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(71) Applicant: **Murata Machinery, Ltd.**
Kyoto-shi,
Kyoto 601-8326 (JP)

(72) Inventor: **SAWADA, Akira**
Kyoto, 612-8686 (JP)

(74) Representative: **Jordan, Volker Otto Wilhelm Weickmann & Weickmann**
Patent- und Rechtsanwälte PartmbB
Postfach 860 820
81635 München (DE)

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(54) **YARN JOINING DEVICE, WINDING UNIT, AND YARN WINDING MACHINE**

(57) A yarn joining device (34) includes a twisting section (52) that joins two yarns (Y1, Y2) by intertwining two tip ends of the yarns; a twisting stopping lever (96), and a motor (73). The twisting stopping lever (96) includes a first twisting stopping member (96a) and a second twisting stopping member (96b) both of which are movable between a waiting position and a pressing position. At the waiting position, the members (96a and 96b) do not contact the two yarns (Y1, Y2). At the pressing position, the members (96a and 96b) press one of the two yarns (Y1, Y2) on one side in a predetermined moving direction from the waiting position thereby suppressing transmission of twisting on the other side of the pressed yarn end. The motor (73) adjusts the pressing positions in the moving direction.

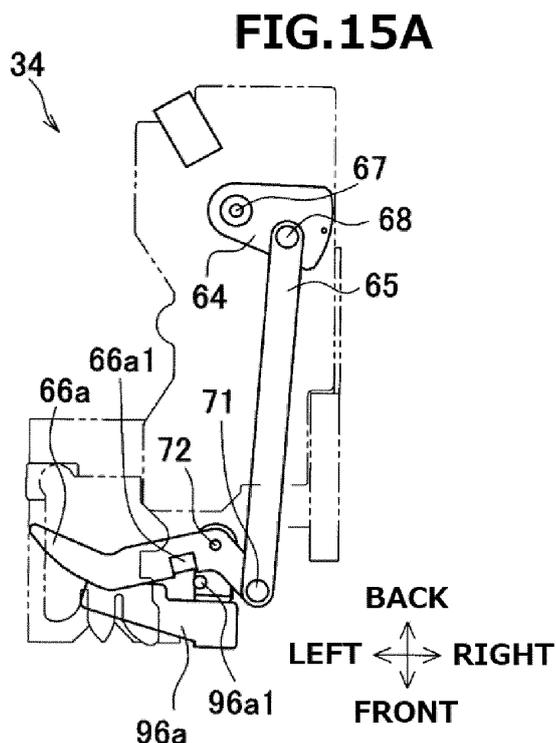
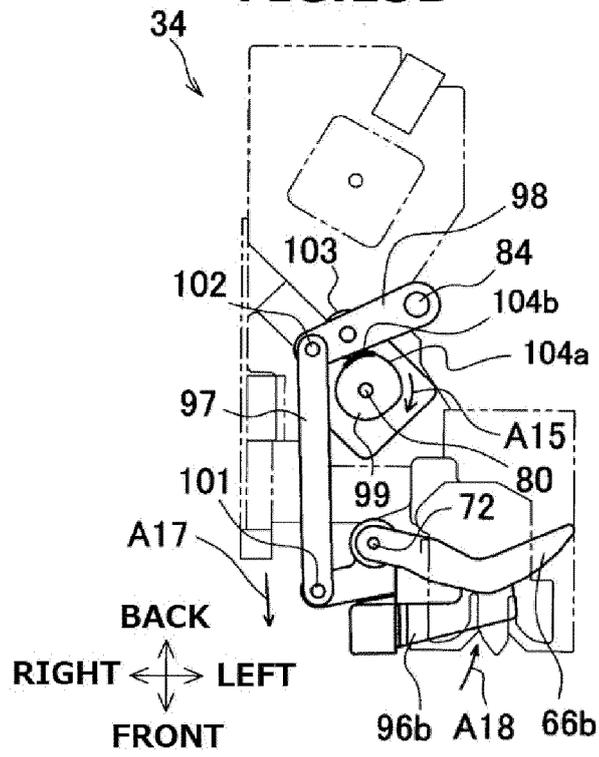


FIG.15B



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a yarn joining device, a winding unit, and a yarn winding machine that includes the yarn joining device.

2. Description of the Related Art

[0002] A yarn joining device that joins two yarns by intertwining tip ends of the yarns is disclosed in Japanese Patent Application Laid-open No. 2019-23120. The yarn joining device includes a twisting section that intertwines the two yarns and a twisting stopping lever that suppresses transmission of twisting of the two yarns on the other side of the twisting section by pressing and bending the two yarns. The twisting stopping lever is rotatably driven by a spring and a position thereof is regulated by a separately provided lever member that is driven by a driving motor. Moreover, the yarn joining device includes a stopper that determines a rotation range of the twisting stopping lever. When the two yarns are being intertwined, a part of the twisting stopping lever touches the stopper, thereby determining a stopping position of the twisting stopping lever.

[0003] Incidentally, the most appropriate pressing position at which the yarn shall be pressed by the twisting stopping lever differs depending on the thickness and the like of the yarn. For example, if a thin yarn is bent excessively by the twisting stopping lever, then the twisting can concentrate on the part at which the yarn is pressed, making the yarn easily breakable. On the other hand, if a thick yarn is not sufficiently bent, the twisting is transmitted to a base end side of the yarn. Therefore, depending on the thickness and the like of the yarns, it is necessary to adjust a stopping position (pressing position) of the yarns at which the yarn shall be stopped (pressed) by the twisting stopping lever at the time of intertwining the two yarns. In the yarn joining device disclosed in Japanese Patent Application Laid-open No. 2019-23120, the pressing position is adjusted by adjusting the position of the stopper. However, because in the conventional yarn joining device the position of the stopper needs to be adjusted manually by an operator, extra efforts are required for such adjustment.

SUMMARY OF THE INVENTION

[0004] An object of the present invention is to reduce the efforts involved in adjustment of a pressing position of a twisting stopping lever.

[0005] According to one aspect of the present invention, a yarn joining device includes a twisting section that joins two yarns by intertwining tip ends thereof; a twisting stopping lever that includes a first twisting stopping mem-

ber that is movable between a waiting position in which the first twisting stopping member does not come in contact with the two yarns, and a pressing position in which the first twisting stopping member presses one of the two yarns on one side in a predetermined moving direction from the waiting position thereby suppressing transmission of twisting on the other side of the pressed yarn end, and a second twisting stopping member that is movable between a waiting position in which the second twisting stopping member does not come in contact with the two yarns, and a pressing position in which the second twisting stopping member presses the other of the two yarns thereby suppressing transmission of twisting on the other side of pressed yarn end; an adjustment driving section that changes the pressing position of the twisting stopping lever in the movement direction; a movement driving section that movably drives the twisting stopping lever in the movement direction; moving members that include the twisting stopping lever and are movably driven by the movement driving section; and a stopper that regulates movement of the twisting stopping lever to one side in the movement direction when the twisting stopping lever is in contact with the moving members. The adjustment driving section is provided separately from the movement driving section and is capable of changing the pressing position by driving the stopper.

[0006] According to another aspect of the present invention, a winding unit includes a yarn supplying section in which a yarn supplying bobbin from which yarn can be pulled is arranged; a winding section that winds a yarn pulled from the yarn supplying section onto a winding bobbin to form a package; a unit controller that controls the winding section, and a yarn joining section that includes the above yarn joining device and joins the yarn disconnected between the yarn supplying section and the yarn winding section in a yarn running direction. The adjustment driving section is controlled by the unit controller.

[0007] According to still another aspect of the present invention, a yarn winding machine includes a plurality of the above winding units.

[0008] The above and other objects, features, advantages and technical and industrial significance of this invention will be better understood by reading the following detailed description of presently preferred embodiments of the invention, when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

FIG. 1 is a front view of an automatic winder according to the present embodiment.

FIG. 2 is a block diagram showing an electrical configuration of the automatic winder.

FIG. 3 is a front view of a winding unit.

FIG. 4 is a perspective view of a yarn joining device.

FIG. 5 is a perspective view of the yarn joining device when seen from a different angle.
 FIGS. 6A to 6C are longitudinal section views of the yarn joining device.
 FIG. 7 is a plan view of the yarn joining device.
 FIG. 8 is a diagram showing a cutter mechanism of the yarn joining device.
 FIG. 9 is a bottom view of the yarn joining device.
 FIGS. 10A to 10F are explanatory diagrams showing a cam or a stopper.
 FIGS. 11A to 11D are explanatory diagrams showing an operation of the yarn joining device.
 FIGS. 12A to 12D are explanatory diagrams showing another operation of the yarn joining device.
 FIGS. 13A to 13D are explanatory diagrams showing still another operation of the yarn joining device.
 FIGS. 14A to 14D are explanatory diagrams showing still another operation of the yarn joining device.
 FIGS. 15A to 15D are explanatory diagrams showing still another operation of the yarn joining device.

DETAILED DESCRIPTION

[0010] Exemplary embodiments of the present invention will be explained below. The horizontal direction on the paper on which FIG. 1 has been printed is referred to as a left-right direction. The direction orthogonal to the left-right direction is referred to as an up-down direction (orthogonal direction). A direction orthogonal to both the left-right direction and the up-down direction is referred to as a front-back direction. Moreover, the direction in which a yarn Y runs is referred to as a yarn running direction.

Structural Outline of the Automatic Winder

[0011] First, a structural outline of an automatic winder 1 (yarn winding machine of the present invention) of the present embodiment is explained with reference to FIGS. 1 and 2. FIG. 1 is a front view of the automatic winder 1. FIG. 2 is a block diagram showing an electrical configuration of the automatic winder 1. The automatic winder 1 includes a plurality of winding units 2, a doffing device 3, and a main control device 4.

[0012] The winding units 2 are arranged in the left-right direction, and each of the winding units 2 winds the yarn Y pulled from a respective yarn supplying bobbin Bs onto a respective winding bobbin Bw to form a respective package P. The doffing device 3 is arranged above the winding units 2. The doffing device 3 is supported so as to be movable in the left-right direction. Upon receiving a signal indicative of completion of winding from a certain winding unit 2, the doffing device 3 travels to a position near the winding unit 2 to perform tasks such as removing the package P from the winding unit 2.

[0013] The main control device 4 communicates with a unit controller 14 (see FIG. 2) of each of the winding units 2 and a not-shown control section of the doffing

device 3, with which it is electrically connected.

Winding Unit

[0014] Next, a structure of the winding unit 2 will be explained with reference to FIG. 3. FIG. 3 is a front view showing an outline of the winding unit 2.

[0015] As shown in FIG. 3, the winding unit 2 includes a yarn supplying section 11, a yarn processing section 12, a winding section 13, and the unit controller 14. In the winding unit 2, the yarn Y pulled from the yarn supplying section 11 is processed by the yarn processing section 12 and the yarn Y is wound by the winding section 13.

[0016] The yarn supplying section 11 supplies the yarn Y while unwinding the yarn Y from the yarn supplying bobbin Bs. As shown in FIG. 3, the yarn supplying section 11 is arranged on the lowermost side of the winding unit 2. The yarn supplying section 11 includes a yarn supplying bobbin supporting member 21 and a yarn unwinding assisting device 22. The yarn supplying bobbin supporting member 21 supports the yarn supplying bobbin Bs substantially vertically. The yarn unwinding assisting device 22 regulates, with the help of a regulating cylinder 23, the bulge formed in the yarn Y when the yarn Y is being unwound from the yarn supplying bobbin Bs. The regulating cylinder 23 is movable in the downward direction as the amount of yarn on the yarn supplying bobbin Bs decreases in order to maintain the size of the bulge constant.

[0017] The yarn processing section 12 performs various processes on the yarn Y. As shown in FIG. 3, the yarn processing section 12 is arranged mid-way between the yarn supplying section 11 and the winding section 13 in the up-down direction. The yarn processing section 12 includes a tension applying device 31, a yarn joining mechanism 32 (yarn joining section of the present invention), and a yarn clearer 33.

[0018] The tension applying device 31 is a device that applies a predetermined amount of tension to the running yarn Y. The tension applying device 31 is arranged right above the yarn supplying section 11. An example of the tension applying device 31 is the so-called gate-type tension applying device. As shown in FIG. 3, a plurality of fixed gate members 31a and a plurality of movable gate members 31b are arranged alternately in the up-down direction. By adjusting the position of the movable gate members 31b in a horizontal direction, the predetermined amount of tension is applied to the yarn Y that runs between the fixed gate members 31a and the movable gate members 31b.

[0019] The yarn joining mechanism 32 is a mechanism that joins the yarn Y (lower yarn Y1) on the yarn supplying section 11 side to the yarn Y (upper yarn Y2) on the winding section 13 side, when the yarn Y becomes noncontinuous between the yarn supplying section 11 and the winding section 13 in the yarn running direction. The yarn joining mechanism 32 includes a yarn joining device 34,

a lower-yarn catching and guiding member 35, and an upper-yarn catching and guiding member 36.

[0020] The yarn joining device 34 is a device that joins the lower yarn Y1 to the upper yarn Y2. The yarn joining device 34 is a splicer that intertwines both the yarn ends by the action of compressed air. The details of the yarn joining device 34 will be explained later.

[0021] The lower-yarn catching and guiding member 35 is configured to catch the lower yarn Y1 on the yarn supplying bobbin Bs side (upstream side in the yarn running direction) and guide the same to the yarn joining device 34. The lower-yarn catching and guiding member 35 is arranged on the lower side of the yarn joining device 34. The lower-yarn catching and guiding member 35 includes a pipe-shaped arm 35b that is rotatable around a shaft 35a, a sucking member 35c arranged at a tip end part of the arm 35b for sucking and catching the yarn end of the lower yarn Y1, and a motor 37 that causes the arm 35b to pivot up and/or down. The lower-yarn catching and guiding member 35 is connected to a not-shown suction source. The upper-yarn catching and guiding member 36 is configured to catch the upper yarn Y2 on the winding section 13 side (downstream side in the yarn running direction) and guide the same to the yarn joining device 34. The upper-yarn catching and guiding member 36 is arranged on the upper side of the yarn joining device 34. The upper-yarn catching and guiding member 36 includes a transparent and pipe-shaped arm 36b that is rotatable around a shaft 36a, a sucking member 36c arranged at a tip end part of the arm 36b for sucking and catching a yarn end of the upper yarn Y2, and a motor 38 that causes the arm 36b to pivot up and/or down. The upper-yarn catching and guiding member 36 is connected to a not-shown suction source.

[0022] In the yarn joining mechanism 32 having the configuration explained above, the yarn joining is performed as explained below. When, for example, a yarn defect is detected by the yarn clearer 33 and the yarn Y is cut during a winding operation, the unit controller 14 controls various components of the winding units 2 to suspend the winding operation. Subsequently, the unit controller 14 controls the yarn joining mechanism 32 and the like so that the disconnected lower yarn Y1 and upper yarn Y2 are sucked and caught, the lower yarn Y1 and the upper yarn Y2 are guided to the yarn joining device 34, and the yarn joining is performed by the yarn joining device 34.

[0023] The yarn clearer 33 acquires information regarding thickness and the like of the running yarn Y and detects whether there is a yarn defect based on this information. The yarn clearer 33 is, for example, arranged on the upper side of the yarn joining device 34. The yarn clearer 33 includes a cutter 33a. When a yarn defect is detected by the yarn clearer 33, the cutter 33a immediately cuts the yarn Y. Also, the yarn clearer 33 outputs a detection signal to the unit controller 14.

[0024] The winding section 13 performs the winding operation. The winding operation includes winding the

yarn Y on the winding bobbin Bw to form the package P. As shown in FIG. 3, the winding section 13 is arranged on the uppermost side of the winding unit 2. The winding section 13 includes a cradle 41 that rotatably holds the winding bobbin Bw, a traverse drum 42, and a drum driving motor 43. In the winding section 13, the drum driving motor 43 rotatably drives the traverse drum 42, which is in contact with the package P, which, in turn, is rotatably supported by the cradle 41; therefore, the package P rotates following the rotation of the traverse drum 42. Accordingly, when the traverse drum 42 is rotated, the yarn Y is wound onto the winding bobbin Bw.

[0025] The cradle 41 rotatably supports the winding bobbin Bw (package P). The traverse drum 42 is a cylindrical member whose axial direction is substantially parallel to the left-right direction. A traverse groove 42a for traversing the yarn Y is formed on an outer peripheral surface of the traverse drum 42. When the traverse drum 42 rotates, while the yarn Y is passed in the traverse groove 42a, the yarn Y is traversed within a predetermined width. Furthermore, the traverse drum 42 rotates in contact with an outer peripheral surface of the package P while traversing the yarn Y via the traverse groove 42a; therefore, the contact friction of the package P with the traverse drum 42 makes the package P to rotate following the rotation of the traverse drum 42. As a result, the package P is formed as the yarn Y is wound around the winding bobbin Bw in the course of traverse of the yarn Y.

[0026] The drum driving motor 43 is a motor that rotationally drives the traverse drum 42. The drum driving motor 43 rotationally drives the traverse drum 42 in a forward rotation direction in which the yarn Y is wound around the package P and in a reverse rotation direction in which the yarn Y is pulled from the package P. In a normal winding operation, the traverse drum 42 is driven in the forward direction to rotate the package P in the forward direction, thus winding the yarn Y onto the winding bobbin Bw. In contrast, in the yarn joining operation explained above, the traverse drum 42 is driven in the reverse direction. Accordingly, when the upper-yarn catching and guiding member 36 is pivoted downward in a state in which the upper yarn Y2 is sucked, the upper yarn Y2 is pulled from the package P.

[0027] The unit controller 14 includes, for example, a CPU, a ROM, and a RAM. The unit controller 14 controls various parts according to a computer program stored in the ROM by using the CPU. Specifically, the unit controller 14 receives signals from the yarn clearer 33 and the like, and controls the motor 37, the motor 38, the drum driving motor 43, motors 63 and 73 (explained later) of the yarn joining device 34 and the like. Moreover, the unit controller 14 outputs, via the main control device 4, a signal to request the doffing device 3 to perform doffing.

Concrete Configuration of Yarn Joining Device

[0028] Next, a configuration of the yarn joining device 34 will be specifically explained with reference to FIGS.

4 to 9. FIG. 4 is a perspective view of the yarn joining device 34 when seen from the top left side of the front side. FIG. 5 is a perspective view of the yarn joining device 34 when seen from the bottom left side of the front side. FIGS. 6A to 6C are longitudinal section views of the yarn joining device 34 showing an overview of the operation of the yarn joining device 34. FIG. 7 is a view of the yarn joining device 34 when seen from the upper side (plan view). FIG. 8 is a view of the yarn joining device 34 when seen from above and is an explanatory diagram showing a cutter 79a explained later. FIG. 9 is a view of the yarn joining device 34 when seen from below (bottom view).

[0029] As shown in FIG. 4, the yarn joining device 34 includes an untwisting section 51, a twisting section 52, guide plates 53 and 54, a yarn shifting mechanism 55, a clamp and cutter mechanism 56, and a twisting stopping mechanism 57. In the yarn joining device 34, the clamp and cutter mechanism 56 holds and cuts the two yarns Y (the lower yarn Y1 and the upper yarn Y2) that are guided to the guide plates 53 and 54 via the yarn shifting mechanism 55, and the tip ends (yarn ends) of the lower yarn Y1 and the upper yarn Y2 are untwisted by the untwisting section 51. Moreover, in the yarn joining device 34, the twisting section 52 intertwines the yarn ends of the lower yarn Y1 and the upper yarn Y2 guided to the twisting section 52 by the yarn shifting mechanism 55. Moreover, in the yarn joining device 34, when the lower yarn Y1 and the upper yarn Y2 are being intertwined, the lower yarn Y1 and the upper yarn Y2 are pressed by the twisting stopping mechanism 57 to suppress the transmission of the twisting on the other side of the tip ends of the lower yarn Y1 and the upper yarn Y2 (in other words, the other side of the twisting section 52 in the up-down direction).

Configuration of Untwisting Section

[0030] The untwisting section 51 is configured so as to untwist the yarn ends of the lower yarn Y1 and the upper yarn Y2. As shown in FIGS. 6A to 6C, the untwisting section 51 includes two untwisting pipes 61a and 61b arranged separated from each other in the up-down direction. The untwisting pipe 61a is arranged on the upper side and the untwisting pipe 61b is arranged on the lower side. The untwisting pipes 61a and 61b are cylindrical members that extend in the front-back direction. Moreover, not-shown injection holes that inject compressed air are formed in the inner walls of the untwisting pipe 61a and the untwisting pipe 61b. When the compressed air is injected through the injection holes, an air current is generated inside the untwisting pipe 61a and the untwisting pipe 61b. Accordingly, the untwisting pipe 61a can suck the lower yarn Y1 from an opening at the front end thereof and the untwisting pipe 61b can suck the upper yarn Y2 from an opening at the front end thereof (see FIG. 6B). Moreover, in the untwisting section 51, the yarn end of the lower yarn Y1 introduced into the untwisting

pipe 61a and the yarn end of the upper yarn Y2 introduced into the untwisting pipe 61b are untwisted by the action of the air current.

[0031] Moreover, as shown in FIGS. 6A to 6C, a front plate 60a that bends the upper yarn Y2 as explained later is arranged on the upper but front side of the untwisting pipe 61a. A front plate 60b that bends the lower yarn Y1 as explained later is arranged on the lower but front side of the untwisting pipe 61b.

Configuration of Twisting Section

[0032] The twisting section 52 is configured so as to join the lower yarn Y1 and the upper yarn Y2 by intertwining the yarn ends of the lower yarn Y1 and the yarn end of the upper yarn Y2 untwisted by the untwisting section 51. As shown in FIGS. 6A to 6C, the twisting section 52 includes a twisting nozzle 62. The twisting nozzle 62 is a substantially cylindrical member that extends in the up-down direction. The twisting nozzle 62 is positioned more on the front side than the untwisting pipe 61a and the untwisting pipe 61b but between the untwisting pipe 61a and the untwisting pipe 61b in the up-down direction. A front end portion of the twisting nozzle 62 is open across the length of the nozzle in the up-down direction (see FIG. 4), making it possible to introduce therein the lower yarn Y1 and the upper yarn Y2 from the front end portion. The lower yarn Y1 guided to the yarn joining device 34 by the lower-yarn catching and guiding member 35 and the upper yarn Y2 guided to the yarn joining device 34 by the upper-yarn catching and guiding member 36 are introduced into the twisting nozzle 62 from the opening thereof in the front end portion.

[0033] As shown in FIGS. 6A to 6C, an injection hole 62a via which the compressed air is injected is formed in the inner wall of the twisting nozzle 62. When the compressed air is injected from the injection hole 62a, a swirling airflow is generated inside the twisting nozzle 62. Accordingly, the twisting section 52 can intertwine the yarn ends of the lower yarn Y1 and the upper yarn Y2 that are untwisted by the untwisting section 51 and guided to the twisting nozzle 62 and perform yarn joining by the action of the swirling airflow.

Configuration of Guide Plates

[0034] The guide plate 53 is a plate-shaped member that is arranged in a substantially horizontal manner. The guide plate 53 is arranged above the untwisting section 51 and the twisting section 52. As shown in FIG. 4, a guide groove 53L that extends in the backward direction and via which the lower yarn Y1 is introduced, and a guide groove 53U that extends in the backward direction and via which the upper yarn Y2 is introduced are formed on the front end of the guide plate 53. The later-explained cutter 79a is arranged near the guide groove 53L (see FIG. 5). A later-explained clamp 78a is arranged near the guide groove 53U (see FIG. 4).

[0035] The guide plate 54 is a plate-shaped member that is arranged in a substantially horizontal manner similar to the guide plate 53. The guide plate 54 is arranged below the untwisting section 51 and the twisting section 52. As shown in FIG. 4, a guide groove 54L that extends in the backward direction and via which the lower yarn Y1 is introduced, and a guide groove 54U that extends in the backward direction and via which the upper yarn Y2 is introduced are formed on the front end of the guide plate 54. The guide groove 54L is arranged almost directly below the guide groove 53L formed on the guide plate 53. The guide groove 54U is arranged almost directly below the guide groove 53U formed on the guide plate 53. A later-explained clamp 78b is arranged near the guide groove 54L (see FIG. 5). A later-explained cutter 79b is arranged near the guide groove 54U (see FIG. 4).

Configuration of Yarn Shifting Mechanism

[0036] The yarn shifting mechanism 55 is configured so as to guide and introduce the lower yarn Y1 and the upper yarn Y2 into the twisting nozzle 62 and the like. As shown in FIG. 4, the yarn shifting mechanism 55 includes the motor 63 (movement driving section of the present invention), a transmission member 64 and a transmission member 65, and yarn shifting levers 66 (a first yarn shifting lever 66a and a second yarn shifting lever 66b). In the yarn shifting mechanism 55, by transmitting the power of the motor 63 to the first yarn shifting lever 66a and the second yarn shifting lever 66b via the transmission members 64 and 65, the first yarn shifting lever 66a and the second yarn shifting lever 66b are pivoted so as to guide and introduce the lower yarn Y1 and the upper yarn Y2 into the twisting nozzle 62 and the like.

[0037] The motor 63, for example, is a known stepping motor. As shown in FIG. 4, the motor 63 is provided on a back end portion of the yarn joining device 34. The motor 63 includes a rotation shaft 67 that extends in the up-down direction. The transmission member 64 is provided on the rotation shaft 67. The transmission member 64 is, for example, a substantially fan-shaped plate member when seen in a plan view. The base end side portion of the transmission member 64 is fixed to the rotation shaft 67. A tip end side portion of the transmission member 64 is rotatably connected to the transmission member 65 via a pivoting shaft 68 having an axial direction thereof in the up-down direction. A magnet 69 is provided at the tip end of the transmission member 64. A magnetic sensor 70 that detects the magnet 69 is provided below the transmission member 64. The transmission member 65 is a rod-like member that extends lengthwise in the substantially front-back direction. The back end portion of the transmission member 65 is connected to the transmission member 64 via the pivoting shaft 68. The front end portion of the transmission member 65 is relatively rotatably connected to the first yarn shifting lever 66a via a pivoting shaft 71 having an axial direction thereof in the

up-down direction.

[0038] The first yarn shifting lever 66a and the second yarn shifting lever 66b are plate-shaped levers arranged in a substantially horizontal manner. The first yarn shifting lever 66a is arranged between the guide plate 53 and the front plate 60a in the up-down direction (see FIGS. 6A to 6C). As shown in FIG. 4, the base end part of the first yarn shifting lever 66a is relatively rotatably connected to the transmission member 65 via the pivoting shaft 71. A middle portion positioned between the base end and the tip end of the first yarn shifting lever 66a is rotatably provided on a pivoting shaft 72 having an axial direction in the up-down direction and a position thereof is fixed. A contact portion 66a1 that is capable of coming in contact with a protrusion 96a1 of a later-explained first twisting stopping member 96a is provided on a part of the first yarn shifting lever 66a that is located farther towards the tip end of the first yarn shifting lever 66a from a part provided on the pivoting shaft 72. The second yarn shifting lever 66b is arranged between the front plate 60b and the guide plate 54 in the up-down direction (see FIGS. 6A to 6C). The second yarn shifting lever 66b is integrally and rotatably connected to the first yarn shifting lever 66a by a not-shown coupling member. The base end portion of the second yarn shifting lever 66b is rotatably provided on the pivoting shaft 72 (see FIG. 5).

[0039] When seen from above, the first yarn shifting lever 66a and the second yarn shifting lever 66b are capable of rotating clockwise from initial positions (see FIGS. 7 and 8) thereof. When at the initial positions, the first yarn shifting lever 66a and the second yarn shifting lever 66b do not come in contact with the lower yarn Y1 and the upper yarn Y2. When the first yarn shifting lever 66a and the second yarn shifting lever 66b are at the initial positions, the first yarn shifting lever 66a and the second yarn shifting lever 66b are positioned outside the twisting section 52 and the like in the left-right direction. When the first yarn shifting lever 66a and the second yarn shifting lever 66b pivot from the initial positions, the tip end side portions of the first yarn shifting lever 66a and the second yarn shifting lever 66b are pressed against the lower yarn Y1 guided to the yarn joining device 34 by the lower-yarn catching and guiding member 35 and the upper yarn Y2 guided to the yarn joining device 34 by the upper-yarn catching and guiding member 36, respectively. The lower yarn Y1 and the upper yarn Y2 pressed by the tip end side parts of the first yarn shifting lever 66a and the second yarn shifting lever 66b are guided and introduced into the twisting section 52 and the like. Specifically, the lower yarn Y1 is guided and introduced into the guide groove 53L, the guide groove 54L, and the twisting nozzle 62, and the upper yarn Y2 is guided and introduced into the guide groove 53U, the guide groove 54U and the twisting nozzle 62.

Configuration of Clamp and Cutter Mechanism

[0040] The clamp and cutter mechanism 56 is driven

by the motor 73 (see FIG. 5), and is configured so as to hold and cut the lower yarn Y1 introduced into the guide groove 53L and the guide groove 54L by the yarn shifting mechanism 55, and the upper yarn Y2 introduced into the guide groove 53U and the guide groove 54U by the yarn shifting mechanism 55. As shown in FIGS. 4, 5, and 7 to 9, the clamp and cutter mechanism 56 includes a cam 74, a cam follower 75, a transmission member 76, a pair of transmission members 77 (transmission member 77a and transmission member 77b), a pair of clamps 78 (clamp 78a and clamp 78b), and a pair of cutters 79 (cutter 79a and cutter 79b). In broader terms, the clamp and cutter mechanism 56 transmits the power of the motor 73 to the clamp 78a and the cutter 79a arranged near the guide plate 53 via the cam 74, the cam follower 75, and the transmission members 76 and 77a. Accordingly, the upper yarn Y2 is held by the clamp 78a, and the lower yarn Y1 is cut by the cutter 79a. Moreover, the clamp and cutter mechanism 56 transmits the power of the motor 73 to the clamp 78b and the cutter 79b via the cam 74, the cam follower 75, and the transmission members 76 and 77b. Accordingly, the lower yarn Y1 is held by the clamp 78b, and the upper yarn Y2 is cut by the cutter 79b.

[0041] The motor 73 is, for example, a known stepping motor, and is provided separately from the motor 63. The motor 73 is provided on a substantially central portion of the yarn joining device 34 in the front-back direction (see FIGS. 4, 5, and 9). The motor 73 includes a rotation shaft 80 that extends in the up-down direction.

[0042] As shown in FIGS. 4, 7, and 8, the cam 74 is provided on the rotation shaft 80. The cam 74 includes a cam surface 81 (explained in detail later). Moreover, magnets 82 are provided on the cam 74. A magnetic sensor 83 that detects the magnets 82 is provided below the cam 74.

[0043] The cam follower 75 is a disk-shaped member that is driven following the movement of the cam 74. The cam follower 75 is arranged such that a peripheral surface thereof comes in contact with the cam surface 81. The cam follower 75 is provided so as to be freely rotatable on the transmission member 76 (see FIG. 4) and is biased towards the cam surface 81 side by a not-shown helical torsion coil spring. The transmission member 76 is pivotably provided on a pivoting shaft 84 (see FIG. 5) that extends in the up-down direction and position thereof is fixed. The transmission member 76 extends in the up-down direction. The upper end of the transmission member 76 is connected to the transmission member 77a via a pivoting shaft 85a having an axial direction thereof in the up-down direction (see FIG. 5). A lower end portion of the transmission member 76 is relatively rotatably connected to the transmission member 77b via a pivoting shaft 85b having an axial direction thereof in the up-down direction (see FIG. 5).

[0044] The transmission member 77a is a crank rod member that extends substantially in the front-back direction. A back end portion of the transmission member 77a is relatively rotatably connected to an upper end por-

tion of the transmission member 76 via the pivoting shaft 85a (see FIGS. 7 and 8). A front end portion of the transmission member 77a is connected to the cutter 79a via a pivoting shaft 86a (see FIG. 8) having an axial direction thereof in the up-down direction. A bent portion 87a that is bent in the substantially left-right direction is formed in an intermediate portion of the transmission member 77a in the front-back direction. A front surface of the bent portion 87a is arranged so as to be capable of coming in contact with a bearing 89a1 of the clamp 78a explained later.

[0045] The clamp 78a is arranged on the upper side than the guide plate 53. As shown in FIG. 7, the clamp 78a includes a fixed piece 88a having a substantially fixed position, and a movable piece 89a that is movable (openable and closeable) against the fixed piece 88a. The movable piece 89a is a plate-shaped member that extends in the front-back direction. The bearing 89a1 capable of coming in contact with the front surface of the bent portion 87a of the transmission member 77a is arranged on a back end portion of the movable piece 89a (see FIG. 4). An intermediate portion of the movable piece 89a in the front-back direction is rotatably provided on a pivoting shaft 90a having an axial direction thereof in the up-down direction and a position thereof is fixed. A helical torsion coil spring 91a that biases the tip end portion of the movable piece 89a towards the fixed piece 88a side is arranged around the pivoting shaft 90a. By closing the movable piece 89a (by causing the movable piece 89a to come in contact with the fixed piece 88a), the clamp 78a holds the upper yarn Y2 by positioning the upper yarn Y2 between the movable piece 89a and the fixed piece 88a. Moreover, the fixed piece 88a is mounted slightly movably so as to dampen the impact generated when the movable piece 89a closes, and smoothly bring the movable piece 89a in contact with the fixed piece 88a.

[0046] The cutter 79a is arranged on the lower side of the guide plate 53. As shown in FIG. 8, the cutter 79a includes a fixed piece 92a having a fixed position, and a substantially L-shaped movable piece 93a that is capable of moving (openable and closeable) against the fixed piece 92a. The fixed piece 92a extends in the front-back direction. A base end portion of the movable piece 93a is relatively rotatably connected to the front end portion of the transmission member 77a via a pivoting shaft 86a. A bent portion of the movable piece 93a is rotatably mounted on the fixed piece 92a via a pivoting shaft 94a having an axial direction thereof in the up-down direction and a fixed position. The tip end portion of the movable piece 93a is formed into a blade. The cutter 79a closes the movable piece 93a and cuts the lower yarn Y1 by positioning thereof between the movable piece 93a and the fixed piece 92a.

[0047] Configurations of the transmission member 77b, the clamp 78b, and the cutter 79b are substantially the same as that of the transmission member 77a, the clamp 78a, and the cutter 79a, respectively, explained above. In other words, the back end portion of the trans-

mission member 77b is relatively rotatably connected to the lower end portion of the transmission member 76 via the pivoting shaft 85b. The front end portion of the transmission member 77b is relatively rotatably connected to the cutter 79b (see FIG. 4). A bent portion 87b is formed on an intermediate portion of the transmission member 77b in the front-back direction. The front surface of the bent portion 87b is arranged so as to be able to come in contact with the back end portion of a movable piece 89b (explained later) of the clamp 78b. The clamp 78b is arranged on the lower side of the guide plate 54. The clamp 78b includes a fixed piece 88b and the movable piece 89b (see FIG. 5). A bearing 89b1 is provided on a back end portion of the movable piece 89b that is capable of coming in contact with the front surface of the bent portion 87b of the transmission member 77b. An intermediate portion of the movable piece 89b in the front-back direction is provided rotatably on a pivoting shaft 90b. A helical torsion coil spring 91b is provided around the pivoting shaft 90b. The cutter 79b is arranged on the upper side of the guide plate 54. The cutter 79b includes a fixed piece 92b and a substantially L-shaped movable piece 93b (see FIG. 4). A base end portion of the movable piece 93b is relatively rotatably connected to the front end portion of the transmission member 77b via a pivoting shaft 86b. A bent portion of the movable piece 93b is rotatably provided on the fixed piece 92b. A blade that is capable of cutting the upper yarn Y2 by positioning the upper yarn Y2 between the movable piece 93b and the fixed piece 92b is formed on the tip end portion of the movable piece 93b.

Configuration of Twisting Stopping Mechanism

[0048] The twisting stopping mechanism 57 is configured so as to press the yarn ends of the lower yarn Y1 and the upper yarn Y2 and suppress transmission of the twisting on the other sides of the tip ends of the lower yarn Y1 and the upper yarn Y2 (in other words, on the other sides of the twisting section 52 in the up-down direction). As shown in FIG. 4, the twisting stopping mechanism 57 includes a helical torsion coil spring 95 and a twisting stopping lever 96 (the first twisting stopping member 96a and a second twisting stopping member 96b). Moreover, as shown in FIGS. 5 and 9, driven members 97 and 98 are connected to the twisting stopping lever 96. Furthermore, a stopper 99 is provided near the driven member 98. When the first twisting stopping member 96a and the second twisting stopping member 96b are biased toward the first yarn shifting lever 66a and the second yarn shifting lever 66b side by the helical torsion coil spring 95, the first twisting stopping member 96a and the second twisting stopping member 96b are integrally pivotable with the first yarn shifting lever 66a and the second yarn shifting lever 66b. Moreover, when the driven member 98 is in contact with the stopper 99, pivoting of the first twisting stopping member 96a and the second twisting stopping member 96b is regulated and the first

twisting stopping member 96a and the second twisting stopping member 96b are relatively pivotable with respect to the first yarn shifting lever 66a and the second yarn shifting lever 66b.

[0049] The helical torsion coil spring 95 is arranged so as to enclose the pivoting shaft 72 explained above (see FIGS. 4 and 5). The helical torsion coil spring 95 is provided so as to bias the first twisting stopping member 96a and the second twisting stopping member 96b towards the first yarn shifting lever 66a and the second yarn shifting lever 66b side. The first twisting stopping member 96a and the second twisting stopping member 96b are the plate-shaped levers arranged substantially horizontally and are provided independently from the first yarn shifting lever 66a and the second yarn shifting lever 66b. The first twisting stopping member 96a and the second twisting stopping member 96b are biased towards the first yarn shifting lever 66a and the second yarn shifting lever 66b by the helical torsion coil spring 95. Base end portions of the first twisting stopping member 96a and the second twisting stopping member 96b are provided pivotably on the pivoting shaft 72 (see FIGS. 7 to 9). The first twisting stopping member 96a is arranged between the front plate 60a and the twisting section 52 in the up-down direction (see FIGS. 6A to 6C). The protrusion 96a1 that extends in the up-down direction and is capable of coming in contact with the contact portion 66a1 of the first yarn shifting lever 66a (see FIGS. 7 and 8) is provided on a middle portion positioned between the base end and a tip end of the first twisting stopping member 96a. The second twisting stopping member 96b is arranged between the twisting section 52 and the front plate 60b in the up-down direction (see FIGS. 6A to 6C). The second twisting stopping member 96b is configured so as to be integrally pivotable with the first twisting stopping member 96a around the pivoting shaft 72. A middle portion positioned between the base end and the tip end of the second twisting stopping member 96b is relatively pivotably connected to the driven member 97 via a pivoting shaft 101 having an axial direction thereof in the up-down direction (see FIG. 9). A direction in which the first twisting stopping member 96a and the second twisting stopping member 96b pivot are equivalent to a moving direction according to the present invention.

[0050] The driven member 97 is a crank rod member that extends substantially in the front-back direction. A front end portion of the driven member 97 is relatively pivotably connected to the middle portion of the second twisting stopping member 96b via the pivoting shaft 101 having the axial direction thereof in the up-down direction. A back end portion of the driven member 97 is relatively pivotably connected to the driven member 98 via a pivoting shaft 102 having the axial direction thereof in the up-down direction. The driven member 98 is a lever arm member that extends substantially in the left-right direction. One end of the driven member 98 is relatively pivotably connected to the driven member 97 via the pivoting shaft 102. The other end of the driven member 98

is pivotably provided on the pivoting shaft 84 having a fixed position explained above (see FIG. 9). A bearing 103 that is capable of coming in contact with the stopper 99 is freely pivotably provided on the middle portion of the driven member 98. The twisting stopping lever 96 and the driven members 97 and 98 are equivalent to the moving members according to the present invention.

[0051] The stopper 99 is a substantially disk-shaped member that is configured so as to regulate pivoting (movement in the moving direction) of the first twisting stopping member 96a and the second twisting stopping member 96b. Details of the stopper 99 will be explained later.

[0052] According to the configuration explained above, the first twisting stopping member 96a and the second twisting stopping member 96b is pivotable (movable) between a waiting position in which the first twisting stopping member 96a and the second twisting stopping member 96b do not come in contact with the lower yarn Y1 and the upper yarn Y2 and a pressing position in which the first twisting stopping member 96a and the second twisting stopping member 96b press the lower yarn Y1 and the upper yarn Y2 so as to suppress the transmission of twisting on the other side of the tip ends of the lower yarn Y1 and the upper yarn Y2. Details thereof will be explained later.

Outline of Yarn Joining Procedure performed by Yarn Joining Device

[0053] Next, an outline of a yarn joining procedure performed by the yarn joining device 34 having the configuration explained above will be explained by referring to FIGS. 6A to 6C. In an initial state, the first yarn shifting lever 66a, the second yarn shifting lever 66b, the first twisting stopping member 96a, and the second twisting stopping member 96b are retracted at the front side and on the outer side in the left-right direction of the untwisting section 51, the twisting section 52, and the like (for example, see FIG. 4).

[0054] Before beginning the operation of the yarn joining device 34, the lower yarn Y1 is guided to the yarn joining device 34 by the lower-yarn catching and guiding member 35, and the upper yarn Y2 is guided to the yarn joining device 34 by the upper-yarn catching and guiding member 36. Accordingly, the lower yarn Y1 and the upper yarn Y2 are arranged so as to be positioned immediately in front of the untwisting section 51, the twisting section 52, the guide plate 53, and the guide plate 54.

[0055] Then, the motor 63 (see FIG. 4) is operated. Accordingly, the first yarn shifting lever 66a and the second yarn shifting lever 66b pivot backward (furthermore, the first twisting stopping member 96a and the second twisting stopping member 96b, too, pivot integrally with the first yarn shifting lever 66a and the second yarn shifting lever 66b). Accordingly, the lower yarn Y1 and the upper yarn Y2 are shifted backward by the first yarn shifting lever 66a and the second yarn shifting lever 66b.

Then, the lower yarn Y1 is guided and introduced into the guide grooves 53L and 54L and the twisting nozzle 62, and the upper yarn Y2 is guided and introduced into the guide grooves 53U and 54U and the twisting nozzle 62 (see FIG. 6A).

[0056] Next, the motor 73 (see FIG. 4) is operated. Accordingly, the clamp and cutter mechanism 56 (see FIG. 4), too, operates. Accordingly, the upper yarn Y2 is held by the clamp 78a and the lower yarn Y1 is held by the clamp 78b. Immediately after that, the lower yarn Y1 is cut by the cutter 79a, and the upper yarn Y2 is cut by the cutter 79b. Accordingly, the yarn end of the lower yarn Y1 is sucked into the untwisting pipe 61a, and the yarn end of the upper yarn Y2 is sucked into the untwisting pipe 61b (see FIG. 6B).

[0057] Next, the motor 63 (see FIG. 4) is operated. As a result, the first yarn shifting lever 66a and the second yarn shifting lever 66b further pivot backwards, and the lower yarn Y1 and the upper yarn Y2 are pressed. Accordingly, a yarn end of the lower yarn Y1 is pulled from the untwisting pipe 61a, and a yarn end of the upper yarn Y2 is pulled from the untwisting pipe 61b. Moreover, at this step, the upper yarn Y2 is pressed by the first twisting stopping member 96a and the front plate 60a, and the upper yarn Y2 is caused to bend. Moreover, the lower yarn Y1 is pressed by the second twisting stopping member 96b and the front plate 60b, and the lower yarn Y1 is caused to bend (see FIG. 6C). Accordingly, transmission of the twisting on the other side of the tip ends of the lower yarn Y1 and the upper yarn Y2 is suppressed. The stop position (pressing position) of the first twisting stopping member 96a and the second twisting stopping member 96b is regulated by the stopper 99 (see FIG. 5). In this state, when the compressed air is injected from the injection hole 62a of the twisting section 52, a swirling airflow is generated in the twisting nozzle 62 and the yarn ends of the lower yarn Y1 and the upper yarn Y2 are twisted by the swirling airflow. The yarn joining is performed by following the steps explained above.

[0058] Conventionally, the stopper used for regulating the pressing position of the first twisting stopping member 96a and the second twisting stopping member 96b was manually adjusted by an operator. As a result, there was a problem that special efforts are required for this adjustment. To reduce the efforts involved in adjustment of the pressing position of the first twisting stopping member 96a and the second twisting stopping member 96b, the stopper 99 and the cam 74 of the clamp and cutter mechanism 56 are configured as follows.

Detailed Configuration of Stopper and Cam

[0059] Next, a configuration of the stopper 99 and the cam 74 will be explained in further detail with reference to FIGS. 4, 5, 7 to 9, and 10A to 10F. FIGS. 10A to 10C are explanatory diagrams showing the cam 74. FIGS. 10D to 10F are explanatory diagrams showing the stopper 99. Furthermore, FIGS. 7, 8, and 10A to 10C show

plan views (diagrams showing views of the yarn joining device 34 when viewed from the top). On the other hand, FIG. 9 and FIGS. 10D to 10F are bottom views (diagrams showing views of the yarn joining device 34 when viewed from below). It should be noted that the left and right sides of the plan view and the bottom view in the present embodiment are arranged on the opposite sides of each other. Specifically, the left side of the paper surface of FIGS. 7, 8, and 10A to 10C is the left side in the left-right direction according to the present embodiment. Moreover, the left side of the paper surface of FIGS. 9 and 10D to 10F is the right side in the left-right direction according to the present embodiment.

[0060] First, the stopper 99 is pivotably driven along with the cam 74 by the motor 73 (adjustment driving section and driving motor of the present invention). The cam 74 and the stopper 99 are provided on the rotation shaft 80 of the motor 73. More specifically, the rotation shaft 80 of the motor 73 extends in the up-down direction (axial direction of the present invention). The rotation shaft 80 includes an upper shaft portion 80a (second shaft portion according to the present invention; see FIG. 4) that protrudes upward (the other side of the present invention) from a housing 73a (see FIG. 5) and a lower shaft portion 80b that protrudes downward (one side of the present invention) from the housing 73a (first shaft portion according to the present invention; see FIG. 5). The cam 74 is provided on the upper shaft portion 80a (see FIGS. 7 and 8). The stopper 99 is provided on the lower shaft portion 80b (see FIG. 9). The stopper 99 is arranged on the front side of the driven member 98.

[0061] Shapes of the stopper 99 and the cam 74 will be explained below. For convenience of explanation, the shape of the cam 74 will be explained first. As shown in FIG. 10A, the cam surface 81 of the cam 74 includes a first surface 81a, a second surface 81b, and a third surface 81c. When viewed from above, the first surface 81a, the second surface 81b, and the third surface 81c are arranged in a clockwise manner around the rotation shaft 80. The first surface 81a matches the peripheral surface of the cam follower 75 (in other words, a shape in which the entire first surface 81a can substantially come into contact with the peripheral surface of the cam follower 75). When the entire first surface 81a substantially comes in contact with the peripheral surface of the cam follower 75, the rotation angle of the cam 74 is an initial angle (first angle) (in other words, the rotation angle of the rotation shaft 80 is the initial angle (first angle)).

[0062] The second surface 81b is substantially flat. The second surface 81b is formed such that the distance thereof from a center of the rotation shaft 80 gradually decreases from the first surface 81a end side to the third surface 81c side end, and then the distance gradually increases again. In other words, the distance between the middle portion of the second surface 81b positioned between the third surface 81c side and the first surface 81a side and the center of the rotation shaft 80 is minimum. As shown in FIG. 10B, when viewed from above,

when the cam 74 rotates counterclockwise by an angle θ_a from the initial angle and the end of the second surface 81b on the third surface 81c side is in contact with the cam follower 75, the rotation angle of the cam 74 is the second angle. In other words, the rotation angle of the rotation shaft 80 in such a state is the second angle.

[0063] The third surface 81c (see a thick line shown in FIGS. 10A to 10C) is substantially arc shaped when viewed from above. In other words, the third surface 81c is a surface in which the distance thereof from the center of the rotation shaft 80 is substantially constant from the second surface 81b side end towards an end on the side opposite to the second surface 81b. As shown in FIG. 10C, when viewed from above, in a state in which the cam 74 rotates counterclockwise by an angle θ_b from the initial angle and the end of the third surface 81c opposite to the second surface 81b comes in contact with the cam follower 75, the rotation angle of the cam 74 is a third angle. In other words, the rotation angle of the rotation shaft 80 in such a state is the third angle. Accordingly, the cam 74 and the rotation shaft 80 of the motor 73 is at least rotatable from the initial angle (first angle) to the third angle via the second angle.

[0064] Details of the shape of the stopper 99 will be explained below. Because, similar to the cam 74, the stopper 99, too, is provided on the rotation shaft 80, the stopper 99 is rotatable from the initial angle (first angle) to the third angle via the second angle (see FIGS. 10D to 10F). The stopper 99 includes a peripheral surface 104 that is formed substantially perpendicular to the rotation shaft 80. The peripheral surface 104 includes a first surface 104a and a second surface 104b (contact surfaces according to the present invention, 104b shown by a thick line in FIGS. 10D to 10F). When viewed from below, the first surface 104a and the second surface 104b are arranged counterclockwise around the rotation shaft 80. The first surface 104a is a surface that is capable of coming into contact with the bearing 103 when the stopper 99 is rotating between the first angle and the second angle. When the rotation angle of the stopper 99 is the first angle, the bearing 103 is capable of coming in contact with an end of the first surface 104a on the opposite side of the second surface 104b (see FIG. 10D). The distance of the first surface 104a from the center of the rotation shaft 80 is, for example, largely constant; however, the distance is not limited thereto.

[0065] The second surface 104b is a surface that is capable of coming into contact with the bearing 103 when the stopper 99 is rotating between the second angle and the third angle. In other words, when the rotation angle of the stopper 99 is the second angle (see FIG. 10E), the end of the second surface 104b on the first surface 104a side is capable of coming into contact with the bearing 103. When the rotation angle of the stopper 99 is the third angle (see FIG. 10F), the end of the second surface 104b on the opposite side of the first surface 104a is capable of coming into contact with the bearing 103. In this configuration, at least the second surface 104b is formed

such that the distance from the center of the rotation shaft 80 changes according to the position of the stopper 99 in the rotational and circumferential direction (circumferential direction). As an example, the second surface 104b is formed such that the distance from the center of the rotation shaft 80 becomes shorter as it goes far from the first surface 104a in the circumferential direction.

Details of Operation of Yarn Joining Device

[0066] Next, operation of the yarn joining device 34 (particularly, operation of the yarn shifting mechanism 55, the clamp and cutter mechanism 56, and the twisting stopping mechanism 57) will be explained in detail with reference to FIGS. 11A to 15D. Among FIGS. 11A to 15D, the diagrams suffixed with "A" are explanatory diagrams showing the operation of the first yarn shifting lever 66a and the first twisting stopping member 96a. The diagrams suffixed with "B" are explanatory drawings showing the operation of the second yarn shifting lever 66b and the second twisting stopping member 96b. The diagrams suffixed with "C" are explanatory diagrams showing the operation of the clamp 78a. The diagrams suffixed with "D" are explanatory diagrams showing the operation of the cutter 79a. Furthermore, because the clamp 78b and the cutter 79b operate on the same principle as that of the clamp 78a and the cutter 79a, illustration and detailed explanation of the operation of the clamp 78b and the cutter 79b is omitted.

[0067] Among FIGS. 11A to 15D, the diagrams suffixed with "A", "C", or "D" are plan views (diagrams showing the yarn joining device 34 when viewed from above). The diagrams suffixed with "B" are bottom views (diagrams showing the yarn joining device 34 when viewed from below). It should be noted that the left and right sides of the plan view and the bottom view in the present embodiment are arranged on the opposite sides of each other.

[0068] A state in which the magnet 69 provided on the transmission member 64 is positioned directly above the magnetic sensor 70, and the magnets 82 provided on the cam 74 are positioned directly above the magnetic sensor 83 (see FIGS. 11A and 11C) is set as an initial state. In this state, the first yarn shifting lever 66a and the second yarn shifting lever 66b, the clamps 78a and 78b, the cutters 79a and 79b, the first twisting stopping member 96a, and the second twisting stopping member 96b are positioned at the initial position (see FIGS. 11A to 11D). In other words, the first yarn shifting lever 66a and the second yarn shifting lever 66b, the first twisting stopping member 96a, and the second twisting stopping member 96b substantially extend in the front-back direction (see FIGS. 11A and 11B) and do not contact the lower yarn Y1 and the upper yarn Y2. The initial position of the first twisting stopping member 96a and the second twisting stopping member 96b is equivalent to the waiting position explained in the present invention. In this position, the clamps 78a and 78b are open (see FIG. 11C). The cutters 79a and 79b, too, are open (see FIG. 11D).

[0069] The motor 63 operates. As a result, the rotation shaft 67 rotates clockwise when viewed from above (see arrow A01 in FIG. 12A). Accordingly, power of the motor 63 is transmitted to the first yarn shifting lever 66a and the second yarn shifting lever 66b via the transmission members 64 and 65, and the yarn shifting levers 66a and 66b rotate clockwise when viewed from above (see arrow A02 in FIG. 12A). The motor 63 stops operating when the first yarn shifting lever 66a and the second yarn shifting lever 66b move to a position (see FIG. 12A) in which the lower yarn Y1 and the upper yarn Y2 are guided and introduced into the twisting section 52 and the like. When the first yarn shifting lever 66a and the second yarn shifting lever 66b are moving in such a manner, the first twisting stopping member 96a and the second twisting stopping member 96b are biased toward the first yarn shifting lever 66a and the second yarn shifting lever 66b by the helical torsion coil spring 95, and the protrusion 96a1 comes in contact with the contact portion 66a1. Accordingly, the first twisting stopping member 96a and the second twisting stopping member 96b rotate (move) integrally with the first yarn shifting lever 66a and the second yarn shifting lever 66b. Moreover, when the first twisting stopping member 96a and the second twisting stopping member 96b rotate, the driven member 97 that is connected to the second twisting stopping member 96b and the driven member 98 that is connected to the driven member 97, too, are driven (see arrow A03 in FIG. 12B). When the bearing 103 provided on the driven member 98 comes in contact with the stopper 99, further movement of the driven member 98 is regulated. Accordingly, rotation of the first twisting stopping member 96a and the second twisting stopping member 96b, too, is regulated (see FIG. 12B). Specifically, the stopper 99 regulates further rotation of the first twisting stopping member 96a and the second twisting stopping member 96b to one side in the moving direction (substantially backward).

[0070] Moreover, simultaneously with the operation of the motor 63 explained above, the motor 73 is also operated. As a result, the rotation shaft 80 rotates counterclockwise when viewed from above. Accordingly, the cam 74 rotates counterclockwise when viewed from above (see arrow A04 in FIGS. 12C and 12D). The cam 74 rotates between the first angle and the second angle. The cam follower 75 comes in contact with the second surface 81b of the cam surface 81, and is caused to move such that the distance between the center of a rotation shaft of the cam follower 75 and a center of the rotation shaft 80 gradually shortens. At this step, the transmission member 76 rotates counterclockwise when viewed from above. Accordingly, the transmission member 77a is moved forward (see arrow A05 in FIGS. 12C and 12D). Subsequently, the bearing 89a1 provided on the movable piece 89a of the clamp 78a is pushed in the forward direction by the bent portion 87a of the transmission member 77a. At this step, the movable piece 89a pivots counterclockwise when viewed from above against the bias force of the helical torsion coil spring 91a around the piv-

oting shaft 90a (see arrow A06 in FIG. 12C). Accordingly, the clamp 78a opens further than in the initial position. The clamp 78b, too, opens further based on the same principle.

[0071] Moreover, when the transmission member 77a is moved in the forward direction as explained above, the movable piece 93a of the cutter 79a rotates slightly in the clockwise direction around the rotation shaft 94a when viewed from above. Accordingly, the cutter 79a opens slightly farther than the initial position (arrow omitted). The cutter 79b, too, opens based on the same principle.

[0072] Moreover, during the operation of the motor 73 explained above, the stopper 99 rotates clockwise when viewed from below (see arrow A07 in FIG. 12B). At this step, the first surface 104a of the stopper 99 comes in contact with the bearing 103 (see FIG. 12B).

[0073] As explained above, at the timing shown in FIGS. 12A to 12D, the lower yarn Y1 and the upper yarn Y2 are guided and introduced into the twisting section 52 and the like by the first yarn shifting lever 66a and the second yarn shifting lever 66b (see FIG. 6A).

[0074] Next, the motor 73 operates further while the operation of the motor 63 is stopped (see FIG. 13A). At this step, the rotation shaft 80 rotates counterclockwise when viewed from above (clockwise when viewed from below) (see FIGS. 13B to 13D). At this step, the rotation angle of the cam 74 reaches the second angle (see arrows A08 in FIGS. 13C and 13D). Moreover, the cam follower 75 comes in contact with the second surface 81b of the cam surface 81, and is caused to move such that the distance between the center of the rotation shaft of the cam follower 75 and the center of the rotation shaft 80 increases gradually. Accordingly, the transmission member 77a is moved backward (see arrow A09 in FIGS. 13C and 13D). Then, the bent portion 87a of the transmission member 77a is separated from the bearing 89a1 provided on the movable piece 89a. At this step, because of the bias force of the helical torsion coil spring 91a, the movable piece 89a rotates clockwise when viewed from above (see arrow A10 in FIG. 13C). Accordingly, the clamp 78a closes, and the upper yarn Y2 is pinched and held between the movable piece 89a and the fixed piece 88a. The clamp 78b, too, closes in the same manner, and the lower yarn Y1 is pinched and held between the movable piece 89b and the fixed piece 88b.

[0075] Moreover, when the transmission member 77a is caused to move backward as explained above, the movable piece 93a of the cutter 79a rotates counterclockwise when viewed from above (see arrow A11 in FIG. 13D). Accordingly, the cutter 79a closes, and the lower yarn Y1 is pinched between the movable piece 93a and the fixed piece 92a and cut. The cutter 79b, too, closes in the same manner, and the upper yarn Y2 is pinched between the movable piece 93b and the fixed piece 92b and cut. At this step, the lower yarn Y1 is sucked into the untwisting pipe 61a, and the upper yarn Y2 is sucked into the untwisting pipe 61b (see FIG. 6B).

[0076] As explained above, the clamp and cutter mechanism 56 can be operated when the rotation shaft 80 and the cam 74 are rotating between the first angle and the second angle. When the rotation angle of the rotation shaft 80 and the cam 74 reach the second angle, the operation of the clamp and cutter mechanism 56 is completed.

[0077] Moreover, when the operation of the motor 73 is performed as explained above, the stopper 99 further rotates clockwise when viewed from below (see arrow A12 in FIG. 13B). At this step, a boundary portion located between the first surface 104a and the second surface 104b of the stopper 99 comes in contact with the bearing 103 (see FIG. 13B).

[0078] Next, the motor 63 is operated. As a result, the rotation shaft 67 and the transmission member 64 of the motor 63 further pivot in a clockwise manner when viewed from above (see arrow A13 in FIG. 14A). Accordingly, when viewed from above, the first yarn shifting lever 66a and the second yarn shifting lever 66b further pivot in a clockwise manner (see arrow A14 in FIG. 14A). At this step, as shown in FIG. 14B, because the bearing 103 comes in contact with the stopper 99, pivoting of the first twisting stopping member 96a and the second twisting stopping member 96b in the backward direction is restricted. Accordingly, the contact portion 66a1 of the first yarn shifting lever 66a separates from the protrusion 96a1 of the first twisting stopping member 96a and a state in which the first yarn shifting lever 66a and the second yarn shifting lever 66b, and the first twisting stopping member 96a and the second twisting stopping member 96b pivot integrally (first state) is released. In other words, the first yarn shifting lever 66a and the second yarn shifting lever 66b pivot relatively to the first twisting stopping member 96a and the second twisting stopping member 96b (second state). In other words, in the second state, the first twisting stopping member 96a and the second twisting stopping member 96b are positioned independently of the first yarn shifting lever 66a and the second yarn shifting lever 66b. Accordingly, the first twisting stopping member 96a and the second twisting stopping member 96b are capable of switching between the first state and the second state. By performing the operation of the first yarn shifting lever 66a and the second yarn shifting lever 66b explained above, the lower yarn Y1 is pulled from the untwisting pipe 61a and the upper yarn Y2 is pulled from the untwisting pipe 61b (see FIG. 6C). At the time of the operation of the motor 63 explained above, the operation of the motor 73, for example, is stopped (see FIGS. 14B to 14D).

[0079] Next, for example, after the operation of the motor 63 is stopped, the motor 73 is operated. As a result, the rotation shaft 80 further rotates counterclockwise when viewed from above

[0080] (clockwise when viewed from below) (see FIGS. 15B to 15D). The rotation shaft 80, the cam 74, and the stopper 99 rotate between the second angle and the third angle (see arrow A15 in FIG. 15B and arrow

A16 in FIGS. 15C and 15D). The cam follower 75 comes in contact with the third surface 81c of the cam surface 81, and maintains a constant distance between the center of the rotation shaft of the cam follower 75 and the center of the rotation shaft 80 (see FIGS. 15C and 15D). Therefore, the operation of the clamp and cutter mechanism 56 is stopped. Moreover, at this step, the second surface 104b of the stopper 99 comes in contact with the bearing 103 (see FIG. 15B). A contact portion of the second surface 104b that comes in contact with the bearing 103 changes depending on the rotation angle of the stopper 99. Accordingly, the distance between the bearing 103 and the center of the rotation shaft 80 changes, and the driven member 98 is pivoted (see, for example, arrow A17 in FIG. 15B). Accordingly, the first twisting stopping member 96a and the second twisting stopping member 96b, too, are pivoted so as to finely adjust the position (see, for example, arrow A18 in FIG. 15B). Specifically, when the rotation angle of the stopper 99 is closer to the second angle, tip end side portions of the first twisting stopping member 96a and the second twisting stopping member 96b are positioned relatively on the front side. Accordingly, the lower yarn Y1 and the upper yarn Y2 are pressed relatively weakly. On the other hand, when the rotation angle of the stopper 99 is closer to the third angle, the front end side portions of the first twisting stopping member 96a and the second twisting stopping member 96b are positioned relatively on the back side. Accordingly, the lower yarn Y1 and the upper yarn Y2 are pressed relatively strongly. Positions of the first twisting stopping member 96a and the second twisting stopping member 96b after the operation of the motor 73 is stopped, and when the rotation of the stopper 99 stops are referred to as pressing positions.

[0081] As explained above, the first twisting stopping member 96a and the second twisting stopping member 96b are pivotable (movable) between the waiting position and the pressing position. The pressing position is positioned on one side of the waiting position in the moving direction. Further movement of the first twisting stopping member 96a and the second twisting stopping member 96b to one side (generally backward) in the moving direction is restricted by the stopper 99. Furthermore, when the motor 73 drives the stopper 99, the pressing position is adjusted. In the present embodiment, driving amount of the motor 73 is controlled (adjusted) by the unit controller 14. The pressing position changes when the rotation shaft 80 and the stopper 99 are being rotated between the second angle and the third angle. Therefore, according to the present embodiment, even in a configuration in which movably driving of the first twisting stopping member 96a and the second twisting stopping member 96b along with the first yarn shifting lever 66a and the second yarn shifting lever 66b by the motor 63, and adjusting the pressing position by operating the motor 63 is difficult, the pressing position can be easily adjusted.

[0082] As explained above, the motor 73 can adjust the pressing position of the first twisting stopping member

96a and the second twisting stopping member 96b without any need of manual intervention. Therefore, efforts involved in adjustment of the pressing position of the first twisting stopping member 96a and the second twisting stopping member 96b can be reduced.

[0083] Moreover, the motor 63 that determines the operation of the first yarn shifting lever 66a, the second yarn shifting lever 66b, the first twisting stopping member 96a, and the second twisting stopping member 96b is provided separately from the motor 73 that drives the stopper 99. Therefore, the position of the stopper 99 can be adjusted without changing the operation of the motor 63. Accordingly, the pressing position of the first twisting stopping member 96a and the second twisting stopping member 96b can be easily changed without being dependent on operations of other mechanisms.

[0084] Moreover, the pressing position of the first twisting stopping member 96a and the second twisting stopping member 96b can be adjusted by adjusting the position of the stopper 99. Furthermore, in the second state in which the first twisting stopping member 96a and the second twisting stopping member 96b are in contact with the stopper 99, the first yarn shifting lever 66a, the second yarn shifting lever 66b, the first twisting stopping member 96a, and the second twisting stopping member 96b can be moved relatively. Therefore, even in a configuration in which the first twisting stopping member 96a, the second twisting stopping member 96b, the first yarn shifting lever 66a, and the second yarn shifting lever 66b are movably driven together, the pressing position of the first twisting stopping member 96a and the second twisting stopping member 96b, and the stop position of the first yarn shifting lever 66a and the second yarn shifting lever 66b can be adjusted independently.

[0085] Moreover, by adjusting the rotation angle of the stopper 99, a contact portion thereof that contacts the moving member of the second surface 104b can be changed, and the pressing position can be adjusted. Accordingly, the pressing position can be adjusted by using a simple configuration. In the present embodiment, adjustment of the rotation angle of the stopper 99 is realized by the unit controller 14 by adjusting the driving amount of the motor 73.

[0086] Moreover, as explained above, at the timing at which the first twisting stopping member 96a and the second twisting stopping member 96b should be positioned at the pressing position, the operation of the clamp and cutter mechanism 56 is already completed. The yarn joining device 34 is configured such that the stopper 99 and the cam 74 are rotationally driven by the motor 73, and furthermore, the cam follower 75 is moved while the rotation shaft 80 is rotating between the first angle and the second angle. Moreover, the pressing position can be adjusted when the rotation shaft 80 is being rotated between the second angle and the third angle. Accordingly, because the operation of the clamp and cutter mechanism 56 and the adjustment of the pressing position can be performed independently depending on the rotation

angle of the rotation shaft 80, the pressing position can be adjusted without increasing the number of driving sources. Therefore, efforts involved in adjustment of the pressing position can be reduced while avoiding the increase in the device size and cost.

[0087] Moreover, the stopper 99 and the cam 74 are provided on the rotation shaft 80. The stopper 99 and the cam 74 can be rotated with such a simple configuration. Therefore, increase in the device size can be avoided.

[0088] Moreover, the stopper 99 is positioned on the opposite side of the cam 74 with the housing 73a of the motor 73 positioned therebetween. Accordingly, compared to the configuration in which the stopper 99 and the cam 74 are provided on the same side in an axial direction of the rotation shaft, interference of the stopper 99 with the clamp and cutter mechanism 56 can be easily avoided.

[0089] Moreover, in the winding unit 2 in which the yarn joining device 34 is provided, efforts involved in the adjustment of the pressing position can be reduced. Therefore, a stopping time of the winding unit 2 required for adjusting can be shortened and operation efficiency can be improved.

[0090] Moreover, with this joining device 34, efforts involved in adjustment of the pressing position in the plurality of the winding units 2 of the automatic winder 1 can be reduced. Particularly, because the pressing position can be adjusted collectively for each span when the settings are changed for each span of the automatic winder 1, efforts involved in the adjustment can be significantly reduced. Therefore, operation efficiency of the automatic winder 1 can be significantly improved.

[0091] Modifications in which the embodiments explained above can be modified are explained below. However, parts and elements that are identical to the embodiment explained above are indicated by the same reference symbols and explanation thereof is omitted.

(1) In the embodiments explained above, the cam 74 is provided on the upper shaft portion 80a of the motor 73 and the stopper 99 is provided on the lower shaft portion 80b of the motor 73; however, the configuration is not limited this configuration. The cam 74 and the stopper 99 can be provided, for example, on the same side of the rotation shaft 80 in the up-down direction.

(2) In the embodiments explained above, the stopper 99 and the cam 74 are provided on the rotation shaft 80 of the motor 73; however, the configuration is not limited this configuration. A not-shown transmission member can be interposed between the rotation shaft 80 and the stopper 99 or the cam 74 in the power transmission direction of the motor 73. Even in such a configuration, the yarn joining device 34 can be configured such that the cam follower 75 can be moved while the rotation shaft 80 is being rotated between the first angle and the second angle, and the pressing position can be adjusted when the ro-

tation shaft 80 is being rotated between the second angle and the third angle.

(3) In the embodiments explained above, the clamp and cutter mechanism 56 and the stopper 99 are driven by the motor 73; however, the configuration is not limited this configuration. A driving source for operating the clamp and cutter mechanism 56 and a driving source for operating the stopper 99 can be provided separately.

(4) In the embodiments explained above, the first yarn shifting lever 66a and the second yarn shifting lever 66b, and the first twisting stopping member 96a and the second twisting stopping member 96b are driven by the motor 63; however, the configuration is not limited this configuration. A driving source for operating the first yarn shifting lever 66a and the second yarn shifting lever 66b, and a driving source that operates the first twisting stopping member 96a and the second twisting stopping member 96b can be provided separately.

(5) In the embodiments explained above, the timing at which the lower yarn Y1 and the upper yarn Y2 are guided towards the twisting section 52 and the like by the first yarn shifting lever 66a and the second yarn shifting lever 66b, the bearing 103 arranged on the driven member 98 comes in contact with the stopper 99. In other words, before the adjustment of the pressing position of the motor 73 and the stopper 99, movement of the first twisting stopping member 96a and the second twisting stopping member 96b is regulated by the stopper 99. However, the timing is not limited to this timing, and a timing at which the bearing 103 is caused to come in contact with the stopper 99 can be during or after the adjustment of the pressing position is performed by the stopper 99. The yarn joining device 34 can be configured so as to regulate the pressing position of the first twisting stopping member 96a and the second twisting stopping member 96b even before the lower yarn Y1 and the upper yarn Y2 are intertwined by the twisting section 52.

(6) In the embodiments explained above, the stopper 99 is rotationally driven by the motor 73 and the pressing position of the first twisting stopping member 96a and the second twisting stopping member 96b is adjusted depending on the rotation angle of the stopper 99; however, the configuration is not limited this configuration. The stopper 99 can be movably driven by, for example, a not-shown linear actuator.

(7) In the embodiments explained above, pivoting (movement) of the first twisting stopping member 96a and the second twisting stopping member 96b is regulated when the bearing 103 provided on the driven member 98 comes in contact with the stopper 99; however, the configuration is not limited this configuration. The stopper 99, for example, can be provided so as to regulate the pivoting (movement) of

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the first twisting stopping member 96a and the second twisting stopping member 96b by directly coming into contact with the first twisting stopping member 96a and / or the second twisting stopping member 96b.

(8) In the embodiments explained above, the first twisting stopping member 96a and the second twisting stopping member 96b are configured so as to be rotationally driven; however, the configuration is not limited this configuration. The first twisting stopping member 96a and the second twisting stopping member 96b can be configured, for example, to be movable linearly.

(9) In the embodiments explained above, the pressing position of the first twisting stopping member 96a and the second twisting stopping member 96b is adjusted by driving the stopper 99; however, the configuration is not limited this configuration. A movement driving section that movably drives the first twisting stopping member 96a and the second twisting stopping member 96b can be operated so as to stop the first twisting stopping member 96a and the second twisting stopping member 96b at a desired pressing position. In other words, the movement driving section can be configured such that the operation of the movement driving section stops at the timing at which the first twisting stopping member 96a and the second twisting stopping member 96b just stop at a desired position.

(10) In the embodiments explained above, the timing at which the lower yarn Y1 and the upper yarn Y2 are pulled from the untwisting pipe 61a and the untwisting pipe 61b respectively by moving the first yarn shifting lever 66a and the second yarn shifting lever 66b, and the timing at which the pressing position of the first twisting stopping member 96a and the second twisting stopping member 96b is adjusted are different. However, the timing is not limited to these timings, and such timings can be the same timing.

(11) In the embodiments explained above, the automatic winder 1 included a plurality of winding units 2; however, the configuration is not limited to this. The automatic winder 1 can include only one winding unit 2.

(12) The present invention is not limited to the automatic winder 1 and can be applied to various yarn winding machines such as a spinning machine that is disclosed in the Japanese Patent Application Laid-Open No. 2019-31380.

[0092] In the present invention, the adjustment driving section can adjust the pressing position of the twisting stopping lever without manual intervention. Therefore, efforts involved in adjusting the pressing position of the twisting stopping lever can be reduced.

[0093] According to one aspect of the present invention, a yarn joining device includes a twisting section that joins two yarns by intertwining tip ends thereof; a twisting

stopping lever that includes a first twisting stopping member that is movable between a waiting position in which the first twisting stopping member does not come in contact with the two yarns, and a pressing position in which the first twisting stopping member presses one of the two yarns on one side in a predetermined moving direction from the waiting position thereby suppressing transmission of twisting on the other side of the pressed yarn end, and a second twisting stopping member that is movable between a waiting position in which the second twisting stopping member does not come in contact with the two yarns, and a pressing position in which the second twisting stopping member presses the other of the two yarns thereby suppressing transmission of twisting on the other side of the pressed yarn end; an adjustment driving section that changes the pressing position of the twisting stopping lever in the movement direction; a movement driving section that movably drives the twisting stopping lever in the movement direction; moving members that include the twisting stopping lever and are movably driven by the movement driving section; and a stopper that regulates movement of the twisting stopping lever to one side in the movement direction when the twisting stopping lever is in contact with the moving members. The adjustment driving section is provided separately from the movement driving section and is capable of changing the pressing position by driving the stopper.

[0094] In the above aspect, for example, because a movement driving section that determines the operation of the moving members that include the twisting stopping lever, and the adjustment driving section that drives the stopper are provided separately, the position of the stopper can be adjusted without changing the operation of the movement driving section. Accordingly, the pressing position of the twisting stopping lever can be changed easily without any interference from the operation of other mechanisms.

[0095] The above yarn joining device includes a yarn shifting lever that is moved and driven by the movement driving section along with the twisting stopping lever to guide the two yarns to the twisting section. The twisting stopping lever is capable of switching between a first state in which movement thereof is not regulated by the stopper and can be integrally moved along with the yarn shifting lever, and a second state in which movement thereof is regulated by the stopper and is positioned independently of the yarn shifting lever.

[0096] In the above aspect, the pressing position of the twisting stopping lever can be adjusted by adjusting the position of the stopper, and, in the second state, in which the twisting stopping lever is in contact with the stopper, the yarn shifting lever and the twisting stopping lever can be caused to move relatively. Accordingly, even in a configuration in which the twisting stopping lever and the yarn shifting lever are moved and driven by a common mechanism, the pressing position of the twisting stopping lever and the stopping position of the yarn shifting lever can be adjusted independently of each other.

[0097] In the above yarn joining device, the adjustment driving section includes a driving motor that rotationally drives the stopper. The stopper has a contact surface, the distance thereof from a center of a rotation shaft of the driving motor depending on the position of the stopper in a rotational and circumferential direction is used to bring the stopper in contact with the moving members. A part of the contact surface that comes in contact with the moving member changes depending on a rotation angle of the stopper.

[0098] In the above aspect, a part of the surface of the twisting stopping lever that comes in contact with the moving member can be changed by adjusting the rotation angle of the stopper so as to enable the adjustment of the pressing position. Accordingly, the pressing position can be adjusted by using a simple configuration.

[0099] The above yarn joining device includes a cam that is rotationally driven along with the stopper by the driving motor; a cam follower that follows the movement of the cam; and a clamp and cutter mechanism that is configured so as to hold and cut the two yarns by moving the cam follower. The rotation shaft of the driving motor is at least rotatable from a predetermined first angle to a third angle via a second angle, a cam surface of the cam is formed such that the cam follower is moved when the rotation shaft is rotating between the first angle and the second angle, and the contact surface of the stopper is formed so as to change the pressing position when the rotation shaft rotates between the second angle and the third angle.

[0100] Generally, in the yarn joining device, the timing at which the clamp and cutter mechanism is operated and the timing at which the twisting stopping lever is set to the pressing position are different. In other words, at the timing at which the twisting stopping lever should be set to the pressing position, operation of the clamp and cutter mechanism is already completed (details explained above). In the yarn joining device according to the present invention, the stopper and the cam are driven rotatably by a driving motor, which is the common driving source, and the cam follower is caused to move when the rotation shaft is being rotated between the first angle and the second angle. Moreover, when the rotation shaft is being rotated between the second angle and the third angle, the pressing position can be changed (that is, the pressing position can be adjusted). Accordingly, because the operation of the clamp and cutter mechanism and the adjustment of the pressing position can be performed independently depending on the rotation angle of the rotation shaft, the pressing position can be adjusted without increasing the number of driving sources. Therefore, efforts involved in adjusting the pressing position can be reduced while avoiding the increase in the device size and cost.

[0101] In the above yarn joining device, the stopper and the cam are provided on the rotation shaft.

[0102] In the above aspect, the stopper and the cam can be caused to rotate with a simple configuration.

Therefore, increase in the device size can be avoided.

[0103] In the above yarn joining device, the rotation shaft of the driving motor includes a first shaft portion that protrudes from a housing of the driving motor toward one side in an axial direction of the rotation shaft; and a second shaft portion that protrudes from the housing toward the other side in the axial direction. The stopper is provided on the first shaft portion, and the cam is provided on the second shaft portion.

[0104] In the above aspect, the stopper is positioned on the opposite side of the cam by interposing the housing. Therefore, interference of the stopper with the clamp and cutter mechanism can be easier avoided than in a configuration in which the stopper and the cam are provided on the same side in the axial direction of the rotation shaft.

[0105] A winding unit according to another aspect of the present invention includes a yarn supplying section in which a yarn supplying bobbin from which yarn can be pulled is arranged; a winding section that winds a yarn pulled from the yarn supplying section onto a winding bobbin to form a package; a unit controller that controls the winding section, and a yarn joining section that includes the above yarn joining device and joins the yarn disconnected between the yarn supplying section and the yarn winding section in a yarn running direction. The adjustment driving section is controlled by the unit controller.

[0106] In the present invention, in the winding unit in which the yarn joining device is arranged, efforts involved in adjustment of the pressing position can be reduced. Therefore, the stopping time of the winding unit required for the adjustment can be minimized and operation efficiency can be improved.

[0107] A yarn winding machine according to still another aspect of the present invention includes a plurality of the above winding units.

[0108] In the present invention, efforts involved in adjustment of the pressing position can be reduced in a plurality of the winding units. Therefore, operation efficiency of the yarn winding machine can be significantly improved.

[0109] In the above explanation, the meaning of "a plurality of" also includes "a predetermined number of".

[0110] Although the invention has been explained with respect to specific embodiments for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art that fairly fall within the scope of the claims.

Claims

1. A yarn joining device (34) comprising:
 - a twisting section (52) that joins two yarns (Y1,

Y2) by intertwining tip ends thereof;
a twisting stopping lever (96) that includes

a first twisting stopping member (96a) that is movable between

a waiting position in which the first twisting stopping member (96a) does not come in contact with the two yarns (Y1, Y2), and

a pressing position in which the first twisting stopping member (96a) presses one of the two yarns (Y2) on one side in a predetermined moving direction from the waiting position thereby suppressing transmission of twisting on the other side of the pressed yarn end, and

a second twisting stopping member (96b) that is movable between

a waiting position in which the second twisting stopping member (96b) does not come in contact with the two yarns (Y1, Y2), and

a pressing position in which the second twisting stopping member (96b) presses the other of the two yarns (Y1) thereby suppressing transmission of twisting on the other side of the pressed yarn end;

an adjustment driving section (73, 74) that changes the pressing position of the twisting stopping lever (96) in the movement direction; a movement driving section (63) that movably drives the twisting stopping lever (96) in the movement direction;

moving members (96, 97, and 98) that include the twisting stopping lever (96) and are movably driven by the movement driving section (63); and a stopper (99) that regulates movement of the twisting stopping lever (96) to one side in the movement direction when the twisting stopping lever (96) is in contact with the other moving members (97, 98), **characterized in that** the adjustment driving section (74) is provided separately from the movement driving section (63) and is capable of changing the pressing position by driving the stopper (99).

2. The yarn joining device (34) as claimed in Claim 1, comprising a yarn shifting lever (66) that is moved and driven by the movement driving section (63) along with the twisting stopping lever (96) to guide the two yarns (Y1, Y2) to the twisting section (52), wherein

the twisting stopping lever (96) is capable of switching between

a first state in which movement thereof is not regulated by the stopper (99) and can be integrally moved along with the yarn shifting lever (66), and

a second state in which movement thereof is regulated by the stopper (99) and is positioned independently of the yarn shifting lever (66).

3. The yarn joining device (34) as claimed in Claim 2, wherein the adjustment driving section (73, 74) includes a driving motor (73) that rotationally drives the stopper (99), wherein the stopper (99) has a contact surface (104b), a distance thereof from a center of a rotation shaft (80) of the driving motor (73) is depending on the position of the stopper (99) in a rotational and circumferential direction to bring the stopper in contact with the moving members (96, 97, 98), and a part of the contact surface (104b) that comes in contact with the moving member (96, 97, 98) changes depending on a rotation angle of the stopper (99).

4. The yarn joining device (34) as claimed in Claim 3, comprising a cam (74) that is rotationally driven along with the stopper (99) by the driving motor (73); a cam follower (75) that follows the movement of the cam (74); and a clamp and cutter mechanism (56) that is configured so as to hold and cut the two yarns (Y1, Y2) by moving the cam follower (75), wherein the rotation shaft (80) of the driving motor (73) is at least rotatable from a predetermined first angle to a third angle via a second angle, a cam surface of the cam (74) is formed such that the cam follower (75) is moved when the rotation shaft (80) is rotating between the first angle and the second angle, and the contact surface (104b) of the stopper (99) is formed so as to change the pressing position when the rotation shaft (80) rotates between the second angle and the third angle.

5. The yarn joining device (34) as claimed in Claim 4, wherein the stopper (99) and the cam (74) are provided on the rotation shaft (80).

6. The yarn joining device (34) as claimed in Claim 5, wherein the rotation shaft (80) of the driving motor (73) includes a first shaft portion (80b) that protrudes from a housing (73a) of the driving motor (73) toward one side in an axial direction of the rotation shaft (80); and a second shaft portion (80a) that protrudes from the housing (73a) toward the other side in the axial direction, and the stopper (99) is provided on the first shaft portion

(80b), and
the cam (74) is provided on the second shaft portion.

7. A winding unit (2) comprising:

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a yarn supplying section (11) in which a yarn
supplying bobbin (Bs) from which yarn can be
pulled is arranged;

a winding section (13) that winds a yarn pulled
from the yarn supplying section (11) onto a wind-
ing bobbin (Bw) to form a package (P) ;

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a unit controller (14) that controls the winding
section (13), and

a yarn joining section (32) that includes the yarn
joining device (34) as claimed in one of Claims
1 to 6 and joins the yarn disconnected between
the yarn supplying section (11) and the yarn
winding section (13) in a yarn running direction,
wherein

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the adjustment driving section is controlled by
the unit controller (14).

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8. A yarn winding machine (1) comprising a plurality of
the winding units (2) as claimed in Claim 7.

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FIG.2

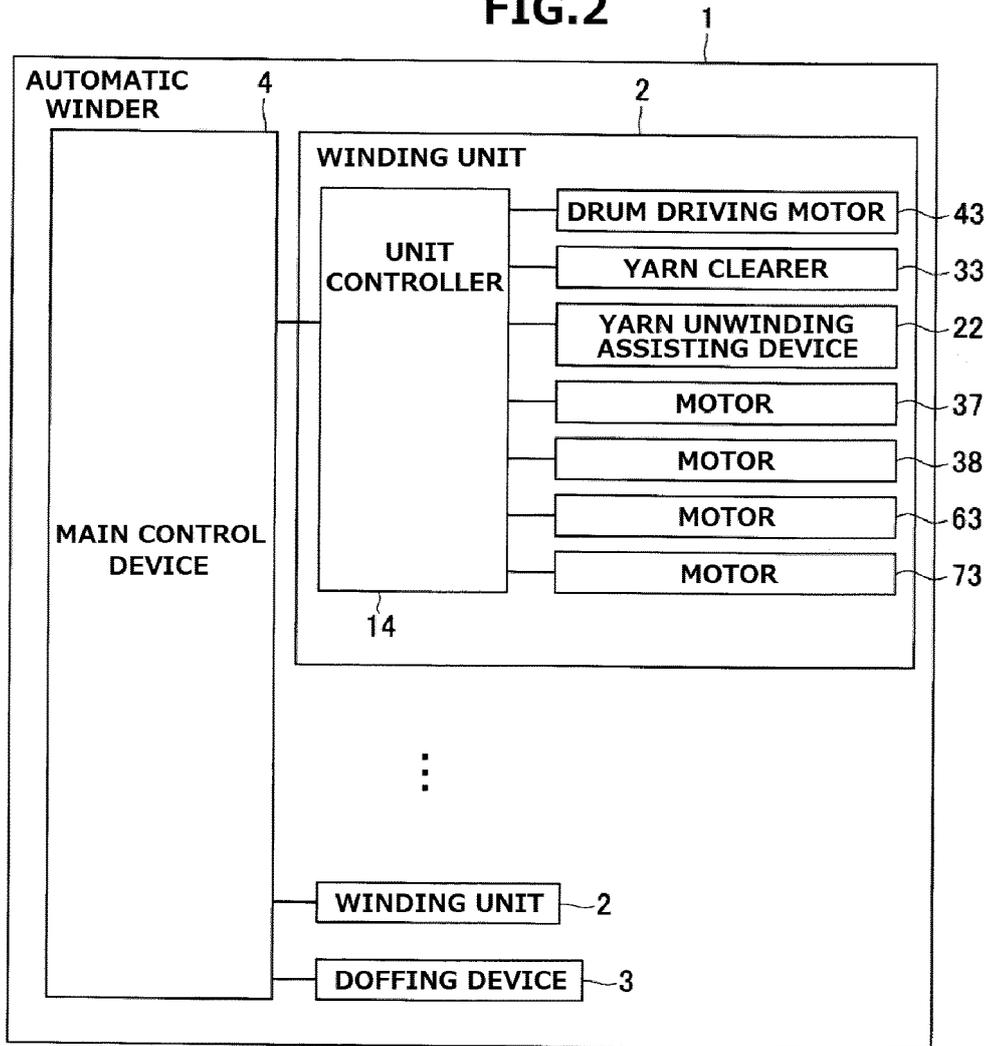


FIG.3

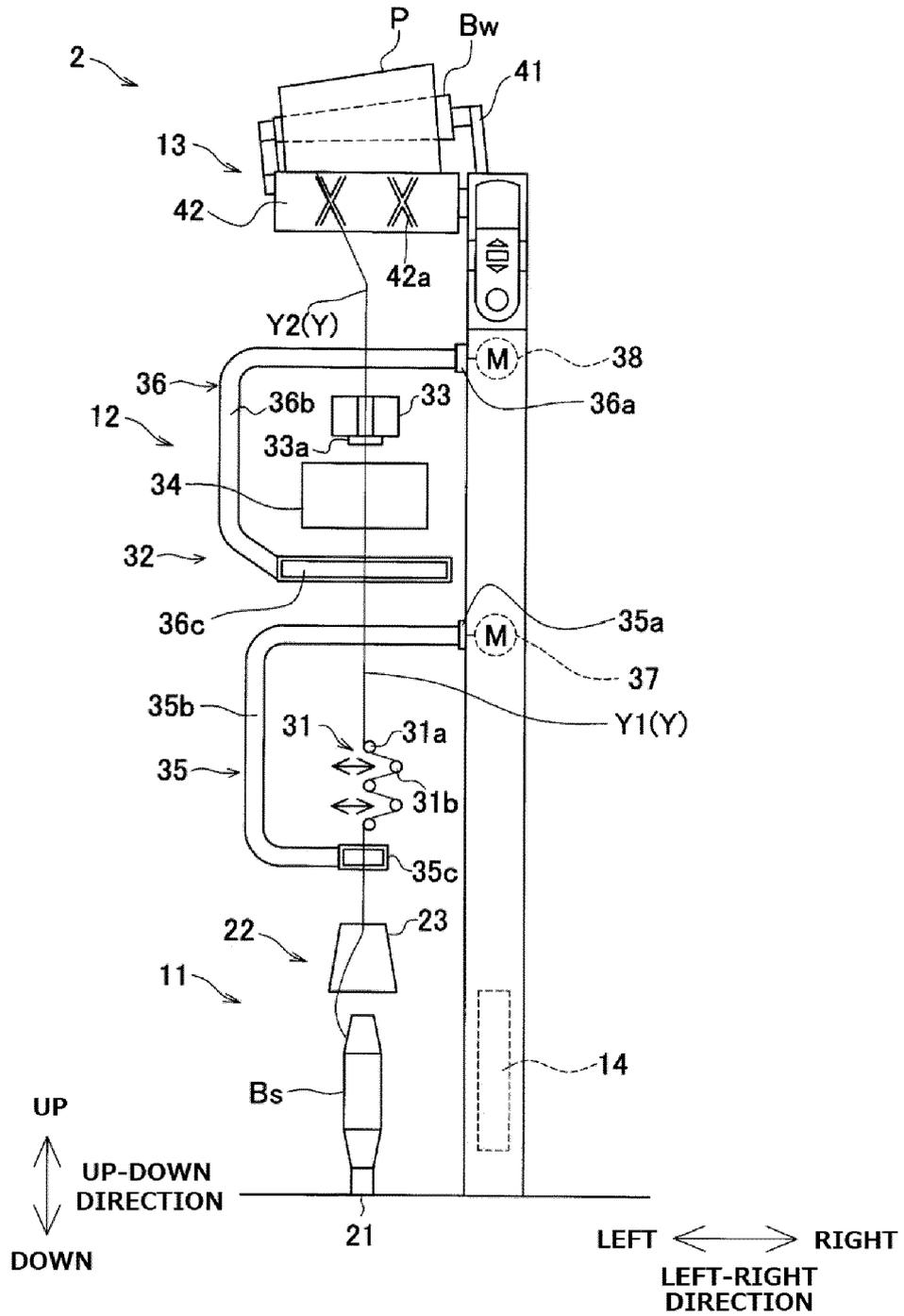


FIG.4

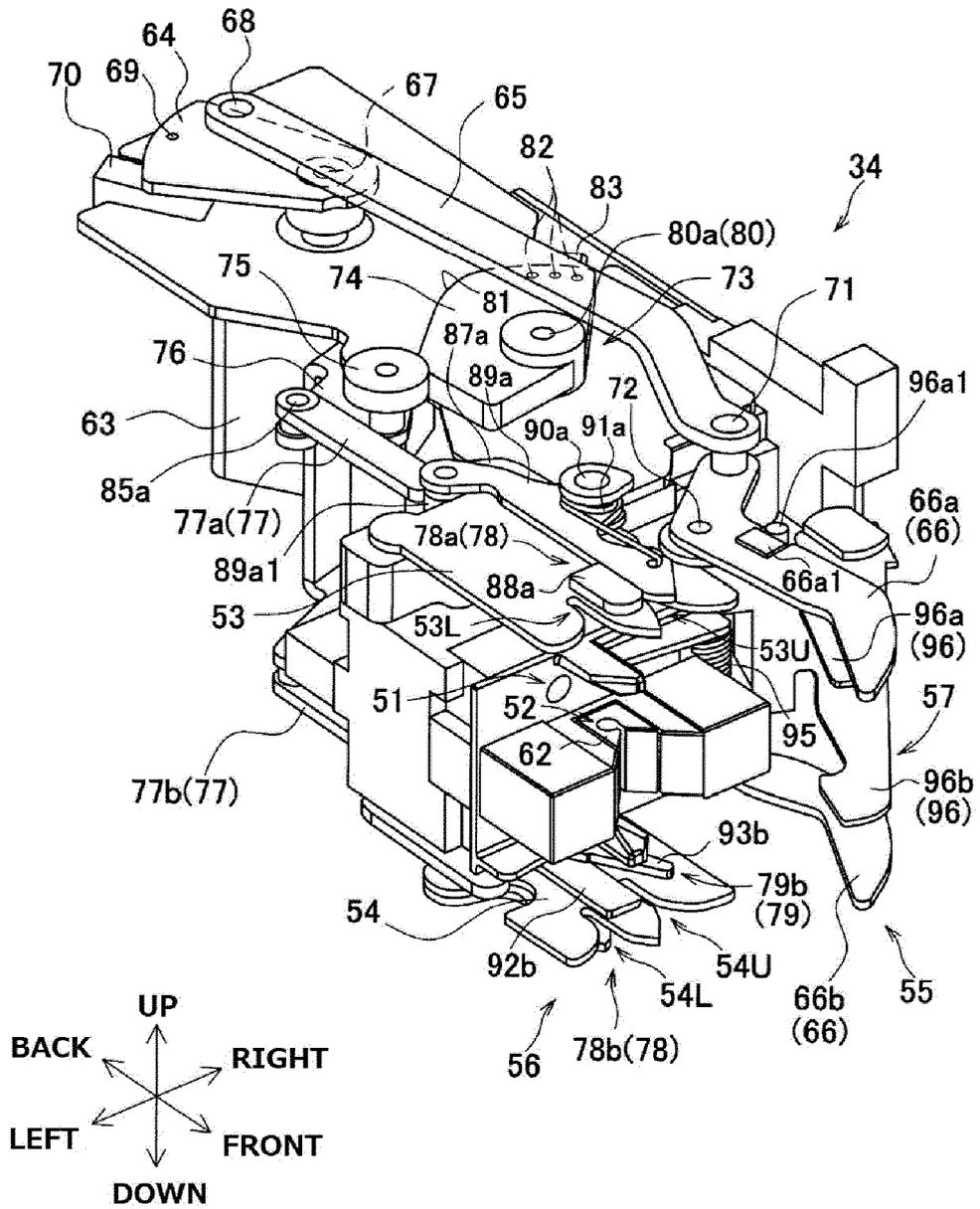
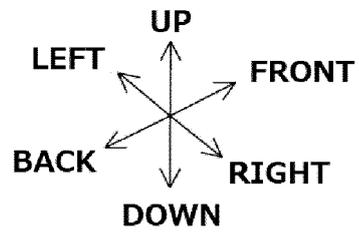
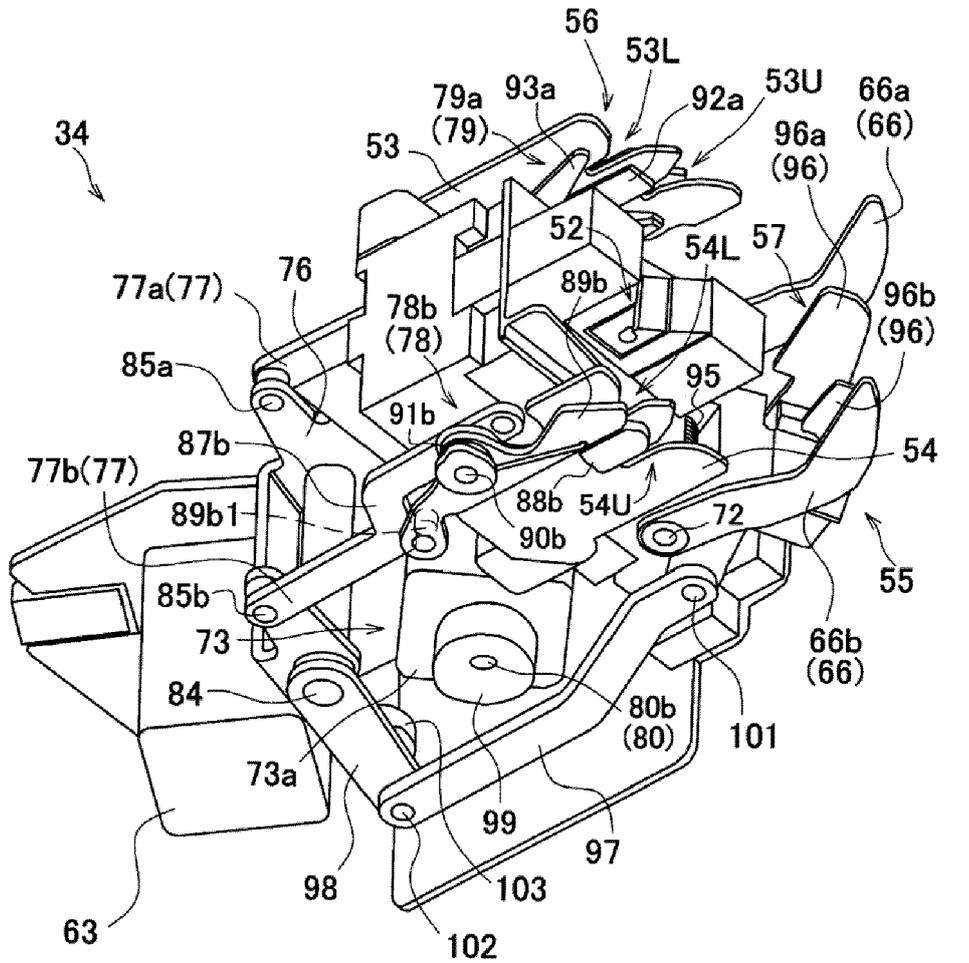


FIG.5



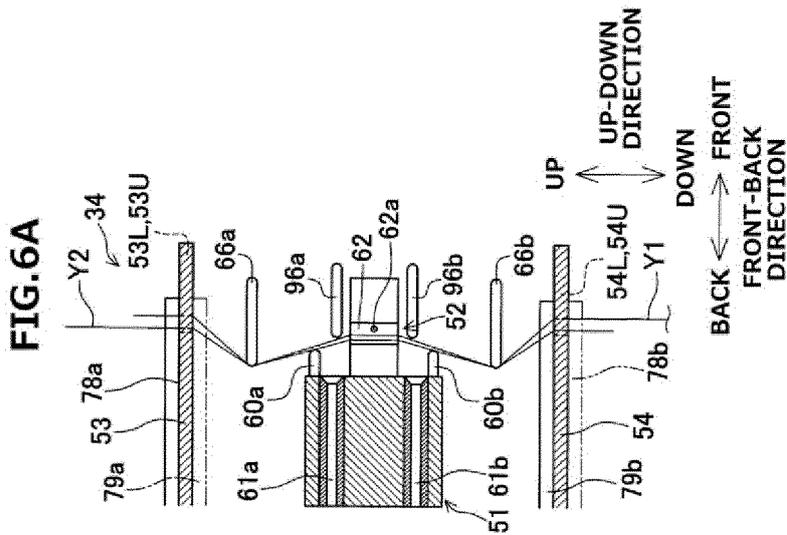
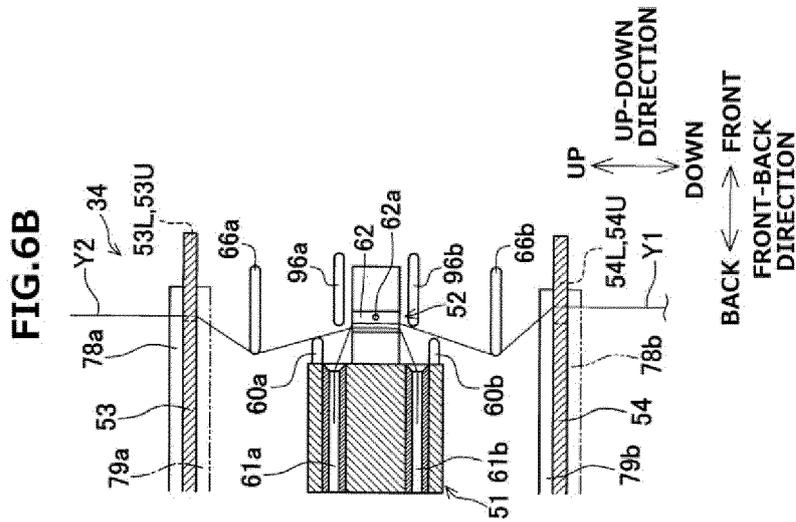
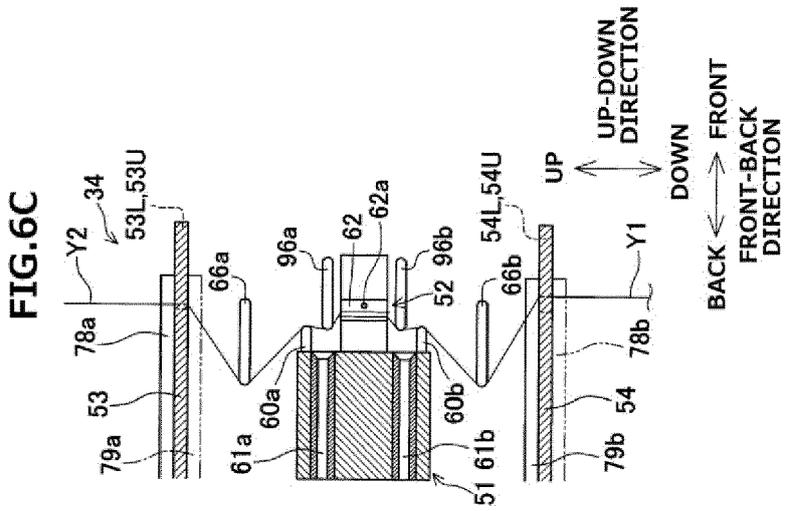


FIG.7

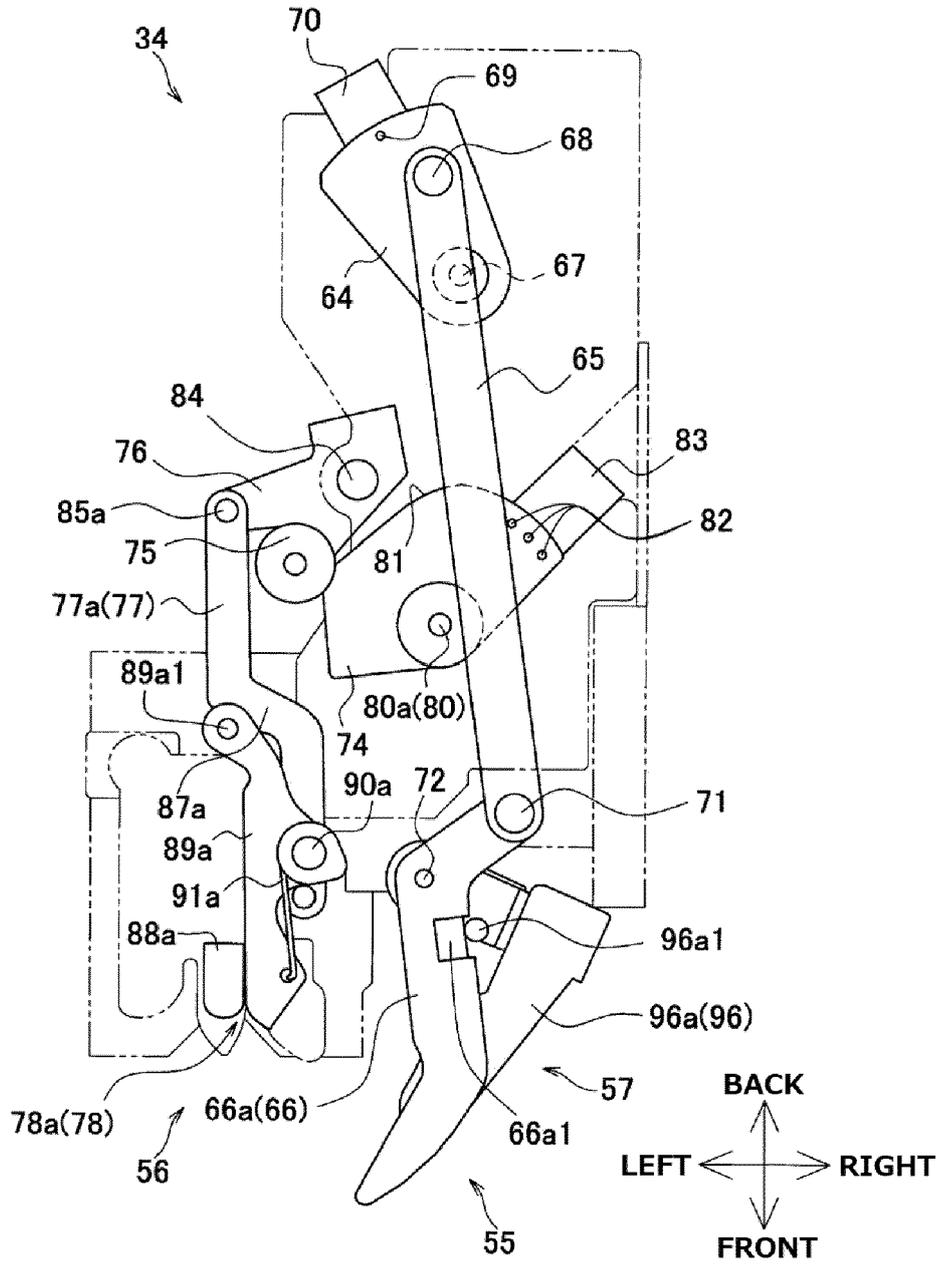


FIG. 8

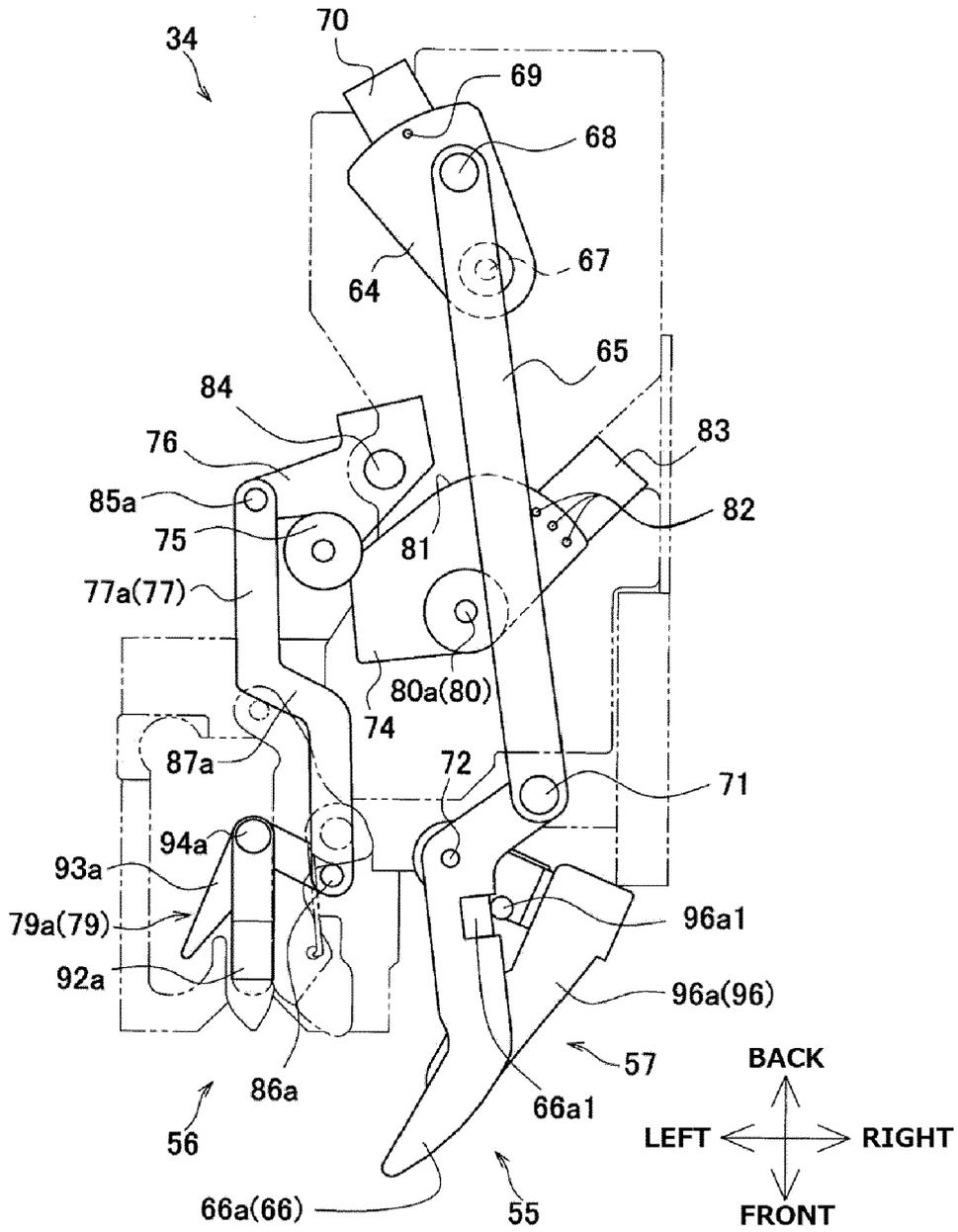


FIG.9

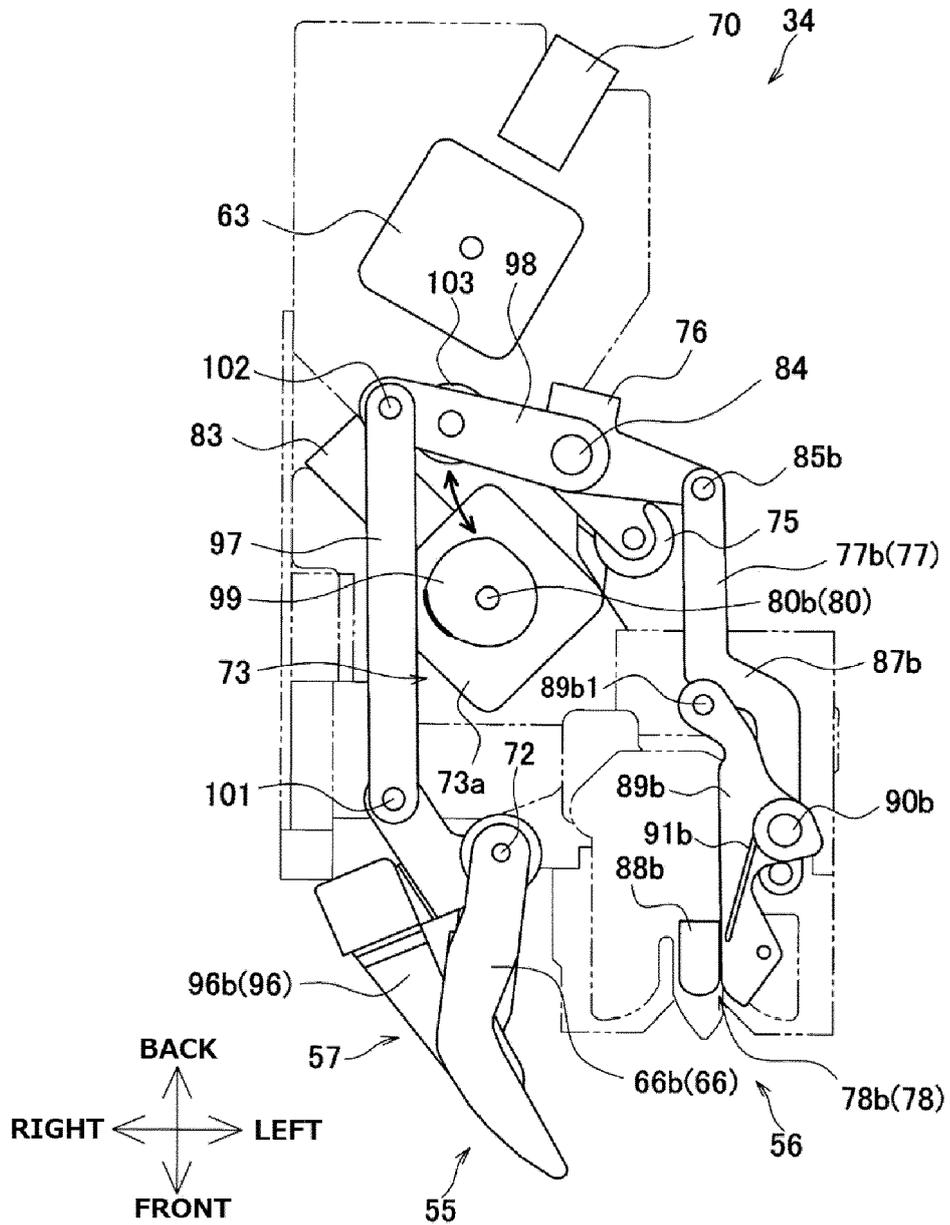


FIG.10A
FIRST ANGLE (CAM)

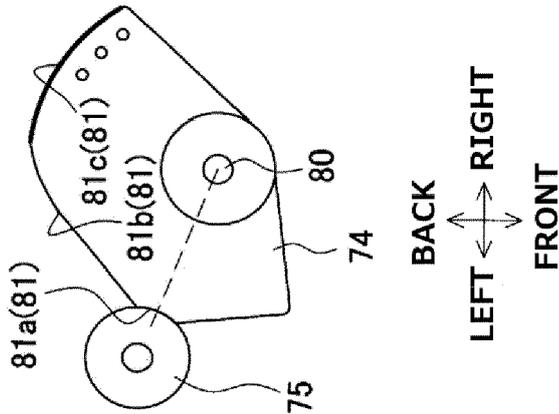


FIG.10B
SECOND ANGLE (CAM)

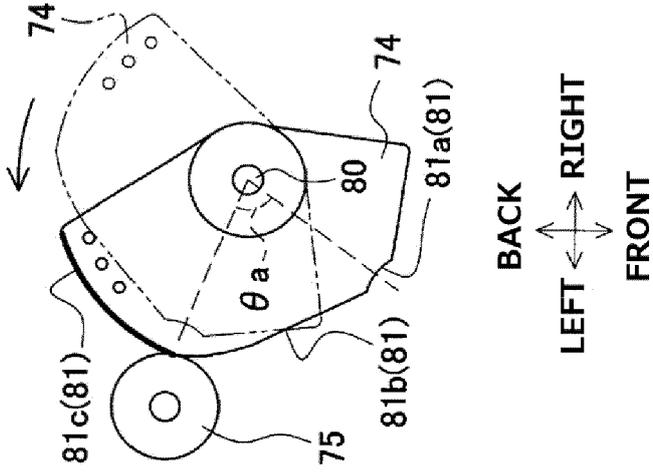


FIG.10C
THIRD ANGLE (CAM)

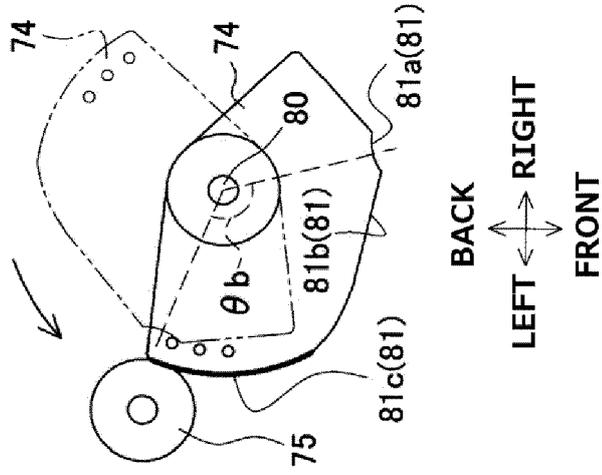


FIG.10D
FIRST ANGLE (STOPPER)

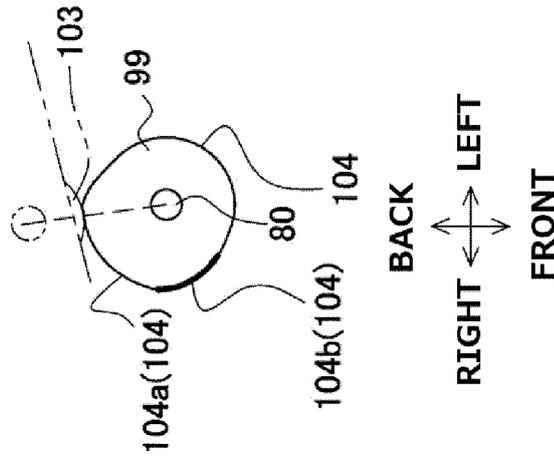


FIG.10E
SECOND ANGLE (STOPPER)

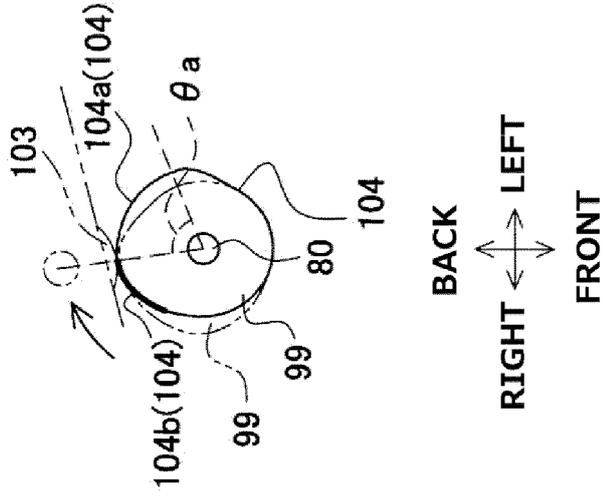


FIG.10F
THIRD ANGLE (STOPPER)

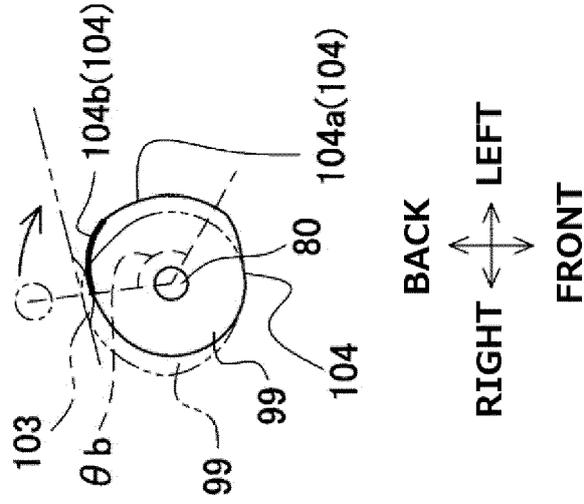


FIG.11B

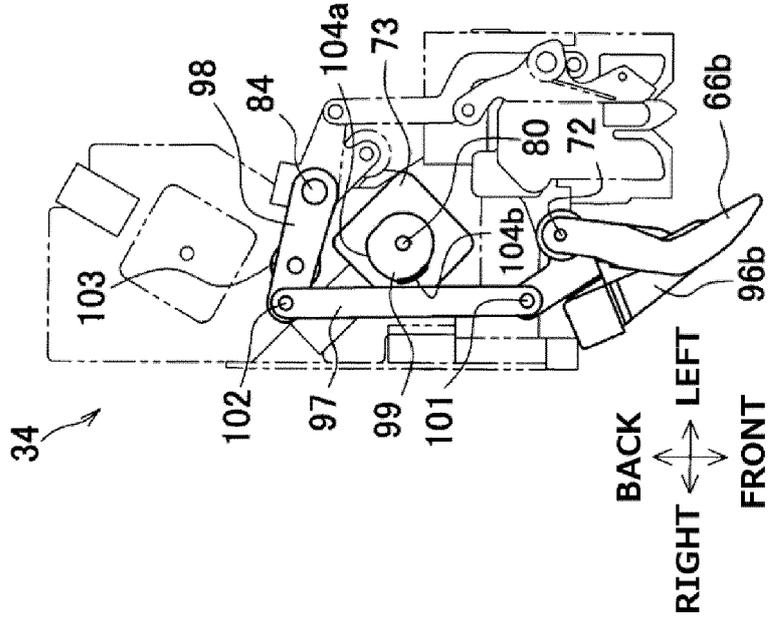
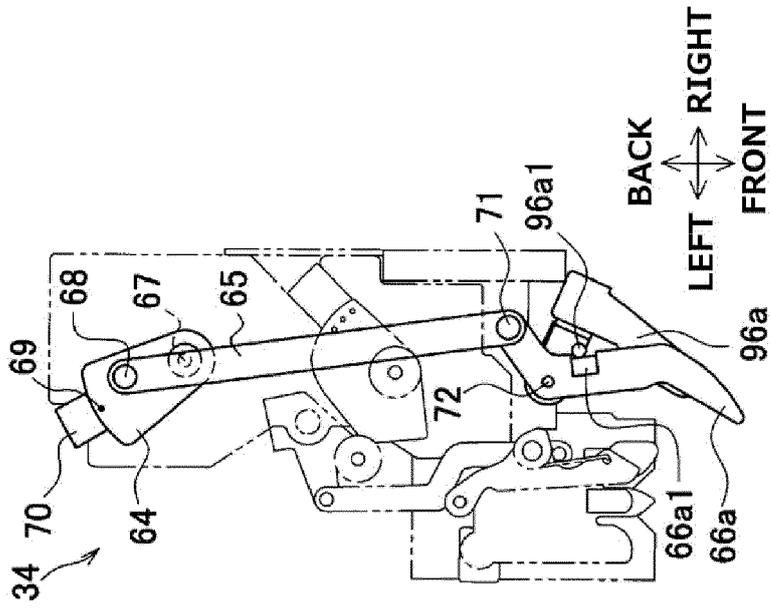
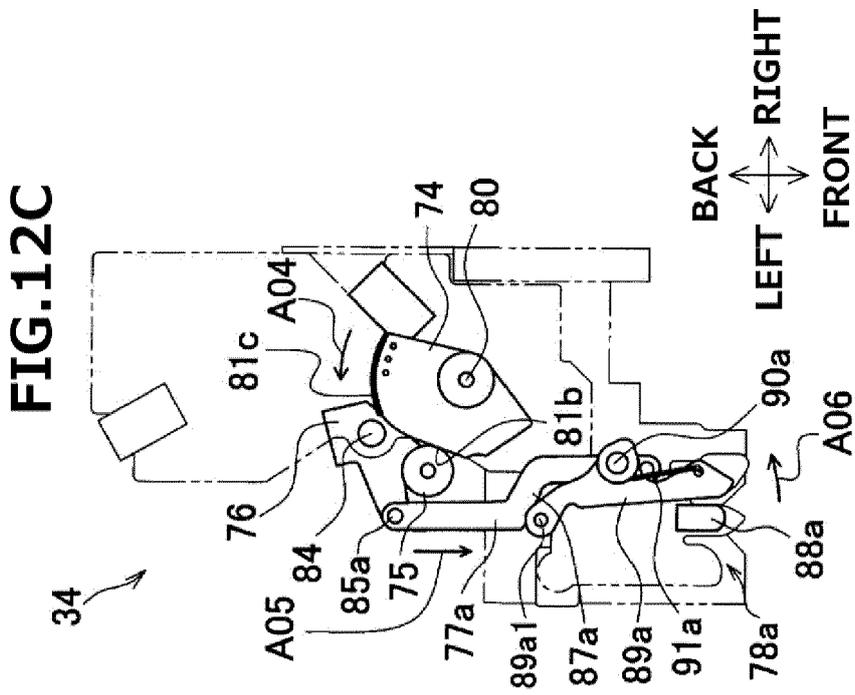
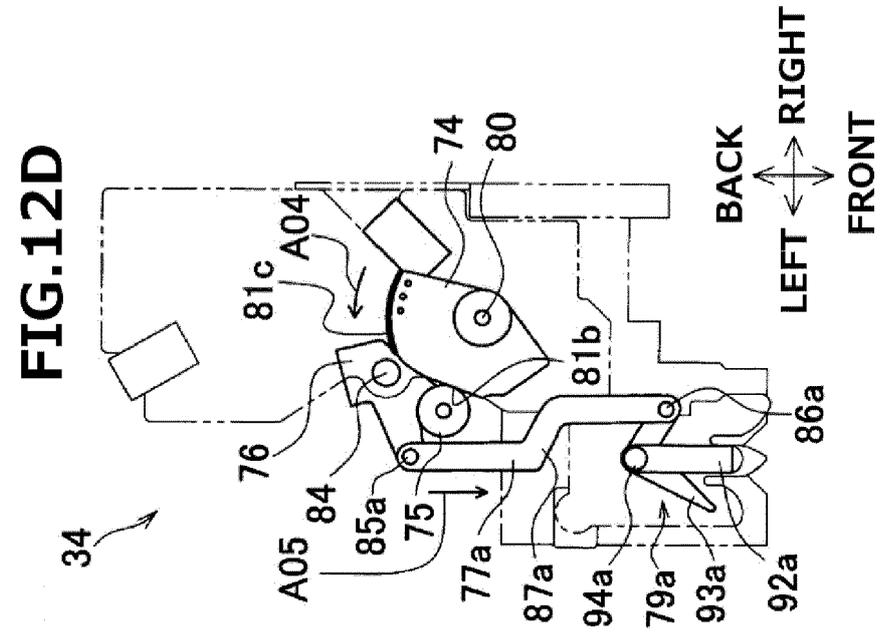
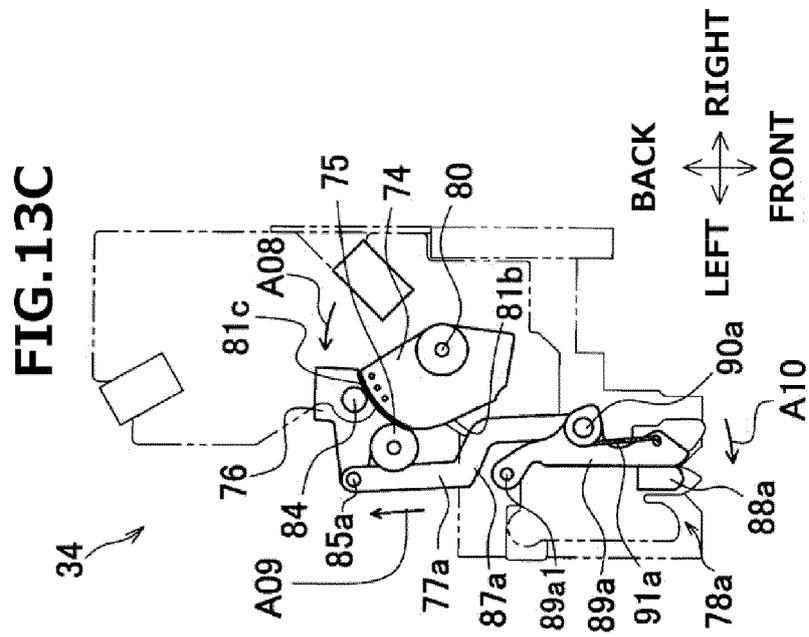
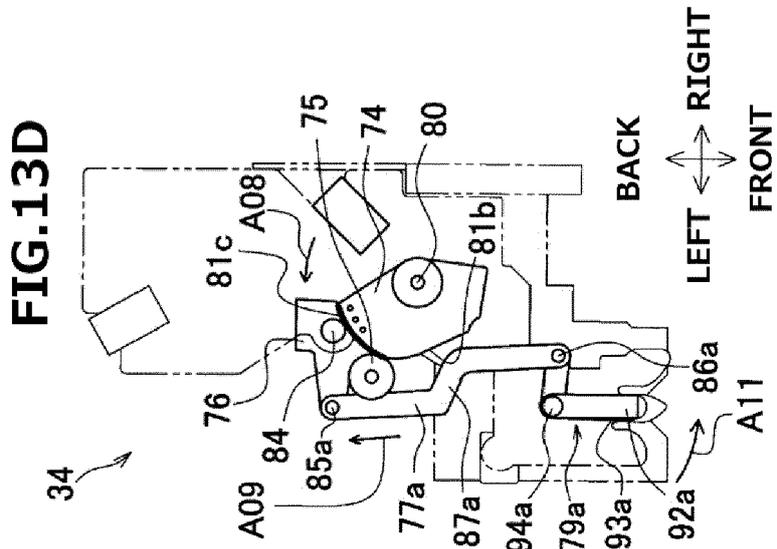
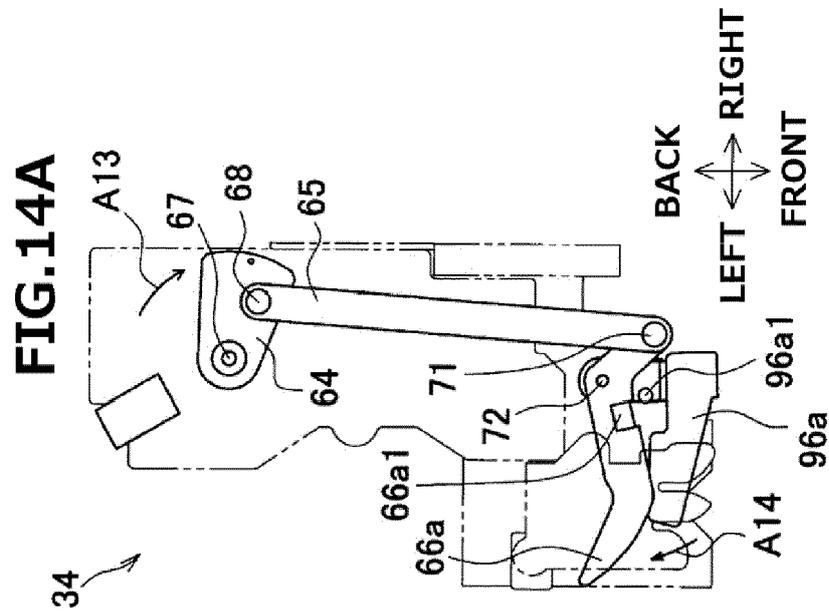
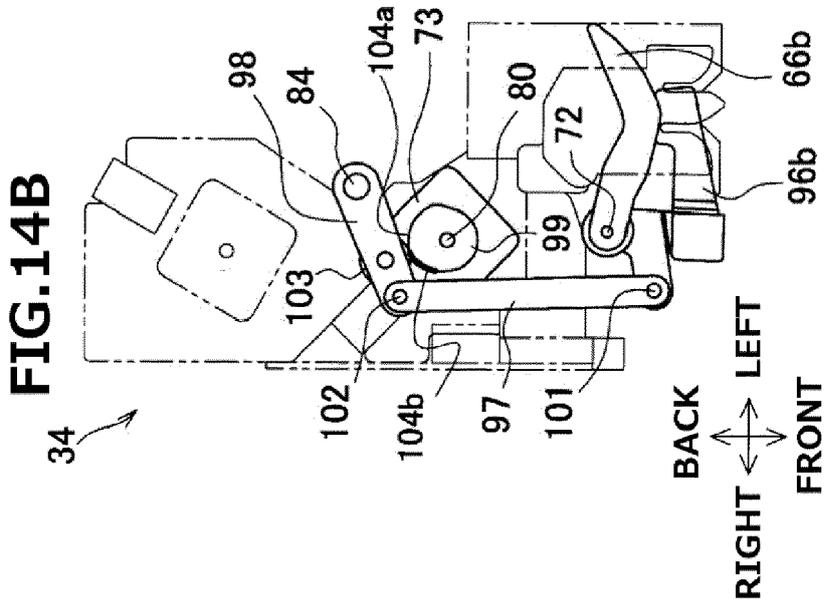


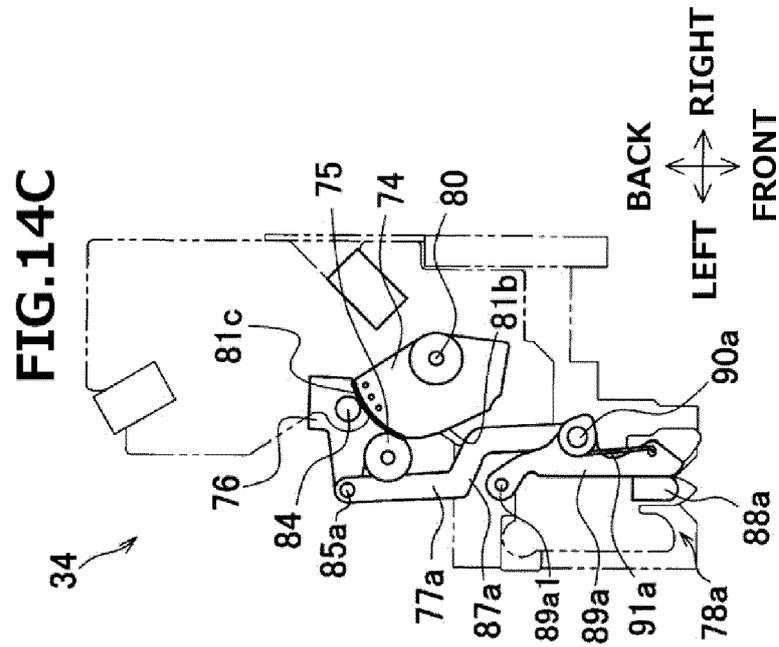
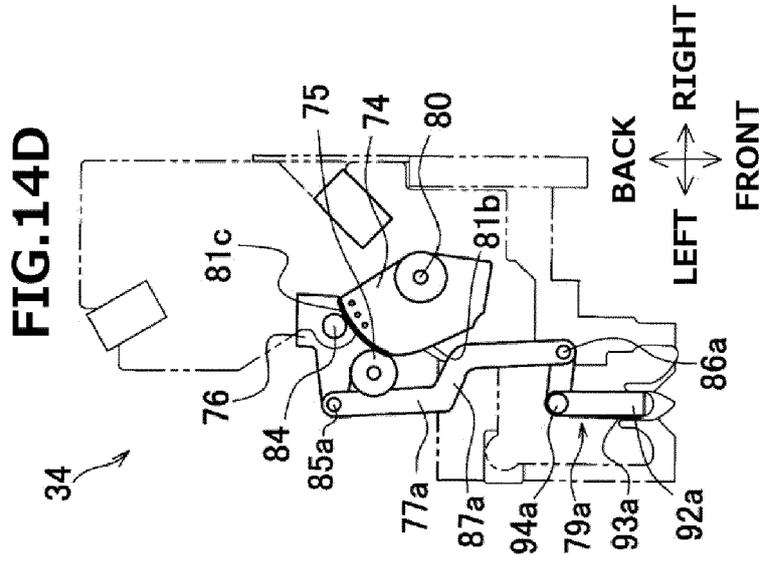
FIG.11A

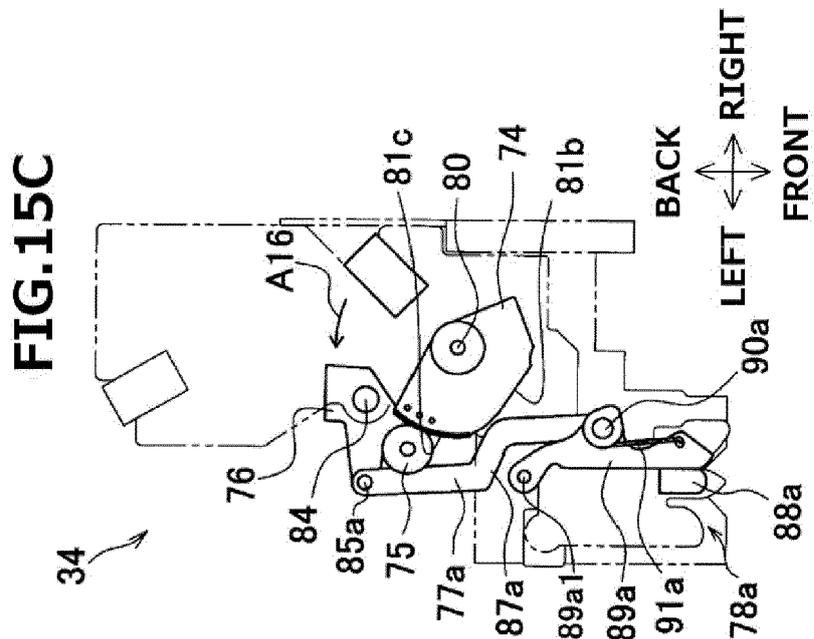
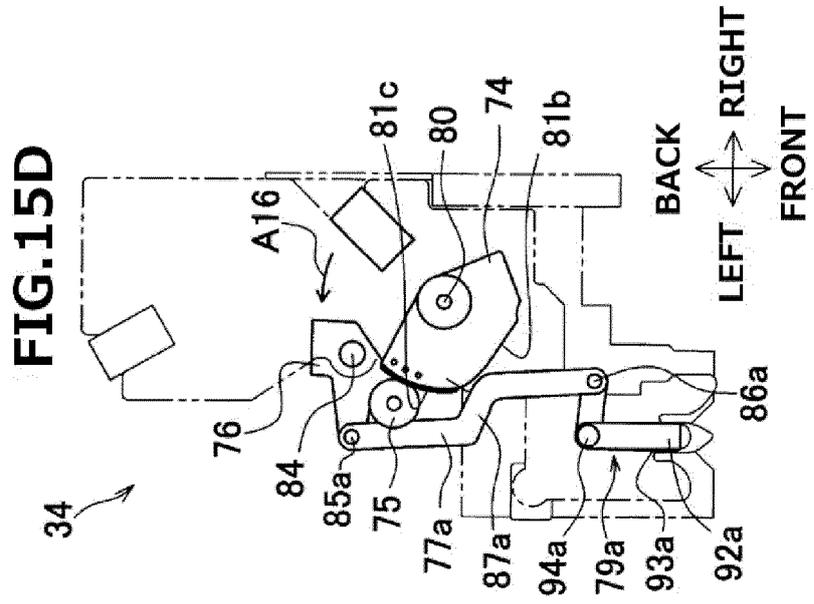














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