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(54) Yarn winder

Spulmaschine für Faden

Bobinoir pour fil

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Description

Field of the Invention

[0001] The present invention relates to a yarn winder that controls a winding tension using a yarn slack eliminating device, and in particular, it is an object of the present invention to prevent the amount of slack retained on a slack eliminating roller of the yarn slack eliminating device from decreasing below a predetermined value.

Background of the Invention

[0002] For example, cone packages are formed using a spinning machine in which a spinning device generates a spun yarn using a sliver (a bundle of fibers) as a material and in which a winding device then winds the spun yarn into a package. In this case, in particular, if a winding tension is not controlled immediately before winding, then disadvantageously the tension of the yarn may vary periodically as it is traversed. This is because the speed at which the yarn is wound (the peripheral speed of a package) differs between the smaller diameter side and larger diameter side of a cone package, so that the amount of slack increases on the smaller diameter side, on which the yarn is wound at a lower speed, whereas the amount of slack decreases on the larger diameter side, on which the yarn is wound at a higher speed.

[0003] Thus, a technique for solving this problem is described in, for example, the West Germany Patent No. 2,553,892. With this technique, a yarn slack eliminating device comprising a slack eliminating roller around which a yarn is wound is provided between a spinning device and a winding device so as to adjust the winding tension on the basis of a variation in the amount of slack retained on the slack eliminating roller. According to the technique described in the West Germany Patent No. 2,553,892, a variation in tension (winding speed) is absorbed by increasing or reducing the amount of slack retained on the slack eliminating roller depending on a variation in the winding speed of a package. Specifically, it is contemplated that a variation in yarn tension (winding speed) may be absorbed by reducing the amount of slack retained on the slack eliminating roller when the yarn winding speed increases above the spinning speed and increasing the amount of slack when the winding speed decreases below the spinning speed.

[Patent Document 1] the West Germany Patent No. 2,553,892

[0004] The yarn slack eliminating device described in the West Germany Patent No. 2,553,892 must keep the yarn wound around the slack eliminating roller in order to absorb a variation in yarn tension. Accordingly, if the slack retained on the slack eliminating roller is about to be exhausted, this must be detected to reduce the rotation speed of the package to increase the amount of slack retained on the slack eliminating roller up to a predetermined value. However, the weight of the package and thus its inertia moment varies depending on its winding diameter. That is, the amount of speed reduction varies in spite of the same speed reduction processing time. Therefore, the amount of slack retained on the slack eliminating roller may not be increased up to the predetermined value simply by uniformly reducing the rotation speed of the package.

Summary of the Invention

[0005] It is an object of the present invention to reliably prevent, in a yarn winding machine provided with a yarn slack eliminating device, the shortage of the amount of slack retained on a slack eliminating roller of the yarn slack eliminating device.

[0006] Claim 1 sets forth a yarn winder created to accomplish this object. This yarn winder comprises a winding device that winds a yarn fed by a supply side into a package and yarn slack eliminating device having a slack eliminating roller that winds a part of the yarn located between the supply side and the winding device to absorb a variation in winding tension. The yarn winder is characterized by being provided with speed reduction control means for controlling a winding speed so that the winding speed is lower than a supply speed, winding diameter detecting means for the package, and adjusting means for adjusting the amount of speed reduction executed by the speed reduction control means, in accordance with the winding diameter of the package.

[0007] The yarn winder according to the present invention configured as described above reduces the winding speed of the package to increase the amount of slack retained on the slack eliminating roller of the yarn slack eliminating device. In this case, the amount of speed reduction control of the winding speed can be adjusted in accordance with the winding diameter of the package. Consequently, an increase in the amount of slack can be set at an appropriate value. The adjustment of the amount of speed reduction control includes the adjustment of a speed reduction processing time and the adjustment of deceleration and acceleration.

[0008] As set forth in Claim 2, the yarn winder according to the present invention may be provided with winding amount detecting means for detecting the amount of yarn wound around the slack eliminating roller, and the speed reduction control means may output a speed reduction control signal for the winding speed on the basis of the winding amount detected by the detecting means.

[0009] According to this yarn winder, if the amount of slack decreases below a predetermined amount, the winding speed of the winding device is reduced below the supply speed of the supply side to increase the amount of slack retained on the slack eliminating roller of the yarn slack eliminating device. This prevents the loss of a slacking yarn retained on the slack eliminating roller.

[0010] In the yarn winder according to the present invention, as set forth in Claim 3, the winding amount detecting means may be provided immediately upstream of the slack eliminating, comprise yarn tension detecting means for detecting a yarn tension immediately before the yarn is wound around the slack eliminating roller, and calculate the amount of slack retained on the slack eliminating roller on the basis of the yarn tension detected by the yarn tension detecting means. In this case, the simple mechanism can be used to detect the amount of slack.

[0011] Moreover, in the yarn winder according to the present invention, as set forth in Claim 4, the winding device may comprise a rotating drum that rotates in contact with the package to rotatively drive the package. The speed reduction control means may comprise a mechanism that separates the package from the rotating drum. The adjusting means may comprise a mechanism that adjusts a time for which the package remains separated, in accordance with the winding diameter of the package as the amount of speed reduction control provided by the speed reduction control means. In this case, the simple control form can be used to reduce costs, while appropriately reducing the speed of the package.

[0012] When the arrangement in Claim 4 is implemented, it is desirable that the winding device comprise a traverse device having a traverse guide and that the speed reduction control means comprise separation control means for separating the package from the rotating drum so as not to disengage the wound yarn from the traverse guide, as set forth in Claim 5.

[0013] Furthermore, as set forth in Claim 6, it is desirable that a plurality of winding devices are arranged in parallel, that the traverse guides provided for the respective winding devices be driven by a common driving shaft so as to simultaneously form a plurality of packages, and that the separation control means and the speed reduction control means can individually control a distance from each of the plurality of packages to the corresponding traverse guide and a rotation speed of the package, respectively. With this arrangement, the winding angle and turn position of each package can be individually adjusted. Consequently, if a plurality of packages are simultaneously formed, optimum settings can be made in accordance with the conditions of each package.

[0014] As set forth in Claim 7, the separation means may be a mechanism that separates the package from the traverse guide of the traverse device, while also separating the package from the rotating drum to reduce the rotation speed of the package. With this arrangement, the separation control means for separating the package from the traverse guide can also be used as speed reduction control means for reducing the rotation speed of the package. This enables the structure of the device to be simplified. The application of this arrangement allows the arrangement in Claim 6 to be easily implemented.

Brief Description of the Drawings

[0015]

Figure 1 is a front view showing an embodiment of a spinning machine according to the present invention.

Figure 2 is a front sectional view schematically showing the structure of essential parts of the spinning machine according to this embodiment.

Figure 3 is a side view schematically showing the configuration of a spinning unit and a work carriage of the spinning machine according to this embodiment.

Figure 4 is a side view schematically showing the configuration of a yarn slack eliminating device section of the spinning machine according to this embodiment during yarn guiding.

Figure 5 is a front view schematically showing the configuration of the yarn slack eliminating device section of the spinning machine according to this embodiment during yarn guiding.

Figure 6 is a side view schematically showing the configuration of the yarn slack eliminating device section of the spinning machine according to this embodiment at the start of yarn elimination.

Figure 7 is a side view schematically showing the configuration of the yarn slack eliminating device section of the spinning machine according to this embodiment during a yarn eliminating operation.

Figure 8 is a front view schematically showing the configuration of the yarn slack eliminating device section of the spinning machine according to this embodiment during a yarn eliminating operation.

Figure 9 is a side view schematically showing the configuration of the spinning unit and work carriage of the spinning machine according to this embodiment during a process of reducing a winding speed.

Figure 10 is s perspective view showing a slack eliminating roller utilized in the yarn slack eliminating device according to this embodiment.

Figure 11 shows the slack eliminating roller and a yarn tension detecting device utilized in the yarn slack eliminating device according to this embodiment, wherein Figure 11A is a front view as viewed from a leading end of the yarn slack eliminating device and Figure 11B is a plan view.

Figure 12 is a side sectional view showing the slack eliminating roller and yarn tension detecting device utilized in the yarn slack eliminating device according to this embodiment.

Figure 13 shows a rotating drum and a package according to this embodiment, wherein Figure 13A is a side view showing that the rotating drum is in contact with the package, Figure 13B is a side view showing that the package has been separated from the rotating drum, and Figure 13C is an enlarged side view showing essential parts of the package

and rotating drum separated from each other.

Figure 14 is a front view showing essential parts of a traverse guide and the package according to this embodiment, wherein Figure 14A is useful in explaining the reason why ribboning can be avoided and Figure 14B is useful in explaining the reason why high selvage can be prevented.

Detailed Description of the Preferred Embodiments

[0016] With reference to the drawings, a description will be given of embodiments of the present invention. In the specification, the terms "upstream" and " downstream" are based on a direction in which a yarn runs during spinning. Specifically, the upstream side corresponds to a spinning device, while the downstream side corresponds to a winding device.

[First Embodiment]

[0017] Figure 1 is a front view showing an example of a spinning machine 1 to which the present invention is applied. Figure 2 is an enlarged view schematically showing the internal structure of a part of the spinning machine 1.

[0018] The spinning machine 1 is composed of, for example, a pneumatic spinning machine. Main constituent members of the spinning machine 1 include a control section 1A, a spinning section 1B in which a large number of spinning units 2 are arranged in line, a blower section 1C, and a work carriage 3 comprising a yarn splicing device and adapted to run freely along a rail R between the spinning units 2. In the present embodiment, the spinning machine 1 is applied to the formation of cone packages but may be used to form cheese packages.

[0019] The control section 1A of the spinning machine 1 controls the operations of driving motors 31, 32, 33 for driving shafts 41, 42, 43 that exert a driving force on all the spinning units 2 constituting the spinning section 1B, the operations of motors 34, 35 provided for each spinning unit 2, the operation of a winding device 12, and the like.

[0020] In the present embodiment, on the basis of various set values (a spinning speed corresponding to a supply speed, the ratio of the spinning speed to a winding roller speed, and the like) inputted to an input section (a), a calculating section (b) outputs spinning speed information to the motors 31 to 34 via an inverter (c) or a driver substrate 30. Furthermore, rotation speed information on a slack eliminating roller (described later) is outputted to the motor 35 of the yarn slack eliminating device 10 via a driver substrate 40.

[0021] The spinning section 1B is composed of the large number of spinning units 2 arranged in line. Each of the spinning units 2 is configured to have its operating conditions set individually. The spinning unit 2 is provided with a yarn slack eliminating device 10, in addition to a spinning device 5 and a winding device 12. The structure of the spinning unit 2 will be described later in detail.

[0022] The blower section 1C houses negative pressure supplying means for supplying a negative pressure (suction pressure) to a desired position of the spinning unit 2 through an air duct. The blower section 1C allows the negative pressure to act on, for example, a yarn sucking device 7.

[0023] On the basis of a yarn splicing request signal, the work carriage 3 is adapted to run on the rail R to move to the position of a spinning unit 2 requiring yarn splicing and then to stop there. As shown Figure 3 that is a side sectional view schematically illustrating the configuration of the spinning section 1B, the work carriage 3 comprises a yarn splicing device 17 such as a knotter or a splicer, a suction pipe 18 that sucks an end of a yarn formed by the spinning device 5 and guides the end to the yarn splicing device 17, a suction mouth 19 that sucks a yarn end of a package 16 supported by the winding device 12 and guides the yarn end to the yarn splicing device 17, and a tension arm 20 that contacts with and tenses a yarn Y as required (see Figure 12). The work carriage 3, which runs along the direction in which the spinning units 2 are arranged in line, is thus provided with the yarn splicing device 17, the suction pipe 18, and the suction mouth 19.

[0024] In another example, the yarn splicing device 17, the suction pipe 18, and the suction mouth 19 may be provided for each spinning unit 2. However, when the yarn splicing device 17, the suction pipe 18, and the suction mouth 19 are loaded on the work carriage 3, which runs along the direction in which the spinning units 2 are arranged in line, a yarn splicing operation can be performed on all the spinning units 2 using only the above set of components. This simplifies the structure of the spinning machine 1.

[0025] The suction pipe 18, provided on the work carriage 3 for yarn splicing, functions as a member that sucks the spinning-side yarn end. The suction pipe 18 comprises a suction port 18a at its leading end and can be rotatively moved around a pivotal supporting section 18b. For a yarn splicing operation, the suction pipe 18 is rotatively moved upward to position the suction port 18a near a yarn discharge port in the spinning device 5. Then, the suction pipe 18 sucks the yarn end of the spun yarn Y and is then rotatively moved downward to its initial position while sucking the yarn Y. The suction pipe 18 thus guides a spinning side yarn Y1 to the yarn splicing device 17. On the other hand, the suction mouth 19 functions as a member that sucks a winding side yarn end. The suction mouth 19 comprises a suction port 19a at its leading end and can be rotatively moved around a pivotal supporting section 19b. For a splicing operation, the package 16 has its rotation stopped and is then rotated in a direction opposite to the normal one to rotatively move the yarn end downward. Then, the yarn Y is sucked by and caught in a suction port 19a at a leading end of the suction mouth 19. The suction mouth 19 is then rotatively moved upward while sucking the yarn Y. The suc-

tion moth 19 thus guides a package 16 side yarn Y to the yarn splicing device 17. To perform a yarn splicing operation, the yarn splicing device 17 uses a yarn handling lever (not shown in the drawings) provided in the yarn splicing device 17 to clamp the yarn ends of those parts of the spinning device 5 side yarn and winding device 12 side yarn which are located near the yarn splicing device 17. The yarn splicing device 17 thus brings these parts of the yarn into a yarn splicing operation performing section.

[0026] The plurality of spinning units 2, arranged in the spinning section 1B, are each a unit of a mechanism that manufactures a yarn using a bundle of fibers S as a material. The configuration of the spinning unit 2 will be described in brief. As shown in Figure 3, the spinning unit 2 is composed of a draft device 4, the spinning device 5, acting as a yarn supply side, a yarn feeding device 6, the yarn sucking device 7, a cutter 8, a yarn defect detector 9, the yarn slack eliminating device 10, a waxing device 11, and the winding device 12. These components are arranged in this order along a yarn path E from its upstream side to downstream side.

[0027] The draft device 4 is composed of four lines including, for example, a back roller 4a, a third roller 4b, a second roller 4d from which an apron 4c is extended, and a front roller 4e, the rollers being arranged in this order from the upstream side. The spinning device 5 is of a pneumatic type that utilizes whirling air currents to generate the spun yarn Y (hereinafter simply referred to as the "yarn Y") from the bundle of fibers S. For example, the spinning device 5 may spin the yarn Y at a high speed of several hundred meters/minute. Alternatively, the spinning device 5 may be replaced with one having a different structure; the spinning device 5 may generates the yarn Y using a pneumatic spinning nozzle and a pair of twisting rollers or may be an open end spinning machine that generates the yarn using rotation of a rotor. The yarn feeding device 6 is composed of a nip roller 6a and a delivery roller 6b to feed the yarn Y downward while sandwiching it between the rollers 6a, 6b. The yarn sucking device 7 always sucks the yarn, and when the yarn defect detector 9 detects a defect in the yarn Y, sucks and removes pieces of the yarn Y cut by the cutter 8.

[0028] The winding device 12 winds the yarn Y around a bobbin 15 held on a cradle arm 14 to form the package 16. The winding device 12 comprises a rotating drum 13 that rotates in contact with the bobbin 15 or the package 16. The cradle arm 14 is configured to pivot around a pivoting shaft 14a. The cradle arm 14 is also configured to use a pivoting control mechanism 60 that is means for reducing the winding speed, to control an operation of contacting the bobbin 15 or the package 16 with the rotating drum 13 as well as the time for which the bobbin 15 or the package 16 remains separate from the rotating drum 13. The pivoting control mechanism 60 according to the present embodiment is composed of an air cylinder 64 having a piston rod 65 connected to one end of the cradle arm 14, a compressed air source that supplies the air cylinder 64 with compressed air for contact pressure and compressed air for separation, a solenoid valve device 63 that switches a path through which compressed air is supplied to the air cylinder 64, a controller 62 that controls operations of the solenoid valve device 63, a unit controller 61 that outputs control signals to the controller 62, and other components.

[0029] During normal spinning, the pivoting control mechanism 60 allows the compressed air for contact pressure to always act on the air cylinder 64 to withdraw the piston rod 65 to press the package 16 against the rotating drum 13 at a predetermined contact pressure. Then, the air cylinder 64 is subjected as required to the compressed air for separation, which has a pressure higher than the compressed air for contact pressure, to extend the piston rod 65 to separate the package 16 from the rotating drum 13. At this time, the unit controller 61 controls the time for which the package 16 remains separated from the rotating drum 13 and timing for the separation. Specifically, the unit controller 61 executes calculations on the basis of already inputted spinning condition data such as yarn type, yarn number, and spinning speed and the time for which the spinning machine 1 has been operated as measured by the timer section. The unit controller 61 then outputs a control signal required to cause the solenoid valve device 63 to perform a desired operation, to the controller 62 in accordance with the winding diameter of the package 16, that is, in association with the weight of the package 16.

[0030] As shown in Figures 10 to 12, the yarn slack eliminating device 10 comprises a yarn slack eliminating roller 21 that winds and retains the yarn Y around its outer peripheral surface 21a, a yarn guiding member 22 that concentrically rotates synchronously with or independently of the slack eliminating roller 21 in accordance with certain conditions, an upstream side guide 23 arranged slightly upstream of the slack eliminating roller 21, driving means 35 such as a stepping motor which rotatively dives the slack eliminating roller 21, a driver substrate 40 (see Figure 2) that controls the driving means 35, and a downstream side guide 36 provided downstream of the slack eliminating roller 21 and having a slit 36a. These components are fixed to the spinning unit 2 using a bracket 37 and the like.

[0031] As shown in Figure 12, the slack eliminating roller 21 is secured to a driving shaft 35a of the driving means 35 to rotate integrally with the driving shaft 35a. Accordingly, the slack eliminating roller 21 can be controllably rotated faithfully in accordance with a rotation speed set by the calculating section (b). A side of the slack eliminating roller 21 which has the unwinding tension applying member 22 is defined as a leading end P and its side connected to the driving means 35 is defined as a proximal end Q. Then, tapered portions 21b, 21d are formed on the proximal end Q side and leading end P side, respectively, of the outer peripheral surface 21a so that their diameters increase toward the corresponding end surfaces. An intermediate portion of the slack

eliminating roller 21 is a cylindrical portion 21c having a fixed diameter. The yarn Y spun by the spinning device 5 is wound around the outer peripheral surface 21a from the proximal end Q side. The yarn Y is then unwound from the leading end P to the winding device 12 (see Figures 7 and 8). The tapered portion 21b on the proximal end Q side has a function of regularly winding the yarn Y around a surface of the cylindrical portion 21c by smoothly moving the supplied and wound yarn Y from a larger diameter portion 21b-1 to a smaller diameter portion 21b-2 and then to the intermediate cylindrical portion 21c. The tapered portion 21d on the leading end P side also has a function of ensuring the smooth pull-out of the yarn Y by inhibiting a slip-out phenomenon in which the wound yarn Y slips out at a time, while sequentially winding the yarn Y around a small diameter portion 21d-2 and then a larger diameter portion 21d-1.

[0032] As shown in Figure 12, a bar-like member 22a is attached to the unwinding tension applying member 22, provided on the leading end P side of the slack eliminating roller 21, so as to be concentrically rotated via a transmitted force adjusting mechanism relative to the slack eliminating roller 21.

[0033] The transmitted force adjusting mechanism is configured as follows.

[0034] A wheel member 22b is rotatably installed, via a bearing member 22c such as a bearing, on a shaft portion 21e projected from a central portion of the slack eliminating roller 21. The proximal portion of the bar-like member 22a is attached to the wheel member 22b. The wheel member 22b is attached by preventing a transmitted force applying member 22f composed of urging means such as a spring from slipping out, using a transmitted force adjustment operating section 22g screwed over a bolt portion at the leading end of the shaft portion 21e and composed of, for example, a nut member 22d and a presser member 22e. Accordingly, the transmitted force adjusting mechanism according to the present embodiment can adjust the pressure (frictional force) of the transmitted force applying mechanism 22f in a non-step-by-step manner by tightening the transmitted force adjustment operating section 22g screwed over the bolt portion of the shaft portion 21e. If the transmitted force adjusting member 22d of the transmitted force adjusting mechanism is exposed from the leading end of the slack eliminating roller 21 as in the case of the present embodiment, the operator can easily adjust the transmitted force.

[0035] The transmitted force adjusting mechanism can adjust the magnitude of the rotational resistance of the bar-like member 22a to the slack eliminating roller 21. Specifically, the pressure (or the frictional force) of the transmitted force applying member 22f, exerted on the wheel member 22b, is reduced by loosening the transmitted force adjusting member 22d such as a nut member. Then, only a light load enables the bar-like member 22a to slip and rotate independently of the rotation of the slack eliminating roller 21. In contrast, the pressure of the transmitted force applying member 22f, exerted on the wheel member 22b, is increased by tightening the transmitted force adjusting member 22d. Then, the bar-like member 22a does not slip unless a very heavy load acts on it, and rotates integrally and in unison with the slack eliminating roller 21. In this manner, the transmitted force adjusting mechanism according to the present embodiment enables the pressure (frictional force) of the transmitted force applying member 22f to be adjusted in a non-step-by-step manner by loosening or tightening the transmitted force adjusting member 22d such as a nut member, which is screwed over the shaft portion 21e.

[0036] Accordingly, the unwinding tension applying member 22 can appropriately adjust the tightening of the presser member 22e to adjust the behavior of the bar-like member 22a, which can rotate independently of the slack eliminating roller 21, in association with the tension of the yarn Y unwound from the slack eliminating roller 21. That is, the transmitted force adjusting mechanism can preset the unwinding tension of the yarn Y from the slack eliminating roller 21, which tension varies depending on the spinning conditions such as the yarn type and the yarn number. The behavior of the bar-like member 22a depends on the interaction between a rotating force transmitted by the slack eliminating roller 21 via the transmitted force applying member 22f and the tension of the yarn Y unwound from the slack eliminating roller 21. Conversely speaking, by using the transmitted force adjusting mechanism to pre-adjust the behavior of the bar-like member 22a, it is possible to preset the magnitude of the resistance of the bar-like member 22a to the yarn Y unwound from the slack eliminating roller 21. That is, the transmitted force adjusting mechanism functions to adjust the unwinding tension provided by the unwinding tension applying member 22, including the bar-like member 22a.

[0037] To allow the yarn Y to be reliably wound around the outer peripheral surface 21a of the slack eliminating roller 21, the bar-like member 22a has a characteristic shape described below.

[0038] The bar-like member 22a first extends, without bending at an acute angle, from its proximal portion, attached to the wheel member 22b, to a position at which it projects slightly beyond the leading tip P of the slack eliminating roller 21 in a direction opposite to the proximal end Q. The bar-like member 22a then bends at three portions (m), (1), (k) located in this order from the inside to outside of the slack eliminating roller 21. Thus, a leading end portion (j) of the bar-like member 22a is located outside the radius of the slack eliminating roller 21. Of the three bent portions (m), (1), (k), the two bent portions (k) and (1) lie outside the radius of the slack eliminating roller 21, while the one bent portion (m) is located inside the radius of a larger-diameter portion 21-d of the slack eliminating roller 21. Then, the bar-like member 22a bends at the inward bent portion (m) so as to extend in a direction opposite to the rotating direction of the slack eliminating roller 21 e during yarn winding. The bar-like

member 22a then bends at the next bent portion (1) toward the proximal end Q side of the slack eliminating roller 21 and finally at the outer bent portion (k) so as to extend in the rotating direction of the slack eliminating roller 21.

[0039] Accordingly, the bar-like member 22a has a yarn engaging portion R formed of the leading end portion (j), the bent portion (k), and the bent portion (1) and having an angle that opens outward in the rotating direction of the slack eliminating roller 21. The yarn engaging section R is located opposite and above the outer peripheral surface 21a of the slack eliminating roller 21 between the leading end P and proximal end Q of the slack eliminating roller 21, while maintaining a predetermined distance from the outer peripheral surface 21a of the slack eliminating roller 21. The bar-like member 22a according to this embodiment rotates with the slack eliminating roller 21 to enable the yarn Y engaged with the bar-like member 22a during slack elimination to be stably wound around the outer peripheral surface 21a of the slack eliminating roller at a predetermined position. The bar-like member 22a also reliably prevents the yarn A from fitting into the gap between the slack eliminating roller 21 and the bar-like member 22a.

[0040] The yarn slack eliminating device 10 according to the present embodiment is provided with a yarn tension detecting device 50 that detects the tension of the yarn Y immediately upstream of the slack eliminating roller 21. As shown in Figures 11 and 12, the yarn tension detecting device 50 is composed of a generally L-shaped wire rod 51 arranged upstream of the slack eliminating roller 21 and close to its proximal end Q, a pivotal supporting section 52 that supports the middle of the wire rod 51 for rotative movement, and a switching member 54 such as a microswitch which outputs an ON operation signal when a terminal portion 53 of the wire rod 51 abuts against the switching member 54 to apply a predetermined pressure or higher to the member 54.

[0041] While the yarn Y is not wound around the slack eliminating roller 21 (see Figures 4 and 5), the wire rod 51 is positioned so as not to come into contact with the yarn Y. Accordingly, no force acts on the wire rod 51, and the terminal portion 54 does not apply any pressure. Consequently, the switching member 54 does not perform an ON operation (see the solid line in Figure 11B). When the yarn Y starts to be wound around the slack eliminating roller 21, the yarn Y comes into contact with the wire rod 51. The wire rod 51 is pressed by the tension of the yarn Y. As a result, as shown by the alternate long and two short dashes line in Figure 11B, the wire rod 51 is rotatively moved using the pivotal supporting section 52 as an axis to cause the terminal portion 53 to press the switching member 54. Then, a predetermined or higher tension acts on the wire rod 51 to allow the terminal portion 53 to apply a pressure of a predetermined value or larger. Then, the switching 54 is turned on to output an operation signal to the unit controller 61.

[0042] As described above, the pressure of the terminal portion 53 on the switching member 54 depends on the magnitude of the tension of the yarn Y, which contacts with the wire rod 51. That is, the switching member 54 is turned on and off depending on the magnitude of the tension of the yarn Y. Furthermore, the tension of the yarn Y is determined by the amount of yarn wound around the slack eliminating roller 21 (the amount of slack). This is because when a large amount of yarn is wound, the sliding frictional resistance between the yarn Y and the slack eliminating roller 21 is large. Accordingly, the yarn Y does not slide smoothly on the surface of the slack eliminating roller 21. Consequently, the tension of the yarn Y is high upstream side of the slack eliminating roller 21. In contrast, when only a small amount of yarn Y is wound, the yarn Y slides smoothly on the surface of the slack eliminating roller 21. Accordingly, the tension of the yarn Y decreases upstream side of the slack eliminating roller 21. Therefore, when there is a large amount of slack of the yarn Y on the slack eliminating roller 21, the yarn tension is high enough to allow the switching member 54 to maintain an ON operation. When the amount of slack of the yarn Y decreases, the yarn tension also decreases to turn off the switching member 54. With this mechanism, by properly setting the yarn tension with which the switching member 54 is turned on, the yarn tension detecting device 50 according to the present embodiment can detect whether the amount of slack of the yarn Y on the slack eliminating roller 21 exceeds a predetermined value or is insufficient. The yarn tension detecting device 50 thus functions as wound yarn amount detecting means. It is therefore possible to detect the amount of slack with using the simple mechanism without optically detecting the amount of yarn wound around the slack eliminating roller 21 or without contacting with the yarn wound around the slack eliminating roller 21.

[0043] During yarn splicing or the like, the upstream side guide 23, arranged upstream of the yarn slack eliminating device 10, is drivingly advanced or withdrawn to move the yarn Y to a position where it does not engage with the unwinding tension applying member 22 (where it is not unwound around the slack eliminating roller 21) so as to prevent a failure to supply the upstream yarn end to the yarn splicing device 17 which may occur when the upstream yarn end is pulled toward the slack eliminating roller 21 immediately before the yarn splicing. Furthermore, to absorb the slack of the yarn Y which occurs when the yarn splicing device 17 clamps the upstream yarn end to splice the yarn Y, the upstream side guide 23 is drivingly advanced or withdrawn to engage the unwinding tension applying member 22 with the yarn Y to start winding the yarn Y around the slack eliminating roller 21. The work carriage 3 is provided with advancing and withdrawing means 24 composed of an air cylinder or the like which advances and withdraws the upstream side guide 23 and control means (not shown in the drawings) for controlling the advancing and withdrawing means 24. That is, the upstream side guide 23 is yarn moving means, and the advancing and withdrawing means 24 is

driving means for the upstream side guide 23. When lying at a forward position, the upstream side guide 23 holds the yarn path at a position where the yarn Y does not engage with the yarn slack eliminating device 10. When lying at a backward position, the upstream side guide 23 moves the yarn path to a position where the yarn Y engages with the bar-like member 22a of the yarn slack eliminating device 10.

[0044] The bar-like member 22a is arranged to engage with the yarn Y on the yarn path joining the upstream side guide 23, which is at the backward position during the normal spinning, to the downstream side guide 36 so as to set the shortest distance between them. That is, the upstream side guide 23 is set so that a rotation surface of the bar-like member 22a, which rotates with the slack eliminating roller 21, crosses the yarn path.

[0045] A description will be given below of operations performed if the spinning machine 1 configured as described previously is used to form a cone package.

[0046] As shown in Figures 3 to 5, while a normal operation is being performed in the spinning unit 2 at which the work carriage 3 is not stopped, the upstream side guide 23 of the yarn slack eliminating device 10 is forcedly pulled by the tensile member such as a spring (not shown in the drawings) and thus remains at the backward position. In this state, a yarn winding operation is performed. Furthermore, in each spinning unit 2 of the spinning machine 1, the draft device 4 feeds the bundle of fibers S to the spinning device 5, and the yarn feeding device 6 feeds downstream the yarn Y spun and generated by the spinning device 5. The yarn Y is then passed directly in front of the yarn sucking device 7 and the yarn defect detector 9 and fed to the winding device 12 via the upstream side guide 23, the downstream side guide 36, and the waxing device 11. Then, the yarn Y is wound around the bobbin 15, rotatively driven by the rotating drum 13, to form the package 16.

[0047] After the yarn Y has started to be wound, a rotation instruction is outputted to the driving motor 35 for the slack eliminating roller 21 via the driver substrate 40 (see Figure 2) at an appropriate time. As shown in Figure 6, the slack eliminating roller 21 is rotatively driven and this rotative driving state is maintained during spinning. As described previously, the rotation locus surface of the bar-like member 22a, provided in the slack eliminating roller 21, is set to cross the yarn path defined by the upstream side guide 23 and the downstream side guide 36. Accordingly, rotating the slack eliminating roller 21 allows the bar-like member 22a to engage naturally with the yarn Y. Furthermore, the bar-like member 22a is shaped so as to engage easily with the yarn Y and so that the yarn Y does not easily fit into the gap between the slack eliminating roller 21 and the bar-like member 22a. The yarn Y can thus be reasonably provided to the outer peripheral surface of the slack eliminating roller 21. Consequently, the mere rotation of the slack eliminating roller 21 enables the yarn Y to be reliably wound around the outer peripheral surface of the slack eliminating roller 21 as shown in Figures 7 and 8. In this connection, on the basis of the yarn Y spinning speed of the spinning device 5 (substantially the yarn feeding speed of the yarn feeding device 6), the rotation speed of the slack eliminating roller 21 is calculated and set by the calculating section (b) on the basis of an input value from the input section (a) so that the yarn Y fed downstream by the yarn feeding device 6 undergoes an appropriate tension immediately after spinning.

[0048] The yarn slack eliminating device 10 provides a function of winding the yarn Y around the slack eliminating roller 21 to eliminate the slack of the yarn Y in the yarn path. The yarn slack eliminating device 10 also provides a function of increasing or reducing the amount of slack to adjust the winding tension of the yarn Y. This mechanism will be described below.

[0049] The amount of slack of the yarn Y retained on the slack eliminating roller 21 is determined by the difference between the upstream side spinning speed and downstream side winding speed (the speed at which the yarn is unwound from the slack eliminating roller 21) of the slack eliminating roller 21. The winding speed is normally set to be slightly higher than the spinning speed in order to apply an appropriate winding tension to the yarn Y. Then, a load equal to the difference in speed acts on the bar-like member 22a. This is because when the spinning speed is higher, the amount of yarn Y supplied to the slack eliminating roller 21 always exceeds the amount of yarn Y unwound and directed to the winding device 12, thus simply increasing the amount of yarn wound around the slack eliminating roller 21.

[0050] As described previously, the bar-like member 22a can be rotated independently of the slack eliminating roller 21. Furthermore, the transmitted force adjusting mechanism can adjust a rotative driving force transmitted by the slack eliminating roller 21 to the bar-like member 22a. Accordingly, when the load acting on the bar-like member 22a has a predetermined value or smaller, the bar-like member 22a rotates integrally with the slack eliminating roller 21. The yarn Y is thus wound around the slack eliminating roller 21 to increase the amount of slack. In contrast, when the load exceeds the predetermined value, the bar-like member 22a rotates or rotatively moves independently of the slack eliminating roller 21 to allow the yarn Y to be unwound from the slack eliminating roller 21. Accordingly, the transmitted force adjusting mechanism can properly set the magnitude of the load associated with the independent rotation (rotative movement) of the bar-like member 22a, to apply a predetermined winding tension to the yarn Y. If the winding speed does not vary but is constant, the yarn Y wound around the slack eliminating roller 21 is unwound at almost a fixed rate.

[0051] If a cone package is formed, the yarn winding radius varies within one traverse. The winding speed thus varies. If the downstream side winding speed increases, there will be an increase in the amount of rotation or rotative movement of the bar-like member 22a independent

of the slack eliminating roller 21 and in the amount of unwound yarn Y. The winding speed is thus allowed to increase. In contrast, if the winding speed drops, there will be a decrease in the amount of rotation or rotative movement of the bar-like member 22a independent of the slack eliminating roller 21 and in the amount of unwound yarn Y. The winding speed is thus allowed to decrease. In either case, the winding tension can be determined by the transmitted force adjusting mechanism provided between the slack eliminating roller 21 and the bar-like member 22a. Consequently, a stable winding tension can be applied without depending on an increase or decrease in winding speed.

[0052] With the above described mechanism, the yarn slack eliminating device 10 according to the present embodiment provides a function of permitting a variation in winding speed that may occur while the yarn is being wound into a cone package, to make the winding tension constant.

[0053] The yarn slack eliminating device 10 according to the present embodiment employs an arrangement in which the bar-like member 22a and the slack eliminating roller 21 are connected together via the transmitted force adjusting mechanism. Consequently, when the bar-like member 22a rotatively moves or rotates independently of the slack eliminating roller 21, the magnitude of the load can be easily varied. It is therefore easy to deal with the winding tension, which varies depending on the various spinning conditions such as the yarn type, yarn number, and spinning speed.

[0054] To allow the yarn slack eliminating device 10 to provide the functions of permitting a variation in winding speed and stabilizing the winding tension and to minimize the number of operations of setting the yarn Y on the slack eliminating roller 21, it is necessary to make every effort to keep the yarn wound around the slack eliminating roller 21, that is, to avoid exhausting the slack. It is also necessary to maintain this state for a long time.

[0055] Furthermore, the winding speed is normally set to be slightly higher than the spinning speed during winding. Accordingly, all of the yarn Y wound around the slack eliminating roller 21 is unwound soon unless the rotation of the package 16 is controlled. Thus, in the present embodiment, the amount of slack is sensed on the basis of the yarn tension sensed by the yarn tension detecting device 50, arranged immediately upstream of the slack eliminating roller 21. If it is detected that the amount of slack is insufficient, the winding speed of the package 16 is reduced to recover the amount of slack.

[0056] If a predetermined or larger amount of slack is present on the slack eliminating roller 21 and the upstream yarn tension has a predetermined value or larger, then as shown in Figure 11B, the switching member 54 of the yarn tension detecting device 50 continuously outputs an ON signal to the unit controller 61 of the pivoting control mechanism 60, shown in Figures 3 and 9. When the amount of slack on the slack eliminating roller 21 decreases to reduce the yarn tension below the predetermined value, the switching member 54 stops outputting the ON signal. Then, the unit controller 61 outputs a control signal to the controller 62 to separate the package 16. The controller 62 then outputs an operation signal to the solenoid valve device 63. Thus, compressed air for separation is supplied to the air cylinder 64. Then, as shown in Figure 9, the piston rod 65 of the air cylinder 64 is extended to pivot the cradle arm 14 to separate the package 16 from the rotating drum 13.

[0057] The package 16 separated from the rotating drum 13 and on which the rotative driving force is no longer exerted has its rotation speed reduced by the frictional resistance between the bobbin 15 and the cradle arm 14 and the like. As a result, as described previously, the downstream side winding speed of the yarn slack eliminating device 10 decreases below the spinning speed of the yarn Y newly introduced into the slack eliminating roller 21 from the upstream side. This difference in speed increases the amount of slack retained on the slack eliminating roller 21. After the time required to increase the amount of slack retained on the slack eliminating roller 21 up to a predetermined value has passed, the controller 62 outputs an operation signal on the basis of a control signal from the unit controller 61. The operation signal causes the solenoid valve device 63 to operate to remove the compressed air for separation from the air cylinder 64. Thus, the piston rod 65 withdraws to pivot the cradle arm 14 in a returning direction to bring the package 16 into contact with the rotating drum 13 again. Then, the yarn winding process is continued at the normal winding speed.

[0058] The package 16 has an inertia moment varying depending on the size of the winding diameter. Thus, the time varies which is required to reduce the winding speed to a predetermined value to increase the amount of slack retained on the slack eliminating roller 21 up to the desired value after the package 16 has been separated from the rotating drum 13. Specifically, when the package 16 has a large winding diameter, it has a large inertia moment. Accordingly, compared to a smaller winding diameter, a long time is required to reduce the winding speed to the predetermined value after the package 16 has been separated from the rotating drum 13. Thus, the present embodiment provides adjusting means for adjusting the amount of speed reduction control for the package 16 by calculating the winding diameter of the package 16 to determine the weight of the package 16 and then controlling the time for which the package 16 remains separated from the rotating drum 13, in accordance with the winding diameter.

[0059] It is contemplated that the adjusting means may be, for example, a winding length calculating section provided in the unit controller 61 and comprising a spinning speed storage section and a timer section, a yarn type and number storage section, a separation time calculating section, and other sections. The winding diameter of the package 16 is determined by the yarn type, yarn number, and winding length. The winding length can be

calculated from the winding speed (or spinning speed) multiplied by the winding time. The yarn type, the yarn number, and the winding speed are preset on the basis of spinning conditions. Accordingly, the winding diameter of the package 16 can be calculated from the winding time measured by the timer section. The winding diameter can then be used to calculate the separation time required to reduce the rotation speed of the package 16 to the predetermined value. In a practical sense, the yarn type, the yarn number, and the winding (spinning) speed have preset values, and the winding time is associated with the winding diameter of the package 16. Consequently, a program can be created such that pre-inputting data on the yarn type, yarn number, and winding (spinning) speed enables a separation time calculating section to calculate the optimum separation time in accordance with the winding diameter on the basis of the winding time measured by the timer section. That is, the package separation time can be adjusted only by the winding time.

[0060] With the above adjusting means, the spinning machine 1 according to the present embodiment operates as follows.

[0061] If the yarn tension detecting device 50 senses during yarn winding that the amount of slack retained on the slack eliminating roller 21 decreases below the predetermined amount, the pivoting control mechanism 60 keeps separating the package 16 from the rotating drum 13 for the predetermined time. The adjusting means contained in the unit controller 61 calculates the optimum separation time in accordance with the winding diameter of the package 16 on the basis of the already inputted spinning conditions and winding time. After the separation time has passed, the package 16 comes into contact with the rotating drum 13 again. When the package 16 has a small winding diameter, its inertia moment is also small. Thus, when the package 16 leaves the rotating drum 13, its rotation speed decreases rapidly. The amount of slack is then immediately recovered. Accordingly, the package separation time may be short. Since the inertia moment increases consistently with the winding diameter, the rotation speed of the package 16 decreases only slightly when the package 16 is separated from the rotating drum 13. Consequently, the separation time required to increase the amount of slack up to the predetermined value is set to be correspondingly long. If the package separation time is not adjusted but is uniformly set, the amount of recovery of the slack amount decreases gradually with increasing winding diameter. As a result, the rotation of the package 16 caused by inertia may prevent the recovery of the amount of slack, thus causing the unwinding of all of the yarn Y wound around the slack eliminating roller 21. In contrast, in the present invention, the amount of retained slack is automatically adjusted in accordance with the package winding diameter. It is thus possible to keep the amount of recovery of the slack amount constant from beginning to end of the winding process to make the winding conditions uniform. This contributes to stabilizing the quality of the package 16.

[0062] When the package 16 has an excessively long separation time, the rotation of the package 16 is stopped. At this time, even though the yarn Y is stopped downstream of the yarn slack eliminating device 10, a traverse guide 70 attempts to traverse the yarn Y. As a result, the traverse guide 70 may affect the quality of the yarn Y or cause yarn breakage. Moreover, if the stopped package 16 is rapidly brought into contact with the rotating drum 13, the yarn tension may vary rapidly to cause yarn breakage. To avoid these problems, it is necessary to properly set the separation time for the package 16.

[0063] Moreover, for a short time after the yarn Y starts to be wound around an empty bobbin, the package 16 has a light weight. In this state, disadvantageously, the above separating operation may quickly stop the rotation of the package 16. Thus, to prevent this, it is desirable that for a short time after winding has been started, the separating operation be performed by repeating separations and contacts at short time intervals to gradually increase the amount of slack retained on the slack eliminating roller 21 while preventing the stoppage of the rotation of the package 16.

[Second Embodiment]

[0064] For the spinning machine 1, an aspect can be employed in which the winding speed of the package 16 is reduced to increase the amount of slack in accordance with a preset predetermined speed reduction schedule regardless of the amount of slack retained on the slack eliminating roller 21 of the yarn slack eliminating device 10. For example, it is contemplated that the amount of slack retained on the slack eliminating roller 21 may be recovered within a specified period by periodically executing a step of pivoting the cradle arm 14 to keep separating the package 16 from the rotating drum 13 for a predetermined time and then pivoting the cradle arm 14 in the returning direction to bring the package 16 into contact with the rotating drum 13 again. This configuration ensures that the amount of slack is recovered within a specified time. As a result, even if the amount of slack retained on the slack eliminating roller 21 decreases while the spinning machine is operating, the tension adjustment during the yarn winding process can be reliably continued without a stop. The speed reduction schedule for the winding speed may be properly set on the basis of the spinning conditions.

[0065] In the present embodiment, the yarn tension detecting device 50 arranged upstream of the slack eliminating roller 21 may be omitted. Furthermore, also in the present embodiment, the speed reduction time required to increase the slack by a predetermined amount increases consistently with the winding diameter of the package 16. Accordingly, adjusting means is desirably provided which increases a speed reduction processing time per step of reducing the speed of the package 16, in accordance with the amount of increase in the winding diameter

of the package 16.

[Third Embodiment]

[0066] A yarn winder used in, for example, a spinning machine, twister, or a false twister winds a yarn fed by a yarn feeding device into a package while using a traverse device to traverse the yarn. Such a yarn winder is normally configured to simultaneously form a plurality of packages. In this case, as described in the Japanese Patent Publication No. 2871595, the traverse device may be configured so that traverse guides provided for the respective packages are attached to a common driving shaft (traverse rod) that integrally drives all the traverse guides.

[0067] It is known that both ribboning or saddle bag problems occur when a yarn winder winds a yarn into a package using a traverse device comprising a reciprocating traverse guide. The ribboning is a phenomenon that may occur when the yarn is wound around a package at the same position a number of times. The saddle bag is a phenomenon that may occur when the amount of wound yarn is larger at the opposite ends of a package than in its middle because the traverse speed is forced to decrease at the opposite ends, which correspond to turn positions where a traverse direction is reversed. As means for solving this problem, the Unexamined Japanese Patent Application Publication (Tokkai-sho) No. 61-217478 describes a technique to periodically vary a traverse width by using a cam mechanism to moving the reciprocation range of the traverse guide, that is, the turn positions.

[Patent Document 2] the Japanese Patent Publication No. 2871595

[Patent Document 3] the Unexamined Japanese Patent Application Publication (Tokkai-sho) No. 61-217478

[0068] The technique described in the Unexamined Japanese Patent Application Publication (Tokkai-sho) No. 61-217478 can solve both ribboning and saddle bag problems of the yarn winder using the reciprocating traverse device. However, this technique disadvantageously requires a complicated mechanism requiring a large number of parts. This mechanism is difficult to produce and requires high costs. It is also very difficult to apply the technique described in the Unexamined Japanese Patent Application Publication (Tokkai-sho) No. 61-217478 to a traverse device with a mechanism in which a common driving shaft is used to drive a large number of traverse guides which is described in the Japanese Patent No.2871595. It has thus been impossible to individually set or control the magnitude of a change in traverse width for each package.

[0069] Thus, the present invention is characterized by comprising the winding device 12, separation control means for varying the distance between a package and the traverse guide, speed reduction control means for reducing the speed of the package. These means can be constructed using, for example, a traverse guide 70 of the reciprocating traverse device, which traverses the yarn Y, and a mechanism that separates or contacts the package 16 from or with the rotating drum 13, which contacts with and rotatively drive the package 16, as shown in Figure 13. It is also contemplated that means for moving the package 16 as described above may be a mechanism that pivots the cradle arm 14, which supports the bobbin for the package 16.

[0070] It is assumed that the package 16 contacted with the rotating drum 13 as shown in Figure 13A is separated from the rotating drum 13 and the traverse guide 70 as shown in Figure 13B. Thus, the package 16 is no longer provided with the rotative driving force of the rotating drum 13. Accordingly, the rotation speed decreases owing to frictional resistance to reduce the winding speed. Subsequently, the mechanism is returned to the state shown in Figure 13A. As shown in Figure 13C, the distance δ between the package 16 and the rotating drum 13, which are separated from each other, is set so as to prevent the yarn Y from being disengaged from the traverse guide 70. Moreover, the operation of separation the package 16 is desirably controlled so that the separation distance δ has a substantially fixed value in spite of a possible variation in the winding diameter of the package 16.

[0071] The yarn winder according to the present invention can solve both ribboning and saddle bag problems by performing the previously described separating and contacting operations on the package 16. The reason will be described below.

[0072] The ribboning is a phenomenon that may occur when the yarn Y is wound into the package 16 while being traversed and because the yarn Y is wound around a package 16 at the same position a number of times. As shown in Figure 14A, the yarn Y is engaged with the traverse guide 70 of the traverse device and traversed within a predetermined range. The yarn Y is thus wound into the package 16 while being inclined at a certain angle. The magnitude of this inclination, that is, a winding angle, is determined by the traverse speed (moving speed) of the traverse guide 70 and the winding speed (the peripheral speed of the package 16). The winding angle of the yarn Y is defined as $\theta 1$ when the traverse speed of the traverse guide 70 is v1 and when the winding speed prior to a speed reduction is v2. It is assumed that the package 16 is separated from the rotating drum 13 to reduce the winding speed to v3. Then, since the traverse speed v1 of the traverse guide 70 is expected to remain substantially unchanged providing that the traverse guide 70 remains at the same position, the winding angle $\theta 2$ of the yarn Y observed at this time is larger than the winding angle $\theta 1$ by an amount equal to the decrease in winding speed to v3. One of the causes of the change in winding angle may be the decrease in the rotation speed of the package, which causes the yarn Y to be slacked to reduce the yarn tension. The above method can be used to vary the winding angle of the yarn Y while preventing the yarn Y from being wound at the

same position. This prevents ribboning.

[0073] The saddle bag is a phenomenon that may occur when the amount of wound yarn Y is larger in turn portions of the package 16 located at its respective ends than in its middle because the speed reduction and reversal of the traverse guide 70 forces the traverse speed to be lower in the turn portions than in the middle. When the traverse guide 70, associated with the reciprocation of the traverse device, reverses its moving direction at the opposite ends of the traverse range, the winding direction of the yarn Y on the package 16 is turned.

[0074] As shown by the alternate long and two short dashes line in Figure 14B, the turn position of the yarn Y is assumed to be T1 corresponding to an end of the package 16 before a decrease in the winding speed resulting from a decrease in the rotation speed of the package 16. When the yarn Y is separated from the traverse guide 70 so as not be disengaged from it at the same time when the package 16 is separated from the rotating drum 13, as shown by the solid line in this figure, the distance from the traverse guide 70 to the package 16 increases. The mere increase in distance causes the turn position of the yarn Y to be shifted to T2 that is closer to the center of the package 16. Furthermore, the yarn Y winding speed decreases consistently with the rotation speed of the package 16. Consequently, the winding angle of the yarn Y increases to shift the substantial turn position to T3 that is further closer to the center of the package 16. By thus periodically shifting the turn position of the yarn Y, it is possible to prevent a larger amount of yarn Y from being locally wound at the opposite ends of the package 16. This avoids the saddle bag problem. Moreover, in the present embodiment, the separating means for separating the package 16 from the traverse guide 70 can also be used as the speed reduction control means for reducing the speed of the package 16. Therefore, the structure of the device can be simplified.

[Fourth Embodiment]

[0075] An object of each of the above embodiments is to recover the amount of slack before the slack retained on the slack eliminating roller 21 of the yarn slack eliminating device 10 is exhausted. However, even if there remains no amount of slack, the degradation of the package 16 may be prevented depending on the spinning conditions if slack elimination can be restarted within a predetermined short time. Thus, it is contemplated an unwinding sensor may be provided which senses that the yarn Y has been completely unwound from the slack eliminating roller 21 so that a process of reducing the speed of the package 16 is executed a predetermined time after the yarn Y has been completely unwound, so as to increase the amount of slack retained on the slack eliminating roller 21 up to a predetermined value.

[0076] In this case, the previously described yarn tension detecting device 50 simply detects whether or not the amount of slack has a predetermined or larger value, using the switching member 54. The yarn tension detecting device 50 does not function as a sensor that detects that the yarn Y wound around the slack eliminating roller 21 has been completely unwound. Thus, for example, a touch sensor, a photoelectric switch, or a microswitch may be separately provided as an unwinding completion sensor to sense that the yarn path of the yarn Y has shifted to one established when the yarn Y is completely unwound from the slack eliminating roller 21 (see Figure 6).

[0077] In the present embodiment, during a spinning process executed by the spinning machine 1, when the yarn Y is completely unwound from the slack eliminating roller 21 for any reason, the unwinding completion sensor detects this and outputs an unwinding sensing signal to the unit controller 61. Upon receiving this signal, the unit controller 61 causes the timer to start clocking. Once a predetermined time has passed, the unit controller 61 outputs a control signal to the controller 62 to separate the package 16 from the rotating drum 13 to reduce the rotation speed of the package 16. Then, after the time required to increase the amount of slack up to a predetermined value has passed, the unit controller 61 brings the package 16 into contact with the rotating drum 13 again. The unit controller 61 then continues the normal winding process. Furthermore, as in the case of the previously described embodiments, the package separation time is adjusted in accordance with the winding diameter of the package 16.

[0078] The spinning machine 1 according to the present embodiment is set so that the yarn path established when the yarn is completely unwound from the slack eliminating roller 21 crosses the rotation locus surface of the bar-like member 22a of the unwinding tension applying member 22, provided in the yarn slack eliminating device 10, as shown in Figure 6. Consequently, when the speed of the package 16 is reduced to slack the yarn Y, the bar-like member 22a immediately engages with the yarn Y. The bar-like member 22a can then wind the yarn Y around the slack eliminating roller 21.

[Other Embodiments]

[0079] Re: Speed Reduction Control Means

[0080] Control means for reducing the rotation speed of the package 16 may be means for pivoting the cradle arm 14 to separate the package 16 from the rotating drum 13 to naturally reduce the rotation speed as described above.

[0081] Alternatively, as the control means for reducing the rotation speed of the package 16, braking means may be provided to apply a braking force to a support shaft of the bobbin 15 or a bobbin supporting section of the cradle arm 14 to force a reduction in the speed of the package 16. This braking means enables the magnitude of the braking force to be adjusted as the amount of speed reduction control. In this case, since the inertia moment varies depending on the winding diameter of the package

16, the braking force may be varied depending on the winding diameter of the package 16. Alternatively, a fixed braking force may be applied. However, in this case, the amount of decrease in package speed may vary. Accordingly, it is still necessary to provide adjusting means for adjusting the time for which the braking force is applied, in accordance with the winding diameter of the package 16.

[0082] Alternatively, if the rotative driving motor for the rotating drum 13 is provided for each spinning unit 2, it is possible to control the operation of the motor to reduce the speed of the package 16. However, in such an embodiment, a motor control means must be newly provided for each unit 2 so as to calculate an acceleration and deceleration pattern for the motor. On the other hand, if the time for which the package 16 remains separated from the rotating drum 13 is adjusted, it is only necessary to control the contact and separation of the package 16 with and from the rotating drum 13. Thus advantageously, a simple control form is implemented to reduce costs.

[0083] Re: Winding Diameter Detecting Means

[0084] Means for detecting the winding diameter of the package includes not only means for calculating the winding diameter from the winding time but also means for measuring the rotation speed of the bobbin 15, which supports the package 16, so that the winding diameter of the package 16 can be calculated from the rotation speed. Normally, the rotation speed of the bobbin 15 is controlled so that the yarn winding speed, that is, the peripheral speed of the package 16 is constant. Accordingly, the rotation speed of the bobbin 15 decreases gradually with increasing winding diameter of the package 16. Therefore, since the rotation speed of the bobbin 15 is closely correlated with the winding diameter of the package 16, the winding diameter of the package 16 can be calculated on the basis of the rotation speed of the bobbin 15.

[Other Embodiments]

[0085] The present invention is very effectively applied to the manufacture of cone packages. However, the present invention is also applicable to the manufacture of cheese packages in which the yarn Y is wound around the slack eliminating roller 21 in order to suppress a variation in winding tension.

[0086] As set forth in Claim 1, a yarn winder according to the present invention comprises a yarn slack eliminating device arranged between a supply side and a winding device to absorb a variation in winding tension. The yarn winder is provided with means for reducing a winding speed, means for detecting the winding diameter of a package, and adjusting means for adjusting the amount of speed reduction control provided by speed reduction control means, in accordance with the winding diameter of the package. It is thus possible to reliably prevent the loss of the slack retained on a slack eliminating roller of the yarn slack eliminating device. Furthermore, the amount of speed reduction control for the winding speed can be adjusted in accordance with the winding diameter of the package. Consequently, when the amount of slack is to be recovered, it can be increased by an appropriate value. This allows the yarn slack eliminating device to uniformly adjust the winding tension. It is therefore possible to easily obtain favorable packages that are uniformly wound. In particular, the present invention very effectively stabilizes the winding tension if it is applied to the manufacture of cone packages in which the winding speed is likely to vary because the winding diameter varies within one traverse.

[0087] As set forth in Claim 2, in the yarn winder according to the present invention, the speed reduction control means outputs a speed reduction control signal for the winding speed on the basis of the amount of yarn wound around the slack eliminating roller which amount is detected by winding amount detecting means. Accordingly, when the amount of slack decreases below a predetermined value, the winding speed of the winding device is reduced to reliably increase the amount of slack retained on the slack eliminating roller of the yarn slack eliminating device. This makes it possible to prevent the loss of a slacking yarn retained on the slack eliminating roller.

[0088] As set forth in Claim 3, in the yarn winder according to the present invention, the amount of slack retained on the slack eliminating roller of the yarn slack eliminating device is calculated on the basis of yarn tension detected by yarn tension detecting means provided immediately upstream of the slack eliminating roller. Consequently, the inexpensive and simple detecting means can be used to monitor the amount of slack. This eliminates the needs for an expensive non-contact sensor such as a pulse counter and a contact sensor that may produce adverse effects by contacting with the yarn on the roller.

[0089] As set forth in Claim 4, in the yarn winder according to the present invention, the speed reduction control means for the winding device comprises a mechanism that separates the package from a rotating drum. Furthermore, the adjusting means comprises a mechanism that adjusts the time for which the package remains separated from the rotating drum. Consequently, the simple control form can be used to appropriately reduce the speed of the package. Therefore, costs can be reduced.

[0090] As set forth in Claim 5, in the yarn winder according to the present invention, if a traverse device has a traverse guide, the speed reduction control means comprises separation control means for separating the package from the rotating drum so as not to disengage the wound yarn from the traverse guide. It is thus possible to reliably perform an operation of traversing the yarn while reducing the winding speed.

[0091] As set forth in Claim 6, the traverse guides provided for the respective winding devices are driven by a common driving shaft so as to enable a plurality of packages to be simultaneously formed. If it is possible to in-

dividually control the distance between each of the plurality of packages and the corresponding traverse guide as well as the rotation speed of the package, the winding angle and turn position of each package can be individually controlled.

[0092] Consequently, if a plurality of packages are simultaneously formed, optimum settings can be made in accordance with the conditions of each package.

[0093] As set forth in Claim 7, in the yarn winder according to the present invention, the separation control means for separating the package from the traverse guide is also used as the speed reduction control means for reducing the rotation speed of the package. This enables the structure of the device to be simplified. Advantageously, the employment of this arrangement allows the arrangement set forth in Claim 6 to be easily implemented.

Claims

1. A yarn winder (12) comprising a winding device that winds a yarn fed by a supply side into a package (16) and yarn slack eliminating device (10) having a slack eliminating roller (21) that winds a part of the yarn located between said supply side and said winding device to absorb a variation in winding tension, the yarn winder being **characterized by** being provided with speed reduction control means for controlling a winding speed so that the winding speed is lower than a supply speed, winding diameter detecting means for said package (16), and adjusting means for adjusting the amount of speed reduction executed by said speed reduction control means, in accordance with the winding diameter of the package.

2. A yarn winder according to Claim 1, **characterized** being provided with winding amount detecting means for detecting the amount of yarn wound around said slack eliminating roller (21) and in that on the basis of the winding amount detected by the detecting means, said speed reduction control means outputs a speed reduction control signal for said winding speed.

3. A yarn winder according to Claim 2, **characterized in that** said winding amount detecting means is provided immediately upstream of the slack eliminating roller (21), comprises yarn tension detecting means for detecting a yarn tension immediately before the yarn is wound around the slack eliminating roller, and calculates the amount of slack retained on said slack eliminating roller on the basis of the yarn tension detected by the yarn tension detecting means.

4. A yarn winder according to any one of Claims 1 to 3, **characterized in that** said winding device comprises a rotating drum (13) that rotates in contact with the package (16) to rotatively drive the package, and said speed reduction control means comprises a mechanism that separates the package from the rotating drum, and said adjusting means comprises a mechanism that adjusts a time for which the package remains separated, as the amount of speed reduction executed by the speed reduction control means.

5. A yarn winder according to Claim 4, **characterized in that** said winding device comprises a traverse device (70) having a traverse guide, and said speed reduction control means comprises separation control means for separating the package from the rotating drum so as not to disengage the wound yarn from the traverse guide.

6. A yarn winder according to Claim 5, **characterized in that** a plurality of winding devices are arranged in parallel, and the traverse guides provided for the respective winding devices are driven by a common driving shaft so as to simultaneously form a plurality of packages, and said separation control means and said speed reduction control means can individually control a distance from each of said plurality of packages to the corresponding traverse guide and a rotation speed of the package, respectively.

7. A yarn winder according to Claim 5 or Claim 6, **characterized in that** while separating the package from the traverse guide of said traverse device, said separation control means also separates the package from the rotating drum to reduce the rotation speed of the package.

Patentansprüche

1. Fadenspulmaschine (12), bestehend aus einer Spulvorrichtung, die einen Faden, der von einer Lieferseite zu einer Auflaufspule (16) zugeführt wird, aufspult, und einer Fadendurchhang-Beseitigungsvorrichtung (10) mit einer Durchhangbeseitigungsrolle (21), die einen Teil des Fadens, der sich zwischen der Lieferseite und der Spulvorrichtung befindet, aufspult, um eine Änderung der Aufspulspannung zu absorbieren, **gekennzeichnet durch** eine Geschwindigkeitsreduktions-Steuereinrichtung zur Steuerung der Aufspulgeschwindigkeit derart, dass diese niedriger als die Liefergeschwindigkeit ist, eine Aufspuldurchmesser-Ermittlungseinrichtung für die Auflaufspule (16), und eine Einstelleinrichtung zum Einstellen der Größe der Geschwindigkeitsreduktion, die von der Geschwindigkeitsreduktions-Steuereinrichtung entsprechend dem Aufspuldurchmesser der Auflaufspule durchgeführt wird.

2. Fadenspulmaschine nach Anspruch 1 **gekenn-**

zeichnet durch eine Mengenermittlungseinrichtung zur Ermittlung der auf die Durchhangbeseitigungsrolle (21) aufgespulten Fadenmenge, und **dadurch** dass auf der Grundlage der von der Ermittlungseinrichtung ermittelten Aufspulmenge die Geschwindigkeitsreduktions-Steuereinrichtung ein Geschwindigkeitsreduktions-Steuersignal für die Aufspulgeschwindigkeit ausgibt.

3. Fadenspulmaschine nach Anspruch 2, **dadurch gekennzeichnet, dass** die Aufspulmengen-Ermittlungseinrichtung unmittelbar stromaufwärts der Durchhangbeseitigungsrolle (21) angeordnet ist, eine Fadenspannungs-Ermittlungseinrichtung zur Ermittlung der Fadenspannung unmittelbar, bevor der Faden auf die Durchhangbeseitigungsrolle aufgespult wird, aufweist, und die auf der Durchhangbeseitigungsrolle aufgenommene Durchhangmenge auf der Grundlage der Fadenspannung berechnet, die von der Fadenspannungs-Ermittlungseinrichtung ermittelt wird.

4. Fadenspulmaschine nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** die Aufspulvorrichtung eine Rolle (13) aufweist, die sich in Kontakt mit der Auflaufspule (16) dreht, um die Auflaufspule zu drehen, und dass die Geschwindigkeitsreduktions-Steuereinrichtung einen Mechanismus aufweist, der die Auflaufspule von der Trommel trennt, und dass die Einstelleinrichtung einen Mechanismus aufweist, der eine Zeit, während der die Auflaufspule getrennt bleibt, als Geschwindigkeitsreduktionsgröße einstellt, die von der Geschwindigkeitsreduktions-Steuereinrichtung durchgeführt wird.

5. Fadenspulmaschine nach Anspruch 4, **dadurch gekennzeichnet, dass** die Spulvorrichtung eine Traversiervorrichtung (70) mit einer Traversierführung aufweist, und dass die Geschwindigkeitsreduktions-Steuereinrichtung eine Trennungssteuereinrichtung zum Trennen der Auflaufspule von der Trommel aufweist, um den aufgespulten Faden nicht von der Traversierführung zu lösen.

6. Fadenspulmaschine nach Anspruch 5, **dadurch gekennzeichnet, dass** mehrere Spulvorrichtungen parallel angeordnet sind, und dass die für die jeweiligen Spulvorrichtungen vorgesehenen Traversierführungen von einer gemeinsamen Antriebswelle angetrieben werden, um gleichzeitig mehrere Auflaufspulen zu bilden, und dass die Trennsteuereinrichtung und die Geschwindigkeitsreduktions-Steuereinrichtung eine Strecke von jeder der Auflaufspulen zu der entsprechenden Traversierführung bzw. die Drehgeschwindigkeit der Auflaufspule individuell steuern kann.

7. Fadenspulmaschine nach Anspruch 5 oder 6, **dadurch gekennzeichnet, dass** während der Trennung der Auflaufspule von der Traversierführung der Traversiervorrichtung die Trennungssteuereinrichtung auch die Auflaufspule von der Trommel trennt, um die Drehgeschwindigkeit der Auflaufspule zu reduzieren.

Revendications

1. Bobinoir pour fil (12) comprenant un dispositif de bobinage qui enroule un fil amené par un côté d'alimentation en un enroulement (16) et un dispositif (10) d'élimination de relâchement de fil ayant un rouleau d'élimination de relâchement (21) qui enroule une partie du fil placée entre ledit côté d'alimentation et ledit dispositif de bobinage pour absorber une variation de la tension de bobinage, le bobinoir pour fil étant **caractérisé en ce qu'**il est muni d'un moyen de commande de réduction de vitesse pour la commande d'une vitesse de bobinage de sorte que la vitesse de bobinage est inférieure à une vitesse d'alimentation, des moyens de détection de diamètre de bobinage pour ledit enroulement (16) et un moyen d'ajustement pour ajuster l'ampleur de la réduction de vitesse exécutée par ledit moyen de commande de réduction de vitesse, selon le diamètre de bobinage de l'enroulement.

2. Bobinoir pour fil selon la revendication 1, **caractérisé en ce qu'**il est muni d'un moyen de détection d'ampleur de bobinage pour la détection de la quantité de fil enroulé autour du rouleau d'élimination de relâchement (21) et **en ce que** sur la base de la quantité de bobinage détectée par le moyen de détection, ledit moyen de commande de réduction de vitesse émet un signal de commande de réduction de vitesse pour ladtie vitesse de bobinage.

3. Bobinoir pour fil, selon la revendication 2, **caractérisé en ce que** ledit moyen de détection d'ampleur de bobinage est disposé juste en amont du rouleau d'élimination de relâchement (21), comprend le moyen de détection de tension de fil pour détecter une tension de fil juste avant que le fil soit bobiné autour du rouleau d'élimination de relâchement et calcule la quantité de relâchement retenue sur ledit rouleau d'élimination de relâchement sur la base de la tension de fil détectée par le moyen de détection de tension de fil.

4. Bobinoir pour fil selon l'une des revendication 1 à 3, **caractérisé en ce que** ledit dispositif de bobinage comprend un tambour de rotation (13) qui tourne en contact avec l'enroulement (16) pour entraîner en

rotation l'enroulement et ledit moyen de commande de réduction de vitesse comprend un mécanisme qui sépare l'enroulement du tambour de rotation et ledit moyen d'ajustement comprend un mécanisme qui sépare l'enroulement du tambour de rotation et ledit moyen d'ajustement comprend un mécanisme qui ajuste une durée pendant laquelle l'enroulement reste séparé, et ce, en tant qu'ampleur de la réduction de vitesse exécutée par le moyen de commande de réduction de vitesse.

5. Bobinoir pour fil selon la revendication 4, **caractérisé en ce que** ledit dispositif de bobinage comprend un dispositif de course (70) ayant un guide de course de fil et ledit moyen de commande de réduction de vitesse comprend un moyen de commande de séparation pour la séparation de l'enroulement du tambour de rotation de manière à ne pas désengager du guide de course de fil le fil enroulé.

6. Bobinoir pour fil selon la revendication 5, **caractérisé en ce qu'**une pluralité de dispositifs d'enroulement sont disposés parallèlement et les guides de course de fil prévus pour les dispositifs de bobinage respectifs sont entraînés par un arbre d'entraînement commun de manière à former simultanément une pluralité d'enroulement et ledit moyen de commande de séparation et le moyen de commande de réduction de vitesse peut commander individuellement une distance entre chaque enroulement et le guide de course de fil correspondant et respectivement une vitesse de rotation de l'enroulement.

7. Bobinoir pour fil selon la revendication 5 ou 6, **caractérisé en ce que** tout en séparant l'enroulement du guide de course de fil dudit dispositif de course de fil, ledit moyen de commande de séparation sépare du tambour de rotation également l'enroulement pour réduire la vitesse de rotation de l'enroulement.

FIG. 1

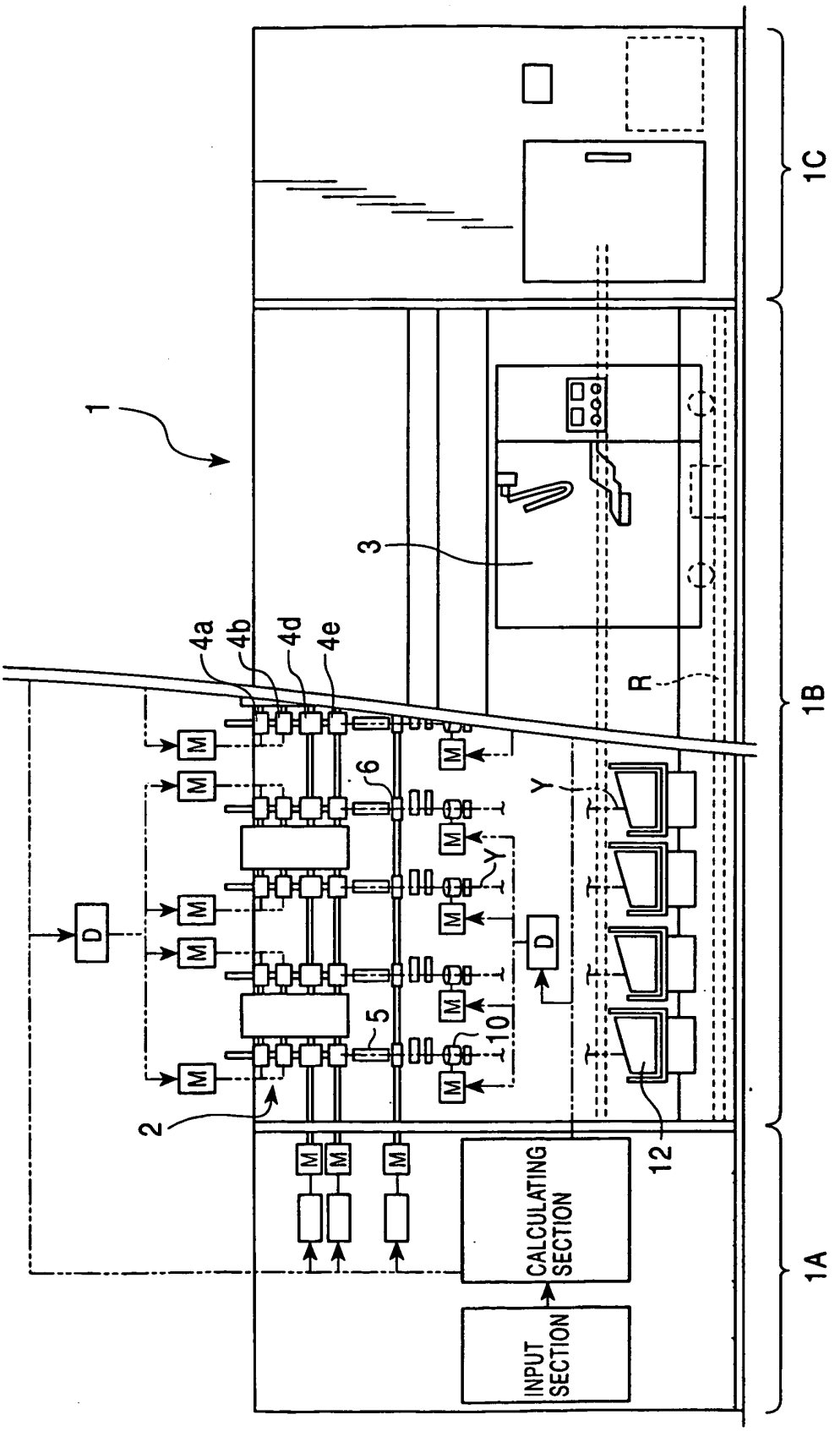
1
1A
1B
1C
2
3
4a
4b
4d
4e
5
6
10
12
R
Y
Y'
M
D
CALCULATING SECTION
INPUT SECTION

FIG. 2

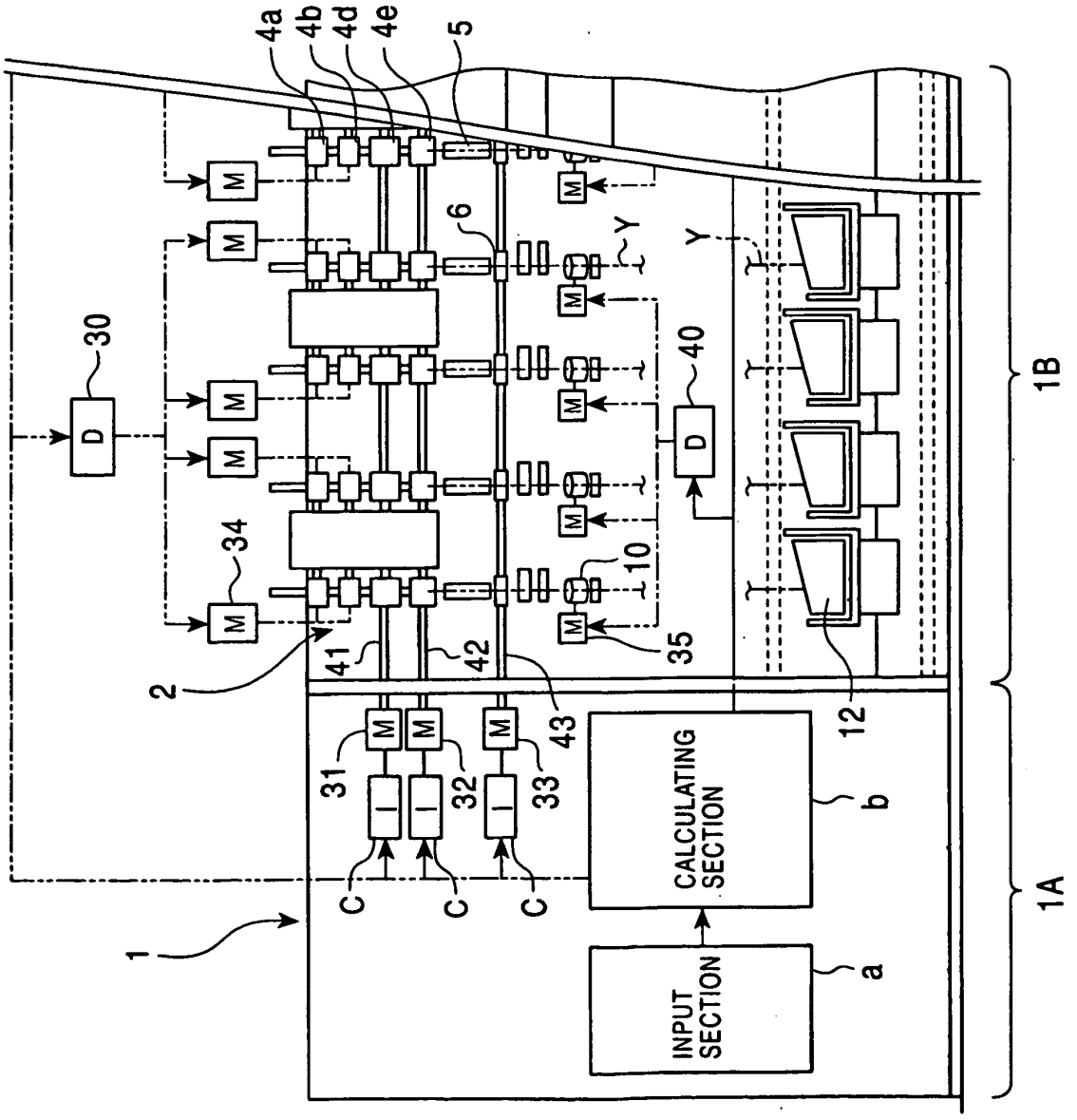
4a
4b
4d
4e
5
6
Y
Y
30
40
34
10
35
41
42
43
2
31
32
33
C
C
C
12
CALCULATING SECTION
b
INPUT SECTION
a
1
1A
1B
M
D
I

FIG. 3

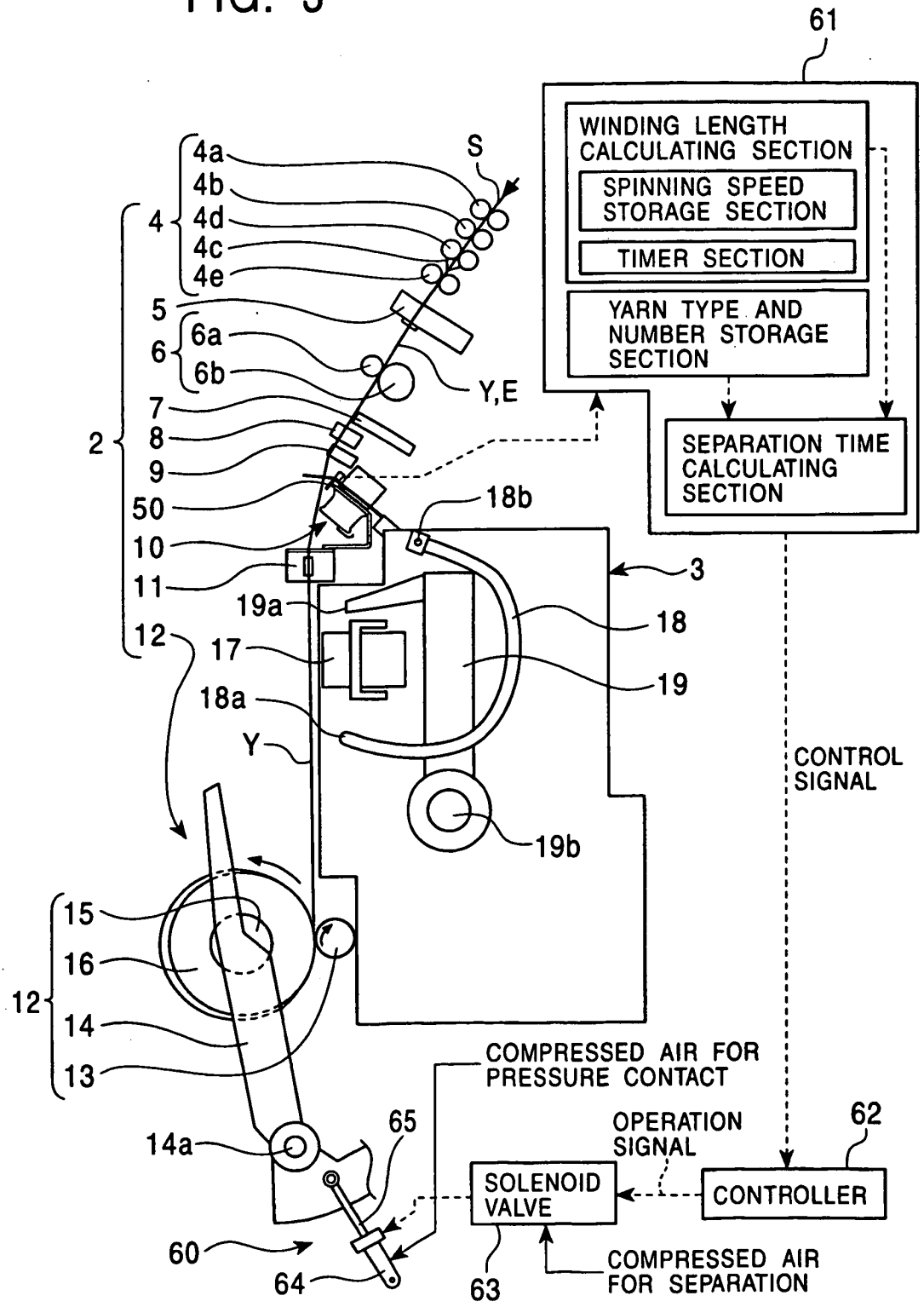
61
WINDING LENGTH CALCULATING SECTION
SPINNING SPEED STORAGE SECTION
TIMER SECTION
YARN TYPE AND NUMBER STORAGE SECTION
SEPARATION TIME CALCULATING SECTION
S
4a
4b
4d
4c
4e
4
5
6
6a
6b
Y,E
7
8
9
50
10
11
2
18b
3
19a
18
17
19
12
18a
Y
CONTROL SIGNAL
19b
15
16
12
14
13
COMPRESSED AIR FOR PRESSURE CONTACT
65
OPERATION SIGNAL
62
14a
SOLENOID VALVE
CONTROLLER
60
64
63
COMPRESSED AIR FOR SEPARATION

FIG. 4

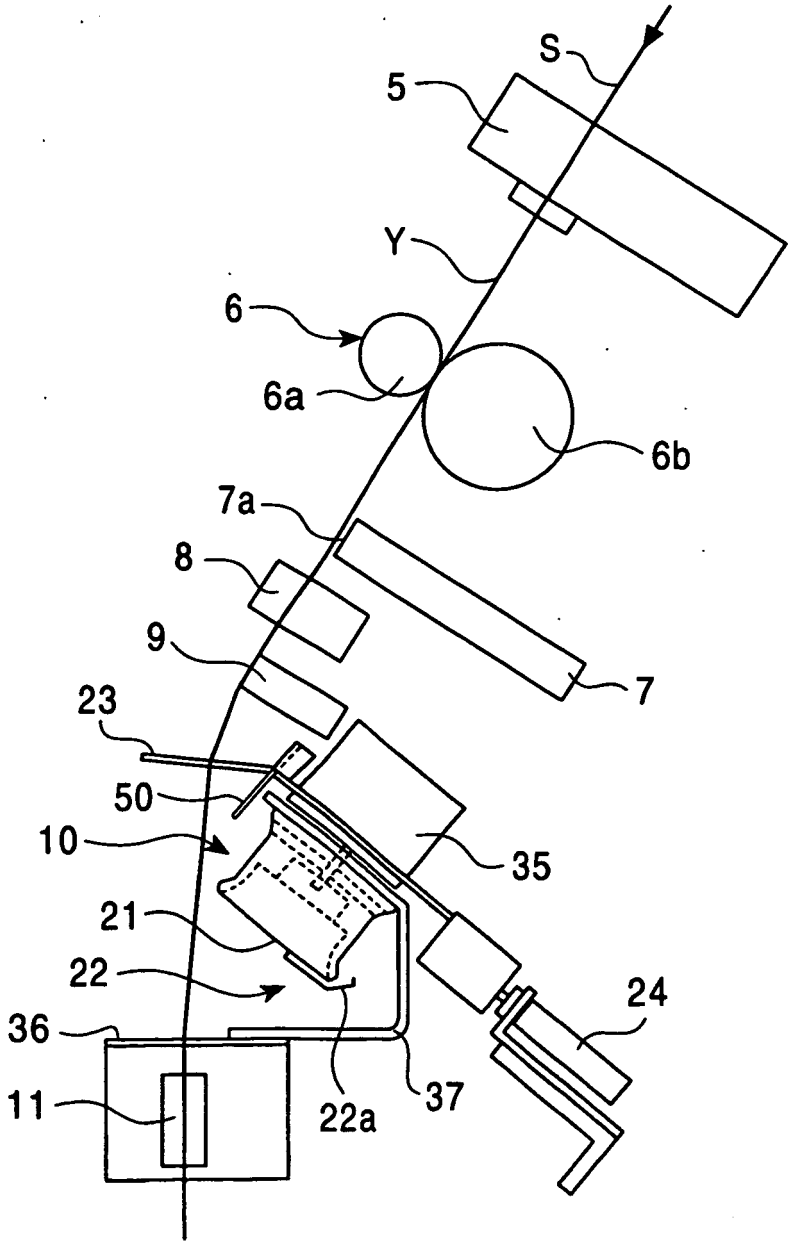

FIG. 5

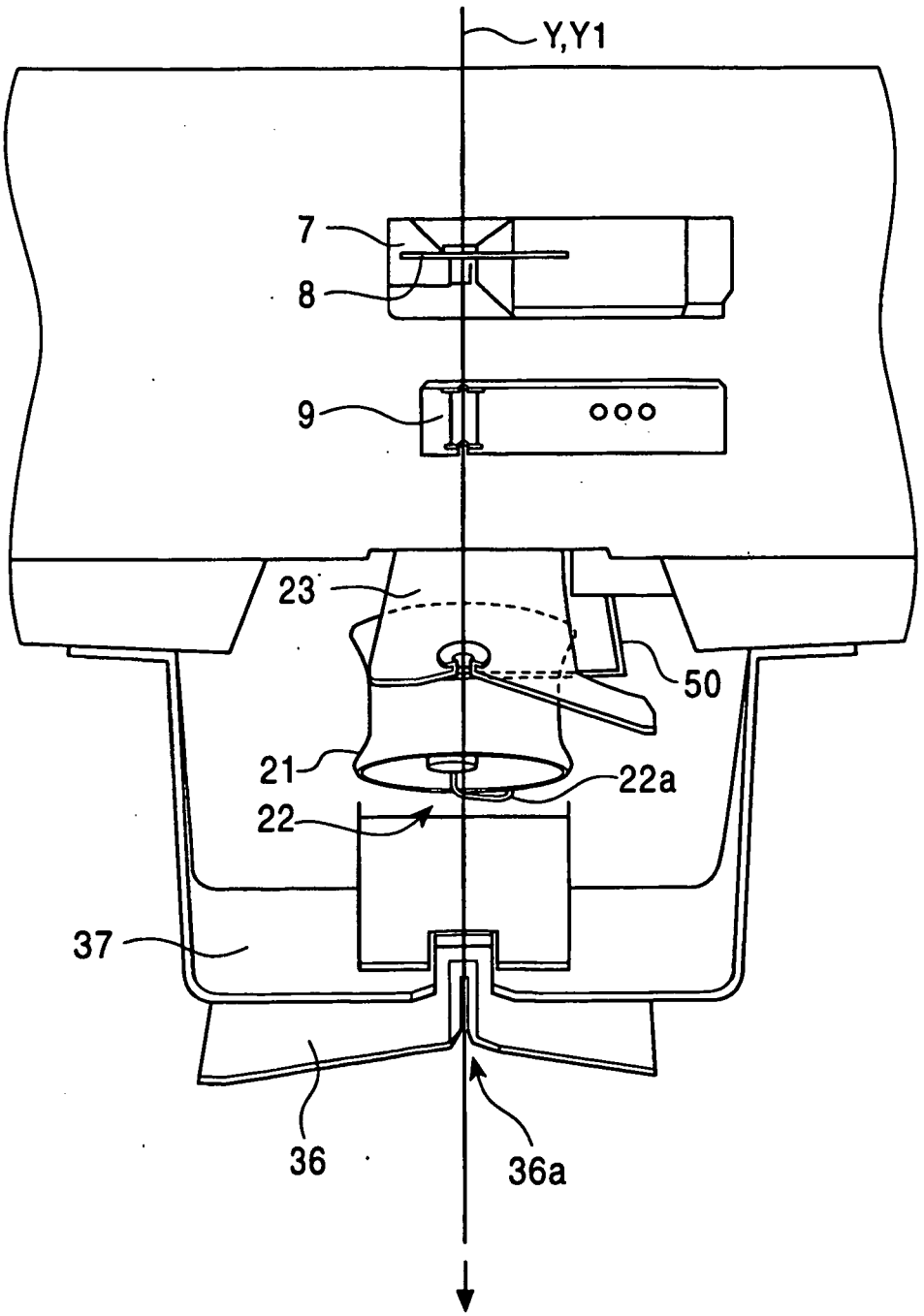

FIG. 6

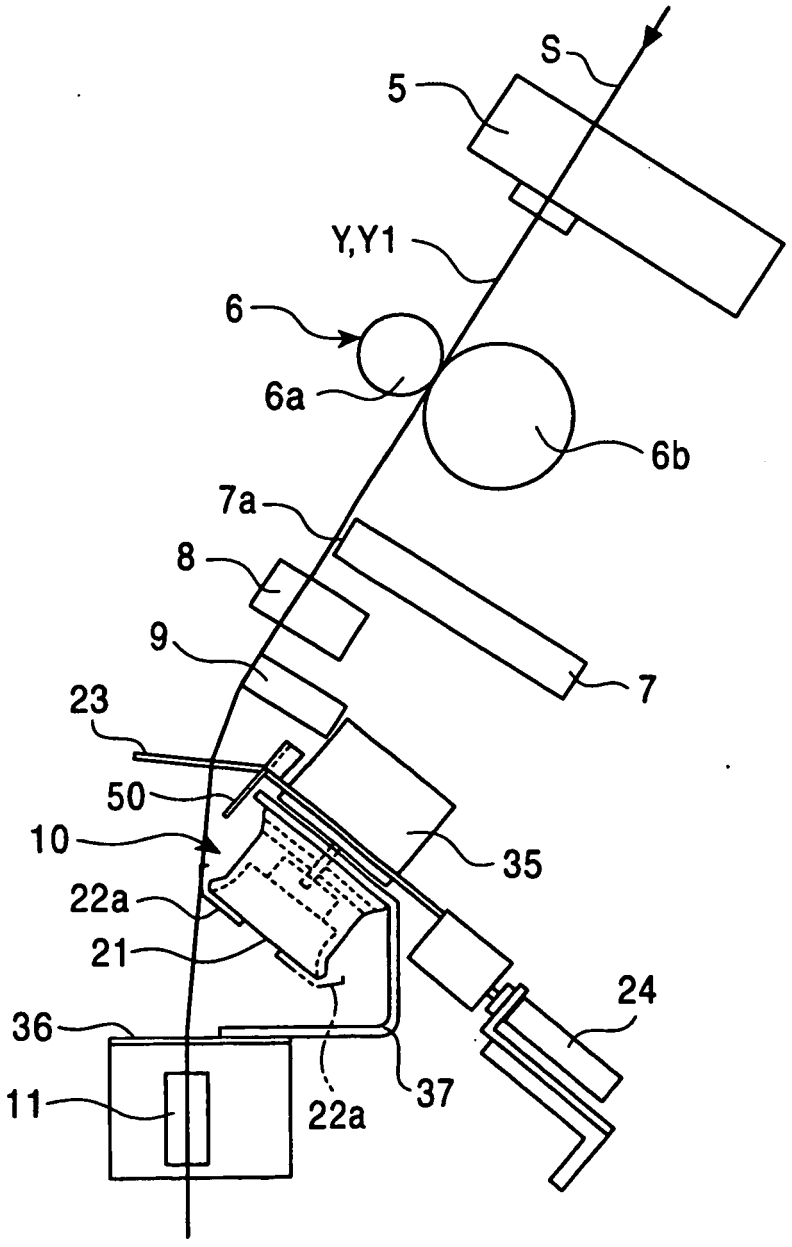

FIG. 7

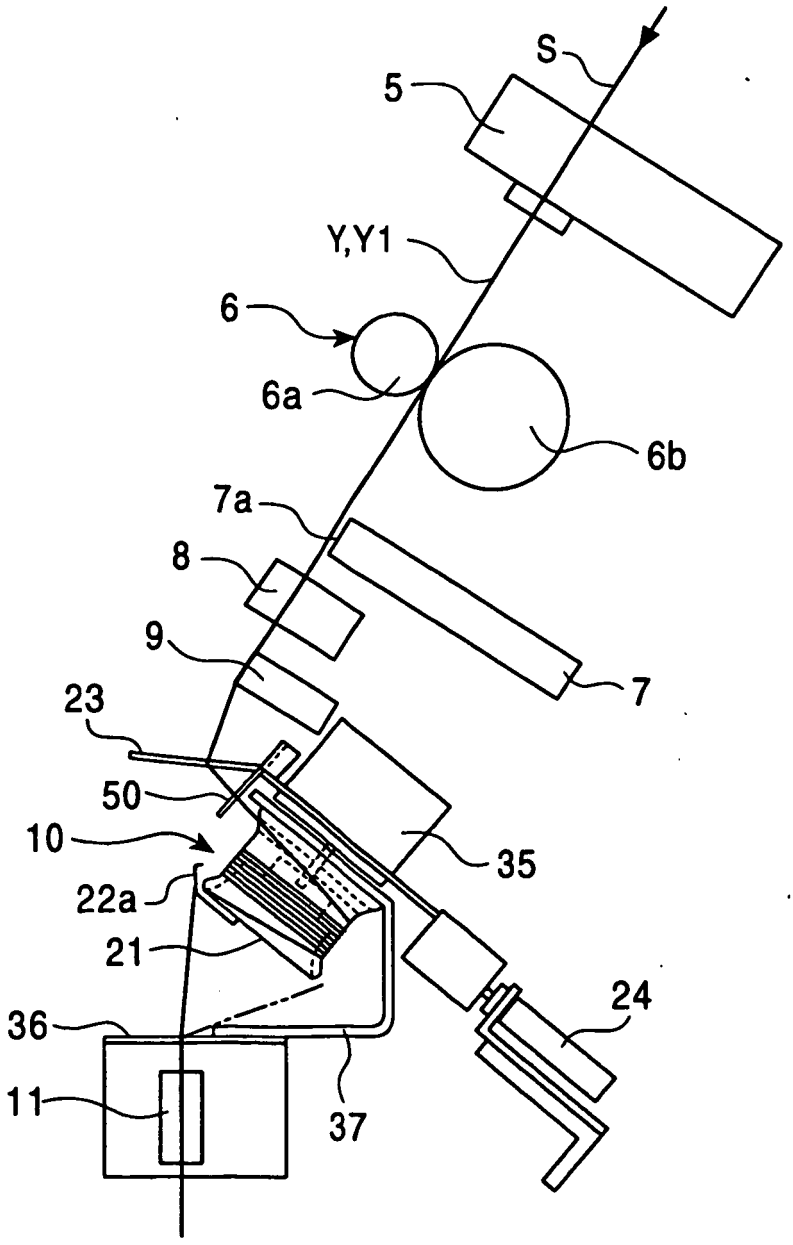

FIG. 8

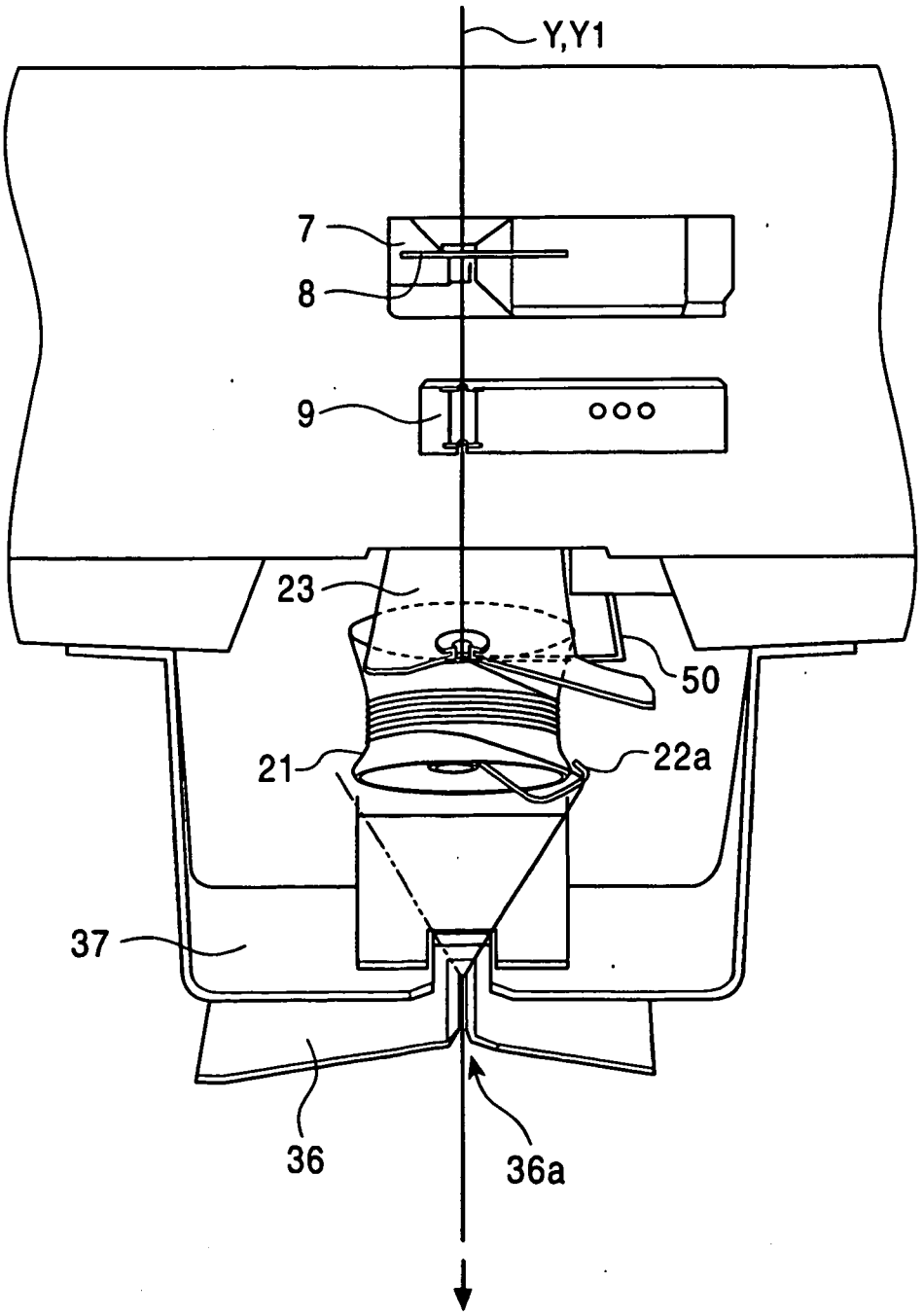

FIG. 9

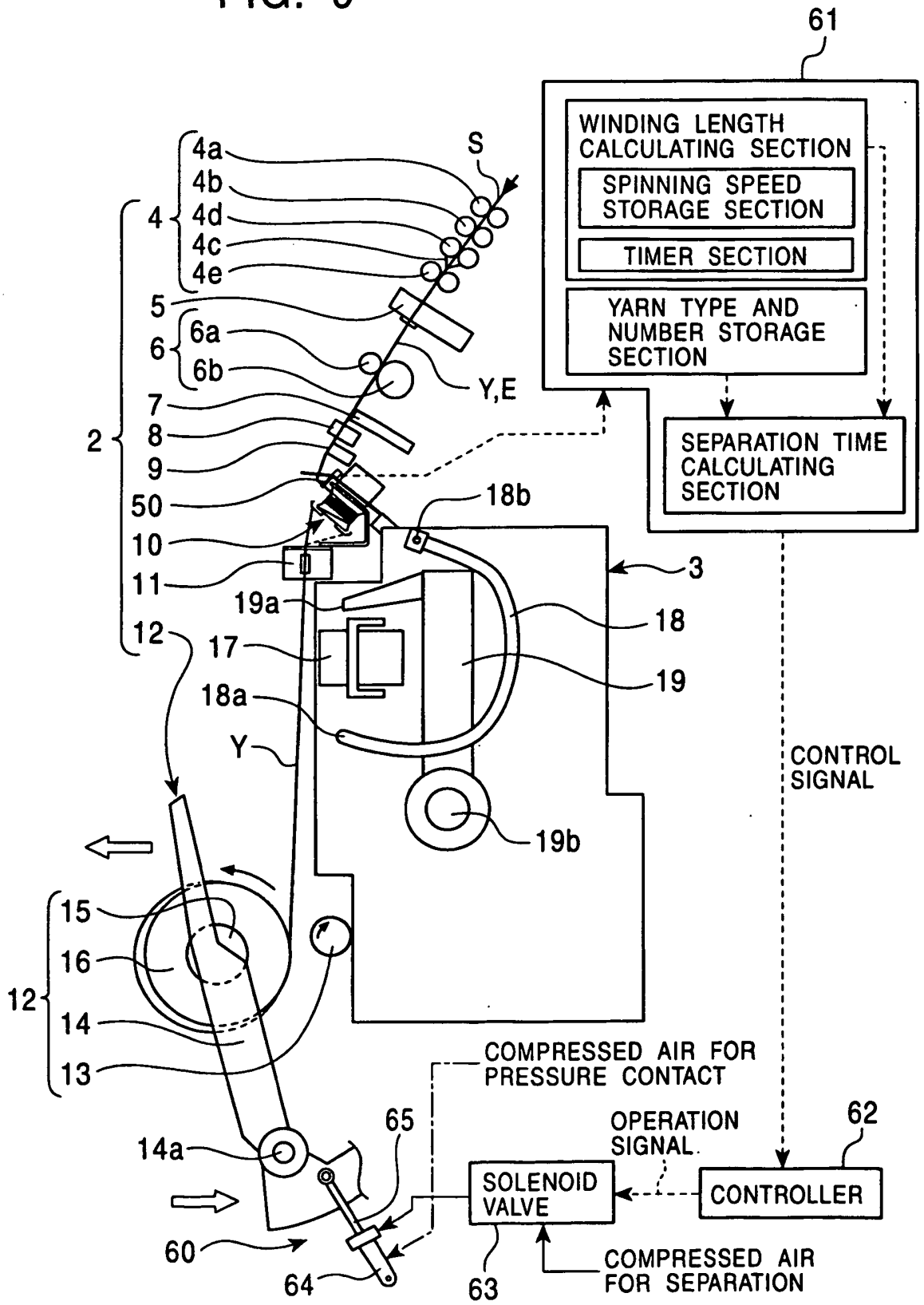
61
WINDING LENGTH CALCULATING SECTION
SPINNING SPEED STORAGE SECTION
TIMER SECTION
YARN TYPE AND NUMBER STORAGE SECTION
SEPARATION TIME CALCULATING SECTION
4a
4b
4d
4c
4e
4
S
5
6a
6b
6
Y,E
7
8
9
50
10
11
2
12
18b
3
19a
18
17
19
18a
Y
19b
CONTROL SIGNAL
15
16
12
14
13
COMPRESSED AIR FOR PRESSURE CONTACT
65
OPERATION SIGNAL
62
14a
SOLENOID VALVE
CONTROLLER
60
64
63
COMPRESSED AIR FOR SEPARATION

FIG. 10

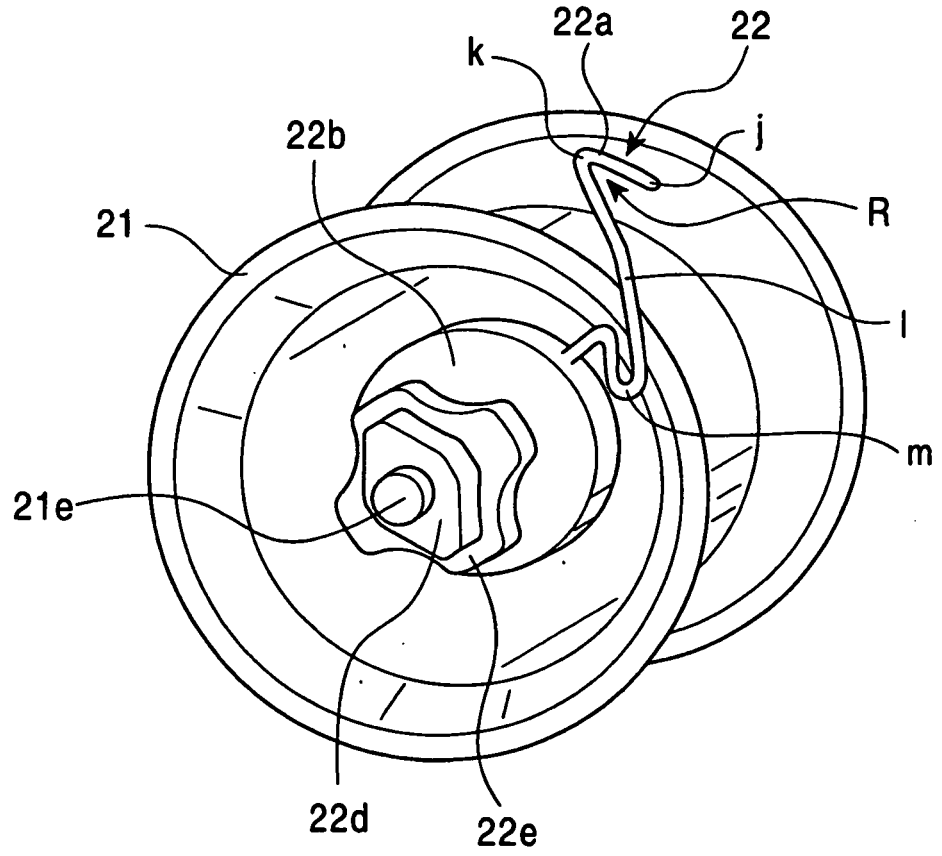

FIG. 11A

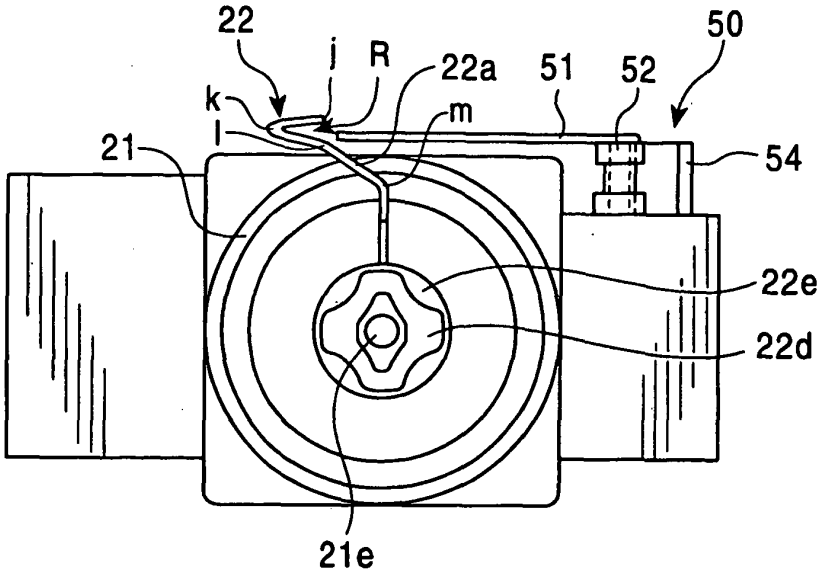

FIG. 11B

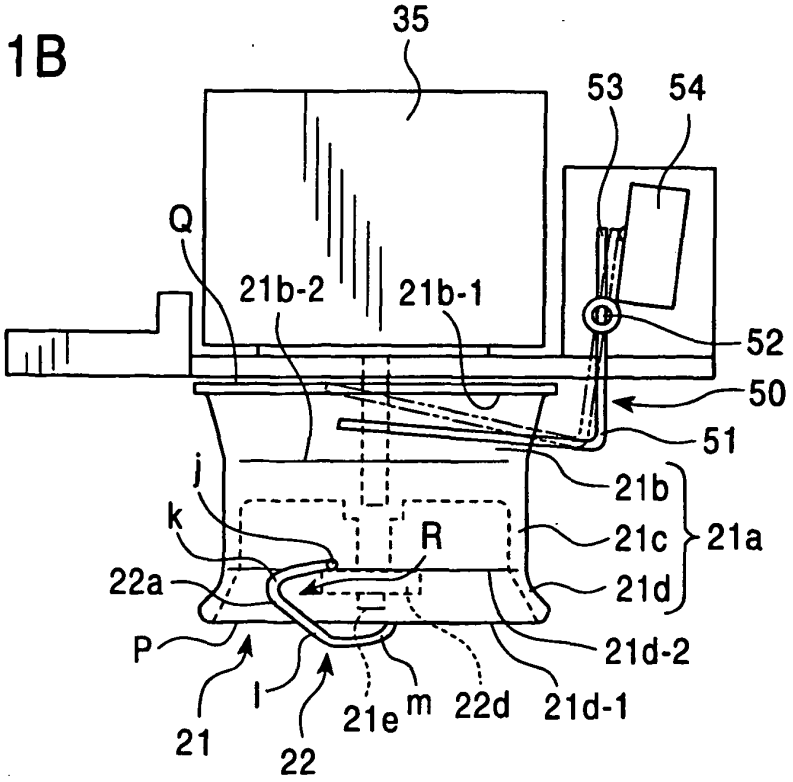

FIG. 12

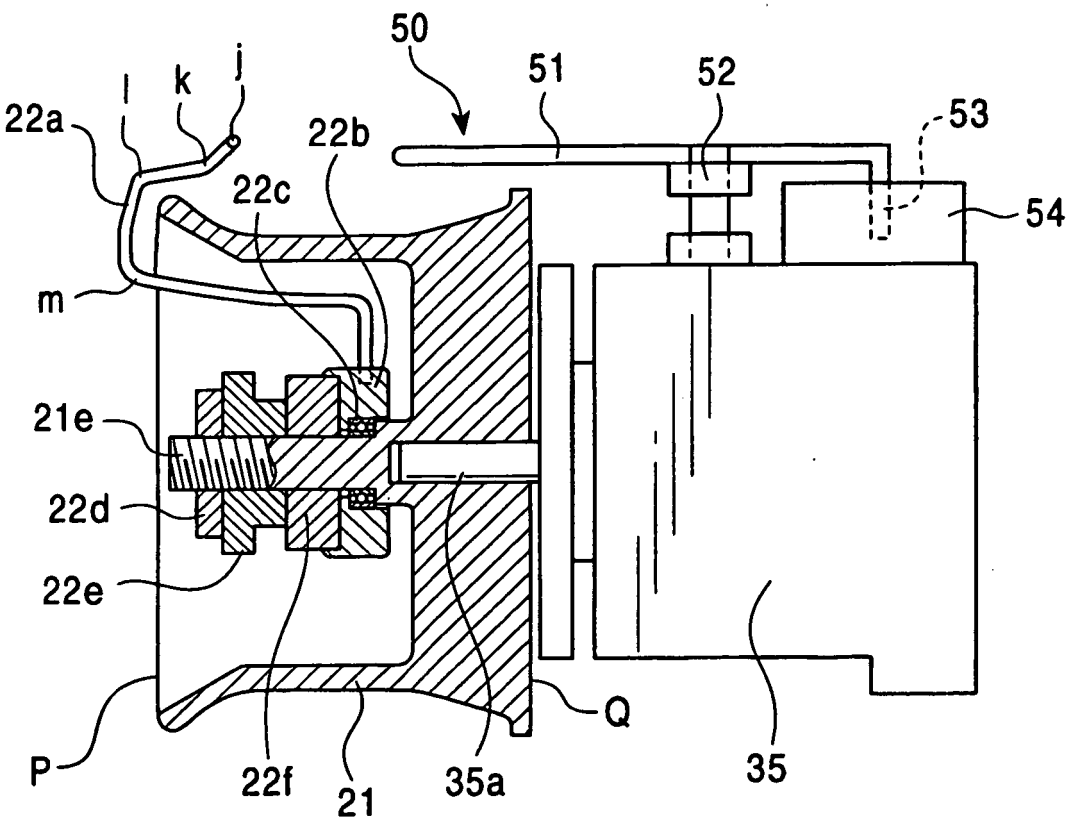

FIG. 13A

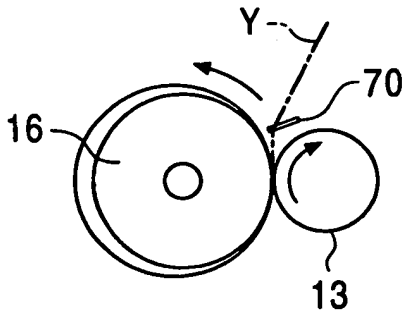

FIG. 13B

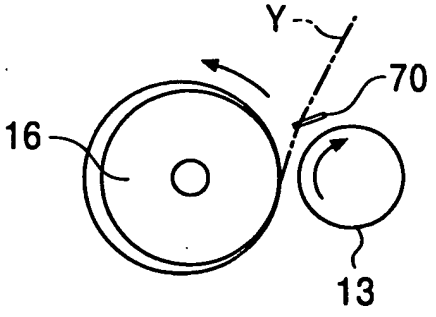

FIG. 13C

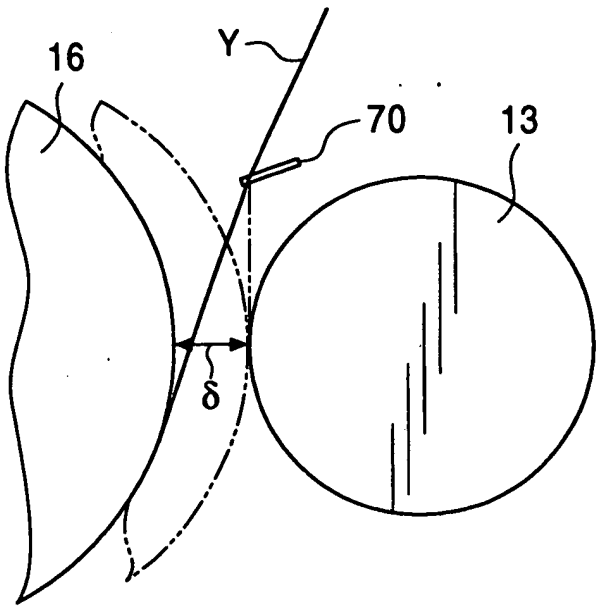

FIG. 14A

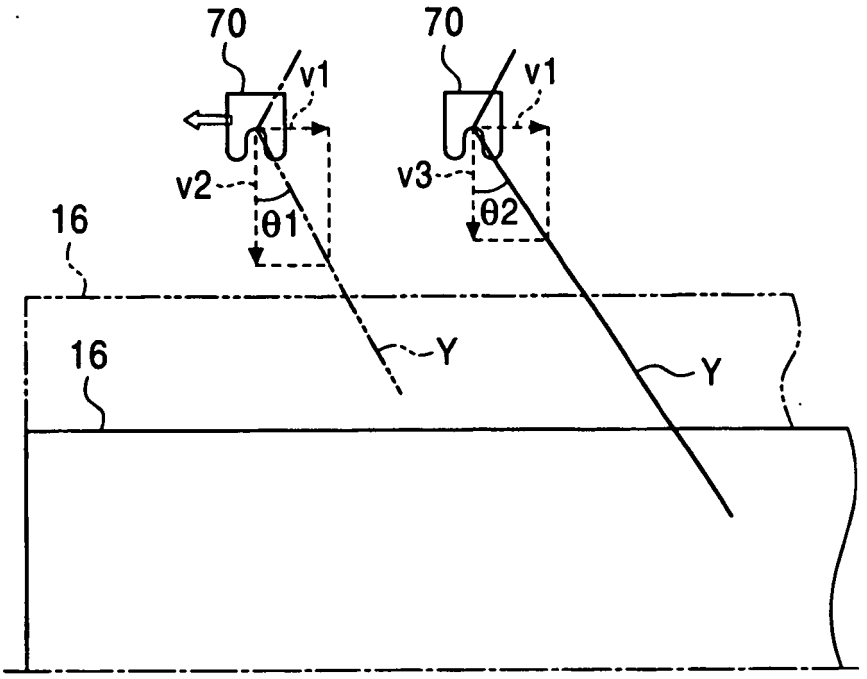

FIG. 14B