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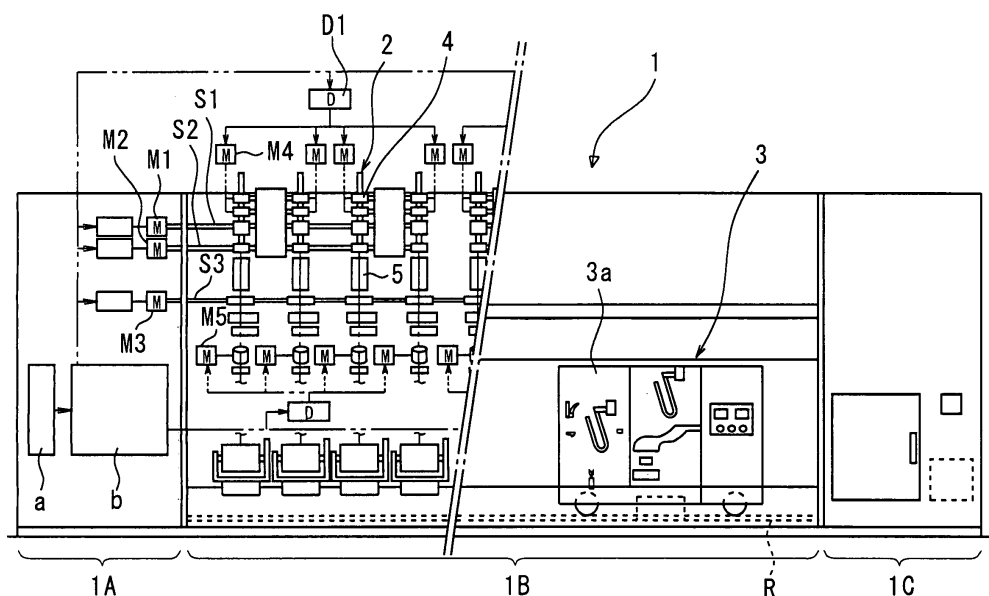
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(54) **Spinning machine with a slack eliminating device**

(57) According to the present invention, there is provided a spinning machine having a spinning device 5 that generates and spins a yarn Y from a bundle of supplied fibers F and a bunch winding machine 19, the spinning machine being provided with a slack eliminating device 10 that retains and absorbs the slack of the yarn between a suction pipe 17 and the spinning device 5 when the yarn is guided to the bobbin holder 14b1 for a bunch winding operation. Furthermore, the running of the yarn fed by the spinning device 5 is substantially

stopped near the bobbin holder. The spinning machine is provided with the slack eliminating roller 21 that retains and absorbs the slack of the yarn between the yarn catching means and the spinning device when the yarn is caught to the bobbin holder for a bunch winding operation, and the running of the yarn fed by the spinning device is substantially stopped near the bobbin holder. Therefore, compared to conventional bunch winding executed on a bobbin rotated in contact with a friction roller at a high speed, the success rate of bunch winding can be improved (Fig. 7).

FIG.1



Description

Field of the Invention

[0001] The present invention relates to a spinning machine comprising a bunch winding device that subjects an empty bobbin to bunch winding during a doffing operation.

Background of the Invention

[0002] A spinning machine has hitherto been known which has a bunch winding device operating as follows. A yarn fed by a spinning machine that generates a yarn is sucked and caught in a suction nozzle. Then, a yarn handling member is moved in a horizontal direction to deliver the yarn to a yarn holding member disposed near an end of an empty bobbin held by a bobbin holding member. Subsequently, a yarn end guiding member is moved downward to move the yarn extended between the yarn holding member and the suction nozzle to the vicinity of a bobbin holder. The yarn is thus caught in a notch portion formed in the bobbin holder and then cut to execute bunch winding on the empty bobbin.

[0003] An example of a spinning machine having a bunch winding device such as the one described above is disclosed in the Japanese Utility Model Application Publication (Jikko-Hei) No. 6-38043.

[0004] With the above described conventional spinning machine, a yarn speed used for bunch winding is equal to a normal spinning (feeding) speed. A bunch winding operation may fail when the following operation is performed on the yarn being run and moved at the normal, high spinning speed: an operation performed by the yarn handling member to deliver the yarn to the yarn holding member by moving in the horizontal direction, or an operation performed by the yarn end guiding member to engage the bobbin holder with the yarn extended between the yarn holding member and the suction nozzle and to transfer the yarn to the bobbin holder. That is, the yarn delivering operation, the transferring operation, or the like is not appropriately preformed when the yarn handling member, the yarn holding member, and the yarn end guide member are not rigorously arranged or when operational timings for them are not strict. This is a serious problem particularly with high-speed spinning machines operating at high spinning speeds.

[0005] It is an object of the present invention to solve the problems of spinning machines having the above described conventional bunch winding device.

Summary of the Invention

[0006] According to the present invention, to accomplish this object, a spinning machine is provided which has a spinning device that generates and spins a yarn from a bundle of supplied fibers and a bunch winding machine. First, the spinning machine is provided with a

slack eliminating roller that retains and absorbs a slack of a yarn between a yarn catching means and the spinning device and a yarn catching member that catches a yarn to the slack eliminating roller to wind a slacking yarn around the slack eliminating roller, and control is provided such that the bunch winding device catches the yarn to the bobbin holder after the yarn has been caught to the slack eliminating roller and wound around the slack eliminating roller.

[0007] Second, the slack eliminating device has a yarn tension applying member that applies a predetermined tension to a yarn supplied by the slack eliminating device to the bunch winding position during bunch winding for a bunch winding operation.

[0008] Third, the slack eliminating device has a slack eliminating roller around which the slacking yarn is wound, and the yarn tension applying member is an unwinding tension applying member which can rotate concentrically with the slack eliminating roller and which rotates synchronously with the slack eliminating roller when a load of a predetermined value or smaller acts on the yarn tension applying member and rotatively moves independently of the slack eliminating roller when a load of larger than the predetermined value acts on the yarn tension applying member, to apply a predetermined yarn tension to the yarn being unwound from the slack eliminating roller.

[0009] Fourth, a transmitted force adjusting mechanism is provided between the slack eliminating roller and the unwinding tension applying member to transmit rotative driving from the slack eliminating roller to the unwinding tension applying member, and the transmitted force adjusting mechanism has a transmitted force adjustment operating section provided at a junction between the slack eliminating roller and the unwinding tension applying member to set the magnitude of a transmitted force.

[0010] Fifth, the spinning machine further comprises a winding device that winds a yarn spun by the spinning device into a package, and a yarn speed limit driving device that sets, before bunch winding, a speed for an amount of yarn corresponding to a predetermined number of windings counted from start of winding to be lower than a winding speed for normal winding.

[0011] Sixth, the yarn speed limit driving device comprises a rotatively drivable roller and an arm member that enables the roller to be moved between a position where the roller abuts against the bobbin and a standby position.

[0012] Seventh, the roller of the yarn speed limit driving device, while having its rotative driving stopped, abuts against a full package to stop an inertial rotation of the full package.

[0013] Eighth, the bunch winding is formed on a cone bobbin.

Brief Description of the Drawings

[0014]

Figure 1 is a schematic front view of a spinning machine according to the present invention.

Figure 2 is a schematic side view of a spinning unit and a work carriage constituting the spinning machine according to the present invention.

Figure 3 is another schematic side view of the spinning unit and work carriage constituting the spinning machine according to the present invention.

Figure 4 is a partly enlarged side view of a low-speed rotative driving device and others constituting the spinning machine according to the present invention.

Figure 5 is a perspective view of a bunch winding device and others constituting the spinning machine according to the present invention.

Figure 6 is a partial vertical sectional view of the bunch winding device and others constituting the spinning machine according to the present invention.

Figure 7 is a partial enlarged sectional view of the spinning unit and others constituting the spinning machine according to the present invention.

Figure 8 is a partial perspective view of the vicinity of a yarn slack eliminating device constituting the spinning machine according to the present invention as viewed from the front of the spinning machine.

Figure 9 is a perspective view of a slack eliminating roller and others constituting the spinning machine according to the present invention.

Figure 10 is a vertical side sectional view of the slack eliminating roller and others of the yarn slack eliminating device constituting the spinning machine according to the present invention.

Figure 11 is a partly enlarged side view similar to Figure 7, showing the spinning unit and others constituting the spinning machine according to the present invention.

Figure 12A is a partly enlarged side view of the yarn slack eliminating device and others constituting the spinning machine according to the present invention, and Figure 12B is a front view of the slack eliminating roller and others in Figure 12A.

Figure 13 is a partial perspective view similar to Figure 8, showing the vicinity of the yarn slack eliminating device constituting the spinning machine according to the present invention as viewed from the front of the spinning machine.

Figure 14 is a driving timing chart for a separating member, the low-speed rotative driving device, a back roller, a movable guide, and the slack eliminating roller all constituting the spinning machine of the present invention.

Detailed Description of the Preferred Embodiment

[0015] An embodiment of the present invention will be described below. However, the present invention is not limited to the present embodiment. Changes or variations may be made to the embodiment without departing from the spirits of the present invention.

[0016] A spinning machine according to the present invention will be described below with reference to an example in which a yarn splicing device is disposed on a work carriage running along the spinning machine. In the specification, the term "upstream" or "downstream" is based on a direction in which a yarn runs during spinning. Specifically, a spinning device side will be referred to as an "upstream side", whereas a winding device side will be referred to as a "downstream side".

[0017] First, with reference to Figures 1 and 2, a brief description will be given of the general configuration of a spinning machine 1, a driving control system, and spinning units 2 constituting the spinning machine 1.

[0018] The spinning machine 1 according to the present invention is equipped with 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 doffing device 3a. The main components of the spinning machine 1 include a work carriage 3 running on a rail R laid along the spinning machine 1.

[0019] The control section 1A controls the operations of motors M1, M2, M3 used to drive driving shafts S1, S2, S3, respectively, that exert driving forces on all the spinning units 2 constituting the spinning section 1B, driving members M4, M5 such as motors which are provided for the respective spinning units 2, a winding device, described later, and the like. In the present embodiment, on the basis of various set values (a spinning 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 M1 to M4 via an inverter (c) or a driver substrate D1. The calculating section b outputs information on the rotation speed of a slack eliminating roller constituting a yarn slack eliminating device, described later, to the driving member M5 for the yarn slack eliminating device via a driver substrate D2.

[0020] The spinning section 1B has a large number of spinning units 2 arranged in line. The blower section 1C houses negative pressure supplying means for exerting a negative pressure (suction pressure) on a desired part of the spinning unit 2 through an air duct. The blower section 1C causes the negative pressure to act on a yarn sucking device and the like, described later.

[0021] The spinning unit 2 is composed of a draft device 4, a spinning device 5, a yarn feeding device 6, the yarn sucking device 7, a yarn cutting device 8, a yarn defect detector 9, the yarn slack eliminating device 10, a waxing device 11, the winding device 12, and other devices. These devices are arranged in the above order from the upstream side to the downstream side.

[0022] By way of example, the draft device 4 is configured as a four-line draft device composed of a back roller 4a, a third roller 4b, a second roller 4c on which an apron 4c is extended, and a front roller 4a. By way of example, the spinning device 5 may be of a type in which whirling air currents are used to generate a yarn Y from a bundle of fibers F. The yarn feeding device 6 is composed of a nip roller 6a and a delivery roller 6b. The nip roller 6a and the always rotating delivery roller 6b sandwich the yarn Y between them and feed it toward the winding device 12. The yarn sucking device 7 always performs a sucking operation. When the yarn defect detector 9 detects a defect in the yarn Y, the yarn sucking device 7 sucks and removes the yarn Y cut by the yarn cutting device 8. The spinning device 5 may also be adapted to generate the yarn Y from the bundle of fibers F using a pneumatic spinning nozzle and a twisting roller instead of utilizing whirling air currents. Various other spinning devices including an open end type may be used. The winding device 12 winds the yarn Y around a bobbin 15 held by a bobbin holding member 14, to form a package 16. The winding device 16 comprises a friction roller 13 that rotates in contact with the empty bobbin 15 or the package 16. The bobbin holding member 14 is configured to move rotatively so as to separate or contact the empty bobbin 15 or the package 16 from or with the friction roller 13.

[0023] The work carriage 3 is configured to run on the rail R to move to and stop at the position of an arbitrary spinning unit 2 requiring doffing, on the basis of a doffing request signal from this spinning unit 2. A doffing device, described later, is disposed on the work carriage 3.

[0024] A suction pipe 17 is provided on the work carriage 3 and has a suction port 17a at its leading end. The suction pipe 17 is configured to move rotatively around a pivotal supporting section 17b during a doffing operation. During a doffing operation, the suction pipe 17 rotatively moves upward as shown by an alternate long and two short dashes line in Figure 3 from its standby position shown by a solid line in the same figure 3, to position the suction port 17a near a yarn discharge port in the spinning device 5. Then, the suction pipe 17 sucks and catches the spun yarn Y and subsequently moves rotatively downward to the standby position. The suction pipe 17 composes a yarn catching means.

[0025] The work carriage 3 is also provided with a low-speed rotative (yarn speed limit) driving device 18 that rotates the empty bobbin 15 and a full package 16f both held by the bobbin holding member 14 at a low speed in a winding direction. The low-speed rotative driving device 18 will be described below with reference mainly to Figure 4.

[0026] The low-speed rotative driving device 18 has a pivoting arm 18b pivotally supported by a horizontal shaft 18a attached to an appropriate frame of the work carriage 3. A pair of pulleys 18c1, 18c2 is pivotally rotatably attached to the horizontal shaft 18a. A horizontal shaft 18b1 is rotatably disposed at a leading end portion

of the pivoting arm 18b via an appropriate bearing. A roller 18b2 and a pulley 18b3 are attached to the horizontal shaft 18b1. A lever 18d is attached to an end portion of the pivoting arm 18b which is located closer to the horizontal shaft 18a. 18e is a cylinder pivotally supported by an appropriate frame of the work carriage 3. A leading end portion of the lever 18d is pivotally attached to a leading end portion of a piston rod 18e1 of the cylinder 18e. 18f is a motor placed on the work carriage 3. A pulley 18f2 is attached to an output shaft 18f1 of the motor 18f. A horizontal shaft 18g is located above the motor 18f near the horizontal shaft 18a and is attached to an appropriate frame of the work carriage 3. A pair of intermediate pulleys 18g1, 18g2 is rotatably attached to the horizontal shaft 18g.

[0027] An endless belt B1 is extended between the pulley 18f2, attached to the output shaft 18f1 of the motor 18f, and one intermediate pulley 18g1 of the intermediate pulleys 18g1, 18g2, constituting the pair and pivotally rotatably attached to the horizontal shaft 18g. An endless belt B2 is extended between the other intermediate pulley 18g2 of the intermediate pulleys 18g1, 18g2, constituting the pair and pivotally rotatably attached to the horizontal shaft 18g, and one pulley 18c1 of the pulleys 18c1, 18c2, constituting the pair and pivotally rotatably attached to the horizontal shaft 18a, by which the pivoting arm 18b is pivotally supported. Moreover, an endless belt B3 is extended between the other pulley 18c2 of the pulleys 18c1, 18c2, constituting the pair and pivotally rotatably attached to the horizontal shaft 18a, by which the pivoting arm 18b is pivotally supported, and the pulley 18b3, attached to the horizontal shaft 18b1, rotatably supported at the leading end portion of the pivoting arm 18b.

[0028] In the standby position, where the pivoting arm 18b lies below the horizontal shaft 18a so as to extend in a substantially vertical direction, when the cylinder 18e is activated to withdraw the piston rod 18e1, the lever 18d, attached to the pivoting arm 18b, moves rotatively around the horizontal shaft 18a in the clockwise direction of Figure 4. Accordingly, the pivoting arm 18b similarly moves rotatively in the clockwise direction to an activated position where it extends in a substantially horizontal direction. The pivoting arm 18b is bent substantially like the letter V so as not to come into contact with the friction roller 13, located above, in the activated position. The pivoting arm 18b is provided with an appropriate number of idlers 18b4 so that the endless belt B3, located along the pivoting arm 18b, bent substantially like the letter V, will not stick out from the pivoting arm 18b.

[0029] The low-speed rotative driving device 18 is configured as described above. Accordingly, when the cylinder 18e is activated to withdraw the piston rod 18e1, the pivoting arm 18b placed in the standby position, where it extends in the substantially vertical direction, can be rotatively moved to the activated position, where it extends in the substantially horizontal direction. On

the other hand, when the piston rod 18e1 is advanced, the pivoting arm 18b placed in the activated position, where it extends in the substantially horizontal direction, can be returned to the standby position, where it extends in the substantially vertical direction. Furthermore, the motor 18f is driven to rotatively drive the roller 18b2, disposed at the leading end portion of the pivoting arm 18b, via the pulley 18f2, the endless belt B1, the intermediate pulley 18g1, the intermediate pulley 18g2, the endless belt B2, the pulley 18c1, the pulley 18c2, the endless belt B3, and the pulley 18b3.

[0030] Moreover, a bunch winding device 19 is disposed on the work carriage 3 to subject the bobbin 15 held by the bobbin holding member 14, to bunch winding. The bunch winding device 19 will be described below with reference mainly to Figures 5 and 6.

[0031] The bunch winding device 19 is located in its standby position near the suction pipe 17 having sucked and caught a yarn end of the spun yarn Y and then moved rotatively to the standby position, and above the holding arm 14a of the bobbin holding member 14. The bunch winding device 19 is composed of a yarn handling member 19A that can move rotatively in the horizontal direction, a fixed yarn holding member 19B located above the other holding arm 14b of the bobbin holding member 14, and a yarn guide member 19C that can be rotatively moved in the vertical direction.

[0032] The yarn handling member 19A is composed of a horizontal rotative driving arm 19a and a yarn locking hook 19b formed at a leading end portion of the horizontal rotative moving arm 19a. The yarn holding member 19B is formed with a yarn locking pawl 19c extending downward. The yarn guide member 19c has a vertical pivoting arm 19d, a moving guide plate 19g attached to a slider 19f that slides along a slot 19e formed at a leading end portion of the vertical pivoting arm 19d, a cylinder 19h attached to a leading end portion of the vertical pivoting arm 19d, and a yarn guide piece 19i also attached to the leading end portion of the vertical pivoting arm 19d and extending upward and substantially perpendicularly to the moving guide plate 19g. The moving guide plate 19g is attached to a piston rod of the cylinder 19h. A yarn engaging concave portion 19g1 is formed in a leading end of the moving guide plate 19g. A yarn engaging concave portion 19i1 is formed near the root of the yarn guide plate 19i.

[0033] Via appropriate bearing members, bobbin holders 14a1, 14b1 are rotatably disposed on the pair of opposite holding arms 14a, 14b, respectively, of the bobbin holding member 14. Figures 5 and 6 and other figures show an example in which the cone bobbin 15 is sandwiched and held between the pair of bobbin holders 14a1, 14b1. A yarn catching concave portion 14b2 is formed around an outer peripheral portion of the bobbin holder 14b1 abutted against a larger diameter portion 15a of the cone bobbin 15. A circumferential groove 14b3 is formed in a side of the bobbin holder 14b1 which is closer to the holding arm 14b. Moreover, a cutter 14c

is attached to a side of the holding arm 14b which is closer to the bobbin holder 14b1. A cutting edge 14c1 of the cutter 14 is located in the circumferential groove 14b3, formed in the side of the bobbin holder 14b1 which is closer to the holding arm 14b.

[0034] Furthermore, as shown in Figure 2 and other figures, a separating member 20 is provided on the bobbin holding member 14 to separate the bobbin 15 or package 16 held by the bobbin holding member 14, from the friction roller 13. The separating member 20 is configured as a cylinder 20b having a piston rod 20a with its leading end portion pivotally supported on a lower arm 14e which is located below a horizontal supporting shaft 14d operating as a rotative moving center of the bobbin holding member 14. A lower end portion of the cylinder 20b has its lower end portion pivotally supported on an appropriate frame of the spinning machine 1. Then, the bobbin 15 or package 16 held by the bobbin holding member 14 can be separated from the friction roller 13 by driving the cylinder 20b to advance the piston rod 20a.

[0035] Now, with reference to Figures 7 to 11, a description will be given of the yarn slack eliminating device 10, provided in each spinning unit 2.

[0036] The yarn slack eliminating device 10 is composed of a slack eliminating roller 21, a bar-like member 22, the driving member M5 such as a stepping motor, which rotatively drives the slack eliminating roller 21, the driver substrate D2, which controls the driving member M5, a downstream side guide 36 having a slit 36a formed downstream side of the slack eliminating roller 21, and other components. The yarn slack eliminating device 10 is disposed in the spinning unit 2 using a bracket 37. During a bunch winding operation performed by the bunch winding device 19, the yarn slack eliminating device 10 winds the yarn Y spun by the spinning device around the slack eliminating roller 21 to retain the yarn to absorb its slack. In a normal spinning state other than the bunch winding operation, the yarn slack eliminating device 10 winds the yarn Y around the slack eliminating roller 21 to absorb and control a variation in the tension of the yarn Y being wound into a package.

[0037] The slack eliminating roller 21, shaped substantially like a hand drum, is secured to a driving shaft 35 of a motor operating as the driving member M5. The driving shaft 35 and the slack eliminating roller 21 rotate integrally. The slack eliminating roller 21 has a cylindrical portion 21a located in an intermediate part of the slack eliminating roller 21 and having a uniform diameter, a proximal tapered portion 21b having a diameter increasing toward a proximal end (the side on which the driving member 35 is present) Q of the slack eliminating roller 21, and a leading tapered portion 21c having a diameter increasing toward a leading end (the side located opposite the driving member 35 across the cylindrical portion 21a) P of the slack eliminating roller 21. During a bunch winding operation, the yarn Y spun by the spin-

ning device 5 is wound around the proximal tapered portion 21b and then passes through the cylindrical portion 21a and the leading tapered portion 21c before being unwound from the leading end P toward the winding device 12. The proximal tapered portion 21b has a function to smoothly move the wound yarn Y to the cylindrical portion 21a and regularly wind it around the cylindrical portion 21a. The leading tapered portion 21c has a function to inhibit the yarn A from slipping out at a time when it is unwound from the slack eliminating roller 21 and to allow the yarn Y to be smoothly pulled out. A cavity portion 21d is formed in substantially the half area of the slack eliminating roller 21. A core member 21e is formed in the cavity portion 21d so as to extend along an axis of the slack eliminating roller 21.

[0038] The bar-like yarn catching and unwinding tension applying member (hereinafter referred to as the "bar-like member") 22, which has a yarn catching function and an unwinding tension control function, can be rotated synchronously with or independently of the slack eliminating roller 21 depending on the load acting on the bar-like member 22. Specifically, the bar-like member 22 is attached to a wheel member 25 disposed on the core member 21e, via a bearing member 24 such as a bearing. A washer-like transmitted force applying member 26 is abutted against the wheel member 25. The transmitted force applying member 26 is mounted on the core member 21e in an insertional manner and cannot be rotated relative to it but can be moved in its axial direction. A presser member 27 is also mounted on the core member 21e in an insertional manner so as to abut against the transmitted force applying member 26. Moreover, a nut 28 is screwed over a threaded portion 21d1 engraved in the core member 21e.

[0039] Rotating the nut 28 allows the adjustment of contact pressure exerted on the wheel member 25 of the transmitted force applying member 26. That is, rotating the nut 28 to cause it to approach the wheel member 25 increases the contact pressure (frictional force) exerted on the wheel member 25 by the transmitted force applying member 26, disposed between the presser member 27 and the wheel member 25. Consequently, a large external force (load) is required to rotatively move the bar-like member 22 independently of the slack eliminating roller 21. On the other hand, rotating the nut 28 to move it away from the wheel member 25 reduces the contact pressure (frictional force) exerted on the wheel member 25 by the transmitted force applying member 26, disposed between the presser member 27 and the wheel member 25. Consequently, a weak external force (load) is sufficient to rotatively move the bar-like member 22 independently of the slack eliminating roller 21. By thus properly rotating the nut 28 to adjust the contact pressure exerted by the transmitted force applying member 26 on the wheel member 25, it is possible to adjust the external force (load) required to rotate the bar-like member 22 independently of the slack eliminating roller 21, to a predetermined value to in turn ad-

just the tension of the yarn Y unwound from the slack eliminating roller 21. In this connection, the transmitted force applying member 26 is adjusted on the basis of the frictional force. However, the transmitted force applying member 26 may be adjusted on the basis of an electromagnetic force; in this case, the transmitted force is an electromagnetic force generated by a magnet and this electromagnetic force is adjusted.

[0040] The above bar-like member 22 is composed of a base portion 22a extending beyond the leading end P of the slack eliminating roller 21 to the vicinity of the leading end P, a turnup portion 22b extending from the leading end of the base portion 22a toward the proximal end Q of the slack eliminating roller 21 so as to surround the leading end P of the slack eliminating roller 21, and a generally V-shaped yarn catching section 22c formed at a leading end portion of the turnup portion 22b.

[0041] The spinning unit 2 has a plate-like movable guide 23 disposed slightly upstream side of the slack eliminating roller 21 and having a guide slot 23a through which the yarn Y can be inserted. The movable guide 23 is urged by an elastic member such as a coil spring (not shown in the drawings) so as to move backward toward the frame of the spinning machine 1. The movable guide 23 is also configured to abut against a stopper (not shown in the drawings) attached to the spinning unit 2 so as to be hindered from further backward movement. In a normal standby position (backward position), the yarn Y generated by the spinning device 5 is inserted through the guide slot 23a in the movable guide 23.

[0042] An advancing and withdrawing member 38 composed of an air cylinder or the like is disposed on the work carriage 3. When a piston rod 38a of the advancing and withdrawal member 38 is advanced to cause a pusher 38b attached to the piston rod 38a to move the movable guide 23 to a forward position (shown by the alternate long and two short dashes line) against the urging force of the elastic member, the yarn path of the yarn Y, generated by the spinning device 5, is positioned to leave a rotation locus plane of the bar-like member 22 of the yarn slack eliminating device 10. When the piston rod 38a of the advancing and withdrawing member 38 is moved backward, the movable guide 23 returns to its standby position (backward position) shown by a solid line in Figure 11 under the effect of the urging force of the elastic member. At the backward position, the yarn path of the yarn Y crosses the rotation locus plane of the bar-like member 22 of the slack eliminating roller 21.

[0043] With the slack eliminating roller 21, which constitutes the above described yarn slack eliminating device 10, if the yarn Y is not wound around the slack eliminating roller 21 in the normal spinning state, the driving member M5 such as a motor, which is disposed in the spinning unit 2, is not driven in this state. Consequently, the slack eliminating roller 21 and the bar-like member 22 are stopped. Furthermore, in the normal spinning state, the bar-like member 22, attached via the bearing

member 24 to the wheel member 25, disposed on the core member 21e of the slack eliminating roller 21, is positioned at a withdrawn position shown by an alternate long and two short dashes line in Figure 11 so as not to come into contact with the yarn Y generated by the spinning device 5. In the normal spinning state, the slack eliminating roller 21 is disposed at a position where it does not contact with the yarn Y.

[0044] In the normal spinning state, shown in Figure 2, the bundle of fibers F is drafted by the draft device 4 and then enters the spinning device 5, which then forms the fibers into the yarn Y. The generated yarn Y is fed by the yarn feeding device 6 toward the winding device 12 and passes through the yarn sucking device 7, the yarn cutting device 8, the yarn defect detector 9, the movable guide 23 lying at its backward position, the yarn slack eliminating device 10, the downstream side guide 36, the waxing device 11, and other components. The yarn is thus wound into a package 16. In this normal spinning state, as described above, the bar-like member 22, which constitutes the yarn slack eliminating device 10, lies at its withdrawn position, shown by the alternate long and two short dashes line in Figure 11. Accordingly, the yarn Y does not come into contact with the bar-like member 22.

[0045] For a doffing operation performed after the normal spinning has been finished, the carriage 3 is stopped at the position of the spinning unit 2 requesting doffing, on the basis of a full package signal from this spinning unit 2. The arrival of the carriage 3 at this spinning unit 2 causes the spinning unit 2 to transmit an arrival sensing signal. On the basis of this signal, the driving member M such as a motor is driven via the driver substrate D2, disposed in the spinning unit 2. This rotatively drives the slack eliminating roller 21 and the bar-like member 22, which constitute the yarn slack eliminating device 10. In this connection, even if the yarn Y is engaged with the yarn catching section 22c, which constitutes the yarn slack eliminating device 10, it is not wound around the slack eliminating roller 21. This is because the slack eliminating roller 21 is not being rotatively driven in this case and because even if it is being rotatively driven, the yarn Y has a specific or higher tension.

[0046] Furthermore, in the normal spinning, the yarn Y can be wound around the slack eliminating roller 21 by always driving the yarn slack eliminating device 10, properly adjusting the winding speed while rotating the slack eliminating roller 21 and the bar-like member 22 to slack the yarn Y, and placing the advancing and withdrawing member 38 at its backward position to engage the yarn Y with the bar-like member 22. This enables the absorption of a variation in yarn tension which may occur when the yarn Y is wound into a package 16.

[0047] Now, a description will be given of a doffing operation and a bunch winding operation performed by the spinning machine 1 configured as described above.

[0048] When any spinning unit 2 detects that the

package 16 is full, a full package signal from the spinning unit 2 is transmitted to the yarn cutting device 8 to cut the yarn Y. The cut yarn Y positioned on the winding device 12 side is wound around the full package 16. If the yarn Y is always wound around the slack eliminating roller 21 even during the normal spinning, rotation of the package 16 causes the yarn Y located on the slack eliminating roller 21 to be completely unwound and wound around the package 16. Subsequently, the rotative driving of the slack eliminating roller 21 is stopped. The cut yarn Y positioned on the winding device 12 side is sucked into the yarn sucking device 7. The full package signal from the spinning unit 2 also stops the rotation of the back roller 4a and third roller 4b of the draft device 4. Then, the bundle of fibers F is cut between the stopped third roller 4b and the continuously rotating second roller 4d. The bundle of cut fibers F lying on the spinning device 5 side is formed into the yarn Y by the spinning device 5 still being driven. The generated yarn Y is sucked and removed by the yarn sucking device 7. Subsequently, the driving of the spinning device 5 is stopped. Moreover, the full package signal from the spinning unit 2 drives the cylinder 20b, which constitutes the separating member 20, to advance the piston rod 20a. As a result, the full package 16 held by the bobbin holding member 14 is separated from the friction roller 13.

[0049] On the basis of the full package signal from the spinning unit 2, the work carriage 3 moves to the spinning unit 2 having the full package 16 formed, and stops in front of this spinning unit 2. Then, the cylinder 18e of the low-speed rotative driving device 18, disposed on the work carriage 3, is activated to withdraw the piston rod 18e1. Thus, the lever 18d, attached to the pivoting arm 18b, is rotatively moved to pivot the pivoting arm 18b lying at its substantially vertical standby position, to its substantially horizontal activated position. This causes the roller 18b2, disposed at the leading end portion of the pivoting arm 18b, to abut against the full package 16 separated from the friction roller 13. In this state, the motor 18f is not driven, so that the roller 18b2 is not rotated. Accordingly, the roller 18b2 abuts against the full package 16 to stop the inertial rotation of the full package 16 rotating inertially immediately after the separation from the friction roller 13. After the inertial rotation of the full package 16 has been stopped, the cylinder 18e is activated to advance the piston rod 18e1 to rotatively move the lever 18d, attached to the pivoting arm 18b. Thus, the pivoting arm 18b lying at the substantially horizontal activated position is returned to the substantially vertical standby position. Subsequently, a holding arm extending member (not shown in the drawings) disposed on the work carriage 3 moves one holding arm 14a of the arms of the bobbin holding member 14 outward to release the full package 16 held by the bobbin holding member 14. The full package 16 is thus placed on a conveying device such as a belt conveyor (not shown in the drawings). Then, a bobbin supplying de-

vice (not shown in the drawings) disposed on the work carriage 3 allows the bobbin holding member 14 to hold the bobbin 15.

[0050] After the full package 16 has been discharged from the bobbin holding member 14 and the bobbin holding member 14 has held the bobbin 15 as described above, an instruction from a control section disposed on the work carriage 3 activates the advancing and withdrawing member 38, disposed on the work carriage 3, to advance the piston rod 38a. Then, the pusher 38b advances the movable guide 23 as shown by the alternate long and two short dashes line in Figure 11. Then, on a signal indicating that the work carriage 3 has arrived at the spinning unit 2, the driving member M5 such as a motor is driven via the driver substrate D2, disposed in the spinning unit 2. At substantially the same time when the slack eliminating roller 21 and bar-like member 22, which constitute the yarn slack eliminating device 10, the suction pipe 17 is rotated upward to position the suction port 17a in the suction pipe 17 near the yarn discharge port in the spinning device 5.

[0051] Furthermore, the stopped back roller 4a and third roller 4b are re-driven to feed the bundle of fibers F into the spinning device 5 driven substantially simultaneously with the re-driving of the back roller 4a and the third roller 4b to restart spinning. The spinning device 5 is re-driven and the yarn Y spun by the spinning device 5 is sucked and caught in the suction pipe 17. Subsequently, the suction pipe 17 rotatively moves downward and stops at its standby position.

[0052] Then, the control section disposed on the work carriage 3 gives an instruction to activate the advancing and withdrawing member 38 to move backward the pusher 38b, attached to the piston rod 38a. Thus, the movable guide 23 is returned to its standby position (backward position) shown by a solid line in Figure 11, under the effect of the urging force of the elastic member. Then, as shown in Figures 12A, 12B, and 13, the yarn Y spun by the spinning device 5 is caught on the yarn catching section 22c of the bar-like member 22 being rotated with the slack eliminating roller 21. The yarn Y is then guided around the outer periphery of the slack eliminating roller 21 and thus wound around the slack eliminating roller 21.

[0053] Subsequently, the above described bunch winding device 19 is activated. Now, with reference to Figures 5 and 6, a description will be given of a bunch winding operation performed by the bunch winding device 19.

[0054] Before the bunch winding device 19 starts a bunch winding operation, the cylinder 18e of the low-speed rotative driving device 18, disposed on the work carriage 3, is reactivated to withdraw the piston rod 18e1. Thus, the lever 18d, attached to the pivoting arm 18b, is rotatively moved to pivot the pivoting arm 18b lying at its substantially vertical standby position, to its substantially horizontal activated position. Accordingly, the roller 18b2, disposed at the leading end portion of

the pivoting arm 18b, is contacted with the bobbin 15 which is separated from the friction roller 13 and is also held by the bobbin holding member 14 to rotate it at a low speed in the same direction as that of normal winding. The term "low speed" as used herein refers to the peripheral speed of the bobbin 15 (the peripheral surface speed of the bobbin 15), rotated by the low-speed rotative driving device 18, which speed is lower than the peripheral speed of the bobbin 15 when the bobbin 15 rotates in contact with the friction roller 13, that is, which speed is lower than the peripheral speed of the bobbin 15 (the peripheral surface speed of the bobbin 15) which occurs during the normal winding.

[0055] Subsequently, the yarn handling member 19A is rotatively moved horizontally from the position shown by the solid line, toward the yarn holding member 19B. The yarn Y sucked and caught in the suction pipe 17 is thus locked on the yarn engaging hook 19b and then moved to the yarn holding member 19B. The yarn Y is thus delivered to the yarn engaging pawl 19c of the yarn holding member 19B. Then, the yarn guiding member 19C is rotatively moved downward to engage the yarn Y extending between the yarn locking pawl 19c of the yarn holding member 19B and the suction pipe 17, with the yarn engaging concave portion 19g1, formed in the moving guide plate 19g, disposed in the yarn guiding member 19C. The yarn guiding member 19C is further rotatively moved downward to place the moving guide plate 19g with which the yarn Y is engaged, near one holding arm 14b of the holding arms of the bobbin holding member 14. This series of operations disengage the yarn Y from the yarn locking pawl 19c of the yarn holding member 19B and extend it between the yarn engaging concave portion 19g1 of the moving guide plate 19g and the suction pipe 17. Furthermore, the yarn Y abuts against the yarn guide piece 19i and engages with the yarn engaging concave portion 19i1, formed in the yarn guide piece 19i.

[0056] Then, the cylinder 19h is activated to advance the piston rod to lower the moving guide plate 19g. Then, the yarn Y extended between the yarn engaging concave portion 19g1 of the moving guide plate 19g and the suction pipe 17 approaches the periphery of the bobbin holder 14b1. Accordingly, the yarn catching concave portion 14b2, formed around the outer peripheral portion of the bobbin holder 14b1, locks the yarn Y extending between the yarn engaging concave portion 19g1 of the moving guide plate 19g and the yarn engaging concave portion 19i1 of the yarn guide piece 19i. Subsequently, the bobbin 15 and the bobbin holder 14b1 rotate to guide the yarn Y to the yarn catching concave portion 14b2, formed around the outer peripheral portion of the bobbin holder 14b1. The yarn Y is then gripped and caught in the yarn catching concave portion 14b2 and is then wound around the bobbin 15. Subsequently, the bobbin 15 and the bobbin holder 14b1 further rotate to cause the yarn Y positioned between the yarn engaging concave portion 19g1 of the moving guide plate 19g and the

yarn catching concave portion 14b2, formed around the outer peripheral portion of the bobbin holder 14b1, to abut against the cutter 14c, attached to the holding arm 14b. The yarn Y is then cut. Subsequently, during bunch winding executed by the above described bunch winding device 19, the bobbin 15 held by the bobbin holding member 14 is initially rotated by the roller 18b2 of the low-speed rotative driving device 18 at a low speed in the same direction as that of the normal winding. Thus, the yarn Y already wound around the slack eliminating roller 21 is wound around the bobbin 15 being rotated at the low speed, into a bunch. Then, with the moving guide plate 19g lowered, the cylinder 18e of the low-speed rotative driving device 18 is activated to advance the piston rod 18e1 to rotatively move the lever 18d, attached to the pivoting arm 18b. Thus, the pivoting arm 18b lying at its substantially horizontal activated position is returned to its substantially vertical standby position. Then, the separating member 20 contacts the bobbin 15 with the friction roller 13 to form a bunch winding with a sufficient amount of yarn Y. The yarn Y abutted against and cut by the cutter 14c is sucked and removed by the suction pipe 17. In this manner, a bunch winding is formed at a predetermined bunch winding position in a larger diameter portion 15a of the cone bobbin 15.

[0057] Subsequently, the yarn Y wound into a bunch is delivered to a traverse guide T1 of a traverse device (not shown in the drawings). Thereafter, the yarn Y is wound around the bobbin 15 while being traversed by the traverse guide T1 of the traverse device, to form the package 16. After the bunch winding operation has been finished, the yarn handling member 19A and yarn end guiding member 19C, which constitute the bunch winding device 19, are returned to their standby positions.

[0058] As described above, during the bunch winding executed by the bunch winding device 19, the bobbin 15 is initially rotated by the low-speed rotative driving device 18 at the low speed in the same direction as that of the normal winding. Furthermore, the yarn Y wound and retained on the slack eliminating roller 21 is used for the bunch winding instead of the yarn Y spun by the spinning device 5 at a high speed. Accordingly, until the yarn Y is caught in the yarn catching concave portion 14b2 of the bobbin holder 14b1 during a bunch winding operation, the yarn handling member 19A and others cooperatively pull out the yarn Y retained on the slack eliminating roller 21. This enables the running of the yarn Y to be substantially stopped. Therefore, in contrast to the handling and delivery of the yarn Y being run and moved, the members can be freely arranged and arbitrary operational timings can be used. This improves the rate at which the yarn catching and thus the bunch winding succeed.

[0059] Furthermore, when the yarn Y is wound by the low-speed rotative driving device 18 after the yarn catching, the yarn Y wound into a bunch runs at a low speed for a predetermined number (for example, 1 or 2) of windings after the start of winding. Accordingly, in

contrast to conventional bunch winding executed on the bobbin 15 contacted with the friction roller 13 and initially rotated at a high speed, it is possible to reduce the difference in the tensile force of the yarn Y between the period before the yarn catching, when the running of the yarn remains stopped, and the period after the yarn catching. The yarn Y is thus prevented from being stretched and broken immediately after the yarn catching. This improves the success rate of the bunch winding. In this case, if all of the bunch winding is executed at a low yarn running speed, the bunch winding operation requires a relatively long time. However, even if the yarn Y is wound into a bunch for a predetermined number of initial windings and the bobbin 15 is subsequently contacted with the friction roller 13 and rotated at a high speed, the yarn Y is prevented from being stretched and broken. Accordingly, after the bunch winding, the rotative driving of the bobbin 15 may be switched from the low-speed rotative driving device 18 to the friction roller 13.

[0060] If the cone bobbin 15, shown in Figures 5 and 6, is used to form a bunch winding on the larger diameter 15a side, the peripheral speed of a surface of the bobbin 15 is higher than that of a surface of a cylindrical cheese bobbin even though the friction roller 13 rotates at the same speed. It is assumed that the spun yarn Y is directly caught and wound into a bunch at the peripheral speed of the larger diameter 15a side of the bobbin 15 contacted with the friction roller 13. Then, the winding speed is higher than the spinning speed, so that a supply of the spun yarn Y cannot catch up with the winding speed of the bunch winding. As a result, the yarn Y may be stretched and broken. Thus, according to the present invention, the yarn Y to be wound into a bunch is pre-wound around the slack eliminating roller 21 to retain a sufficient amount of yarn Y on it. Then, during bunch winding, a required amount of yarn Y is unwound from the slack eliminating roller 21. Therefore, even if bunch winding is executed on the larger diameter 15a side, it is possible to avoid the shortage of the supply of the yarn Y from the spinning side to prevent the yarn Y from being stretched and broken.

[0061] As described above, during the bunch winding operation, the yarn Y generated and fed by the spinning device 5 is wound around the rotating slack eliminating roller 21. Subsequently, the yarn Y continues to be wound around the slack eliminating roller 21 of the yarn slack eliminating device 10 being continuously driven. The winding speed of the yarn Y being wound around the bobbin 15 or package 16 is set to be slightly higher than the spinning speed of the yarn Y being spun by the spinning device 5 in order to apply an appropriate tension to the yarn Y. Accordingly, the tension of the yarn Y between the yarn slack eliminating device 10 and the winding device 12 increases above a specified value to exert, on the yarn Y, a force that pulls the yarn Y to the winding device 1. Consequently, the tension of the yarn Y between the yarn slack eliminating device 10 and the

winding device 12 causes a predetermined load to act on the bar-like member 22. When the predetermined load thus acts on the bar-like member 22, the bar-like member 22 starts to rotate independently against the force transmitted by the slack eliminating roller 21 being rotated in the winding direction of the yarn Y being spun by the spinning device 5. The yarn Y wound and retained on the slack eliminating roller 21 is gradually pulled out and unwound from the slack eliminating roller 21 via the downstream side guide 36. On the other hand, if the winding speed increases between the bar-like member 22 and the winding device 12, the bar-like member 22 rotates independently of the slack eliminating roller 21 in a direction opposite to that in which the slack eliminating roller 21 is rotating. This reduces the tension of the yarn Y between the bar-like member 22 and the winding device 12 which tension otherwise increases. It is thus possible to always make uniform the unwinding tension of the yarn Y unwound from the slack eliminating roller 21. Thus, particularly during the bunch winding operation, an appropriate clamping force can be exerted on the bobbin 15 for bunch winding. This prevents the bunch winding from coming loose after the bunch winding operation.

[0062] As shown in Figure 13, the position of the downstream side guide 36 through which the yarn passes is on an extension of the central axis of the slack eliminating roller 21 on its leading end P side. The reason will be described below.

[0063] When the yarn Y is unwound from the slack eliminating roller 21 and if the position of the downstream side guide 36 through which the yarn passes is offset from the extension of the central axis of the slack eliminating roller 21, then depending on a position where the yarn Y leaves the slack eliminating roller 21, a variation may occur in the distance between this position and the downstream side guide 36 and thus in the unwinding tension of the yarn Y from the slack eliminating roller 21. If the position of the downstream side guide 36 through which the yarn Y passes is extremely offset from the extension of the central axis of the slack eliminating roller 21, then a force may be exerted which uses the rotating force of the slack eliminating roller 21 to wind the yarn Y otherwise wound into the package 16, around the slack eliminating roller 21.

[0064] It is assumed that the operation of winding the yarn Y into the package 16 has been restarted. Then, if in the normal winding state, the yarn Y is not wound around the slack eliminating roller 21 but the yarn Y wound and retained on the slack eliminating roller 21 is exhausted in due course, then the bar-like member 22a remains engaged with the yarn Y at the position shown in Figure 12 because of the balance between the rotating force received from the slack eliminating roller 21 and the tension of the running yarn Y. If in the normal spinning state, the yarn Y is not wound around the slack eliminating roller 21 but is left as it is, it runs in contact with the yarn catching section 22c of the bar-like mem-

ber 22 before being wound into the package 16. Consequently, the quality of the yarn Y may be affected by the friction between the yarn Y and the yarn catching section 22c of the bar-like member 22. Thus, if the yarn Y wound and retained on the slack eliminating roller 21 is exhausted, the slack eliminating roller 21 is reversely rotated through about 180 degrees to move the yarn catching section 22c of the bar-like member 22 to a position where it does not contact with the yarn Y, as shown by the alternate long and two short dashes line in Figure 11. Subsequently, the driving of the yarn slack eliminating device 10 and thus the rotation of the slack eliminating roller 21 is stopped. This serves to prevent the yarn Y from being degraded by its contact with the bar-like member 22.

[0065] A timing for reversely rotating the slack eliminating roller 21 as described above can be adjusted by, for example, timer control. Specifically, setting may be made such that the slack eliminating roller 21 is automatically rotated reversely and then stopped once the time for which the slack eliminating roller 21 has been rotating since the start of a yarn slack eliminating operation in the yarn slack eliminating device 10 reaches a predetermined time.

[0066] Alternatively, a tension sensor may be located at an appropriate position upstream or downstream of the slack eliminating roller 21 to monitor the tension of the yarn being unwound. Then, once the value of the tension reaches a specified condition, it is determined that the yarn Y on the slack eliminating roller 21 has been completely exhausted. Then, the slack eliminating roller 21 may be reversely rotated and then stopped.

[0067] Alternatively, if for example, the cone bobbin 15 shown in Figures 5 and 6 is used, then in the normal spinning state of the spinning device 5, the yarn slack eliminating device 10 may always be activated to continue rotating the slack eliminating roller 21. In this case, a separating member different from the above described separating member 20 is provided. A predetermined time after the amount of yarn Y wound around the slack eliminating roller 21 has reached a predetermined or smaller value or become zero, the separating member is driven to separate the package 16 from the friction roller 13 to temporarily reduce the rotation speed of the package 16. The winding speed of the yarn Y wound into the package 16 is reduced below the spinning speed of the yarn Y spun by the spinning device 5 to increase the amount of yarn Y wound around the slack eliminating roller 21. If the amount of yarn Y wound around the slack eliminating roller 21 reaches a predetermined value, the separating member brings the package 16 into contact with the friction roller 13 to continue winding the yarn Y into the package 16. This operation serves to keep the predetermined amount of yarn Y wound around the slack eliminating roller 21. Alternatively, a motor may be provided in each spinning unit to rotatively drive the friction roller 13 so as to properly control its acceleration and deceleration.

[0068] By thus keeping the predetermined amount of yarn Y wound around the slack eliminating roller 21, it is possible to rotate the bar-like member 22 independently of the slack eliminating roller 21 to absorb a difference in yarn tension between the larger diameter portion 15a and smaller diameter portion 15b of the cone bobbin 15 or cone-like package 16 which difference may result from the larger diameter portion 15a and the smaller diameter portion 15b when the yarn Y is wound around the cone bobbin 15 to form the cone-like package 16. Therefore, the winding tension of the yarn Y can always be made substantially constant.

[0069] Figure 14 shows a timing for activating the separating member 20, a timing for activating the low-speed rotative driving device 18, a timing for stopping the driving of the back roller 4a and third roller 4b, timings for moving the movable guide 23 forward and backward, and a timing for stopping the rotation of the slack eliminating roller 21.

[0070] If any spinning unit 2 detects that the package 16 is full, the rotation of the back roller 4a and third roller 4b of the draft device 4 is stopped. Subsequently, the separating member 20 (cylinder 20b) is activated to separate the full package 16 from the friction roller 13 (time T1). Then, the low-speed rotative driving device 18 is activated to pivot the pivoting arm 18b to its substantially horizontal activated position to abut the roller 18b2 not being rotated, against the full package 16 separated from the friction roller 13 (time T2). The inertial rotation of the full package 16 is thus stopped. Subsequently, the full package 16 is discharged from the bobbin holding member 14, and a new bobbin 15 is installed in the bobbin holding member 14. Thereafter, the pivoting arm 18b of the low-speed rotative driving device 18 is returned to its standby position (time T3). The separating member 20 is still active, so that even after the bobbin holding member 14 has held the bobbin 15, the bobbin 15 does not contact with the friction roller 13.

[0071] In a bunch winding operation, the advancing and withdrawing member 38 is activated to place the movable guide 23 at its forward position (time T4). Furthermore, before the driving of the back roller 4a and third roller 4b is restarted, the suction port 17a in the suction pipe 17 is positioned near the yarn discharge port in the spinning device 5. Subsequently, the driving of the back roller 4a and third roller 4b is restarted and the spinning device 5 is caused to restart generating the yarn Y. Then, the suction pipe 17 sucks and catches the yarn Y fed by the spinning device 5 and is subsequently rotatively moved downward. Moreover, at substantially the same time when the driving of the back roller 4a and third roller 4b is restarted, the slack eliminating roller 21 is rotated (time T5).

[0072] A predetermined time after the driving of the back roller 4a and third roller 4b has been restarted, the movable guide 23 is moved backward to wind, around the slack eliminating roller 21, the yarn Y fed by the spinning device 5 the driving of which has been restarted

(time T6). Subsequently, the cylinder 18e of the low-speed rotative driving device 18 is reactivated to pivoting arm 18b to its substantially horizontal activated position. Furthermore, the roller 18b2 starts rotating under drive from the motor 18f. The roller 18b2 is thus abutted against the bobbin 15 separated from the friction roller 13 to rotate the bobbin 15 at a low speed (time T7). Subsequently, the bunch winding device 19 is lowered to perform a bunch winding operation as described above (time T8 to T11).

[0073] After the bunch winding has been started (time T8), bunch winding is executed at a low speed (low-speed bunch winding) while the roller 18b2 of the low-speed rotative driving device 18 is in contact with bobbin 15. Subsequently, the cylinder 18e of the low-speed rotative driving device 18 is activated to return the pivoting arm 18b to its substantially vertical standby position (time T9). Then, the separating member 20 brings the bobbin 15 into contact with the friction roller 13 (time T10). Bunch winding is then executed at a high speed (high-speed bunch winding). Then, once sufficient bunch winding has been executed, the moving guide plate 19g is elevated to finish the bunch winding. The bobbin 15 subjected to the bunch winding is brought into the normal winding state (time T11).

[0074] In the above described embodiment, the work carriage 3 is used. However, if the work carriage 3 is not used, each spinning unit 2 is provided with the members provided on the work carriage 3 and required for bunch winding, for example, the suction pipe 17, the low-speed rotative driving device 18, and the advancing and withdrawing member 38.

[0075] The present invention is configured as described above and can thus produce the effects described below.

[0076] The spinning machine is provided with the slack eliminating roller that retains and absorbs the slack of the yarn between the yarn catching means and the spinning device and the yarn catching member that catches the yarn to the slack eliminating roller to wind a slacking yarn around the slack eliminating roller. Furthermore, control is provided such that the bunch winding device catches the yarn to the bobbin holder after the yarn has been caught to the slack eliminating roller and wound around roller. Consequently, compared to the conventional bunch winding executed on the bobbin, the success rate of bunch winding can be improved.

[0077] The slack eliminating device has the yarn tension applying member that applies a predetermined tension to the yarn supplied by the slack eliminating device to the bunch winding position during bunch winding for a bunch winding operation. This prevents the yarn for the bunch winding operation from being slacked or stretched and broken. The success rate of bunch winding can thus be improved.

[0078] The slack eliminating device has the slack eliminating roller around which the slacking yarn is wound, and the yarn tension applying member is con-

figured to function as the unwinding tension applying member which can rotate concentrically with the slack eliminating roller and which rotates synchronously with the slack eliminating roller when a load of a predetermined value or smaller acts on the yarn tension applying member and rotatively moves independently of the slack eliminating roller when a load of larger than the predetermined value acts on the yarn tension applying member, to apply a predetermined yarn tension to the yarn being unwound from the slack eliminating roller. It is thus possible to always make uniform the unwinding tension of the yarn unwound from the slack eliminating roller. In particular, during the bunch winding operation, an appropriate clamping force can be exerted on the bobbin for bunch winding. This makes it possible to prevent, for example, the bunch winding from coming loose after the bunch winding operation.

[0079] The spinning machine is provided with the yarn speed limit driving device that sets, before bunch winding, the speed for an amount of yarn corresponding to a predetermined number of windings counted from the start of winding to be lower than the winding speed for normal winding. Consequently, the success rate of bunch winding can be improved. Furthermore, the time required for the bunch winding operation can be reduced.

[0080] The package is formed on the cone bobbin. Even if bunch winding is executed on the larger diameter portion of the cone bobbin, the yarn can be prevented from being stretched and broken during the bunch winding.

Claims

1. A spinning machine having a spinning device that generates and spins a yarn from a bundle of supplied fibers and a bunch winding machine, the spinning machine being **characterized by** being provided with a slack eliminating roller that retains and absorbs a slack of a yarn between a yarn catching means and the spinning device and a yarn catching member that catches a yarn to the slack eliminating roller to wind a slacking yarn around the slack eliminating roller, and in that control is provided such that the bunch winding device guides the yarn to the bobbin holder after the yarn has been caught to the slack eliminating roller and wound around at the slack eliminating roller.
2. A spinning machine according to Claim 1, **characterized in that** said slack eliminating device has a yarn tension applying member that applies a predetermined tension to a yarn supplied by the slack eliminating device to the bunch winding position during bunch winding for a bunch winding operation.
3. A spinning machine according to Claim 2, **characterized in that** said slack eliminating device has a slack eliminating roller around which the slacking yarn is wound, and said yarn tension applying member is an unwinding tension applying member which can rotate concentrically with the slack eliminating roller and which rotates synchronously with the slack eliminating roller when a load of a predetermined value or smaller acts on the yarn tension applying member and rotatively moves independently of the slack eliminating roller when a load of larger than the predetermined value acts on the yarn tension applying member, to apply a predetermined yarn tension to the yarn being unwound from the slack eliminating roller.
4. A spinning machine according to Claim 3, **characterized in that** a transmitted force adjusting mechanism is provided between the slack eliminating roller and the unwinding tension applying member to transmit rotative driving from the slack eliminating roller to the unwinding tension applying member, and the transmitted force adjusting mechanism has a transmitted force adjustment operating section provided at a junction between the slack eliminating roller and the unwinding tension applying member to set the magnitude of a transmitted force.
5. A spinning machine according to any one of Claims 1 to 4, **characterized by** further comprising a winding device that winds a yarn spun by the spinning device into a package, and a yarn speed limit driving device that sets, before bunch winding, a speed for an amount of yarn corresponding to a predetermined number of windings counted from start of winding to be lower than a winding speed for normal winding.
6. A spinning machine according to Claim 5, **characterized in that** said yarn speed limit driving device comprises a rotatively drivable roller and an arm member that enables the roller to be moved between a position where the roller abuts against the bobbin and a standby position.
7. A spinning machine according to Claim 6, **characterized in that** the roller of said yarn speed limit driving device, while having its rotative driving stopped, abuts against a full package to stop an inertial rotation of the full package.
8. A spinning machine according to any one of Claims 1 to 7, **characterized in that** said bunch winding is formed on a cone bobbin.

FIG.1

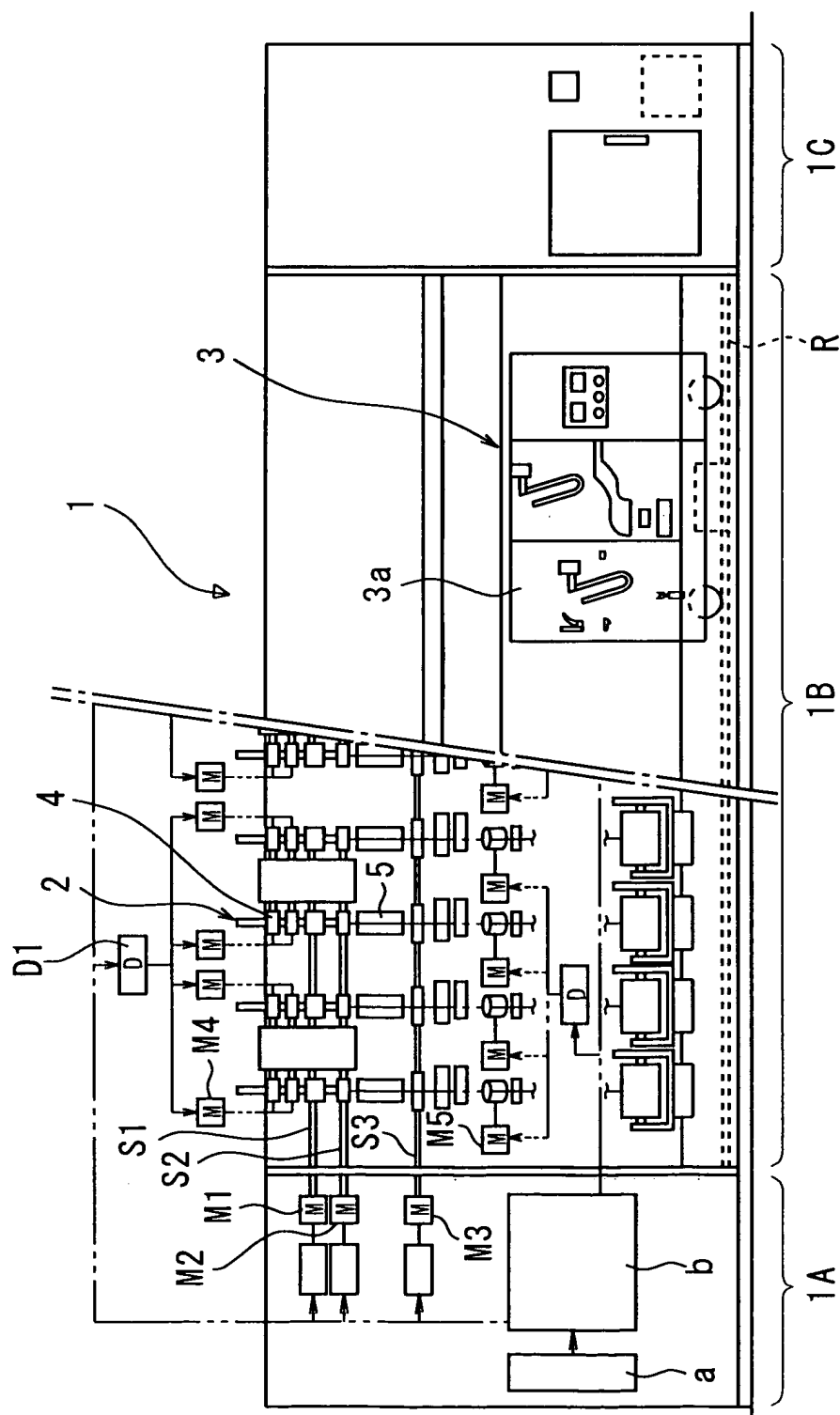


FIG.2

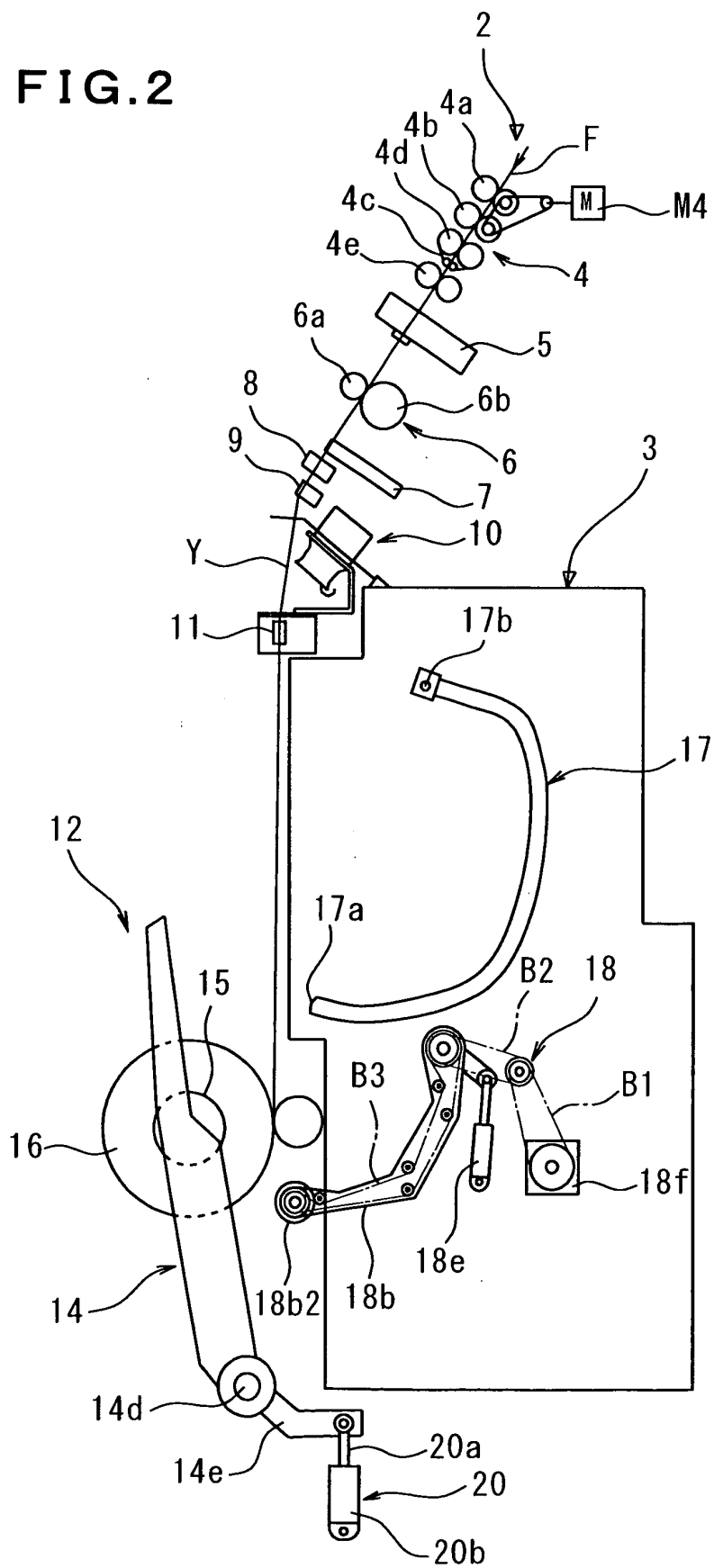


FIG. 3

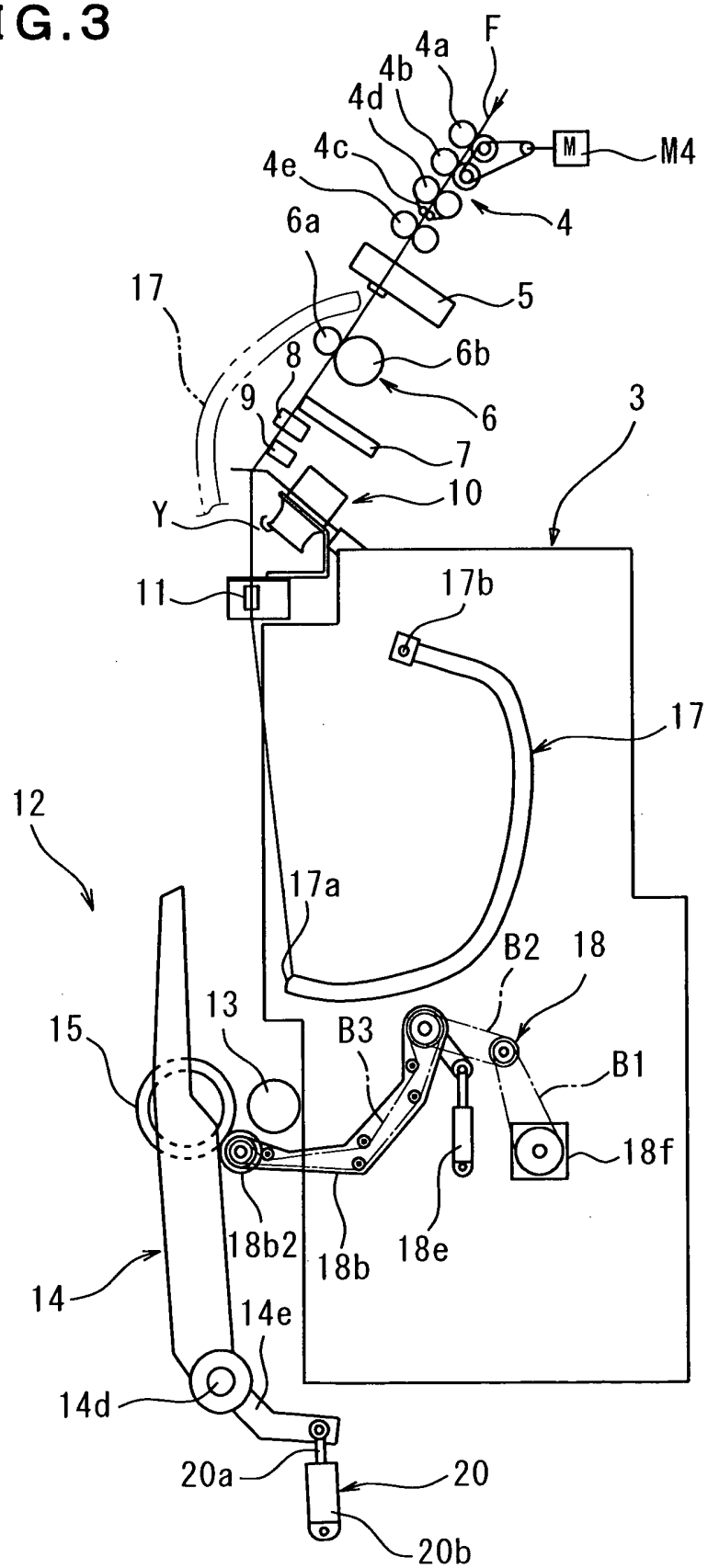


FIG. 4

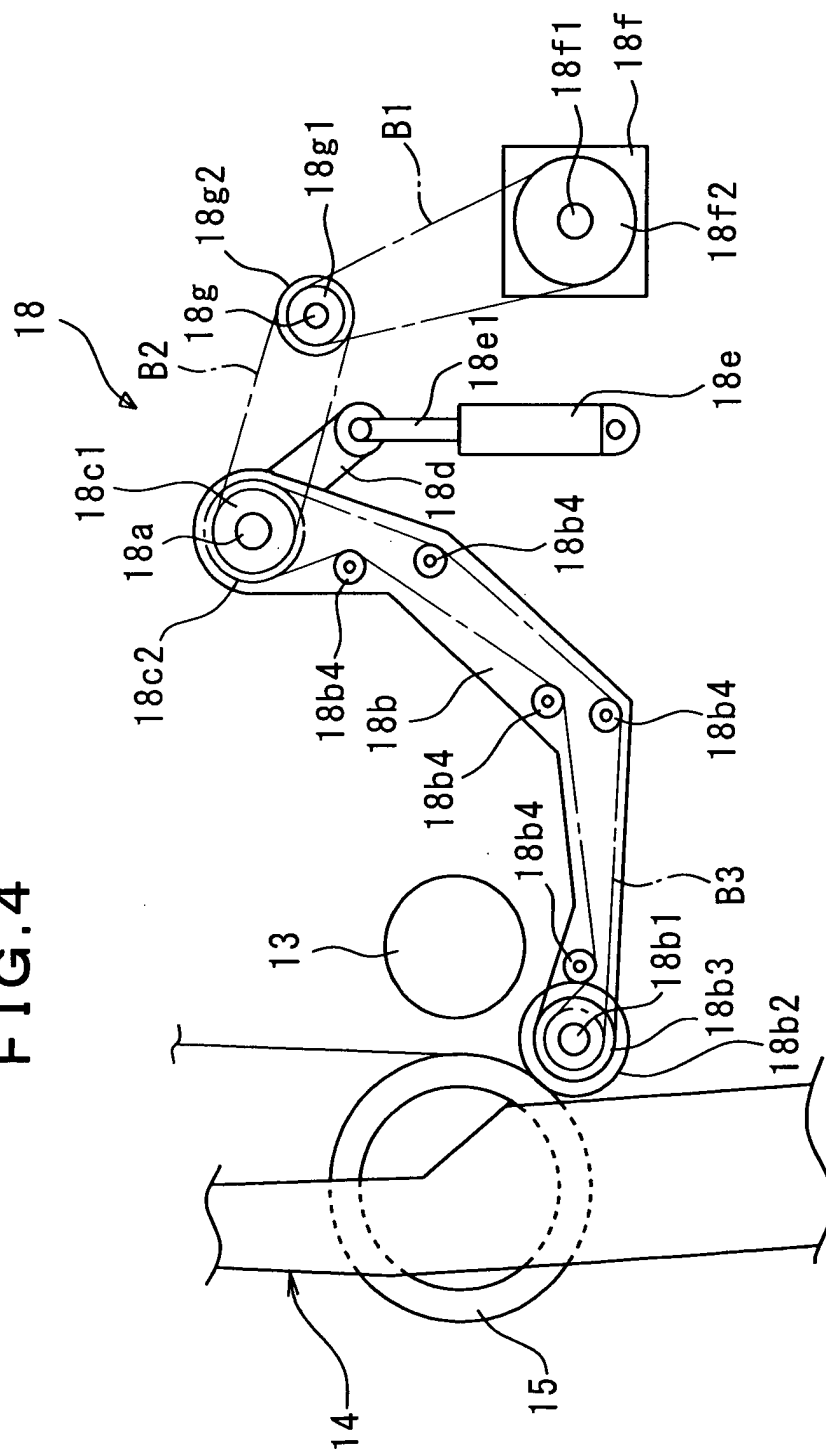


FIG.5

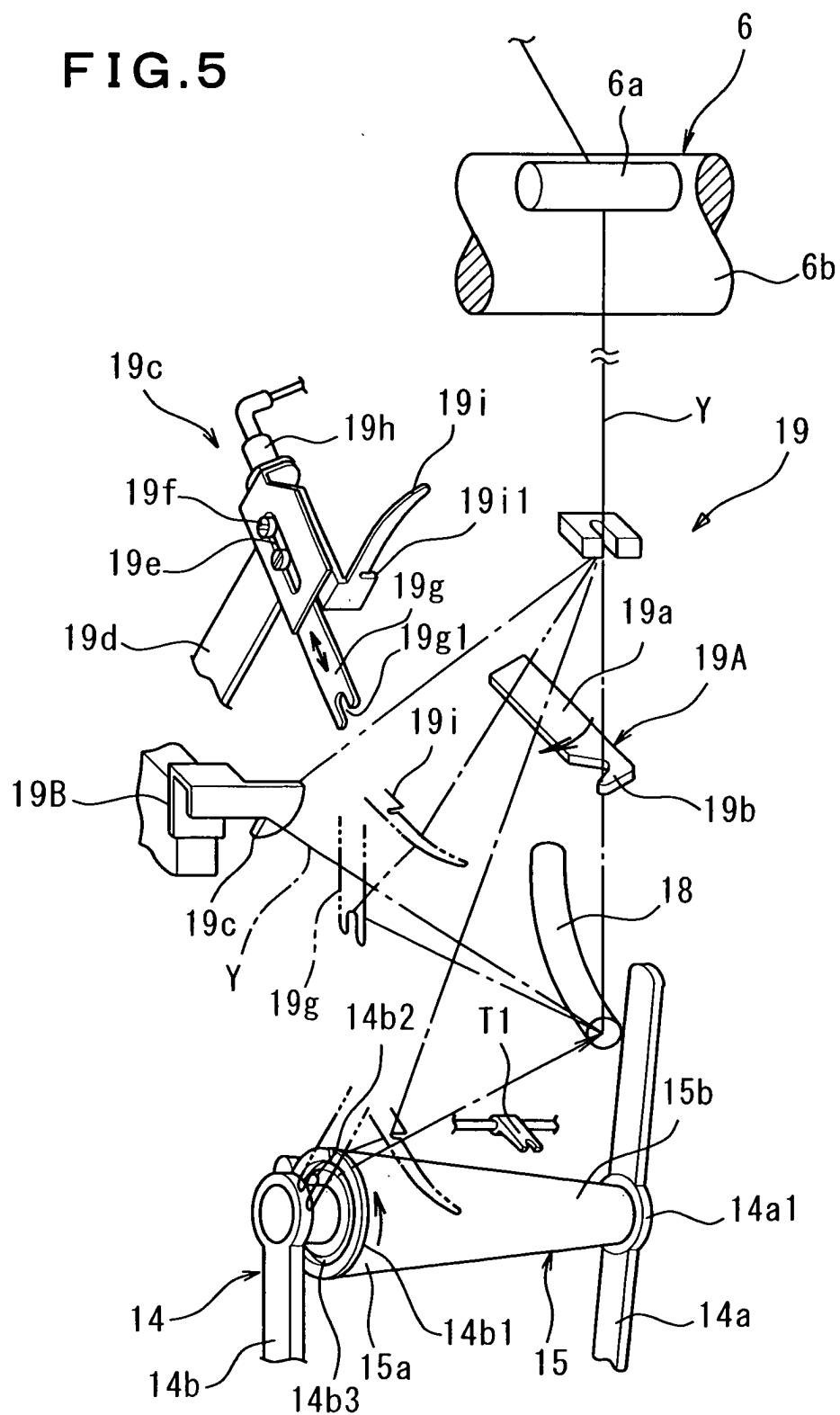


FIG.6

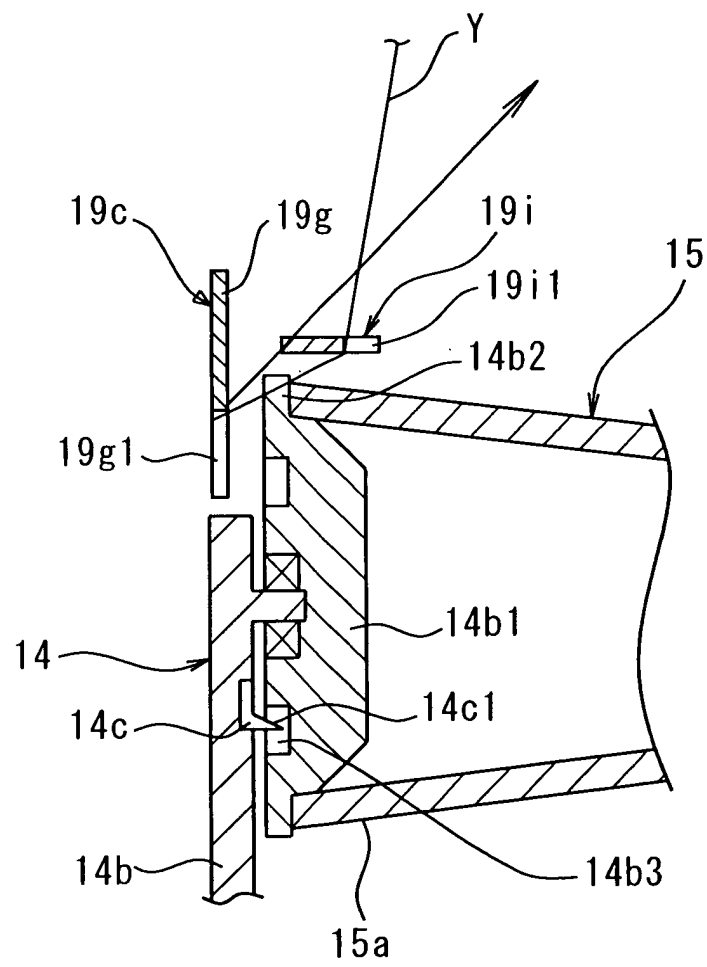


FIG. 7

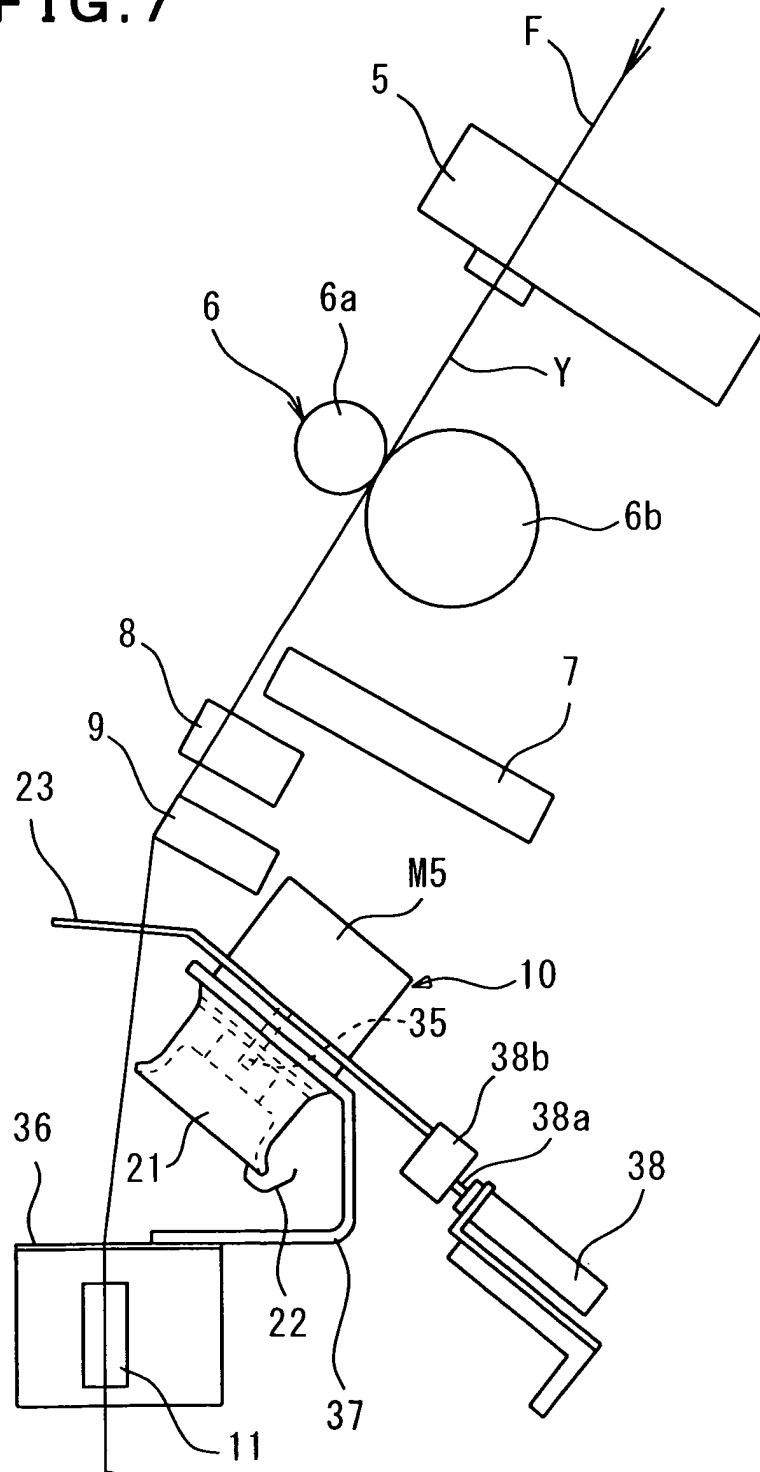


FIG.8

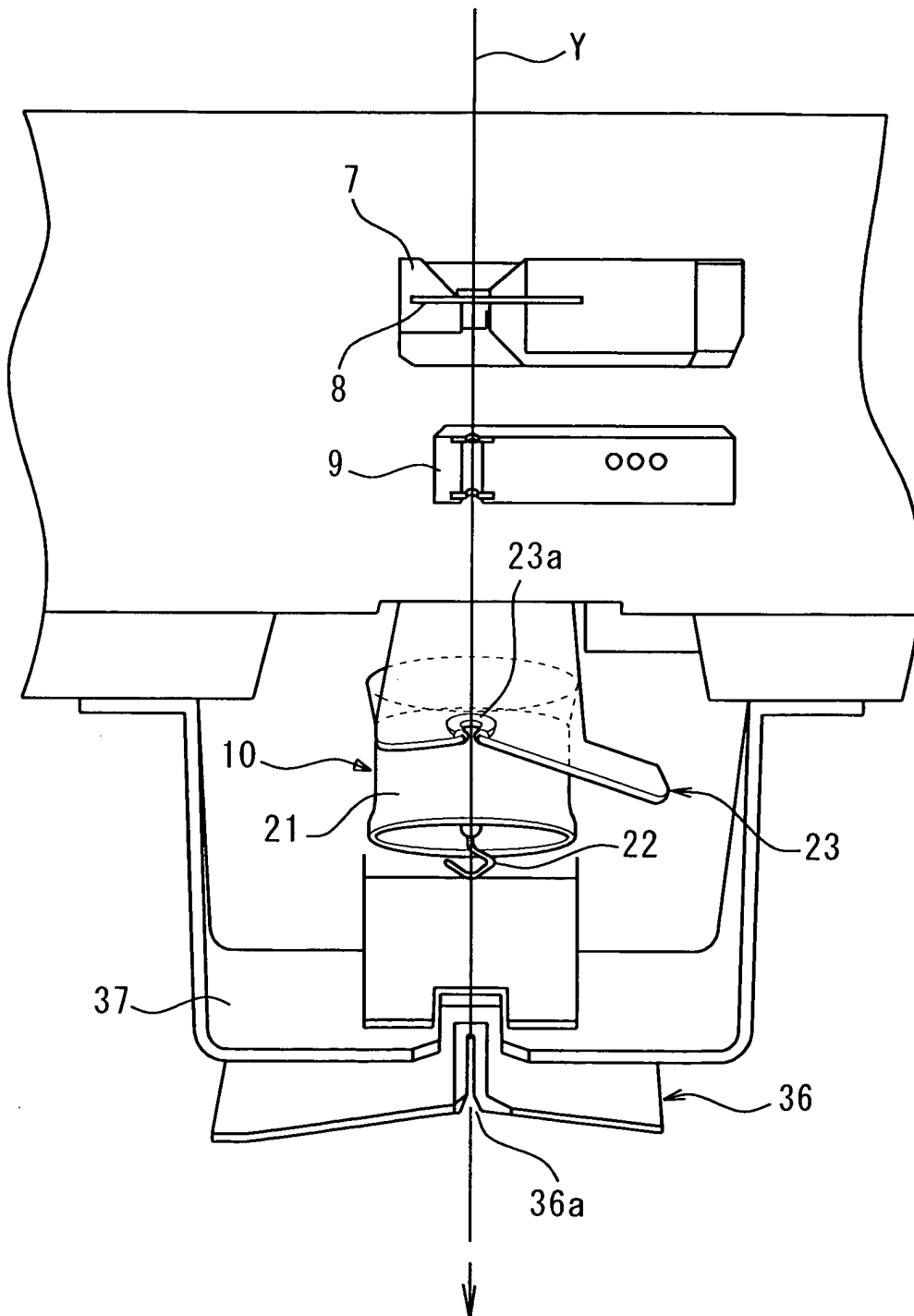


FIG.9

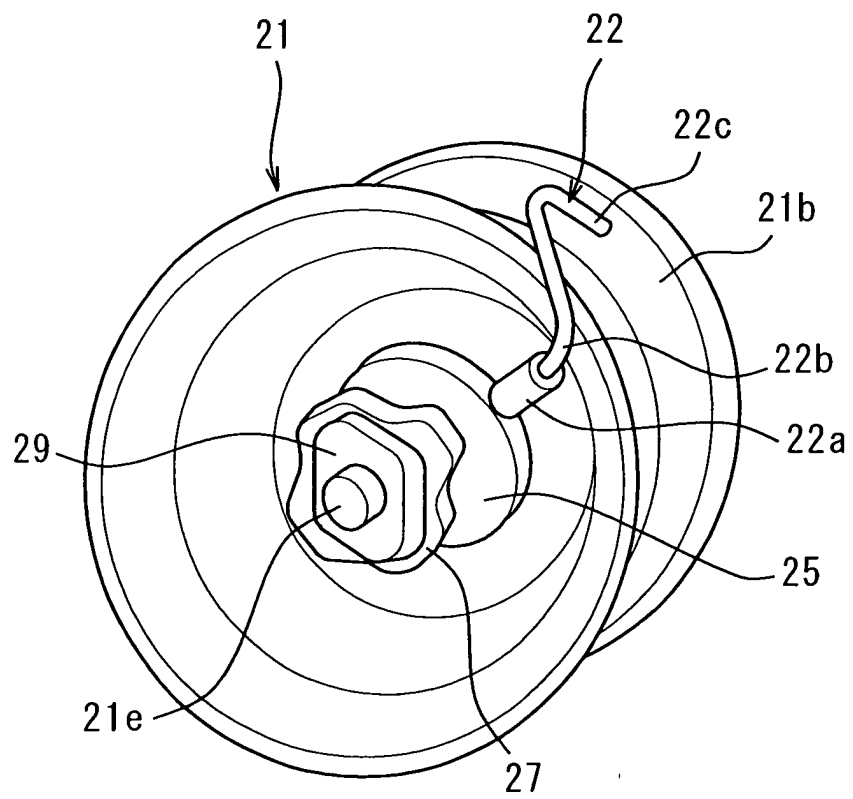


FIG.10

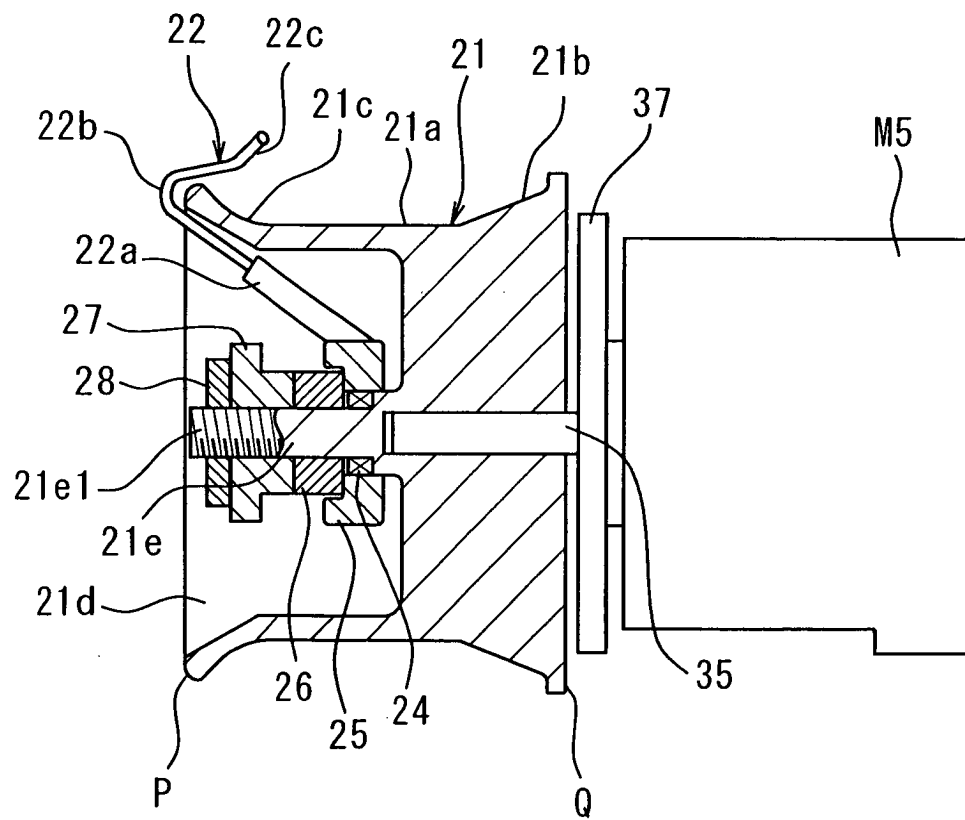


FIG.11

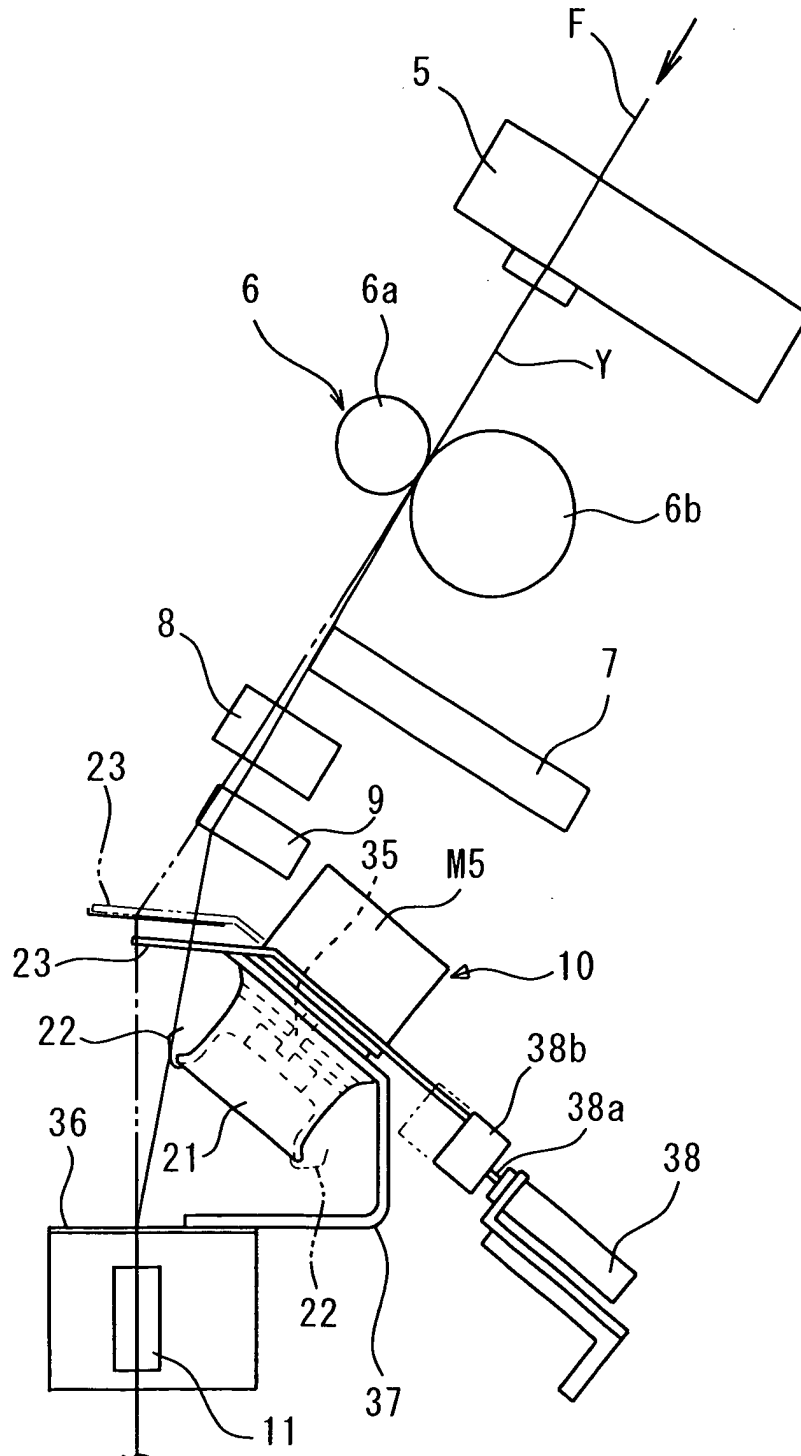


FIG.12A

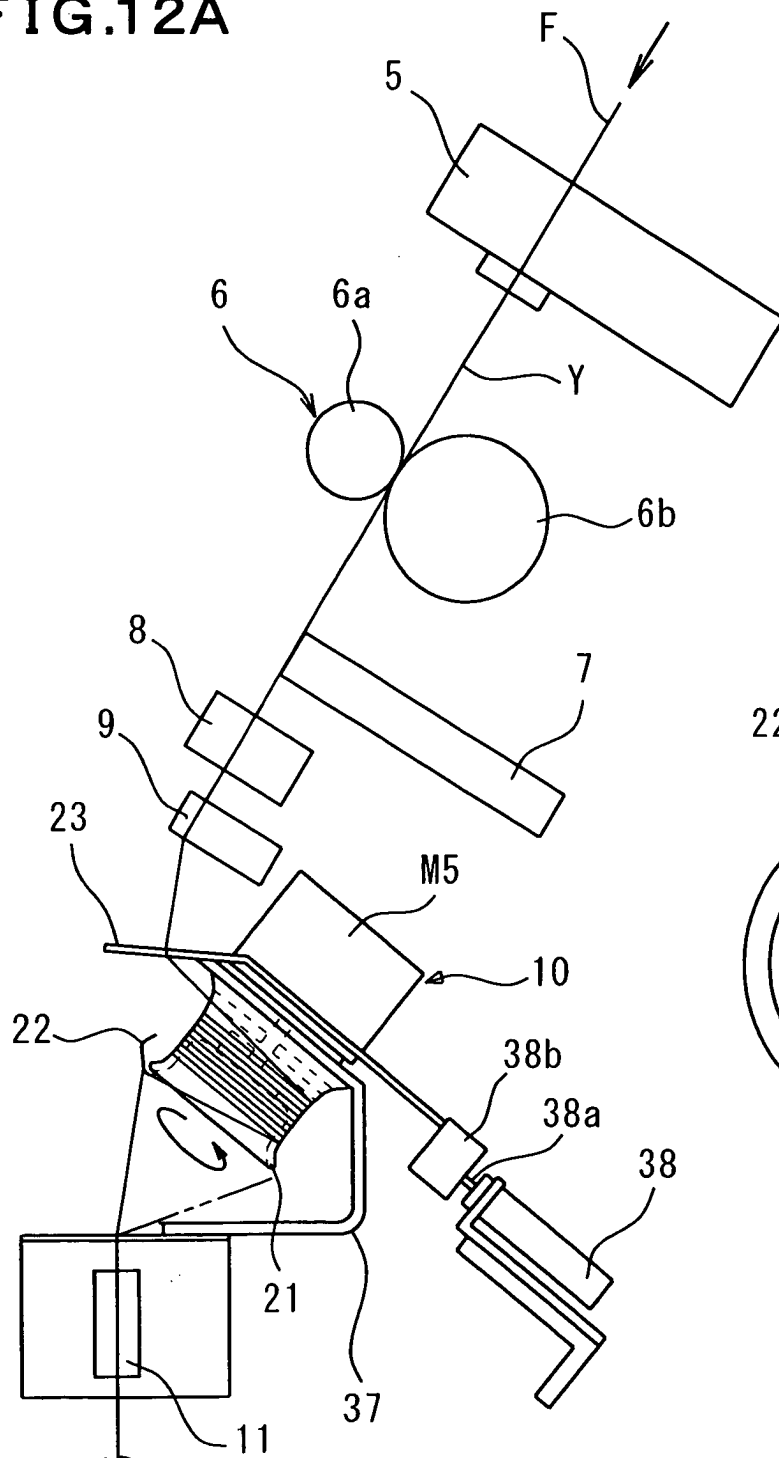


FIG.12B

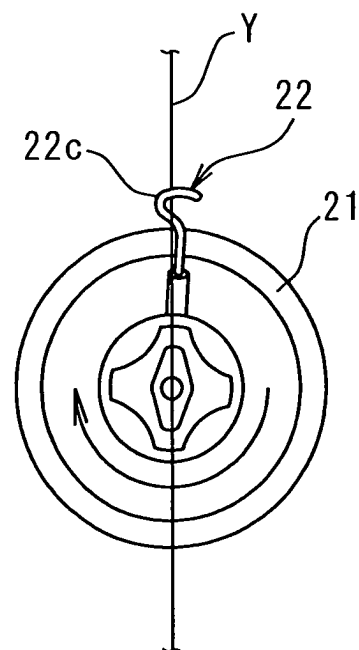


FIG.13

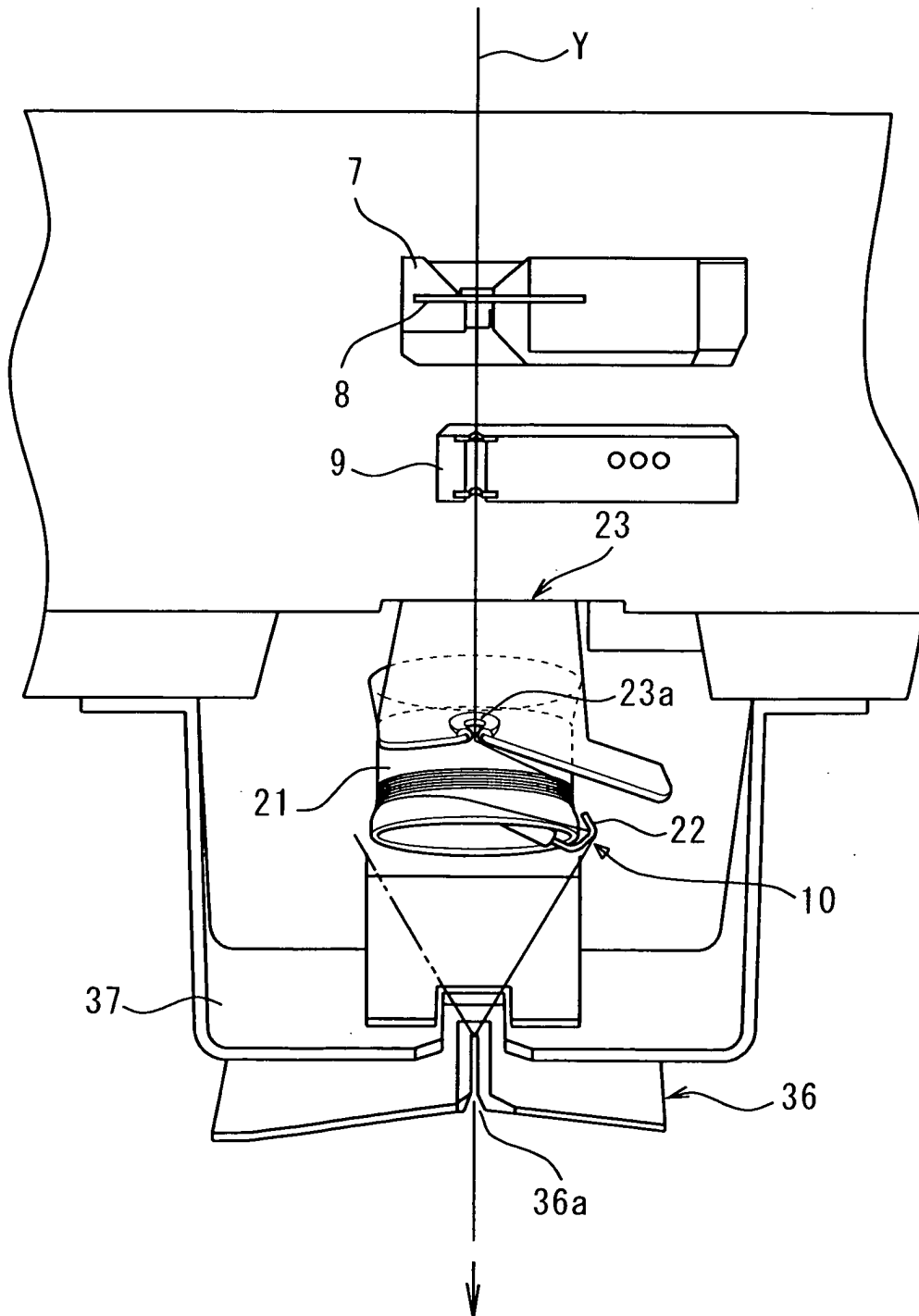


FIG.14

