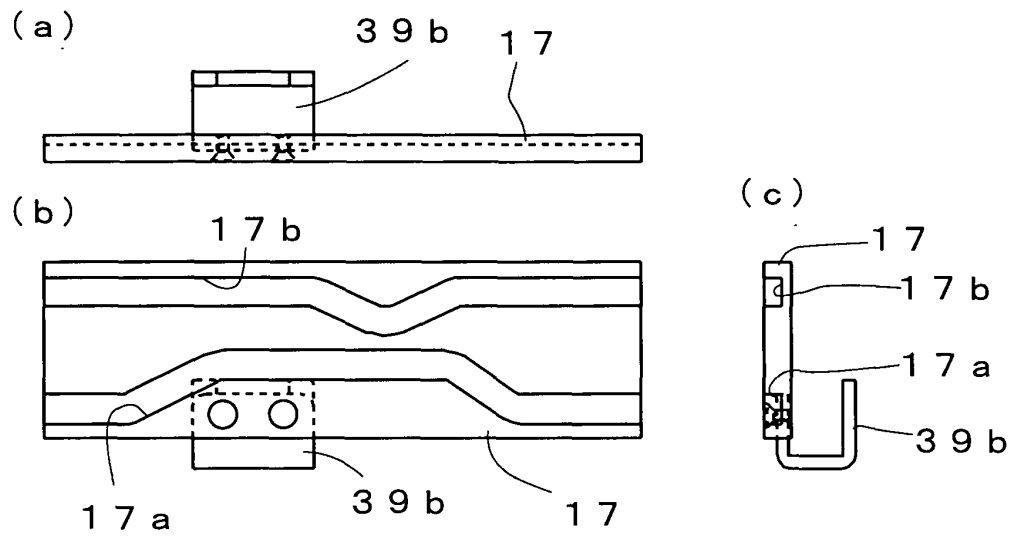
[Fig. 9]



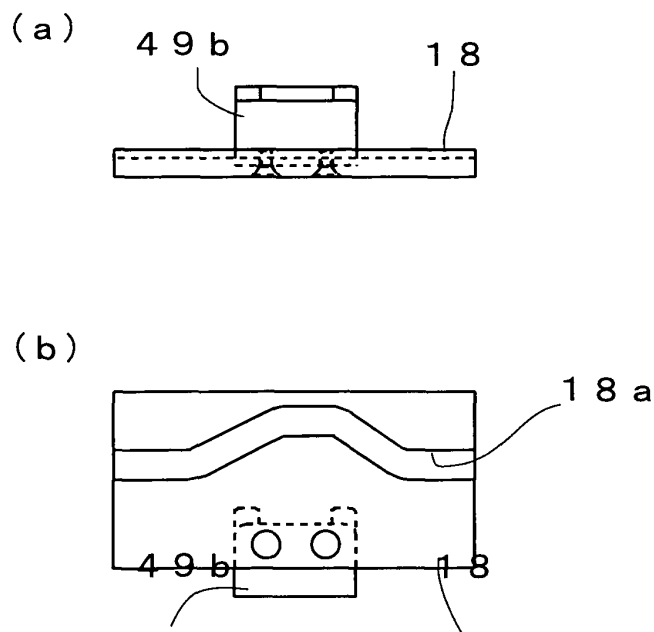
[Fig. 10]



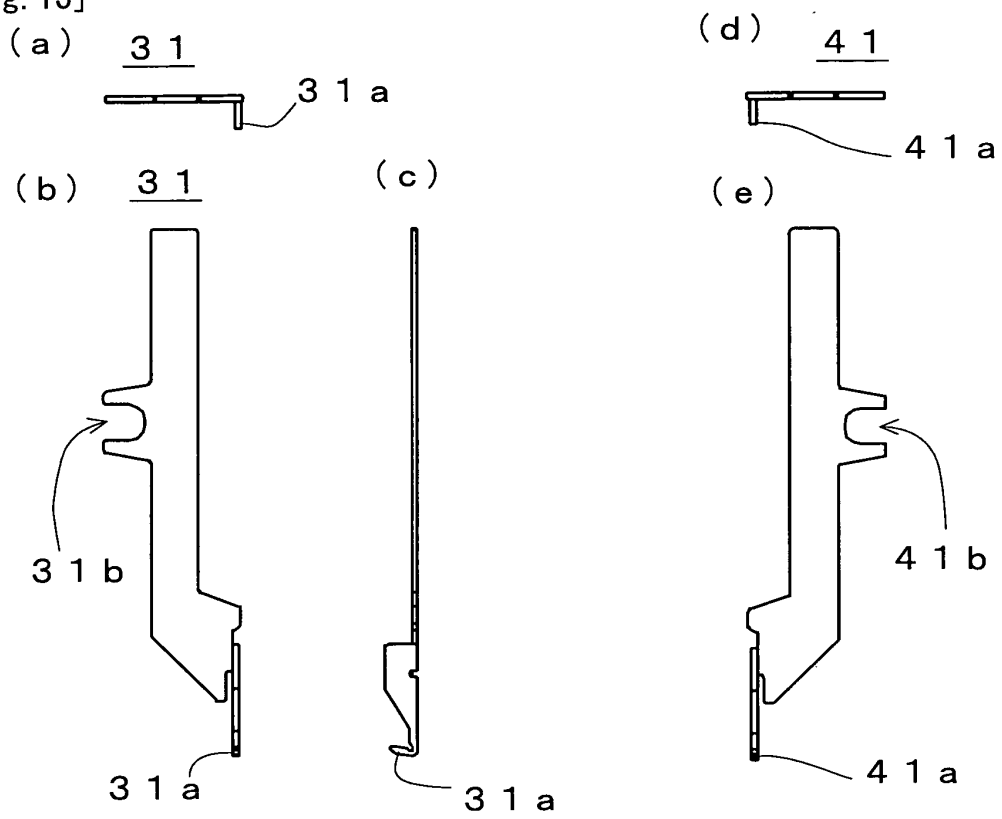
[Fig. 11]



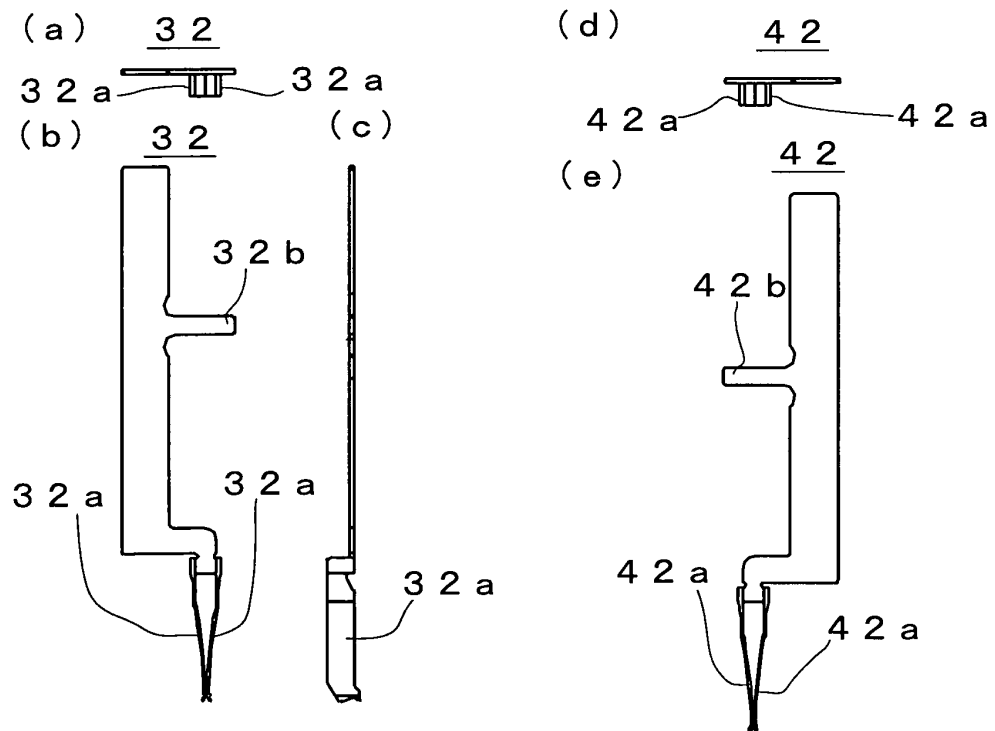
[Fig. 12]



[Fig. 13]

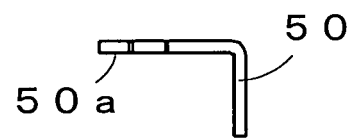


[Fig. 14]

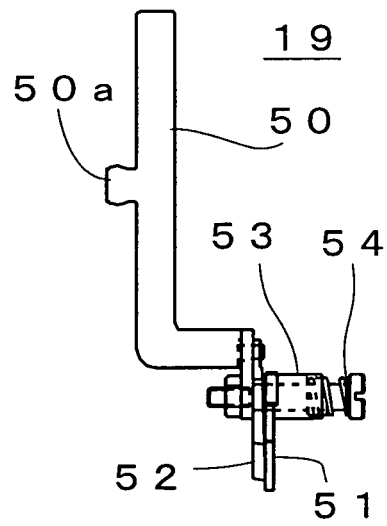


[Fig. 15]

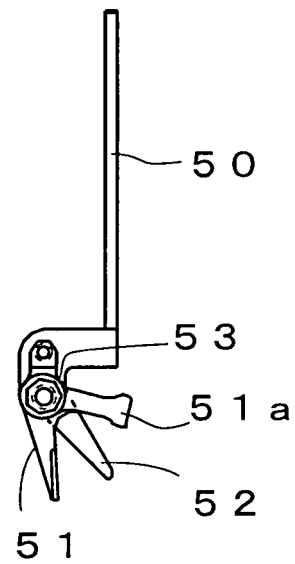
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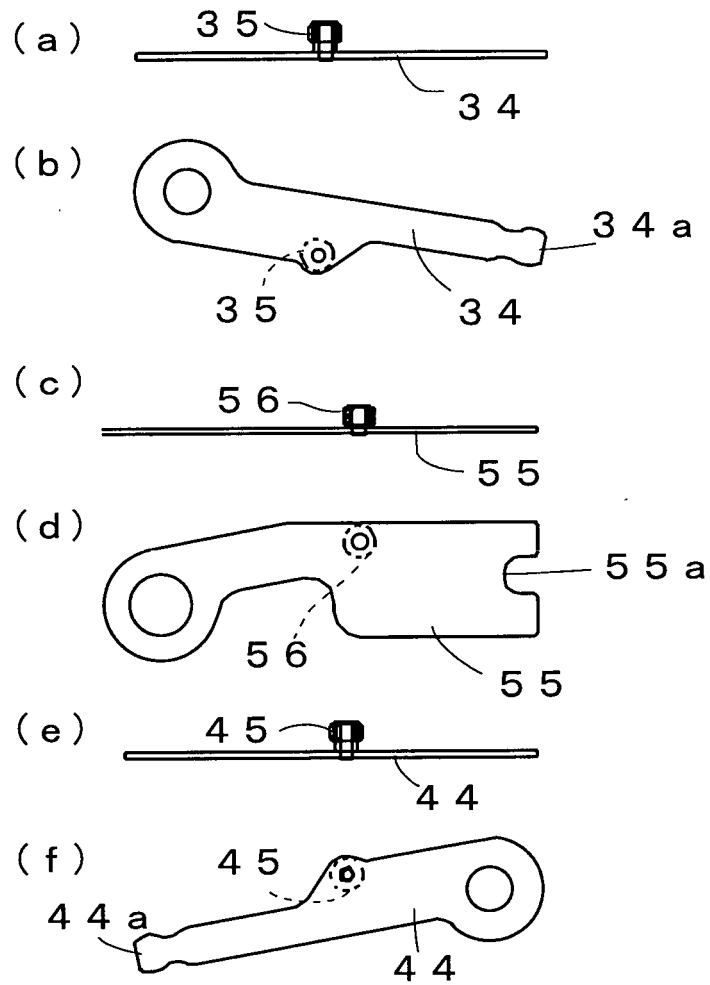
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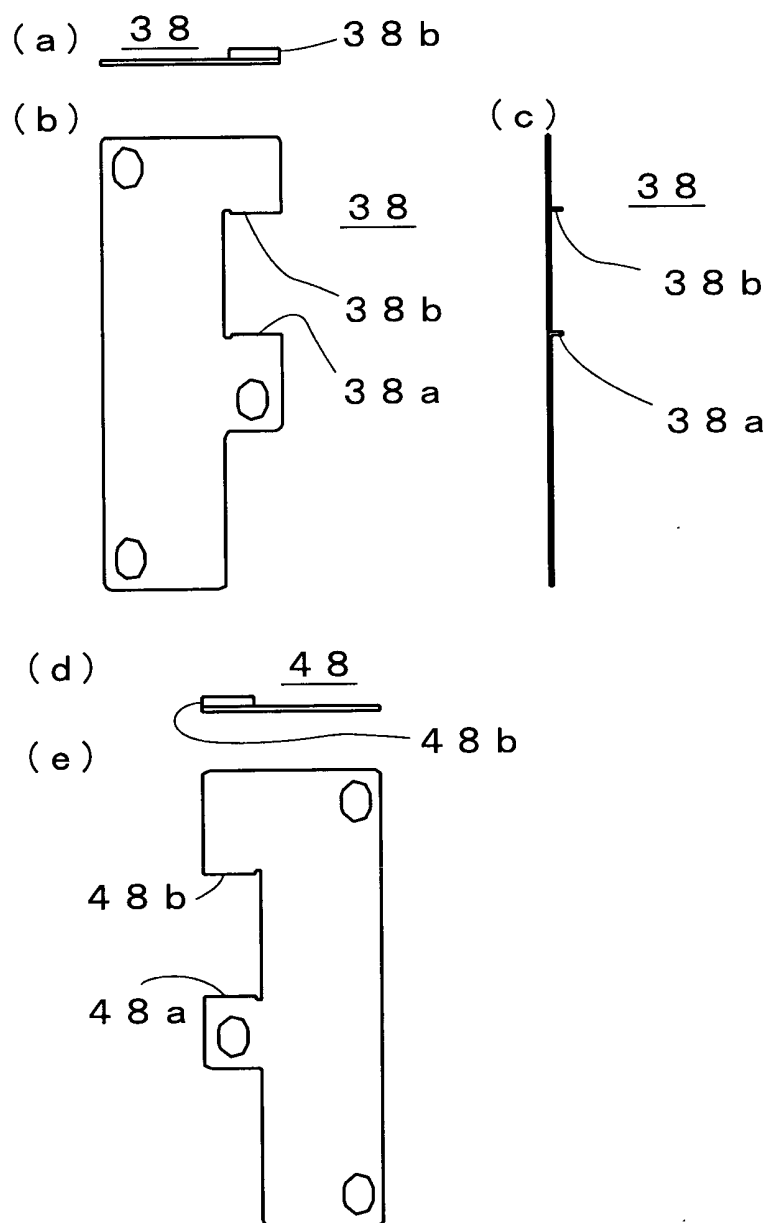
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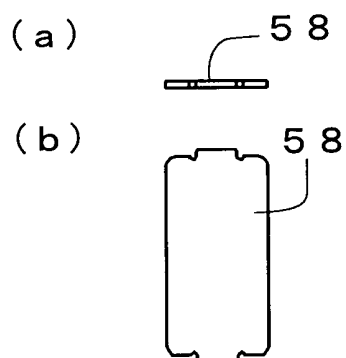
[Fig. 16]



[Fig. 17]

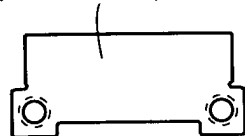


[Fig. 18]



[Fig. 19]

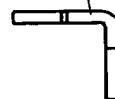
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(c) 39 a, 49 a



[Fig. 20]

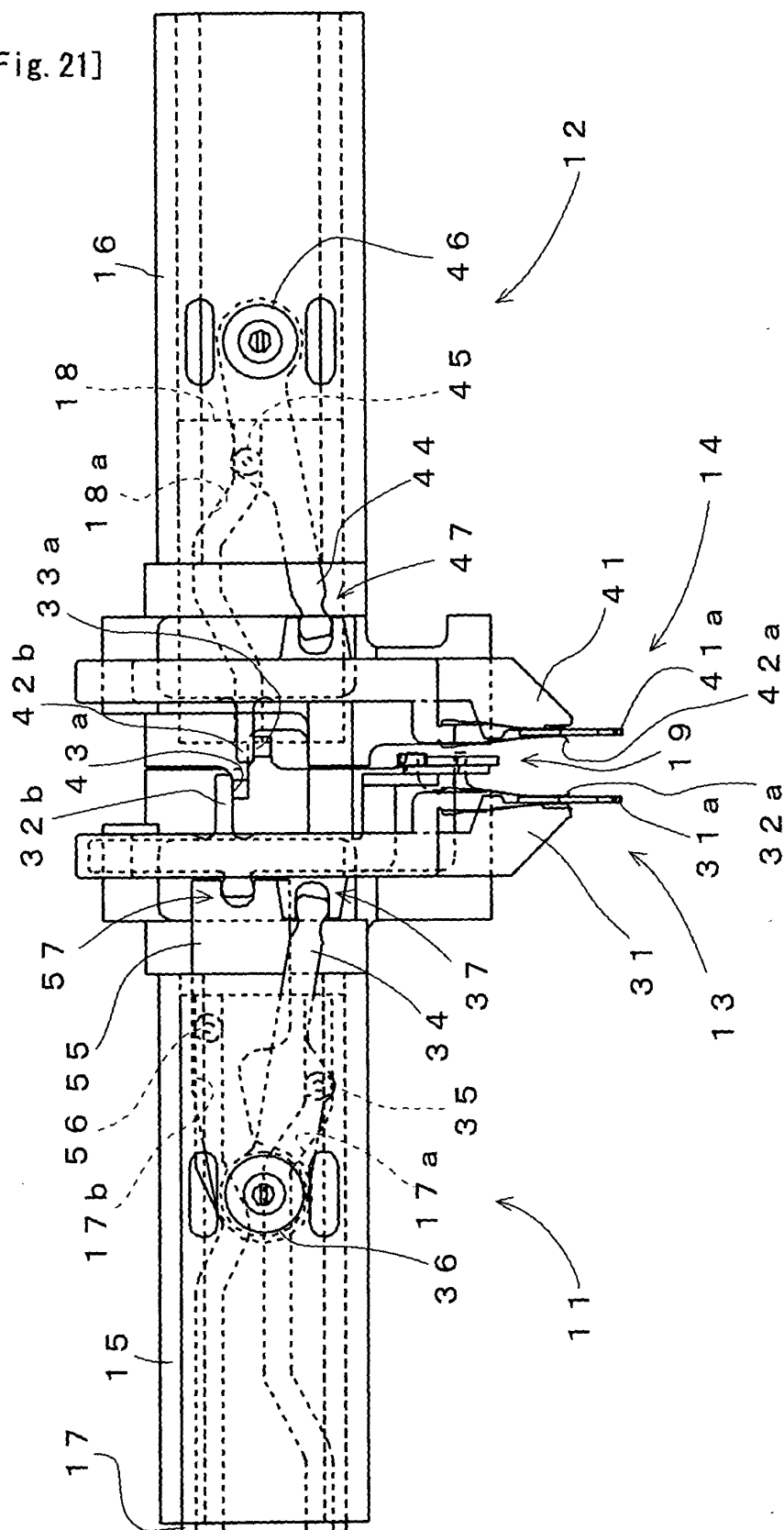
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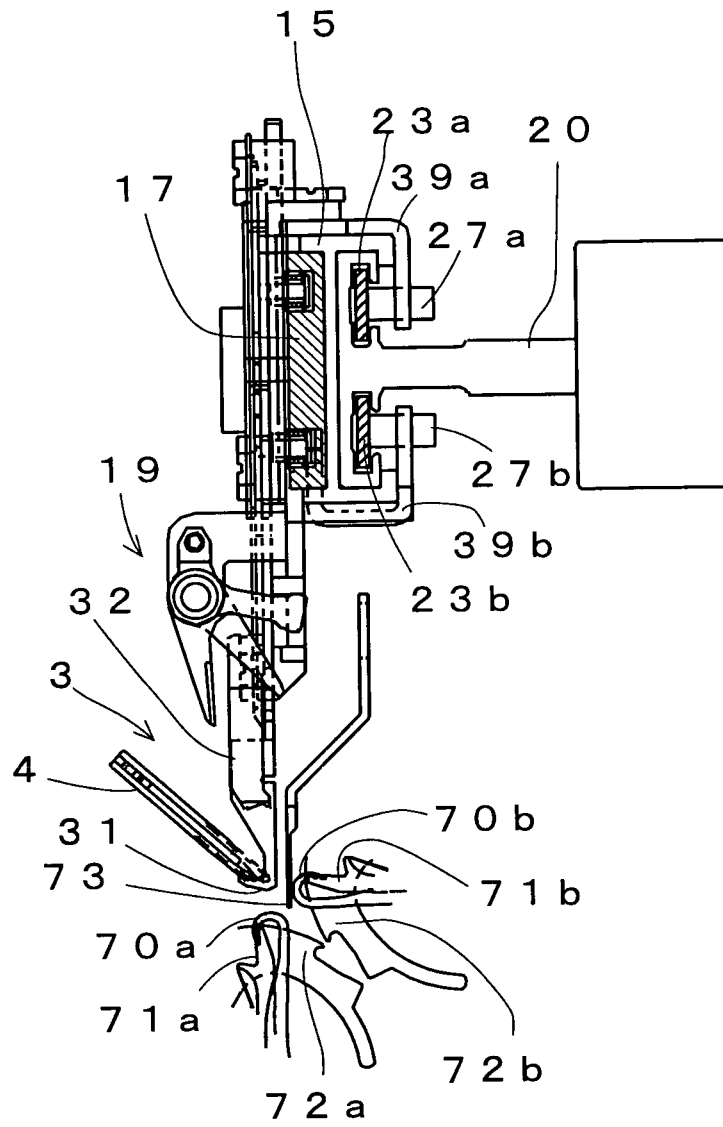
(b) 27 a, 27 b



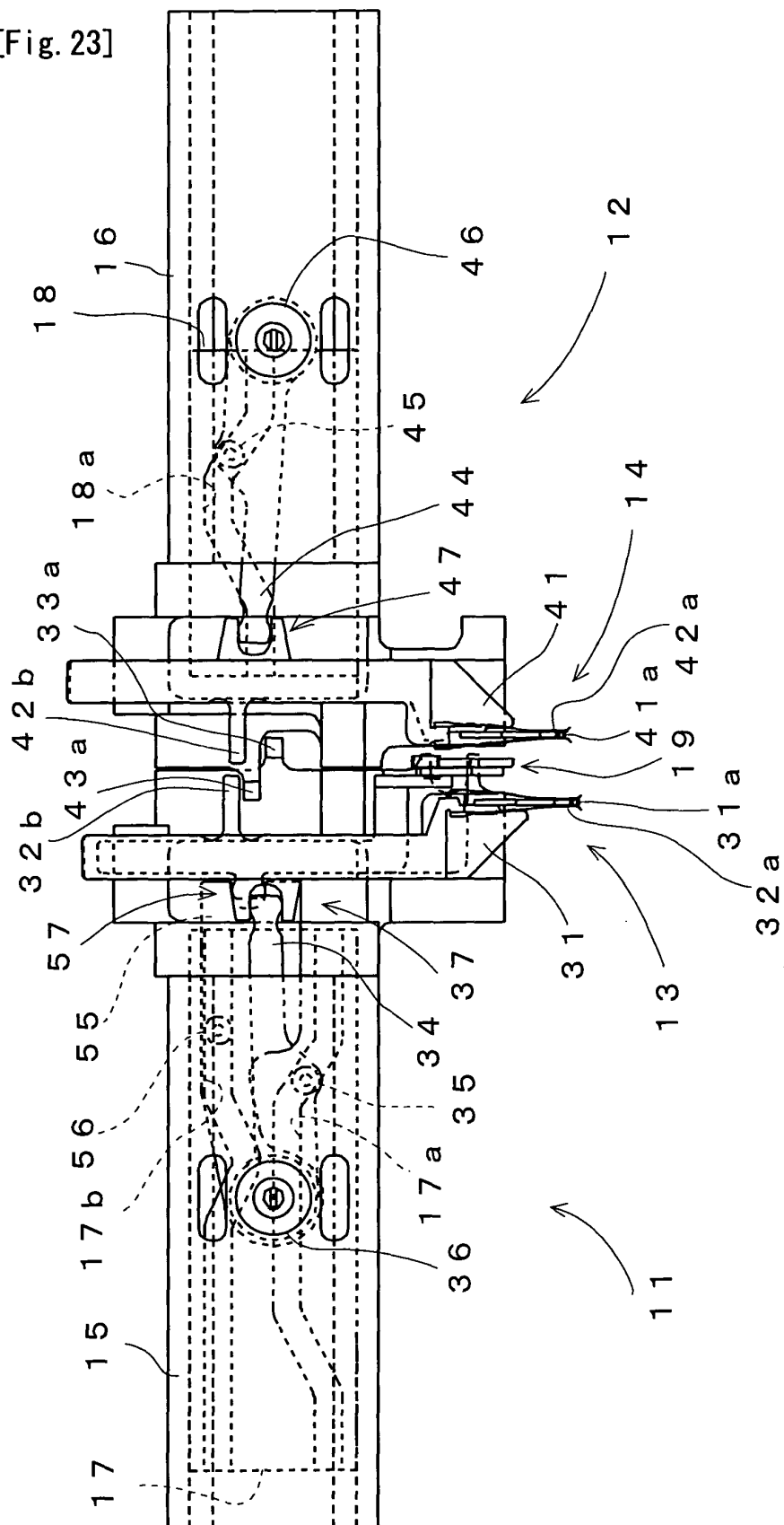
[Fig. 21]



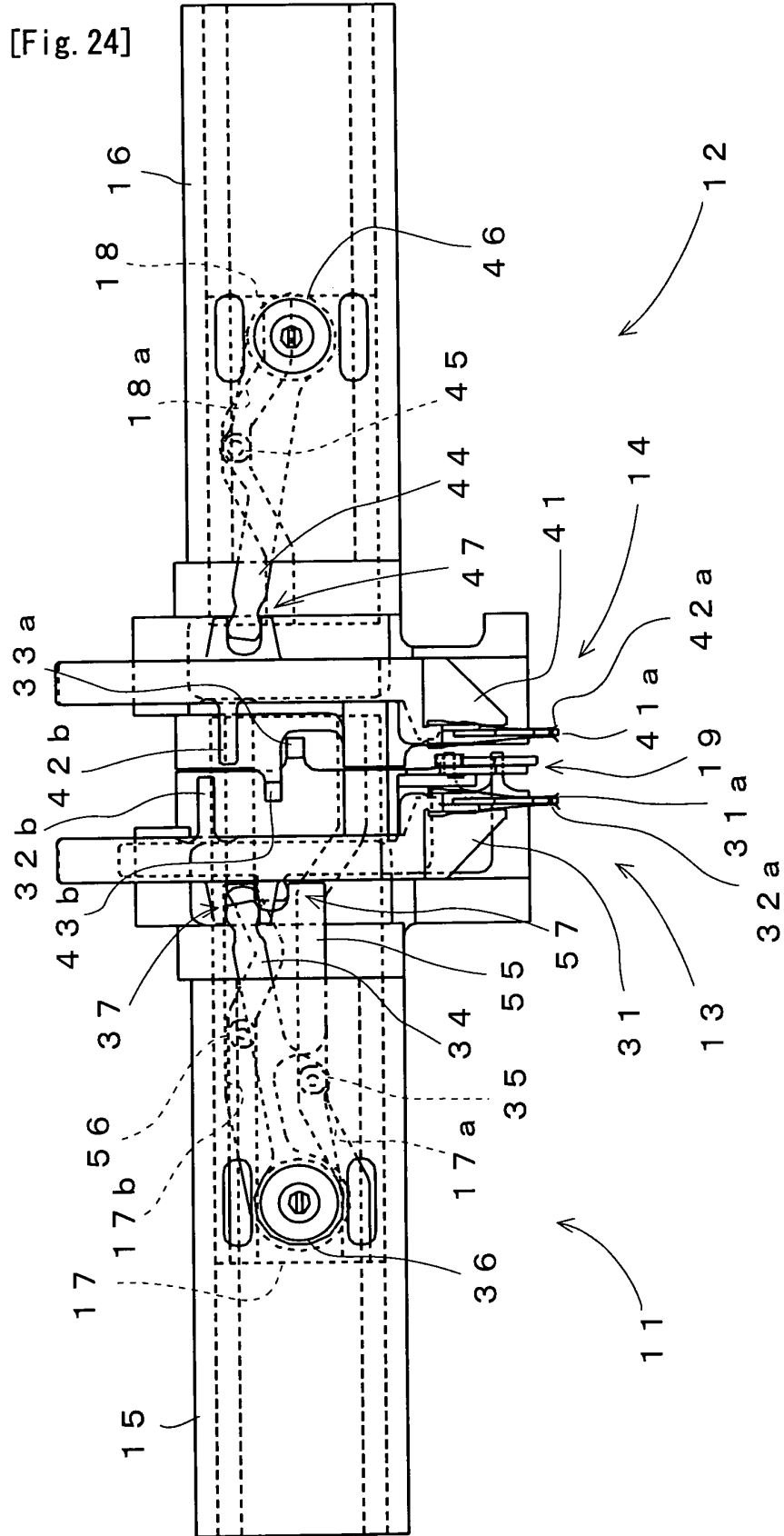
[Fig. 22]



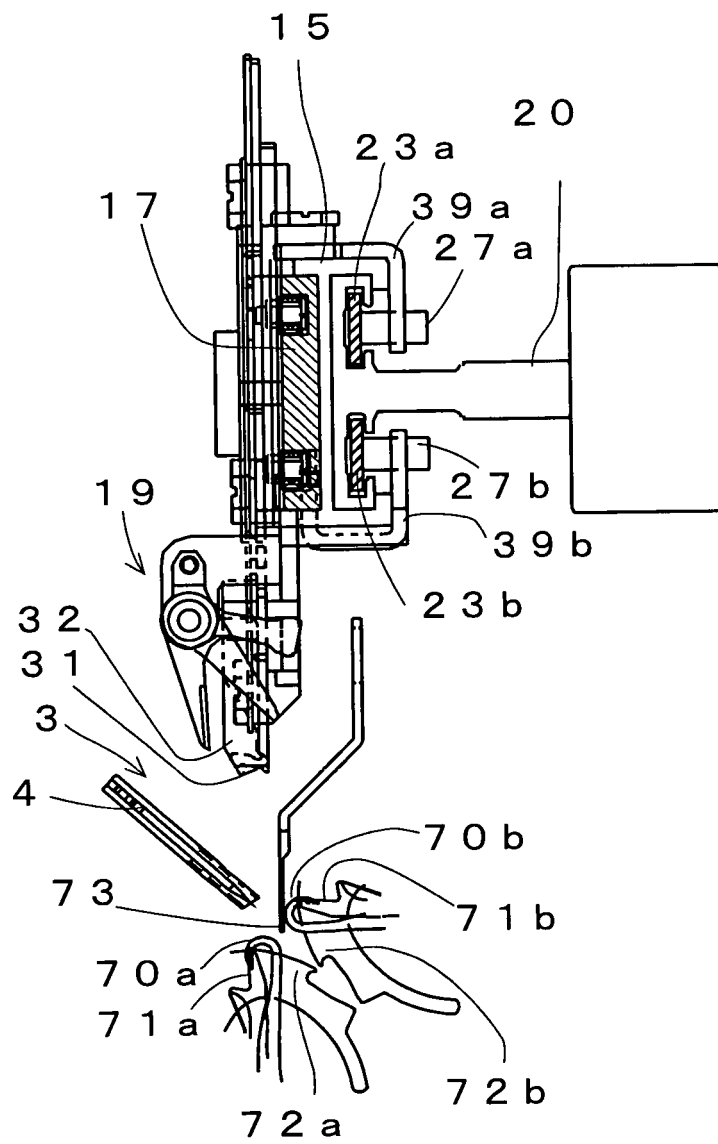
[Fig. 23]



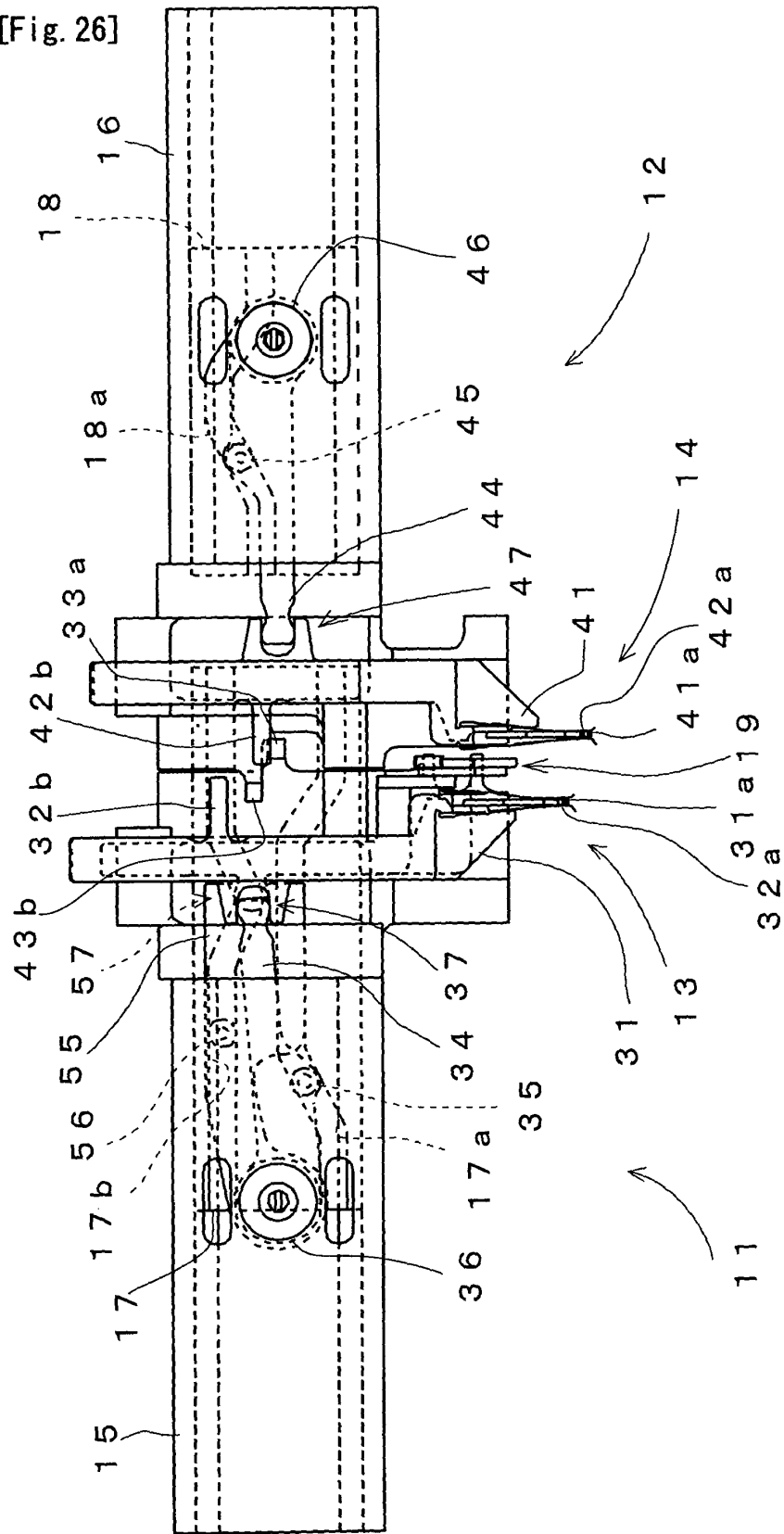
[Fig. 24]



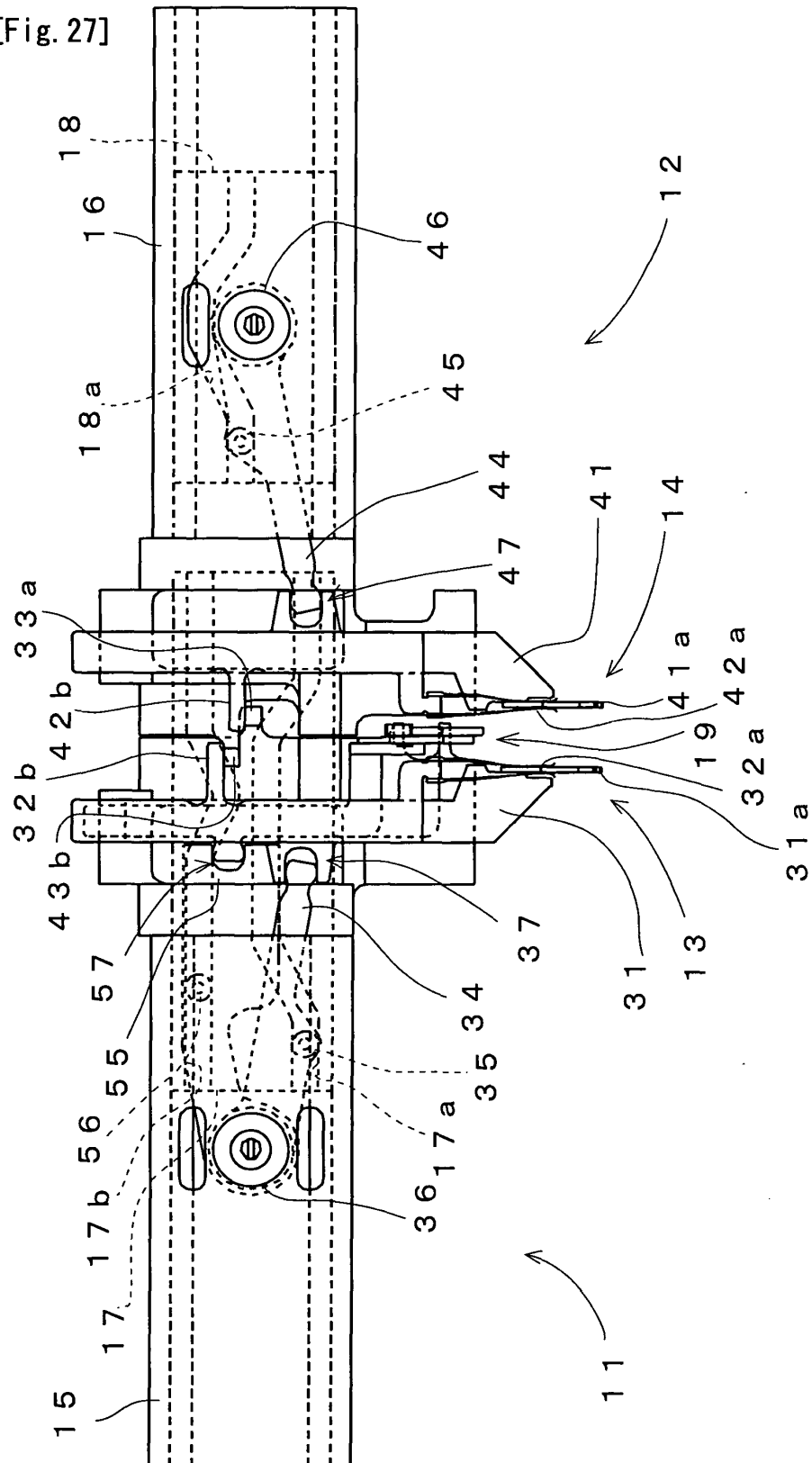
[Fig. 25]



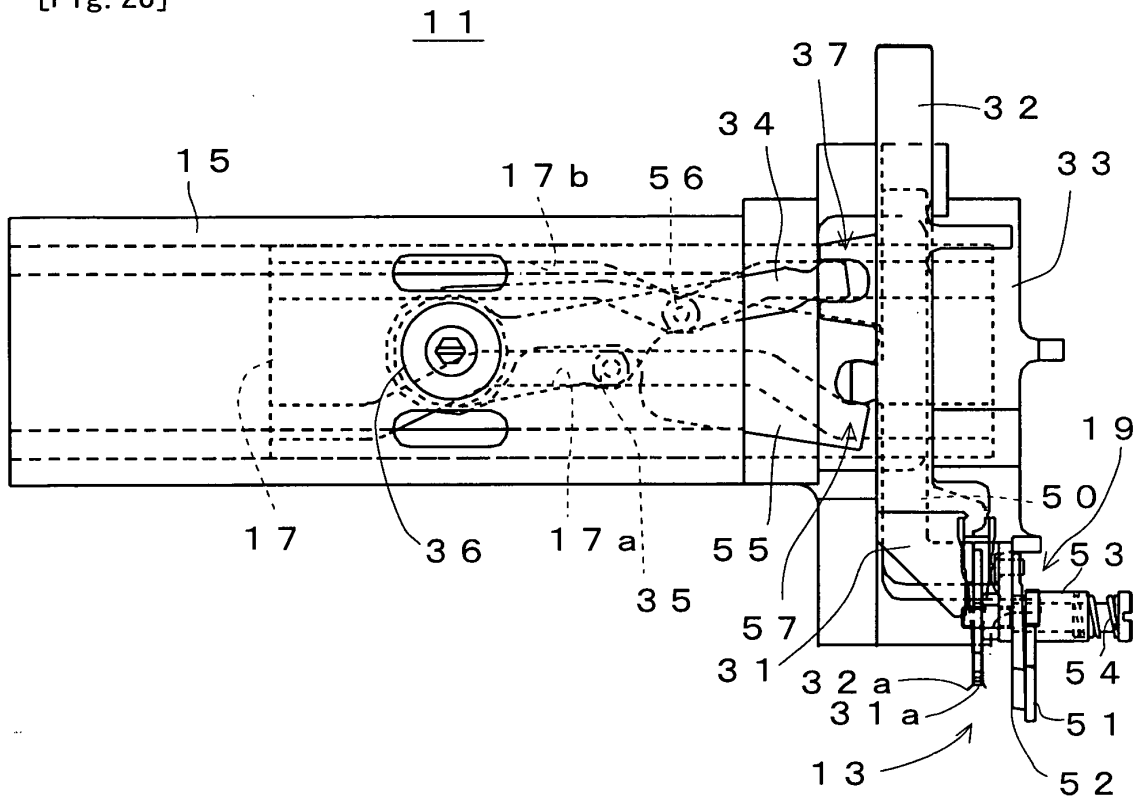
[Fig. 26]



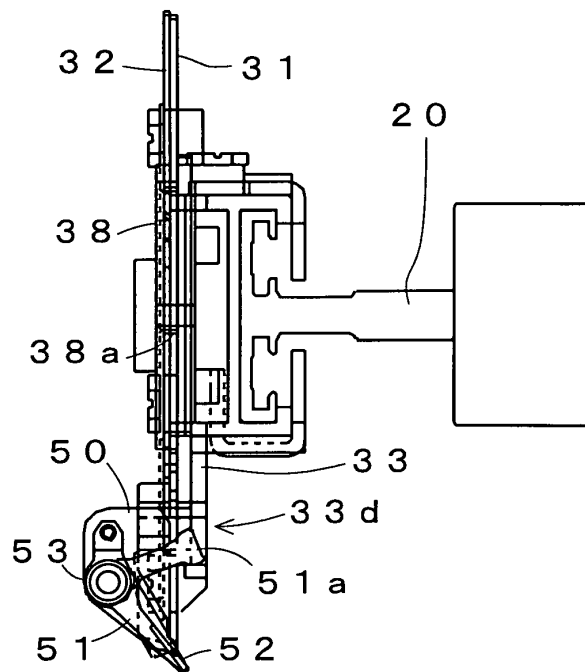
[Fig. 27]



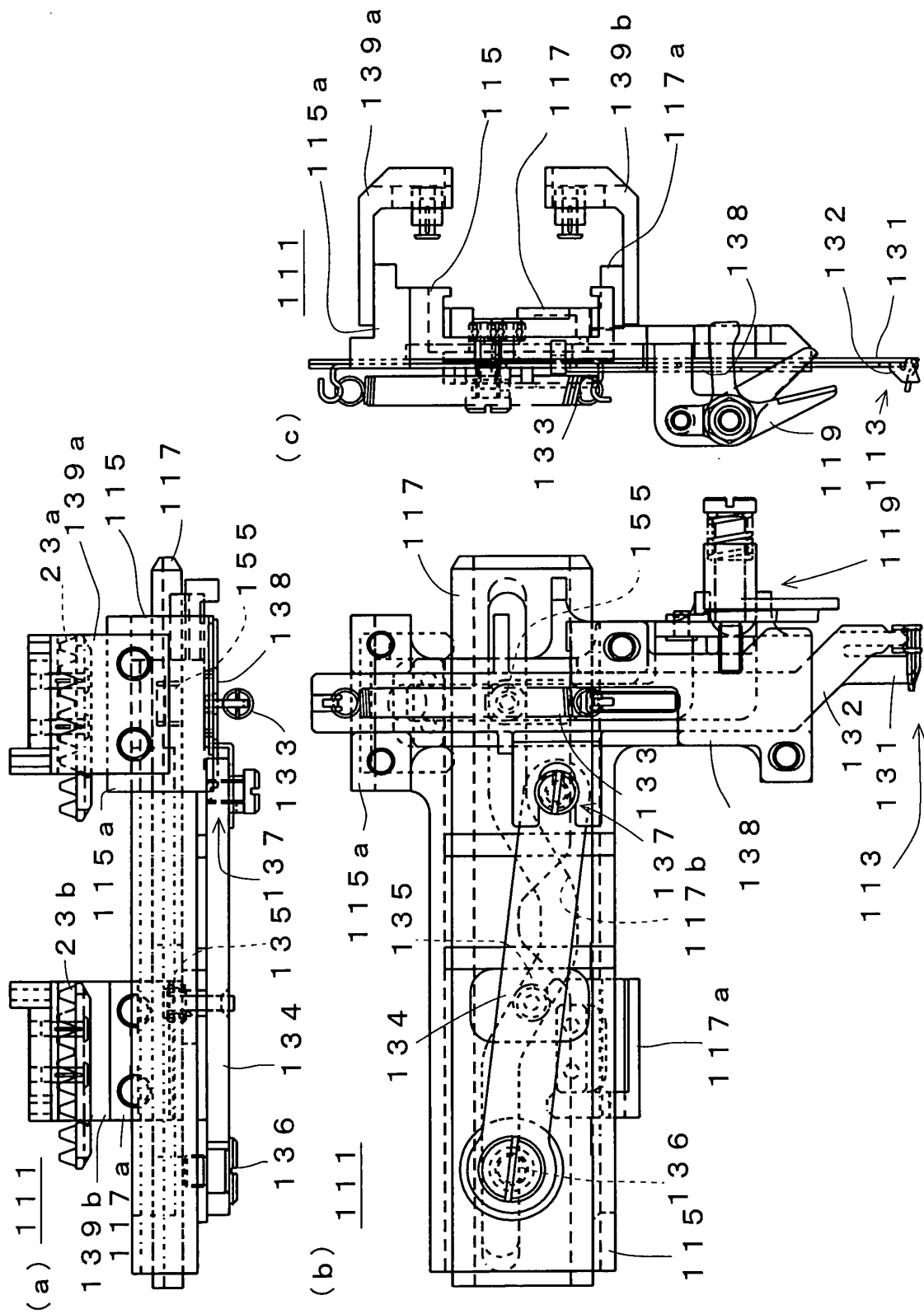
[Fig. 28]



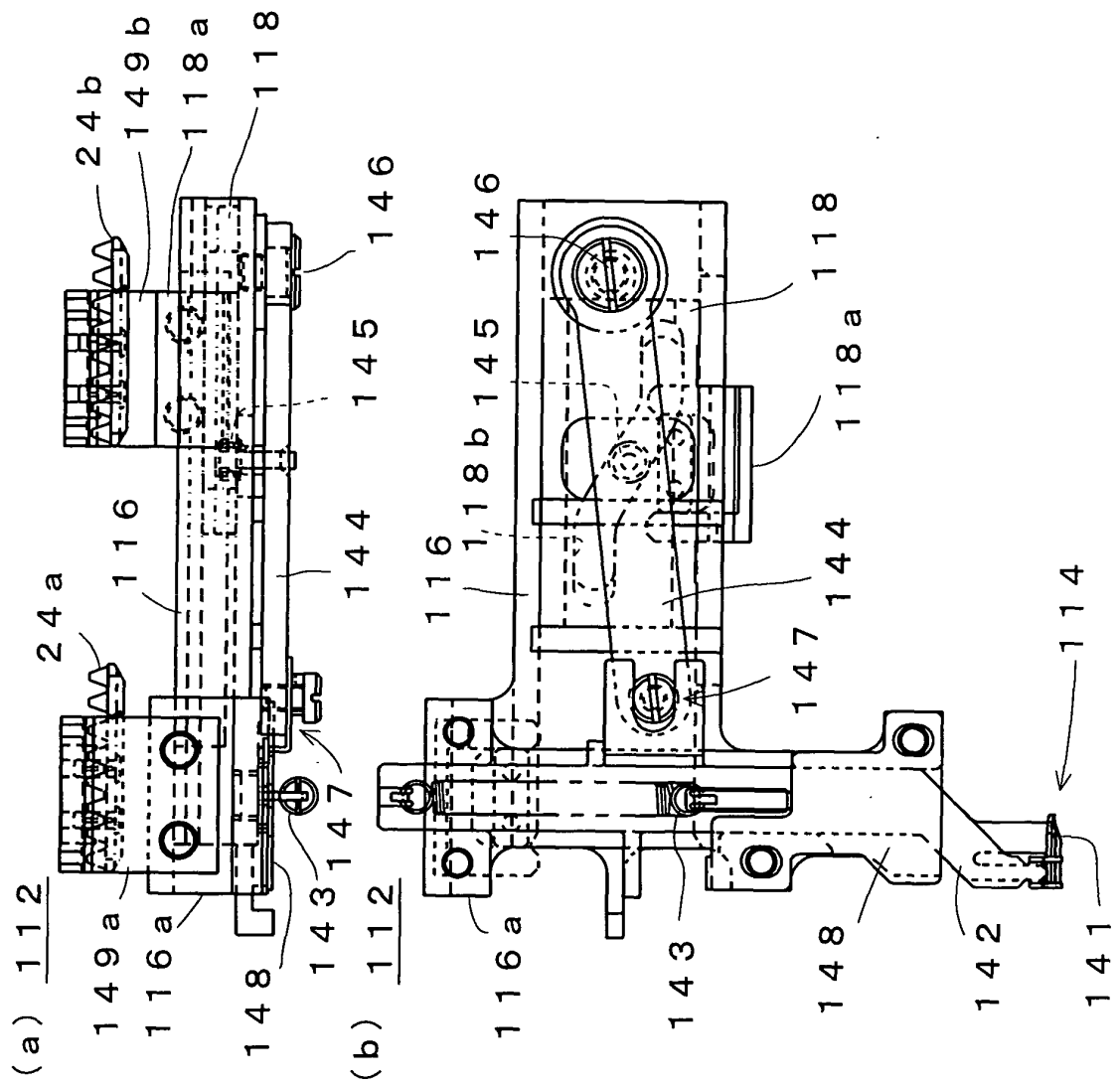
[Fig. 29]



[Fig. 30]



[Fig. 31]



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2007/001462

A. CLASSIFICATION OF SUBJECT MATTER

D04B15/56(2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D04B7/34, 15/38-15/64

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2008

Kokai Jitsuyo Shinan Koho 1971-2008 Toroku Jitsuyo Shinan Koho 1994-2008

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.
Y	JP 2005-089933 A (Shima Seiki Mfg., Ltd.), 07 April, 2005 (07.04.05), & WO 2005/028726 A1 & EP 1666653 A1 & US 2006/254400 A1 & CN 1853010 A & KR 2006121905 A	1-5
Y	US 2705408 A (FAHRRADWERK ELITE DIAMANT VVB), 05 April, 1955 (05.04.55), (Family: none)	1-5
Y	JP 08-325901 A (Shima Seiki Mfg., Ltd.), 10 December, 1996 (10.12.96), (Family: none)	4, 5

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Date of the actual completion of the international search

22 February, 2008 (22.02.08)

Date of mailing of the international search report

04 March, 2008 (04.03.08)

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2007/001462

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 3347079 B2 (Shima Seiki Mfg., Ltd.), 20 November, 2002 (20.11.02), & US 6119486 A & KR 2000048141 A & TW 457310 A & KR 457453 B & EP 1010789 B1	4, 5
A	JP 2602156 B2 (Shima Seiki Mfg., Ltd.), 23 April, 1997 (23.04.97), & US 5415016 A & EP 597548 B1	1-5
P, A	WO 2007/058274 A1 (Shima Seiki Mfg., Ltd.), 24 May, 2007 (24.05.07), (Family: none)	1-5

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Patent documents cited in the description

- JP H08325901 B [0003]
- JP 2005089933 A [0003]