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(72) Inventors:
• **Hirao, Osamu**
Uji-shi Kyoto (JP)
• **Baba, Kenji**
Minami-ku Kyoto (JP)

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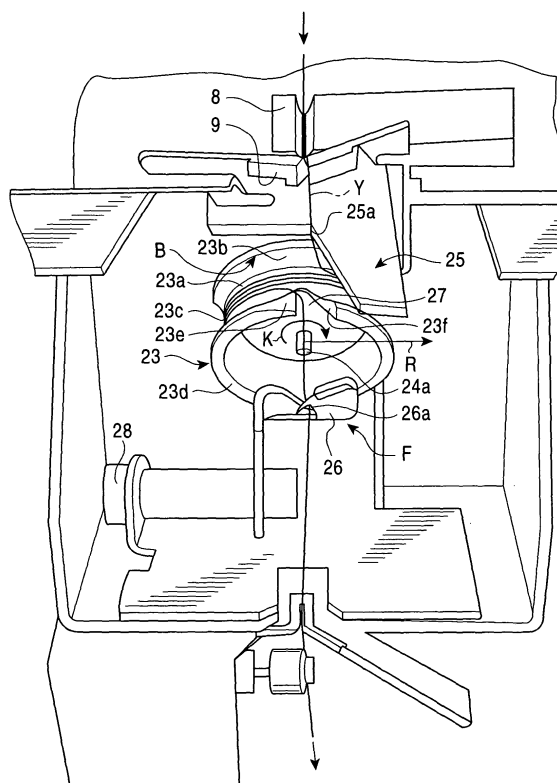
(74) Representative: **Liedl, Christine et al**
c/o Hansmann & Vogeser,
Albert-Rosshaupter-Strasse 65
81369 München (DE)

(71) Applicant: **Murata Kikai Kabushiki Kaisha**
Minami-ku, Kyoto-shi, Kyoto 601 (JP)

(54) **Yarn slack eliminating device for spinning machine**

(57) It is an object of the present invention to provide a spinning machine that enables the elimination of slack that may occur between a spinning device that spins a yarn and a winding device that winds a yarn. A yarn slack eliminating device for a spinning machine comprises a slack eliminating roller 23 arranged so as to engage with a yarn spun by a spinning device of the spinning machine and winding a yarn Y around its outer peripheral surface 23a, driving means 24 for rotatively driving the slack eliminating roller 23, and a downstream guide 26 arranged downstream of the slack eliminating roller 23 to guide the yarn Y on a centerline of rotation A of the slack eliminating roller 23. The yarn slack eliminating device supplies the yarn to a proximal end B of the outer peripheral surface 23a of the slack eliminating roller 23 and then winds the yarn Y around the proximal end B, and unwinds the wound yarn Y from the slack eliminating roller so that the unwinding starts with a leading end D of the slack eliminating roller and moves toward the downstream guide 26. An upstream guide 25 is arranged upstream of the slack eliminating roller 23 and close to the proximal end B of the outer peripheral surface 23a of the slack eliminating roller 23 (Fig.4).

FIG. 4



Description

Field of the Invention

[0001] The present invention relates to a slack eliminating device for a spinning machine which eliminates the slack of a yarn that may occur between a spinning device that spins the yarn and a winding device that winds the yarn.

Background of the Invention

[0002] With a high-speed spinning machine such as a pneumatic spinning machine, when a defective part of a yarn is detected, the defective part is cut using a cutter and is then removed. Then, a leading end of a yarn sequentially delivered by the spinning device is pieced to a trailing end of a yarn wound into a package. This yarn piecing is carried out while both yarn ends are stopped. Accordingly, the yarn sequentially delivered by the spinning device is sucked using a sucking tube called a "slack tube" to eliminate slack. However, a recent increase in spinning speed increases the amount of yarn slack. Thus, a longer sucking tube has been required, so that the sucking tube method has reached the limits of its capabilities. Accordingly, a yarn slack eliminating device has been proposed which eliminates the slack of a yarn by temporarily winding a delivered yarn around a slack eliminating roller (for example, refer to the Examined Japanese Patent Publication (Tokko-Hei) No. 4-13272).

[0003] However, the yarn slack eliminating device has a complicated structure because the slack eliminating roller contains a clutch mechanism or a mechanism that moves a return pin forward and backward. Further, the yarn may not be smoothly wound around the slack eliminating roller or unwound from it. Thus, the present invention improves this slack eliminating device in order to solve these problems.

Summary of the Invention

[0004] As means for regularly winding a yarn around a slack eliminating roller, the aspect of the present invention set forth in Claim 1 provides a yarn slack eliminating device for a spinning machine, the device comprising a slack eliminating roller arranged so as to engage with a yarn spun by a spinning device of the spinning machine and winding a yarn around its outer peripheral surface, driving means for rotatively driving the slack eliminating roller, and a downstream guide arranged downstream of the slack eliminating roller to guide the yarn on a centerline of rotation of the slack eliminating roller, the device supplying the yarn to a proximal end of the outer peripheral surface of the slack eliminating roller and then winding the yarn around the proximal end, and unwinding the wound yarn from the slack eliminating roller so that the unwinding starts with

a leading end of the slack eliminating roller and moves toward the downstream guide, the device being characterized in that an upstream guide is arranged upstream of the slack eliminating roller and close to the proximal end of the outer peripheral surface of the slack eliminating roller. According to this aspect, the position on the slack eliminating roller to which the yarn is supplied is stabilized, thus enabling the yarn to be regularly wound around the slack eliminating roller.

[0005] Means employed by the aspect of the present invention set forth in Claim 2 is a yarn slack eliminating device for a spinning machine according to Claim 1, wherein a yarn guide point of the upstream guide is arranged at a position corresponding to a right half of the slack eliminating roller if the slack eliminating roller is rotated rightward, and is arranged at a position corresponding to a left half of the slack eliminating roller if the slack eliminating roller is rotated leftward. According to this aspect, the direction in which the yarn approaches the slack eliminating roller is the same as the direction in which the slack eliminating roller is rotated. Consequently, the position on the slack eliminating roller to which the yarn is supplied is stabilized, thus enabling the yarn to be regularly wound around the slack eliminating roller.

[0006] Means employed by the aspect of the present invention set forth in Claim 3 is a yarn slack eliminating device for a spinning machine according to Claim 1 or Claim 2, wherein the yarn guide point of the upstream guide is positioned so that the yarn is introduced into a larger-diameter side of a tapered portion formed at the proximal end of the slack eliminating roller and having a diameter decreasing gradually toward the leading end of the slack eliminating roller. According to this aspect of the present invention, the yarn is supplied to and wound around the larger-diameter side of the tapered portion of the slack eliminating roller. Consequently, the wound yarn moves toward the smaller-diameter side of the tapered portion, thus enabling the yarn to be regularly wound around the slack eliminating roller.

[0007] As means for regularly winding a yarn around a slack eliminating roller and unwinding the wound yarn, the aspect of the present invention set forth in Claim 4 provides a yarn slack eliminating device for a spinning machine, the device comprising a slack eliminating roller arranged so as to engage with a yarn spun by a spinning device of the spinning machine and catching and winding a yarn around its outer peripheral surface, driving means for rotatively driving the slack eliminating roller, and a downstream guide arranged downstream of the slack eliminating roller to guide the yarn on a centerline of rotation of the slack eliminating roller, the device supplying the yarn to a proximal end of the outer peripheral surface of the slack eliminating roller and then winding the yarn around the proximal end, and unwinding the wound yarn from the slack eliminating roller so that the unwinding starts with a leading end of the slack eliminating roller and moves toward the down-

stream guide, the device being characterized in that the outer peripheral surface of the slack eliminating roller is shaped to have a tapered portion at the proximal end of the slack eliminating roller which portion has a diameter decreasing gradually toward the leading end of the slack eliminating roller, a flange portion at the leading end of the slack eliminating roller, and a cylindrical portion arranged between the tapered portion and the flange portion and having a uniform diameter. According to this aspect of the present invention, the yarn supplied to and wound around the tapered portion of the slack eliminating roller moves to the smaller-diameter part of the tapered portion and then reaches the cylindrical portion of the uniform diameter. Accordingly, the yarn can be regularly wound around the cylindrical portion of the slack eliminating roller. Further, during unwinding, the flange portion at the leading end of the slack eliminating roller hinders the whole yarn wound around the cylindrical portion from slipping off the cylindrical portion at a time. Consequently, the yarn can be sequentially drawn out starting with its part wound first.

[0008] As means for simplifying the structure of catching means, the aspect of the present invention set forth in Claim 5 provides a yarn slack eliminating device for a spinning machine according to Claim 4, wherein as the means for catching the yarn, a notch portion is formed in a part of a circumference of the flange portion at the leading end of the slack eliminating roller, and the yarn moved to the notch portion is caught in the notch portion to allow the start of supply of the yarn to the proximal end of the slack eliminating roller. According to this aspect, the traveling yarn is moved to the notch portion, which then catches the yarn. Then, it is possible to start supplying the yarn to the proximal end of the slack eliminating roller.

[0009] As means for preventing the catching means from obstructing the unwinding, the aspect of the present invention set forth in Claim 6 provides a yarn slack eliminating device for a spinning machine according to Claim 5, wherein a chamfered portion is formed in an outer periphery of the flange portion and adjacent to the notch portion, and when the yarn is subjected to the unwinding while being moved in a direction opposite to a winding direction, the chamfered portion is used to guide the yarn so that the yarn will not be caught in the notch portion. According to this aspect, the chamfered portion can be used to guide the yarn unwound while moving in the direction opposite to the winding direction so that the yarn will not be caught in the notch portion.

[0010] As means for ensuring successful yarn piecing, the aspect of the present invention set forth in Claim 7 provides a yarn slack eliminating device for a spinning machine comprising a yarn piecing device, the slack eliminating device comprising a slack eliminating roller arranged so as to engage with a yarn spun by a spinning device of the spinning machine and catching and winding a yarn around its outer peripheral surface, driving means for rotatively driving the slack eliminating roller,

and a downstream guide arranged downstream of the slack eliminating roller to guide the yarn on a centerline of rotation of the slack eliminating roller, the slack eliminating device supplying the yarn to a proximal end of the outer peripheral surface of the slack eliminating roller and then winding the yarn around the proximal end, and unwinding the wound yarn from the slack eliminating roller so that the unwinding starts with a leading end of the slack eliminating roller and moves toward the downstream guide, the slack eliminating device being characterized in that the yarn is caught and then starts to be supplied to the slack eliminating roller at the same time when or immediately after the yarn piecing device starts to stop the yarn for piecing. According to this aspect, the yarn starts to be supplied to and wound around the slack eliminating roller at the same time when or immediately after the yarn piecing device starts to stop the yarn for piecing. Accordingly, the yarn guided to the yarn piecing device can be pieced without being moved even if it is pulled to the slack eliminating roller. Further, the yarn delivered by the spinning device during yarn piecing is wound around the slack eliminating roller to prevent slack.

[0011] As means for smoothly moving a yarn so as to catch and unwind it properly, the aspect of the present invention set forth in Claim 8 provides a yarn slack eliminating device for a spinning machine, the device comprising a slack eliminating roller arranged so as to engage with a yarn spun by a spinning device of the spinning machine and catching and winding a yarn around its outer peripheral surface, driving means for rotatively driving the slack eliminating roller, and a downstream guide arranged downstream of the slack eliminating roller to guide the yarn on a centerline of rotation of the slack eliminating roller, the device supplying the yarn to a proximal end of the outer peripheral surface of the slack eliminating roller and then winding the yarn around the proximal end, and unwinding the wound yarn from the slack eliminating roller so that the unwinding starts with a leading end of the slack eliminating roller and moves toward the downstream guide, the device being characterized in that the downstream guide moves forward and backward between a forward position at which the yarn being guided is caught on the slack eliminating roller and a backward position at which a yarn guide point is positioned on the centerline of rotation in front of the leading end of the slack eliminating roller. According to this aspect, the downstream guide is moved forward and backward between the forward position and the backward position. This enables the yarn to be moved between the position at which it is caught and the position at which it is unwound without being caught, while being guided by the downstream guide.

[0012] As means for simplifying the whole structure, the aspect of the present invention set forth in Claim 9 provides a yarn slack eliminating device for a spinning machine, the device comprising a slack eliminating roller arranged so as to engage with a yarn spun by a spin-

ning device of the spinning machine and catching and winding a yarn around its outer peripheral surface, driving means for rotatively driving the slack eliminating roller, and a downstream guide arranged downstream of the slack eliminating roller to guide the yarn on a centerline of rotation of the slack eliminating roller, the device supplying the yarn to a proximal end of the outer peripheral surface of the slack eliminating roller and then winding the yarn around the proximal end, and unwinding the wound yarn from the slack eliminating roller when the yarn is not caught, so that the unwinding starts with a leading end of the slack eliminating roller and moves toward the downstream guide, the device being characterized in that the slack eliminating roller is provided with a catching member for catching the yarn so that the catching member can be freely moved forward and backward, and while the slack eliminating roller is stopped or is rotating at a fixed speed, urging means pulls the catching member into the slack eliminating roller so that the catching member cannot catch the yarn, and while the slack eliminating roller is being rotated and accelerated, the catching member projects from the slack eliminating roller to its catching position against the urging means. According to this aspect, when the slack eliminating roller is activated, the catching member projects to its catching position during accelerating rotation. Accordingly, the yarn delivered by the spinning device can be wound around the slack eliminating roller to eliminate slack. Therefore, a yarn piecing operation can be completed before the slack eliminating roller reaches rotating at a fixed speed and the catching member goes into the position at which the catching member cannot catch the yarn. Further, by rotating the slack eliminating roller to push out and pull back the catching member, the yarn can be caught on and unwound from the slack eliminating roller with the downstream guide stopped at a predetermined position.

[0013] As means for ensuring that the yarn travels smoothly during and after unwinding, the aspect of the present invention set forth in Claim 10 provides a yarn slack eliminating device for a spinning machine according to any one of Claims 1 to 9, wherein a yarn tension adjusting device is provided between the downstream guide and the winding device to tense the yarn. According to this aspect, the yarn unwound from the slack eliminating roller and traveling to the winding device can be subjected to a moderate tension.

[0014] As means for preventing the cut yarn from remaining on the slack eliminating roller, the aspect of the present invention set forth in Claim 11 provides a yarn slack eliminating device for a spinning machine according to any one of Claims 1 to 10, characterized in that the slack eliminating roller is provided between the winding device and a cutting device that cuts the yarn when a yarn defect is detected. According to this aspect, when the yarn cutting device cuts the yarn after a yarn defect has been detected, the winding device winds that part of the yarn which is wound around the slack winding roll-

er. This prevents the yarn from remaining on the slack eliminating roller.

Brief Description of the Drawings

[0015]

Figure 1 is a side view showing essential parts of a first embodiment of a spinning machine comprising a yarn slack eliminating device according to the present invention.

Figure 2 is an enlarged side view showing the vicinity of the yarn slack eliminating device and showing that a slack eliminating roller is not eliminating slack.

Figure 3 is an enlarged side view showing the vicinity of the yarn slack eliminating device and showing a state observed immediately before the slack eliminating roller catches a yarn.

Figure 4 is an enlarged perspective view of the vicinity of the yarn slack eliminating device, showing that the slack eliminating roller is eliminating slack.

Figure 5 is an enlarged side view showing the vicinity of the yarn slack eliminating device and showing that the yarn is being unwound from the slack eliminating roller.

Figure 6 is an enlarged perspective view showing the vicinity of the yarn slack eliminating device and showing that the yarn is being unwound from the slack eliminating roller.

Figure 7 shows the vicinity of the unitary slack eliminating roller, wherein Figure 7A is a front view, Figure 7B is a right side view, and Figure 7C is a sectional view taken along line VIIC-VIIC.

Figure 8 is a side view showing essential parts of a second embodiment of a spinning machine comprising a yarn slack eliminating device according to the present invention.

Figure 9 is an enlarged side view showing the vicinity of a yarn slack eliminating device according to a third embodiment of a spinning machine comprising the yarn slack eliminating device according to the present invention.

Figure 10 is a plan view showing a slack eliminating roller with an electric motor and showing that a catching member has been moved backward.

Figure 11 is a front sectional view taken along line XI-XI in Figure 10.

Figure 12 shows the slack eliminating roller with the electric motor according to the third embodiment and shows that the catching member has been projected, wherein Figure 12A is a plan view and Figure 12B is a front view.

Detailed Description of the Preferred Embodiments

[0016] With reference to the drawings, showing embodiments of the present invention, a description will be

given of a slack eliminating device for a spinning machine according to the present invention. In the specification, the term "upstream" refers to an upstream side with respect to the direction in which the yarn travels.

(First Embodiment)

[0017] Figures 1 to 7 show a first embodiment of a slack eliminating device according to the present invention.

[0018] As shown in Figure 1, a spinning machine 1 according to the present embodiment comprises a spinning machine main body 2 having a plurality of spinning units U juxtaposed in a direction orthogonal to the sheet of the drawing and a working carriage 3 for yarn splicing which carriage runs along the spinning machine main body 2 with the juxtaposed spinning units U. Each spinning unit U is composed of a draft section 4, a spinning device 5, a yarn feeding section 6, a yarn sucking device 7, a cutter 8, a yarn defect detector 9, a yarn tension adjusting device 11, and a winding device 12 arranged in this order along a yarn path E from its upstream side to downstream side. The working carriage 3 is adapted to move to and stop at a predetermined position on the spinning unit U to undergo yarn splicing. The working carriage 3 comprises a yarn piecing device 17 such as a knotter or a splicer, a suction pipe 18 that can be rotatively moved to suck an end of the yarn formed by the spinning device 5 and guide the yarn end to the yarn piecing device 17, and a suction mouth 19 used to suck a yarn end wound to a package 16 supported by the winding device 12 and guide this yarn end to the yarn piecing device 17. Each spinning unit U is provided with a yarn slack eliminating device 10. The yarn slack eliminating device 10 is provided away from the normal yarn path E and can engage with the yarn between the yarn defect detector 9 and the yarn tension adjusting device 11.

[0019] As shown in Figure 1, the draft section 4 of each spinning unit U is selected, by way of example, to be of a four line type composed of a back roller 4a, a third roller 4b, a second roller 4d formed by extending an apron 4c, and a front roller 4e. The spinning device 5 is selected, by way of example, to generate a spun yarn (hereinafter simply referred to as a "yarn") utilizing a whirling air current. The yarn feeding section 6 comprises a nip roller 6a and a delivery roller 6b that feed the yarn Y downstream while sandwiching it between them. The yarn sucking device 7 is adapted to suck a yarn at all times. When the yarn defect detector 9 detects a defect in slab or the like, the cutter 8 cuts the yarn Y, and a suction opening 7a of the yarn sucking device 7 sucks and removes that part of the yarn Y which is engaged with the spinning device 5.

[0020] The yarn slack eliminating device 10 of each spinning unit U is arranged in the middle of a yarn path for yarn piecing which extends from the spinning device 5 of the spinning machine main body 2 to the yarn piec-

ing device 17 of the working carriage 3. As shown in Figure 2, the yarn slack eliminating device 10 comprises the slack eliminating roller 23, which winds the yarn Y around its outer peripheral surface, driving means 24 that rotatively drives the slack eliminating roller 23, an upstream guide 25 arranged upstream of the slack eliminating roller 23 and close to a proximal end B of an outer peripheral surface 23a of the slack eliminating roller 23, and a downstream guide 26 arranged downstream of the slack eliminating roller 23 to guide the yarn Y on a centerline of rotation A of the slack eliminating roller 23. During yarn piecing, the yarn slack eliminating device 10 uses the upstream guide 25 to guide the yarn Y spun by the spinning device 5 of the spinning unit U to the proximal end B of the outer peripheral surface 23a of the slack eliminating roller 23 and then wind the yarn Y around the proximal end B as shown in Figure 4. Further, the yarn slack eliminating device 10 unwinds the yarn from a leading end D of the slack eliminating roller 23 toward the downstream guide 26 as shown in Figures 5 and 6. The driving means 24 is composed of an electric motor and has an output shaft 24a to which the slack eliminating roller 23 is attached. Although not shown, the driving means 24 may be formed to transmit the rotative power of a line shaft driving the yarn feeding section 6, to the slack eliminating roller 23 via a transmission belt or the like to rotate the slack eliminating roller 23 at all times.

[0021] As shown in Figure 4, the upstream guide 25 is used to guide the yarn Y to the proximal end B of the outer peripheral surface 23a of the slack eliminating roller 23. The upstream guide 25 stabilizes that position on the slack eliminating roller 23 to which the yarn Y is supplied. Accordingly, the yarn Y can be regularly wound around the slack eliminating roller 23. A yarn guide point 25a of the upstream guide 25 with which the yarn is contacted and guided is located above the slack eliminating roller 23. The yarn guide point 25a is arranged at a position corresponding to a right half R of the slack eliminating roller 23 if a rotating direction K of the slack eliminating roller 23 is rightward with respect to the front surface of the slack eliminating roller 23 as shown in Figure 4. Although not shown, the yarn guide point 25a is arranged at a position corresponding to a left half of the roller if the rotating direction K is leftward. With the yarn slack eliminating device 10, the thus positioned yarn guide point 25a enables the yarn Y to approach the slack eliminating roller 23 smoothly. Accordingly, that position on the slack eliminating roller 23 to which the yarn Y is supplied is stabilized. This allows the yarn to be regularly wound around the slack eliminating roller 23. The slack eliminating roller 23 may be arranged so that the centerline of rotation A is inclined with the leading end D of the slack eliminating roller 23 facing downward as shown in Figure 2 or extends in a horizontal direction as shown in Figure 8.

[0022] Furthermore, as shown in Figures 5 and 6, the yarn guide 25a of the upstream guide 25 is positioned

so that the yarn Y is introduced into a larger-diameter side of a tapered portion 23b (see Figure 7B) formed at the proximal end B of the slack eliminating roller 23 and having a diameter decreasing gradually toward the leading end D of the slack eliminating roller 23. With the yarn slack eliminating device 10, the thus positioned yarn guide point 25a allows the yarn to be supplied to and wound around the larger-diameter side of the tapered portion 23b. Accordingly, the wound yarn moves toward a smaller-diameter side of the tapered portion 23b. This enables the yarn Y to be regularly wound around the slack eliminating roller 23.

[0023] The downstream guide 26 is moved forward and backward between its forward position F at which the yarn Y being guided through the yarn guide point 26a is caught on the slack eliminating roller 23 as shown in Figures 3 and 4, and its backward position G at which the yarn guide point 26a is located on the centerline of rotation A in front of the leading end D of the slack eliminating roller 23 as shown in Figures 5 and 6. The downstream guide 26 is moved forward and backward by being pivotally supported around a pivoting portion 28 so as to be rotatively movable or being slidably guided along the centerline of rotation A using a slider or the like (not shown in the drawings). By moving the downstream guide 26 forward and backward between its forward position F and backward position G, the yarn slack eliminating device 10 can stably move the yarn Y traveling through the yarn guide point 26a of the downstream guide 26, between a position at which the yarn Y is caught and a position at which the yarn Y is unwound while guiding the yarn Y by the downstream guide 26.

[0024] As shown in Figure 7, the outer peripheral surface 23a of the slack eliminating roller 23 is shaped to have the tapered portion 23b at the proximal end B, which has the diameter decreasing gradually toward the leading end D of the slack eliminating roller 23, a flange portion 23d at the leading end D of the slack eliminating roller 23, and a cylindrical portion 23c of a uniform diameter between the tapered portion 23b and the flange portion 23d. With the slack eliminating roller 23, the yarn Y can be regularly wound around the cylindrical portion 23c because the yarn Y supplied to and wound around the larger-diameter part 23b-2 of the tapered portion 23b moves to the smaller-diameter part 23b-1 of the tapered portion 23b and then reaches the cylindrical portion 23c of the uniform diameter (see Figure 4). Further, the yarn Y can be drawn out sequentially starting with its part wound first because during unwinding, the flange portion 23d at the leading end D of the slack eliminating roller 23 hinders the whole yarn Y wound around the cylindrical portion 23c from slipping off the cylindrical portion 23c at a time (see Figures 5 and 6).

[0025] Furthermore, as shown in Figure 7, the slack eliminating roller 23 is provided with a notch portion 27 in a part of circumference of the flange portion 23d at its leading end D. Thus, the yarn moved to the flange por-

tion 23d is caught in the notch portion 27 (see Figure 3) to allow the start of supply of the yarn Y to the proximal end B of the slack eliminating roller 23. The notch portion 27 is a substantially V shaped recess tapered from the leading end D to proximal end B of the slack eliminating roller 23. The notch portion 27 is formed of a catching portion 27a parallel with the centerline of rotation A and an escape portion 27b inclined in the rotating direction K so as to allow the yarn Y to be easily introduced into the notch portion 27. The slack eliminating roller 23 can start supplying the yarn to the proximal end B of the slack eliminating roller 23 by moving the downstream guide 26 from its backward position G to forward position F to move the traveling yarn Y into the notch portion 27 so that the yarn Y can be caught in the catching portion 27a of the notch portion 27.

[0026] Further, to prevent the notch portion 27 as catching means from obstructing an unwinding operation, the slack eliminating roller 23 is provided with chamfered portions 23e, 23f in an outer periphery of the flange portion 23d and adjacent to the notch portion 27. Accordingly, when the yarn Y is unwound while being moved in a direction opposite to the winding direction, the chamfered portions 23e, 23f guide the yarn Y to prevent it from being caught in the notch portion 27 (see Figure 7). The slack eliminating roller 23 can smoothly unwind the yarn Y by causing the chamfered portions 23e, 23f to guide the yarn Y to prevent it from being caught in the notch portion 27.

[0027] With the yarn slack eliminating device 10, the downstream guide 26 is moved from its backward position G (see Figure 5) to forward position F (see Figure 3) to catch the traveling yarn Y on the slack eliminating roller 23 at the same time when or immediately after a spinning-side yarn Y1 is stopped (clamped) at the yarn piecing device 17 (see Figure 1) for yarn piecing. If the yarn Y is caught too early, due to the movement of the downstream guide 26 and the winding of the yarn around the slack eliminating roller 23, the yarn being guided to the yarn piecing device 17 is pulled. This may result in a yarn piecing error. On the other hand, if the yarn Y is caught too late, the yarn is excessively slacked and the downstream guide 26 or the slack eliminating roller 23 fails to be caught the yarn. Accordingly, the use of the above timing enables the yarn Y1 located downstream of the slack eliminating roller 23 and guided to the yarn piecing device 17 to be pieced without being moved even if it is pulled to the slack eliminating roller 23, around which it is being wound (see Figure 4). Further, during yarn piecing, the yarn Y1 delivered by the spinning device 5 is wound around the slack eliminating roller 23 and thus prevented from being slacked.

[0028] As shown in Figure 1, the yarn tension adjusting device 11, provided downstream of the yarn slack eliminating device 10, is selected to be of a well-known type in which, for example, the yarn is tensed by a movable guide roller urged away from a fixed guide roller, though not shown in detail. The winding device 12 com-

prises a friction roller 13 and a cradle arm 14. The winding device 12 is configured to form the package 16 by contacting a bobbin 15 rotatably gripped by the cradle arm 14 with the friction roller 11, while winding the yarn around the bobbin 15.

[0029] As shown in Figure 1, the suction pipe 18, provided on the working carriage 3 for yarn piecing, is arranged so as to be rotatively movable around a pivoting portion 20. The suction pipe 18 functions as a spinning-side sucking member as described below. At a time of a yarn piecing operation, a suction opening 18a located at the leading end of the suction pipe 18 is rotatively moved upward as shown by an alternate long and two short dashes line in the figure and thus moved to the vicinity of a yarn discharge port of the spinning device 5, to suck the spun yarn Y. Then, while the yarn Y is being sucked, the suction opening 18a is rotatively moved downward as shown by a solid line in the figure to guide the yarn Y to the yarn piecing device 17. The suction mouth 19 is provided so as to be rotatively movable around a pivoting portion 21. The suction mouth 19 functions as a winding-side suction member as described below.

[0030] At a time of a yarn piecing operation, the suction opening 19a located at the leading end of the suction mouth 19 is rotatively moved downward as shown by an alternate long and two short dashes line in the figure and suck a yarn end of the package 16 separated from the friction roller 13 and stopped rotating, to withdraw the yarn. Then, while the yarn is being sucked, the suction opening 19a is rotatively moved upward as shown by a solid line in the figure to guide a package-side yarn Y2 to the yarn piecing device 17. Thus, the yarn piecing device 17, the suction pipe 18 and the suction mouth 19 are provided on the working carriage 3, which runs along the direction in which the spinning units U are juxtaposed. This eliminates the need to provide these components in each spinning unit U. As a result, the structure is simplified.

[0031] With the spinning machine 1 configured as described previously, during spinning, a bundle of fibers S, shown in Figure 1, is drafted by the draft section 4 and then placed in the spinning device 5. Then, the bundle of fibers S is twisted by a whirling air current occurring in the spinning device 5, to generate a yarn Y. Subsequently, the yarn Y is fed downstream while being sandwiched between the nip roller 6a and the delivery roller 6b, which constitute the yarn feeding section 6. Then, as shown in Figure 2, the yarn Y is passed by the suction opening 7a of the yarn sucking device 7 and then the yarn defect detector 9. The yarn Y is then fed to the winding device 12 without contacting with the slack eliminating roller 23 of the yarn slack eliminating device 10. The yarn Y is then wound into the package 16 rotating in contact with the friction roller 13.

[0032] If the yarn defect detector 9 detects a defect in the yarn Y such as slab, the cutter 8 is activated to cut the yarn Y. The package-side cut yarn Y which is en-

gaged with the package 16 is wound around the package 16. Further, the draft section 4 stops rotating the back roller 4a and the third roller 4b to cut the bundle of fibers S between the third roller 4b and the second roller 4d, which is still rotating. The spinning device-side yarn Y engaged with the spinning device 5 and the bundle of fibers S which are separated by this cutting and the cutting with the cutter 8 are sucked and removed by the yarn sucking device 7, while being fed by the second roller 4d and the front roller 4e which are still rotating.

[0033] Subsequently, the back roller 4a and third roller 4b of the draft section 4, which have been stopped, are activated to cause the second roller 4d and the front roller 4e which are still rotating to draft the bundle of fibers S. Further, the bundle of fibers S is fed into the spinning device 5. A spinning operation is then resumed to generate the yarn Y. As shown by an alternate long and two short dashes line in the figure, a yarn end of the yarn Y1 generated and continuously spun out is sucked and caught in the suction pipe 18, which has moved its suction opening 18a to the vicinity of a yarn discharge opening in the spinning device 5. Subsequently, as shown by a solid line in the figure, the suction pipe 18 is rotatively moved downward to introduce the yarn Y1 into the yarn feeding section 6 from a side of the nip roller 6a. The yarn Y1 is then guided to the yarn piecing device 17. At this time, the suction opening 7a in the yarn sucking device 7 is closed. Concurrently with the rotative movement of the suction pipe 18, the suction mouth 19 rotatively moves the suction opening 19a, located at its leading end, downward as shown by an alternate long and two short dashes line in the figure. Thus, the yarn end of the package 16 separated from the friction roller 13 and stopped rotating is sucked to withdraw the yarn. Further, while the yarn is being sucked, the suction opening 19a is rotatively moved upward as shown by a solid line in the figure. Thus, a package-side yarn Y2 engaged with the package 16 is positioned close to the yarn piecing device 17.

[0034] A yarn handling lever of a yarn handling member (not shown in the drawings) is rotatively moved to introduce the spinning device-side yarn end Y1 engaged with the spinning device 5 and the package-side yarn end Y2 engaged with the package 16, into a yarn piecing section of the yarn piecing device 17 for yarn piecing, the yarn ends Y1, Y2 being positioned close to the yarn piecing device 17. The yarn slack eliminating device 10 moves the downstream guide 26 from its backward position G to forward position F simultaneously with or a very short time (for example, 5 msec.) after an operation of stopping the yarn after the yarn handling (yarn clamping operation). Thus, the traveling yarn Y1 is caught on and wound around the slack eliminating roller 23 to store, on the slack eliminating roller 23, a slack in the yarn Y1 that may occur between the spinning device 5 and the yarn piecing device 17 during a yarn piecing operation (rotation of a knotter head or the like). If this movement of the downstream guide 26 oc-

curs before the yarn stopping operation is started, during a yarn piecing operation, due to the movement of the downstream guide 26 and the winding of the yarn around the slack eliminating roller 23, the yarn Y is pulled toward the slack eliminating roller 23. This may result in a yarn piecing error. On the other hand, if this movement occurs a long time after the yarn stopping operation is started, the yarn Y sequentially spun out by the spinning device 5 is slacked and fails to be caught in the slack eliminating roller 23.

[0035] Immediately after the yarn piecing operation, the spinning machine 1 moves the downstream guide 26 of the yarn slack eliminating device 10 from its forward position F (see Figure 4) to backward position G (see Figure 6). Further, the package 16 is contacted with the friction roller 13 to resume winding. The pieced yarn Y is wound around the package 16, which has restarted to be rotated, as well as the yarn Y unwound from the slack eliminating roller 23 (see Figure 6). The yarn Y1 unwound from the slack eliminating roller 23 is subjected to a moderate tension by the yarn tension adjusting device 11 and is then smoothly wound around the package 16. As shown in Figure 2, the yarn Y can be naturally separated from the slack eliminating roller 23 by setting the speed at which the yarn is unwound from the slack eliminating roller 23 (i.e. the speed at which the yarn is wound around the package 16) to be higher than the speed at which the yarn Y spun out by the spinning device 5 is wound around the slack eliminating roller 23, to unwind the whole yarn stored on the slack eliminating roller 23.

(Second Embodiment)

[0036] Figure 8 is a side view showing essential parts of a second embodiment of a spinning machine comprising a yarn slack eliminating device according to the present invention. An alternate long and short dash line L1 shows that the slack eliminating roller 23 is eliminating slack from the yarn. A solid line L2 shows that the yarn is being unwound from the slack eliminating roller 23. An alternate long and two short dashes line L3 shows that the yarn is traveling without having its slack eliminated by the slack eliminating roller 23.

[0037] The present embodiment is markedly different from the first embodiment in that the slack eliminating roller 23 is arranged so that its centerline of rotation A extends in a horizontal direction and that the yarn sucking device 7, the cutter 8 and the yarn defect detector 9 are arranged downstream of the slack eliminating roller 23. Except for these points, the configuration of the present embodiment is substantially the same as that of the first embodiment.

(Third Embodiment)

[0038] Figures 9 and 12 show a third embodiment of a yarn slack eliminating device according to the present

invention. Figure 9 is an enlarged side view showing the vicinity of a yarn slack eliminating device of a spinning machine. This figure shows a state observed immediately before the yarn is caught on a roller main body 51 of a slack eliminating roller 43. Figure 10 is a plan view showing the slack eliminating roller 43 with an electric motor. This figure shows that a catching member 52 has been moved backward. Figure 11 is a front sectional view taken along line XI-XI in Figure 10. Figure 12 shows the slack eliminating roller 43 with the electric motor. This figure shows that the catching member 52 has been projected. Figure 12A is a plan view, and Figure 12B is a front view.

[0039] A spinning machine 31 according to the present embodiment differs from the spinning machine 1 according to the first embodiment (see Figures 1 to 7) in the slack eliminating roller 43 and a downstream guide 46 of a yarn slack eliminating device 40 provided in each spinning unit U. Except for these points, the configuration of the present embodiment is substantially the same as that of the first embodiment. The same reference numerals as those shown in Figures 1 to 7 denote the same components and the like.

[0040] In the slack eliminating roller 43, the roller main body 51 rotatively driven by the driving means 24, is provided with the catching member 52 so that the catching member 52 can be freely moved forward and backward. While the roller main body 51 of the slack eliminating roller 43 is stopped or is rotating at a fixed speed, the catching member 52 has its leading end 52a pulled into the roller main body 51 owing to the resilience of urging means such as a spring and cannot catch the yarn (see Figure 10). While the slack eliminating roller 43 is being rotated and accelerated, the leading end 52a projects from the roller main body 51 to its catching position M against the resilience of the urging means 53 (see Figure 12).

[0041] As shown in Figures 11 and 10, the slack eliminating roller 43 comprises the roller main body 51 rotatably supported, via a bearing member 55 such as a ball bearing, on a fixing portion 54 such as a bracket on which the driving means 24 is mounted, the bar-like catching member 52 slidably inserted through an insertion hole 51a in the roller main body 51, a boss portion 56 secured to the output shaft 24a of the driving means 24, a pivoting member 58 which pivotally supports the boss portion 56 around a pivoting portion 57 and on which a bent rear end 52b of the catching member 52 is locked, a regulating member 59 attached to the roller main body 51 using screws or the like, in order to regulate the pivoting of the pivoting member 58, and the urging means 53 arranged between the regulating member 59 and the pivoting member 58 and composed of a helical spring or the like. The urging means 53 always acts in a direction in which the catching member 52 is moved back into the roller main body 51. The catching member 52 is adapted to slide along a tangential direction of rotation of the roller main body 51.

[0042] With the slack eliminating roller 43, at a point in time during acceleration, the catching member 52 projects from the roller main body 51 to its catching position M (see Figure 12) on the basis of the relationship between centrifugal force generated in the catching member 52 (the force acting in the direction in which the catching member 52 is projected) and inertia force generated in the roller main body 51 (the force acting in the direction in which the catching member 52 is projected), and the elastic force of the urging means 53 (the force acting in the direction in which the catching member 52 is moved back). When the rotation of the roller main body 51 approaches a fixed speed, the catching member 52 starts moving backward to its backward position N (see Figure 10) in the roller main body 51.

[0043] As shown in Figure 9, a yarn guide point 46a of the downstream guide 46 which guides the yarn Y is located at a predetermined position on the centerline of rotation of the slack eliminating roller 43. The yarn Y extended between the yarn guide point 46a and the yarn guide point 25a of the upstream guide 25 is fed downstream without contacting with the slack eliminating roller 43 when the catching member 52 of the slack eliminating roller 43 has moved backward to the backward position N (see Figure 10) and pulled into the roller main body 51. On the other hand, when the catching member 52 of the slack eliminating roller 43 projects to its catching position M (see Figure 12), the yarn is caught on the leading end 52a of the catching member 52 and wound around the outer peripheral surface 51a of the roller main body 51 for storage.

[0044] With the yarn slack eliminating device 40, when the slack eliminating roller 43 is activated at the same time when or immediately after the yarn Y directed to the yarn piecing device 17 (see Figure 1) is stopped (clamped) for yarn piecing, the catching member 52 projects to its catching position M. Accordingly, the yarn Y delivered by the spinning device 5 can be wound around the roller main body 51 of the slack eliminating roller 43 to eliminate slack. Further, by rotating the slack eliminating roller 43 to push the leading end 52a of the catching member 52 out of the roller main body 51 and pull the former back into the latter, the yarn Y can be caught on and unwound from the slack eliminating roller 43 with the yarn guide point 46a of the downstream guide 46 stopped at a predetermined position.

[0045] Once the yarn piecing is completed, the winding device 12 (see Figure 1) pulls the yarn wound around and stored on the outer peripheral surface of the roller main body 51 to unwind it from the leading end D of the slack eliminating roller 43 to the downstream guide 46.

[0046] As shown in Figure 12B, the outer peripheral surface 51a of the roller main body 51 of the slack eliminating roller 43 is shaped to have the tapered portion 51b at the proximal end B, which has the diameter decreasing gradually toward the leading end D of the slack eliminating roller 43, a flange portion 51d at the leading end D of the slack eliminating roller 43, and an interme-

mediate tapered portion 51c between the tapered portion 51b and the flange portion 51d. The intermediate tapered portion 51c has a diameter decreasing gradually toward the leading end D of the slack eliminating roller 43. The magnitude of a gradual decrease in the diameter of the intermediate portion 51c is smaller than that of a gradual decrease in the diameter of the tapered portion 51b at the proximal end B. With the roller main body 51 of the slack eliminating roller 43, the yarn Y supplied to the tapered portion 51b at the proximal end B by the upstream guide 25 is guided to the intermediate tapered portion 51c. Accordingly, the yarn Y can be regularly wound around the intermediate tapered portion 51c. Further, the wound yarn can be gradually moved toward the leading end D of the slack eliminating roller 43, i.e. in the direction in which the diameter of the slack eliminating roller 43 decreases gradually. Moreover, during unwinding, the flange portion 51d at the leading end D of the slack eliminating roller 43 hinders the whole yarn wound around the intermediate tapered portion 51c from slipping off this portion 51c at a time. Consequently, the yarn Y can be sequentially drawn out starting with its part wound first.

[0047] With the yarn slack eliminating device for the spinning machine according to the aspect of the present invention set forth in Claim 1, the position on the slack eliminating roller to which the yarn is supplied is stabilized. Accordingly, the yarn can be regularly wound around the slack eliminating roller, and the wound yarn can be regularly unwound. This avoids troubles such as yarn breakage.

[0048] With the yarn slack eliminating device for the spinning machine according to the aspect of the present invention set forth in Claim 2, the direction in which the yarn approaches the slack eliminating roller is the same as the direction in which the slack eliminating roller is rotated. Consequently, the position on the slack eliminating roller to which the yarn is supplied is stabilized, thus enabling the yarn to be regularly wound around the slack eliminating roller.

[0049] With the yarn slack eliminating device for the spinning machine according to the aspect of the present invention set forth in Claim 3, the yarn supplied to and wound around the larger-diameter side of the tapered portion of the slack eliminating roller moves toward the smaller-diameter side of the tapered portion. Therefore, the yarn can be regularly wound around the slack eliminating roller.

[0050] With the yarn slack eliminating device for the spinning machine according to the aspect of the present invention set forth in Claim 4, the yarn can be regularly wound around the slack eliminating roller. Further, the wound yarn can be regularly unwound from the slack eliminating roller.

[0051] With the yarn slack eliminating device for the spinning machine according to the aspect of the present invention set forth in Claim 5, the traveling yarn is moved to the notch portion, which then catches the yarn. Then,

it is possible to start supplying the yarn to the proximal end of the slack eliminating roller. This simplifies the structure of the catching means.

[0052] With the yarn slack eliminating device for the spinning machine according to the aspect of the present invention set forth in Claim 6, the catching means does not obstruct unwinding. Therefore, the yarn can be smoothly unwound from the slack eliminating roller.

[0053] With the yarn slack eliminating device for the spinning machine according to the aspect of the present invention set forth in Claim 7, the yarn delivered by the spinning device during yarn piecing is wound around the slack eliminating roller to prevent slack. Further, the yarn can be pieced while the yarn guided to the yarn piecing device is stopped. This ensures yarn piecing.

[0054] With the yarn slack eliminating device for the spinning machine according to the aspect of the present invention set forth in Claim 8, the yarn can be moved between the position at which it is caught and the position at which it is unwound without being caught, while being guided by the downstream guide. This enables the yarn to be reliably caught and unwound.

[0055] With the yarn slack eliminating device for the spinning machine according to the aspect of the present invention set forth in Claim 9, the yarn can be caught on and unwound from the slack eliminating roller by pushing out and pulling back the catching member. This simplifies the whole structure.

[0056] With the yarn slack eliminating device for the spinning machine according to the aspect of the present invention set forth in Claim 10, the yarn unwound from the slack eliminating roller and traveling to the winding section is subjected to a moderate tension. This ensures that the yarn travels smoothly both during and after unwinding.

[0057] With the yarn slack eliminating device for the spinning machine according to the aspect of the present invention set forth in Claim 11, the cut yarn does not remain on the slack eliminating roller.

Claims

1. A yarn slack eliminating device for a spinning machine, the device comprising a slack eliminating roller arranged so as to engage with a yarn spun by a spinning device of the spinning machine and winding a yarn around its outer peripheral surface, driving means for rotatively driving the slack eliminating roller, and a downstream guide arranged downstream of the slack eliminating roller to guide the yarn on a centerline of rotation of the slack eliminating roller, the device supplying the yarn to a proximal end of the outer peripheral surface of the slack eliminating roller and then winding the yarn around the proximal end, and unwinding the wound yarn from the slack eliminating roller so that the unwinding starts with a leading end of the slack eliminating

roller and moves toward the downstream guide, the device being **characterized in that** an upstream guide is arranged upstream of the slack eliminating roller and close to the proximal end of the outer peripheral surface of the slack eliminating roller.

2. A yarn slack eliminating device for a spinning machine according to Claim 1, **characterized in that** a yarn guide point of said upstream guide is arranged at a position corresponding to a right half of the slack eliminating roller if the slack eliminating roller is rotated rightward, and is arranged at a position corresponding to a left half of the slack eliminating roller if the slack eliminating roller is rotated leftward.
3. A yarn slack eliminating device for a spinning machine according to Claim 1 or Claim 2, **characterized in that** the yarn guide point of said upstream guide is positioned so that the yarn is introduced into a large-diameter side of a tapered portion formed at the proximal end of said slack eliminating roller and having a diameter decreasing gradually toward the leading end of the slack eliminating roller.
4. A yarn slack eliminating device for a spinning machine, the device comprising a slack eliminating roller arranged so as to engage with a yarn spun by a spinning device of the spinning machine and catching and winding a yarn around its outer peripheral surface, driving means for rotatively driving the slack eliminating roller, and a downstream guide arranged downstream of the slack eliminating roller to guide the yarn on a centerline of rotation of the slack eliminating roller, the device supplying the yarn to a proximal end of the outer peripheral surface of the slack eliminating roller and then winding the yarn around the proximal end, and unwinding the wound yarn from the slack eliminating roller so that the unwinding starts with a leading end of the slack eliminating roller and moves toward the downstream guide, the device being **characterized in that** the outer peripheral surface of the slack eliminating roller is shaped to have a tapered portion at the proximal end of the slack eliminating roller which portion has a diameter decreasing gradually toward the leading end of the slack eliminating roller, a flange portion at the leading end of the slack eliminating roller, and a cylindrical portion arranged between the tapered portion and the flange portion and having a uniform diameter.
5. A yarn slack eliminating device for a spinning machine according to Claim 4, **characterized in that** as said means for catching the yarn, a notch portion is formed in a part of a circumference of the flange portion at the leading end of said slack eliminating

roller, and the yarn moved to the notch portion is caught in the notch portion to allow the start of supply of the yarn to the proximal end of the slack eliminating roller.

6. A yarn slack eliminating device for a spinning machine according to Claim 5, **characterized in that** a chamfered portion is formed in an outer periphery of the flange portion and adjacent to the notch portion, and when said yarn is subjected to said unwinding while being moved in a direction opposite to a winding direction, the chamfered portion is used to guide the yarn so that the yarn will not be caught in said notch portion.

7. A yarn slack eliminating device for a spinning machine comprising a yarn piecing device, the slack eliminating device comprising a slack eliminating roller arranged so as to engage with a yarn spun by a spinning device of the spinning machine and catching and winding a yarn around its outer peripheral surface, driving means for rotatively driving the slack eliminating roller, and a downstream guide arranged downstream of the slack eliminating roller to guide the yarn on a centerline of rotation of the slack eliminating roller, the slack eliminating device supplying the yarn to a proximal end of the outer peripheral surface of the slack eliminating roller and then winding the yarn around the proximal end, and unwinding the wound yarn from the slack eliminating roller so that the unwinding starts with a leading end of the slack eliminating roller and moves toward the downstream guide, the slack eliminating device being **characterized in that** the yarn is caught and then starts to be supplied to said slack eliminating roller at the same time when or immediately after said yarn piecing device starts to stop the yarn for piecing.

8. A yarn slack eliminating device for a spinning machine, the device comprising a slack eliminating roller arranged so as to engage with a yarn spun by a spinning device of the spinning machine and catching and winding a yarn around its outer peripheral surface, driving means for rotatively driving the slack eliminating roller, and a downstream guide arranged downstream of the slack eliminating roller to guide the yarn on a centerline of rotation of the slack eliminating roller, the device supplying the yarn to a proximal end of the outer peripheral surface of the slack eliminating roller and then winding the yarn around the proximal end, and unwinding the wound yarn from the slack eliminating roller so that the unwinding starts with a leading end of the slack eliminating roller and moves toward the downstream guide, the device being **characterized in that** said downstream guide moves forward and backward between a forward position at which the

yarn being guided is caught on said slack eliminating roller and a backward position at which a yarn guide point is positioned on said centerline of rotation in front of the leading end of said slack eliminating roller.

9. A yarn slack eliminating device for a spinning machine, the device comprising a slack eliminating roller arranged so as to engage with a yarn spun by a spinning device of the spinning machine and catching and winding a yarn around its outer peripheral surface, driving means for rotatively driving the slack eliminating roller, and a downstream guide arranged downstream of the slack eliminating roller to guide the yarn on a centerline of rotation of the slack eliminating roller, the device supplying the yarn to a proximal end of the outer peripheral surface of the slack eliminating roller and then winding the yarn around the proximal end, and unwinding the wound yarn from the slack eliminating roller when the yarn is not caught, so that the unwinding starts with a leading end of the slack eliminating roller and moves toward the downstream guide, the device being **characterized in that** said slack eliminating roller is provided with a catching member for catching the yarn so that the catching member can be freely moved forward and backward, and while the slack eliminating roller is stopped or is rotating at a fixed speed, urging means pulls the catching member into the slack eliminating roller so that the catching member cannot catch the yarn, and while the slack eliminating roller is being rotated and accelerated, the catching member projects from the slack eliminating roller to its catching position against the urging means.

10. A yarn slack eliminating device for a spinning machine according to any one of Claims 1 to 9, **characterized in that** a yarn tension adjusting device is provided between said downstream guide and said winding device to tense the yarn.

11. A yarn slack eliminating device for a spinning machine according to any one of Claims 1 to 10, **characterized in that** said slack eliminating roller is provided between said winding device and a cutting device that cuts the yarn when a yarn defect is detected.

FIG. 1

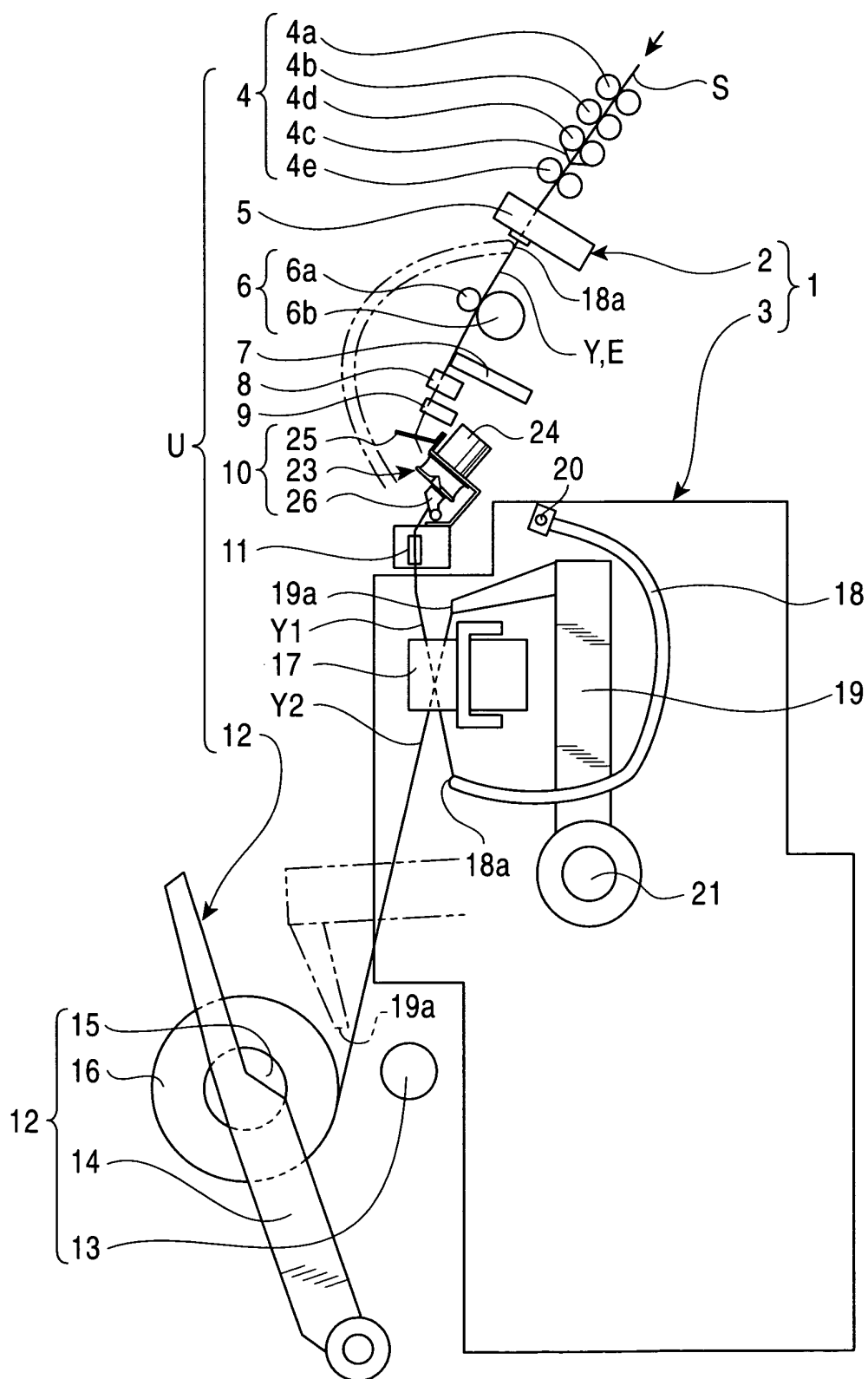


FIG. 2

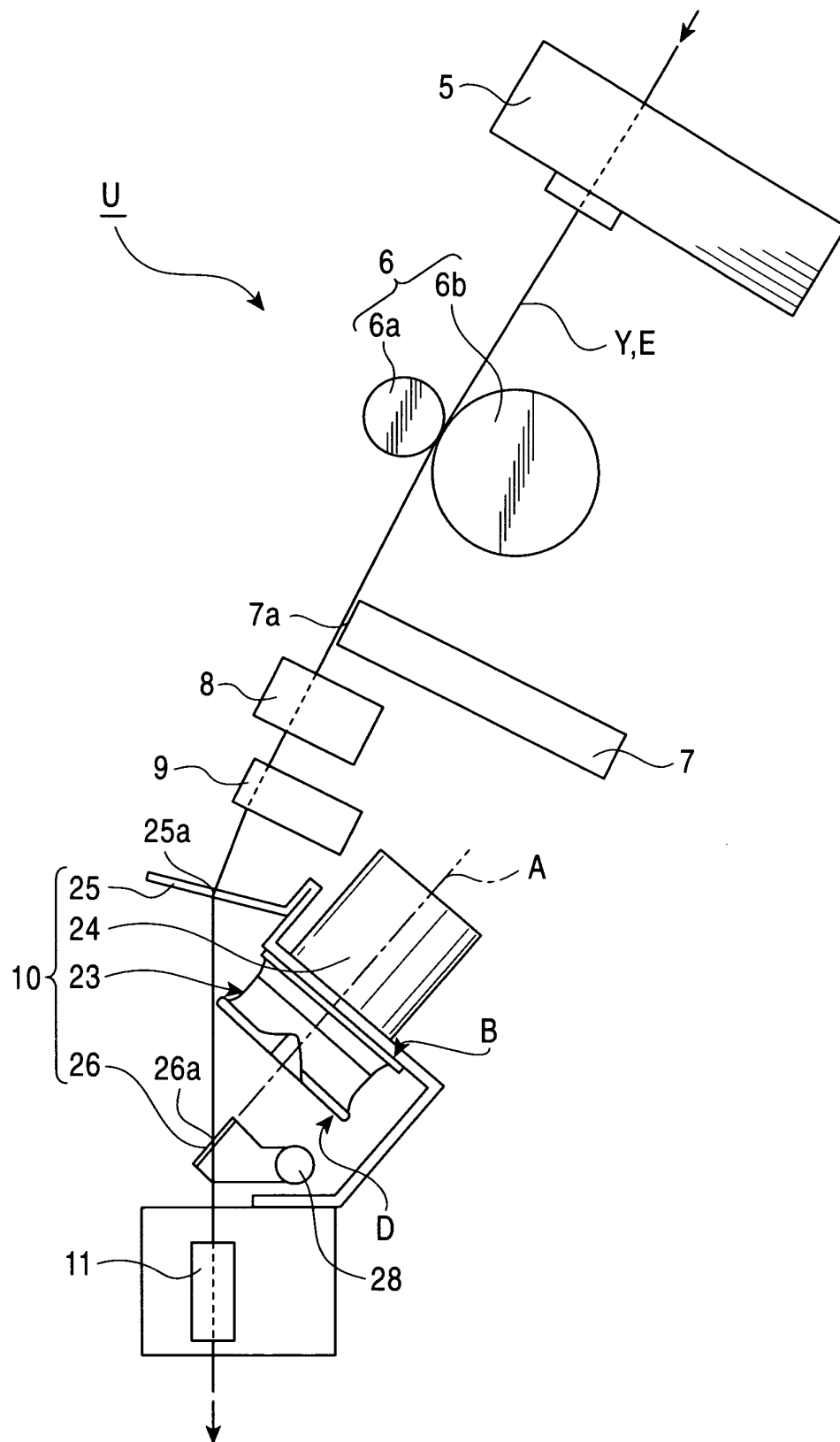


FIG. 3

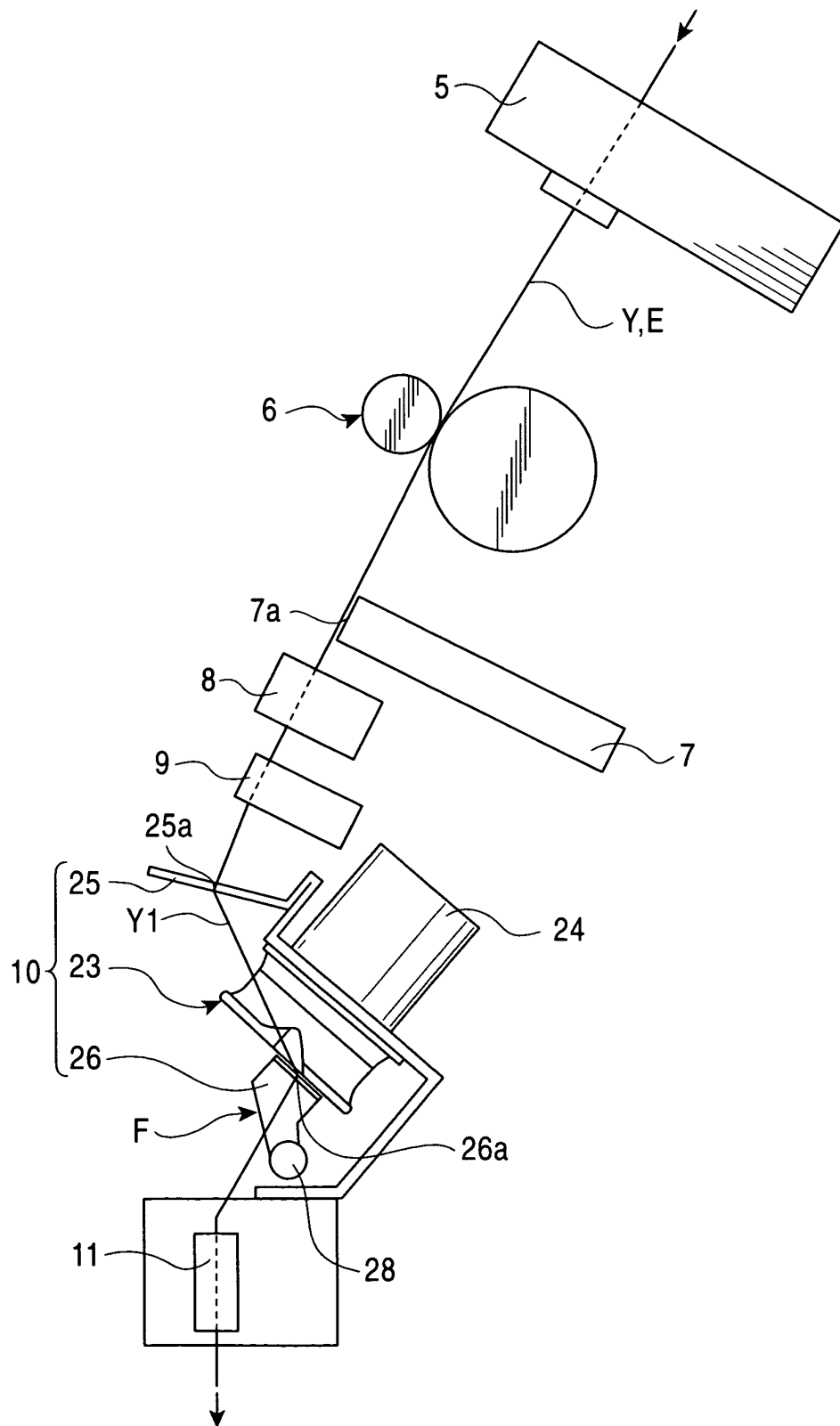


FIG. 4

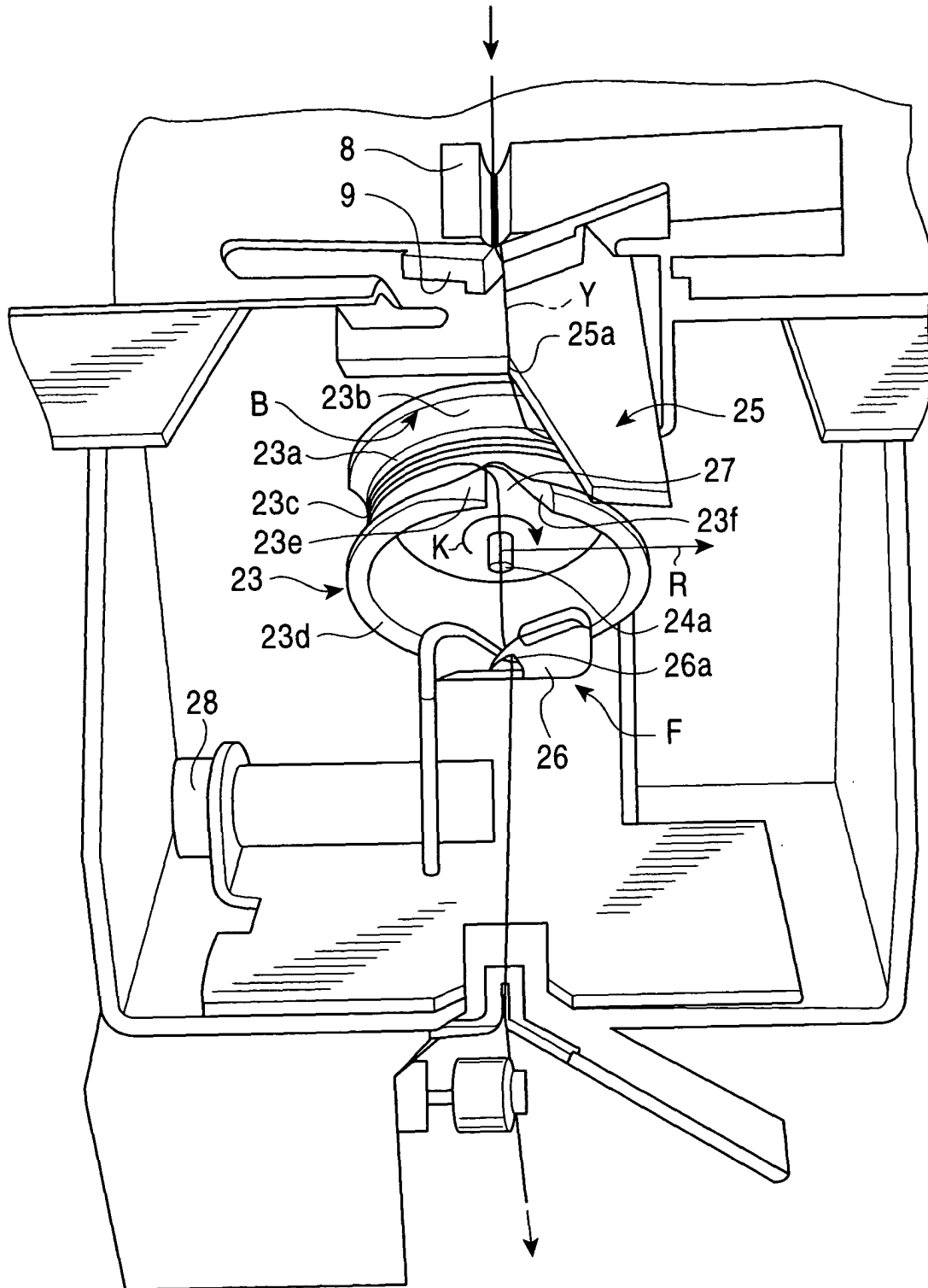


FIG. 5

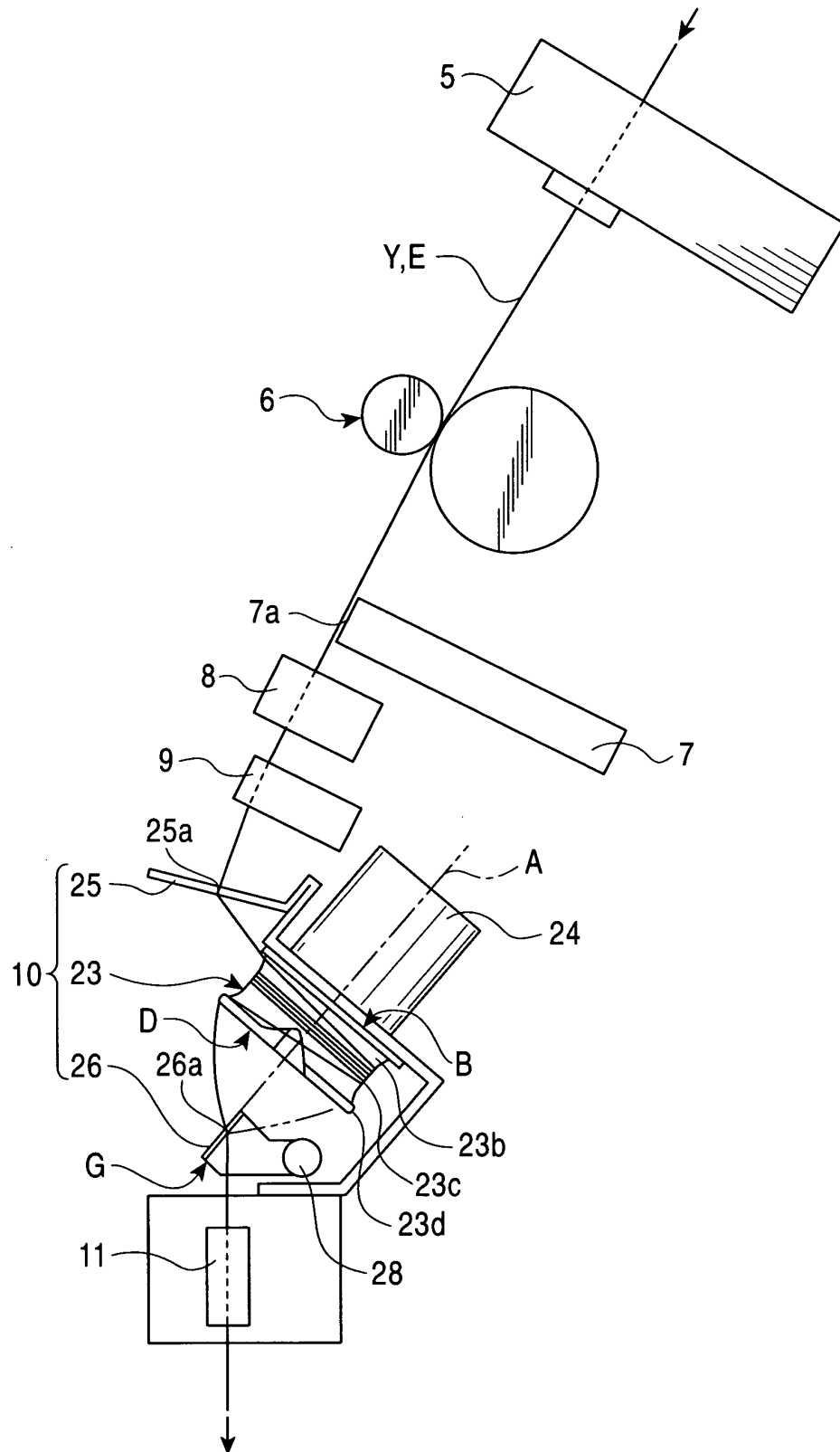


FIG. 6

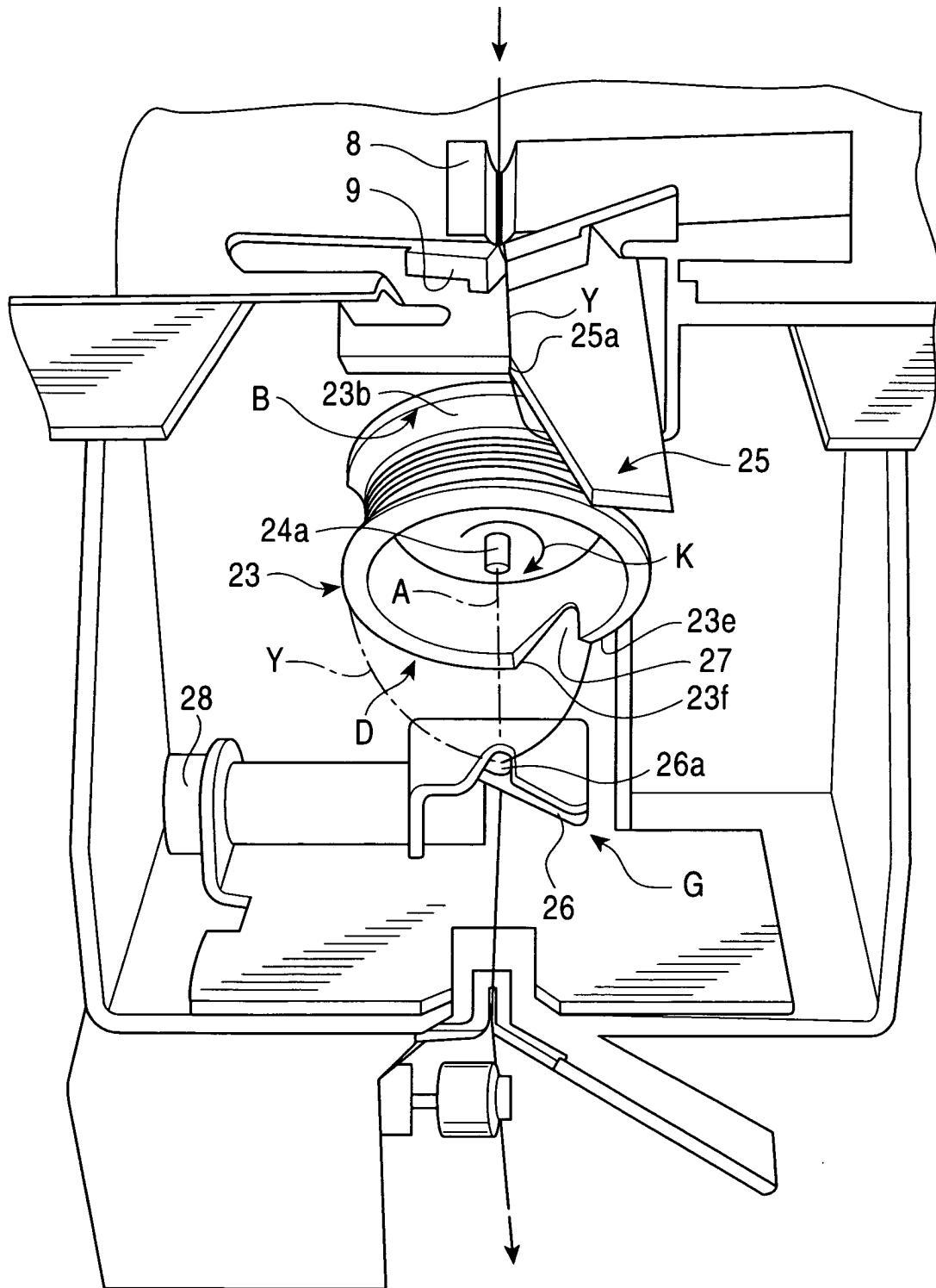


FIG. 7A

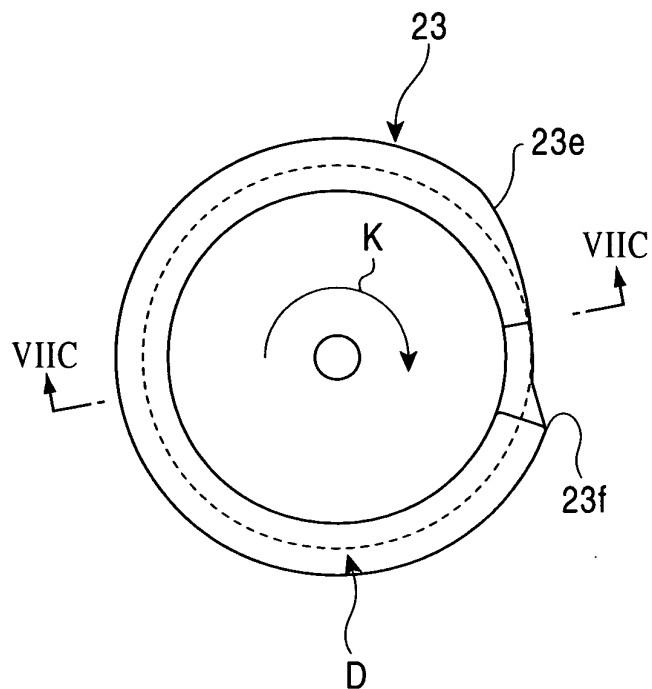


FIG. 7B

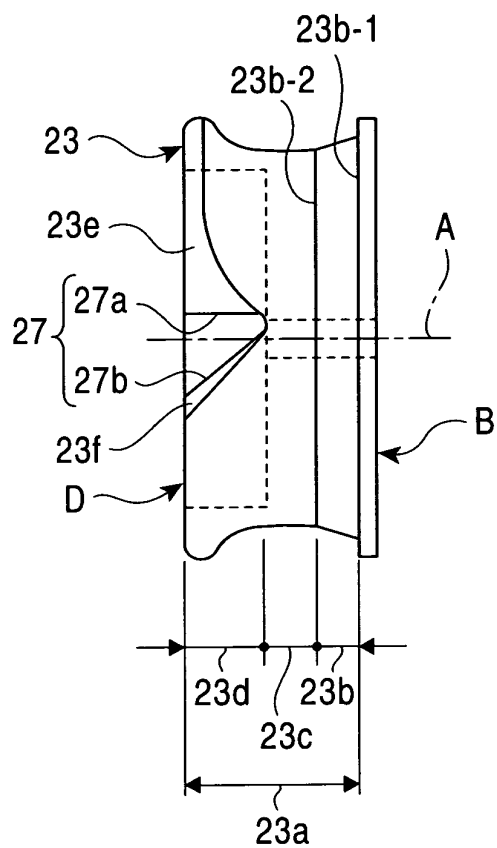


FIG. 7C

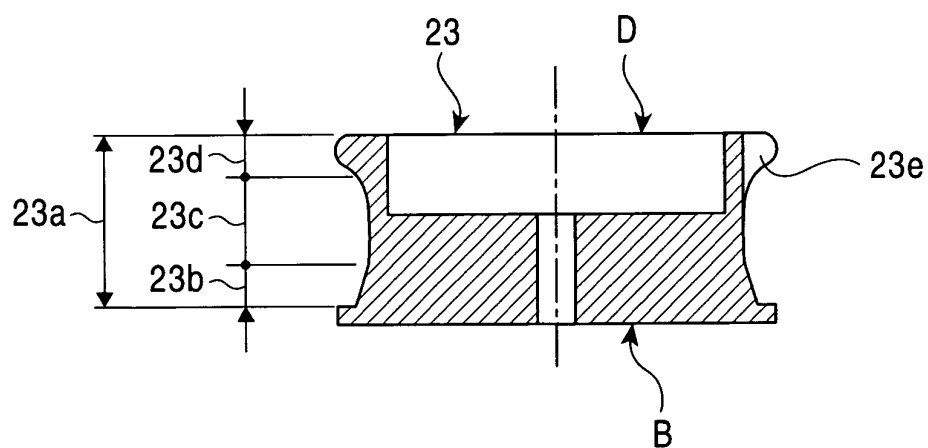


FIG. 8

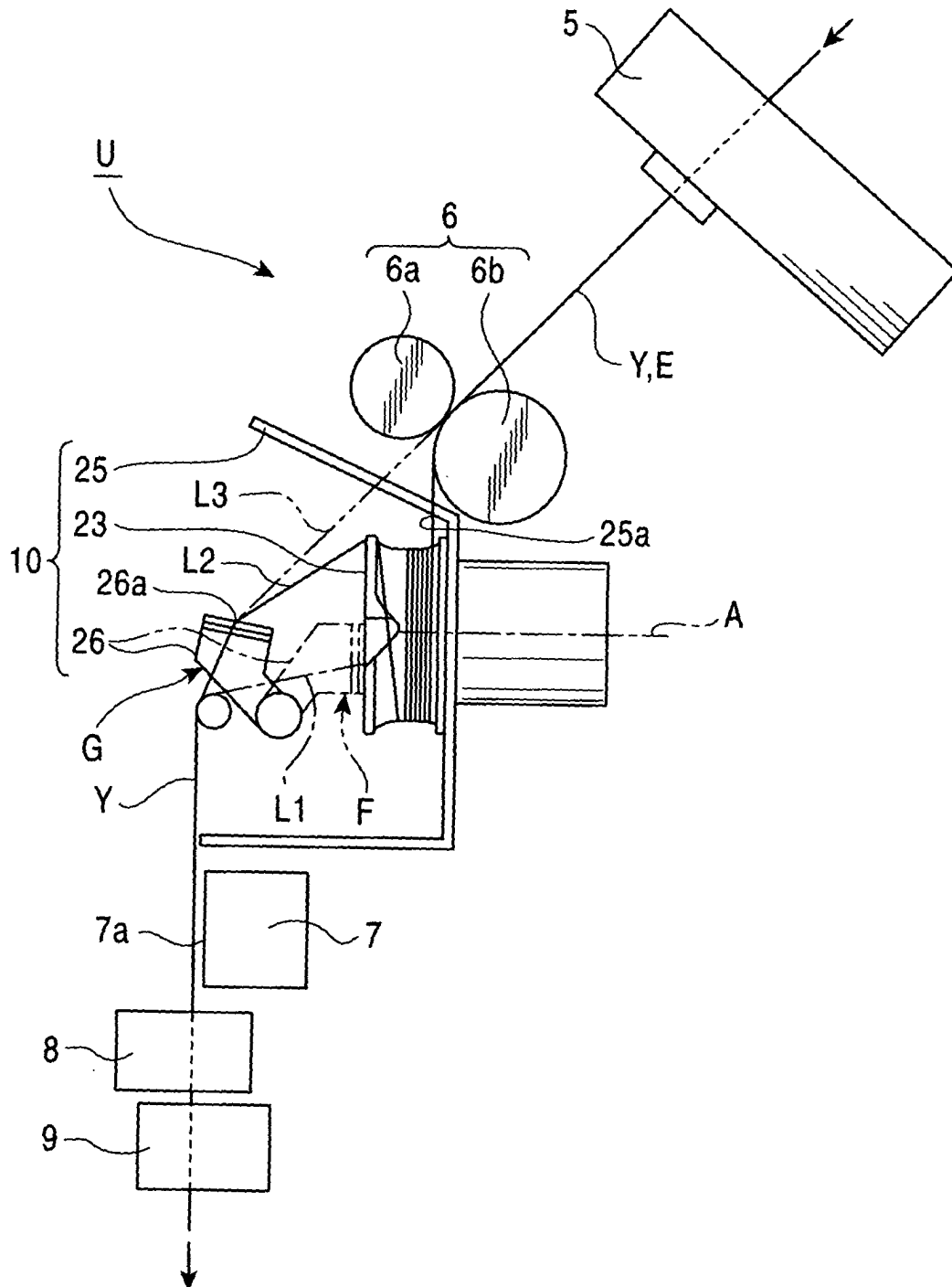


FIG. 9

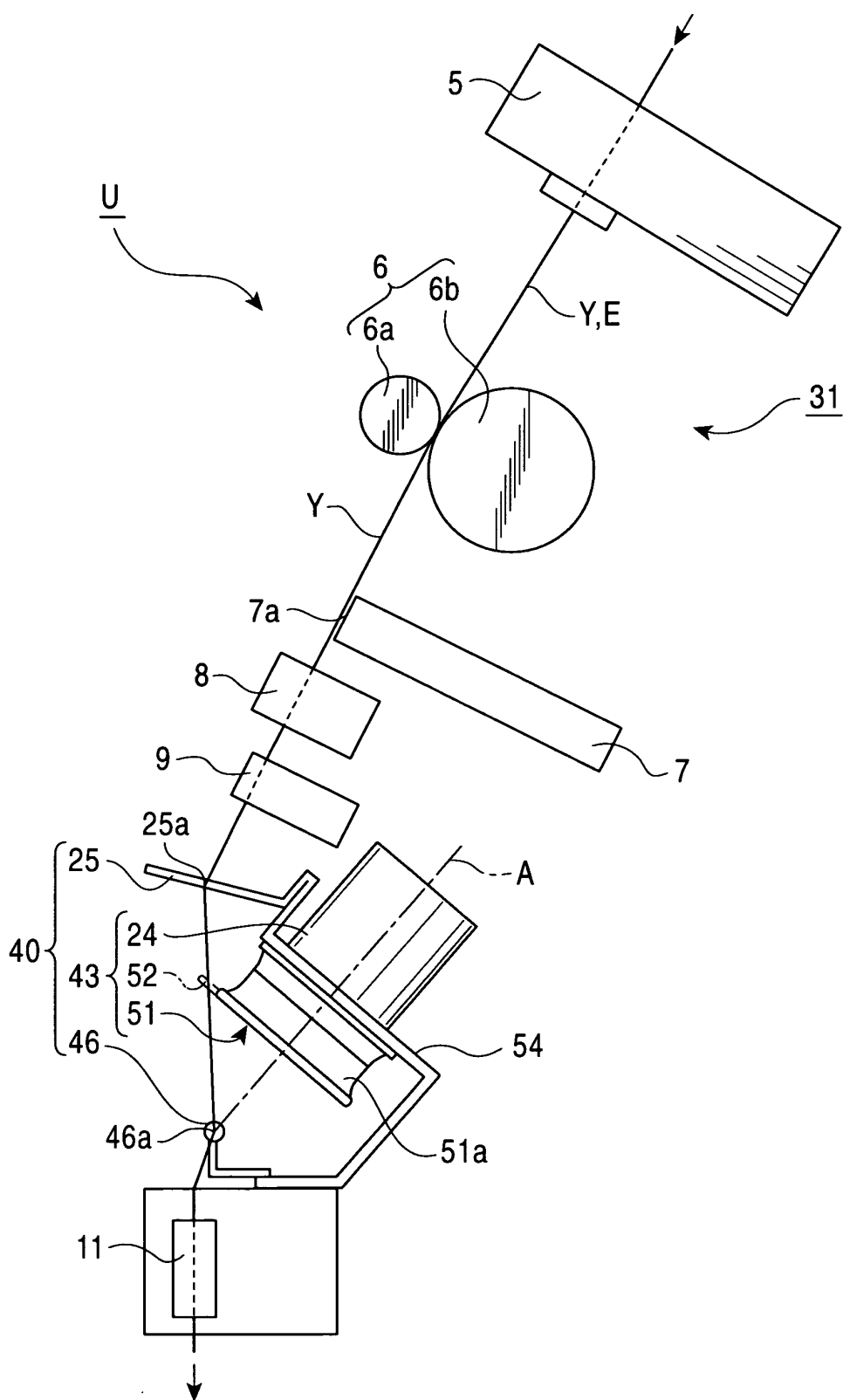


FIG. 10

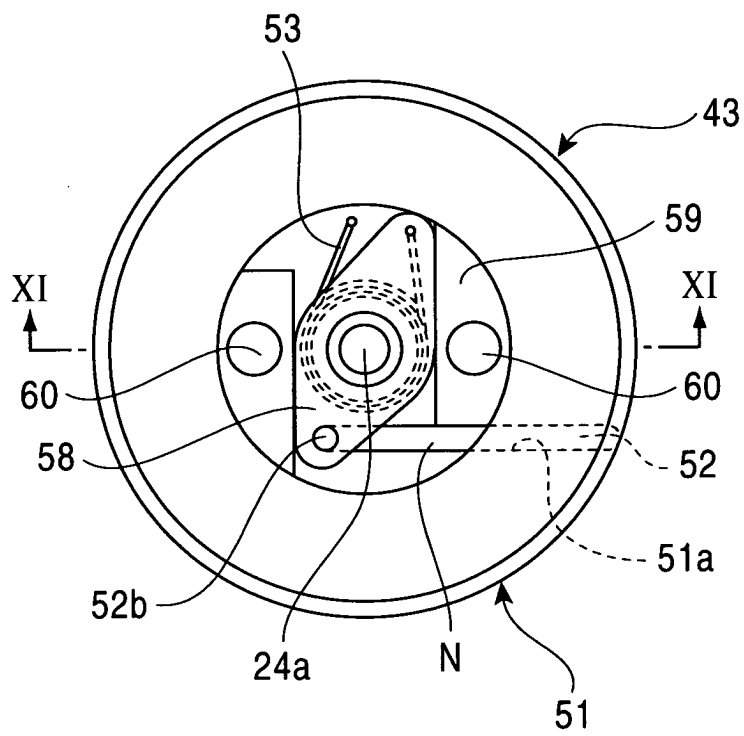


FIG. 11

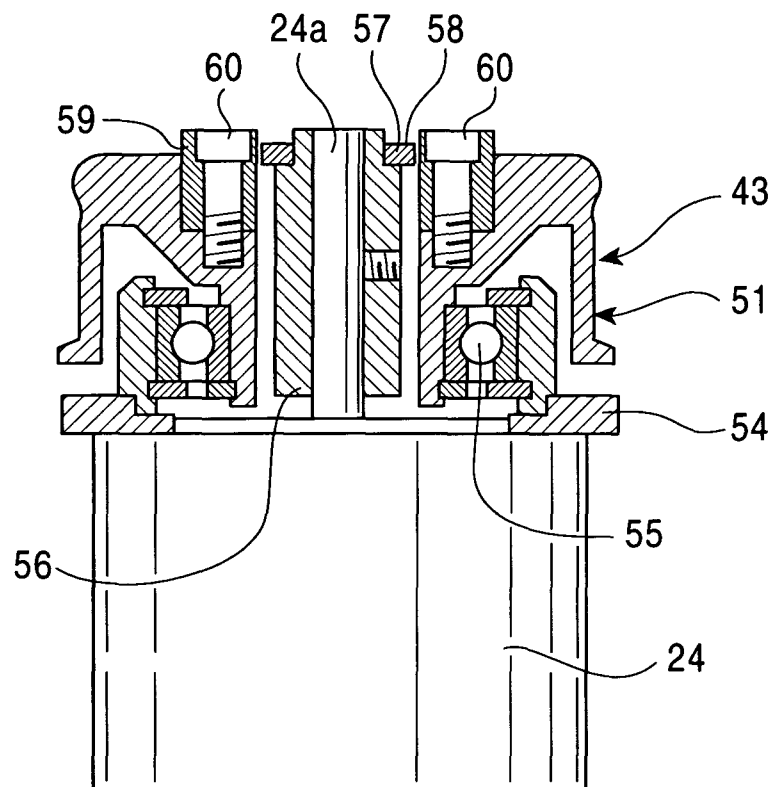


FIG. 12A

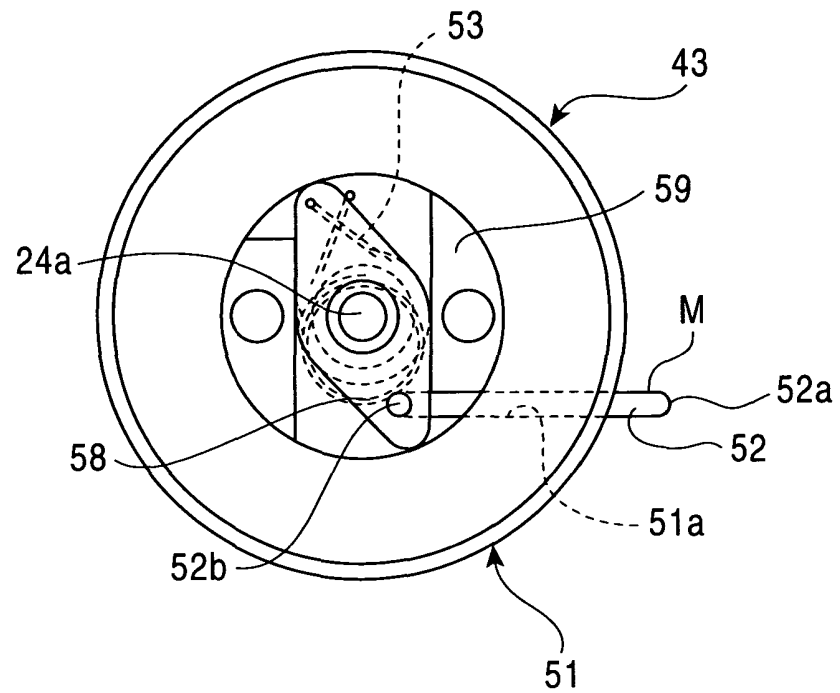


FIG. 12B

