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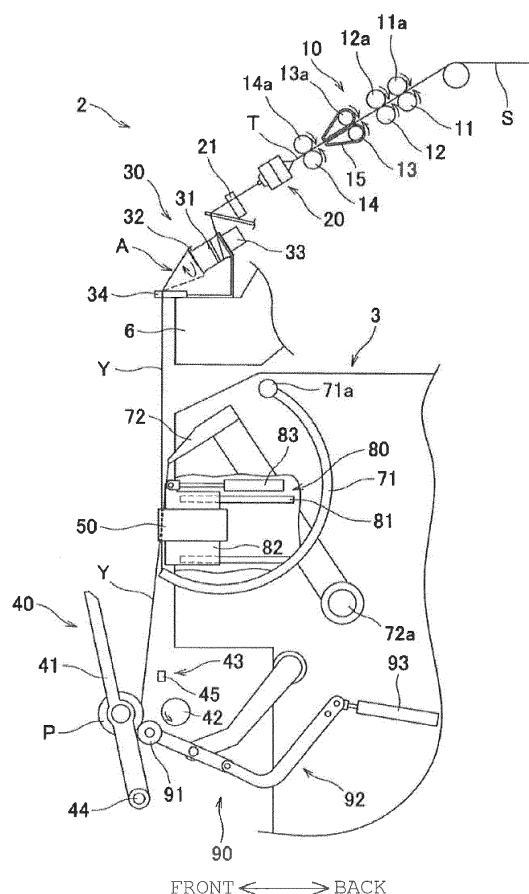
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(54) **SPINNING MACHINE**

(57) The spinning machine includes a spinning device (20) that spins and produces a yarn (Y), a winding device (40) that winds the yarn (Y) produced by the spinning device (20) to form a package, a yarn joining device (50) that carries out a yarn knotting operation of a first yarn from the spinning device (20) and a second yarn from the winding device (40) when the yarn (Y) is disconnected between the spinning device (20) and the winding device (40), a first yarn suction member (71) that sucks and holds the first yarn, and guides the first yarn to the yarn joining device (50), an accumulating roller (31) that is arranged between the spinning device (20) and the winding device (40) and winds the first yarn guided by the yarn joining device (50) by the first yarn suction member (71) around an outer peripheral surface, and a cutting member that cuts the first yarn sucked by the first yarn suction member (71).

FIG. 5



FRONT ← → BACK

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a spinning machine equipped with a yarn joining device.

2. Description of the Related Art

[0002] For example, Japanese Laid-Open Patent Publication No. 2002-249935 discloses a spinning machine configured to wind a yarn produced by a spinning device with a winding device. In such a spinning machine, a yarn joining device adapted to knot and connect the yarns is arranged between the spinning device and the winding device. In such a spinning machine, when the yarn is disconnected between the spinning device and the winding device, an upper yarn from the spinning device is sucked and held with a suction pipe and guided to the yarn joining device, and a lower yarn from the winding device is sucked and held with a suction mouth and guided to the yarn joining device, and then the yarns are knotted in the yarn joining device.

[0003] The suction pipe and the suction mouth of Japanese Laid-Open Patent Publication No. 2002-249935 are connected to a common blower duct. Thus, when the upper yarn and the lower yarn are entangled in the blower duct, a high tension is applied on the yarn, whereby yarn breakage may occur at the time of a yarn knotting operation. Thus, in Japanese Laid-Open Patent Publication No. 2002-249935, a cutter adapted to cut the lower yarn sucked by the suction mouth is arranged, and the upper yarn and the lower yarn are prevented from getting entangled in the blower duct by cutting the lower yarn with the cutter.

[0004] In Japanese Laid-Open Patent Publication No. 2002-249935, a suction tube called a slack tube is installed as a slackening removing device adapted to absorb the slackening of the yarn generated at the time of the yarn joining operation of the yarn joining device. The slack tube is located upstream of the yarn joining device at the time of the yarn joining operation. The upper yarn sucked by the suction pipe at the time of the yarn joining operation is basically not sucked by the slack tube until the upper yarn is clamped by the yarn joining device. In a state where the suction pipe is swung toward a lower side, a member adapted to stop the suctioning of the yarn to the suction pipe does not exist between the spinning device and the suction pipe. As the yarn produced by the spinning device is continuously supplied from the upstream, the tension of the upper yarn sucked by the suction pipe is very low. Since the tension of the upper yarn at the time of clamping with the yarn joining device is low, the yarn breakage does not become a problem in the yarn joining operation after the clamping, and hence the upper yarn sucked by the suction pipe is not cut.

BRIEF SUMMARY OF THE INVENTION

[0005] In recent years, however, an accumulating roller is being used as the slackening removing device due to reasons such as higher speed in the spinning speed. The upper yarn sucked by the suction pipe at the time of the yarn joining operation is wound around the accumulating roller when the suction pipe is swung toward the lower side. In the spinning machine using the accumulating roller as the slackening removing device as well, the upper yarn sucked by the suction pipe is not cut in the suction tube. As the yarn cannot be unwound from the accumulating roller with the suction force of the suction pipe, the tension of the upper yarn sucked by the suction pipe becomes excessively large while the yarn is wound around the accumulating roller. Therefore, the tension of the upper yarn at the time of clamping with the clamp of the yarn joining device becomes excessively large, and the yarn breakage may occur in the yarn joining operation after the clamping.

[0006] The present invention has been made in view of the above circumstances, and an object of the present invention is to prevent a yarn breakage of an upper yarn at the time of the yarn knotting operation.

[0007] A spinning machine according to the present invention includes a spinning device, a winding device, a yarn joining device, a first yarn suction member, a first yarn suction tube, an accumulating roller, and a cutting member. The spinning device is adapted to produce a yarn by spinning. The winding device is adapted to wind the yarn produced by the spinning device to form a package. The yarn joining device knots and connects a first yarn (upper yarn) from the spinning device and a second yarn (lower yarn) from the winding device when the yarn is disconnected between the spinning device and the winding device. The first yarn suction member is adapted to suck and hold the first yarn, and guide the yarn to the yarn joining device. The first yarn suction tube is connected to the first yarn suction member, and is adapted to pull in the sucked first yarn into the tube. The accumulating roller is arranged between the spinning device and the winding device, and is adapted to wind the first yarn guided to the yarn joining device by the first yarn suction member around an outer peripheral surface. The cutting member is adapted to cut the yarn end of the first yarn in the first yarn suction tube.

[0008] According to the present invention, the sucked and held first yarn can be cut, and thus the tension of the first yarn can be prevented from becoming excessively large. Therefore, the yarn breakage of the first yarn at the time of the yarn knotting operation can be prevented.

[0009] Furthermore, in embodiments of the present invention, a second yarn suction member, a second yarn suction tube, and a second yarn cutting member are further preferably arranged. The second yarn suction member is adapted to suck and hold the second yarn, and guide the yarn to the yarn joining device. The second yarn suction tube is connected to the second yarn suction

member, and is adapted to pull in the sucked second yarn into the tube. The second yarn cutting member is adapted to cut the second yarn in the second yarn suction tube.

[0010] According to the present invention, the sucked and held second yarn can be cut, and thus the tension of the second yarn can be prevented from becoming excessively large. Therefore, the yarn breakage of both the first yarn and the second yarn at the time of the yarn knotting operation can be prevented.

[0011] Moreover, in embodiments of the present invention, a second yarn suction member and a second yarn suction tube are further preferably arranged. The second yarn suction member is adapted to suck and hold the second yarn, and guide the yarn to the yarn joining device. The second yarn suction tube is connected to the second yarn suction member, and is adapted to pull in the sucked second yarn into the tube. The second yarn suction tube may preferably be merged and connected to a middle portion of the first yarn suction tube, and the cutting member is also preferably used as a yarn cutting member to cut the sucked second yarn.

[0012] One cutting member is thus merely necessary, which is advantageous from the standpoint of cost and space.

[0013] Furthermore, in embodiments of the present invention, the first yarn is preferably cut after the second yarn is cut.

[0014] The second yarn is sucked by an amount pulled out from the package, whereas the first yarn is endlessly sucked by an amount spun from the spinning device. Therefore, even if the first yarn is cut early, the length sucked after the cutting is gradually increased, and the tension of the first yarn may not be reduced. Thus, the first yarn is cut after the second yarn, as described above, so that the tension of the first yarn can be effectively suppressed from becoming large.

[0015] In embodiments of the present invention, the second yarn remaining in the first yarn suction tube is preferably pulled toward the second yarn suction member than the middle portion by winding the second yarn into the package after the second yarn is cut and before the first yarn is sucked by the first yarn suction member.

[0016] Since one part of the second yarn may remain in the first yarn suction tube even after the second yarn is cut with the cutting member in the first yarn suction tube, the remaining yarn may get entangled with the first yarn sucked after. Thus, as described above, the second yarn is pulled out toward the second yarn suction member than the middle portion after the cutting of the second yarn and before the suction of the first yarn, so that the first yarn and the second yarn can be prevented from entangling in the first yarn suction tube.

[0017] Furthermore, in embodiments of the present invention, the first yarn and the second yarn are preferably cut before the yarn knotting operation by the yarn joining device is started.

[0018] When carrying out the yarn knotting operation,

the first yarn and the second yarn are pulled and the tension becomes large, whereby the yarn breakage tends to easily occur. Therefore, the first yarn and the second yarn are cut before the start of the yarn knotting operation, as described above, whereby the yarn breakage at the time of the yarn knotting operation can be effectively suppressed.

[0019] Furthermore, in embodiments of the present invention, the yarn joining device further preferably includes a yarn path regulating member. The yarn path regulating member is movable between a standby position of not making contact with the yarn and a regulating position of making contact with the yarn to regulate the yarn path in the yarn joining device. The yarn path regulating member is preferably moved to the regulating position before the yarn knotting operation by the yarn joining device is started, and the first yarn and the second yarn are preferably cut before the yarn path regulating member is moved to the regulating position.

[0020] The tension of the first yarn and the second yarn becomes large when the yarn path regulating member is brought into contact with the first yarn and the second yarn thus regulating the yarn path before starting the yarn knotting operation. Thus, the yarn breakage can be suppressed by cutting the first yarn and the second yarn in advance and reducing the tension before moving the yarn path regulating member to the regulating position, as described above.

[0021] Furthermore, in embodiments of the present invention, the yarn joining device further preferably includes an air injecting device adapted to inject air to the yarn; and the first yarn and the second yarn are preferably cut before the injection of air by the air injecting device is started.

[0022] The slackening of the yarn can be removed by injecting air to the yarn and blowing and pushing the yarn, but in this case, the tension of the yarn becomes large. Thus, the yarn breakage can be suppressed by cutting the first yarn and the second yarn and lowering the tension in advance before starting the injection of the air, as described above.

[0023] Furthermore, in embodiments of the present invention, the spinning machine includes a plurality of spinning units each including the spinning device and the winding device, and a yarn joining cart adapted to be movable among the plurality of spinning units, the yarn joining cart preferably including the yarn joining device, the first yarn suction member, the first yarn suction tube, and the cutting member.

[0024] According to the spinning machine, the yarn breakage of the first yarn can be prevented when carrying out the yarn knotting operation with the yarn joining cart. Furthermore, as the yarn joining device, the first yarn suction member, the first yarn suction tube, and the cutting member are arranged on the yarn joining cart, such devices and members do not need to be arranged for every spinning unit and can be commonly used.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025]

FIG. 1 is a front view illustrating an overall configuration of a spinning machine according to the present embodiment;

FIG. 2 is a side view of a spinning unit and a yarn joining cart;

FIG. 3 is a side view illustrating a state of sucking and holding a yarn with a suction member of the yarn joining cart;

FIG. 4 is a side view illustrating a state of guiding the yarn to the yarn joining device with the suction member of the yarn joining cart;

FIG. 5 is a side view illustrating a state in which the yarn joining device is located at a yarn joining position;

FIG. 6 is a schematic view illustrating a suction path of a suction member;

FIGS. 7A and 7B are schematic views illustrating a shutter cutter arranged on the suction path;

FIG. 8 is a perspective view of the yarn joining device;

FIGS. 9A to 9D are front views illustrating a series of operations of a yarn joining section;

FIGS. 10A to 10D are front views illustrating a series of operations of the yarn joining section;

FIG. 11 is a view of a slackening propagation suppressing member and the like seen from above;

FIG. 12 is a cross-sectional view taken along XII-XII cross-section of FIG. 11;

FIG. 13 is a timing chart illustrating an operation of each member at the time of the yarn joining operation;

FIGS. 14A to 14D are schematic views illustrating a suction state of a yarn in the suction path; and

FIG. 15 is a view of a slackening propagation suppressing member and the like according to an alternative embodiment seen from above.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

[Present Embodiment]**(Overall configuration of spinning machine)**

[0026] A spinning machine (winding machine) according to one embodiment of the present invention will be described with reference to the drawings. A spinning machine 1 (spinning machine) illustrated in FIG. 1 includes a plurality of spinning units 2 (winding units) arranged side by side in a predetermined arranging direction (left and right direction in FIG. 1), a yarn joining cart 3 adapted to be movable in the arranging direction, a blower box 4 arranged on one end side of the arranging direction, and a motor box 5 arranged on the other end side of the arranging direction.

[0027] Each spinning unit 2 spins a fiber bundle T fed from a draft device 10 with a spinning device 20 to produce a yarn Y, and winds the yarn Y around a bobbin B with a winding device 40 to form a package P. When yarn breakage, which is caused by an excessive tension, etc., or yarn cut, which is carried out to remove a yarn defect occurs in one of the spinning units 2, the yarn joining cart 3 moves to the relevant spinning unit 2 to carry out the yarn joining operation. A negative pressure source, and the like adapted to supply a negative pressure to each spinning unit 2 is arranged in the blower box 4. Furthermore, a driving source, and the like common to the plurality of the spinning units 2 is arranged in the motor box 5.

[0028] In the spinning machine 1 of the present embodiment, one unit control section 2a is arranged for every predetermined number of spinning units 2 to control the operation of each section of the spinning unit 2. A cart control section 3a (control section) is arranged in the yarn joining cart 3 to control the operation of each section of the yarn joining cart 3. The unit control section 2a and the cart control section 3a are configured to mutually exchange control signals.

(Spinning unit)

[0029] As illustrated in FIGS. 2 to 5, a side on which a yarn path exists when seen from the yarn joining cart 3 is defined as a front side, and the opposite side is defined as a back side. Furthermore, in the following description, upstream and downstream in a travelling direction of the yarn Y at the time of the normal winding are simply referred to as "upstream" and "downstream".

[0030] The spinning unit 2 includes, as main components, the draft device 10, the spinning device 20, a yarn accumulating device 30 (yarn supplying section), and the winding device 40 arranged in this order from upstream to downstream.

[0031] The draft device 10 is arranged in proximity to an upper end of a frame 6 of the spinning machine 1. The draft device 10 includes four draft rollers 11 to 14, i.e., a back roller 11, a third roller 12, a middle roller 13, and a front roller 14 in this order from the upstream. A rubber apron belt 15 is provided on the middle roller 13. Each draft roller 11 to 14 is rotatably driven at a predetermined rotation speed. Furthermore, the draft device 10 includes opposing rollers 11a to 14a arranged to face the draft rollers 11 to 14. The draft device 10 draws (drafts) a sliver S, which is a material of the fiber bundle T, to a predetermined width to obtain the fiber bundle T by conveying the sliver S between the rotating draft rollers 11 to 14 and the opposing rollers 11a to 14a facing the draft rollers.

[0032] The spinning device 20 is arranged immediately downstream of the front roller 14. The spinning device 20 applies twists to the fiber bundle T supplied from the draft device 10 to spin the fiber bundle, and produces the spun yarn Y. In the present embodiment, a pneumatic type spinning device that applies twists to the fiber bundle

T using a whirling airflow is adopted for the spinning device 20, but, needless to say, other types can be adopted.

[0033] The yarn accumulating device 30 is arranged between the spinning device 20 and the winding device 40. The yarn accumulating device 30 includes an accumulating roller 31, a yarn hooking member 32, and a motor 33. The accumulating roller 31 can wind the yarn Y on an outer peripheral surface thereof to temporarily accumulate the yarn Y. The accumulating roller 31 is rotatably driven by the motor 33. The yarn hooking member 32 is attached to a downstream end of the accumulating roller 31. The yarn hooking member 32 can hook the yarn Y. The yarn hooking member 32 is attached in a relatively rotatable manner with respect to the accumulating roller 31.

[0034] A permanent magnet is attached to one of the accumulating roller 31 and the yarn hooking member 32, and a magnetic hysteresis material is attached to the other one of the accumulating roller 31 and the yarn hooking member 32. Such magnetic means generates a resistance torque when the yarn hooking member 32 is relatively rotated with respect to the accumulating roller 31. When a force exceeding the resistance torque is applied on the yarn hooking member 32 (when a predetermined tension or greater is applied on the yarn Y), the yarn hooking member 32 is relatively rotated with respect to the accumulating roller 31, and the yarn Y wound around the accumulating roller 31 can be unwound. When a force exceeding the resistance torque is not applied to the yarn hooking member 32, the accumulating roller 31 integrally rotates with the yarn hooking member 32, and the yarn Y is accumulated on the accumulating roller 31.

[0035] Thus, the yarn accumulating device 30 operates to unwind the yarn Y when the tension of the yarn Y from the downstream is increased, and stop the unwinding of the yarn Y when the tension of the yarn Y from the downstream is reduced (when the yarn Y starts to slacken). Thus, the yarn accumulating device 30 can resolve the slackening of the yarn Y, and apply an appropriate tension to the yarn Y. Furthermore, the yarn hooking member 32 operates to absorb the fluctuation of the tension applied to the yarn Y between the yarn accumulating device 30 and the winding device 40 as described above. In other words, the yarn hooking member 32 can prevent the tension fluctuation of the yarn Y by the winding device 40 from affecting the yarn Y from the spinning device 20 to the yarn accumulating device 30.

[0036] Moreover, a yarn path guide 34 adapted to guide the yarn Y pulled out from the yarn accumulating device 30 toward the downstream is arranged at the downstream of the yarn accumulating device 30. The yarn path guide 34 is adapted to guide the yarn Y pulled out from the accumulating roller 31 so as to pass an extended line of a rotational axis of the accumulating roller 31. Therefore, in a state where the yarn hooking member 32 is rotating with the yarn Y hooked thereto, the yarn Y is swung and a substantially conical balloon A is formed

between the accumulating roller 31 and the yarn path guide 34.

[0037] A yarn monitoring device 21 adapted to monitor the quality of the yarn Y is arranged between the spinning device 20 and the yarn accumulating device 30. The yarn monitoring device 21 is configured to monitor the thickness of the travelling yarn Y with an optical sensor (not illustrated). The yarn monitoring device 21 detects a yarn defect (area of abnormality in the thickness of the yarn Y, etc.) of the yarn Y. The yarn monitoring device 21 is not limited to the optical sensor and may be, for example, a capacitance sensor. The yarn monitoring device 21 may also detect a foreign substance in the yarn Y as a yarn defect.

[0038] A cutter (not illustrated) adapted to immediately cut the yarn Y when the yarn defect of the yarn Y is detected with the yarn monitoring device 21 is arranged in proximity to the yarn monitoring device 21. In place of the cutter, the spinning unit 2 may stop the supply of air to the spinning device 20, and interrupt the production of the yarn Y to cut the yarn Y.

[0039] The winding device 40 is arranged downstream of the yarn accumulating device 30, and is adapted to wind the yarn Y around the bobbin B while traversing to form the package P. The winding device 40 includes a cradle arm 41, a winding drum 42, and a traverse device 43.

[0040] The cradle arm 41 is supported to be swingable about a supporting shaft 44. The cradle arm 41 can rotatably support a bobbin B (package P) for winding the yarn Y. The winding drum 42 is rotatably driven at a constant rotation speed in a predetermined direction. The cradle arm 41 can bring the outer peripheral surface of the bobbin B (package P) into contact with or move the outer peripheral surface of the bobbin B (package P) away from the winding drum 42 by being swung about the supporting shaft 44. The outer peripheral surface of the bobbin B (package P) is brought into contact with the rotatably driven winding drum 42 so that the bobbin B (package P) is rotated in the winding direction accompanying the rotation of the winding drum 42, thus winding the yarn Y around the outer peripheral surface of the bobbin B (package P).

[0041] The traverse device 43 includes a traverse guide 45 that can be engaged with the yarn Y. The traverse guide 45 is configured to reciprocate in a direction parallel to an axial direction of the winding drum 42 by a driving source (not illustrated). The traverse guide 45 engaging the yarn Y is caused to reciprocate while the winding drum 42 is rotatably driven, so that the yarn Y can be wound into the package P while being traversed.

(Yarn joining cart)

[0042] Next, a description will be made on the yarn joining cart 3. As illustrated in FIG. 1, a rail 7 is arranged on the frame 6 of the spinning machine 1 along the arranging direction in which the spinning units 2 are lined.

The yarn joining cart 3 is configured so as to be able to travel on the rail 7, and can travel among the plurality of spinning units 2. When yarn breakage or yarn cut occurs in a spinning unit 2, the yarn joining cart 3 is moved to the relevant spinning unit 2 to carry out the yarn joining operation of the yarn Y disconnected between the spinning device 20 and the winding device 40.

[0043] As illustrated in FIGS. 2 to 4, the yarn joining cart 3 includes, as main components, a yarn joining device 50, a suction pipe 71, a suction mouth 72, a forward/backward moving mechanism 80, and a reverse rotation driving mechanism 90.

[0044] When the yarn Y is disconnected between the spinning device 20 and the winding device 40, the yarn joining device 50 joins the yarn Y (hereinafter appropriately referred to as "upper yarn") from the spinning device 20 guided by the suction pipe 71 and the yarn Y (hereinafter appropriately referred to as "lower yarn") from the winding device 40 guided by the suction mouth 72. In a state where the yarn joining cart 3 is moved to a target spinning unit 2, the yarn joining device 50 is located between the yarn accumulating device 30 and the winding device 40 in the travelling direction of the yarn Y. The details of the yarn joining device 50 will be described later.

[0045] The suction pipe 71 is configured to be vertically swingable with a shaft 71a as a center by a driving source (not illustrated) controlled by the cart control section 3a. As illustrated in FIG. 3, when the suction pipe 71 is swung toward the upper side, the distal end of the suction pipe 71 is located in proximity to the downstream of the spinning device 20, and thus can suck the upper yarn Y spun from the spinning device 20, and suck and hold the upper yarn Y. In other words, a suction port of the suction pipe 71 is movable in the yarn path direction. Furthermore, as illustrated in FIG. 4, the suction pipe 71 can guide the upper yarn Y to the yarn joining device 50 by being swung toward the lower side while sucking and holding the upper yarn Y spun from the spinning device 20. As the suction pipe 71 guides the upper yarn Y to the yarn joining device 50, the upper yarn Y sucked by the suction pipe 71 is wound around the accumulating roller 31 and accumulated thereon. In other words, the upper yarn Y is caught by the yarn hooking member 32 of the accumulating roller 31 in the middle of the swinging of the suction pipe 71, and thereafter, the upper yarn Y is wound around the outer peripheral surface of the accumulating roller 31. After being wound by a constant amount, the upper yarn Y is removed from the yarn hooking member 32 by a yarn removing member (not illustrated), whereby a state where the upper yarn Y continuously supplied from the spinning device 20 on the upstream is sucked by the suction pipe 71 without passing the accumulating roller 31 is obtained. In this case, the length of the upper yarn sucked by the suction pipe 71, the upper yarn suction tube 75, and a suction duct 8 becomes very long. Since a member adapted to stop the travelling of the upper yarn Y does not exist between the spinning device 20 and the suction pipe 71, the tension of the upper yarn Y is in a

low state. Subsequently, the yarn removing member is returned to a standby position, whereby the winding of the upper yarn Y to the accumulating roller 31 is started. The suction force of the suction pipe 71 is smaller than a strength the yarn can be unwound from the accumulating roller 31, and hence the upper yarn Y sucked by the suction pipe 71 will not be unwound from the accumulating roller 31 while the yarn is wound around the accumulating roller 31. Therefore, the tension of the upper yarn Y sucked by the suction pipe 71 becomes excessively large.

[0046] The suction mouth 72 is configured to be vertically swingable with a shaft 72a as a center by a driving source (not illustrated) controlled by the cart control section 3a. As illustrated in FIG. 3, when the suction mouth 72 is swung toward the lower side, the distal end of the suction mouth 72 is located in proximity to the outer peripheral surface of the package P, and thus can suck the lower yarn Y pulled out from the package P, and suck and hold the lower yarn Y. In other words, a suction port of the suction mouth 72 is movable in the yarn path direction. Furthermore, as illustrated in FIG. 4, the suction mouth 72 can guide the lower yarn Y to the yarn joining device 50 by being swung toward the upper side while sucking and holding the lower yarn Y pulled out from the package P.

[0047] As illustrated in FIG. 6, the upper yarn suction tube 75 is connected to the suction pipe 71, and a lower yarn suction tube 76 is connected to the suction mouth 72. Moreover, the lower yarn suction tube 76 is merged and connected to a middle portion of the upper yarn suction tube 75. The upper yarn suction tube 75 and the lower yarn suction tube 76 are attached to the yarn joining cart 3.

[0048] The upper yarn suction tube 75 is configured to be connectable to the suction duct 8 arranged on the frame 6 of the spinning machine 1. The suction duct 8 is extended along the arranging direction (perpendicular direction in the plane of drawing of FIG. 6) of the spinning machine 1, and one end of the suction duct 8 is connected to the blower box 4. A connecting portion 8a as illustrated in FIG. 6 is arranged in plurals in the arranging direction on the suction duct 8, so that when the yarn joining cart 3 is moved to a spinning unit 2, the upper yarn suction tube 75 is connected to the corresponding connecting portion 8a so that the suction flow is generated at the suction pipe 71 and the suction mouth 72. The upper yarn suction tube 75 is arranged between the suction pipe 71 and the suction duct 8. The lower yarn suction tube 76 is arranged between the suction mouth 72 and the suction duct 8. A common portion in the upper yarn suction tube 75 is located between the lower yarn suction tube 76 and the suction duct 8.

[0049] A slit 75a orthogonal to the axial direction is formed downstream of the middle portion of the upper yarn suction tube 75, and a shutter cutter 77 that can be inserted into the slit 75a is arranged. As illustrated in FIGS. 7A and 7B, the shutter cutter 77 includes a sup-

porting shaft 77a extending along the axial direction (perpendicular direction in the plane of drawing of FIGS. 7A and 7B) of the upper yarn suction tube 75, a movable blade 77b adapted to be swingable about the supporting shaft 77a, and a fixed blade 77c fixed to the supporting shaft 77a.

[0050] When swung so that the movable blade 77b is inserted to the slit 75a as illustrated in FIG. 7B from a state where the movable blade 77b is on the outer side of the upper yarn suction tube 75 as illustrated in FIG. 7A, the movable blade 77b traverses the upper yarn suction tube 75 and reaches the fixed blade 77c, so that the yarn Y in the upper yarn suction tube 75 can be cut. The movable blade 77b is swung by a driving source (not illustrated) controlled by the cart control section 3a. The movable blade 77b is movable between two positions, a standby position illustrated in FIG. 7A and a cutting position illustrated in FIG. 7B. It is not necessary to stop the movable blade at a middle position between the standby position and the cutting position. The upstream suction tube of the connecting portion 8a of the suction duct 8 includes an upper yarn dedicated portion, a lower yarn dedicated portion, and a common portion. The lower yarn dedicated portion is the lower yarn suction tube 76. The upper yarn suction tube 75 includes the upper yarn dedicated portion and the common portion. The common portion is between the merging portion and the connecting portion 8a. The merging portion is a portion where the upper yarn dedicated portion and the lower yarn dedicated portion are merged. In the present embodiment, the shutter cutter 77 is arranged at the common portion and not at the upper yarn dedicated portion nor the lower yarn dedicated portion. Therefore, one shutter cutter 77 can be used for both the upper yarn and the lower yarn.

[0051] Returning back to FIGS. 2 to 5, the forward/backward moving mechanism 80 is configured to be movable in a direction (front and back direction) of moving the yarn joining device 50 closer to or away from the yarn path during the winding. As illustrated in FIG. 2, the yarn path during the winding is a straight line connecting the yarn path guide 34 and the outer peripheral surface of the package P. The forward/backward moving mechanism 80 includes a rail 81, a supporting bracket 82, and an air cylinder 83. The rail 81 is fixedly attached to the yarn joining cart 3 so as to lie along the front and back direction. The supporting bracket 82 is attached to the rail 81 so as to be slidable with respect to the rail 81. The yarn joining device 50 is fixed to the supporting bracket 82. The air cylinder 83 is a driving source for moving the supporting bracket 82 along the rail 81, and is controlled by the cart control section 3a. The yarn joining device 50 fixed to the supporting bracket 82 can be moved along the rail 81 by extending and contracting the air cylinder 83. The driving source for moving the yarn joining device 50 along the rail 81 is not limited to only the air cylinder 83. When using a motor as a driving source, a cam mechanism connected to the motor can be used.

[0052] As illustrated in FIG. 5, at a position where the air cylinder 83 is extended and the yarn joining device 50 is moved closer to the yarn path during the winding (hereinafter referred to as "yarn joining position"), the yarn Y guided by the suction pipe 71 and the suction mouth 72 is introduced to the yarn joining device 50. On the other hand, as illustrated in FIG. 2, when the air cylinder 83 is contracted and the yarn joining device 50 is moved to a position (hereinafter referred to as "retreated position") where the yarn joining device 50 is moved away from the yarn path during the winding, the interference of the yarn joining device 50 and the yarn Y can be prevented at the time of movement between the spinning units 2 of the yarn joining cart 3.

[0053] The reverse rotation driving mechanism 90 is a mechanism adapted to rotate the package P in a pull-out direction, which is the opposite direction of the winding direction. The reverse rotation driving mechanism 90 includes a reverse rotation roller 91, a link mechanism 92, and an air cylinder 93. The reverse rotation roller 91 is attached to the link mechanism 92, and rotatably driven in an opposite direction from the winding drum 42 by a motor (not illustrated) controlled by the cart control section 3a. The reverse rotation roller 91 and the air cylinder 93 are attached to the link mechanism 92 at appropriate positions, respectively. The air cylinder 93 is a driving source for extending and contracting the link mechanism 92, and is controlled by the cart control section 3a.

[0054] The reverse rotation roller 91 is moved to a position (hereinafter referred to as "contacting position") of making contact with the package P, as illustrated in FIGS. 3 and 4, by extending the link mechanism 92 with the air cylinder 93. On the other hand, the reverse rotation roller 91 is moved to a position (hereinafter referred to as "retreated position") of retreating into the yarn joining cart 3, as illustrated in FIG. 2, by contracting the link mechanism 92 with the air cylinder 93. The lower yarn Y can be pulled out from the package P by rotatably driving the reverse rotation roller 91 in the opposite direction from the winding drum 42 while the reverse rotation roller 91 is at the contacting position. In the present embodiment, the reverse rotation roller 91 is rotatably driven not only in the opposite direction from the winding drum 42 but also in the same direction as the winding drum 42.

(Details of yarn joining device)

[0055] Next, details of the yarn joining device 50 will be described. FIG. 8 is a perspective view of the yarn joining device 50. The yarn joining device 50 mainly includes a yarn joining section 51, a stepping motor 52, a frame 53, a yarn moving lever 54, and an air cylinder 55. In FIG. 8, the illustration of some members constituting the yarn joining section 51 is omitted to avoid the figures from becoming complicating. Furthermore, in the following description, the directional terms defined in FIG. 8 are appropriately used.

[0056] The yarn joining section 51 is a section for join-

ing the upper yarn Y guided by the suction pipe 71 and the lower yarn Y guided by the suction mouth 72. A specific configuration example of the yarn joining section 51 includes a knotter adapted to knot the upper yarn Y and the lower yarn Y by having a plurality of members move in cooperation mechanically, and a splicer adapted to apply twists to the yarn ends of the upper yarn Y and the lower yarn Y with whirling airflow to form a seam. In the present embodiment, the knotter is adopted for the yarn joining section 51, and the stepping motor 52 is arranged for the driving source of the yarn joining section 51. The stepping motor 52 is controlled by the cart control section 3a.

[0057] The frame 53 is a structural body that detachably supports the yarn joining section 51, and is fixed to the supporting bracket 82 of the forward/backward moving mechanism 80. Furthermore, the yarn joining section 51 includes two types, i.e., the knotter and the splicer, as described above, and the yarn joining device 50 including the knotter and the yarn joining device 50 including the splicer are mutually replaceable with respect to the yarn joining cart 3.

[0058] The yarn moving lever 54 serving as the yarn path regulating member is a lever-like member swingably attached to the frame 53, and two yarn moving levers are vertically arranged in a line. The yarn moving lever 54 is swung with a vertically extending shaft 54a as a center by being driven by the air cylinder 55 serving as the driving source. The air cylinder 55 is controlled by the cart control section 3a. In general, the yarn moving lever 54 is at a position (position illustrated in FIG. 8, hereinafter referred to as "standby position") of not making contact with the yarn Y. When the air cylinder 55 is driven, the yarn moving lever 54 at the standby position is swung such that the distal end portion of the yarn moving lever enters the far side of the yarn joining section 51 (see arrows of FIG. 8). The yarn moving lever 54 is thereby brought into contact with the upper yarn Y and the lower yarn Y guided by the yarn joining section 51, and is further movable to a position (hereinafter referred to as "regulating position") of pushing the upper yarn Y and the lower yarn Y to the far side of the yarn joining section 51 and regulating the yarn path.

[0059] The yarn joining section 51 will be described in detail. FIGS. 9A to 9D and FIGS. 10A to 10D are front views illustrating a series of operations of the yarn joining section 51. The yarn joining section (knotter) 51 has a configuration in which the front side is opened, and is adapted to join (knot) the upper yarn Y guided from the front side by the suction pipe 71 and the lower yarn Y guided from the front side by the suction mouth 72. The yarn joining section 51 includes two guide plates 63, 64, two knotter bills 65, 65, one crosser 66, two extractors 67, two clamps 68, 68, and a housing 69.

[0060] The guide plate 63 on the upper side configures the upper surface of the housing 69, and the guide plate 64 on the lower side configures the lower surface of the housing 69. As illustrated in FIG. 8, the guide plate 63

on the upper side is formed with a first slit 63a and a second slit 63b, which are opened toward the front side of the yarn joining section 51, so as to be lined in a left and right direction. The guide plate 64 on the lower side is formed with a first slit 64a and a second slit 64b, which are opened toward the front side of the yarn joining section 51, so as to be lined in the left and right direction. The first slit 63a and the second slit 64b are slits deeper than the second slit 63b and the first slit 64a.

[0061] In the yarn knotting operation, the upper yarn Y sucked and held by the suction pipe 71 is guided to the first slits 63a, 64a of the two guide plates 63, 64, and the lower yarn Y sucked and held by the suction mouth 72 is guided to the second slits 63b, 64b of the two guide plates 63, 64 (see FIG. 9B). Thus, by guiding the upper yarn Y to the first slits 63a, 64a and guiding the lower yarn Y to the second slits 63b, 64b, and thereafter, moving the yarn moving lever 54 described above to the regulating position, the upper yarn Y is pushed into the far side of the first slit 63a of the guide plate 63 on the upper side and the lower yarn Y is pushed into the far side of the second slit 64b of the guide plate 64 on the lower side, so that the upper yarn Y and the lower yarn Y can be regulated to a position where the yarns can be gripped by the clamp 68.

[0062] One of the two knotter bills 65 is arranged to project out toward a left side from a central portion of a right wall surface of the housing 69, and the other knotter bill is arranged to project out toward a right side from a central portion of a left wall surface of the housing 69. The knotter bill 65 is an L-shaped member, and is configured to be rotatable about a shaft portion 65a projecting out in the left and right direction from the wall surface of the housing 69. A clamp cutter 65b, which is a yarn holding member, is formed at a distal end portion of the knotter bill 65, and the clamp cutter 65b carries out one opening/closing operation while the knotter bill 65 makes one rotation. When the clamp cutter 65b is switched from an opened state to a closed state, the knotter bill 65 can hold and cut the yarn Y in a predetermined region R (see FIG. 9D), which is a rotational trajectory of the clamp cutter. The two knotter bills 65 are rotated in opposite directions to each other.

[0063] The crosser 66 has a shape in which one part of a disc is cut out, and is configured to be swingable about a center axis (clockwise or counterclockwise in FIGS. 9A to 9D and FIGS. 10A to 10D) extending in the front and back direction. A hooking portion 66a projecting toward the front side is formed at two positions (two positions spaced apart by 180 degrees in a peripheral direction) facing each other at a peripheral edge portion of the crosser 66. Thus, when the crosser 66 is swung, the yarn Y can be hooked and pulled by the hooking portion 66a.

[0064] The two extractors 67 are arranged so as to be lined in the left and right direction. Each extractor 67 is a vertically long member, and has a push-up portion 67a that is formed at a central portion of the extractor 67 and

can engage the yarn Y and push up the yarn Y toward the front side. The extractor 67 on the right side is supported in a freely swingable manner at an upper end portion of the right wall surface of the housing 69, and when swung in the front and back direction with a basal end portion as a supporting point, the push-up portion 67a is movable in the front and back direction. Furthermore, the extractor 67 on the left side is supported in a freely swingable manner at a lower end portion of the left wall surface of the housing 69, and when swung in the front and back direction with a basal end portion as a supporting point, the push-up portion 67a is movable in the front and back direction. The knot of the yarn Y can be squeezed by simultaneously swinging the two extractors 67 toward the front side.

[0065] One of the two clamps 68 is arranged adjacent to a lower side of the first slit 63a of the guide plate 63 on the upper side, and the other clamp is arranged adjacent to an upper side of the second slit 63b of the guide plate 63 on the lower side. The clamp 68 on the upper side thus can grip the upper yarn Y passing the first slit 63a, and the clamp 68 on the lower side can grip the lower yarn Y passing the second slit 63b (see FIG. 9C etc.).

[0066] The knotter bills 65, the crosser 66, the extractors 67, and the clamps 68 configure a yarn knotting member, and are each configured so as to operate in cooperation at defined timing by a cylindrical cam serving as a cam mechanism (not illustrated) on a cam surface of the cylindrical cam. When each of the members 65 to 68 carries out an operation of one cycle starting from an origin position and returning back to the origin position by the cam mechanism, the knotter bills 65, the crosser 66, and the extractors 67 carry out the yarn knotting operation in cooperation. The cam mechanism described above is driven by the stepping motor 52, and the rotation and stop are controlled by the cart control section 3a.

(Yarn knotting operation)

[0067] A series of operations of the yarn joining section (knotter) 51 will be described with reference to FIGS. 9A to 9D and FIGS. 10A to 10D. The series of operations are defined by the cam surface of the cylindrical cam. FIG. 9A illustrates a state where the knotter bills 65, the crosser 66, the extractors 67, and the clamps 68 are at the respective origin positions. At this time, the knotter bill 65 is closed with the clamp cutter 65b facing the front side. Furthermore, the clamp 68 is opened.

[0068] When the upper yarn Y is guided to the first slits 63a, 64a of the two guide plates 63, 64 by the suction pipe 71 and the lower yarn Y is guided to the second slits 63b, 64b of the two guide plates 63, 64 by the suction mouth 72 from the state illustrated in FIG. 9A, the respective yarn paths of the upper yarn Y and the lower yarn Y become substantially parallel in a vertical direction in the yarn joining section 51, as illustrated in FIG. 9B. Thereafter, the upper yarn Y is moved to the far side of the first

slit 63a and the lower yarn Y is moved to the far side of the second slit 64b by moving the yarn moving lever 54 to the regulating position. The upper yarn Y and the lower yarn Y are thereby moved to the positions where the yarns can be gripped by the clamp 68.

[0069] Then, when the stepping motor 52 is activated and the cam mechanism is operated, the clamp 68 is first closed and the upper yarn Y and the lower yarn Y are gripped. The knotter bill 65 then starts to be rotated, and the crosser 66 starts to be swung in the counterclockwise direction. As a result, as illustrated in FIG. 9C, the yarn Y is locked by the knotter bill 65, and pulled and bent by the hooking portion 66a of the crosser 66, whereby a ring is formed by the two yarns Y.

[0070] Subsequently, the swinging of the crosser 66 is once stopped, but the knotter bill 65 continues to be rotated, and the clamp cutter 65b becomes the opened state, as illustrated in FIG. 9D. In this case, the upper yarn Y and the lower yarn Y are both within a predetermined region R where the upper yarn Y and the lower yarn Y can be cut and held by the knotter bill 65. Furthermore, as the rotation of the knotter bill 65 is advanced, the clamp cutter 65b enters the closed state, and the yarn Y is cut and held by the knotter bill 65, as illustrated in FIG. 10A. When the yarn Y is pulled accompanying the rotation of the knotter bill 65, the knot is formed. After the knot is formed, the extractor 67 is swung toward the front side, and the upper yarn Y and the lower yarn Y are pushed up toward the front side by the push-up portion 67a. Furthermore, the holding of the yarn Y by the knotter bill 65 is released in the process. As illustrated in FIG. 10B, the knot is thereby pulled and squeezed, and the yarn knotting operation is completed.

[0071] After the yarn knotting operation is completed, the crosser 66 is swung in the clockwise direction, and the extractor 67 swung toward the front side is returned to the back side. Furthermore, the clamp 68 is opened, and the gripping of the yarn Y is released. With the operations, the tension acting on the yarn Y in the bent state is loosened at once, whereby a state where the yarn Y is slackened in the yarn joining section 51 is obtained, as illustrated in FIG. 10C. When the yarn Y is slackened, the yarn Y sometimes enters the predetermined region R. At this time point, the clamp cutter 65b is transitioned to the second opening/closing operation and the clamp cutter 65b is in the opened state, and hence if the slackened yarn Y is in the predetermined region R, the yarn Y is sandwiched when the clamp cutter 65b returns to the closed state and the yarn Y may get hooked at the knotter bill 65. If the winding is started while the yarn Y is hooked at the knotter bill 65, drawbacks such as damage of the knotter bill 65 may occur. Furthermore, problems such as the yarn pulling may occur when the yarn joining cart 3 moves.

[0072] In the configuration of the cam mechanism for driving the yarn joining section 51, the knotter bill 65 makes two rotations while each member 65 to 68 configuring the yarn joining section 51 carry out the operation

of one cycle starting from the origin position and returning back to the origin position. The first opening/closing operation is to carry out the cutting and the holding of the yarn Y, as described above, and is an operation absolutely necessary for the yarn knotting operation, but the second opening/closing operation after the yarn knotting operation is completed does not particularly have a meaning. The second opening/closing operation rather becomes a cause for hooking the slackened yarn Y, as described above, but the second opening/closing operation cannot be omitted as each member 65 to 68 is configured to cooperate by the cam mechanism.

[0073] Thus, in the present embodiment, the operation of the yarn joining section 51 is temporarily stopped (stepping motor 52 is stopped) after the yarn knotting operation is completed, and a tension is applied on the slackened yarn Y so that the yarn Y after the yarn knotting operation is moved to the outside of the predetermined region R, as illustrated in FIG. 10D. The operation of the yarn joining section 51 is then resumed (stepping motor 52 is activated again) after the yarn Y is moved to the outside of the predetermined region R, and the knoter bill 65 is returned to the origin position, so that the yarn Y after the yarn knotting operation is prevented from getting hooked at the knoter bill 65. Specifically, as will be described later, the winding of the yarn Y is started while the yarn joining section 51 is temporarily stopped, so that the tension is applied to the yarn Y and the yarn Y is moved to the outside of the predetermined region R.

(Other features of yarn joining device)

[0074] The yarn joining device 50 of the present embodiment further includes a guide bracket 56, a slackening propagation suppressing member 57, an air injecting device 58, and a receiving member 59, as illustrated in FIG. 8, to suppress the influence of the slackening of the yarn Y generated in the yarn joining section 51 as described above. The guide bracket 56 is configured as a plate-shaped member substantially parallel to a horizontal plane, and is fixed to the frame 53 at an upper side (upstream) of the yarn joining section 51. The slackening propagation suppressing member 57 is fixed to the upper surface of the guide bracket 56 while being slightly spaced apart from the guide bracket 56 toward the upper side. Furthermore, the air injecting device 58 and the receiving member 59 are fixed to the lower surface of the guide bracket 56.

[0075] As illustrated in FIG. 11, the guide bracket 56 is formed with a slit 56a opened toward the front side. The slackening propagation suppressing member 57 is configured as a plate-shaped member substantially parallel to the horizontal plane, and a right edge thereof acts as a yarn hooking surface 57a to which the yarn Y is hooked at the time of the yarn joining operation. The slackening propagation suppressing member 57 is arranged to cover the slit 56a of the guide bracket 56 when seen from above. The yarn hooking surface 57a of the

slackening propagation suppressing member 57 is thereby arranged at a position not facing the slit 56a when seen from the yarn travelling direction.

[0076] At the time of winding the yarn Y, the yarn Y is located at the winding position P1 illustrated in FIG. 11, but at the time of carrying out the yarn knotting operation in the yarn joining section 51, the upper yarn Y is located at the yarn joining position P2 illustrated in FIG. 11. Specifically, when the yarn moving lever 54 is swung to the regulating position, the upper yarn Y is moved to the far side of the first slit 63a of the guide plate 63 and the slit 56a of the guide bracket 56, and the upper yarn Y is gripped by the clamp 68 of the yarn joining section 51 in this state. As a result, as illustrated in FIG. 12, the upper yarn Y is formed with a yarn path so as to path between the first slit 63a of the guide plate 63 on the upper side and the slit 56a of the guide bracket 56 during the yarn knotting operation.

[0077] As illustrated in FIG. 11, a front end portion of the slackening propagation suppressing member 57 has an arc shape projecting toward the front side. Therefore, when the yarn moving lever 54 is swung to the regulating position, the upper yarn Y is first brought into contact with the front end portion of the slackening propagation suppressing member 57 covering the slit 56a, but is smoothly guided toward the back side along the arc front end portion and eventually reaching the slit 56a.

[0078] If the slackening propagation suppressing member 57 does not exist, the yarn path of the yarn Y on the upstream of the yarn joining section 51 lies along more or less vertically, as illustrated with a broken line in FIG. 12. In the present embodiment, the slackening propagation suppressing member 57, which is the plate-shaped member, is arranged so as to intersect and furthermore so as to become substantially perpendicular to the yarn path described above. Thus, the yarn Y on the upstream of the guide bracket 56 is greatly bent by being brought into contact with the edge of the slackening propagation suppressing member 57, as illustrated in FIG. 12. Therefore, the slackening of the yarn Y generated in the yarn joining section 51 can be suppressed from being propagated to upstream beyond the slackening propagation suppressing member 57.

[0079] For example, if the slackening of the yarn Y is propagated to the yarn accumulating device 30, a balloon A (see FIG. 4) formed downstream of the accumulating roller 31 is greatly inflated, whereby the yarn Y may get entangled with the yarn hooking member 32 and yarn breakage may occur. In particular, if the yarn Y is thick, a centrifugal force acting on the balloon A tends to become large, and hence such a problem tends to become significant. However, the slackening of the yarn Y can be prevented from being propagated to the yarn accumulating device 30 by arranging the slackening propagation suppressing member 57, and the above described problem can be resolved.

[0080] In the present embodiment, in addition to the slackening propagation suppressing member 57 adapt-

ed to suppress the propagation of the slackening of the yarn Y, the air injecting device 58 is further arranged to remove the slackening of the yarn Y itself. As illustrated in FIG. 12, the air injecting device 58 is configured to be able to inject compressed air toward the yarn Y passing between the first slit 63a of the guide plate 63 on the upper side and the slit 56a of the guide bracket 56. The slackening of the yarn Y can be removed by blowing and pushing the yarn Y with the compressed air injected from the air injecting device 58. Furthermore, in the present embodiment, the air injecting device 58 is arranged to inject air in a direction (see an arrow of FIG. 12) of increasing a bent angle of the yarn Y making contact with the edge of the slackening propagation suppressing member 57. The effect of suppressing the propagation of the slackening of the yarn Y by the slackening propagation suppressing member 57 thus can be increased. The air injecting device 58 is controlled by the cart control section 3a.

[0081] The receiving member 59 is arranged at substantially the same position as the air injecting device 58 in a vertical direction, so that the upper yarn Y passes between the air injecting device 58 and the receiving member 59. The receiving member 59 is configured as a plate-shaped member having a receiving surface 59a facing an injection port (not illustrated) of the air injecting device 58, and is arranged so that the receiving surface 59a is substantially parallel in the vertical direction. The compressed air injected from the air injecting device 58 is received by the receiving member 59, and the airflow generated as a result can be used to blow and push the yarn Y, whereby the yarn slackening can be more suitably removed.

[0082] Furthermore, as illustrated in FIG. 8, the yarn joining device 50 of the present embodiment includes an origin detection means 60 adapted to be able to detect whether or not each member 65 to 68 of the yarn joining section 51 is at the origin position. A disc shaped cooperating member 61 rotatable about a shaft substantially parallel in the left-right direction is arranged on the exterior of the left side of the housing 69 of the yarn joining section 51. The cooperating member 61 is coupled to the cam mechanism described before that moves each member 65 to 68 of the yarn joining section 51 in cooperation, and when the cam mechanism is driven by the stepping motor 52, the cooperating member 61 is also synchronously rotated in cooperation with each member 65 to 68. The cooperating member 61 is configured to make one rotation while each member 65 to 68 carries out the operation of one cycle starting from the origin position and returning back to the origin position.

[0083] A magnet 61a is arranged at a peripheral edge portion of the cooperating member 61, so that the magnet 61a is also rotated when the cooperating member 61 is rotated. The cooperating member 61 is coupled to the cam mechanism so that the magnet 61a is at the lowermost position when each member 65 to 68 of the yarn joining section 51 is at the origin position. A magnetic

sensor 62 is arranged at a position facing the magnet 61a when the magnet 61a is at the lowermost position. Thus, when the magnet 61a is at the lowermost position, that is, when each member 65 to 68 is at the origin position, the magnetic sensor 62 can detect the magnetism generated from the magnet 61a. The magnetic sensor 62 is fixed to the frame 53 of the yarn joining device 50, and transmits a detection signal to the cart control section 3a.

[0084] When each member 65 to 68 of the yarn joining section 51 is not at the origin position, that is, when the magnetism from the magnet 61a is not detected by the magnetic sensor 62 such as at immediately after attaching the yarn joining section 51 to the frame 53, and the like, the cart control section 3a drives the stepping motor 52 to return each member 65 to 68 to the origin position. Each member 65 to 68 is thereby operated, and the cooperating member 61 is rotated. When each member 65 to 68 is returned to the origin position, that is, when the magnet 61a is at the lowermost position, the magnetism from the magnet 61a is detected by the magnetic sensor 62. The cart control section 3a that has received the detection signal from the magnetic sensor 62 stops the stepping motor 52. Thus, when each member 65 to 68 of the yarn joining section 51 is not at the origin position, each member 65 to 68 can be returned to the origin position automatically.

(A series of flow of yarn joining operation)

[0085] Lastly, a series of flow of the yarn joining operation (yarn knotting operation) by the yarn joining cart 3 will be described. When the yarn Y between the spinning device 20 and the winding device 40 is in a disconnected state in a spinning unit 2, the unit control section 2a of such spinning unit 2 swingably drives the cradle arm 41 to move the package P away from the winding drum 42.

[0086] Then, the unit control section 2a transmits a control signal to the cart control section 3a of the yarn joining cart 3. The yarn joining cart 3 that has received the control signal moves to the target spinning unit 2 and stops at the target spinning unit 2. While the yarn joining cart 3 travels between the spinning units 2, the yarn joining device 50 is retreated to the retreated position by the forward/backward moving mechanism 80. Thus, the yarn joining device 50 can be prevented from making contact with the yarn Y travelling through each spinning unit 2 at the time of travelling of the yarn joining cart 3.

[0087] After the yarn joining cart 3 stops at the target spinning unit 2, the cart control section 3a activates a brake mechanism (not illustrated) arranged on the yarn joining cart 3 to stop the rotation of the package P. The reverse rotation roller 91 is then advanced to the contacting position and the reverse rotation roller 91 is rotatably driven in the opposite direction from the winding drum 42 to rotate the package P in the pull-out direction.

[0088] Then, the suction mouth 72 is swung toward the lower side, and the lower yarn Y pulled out from the pack-

age P is sucked and held by the suction mouth 72 (see FIG. 3). The lower yarn Y is guided to the yarn joining device 50 by stopping the drive of the reverse rotation roller 91 and stopping the rotation of the package P, and swinging the suction mouth 72 toward the upper side at the timing of sucking and holding the lower yarn Y (see FIG. 4). The reverse rotation drive of the package P is stopped in the middle of swinging the suction mouth 72 toward the upper side or when the swinging is completed. In this case, as illustrated in FIG. 14A, the lower yarn Y reaches the suction duct 8 through the lower yarn suction tube 76 and the upper yarn suction tube 75.

[0089] Next, the cart control section 3a activates the shutter cutter 77 arranged on the upper yarn suction tube 75. The lower yarn Y is thereby cut, and the suction length of the lower yarn Y can be shortened, as illustrated in FIG. 14B. The suction force acting on the lower yarn Y thus can be suppressed from becoming excessively large, and the lower yarn Y can be sucked and held with an appropriate suction force. After the activation (after moving to the cutting position), the shutter cutter 77 is returned to the standby position. The suction force again acts on the lower yarn Y in the suction mouth 72 by returning to the standby position, but the suction length of the lower yarn Y does not become any longer as the lower yarn Y is not pulled out from the package P. However, one part of the lower yarn Y still exists in the upper yarn suction tube 75 even after the cutting, and thus if the suction of the upper yarn Y is carried out in this state, the upper yarn Y and the lower yarn Y get entangled in the upper yarn suction tube 75 (common portion), and the lower yarn Y is pulled by the upper yarn Y, whereby yarn breakage may occur in the lower yarn Y at the time of the yarn knotting operation.

[0090] Thus, before guiding the upper yarn Y to the yarn joining device 50 with the suction pipe 71, the cart control section 3a slightly rotatably drives the reverse rotation roller 91 in the same direction as the winding drum 42 to rotate the package P in the winding direction, and the yarn end of the lower yarn Y is pulled out from the upper yarn suction tube 75 to the lower yarn suction tube 76, as illustrated in FIG. 14C. That is, the yarn end of the lower yarn Y is located upstream (lower yarn dedicated portion) of the middle portion (merging portion) where the lower yarn suction tube 76 merges with the upper yarn suction tube 75, so that the lower yarn Y is not located in the upper yarn suction tube 75 (common portion). After the yarn end of the lower yarn Y is pulled out from the upper yarn suction tube 75 (common portion), the reverse rotation roller 91 is stopped so that the lower yarn Y is not pulled out from the package P, whereby the lower yarn Y does not enter the upper yarn suction tube 75 (common portion) again.

[0091] Then, the cart control section 3a swings the suction pipe 71 toward the upper side, and swings the suction pipe 71 toward the lower side after sucking and holding the upper yarn Y spun from the spinning device 20 with the suction pipe 71 (see FIG. 3) to guide the upper yarn

Y to the yarn joining device 50 (see FIG. 4). In this case, the upper yarn Y is caught by the yarn hooking member 32 in the middle of the swinging of the suction pipe 71. After being caught, the upper yarn Y continuously supplied from the upstream is wound around the accumulating roller 31. As illustrated in FIG. 14D, although the upper yarn Y reaches the suction duct 8 through the upper yarn suction tube 75, the upper yarn Y and the lower yarn Y are not entangled in the suction tube as the lower yarn Y does not exist in the upper yarn suction tube 75 (common portion), as described above. After guiding the upper yarn Y to the yarn joining device 50, the cart control section 3a activates the shutter cutter 77 again to cut the upper yarn Y. The suction length of the upper yarn Y thus can be prevented from becoming too long, and the upper yarn Y can be sucked and held with an appropriate suction force. After the activation (after moving to the cutting position), the shutter cutter 77 is returned to the standby position. The suction force again acts on the upper yarn Y in the suction pipe 71 by returning to the standby position, but the suction length of the upper yarn Y will not become any longer as the upper yarn Y is not unwound from the accumulating roller 31.

[0092] Thus, in the present embodiment, the upper yarn Y and the lower yarn Y can be sucked and held with an appropriate suction force, and the tension of the upper yarn Y and the lower yarn Y can be prevented from becoming excessively large by cutting both the upper yarn Y and the lower yarn Y before the start of the operations of the yarn moving lever 54 and the yarn joining section (knotter) 51. Therefore, even if the tension of the upper yarn Y and the lower yarn Y becomes large at the time of the following yarn joining operation, the yarn breakage can be suppressed from occurring. Since the upper yarn Y is spun from the spinning device 20 without stopping, the suction length of the upper yarn Y becomes longer and longer. Therefore, it is effective to cut the upper yarn Y immediately before the start of the operations of the yarn moving lever 54 and the yarn joining section (knotter) 51 as much as possible.

[0093] At substantially the same time as the second activation of the shutter cutter 77, the cart control section 3a moves the yarn joining device 50 to the yarn joining position by the forward/backward moving mechanism 80. When the yarn joining device 50 is advanced to the yarn joining position, the upper yarn Y guided by the suction pipe 71 and the lower yarn Y guided by the suction mouth 72 are introduced to the yarn joining device 50 (yarn joining section 51). The yarn joining device 50 is maintained at the yarn joining position while the yarn joining operation is being carried out.

[0094] When the yarn joining device 50 is advanced to the yarn joining position, the cart control section 3a swings the yarn moving lever 54 to the regulating position. Thus, the yarn path is regulated so that upper yarn Y is moved to the far side of the first slit 63a and the upper yarn Y can be gripped by the clamp 68 on the upper side, and the lower yarn Y is moved to the far side of the second

slit 64b and the lower yarn Y can be gripped by the clamp 68 on the lower side. In this case, the upper yarn Y is pushed into the far side of the slit 56a of the guide bracket 56 and moved to a yarn joining position P2 (see FIG. 11) by the yarn moving lever 54. As illustrated in FIG. 12, the upper yarn Y is brought into contact with and bent by the edge of the slackening propagation suppressing member 57, and the slackening of the yarn Y generated by the yarn joining section 51 can be suppressed from being propagated to upstream of the slackening propagation suppressing member 57. The yarn moving lever 54 is returned to the standby position after the yarn joining section 51 starts the operation and the upper yarn Y is gripped by the clamp 68 of the yarn joining section 51.

[0095] The cart control section 3a starts the injection of the compressed air by the air injecting device 58 at substantially the same time as swinging the yarn moving lever 54. The slackening of the yarn Y generated by the yarn joining section 51 is thereby removed by being blown and pushed by the compressed air during the following yarn joining operation.

[0096] Then, the cart control section 3a drives the stepping motor 52, and starts the yarn knotting operation by the yarn joining section (knotter) 51. As previously described, although the knotter bills 65, the crosser 66, and the extractor 67 cooperatively operate to carry out the yarn knotting operation while each member 65 to 68 configuring the yarn joining section 51 carries out one cycle starting from the origin position and returning back to the origin position, the yarn knotting operation itself is completed in the middle of one cycle. To avoid the slackened yarn Y from being hooked after the completion of the yarn knotting operation by the second opening/closing operation of the knotter bill 65 after the completion of the yarn knotting operation, the stepping motor 52 is temporarily stopped after the completion of the yarn knotting operation in the present embodiment. The operation of the knotter bill 65 is thereby temporarily stopped, and meanwhile, the winding of the yarn Y is started, so that the slackened yarn Y is moved to the outside of the predetermined region R.

[0097] Specifically, the cart control section 3a temporarily stops the stepping motor 52, and then returns the yarn joining device 50 to the standby position by the forward/backward moving mechanism 80. The unit control section 2a swings the cradle arm 41, and brings the outer peripheral surface of the package P into contact with the rotating winding drum 42. The stopped package P is thereby started to rotate in the winding direction, and the winding of the yarn Y is started (resumed). In the present embodiment, the winding drum 42 is driven all together by a common rotational axis with respect to all the spinning units 2.

[0098] After the winding of the yarn Y is started, a sufficient tension is acted on the yarn Y, thus resolving the slackening, and the yarn Y is moved to the outside of the predetermined region R, as illustrated in FIG. 10D. Therefore, the yarn Y will not be sandwiched by the knot-

ter bill 65 thereafter even if the knotter bill 65 is closed. Furthermore, after the winding of the yarn Y is started, the yarn Y is moved from the yarn joining position P2 to the winding position P1 (see FIG. 11). Thus, the yarn Y can be prevented from making contact with the slackening propagation suppressing member 57 at the time of winding.

[0099] In the present embodiment, since compressed air is injected by the air injecting device 58 immediately before the yarn knotting operation, the slackening of the yarn Y is continuously removed. However, since the slackening of the yarn Y is resolved, and the injection of the compressed air becomes unnecessary after the start of winding of the yarn Y, the cart control section 3a stops the injection of the compressed air by the air injecting device 58 when the winding is started. In other words, the slackening of the yarn Y generated during the yarn knotting operation can be removed by carrying out the injection of the compressed air by the air injecting device 58 during the yarn knotting operation. In particular, the injection of the compressed air is started before the start of the yarn knotting operation, and stopped after the yarn knotting operation is completed and the winding is started, so that the slackening of the yarn Y generated during the yarn knotting operation and immediately after the start of winding can be more reliably removed.

[0100] When the winding of the yarn Y is started from a state where the yarn Y is slackened in the yarn joining section 51 illustrated in FIG. 10C, and the tension is acted on the yarn Y, the yarn Y may get hooked to each member 65 to 67 of the yarn joining section 51 and the yarn Y may not be able to move to the outside of the predetermined region R. In view of such a case, the yarn moving lever 54 is once moved to the regulating position after the start of the winding of the yarn Y in the present embodiment. The hooking is released by regulating the yarn Y to a regular yarn path, and the yarn Y can be reliably moved to the outside of the predetermined region R. Lastly, the cart control section 3a drives the stepping motor 52 again, resumes the operation of the yarn joining section 51 temporarily stopped in the middle of one cycle, and returns each member 65 to 68 of the yarn joining section 51 to the origin position.

[Effect]

[0101] In the present embodiment, the shutter cutter 77 (cutting member) adapted to cut the upper yarn Y sucked by the suction pipe 71 (upper yarn suction member) is arranged, the tension of the upper yarn Y can be prevented from becoming excessively large, and the yarn breakage of the upper yarn Y at the time of yarn knotting operation can be prevented.

[0102] In the present embodiment, the shutter cutter 77 (lower yarn cutting member) adapted to cut the lower yarn Y sucked by the suction mouth 72 (lower yarn suction member) is further arranged, and thus the tension of the lower yarn Y can be prevented from becoming

excessively large, and the yarn breakage of the lower yarn Y at the time of yarn knotting operation can be prevented.

[0103] Furthermore, in the present embodiment, the lower yarn suction tube 76 is merged and connected to the middle portion (merging portion) of the upper yarn suction tube 75, and the shutter cutter 77 arranged on the upper yarn suction tube (common portion) 75 is used as the cutting member and the lower yarn cutting member. One shutter cutter 77 is thus merely necessary, which is advantageous from the standpoint of cost and space.

[0104] Furthermore, in the present embodiment, the upper yarn Y is cut by the shutter cutter 77 after the lower yarn Y is cut by the shutter cutter 77. The lower yarn Y is sucked by an amount pulled out from the package P, whereas the upper yarn Y is endlessly sucked by an amount spun from the spinning device 20. Therefore, even if the upper yarn Y is cut early, the length sucked after the cutting is gradually increased, and the tension of the upper yarn Y may not be reduced. Thus, the upper yarn Y is cut after the lower yarn Y, as described above, so that the tension of the upper yarn Y can be effectively suppressed from becoming large.

[0105] Moreover, in the present embodiment, the lower yarn Y is wound into the package P after the lower yarn Y is cut by the shutter cutter 77 and before the upper yarn Y is sucked by the suction pipe 71, so that the lower yarn Y remaining in (the common portion of) the upper yarn suction tube 75 is pulled out toward the suction mouth 72 side than the middle portion (merging portion). Since a part of the lower yarn Y remains in (the common portion of) the upper yarn suction tube 75 even after the lower yarn Y is cut with the shutter cutter 77 at the upper yarn suction tube 75 (common portion), the remaining lower yarn may entangle with the subsequently sucked upper yarn Y. The yarn end of the lower yarn Y is thus pulled out toward the suction mouth 72 side than the middle portion (merging portion) after the cutting of the lower yarn Y and before the suction of the upper yarn Y, as described above, so that the upper yarn Y and the lower yarn Y can be prevented from getting entangled at the upper yarn suction tube 75 (common portion).

[0106] Furthermore, in the present embodiment, the upper yarn Y is cut with the shutter cutter 77 and the lower yarn Y is cut with the shutter cutter 77 before the yarn knotting operation by the yarn joining device 50 is started. When carrying out the yarn knotting operation, the upper yarn Y and the lower yarn Y are pulled and the tension becomes large, whereby the yarn breakage tends to easily occur. Therefore, the upper yarn Y and the lower yarn Y are cut before the start of the yarn knotting operation, as described above, whereby the yarn breakage at the time of the yarn knotting operation can be effectively suppressed.

[0107] Furthermore, in the present embodiment, the yarn joining device 50 further includes the yarn moving lever 54 (yarn path regulating member) movable between

the standby position of not making contact with the yarn Y and the regulating position of making contact with the yarn Y to regulate the yarn path in the yarn joining device 50. The yarn moving lever 54 is moved to the regulating position before the yarn knotting operation by the yarn joining device 50 is started, and the upper yarn Y is cut by the shutter cutter 77 and the lower yarn Y is cut by the shutter cutter 77 before the yarn moving lever 54 is moved to the regulating position. The tension of the upper yarn Y and the lower yarn Y becomes large when the yarn moving lever 54 is brought into contact with the upper yarn Y and the lower yarn Y thus regulating the yarn path before starting the yarn knotting operation. Thus, the yarn breakage can be suppressed by cutting the upper yarn Y and the lower yarn Y in advance and reducing the tension before moving the yarn moving lever 54 to the regulating position, as described above.

[0108] Moreover, in the present embodiment, the yarn joining device 50 further includes the air injecting device 58 adapted to inject air to the yarn Y, and the upper yarn Y is cut by the shutter cutter 77 and the lower yarn Y is cut by the shutter cutter 77 before starting the injection of air by the air injecting device 58. The slackening of the yarn Y can be removed by injecting air to the yarn Y and blowing and pushing the yarn Y, but in this case, the tension of the yarn Y becomes large. Thus, the yarn breakage can be suppressed by cutting the upper yarn Y and the lower yarn Y and lowering the tension in advance before starting the injection of the air, as described above.

[0109] Furthermore, in the present embodiment, the plurality of spinning units 2 each including the spinning device 20 and the winding device 40, and the yarn joining cart 3 movable among the plurality of spinning units 2 are arranged, and the yarn joining device 50, the suction pipe 71, the upper yarn suction tube 75, and the shutter cutter 77 are arranged on the yarn joining cart 3. Therefore, the yarn breakage of the upper yarn Y can be prevented when carrying out the yarn knotting operation with the yarn joining cart 3. Furthermore, as the yarn joining device 50, the suction pipe 71, the upper yarn suction tube 75, and the shutter cutter 77 are arranged on the yarn joining cart 3, the devices and members do not need to be arranged for every spinning unit 2 and can be commonly used.

[Other Embodiments]

[0110] The embodiment of the present invention has been described above, but the mode in which the present invention can be applied is not limited to the above-described embodiment, and modifications can be appropriately made within a scope not deviating from the gist of the present invention, as illustrated below.

[0111] In the above-described embodiment, the shutter cutter 77 arranged on the upper yarn suction tube 75 is also used as the cutting member adapted to cut the upper yarn Y and the lower yarn cutting member adapted

to cut the lower yarn Y. However, the cutting member and the lower yarn cutting member may be separately prepared, and the cutting member may be arranged on the upper yarn suction tube 75 (upper yarn dedicated section) and the lower yarn cutting member may be arranged on the lower yarn suction tube 76 (lower yarn dedicated section). In this case, the lower yarn Y, which is cut first, does not remain in the upper yarn suction tube (common portion) 75, and thus the upper yarn Y and the lower yarn Y can be avoided from being entangled without performing the operation of winding the lower yarn Y into the package after cutting the lower yarn Y.

[0112] Furthermore, in the above-described embodiment, the lower yarn Y is cut first with the shutter cutter 77, and then the upper yarn Y is cut. However, the lower yarn Y may be cut after the upper yarn Y is cut, or the upper yarn Y and the lower yarn Y may be simultaneously cut.

[0113] Furthermore, in the above-described embodiment, after the lower yarn Y is cut, the lower yarn Y remaining in the upper yarn suction tube (common portion) 75 is pulled out. However, if the entangling of the upper yarn Y and the lower yarn Y is not a great problem, one part of the lower yarn Y may remain in the upper yarn suction tube 75.

[0114] Moreover, in the above-described embodiment, the lower yarn suction tube 76 is merged and connected to the middle portion (merging portion) of the upper yarn suction tube 75, but a configuration in which the lower yarn suction tube 76 is not merged to the upper yarn suction tube 75 may be adopted.

[0115] Furthermore, in the above-described embodiment, the shutter cutter 77 is arranged as the cutting member, but a specific configuration of the cutting member may be another tool other than the shutter cutter.

[0116] Furthermore, in the above-described embodiment, the yarn joining device 50 is arranged on the yarn joining cart 3, but the yarn joining device 50 may be arranged on each spinning unit 2.

[0117] Moreover, in the above-described embodiment, the spinning device 20 is arranged on the upper side of the winding device 40, so that the yarn Y from the spinning device 20 is the upper yarn and the yarn Y from the winding device 40 is the lower yarn. However, the winding device 40 may be on the upper side of the spinning device 20, and the yarn Y from the winding device 40 may be the upper yarn and the yarn Y from the spinning device 20 may be the lower yarn.

[0118] The spinning machine may be a winding machine including the yarn supplying section, the winding device, the yarn joining device, and the control section. The yarn supplying section is adapted to supply the yarn. The winding device is adapted to wind the supplied yarn. The yarn joining device is adapted to join and connect the yarn from the yarn supplying section and the yarn from the winding device. The control section is adapted to control the operation of the members. The yarn joining device includes a motor and a yarn holding member. The

yarn holding member receives a driving force from the motor. The yarn holding member is opened/closed while rotating about its own axis, and can hold the yarn on the rotation path of the yarn holding member when switching from the opened state to the closed state. The control section stops the rotation of the yarn holding member after the yarn joining device knots the yarns, and controls at least one of the yarn joining device or the winding device before the rotation of the yarn holding member is resumed to eliminate the yarn from the rotation path of the yarn holding member. With this configuration, the yarn holding member in the opened state after the yarn knotting operation is temporarily stopped, and returned to the closed state after the yarn is moved to the outside of the rotation path where the yarn is held by the yarn holding member. Thus, the yarn after the yarn knotting operation can be prevented from getting hooked to the yarn holding member when the yarn holding member is closing.

[0119] The spinning machine may be a winding machine including the yarn supplying section, the winding device, the yarn joining device, and the control section. The yarn supplying section is adapted to supply the yarn. The winding device is adapted to wind the supplied yarn.

The yarn joining device is adapted to join and connect the yarn from the yarn supplying section and the yarn from the winding device. The control section is adapted to control the operation of the members. The yarn joining device includes a motor and a yarn holding member. The yarn holding member receives a driving force from the motor. The yarn holding member is opened/closed while rotating about its own axis, and can hold the yarn on the rotation path of the yarn holding member when switching from the opened state to the closed state. The control section makes the rotation speed of the yarn holding member in the opened state after the yarn knotting operation slower than the rotation speed of the yarn holding member at the time of the yarn knotting operation at least temporarily, and controls at least one of the yarn joining device or the winding device to eliminate the yarn from the rotation path of the yarn holding member. The time until the yarn holding member is closed can be gained by at least temporarily slowing the rotation speed of the yarn holding member after the yarn knotting operation, so that the yarn can be easily moved out from the rotation path before the yarn holding member is closed. Thus, the yarn after the yarn knotting operation can be prevented from getting hooked to the yarn holding member when the yarn holding member is closing.

[0120] Furthermore, in the winding machine, the control section preferably makes the rotation speed of the yarn holding member slower than the rotation speed of the yarn holding member at the time of the yarn knotting operation until the yarn holding member in the opened state after the yarn knotting operation is switched to the closed state. Until the yarn holding member is switched to the closed state after the yarn knotting operation, the rotation speed of the yarn holding member is slowed so

that the time until the yarn holding member is closed can be more reliably gained.

[0121] After the winding of the yarn is started by the winding device, the control section preferably returns the yarn holding member in the opened state after the yarn knotting operation to the closed state. When the winding of the yarn is started, the tension of the yarn becomes large, and thus the yarn can be moved to the outside of the rotation path of the yarn holding member using the tension. Therefore, the yarn can be suppressed from getting hooked at the yarn holding member by returning the yarn holding member to the closed state after the start of the winding.

[0122] Furthermore, the yarn joining device further preferably includes a yarn path regulating member adapted to be movable between a standby position of not making contact with the yarn and a regulating position of making contact with the yarn to regulate the yarn path in the yarn joining section, and after the yarn path regulating member is once moved to the regulating position after the yarn knotting operation, the control section preferably returns the yarn holding member in the opened state after the yarn knotting operation to the closed state. The yarn can be moved to the outside of the rotation path of the yarn holding member by moving the yarn path regulating member to the regulating position. Therefore, the yarn can be regulated to the regular yarn path, and the yarn can be suppressed from getting hooked at the yarn holding member by once moving the yarn path regulating member to the regulating position after the yarn knotting operation and then returning the yarn holding member to the closed state.

[0123] Furthermore, the yarn joining device further preferably includes an air injecting device adapted to inject air to the yarn, and after the air is injected to the yarn by the air injecting device after the yarn knotting operation, the control section preferably returns the yarn holding member in the opened state after the yarn knotting operation to the closed state. The tension can be acted on the yarn to remove the slackening of the yarn by injecting the air to the yarn. Therefore, the yarn can be suppressed from getting hooked to the yarn holding member by injecting the air to the yarn after the yarn knotting operation and then returning the yarn holding member to the closed state.

[0124] Furthermore, a forward/backward moving mechanism adapted to move the yarn joining device forward/backward with respect to the yarn is further preferably arranged, and after the forward/backward moving mechanism moves the yarn joining device in a direction away from the yarn, the control section preferably returns the yarn holding member in the opened state after the yarn knotting operation to the closed state. With the arrangement of the forward/backward moving mechanism and the movement of the yarn joining device in the direction away from the yarn, the yarn after the yarn knotting operation can be forcibly eliminated from the rotation path of the yarn holding member in the yarn joining device.

[0125] The yarn joining device may include a yarn joining section, a guide member, and a slackening propagation suppressing member. The yarn joining section carries out the yarn joining operation with the yarn being in a bent state. The guide member has a slit through which the yarn passes on the upstream in the yarn travelling direction of the yarn joining section. The slackening propagation suppressing member has a yarn hooking surface that does not face the slit when seen from the yarn travelling direction at the upstream in the yarn travelling direction of the guide member. With this configuration, the yarn path at the time of the yarn joining operation is defined by the slit of the guide member, and the yarn can be bent by being hooked at the slackening propagation suppressing member having a yarn hooking surface that does not face the slit. Therefore, the slackening of the yarn generated in the yarn joining section can be suppressed from being propagated to other areas beyond the slackening propagation suppressing member, and an unstable behavior of the yarn by the slackening of the yarn can be suppressed.

[0126] The yarn joining device may also include a yarn joining section and a yarn path regulating member. The yarn joining section includes a yarn knotting member adapted to mechanically carry out the yarn knotting operation. The yarn path regulating member is movable between a standby position of not making contact with the yarn and a regulating position of making contact with the yarn to regulate the yarn path in the yarn joining section. A yarn path regulating member driving section adapted to drive the yarn path regulating member is arranged separately from the yarn joining section driving section adapted to drive the yarn joining section. With this configuration, the yarn path regulating member driving section adapted to drive the yarn path regulating member is arranged separately from the yarn joining section driving section adapted to drive the yarn joining section, and thus the yarn path regulating member can be driven independently from the yarn joining section. Therefore, a rigorous assembly at the initial operation position of the yarn joining section and the yarn path regulating member becomes unnecessary.

Claims

1. A spinning machine **characterized by** comprising:

- a spinning device (20) adapted to spin and produce a yarn (Y);
- a winding device (40) adapted to wind the yarn (Y) produced by the spinning device (20) to form a package (P);
- a yarn joining device (50) adapted to knot and connect a first yarn (Y) from the spinning device (20) and a second yarn (Y) from the winding device (40) when the yarn (Y) is disconnected between the spinning device (20) and the winding

- device (40);
 a first yarn suction member (71) adapted to suck and hold the first yarn (Y) and guide the first yarn (Y) to the yarn joining device (50);
 a first yarn suction tube (75) connected to the first yarn suction member (71) and adapted to pull in the sucked first yarn (Y) into the first yarn suction tube (75);
 an accumulating roller (31) arranged between the spinning device (20) and the winding device (40) and adapted to wind the first yarn (Y) guided to the yarn joining device (50) by the first yarn suction member (71) around an outer peripheral surface to accumulate the first yarn (Y); and
 a cutting member (77) adapted to cut the first yarn (Y) in the first yarn suction tube (75).
2. The spinning machine according to claim 1, **characterized by** further comprising:
- a second yarn suction member (72) adapted to suck and hold the second yarn (Y) and guide the second yarn (Y) to the yarn joining device (50);
 a second yarn suction tube (76) connected to the second yarn suction member (72) and adapted to pull in the sucked second yarn (Y) into the second yarn suction tube (76); and
 a second yarn cutting member adapted to cut the second yarn (Y) in the second yarn suction tube (76).
3. The spinning machine according to claim 1, **characterized by** further comprising:
- a second yarn suction member (72) adapted to suck and hold the second yarn (Y) and guide the second yarn (Y) to the yarn joining device (50);
 a second yarn suction tube (76) connected to the second yarn suction member (72) and adapted to pull in the sucked second yarn (Y) into the second yarn suction tube (76),
 wherein the second yarn suction tube (76) is merged and connected to a middle portion of the first yarn suction tube (75), and wherein the cutting member (77) is also adapted to cut the second yarn (Y).
4. The spinning machine according to claim 3, **characterized in that** the spinning machine is adapted to cut the first yarn (Y) after the second yarn (Y) is cut.
5. The spinning machine according to claim 4, **characterized in that** the spinning machine is adapted to pull the second yarn (Y) remaining in the first yarn suction tube (75) toward a second yarn suction member (72) with respect to the middle portion by winding
- the second yarn (Y) into the package (P) after the second yarn (Y) is cut and before the first yarn (Y) is sucked by the first yarn suction member (71).
6. The spinning machine according to any one of claims 2 to 5, **characterized in that** the spinning machine is adapted to cut the first yarn (Y) and the second yarn (Y) before a yarn knotting operation by the yarn joining device (50) is started.
7. The spinning machine according to claim 6, **characterized in that** the yarn joining device (50) further includes a yarn path regulating member (54) adapted to be movable between a standby position of not making contact with the yarn (Y) and a regulating position of making contact with the yarn (Y) to regulate a yarn path in the yarn joining device (50), the spinning machine is adapted to move the yarn path regulating member (54) to the regulating position before the yarn knotting operation by the yarn joining device (50) is started, and the spinning machine is adapted to cut the first yarn (Y) and the second yarn (Y) before the yarn path regulating member (54) is moved to the regulating position.
8. The spinning machine according to any one of claims 2 to 7, **characterized in that** the yarn joining device (50) further includes an air injecting device (58) adapted to inject air to the yarn (Y), and the spinning machine is adapted to cut the first yarn (Y) and the second yarn (Y) before injection of air by the air injecting device (58) is started.
9. The spinning machine according to any one of claims 1 to 8, **characterized by** further comprising:
- a plurality of spinning units (2) each including the spinning device (20) and the winding device (40); and
 a yarn joining cart (3) adapted to be movable among the plurality of spinning units (2);
 wherein the yarn joining cart (3) includes the yarn joining device (50), the first yarn suction member (71), the first yarn suction tube (75), and the cutting member (77).

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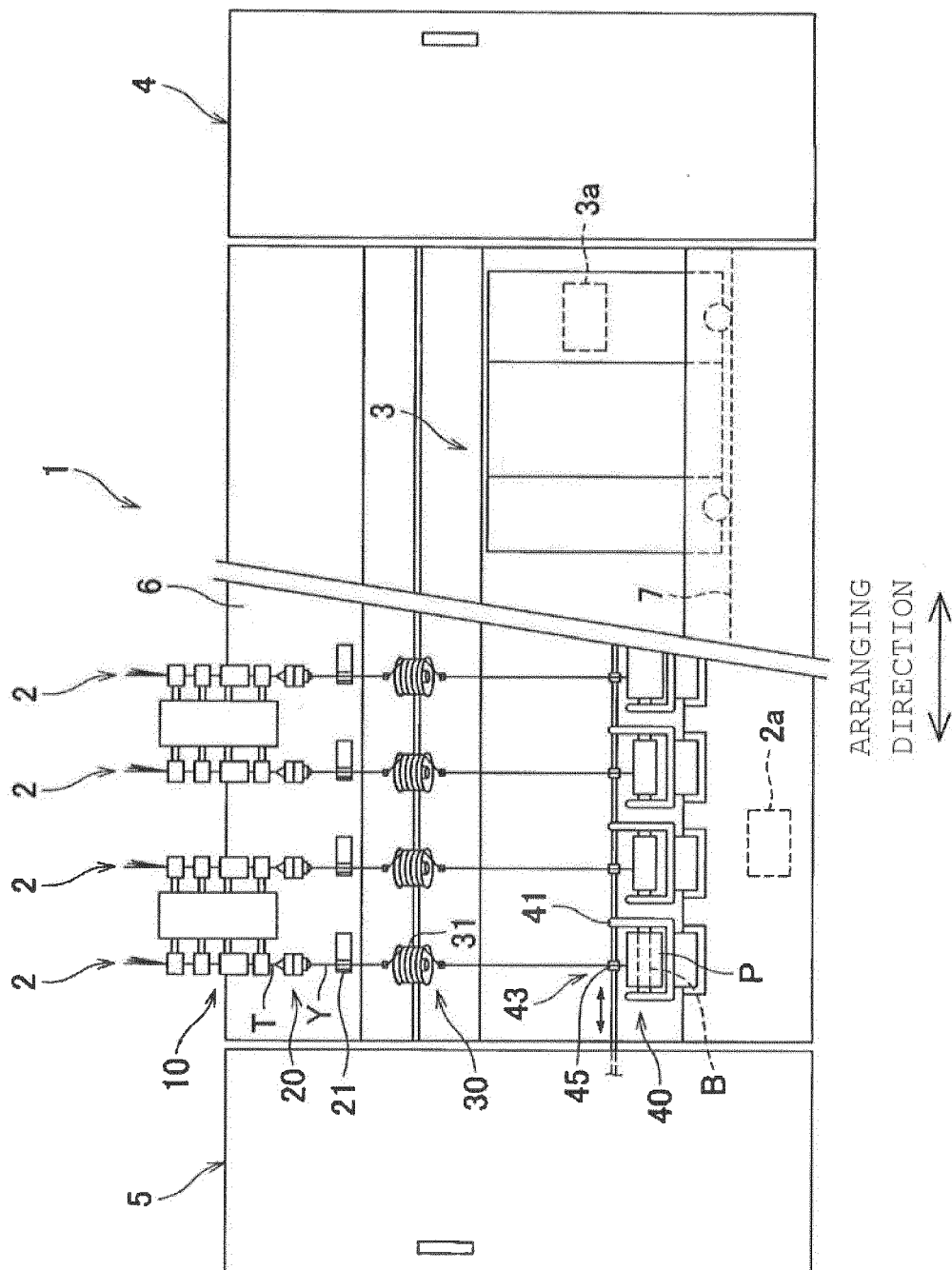
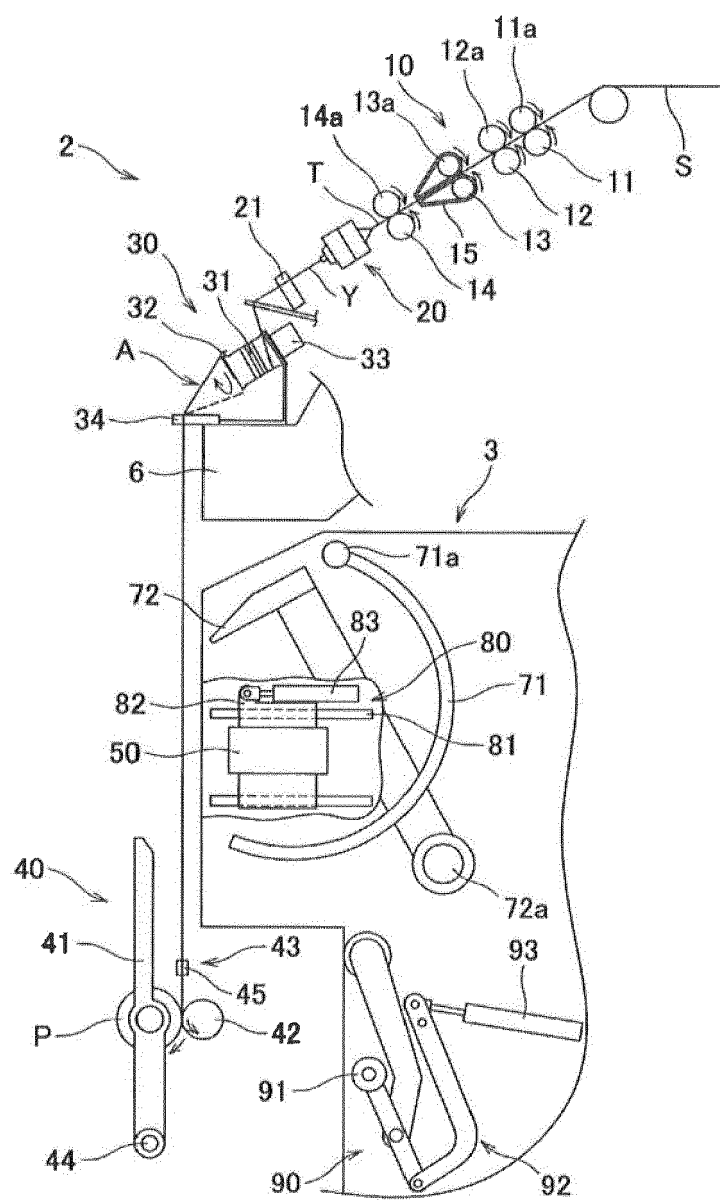


FIG. 2



FRONT $\longleftrightarrow$ BACK

FIG. 3

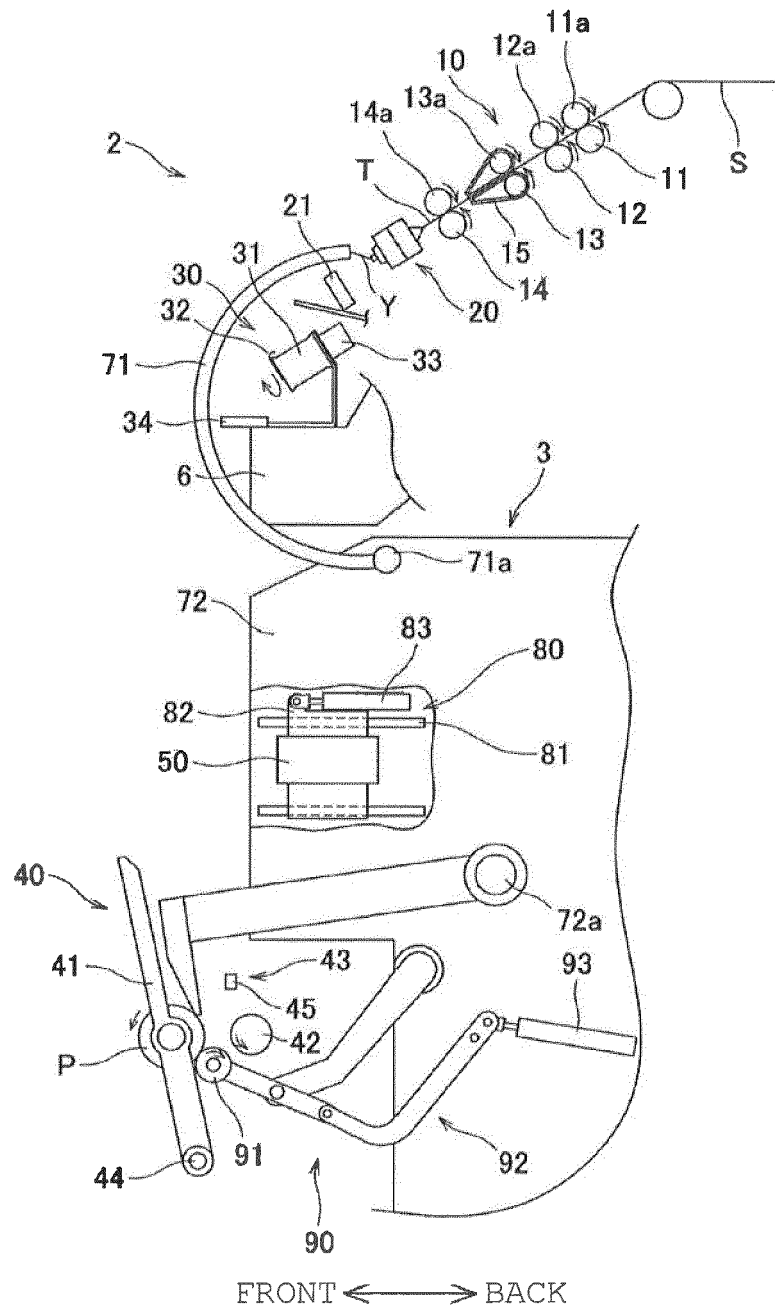


FIG. 4

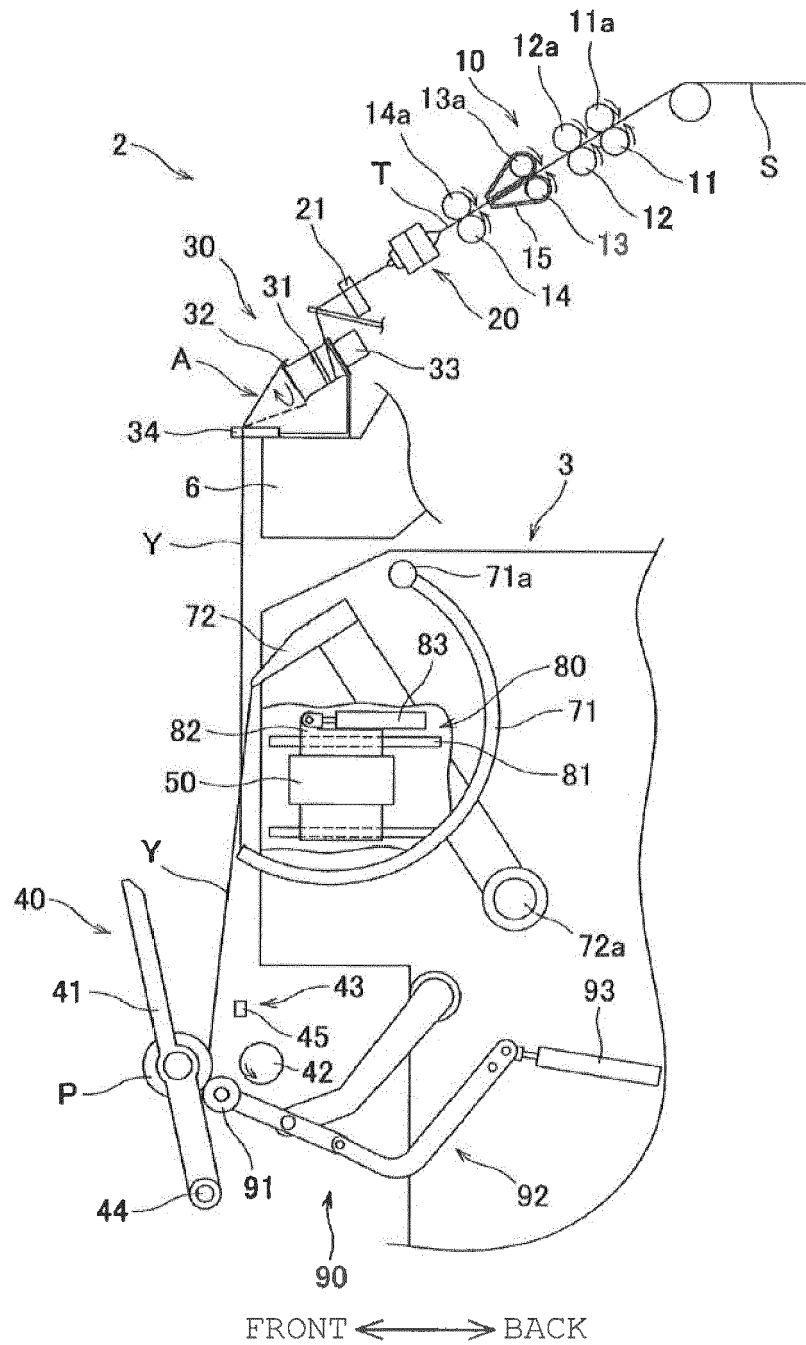


FIG. 5

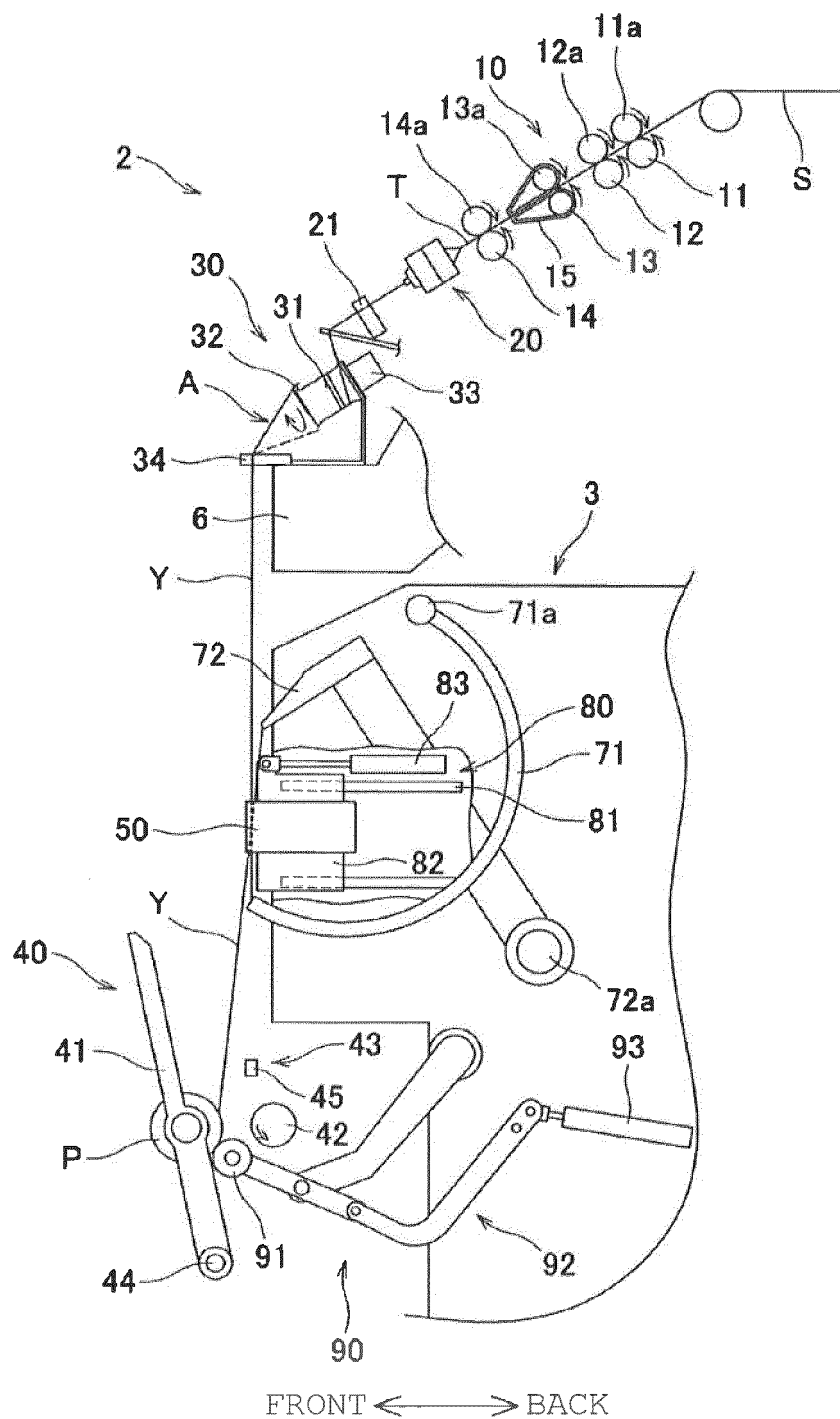


FIG. 6

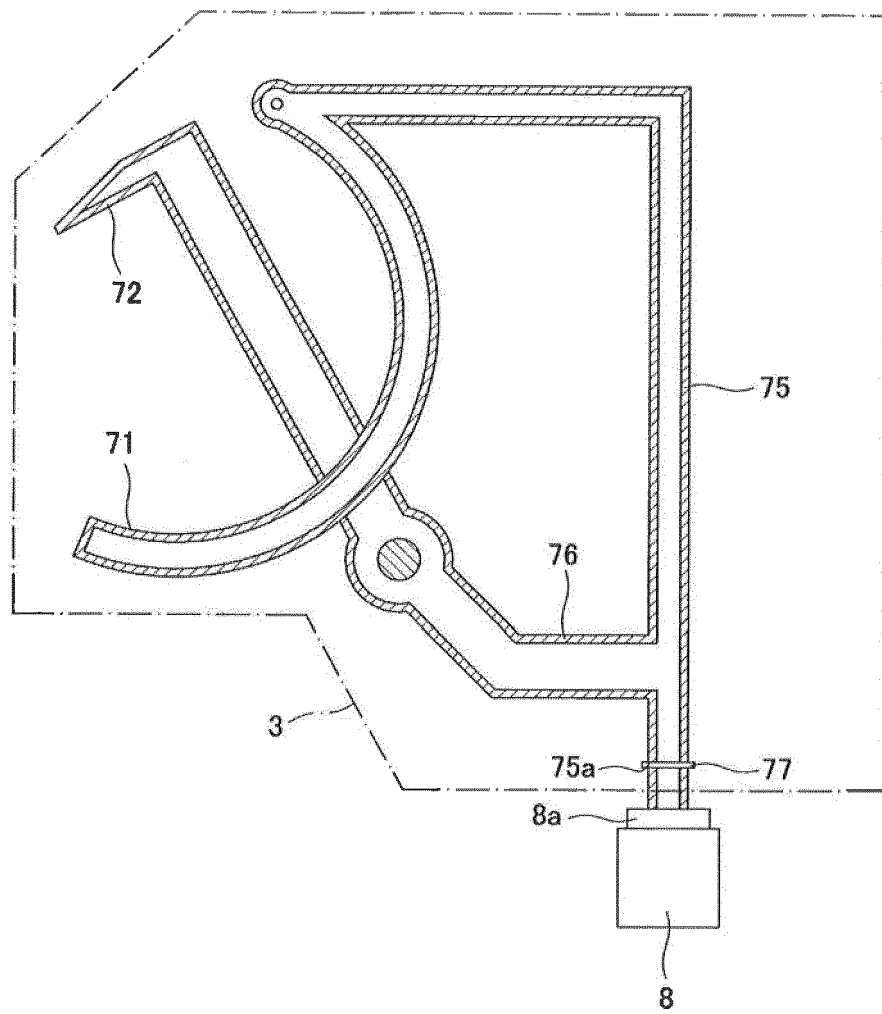
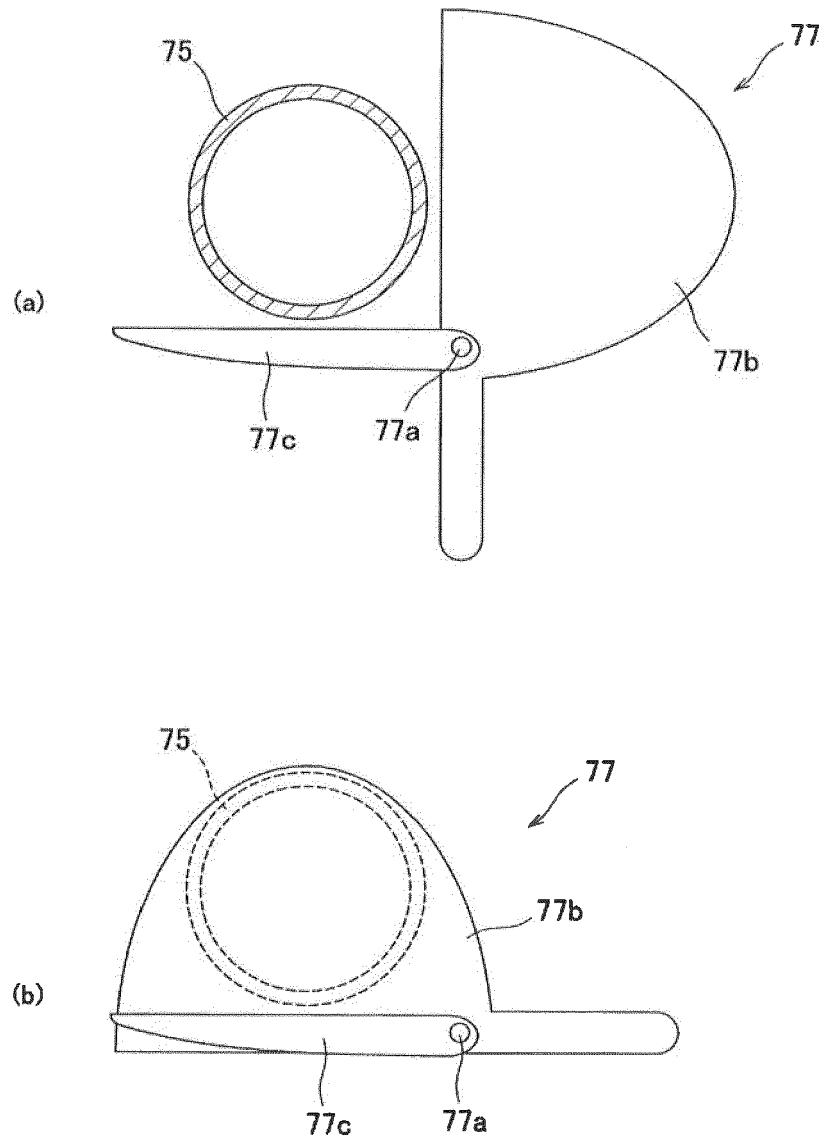
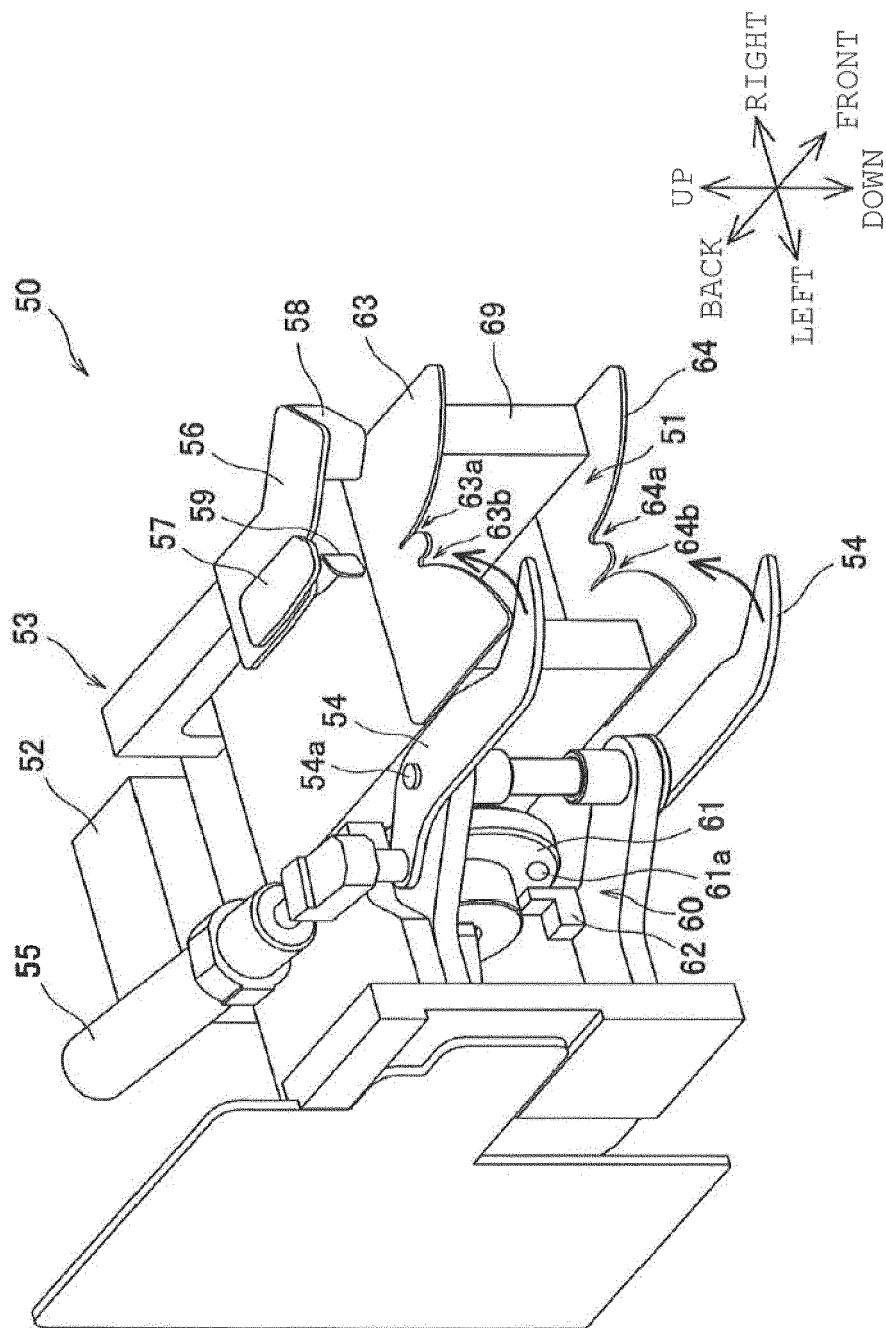


FIG. 7



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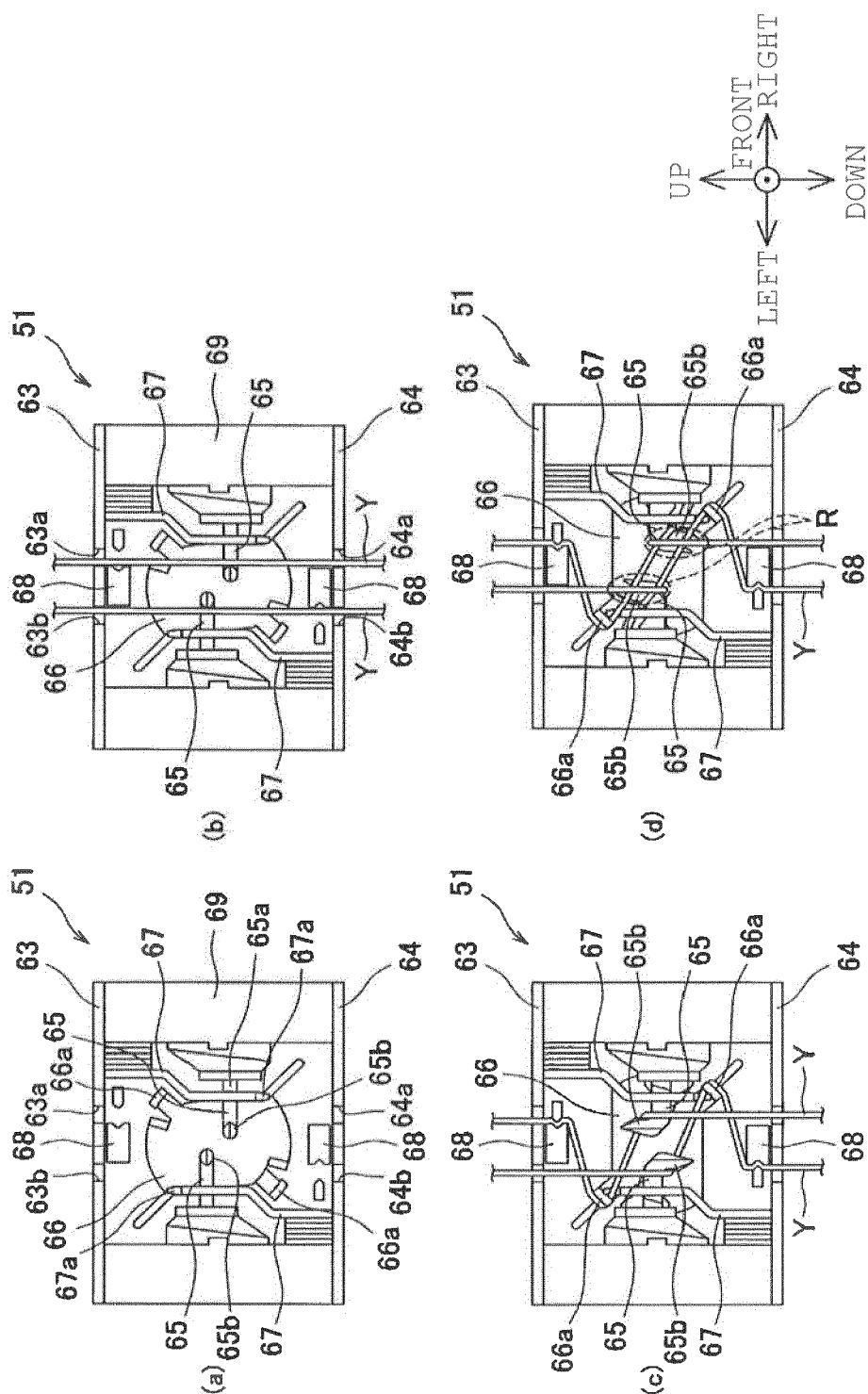


FIG. 10

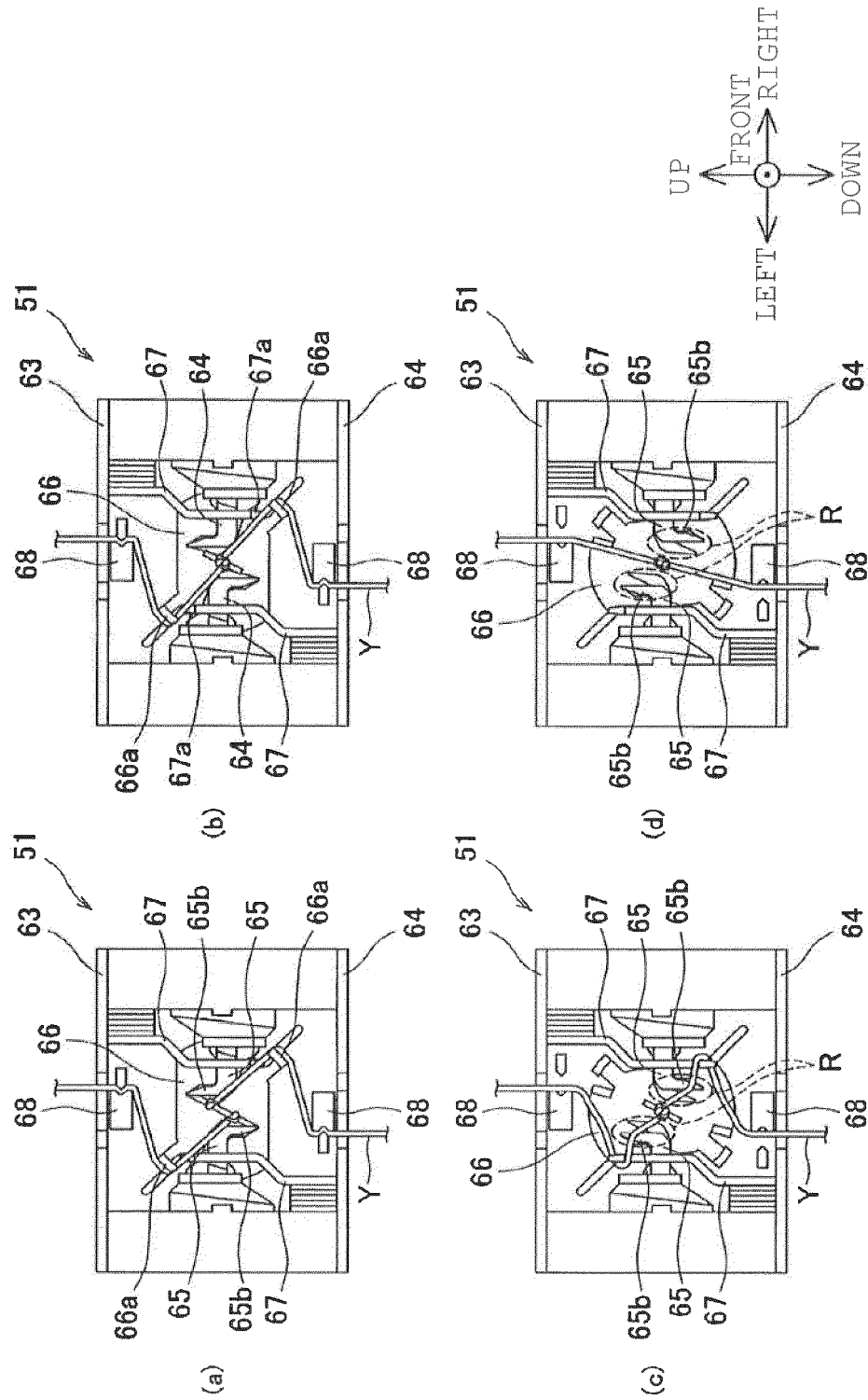


FIG. 11

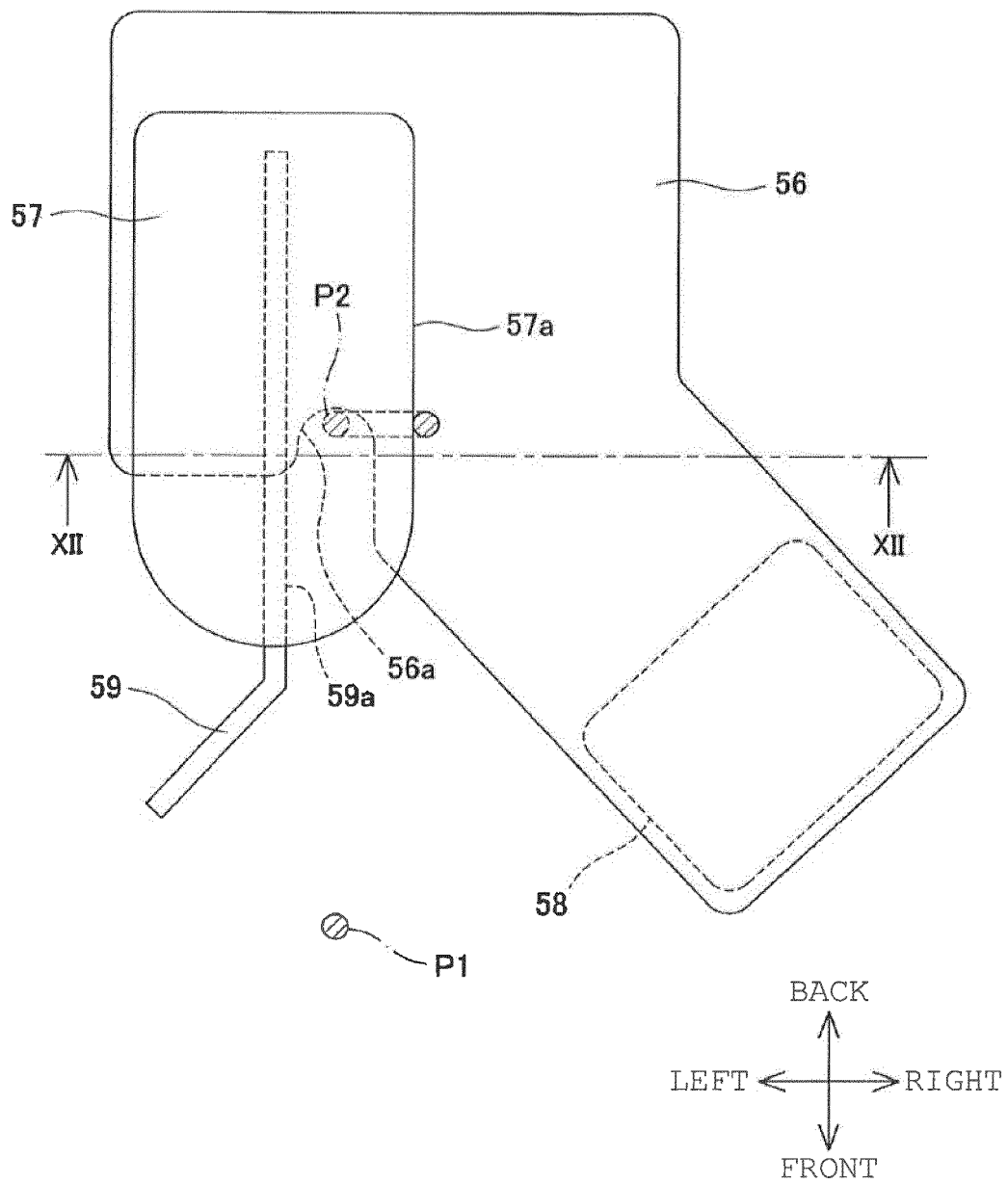


FIG. 12

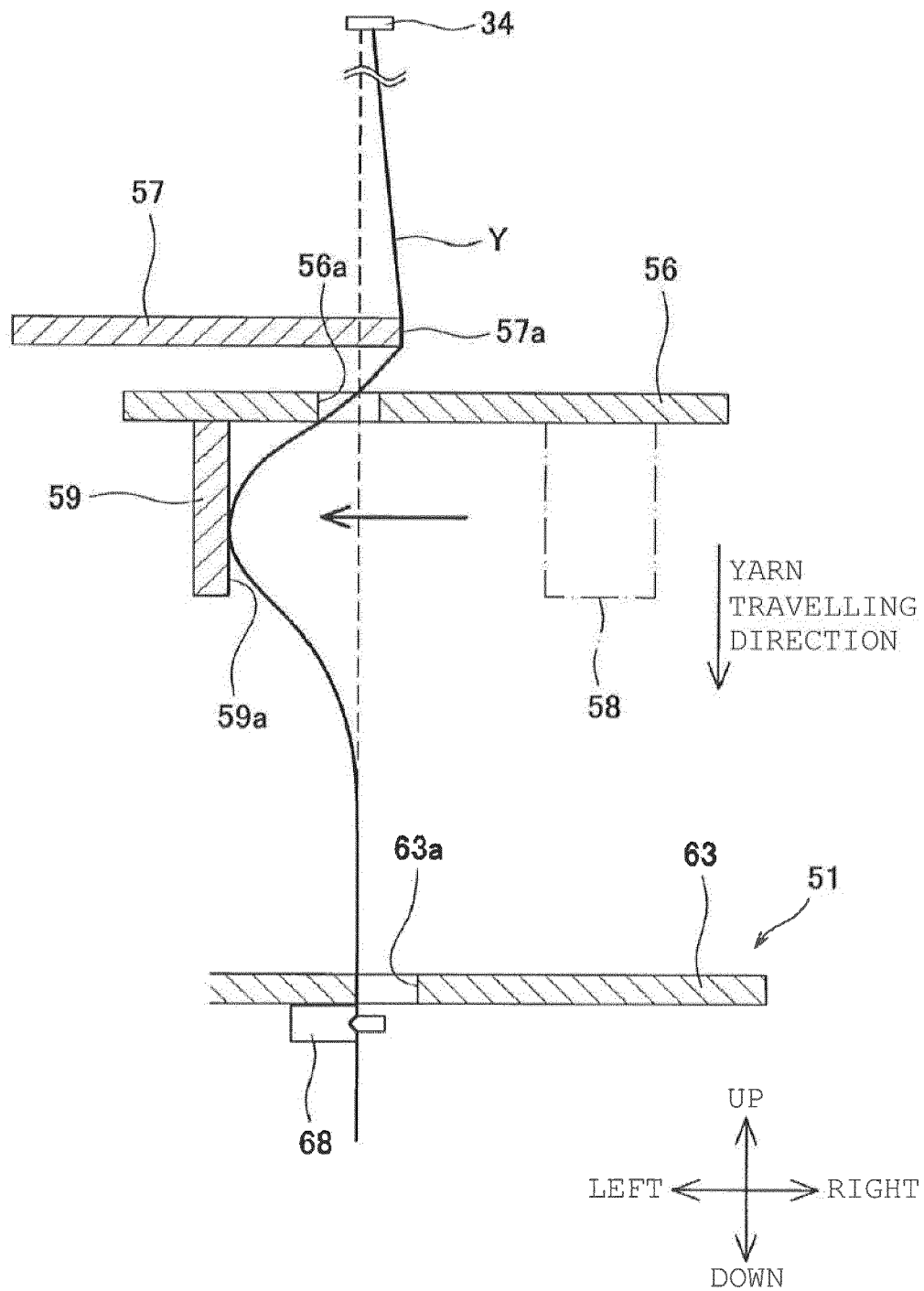


FIG. 13.

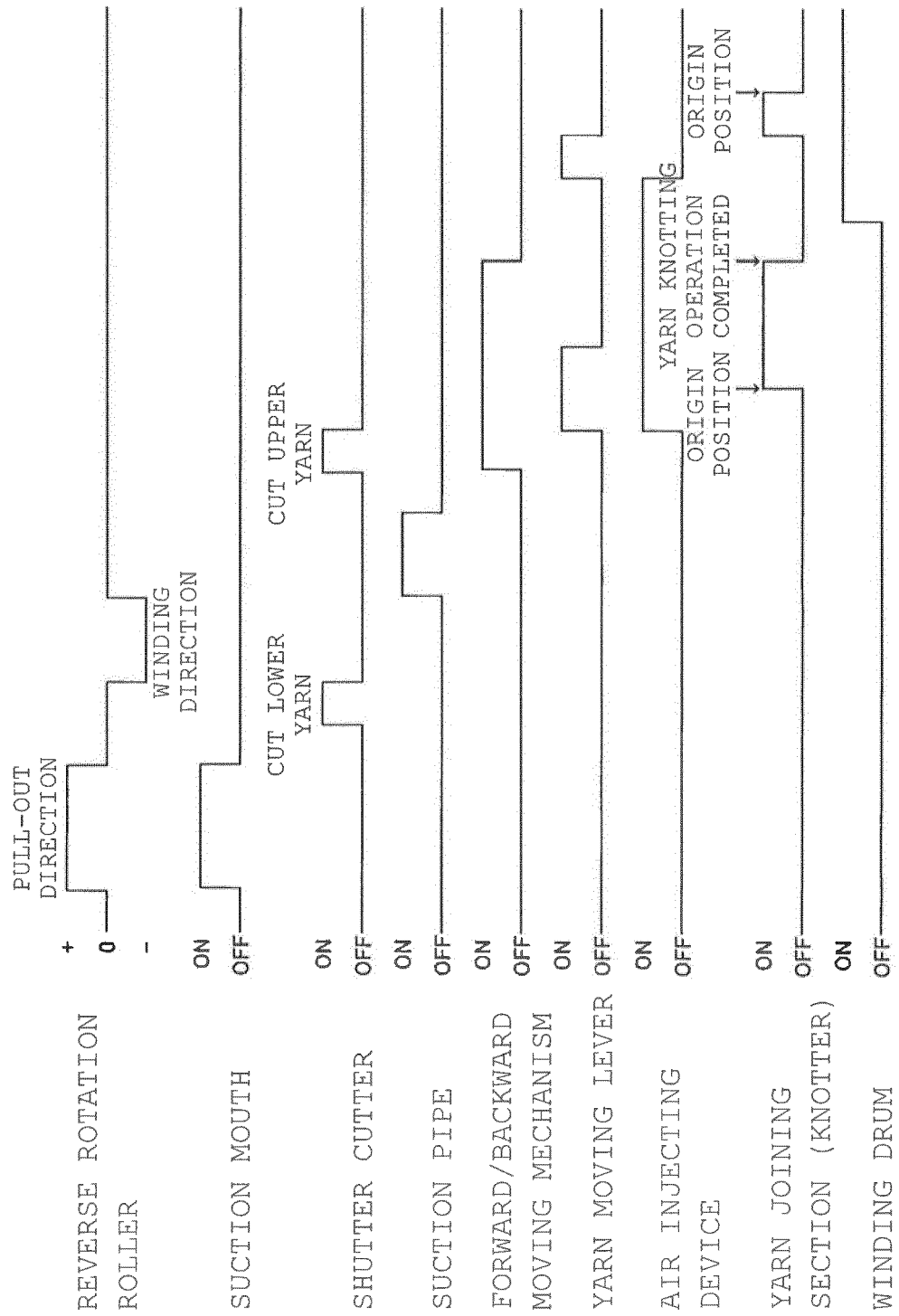


FIG. 14

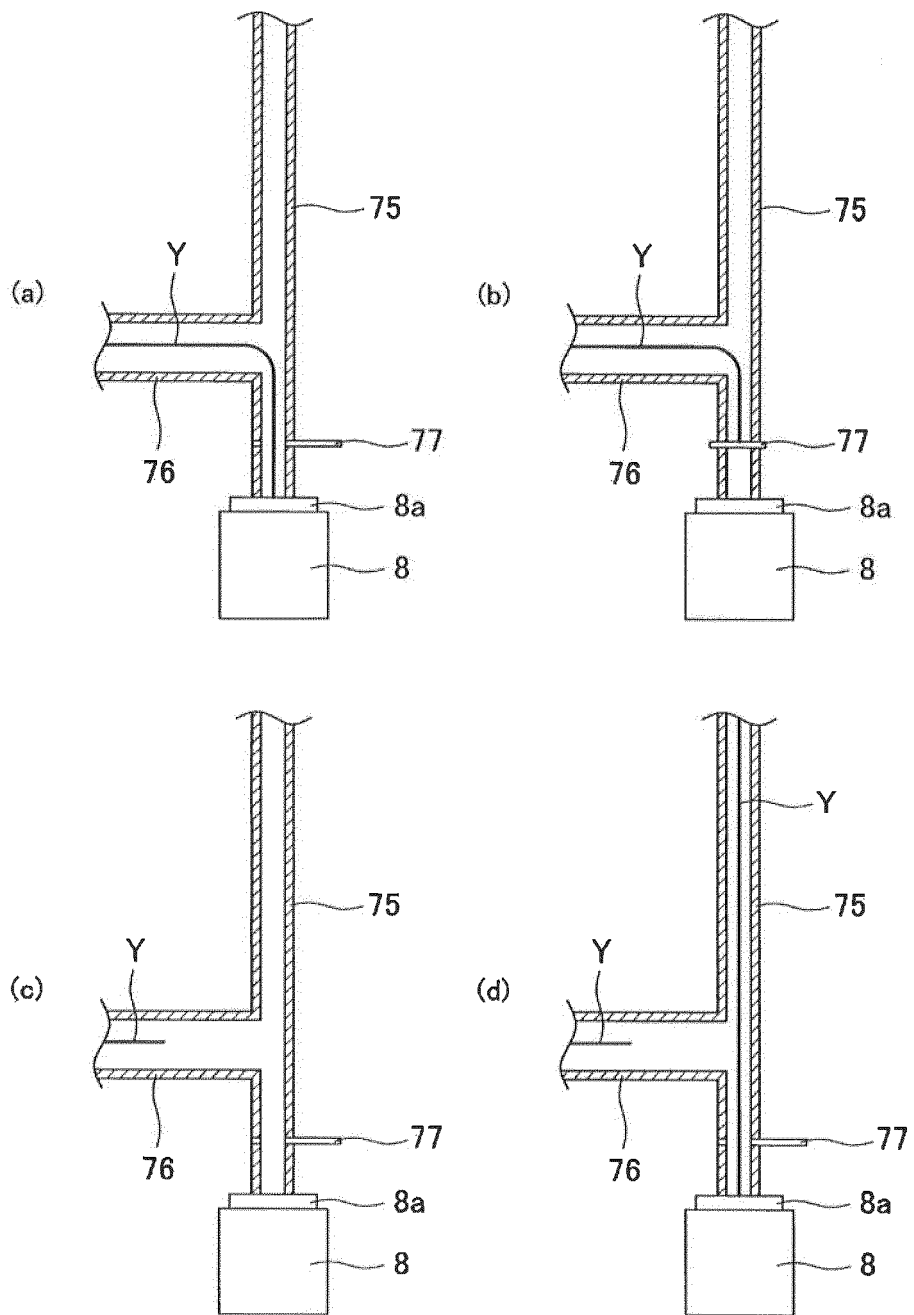
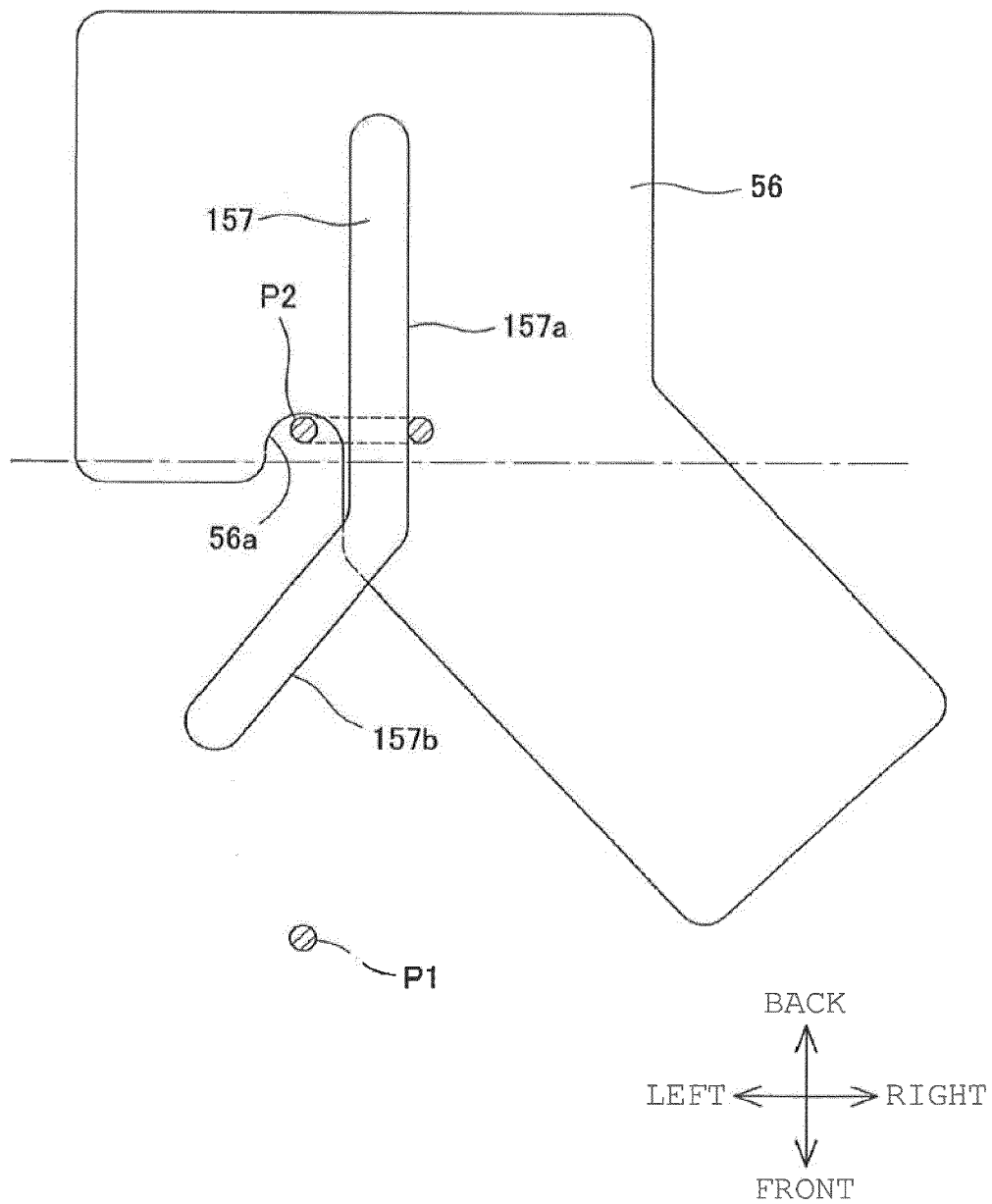


FIG. 15





EUROPEAN SEARCH REPORT

Application Number
EP 18 15 6671

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	EP 2 573 232 A2 (MURATA MACHINERY LTD [JP]) 27 March 2013 (2013-03-27) * paragraph [0044] - paragraph [0048] * * figures 1-14 *	1	INV. D01H4/48 D01H15/00
Y,D	JP 2002 249935 A (MURATA MACHINERY LTD) 6 September 2002 (2002-09-06) * abstract; figures 1,2 *	1	
A	JP H05 64172 U (UNKNOWN) 24 August 1993 (1993-08-24) * claims 1,2 * * figures 1,3 *	3	
			TECHNICAL FIELDS SEARCHED (IPC)
			D01H B65H
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 14 August 2018	Examiner Humbert, Thomas
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EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 18 15 6671

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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14-08-2018

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JP H0564172 U	24-08-1993	NONE	

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- JP 2002249935 A [0002] [0003] [0004]