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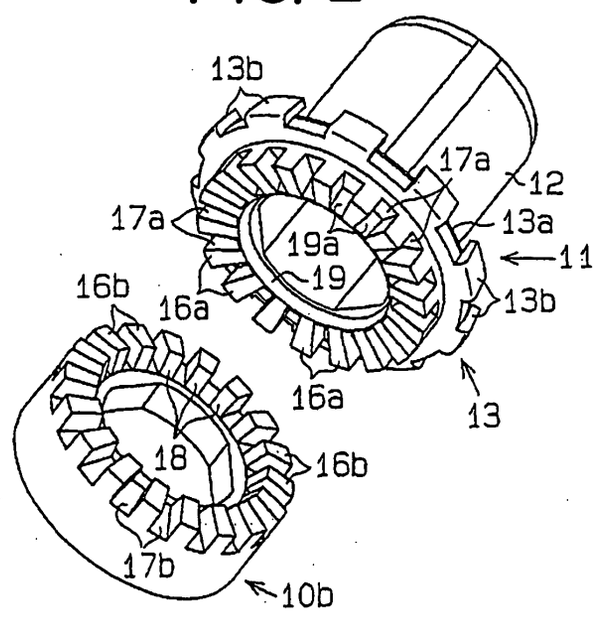
(54) Method of operating ring spinning machine during suspension for doffing and method of cutting yarn during doffing

(57) Disclosed are a method of operating a ring spinning machine during suspension for doffing and a method of cutting yarn during doffing. There is provided a drafting device allowing draft ratio change independently of the driving of a spindle drive system. Prior to forming an oblique winding on cop during suspension for doffing, the draft ratio of the drafting device is changed so as to be larger than the draft ratio of the spinning conducted until then without changing the number of twists to perform the operation during suspension for doffing. By increasing the degree to which the rotating speed of a back bottom roller is reduced, the draft ratio is increased. The number of twists of the yarn forming the oblique winding remains the same while the yarn becomes thinner, so that, when doffing is performed by a doffing device, it is possible to cut the tail yarn at a tail yarn cutting portion so as to attain a short yarn end.

FIG. 2



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Description

BACKGROUND OF THE INVENTION

Field of the Invention:

[0001] The present invention relates to a method of operating a ring spinning machine during suspension for doffing and a method of cutting yarn during doffing. More specifically, the present invention relates to a method of performing operation during suspension for doffing and a method of cutting yarn during doffing in a spinning machine in which a spindle is equipped with a tail yarn cutting portion and in which yarn take-up is automatically effected when the machine is re-started after fitting of an empty bobbin onto a spindle from which cop has been pulled up by a doffing device.

Description of the Related Art:

[0002] In a ring spinning machine, in which yarn is taken up through a traveler, it is required that yarn connected to a roller part be connected to the spindle while passing the traveler, so that itispossibletoautomatically perform bobbin replacing operation in a full bobbin state and automatically take up the yarn on an empty bobbin upon the re-starting of the machine after the bobbin replacement. To meet this requirement, there have conventionally been provided a tail yarn cutting portion on the spindle base portion and a tail yarn winding portion below the same; after a full bobbin state has been attained, a ring rail is abruptly lowered to perform oblique winding, and then yarn is wound around the tail yarn winding portion, the yarn (tail yarn) connected from the tail yarn winding portion to the full cop being cut by the tail yarn cutting portion when the full cop is pulled out.

[0003] In this cutting method, however, the tail yarn wound around the tail yarn winding portion remains thereon after doffing, and the amount of remnant yarn increases as doffing is repeated, so that it is necessary to frequently perform remnant yarn treatment. Further, since the winding length of the tail yarn is large, the remnant yarn is hard to remove.

[0004] To solve the above problems in the prior art, there has been proposed a tail yarn cutting method (see, for example, JP 2002-173837 A (paragraphs [0021] to [0028], Figs 1-3)) in which the yarn connected from the traveler to the cop is grasped by a grasping portion capable of opening/closing and in which the yarn connected from the grasping portion to the cop is cut by a cutter through the operation of pulling up the cop by a doffing device.

[0005] In the method as disclosed in JP 2002-173837 A, there is used a special tail yarn cutting member provided so as to be capable of ascending and descending with respect to a blade extending upwardly from the spindle base portion. As shown in Fig. 10B of the present application, a tail yarn cutting member 61 is equipped with a bobbin fitting portion 61 onto which a bobbin B is fitted and a cutter portion 61b provided below the bobbin fitting portion 61a. During suspension for doffing, a ring rail is stopped in a state in which yarn connected to cop by way of a traveler passes a position below the contact portion where the tail yarn cutting member and the spindle base portion are in contact with each other; the spindle is stopped, with about a roll or less of yarn wound at a position somewhat below the above-mentioned contact portion. In this state, as shown in Fig. 10A of the present application, cop 63 is pulled up by a doffing device 62, and the tail yarn cutting member 61 is raised together with the cop 63 up to halfway through the pulling up, and yarn Y connected from the cop 63 to a traveler 66 of a ring rail 65 is guided to a position between the tail yarn cutting member 61 and a spindle base portion 64.

[0006] Thereafter, the ascent of the tail yarn cutting member 61 is regulated by a regulating means, and as shown in Fig. 10B of the present application, the tail yarn cutting member 61 detached from the cop 63 descends to a position where it abuts the spindle base portion 64. Then, the yarn Y connected from the cop 63 to the traveler 66 of the ring rail 65 is grasped between the tail yarn cutting member 61 and the spindle base portion 64, and the cop 63 further ascends, whereby the yarn Y is cut by the cutter portion 61b.

[0007] Further, there has also been disclosed a method (see, for example, JP 10-317233 A (paragraphs [0009] and [0014], Figs. 1, 2, and 9)), in which yarn connected from a traveler to cop is grasped between a stationary under-winding collar provided in the lower portion of a spindle and a sleeve provided below the same so as to be capable of ascending and descending, and in which yarn connected from the cop to a grasping portion is caused to abut an edge portion halfway through doffing to tear off the yarn without using any cutter.

[0008] However, in the case of low count yarn, the single yarn breaking strength is high, and the yarn is not cut at a position corresponding to the cutter portion or the edge portion but is torn off, with the result that the cut yarn-end portion is longer as compared with the case in which the yarn is cut at the cutter portion 61b or the edge portion. When the cut yarn-end portion becomes longer, the requisite consumption power for rotating the spindle at the time of taking up increases, and also causes scattering of cotton waste.

[0009] Further, when low count yarn is spun in spinning or large diameter cop is used in twisting, the angle at which the yarn Y forming an oblique winding 63a is wound around the bobbin (i.e., the angle thereof with respect to the horizontal plane) is smaller as compared with the case of high count yarn, as shown in Fig. 10C. When the method according to JP 2002-173837 A is executed in a state in which the above-mentioned winding angle is small, it can occur that the yarn Y connected from the cop 63 to the grasping portion is wound around the bobbin fitting portion 61a and the spindle during the

further ascent of the cop 63 from the state in which the yarn Y is grasped between the tail yarn cutting member 61 and the spindle base portion 64. In this case, the yarn Y is not easily cut by the cutter portion 61b but is torn off. When the diameter of the cutter portion 61b is increased, the yarn Y can be cut at a position where it abuts the cutter portion 61b. However, this involves an increase in the power consumption during take-up operation.

[0010] To perform the yarn cutting in a satisfactory manner by the tail yarn cutting device, a method is available in which the yarn twist is made somewhat loose to facilitate the cutting. In some cases, however, this does not suffice. Further, there is a problem of a reduction in the degree of freedom in the combination of a desired thickness and a desired twist.

SUMMARY OF THE INVENTION

[0011] The present invention has been made in view of the above problems in the prior art. It is a first object of the present invention to provide a method of operating a ring spinning machine during suspension for doffing which makes it possible to perform cutting so as to attain a state in which the resultant yarn end is short even in the case of low count yarn. It is a second object of the present invention to provide a method of cutting yarn in a ring spinning machine during doffing so as to attain a state in which the resultant yarn end is short even in the case of low count yarn.

[0012] According to the present invention, there is provided a method of performing operation during suspension for doffing in a ring spinning machine in which a spindle is equipped with a tail yarn cutting portion and in which yarn take-up is automatically effected when restarting the machine after fitting of an empty bobbin onto a spindle from which cop has been pulled up by a doffing device, the method including the steps of: providing a drafting device allowing draft ratio change independently of a driving of a spindle drive system; and changing a draft ratio of the drafting device so as to be larger than a draft ratio of spinning conducted until then to perform the operation during suspension for doffing prior to forming an oblique winding on the cop during suspension for doffing.

[0013] In this invention, the yarn forming the oblique winding is thin, sothatduringdoffingbythedoffingdevice, it is possible to cut the tail yarn at the tail yarn cutting portion so as to obtain a short yarn end.

[0014] Note that, the drafting device has a front bottom roller, a middle bottom roller, and a back bottom roller, and the changing of the draft ratio can be effected by reducing rotating speeds of the middle bottom roller and the back bottom roller.

[0015] It might be possible to increase the draft ratio by reducing solely the rotating speed of the back bottom roller. In that case, however, a large draft would be involved between the middle bottom roller and the back bottom roller, resulting in fiber draining. At worst, yarn breakage can occur. To avoid this, a special measure, such as forming an apron roller, would have to be taken.

[0016] Preferably, in the operation method, the spindle is equipped with a tail yarn cuttingmember capable of ascending and descending within a predetermined range along a blade extending upwardly from a spindle base portion and capable of grasping between the tail yarn cutting member and the spindle base portion yarn connected from a traveler to the cop, the tail yarn cutting member being equipped with a bobbin fitting portion onto which a bobbin is fitted and a cutter portion provided below the bobbin fitting portion, and the method further includes the steps of: drive-controlling a lifting drive system and the spindle drive system such that, at the time of stopping doffing, a ring rail is stopped, with the yarn connected to the cop by way of the traveler passing a position below a position where the tail yarn cutting member and the spindle base portion are in contact with each other, and that the spindle is stopped, with one roll or less of yarn wound at a position below the position where the tail yarn cutting member and the spindle base portion are in contact with each other.

[0017] In this case, there is used a tail yarn cutting member equipped with a bobbin fitting portion allowing fitting of a bobbin and a cutter portion provided below the bobbin fitting portion, the spindle being stopped with one roll or less of yarn being wound at a position below the portion where the tail yarn cutting member and the spindle base portion are in contact with each other. When the cop is pulled up by the doffing device, the yarn connected from the cop to the traveler is guided to a position between the tail yarn cutting member and the spindle base portion halfway through the pulling up. Thereafter, the tail yarn cutting member is regulated in its ascent and is separated from the cop. Then, the above-mentioned yarn is held between the tail yarn cutting member, which has been separated from the cop and lowered, and the spindle base portion. When, in this state, the cop is further raised by the doffing device, the yarn is cut by the cutter portion. Thus, tail yarn wound around the tail yarn winding portion in one or more rolls (normally two to three rolls) remains in the tail yarn winding portion after the doffing. Thus, in contrast to the conventional device, in which, as doffing is repeated, the amount of remnant yarn increases, making it necessary to frequently perform remnant yarn treatment, there is no need to perform such tail yarn treatment.

[0018] According to the present invention, there is provided a method of cutting yarn during suspension for doffing in a ring spinning machine, the method including the steps of: starting doffing by a doffing device after operation stop is effected in the above-described method of performing operation during suspension for doffing in a ring spinning machine; pulling up the cop by the doffing device; raising the tail yarn cutting member with the cop halfway through the pulling up of the cop; guiding the yarn connected to the traveler from the cop to a po-

sition between the tail yarn cutting member and the spindle base portion; grasping the yarn between the tail yarn cutting member detached from the cop and the spindle base portion by regulating ascent of the tail yarn cutting member with a regulating means; grasping the cop by the doffing device; enlarging an angle at which the yarn of the oblique winding formed on the cop abuts the cutter portion by rotating the spindle, with the spindle being capable of relative rotation with respect to the cop; and raising the cop further by the doffing device to cut the yarn.

[0019] In the spinning of low count yarn, the winding angle of the yarn forming the oblique winding with respect to the bobbin (the angle thereof with respect to the horizontal plane) is small, so that the angle at which the yarn abuts the cutter portion when the cop is raised by the doffing device is reduced, and the yarn is not easily cut at the position corresponding to the cutter portion. In this invention, however, the angle at which the yarn of the oblique winding formed on the cop abuts the cutter portion is enlarged, and then the cop is further raised by the doffing device to cut the yarn, so that the yarn is cut at the position corresponding to the cutter portion. Thus, even in the case of low count yarn, it is possible to effect cutting such that the resultant yarn end is short.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020]

Fig. 1 is a graph showing changes with time of spindle rotating speed, bottom roller rotating speed, and ring rail position during suspension for doffing;

Fig. 2 is a schematic perspective view of a tail yarn cutting member and a spindle base portion;

Fig. 3 is a schematic diagram showing the construction of a ring spinning machine;

Fig. 4A is a schematic side view, partly in section, of a spindle;

Fig. 4B is a sectional view showing how the tail yarn cutting member is mounted;

Figs. 5A and 5B, 6A through 6C, and 7A through 7C are schematic main-portion side views for illustrating the operation during doffing in an embodiment of the present invention;

Figs. 8A and 8B are schematic diagrams showing the relationship between the spinning machine and the doffing device;

Fig. 9 is a sectional view of a tail yarn cutting member according to another embodiment of the present invention;

Figs. 10A and 10B are schematic main-portion side views for illustrating the operation during doffing in the prior-art technique; and

Fig. 10C is a schematic main-portion side view showing the case in which low-count, large-diameter cop is used in the prior-art technique.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] An embodiment of the present invention will now be described with reference to Figs. 1 through 8B. Fig. 1 is a graph showing changes with time of spindle rotating speed, bottom roller rotating speed, and ring rail position during suspension for doffing; Fig. 2 is a schematic perspective view of a tail yarn cutting member and a spindle base portion; Fig. 3 is a schematic diagram showing the construction of a ring spinning machine; Fig. 4A is a schematic side view, partly in section, of a spindle; Fig. 4B is a sectional view showing how the tail yarn cutting member is mounted; Figs. 5A through 7C are schematic main-portion side views for illustrating the operation during doffing; and Figs. 8A and 8B are schematic diagrams showing the relationship between the spinning machine and the doffing device.

[0022] As shown in Fig. 3, spindles 1 are rotated by a spindle drive mechanism equipped with a driving pulley 3 driven by a motor 2, a driven pulley 4, and a tangential belt 5 wrapped around the pulleys 3 and 4. As the motor 2, there is used a variable-speed motor driven through an inverter 6, the motor being equipped with a rotary encoder 2a.

[0023] As shown in Fig. 4A, the spindle 1 is rotatably supported by a bolster 8 fixed to a spindle rail 7, through the intermediation of a bearing 9. The spindle 1 is equipped with a blade portion 10 and a spindle shaft 1a firmly attached to the lower central portion of the blade portion 10, and the spindle shaft 1a is rotatably supported by the bolster 8. The blade portion 10 is formed of aluminum or an aluminum alloy except for a spindle base portion 10b, and the spindle base portion 10b, which is formed of resin, is fitted into the lower portion of a blade 10a. The spindle shaft 1a is insert-molded in the blade portion 10, which is formed of aluminum or an aluminum alloy.

[0024] On the blade 10a extending upwards beyond the spindle base portion 10b, a tail yarn cutting member 11 is provided so as to be capable of ascending and descending within a predetermined range. As shown in Fig. 4B, the tail yarn cutting member 11 is equipped with a bobbin fitting portion 12 onto which a bobbin B is fitted and a cutter portion 13 provided below the bobbin fitting portion 12. The cutter portion 13 includes a separate annular cutter member 13a and is equipped with a plurality of lock protrusions 13b for fixing the cutter member 13a. In this embodiment, the diameter of the forward end portion of the cutter member 13a is larger than the outer diameter of the lower end portion of the bobbin B.

[0025] The bobbin fitting portion 12 is formed in a cylindrical configuration, and has on its inner side a recess 12a for accommodating a coil spring 14. The lower end portion of the tail yarn cutting member 11 is kept in contact with the spindle base portion 10b, making it possible to grasp tail yarn between the tail yarn cutting member 11 and the spindle base portion 10b.

[0026] A collar 15 serving as a stopper is fixed to the blade 10a at a position where its lower portion is opposed to the upper end of the bobbin fitting portion 12 in a state in which the tail yarn cutting member 11 as a tail yarn cutting portion is in contact with the spindle base portion 10b. The outer diameter of the collar 15 is somewhat smaller than the inner diameter of the recess 12a, and the tail yarn cutting member 11 slides along the collar 15. The bobbin fitting portion 12 is formed such that its outer diameter gradually decreases toward its upper end.

[0027] The coil spring 14 is accommodated in the recess 12a, with its lower end abutting the lower end of the recess 12a and its upper end abutting the lower end of the collar 15. The coil spring 14 constitutes a spring for constantly urging the tail yarn cutting member 11 toward the spindle base portion 10b. Further, the coil spring 14 is provided between the tail yarn cutting member 11 and the blade 10a and constitutes a regulating means adapted to prohibit, at the time of doffing, the ascent of the tail yarn cutting member 11 beyond the position where the tail yarn cutting member 11 is in contact with the spindle base portion 10b by a predetermined height or more.

[0028] As shown in Fig. 4B and Fig. 2, on the lower end portion of the tail yarn cutting member 11 and on the upper end portion of the spindle base portion 10b opposed to the above-mentioned lower end portion, there are provided a plurality of radially extending protrusions 16a and 16b and recesses 17a and 17b that can be engaged with each other. Thus, the lower end portion of the tail yarn cutting member 11 and the upper end portion of the spindle base portion 10b are equipped with a plurality of teeth in mesh with each other. It is desirable that the height of the protrusions 16a and 16b and the depth of the recesses 17a and 17b be approximately 2 mm.

[0029] The lower end portion of the tail yarn cutting member 11 is formed so as to constitute a part of the slope of an imaginary cone whose rotation center is the spindle 1 and whose apex is situated above a plane including the outer periphery of the above-mentioned lower endportion andperpendicular to the spindle 1. The upper end portion of the spindle base portion 10 is also formed so as to constitute a part of the slope of an imaginary cone whose rotation center is the spindle 1 and whose apex is situated above a plane including the outer periphery of the above-mentioned lower end portion andperpendicular to the spindle 1.

[0030] End surfaces 18 on the blade 10a side of the protrusions 16b of the spindle base portion 10b are formed so as to be curved surfaces constituting the slope of a downwardly facing imaginary cone whose rotation center is the spindle 1. On the blade 10a side of the recesses 17a of the tail yarn cutting member 11, there is formed a wall 19 capable of abutting the end surfaces 18 and having a curved surface 19a forming the slope of an imaginary cone whose rotation center is the spindle. The end surfaces 18 and the wall 19 constitute an aligning means for securing coaxiality of the tail yarn cutting member 11 with respect to the spindle base portion 10b.

[0031] In the lower outer peripheral surface of the bobbin fitting portion 12, there is formed an annular groove 20, in which a rubber ring 21 is accommodated so as to partially protrude from the groove 20. The rubber ring 21 constitutes a fitting force enhancing means for enhancing the force with which the bobbin fitting portion 12 and the bobbin B are connected together by fitting.

[0032] Along the row of spindles, a line shaft 22 is rotatably arranged. On the line shaft 22, there are arranged, at predetermined intervals, ascent/descent units 25 (only one of which is shown), each unit raising and lowering a ring rail 23, equipped with a ring 23a allowing travel of a traveler T, and a lappet 24 equipped with a snail wire 24a (shown in Figs. 5 through 7) .

[0033] The ascent/descent unit 25 is equipped with a screw gear 26 fit-secured to the line shaft 22 so as to be capable of integral rotation, and a nut member 28 threadedly engaged with a screw portion 27a formed in the lower portion of a porker pillar 27 supporting the ring rail 23 and in mesh with the screw gear 26. The line shaft 22 is connected to the drive shaft of a motor 29 through a gear mechanism (not shown) . Through normal and reverse rotation of the motor 29, the ring rail 23 is caused to ascend and descend. These components are basically of the same construction as those, for example, of the device disclosed in JP 7-300728 A. As the motor 29, there is used a servo motor controlled through a servo driver 30, the motor being equipped with a rotary encoder 29a. The line shaft 22, the ascent/descent unit 25, the porker pillar 27, etc. constitute a lifting drive system. The lappet 24 can also be caused to ascend and descend by a similar ascent/descent mechanism in synchronism with the ring rail 23.

[0034] A front bottom roller 32 constituting a drafting device 31 is connected to a first servo motor 33. A middle bottom roller 34 is connected to a second servo motor 35, and a back bottom roller 36 is connected to a third servo motor 37. That is, the bottom rollers 32, 34, and 36 are respectively driven by independent drive motors. The servo motors 33, 35, and 37 are respectively equipped with rotary encoders 33a, 35a, and 37a.

[0035] As shown in Figs. 8A and 8B, the ring spinning machine is equipped with a well-known overall type doffing device (bobbin replacing device) 38. The doffing device 38 is equipped with a doffing bar 39 equipped with a bobbin grasping device 39a, replacing an empty bobbin E on a peg 40a of a feeding device 40 arranged below the spindle rail 7 and cop 41 on the spindle 1. As shown in Fig. 8A, during doffing operation, the bobbin grasping device 39a provided on the doffing bar 39 moves along the line indicated by the arrow, fitting the empty bobbin E pulled up from the peg 40a onto an intermediate peg 42. Next, the bobbin grasping device

39a moves to a position corresponding to the top of the cop 41 on the spindle 1, and after grasping the cop 41, moves along the line indicated by the arrow in Fig. 8B, pulls up the cop 41 on the spindle 1, and then fits it onto the peg 40a of the feeding device 40. Next, the bobbin grasping device 39a moves again along the line indicated by the arrow in Fig. 8A, and fits the empty bobbin E on the intermediate peg 42 onto the spindle 1 before moving along the line indicated by the arrow in Fig. 8B to be returned to the standby position above the peg 40a.

[0036] A control device 43 for controlling the motors 2 and 29 and the servo motors 33, 35, and 37 is equipped with a CPU (central processing unit) 44, a program memory 45, an operation memory 46, and an input device 47. The CPU 44 operates based on predetermined program data stored in the program memory 45, and is connected to an inverter 6 through an interface (not shown) and a drive circuit, and connected to the motor 29 through an interface (not shown), a drive circuit and a servo driver 30. Further, connection to the CPU 44 is effected through interfaces (not shown), drive circuits, and servo drivers 48, 49, and 50.

[0037] The program memory 45 consists of read only memory (ROM), which stores the above-mentioned program data and various items of data necessary for the execution thereof. The program data includes a control program for controlling the motors 2 and 29 and the servo motors 33, 35, and 37 during take-up operation, a control program for controlling the doffing device during doffing operation (bobbin replacement operation) after doffing stop, and a control program for controlling the motor 2. For example, the various items of data include spinning conditions, such as the count of the yarn to be spun and the spindle RPM during spinning operation, and data corresponding to the number of times that chasing of the ring rail 23 is effected until a full bobbin state is attained.

[0038] The operation memory 46 consists of memory allowing reading and rewriting (RAM), and temporarily stores data input by the input device 47, computation results obtained by the CPU 44, etc. The operation memory 46 is equipped with a backup power source (not shown).

[0039] The input device 47 is used to input spinning condition data, such as the number of the yarn to be spun, the spindle RPM during spinning operation, the spinning length, the lift length, the chase length, etc.

[0040] The CPU 44 computes the rotating speeds of the motors 2 and 29 and the servo motors 33, 35, and 37 based on the output signals of the rotary encoders 2a, 29a, 33a, 35a, and 37a, and performs control so as to drive the spindle drive system, the draft part drive system, and the lifting drive system in synchronism with each other at predetermined speeds corresponding to the spinning conditions. The CPU 44 computes the RPM of the front bottom roller 32, that is, the spinning yarn length, based on the output signal from the rotary encoder 33a. When a predetermined spinning length is attained, the CPU 44 causes the lifting mechanism to operate so as to cause the lifting rail 23 to perform raising/lowering operation during full bobbin suspension.

[0041] The CPU 44 controls the servo motors 33, 35, 37, etc. such that, prior to the formation of the oblique winding 41a on the cop 41 during doffing suspension, operation is conducted, with the draft ratio of the drafting device 31 being made larger than that of the spinning conducted until then without changing the number of twists. In this embodiment, the control is effected so as to increase the draft ratio from the point in time at which the top bunch winding is formed.

[0042] The CPU 44 recognizes, based on a signal from the doffing device 38, the stage of the doffing operation. During doffing operation, the yarn Y connected from the cop 41 to the traveler T is grasped by the tail yarn cutting member 11 and the spindle base portion 10b, and then the spindle 1 is rotated at low speed by a predetermined amount. The ascertaining of the grasping of the yarn Y by the tail yarn cutting member 11 is effected based on a signal from the rotary encoder 29a corresponding to a predetermined position during doffing rise of the doffing device 38previouslyobtainedbyexperiment. Further, the predetermined amount by which the spindle 1 is rotated at low speed is previously obtained by experiment in correspondence with the spinning conditions.

[0043] Next, the operation of this device, constructed as described above, will be illustrated. Prior to the operation of the spinning machine, the spinning condition data, such as the count of the yarn to be spun, the spindle RPM during spinning operation, the spinning length, the lift length, and the chase length, is input by the input device 47. The bobbin B is attached to the spindle 1 so as to be capable of integral rotation in a state in which the lower portion of the bobbin B is fitted onto the bobbin fitting portion 12 of the tail yarn cutting member 11, with its upper portion being engaged with a lock member.

[0044] The control device 43 drive-controls the motors 2 and 29, and the servo motors 33, 35 and 37 in accordance with the spinning conditions input by the input device 47 and stored in the operation memory 46. When the motor 29 is driven, the line shaft 22 is rotated, and the ring rail 23, the lappet 24, etc. are caused to ascend or descend. Further, the yarn Y sent out from the front rollers including the front bottom roller 32 is taken up on the bobbin B by way of the snail wire 24a and the traveler T.

[0045] As shown in Fig. 5A, when, after continuationof the spinning, a full-bobbin-stop time is reached, a top bunch winding 51 is formed, and then the ring rail 23 is abruptly lowered to form an oblique winding (barrel winding) 41a on the cop (full bobbin) 41 attached to the spindle 1. Thereafter, the ring rail 23 is stopped in a state in which the yarn Y connected to the cop 41 by way of the traveler T passes a position below the contact portion where the tail yarn cutting member 11 and the spin-

dle base portion 10b are in contact with each other. Then, braking is effected to stop the spindle 1 so as to attain a state in which one roll or less of yarn is wound at a position somewhat below the contact portion where the tail yarn cutting member 11 and the spindle base portion 10b are in contact with each other, thereby attaining the state as shown in Fig. 5B.

[0046] Next, as shown in Fig. 6A, the lappet 24 is arranged at a retracted position where it does not interfere with doffing, and then the cop (full bobbin) 41 is pulled up by the bobbin grasping device 39a of the doffing device 38. The tail yarn cutting member 11 is raised together with the cop 41 halfway through the pulling up, and the yarn Y connected from the cop 41 to the traveler T is guided to a position between the tail yarn cutting member 11 and the spindle base portion 10b. When the tail yarn cutting member 11 rises together with the cop 41, the yarn Y wound around the spindle base portion 10b moves along the outer surface of the blade 10 a. When the tail yarn cutting member 11 rising together with the cop 41 reaches a predetermined height, the tail yarn cutting member 11 is detached from the cop 41 by the urging force of the coil spring 14.

[0047] Then, as shown in Fig. 6B, the tail yarn cutting member 11 is lowered to the position where it abuts the spindle base portion 10b, and the yarn Y connected from the cop 41 to the traveler T is grasped between the tail yarn cutting member 11 and the spindle base portion 10b. After the yarn Y is grasped between the tail yarn cutting member 11 and the spindle base portion 10b, the spindle 1 is rotated in a state in which it is capable of relative rotation with respect to the cop 41 grasped by the bobbin grasping device 39a. Then, a state is attained in which the oblique winding 41a formed on the cop 41 extends straight from the top of the cop 41 to the position where,the yarn is grasped by the tail yarn cutting member 11. At this time, the yarn Y extending from the snail wire 24a of the lappet 24 to the traveler T is loosely wound around the cop 41.

[0048] Thereafter, the cop 41 is further raised by the bobbin grasping device 39a, and a state is attained in which the yarn Y abuts the cutter portion 13 at a large angle close to 90 degrees, and the yarn Y is reliably cut by the cutter portion 13, thus attaining the state as shown in Fig. 6C. Further, the operation of the doffing device 38 is continued and the cop 41 undergoes doffing until the state as shown in Fig. 7A is attained.

[0049] Next, as shown in Fig. 7B, the lappet 24 is returned to the spinning position, whereby the winding of the yarn Y around the spindle 1 is canceled. Next, the lappet 24 is reversed to the retracted position again, and as shown in Fig. 7C, a state is attained in which the yarn Y extending to the traveler T by way of the lappet 24 is straight. Thereafter, the empty bobbin B is fitted onto the spindle 1, and the lappet 24 is rotated to the take-up position, and then the spinning machine is re-started. The end portion of the yarn Y connected to the traveler T is held between the tail yarn cutting member 11 and the spindle base portion 10b until the next doffing. Then, the tail yarn held between the tail yarn cutting member 11 and the spindle base portion 10b is connected to the cop 41 upon the next doffing and detached from the spindle 1.

[0050] As shown in Fig. 1, during suspension for doffing, the rotating speeds of the bottom rollers 32, 34, and 36 are reduced prior to the formation of the top bunch winding 51, and halfway through the taking up of the top bunch winding 51, the rotating speeds of the middle bottom roller 34 and the back bottom roller 36 are further reduced. Furthermore, prior to the formation of the oblique winding 41a, the draft ratio of the drafting device 31 is changed so as to be larger than the draft ratio during the spinning until then without changing the number of twists. Thus, the oblique winding 41a and the yarn Y extending from the oblique winding 41a to the traveler T are spun in a thickness reduced as compared with that at the time of the spinning until then. As a result, the yarn is cut at a position where it abuts the cutter portion 13. In Fig. 1, the two-dot chain lines indicate the changes in the rotating speeds of the middle bottom roller 34 and the back bottom roller 36 in the case in which the draft ratio is not changed, and the solid lines indicate the changes in rotating speeds of the middle bottom roller 34 and the back bottom roller 36 in the case in which the draft ratio is changed. It is to be noted that Fig. 1 shows the positional change of the ring rail 23 and the tendency of the changes in the rotating speeds of the spindle 1 and the bottom rollers 32, 34, and 36, and the proportion of the rotating speeds of the spindle 1 and the bottom rollers 32, 34, and 36 as shown in the drawing is different from the actual proportion. Further, the ascending/descending amount of the ring rail 23 does not reflect the actual value.

[0051] When the large diameter cop 41 is produced for the spinning of low count yarn, the winding angle of the yarn Y forming the oblique winding 41a with respect to the bobbin B (the angle thereof with respect to the horizontal plane) is small, so that, when the cop 41 is raised as it is, the portion of the yarn Y below the oblique winding 41a may be wound around the spindle 1. When the cop 41 is pulled up in this state, the yarn Y is not cut by the cutter portion 13 despite the presence of the cutter portion 13 but torn off above the cutter portion 13, resulting in a long yarn end. In this embodiment, however, the cop 41 is not raised as it is from the position shown in Fig. 6B but raised after a change to cause the oblique winding 41a to extend straight, so that the yarn Y abuts the cutter portion 13 at a large angle, whereby the yarn Y is cut reliably by the cutter portion 13.

[0052] When the empty bobbin is fitted onto the spindle 1 in the state as shown in Fig. 7A, the yarn is wound around the spindle 1, and the fitting of the empty bobbin onto the spindle 1 is rather difficult due to accumulation of the yarn thus wound. However, prior to the fitting of the empty bobbin onto the spindle 4, the lappet 24 is returned to the spinning position to thereby cancel the

winding of the yarn Y around the spindle 1, and then the lappet 24 is arranged again at the retracted position where it does not interfere with doffing before fitting the empty bobbin onto the spindle 1. Thus, it is possible to prevent the yarn Y extending from the lappet 24 to the traveler T from being caught by the empty bobbin, and the taking up of the yarn Y is started in the normal fashion at the re-starting of the machine.

[0053] This embodiment provides the following advantages:

(1) There is provided the drafting device 31 allowing draft ratio change independently of the driving of the spindle drive system, and, prior to the formation of the oblique winding 41a on the cop 41 during suspension for doffing, the draft ratio of the drafting device 31 is changed so as to be larger than that during the spinning until then, and the operation during suspension for doffing is conducted. Thus, the yarn Y forming the oblique winding 41a is thin, so that during doffing by the doffing device 38, it is possible to cut the tail yarn by the cutter portion 13 so as to attain a state in which the resultant yarn end is short. As a result, it is possible to prevent an increase in the requisite power consumption for rotating the spindle 1 at the time of taking up and an increase in scattered waste cotton.

(2) The changing of the draft ratio of the drafting device 31 is effected by reducing the rotating speeds of those of the bottom rollers allowing speed change which are situated on the upstream side, i.e., the middle bottom roller 34 and the back bottom roller 36. It is desirable for the ratio in rotating speed between the middle bottom roller 34 and the back bottom roller 36 to be not changed beyond a predetermined proportion. In this case, in contrast to the case in which solely the rotating speed of the back bottom roller is reduced to enlarge the draft ratio, there is no fear of a great draft being involved between the middle bottom roller 34 and the back bottom roller 36. Thus, it is possible to prevent generation of fiber draining and, at worst, yarn breakage, without taking any special measures, making it possible to change the draft ratio without adversely affecting the draft operation.

(3) There is used the tail yarn cutting member 11 equipped with the bobbin fitting portion 12 onto which the bobbin B is fitted and the cutter portion 13 provided below the bobbin fitting portion 12, and the spindle 1 is stopped, with one roll or less of yarn Y being wound at a position not higher than the portion where the tail yarn cutting member 11 and the spindle base portion 10b are in contact with each other. Next, halfway through the doffing by the doffing device 38, the yarn Y connected from the cop 41 to the traveler T is held between the tail yarn cutting member 11 and the spindle base portion 10b, and is cut by the cutter portion 13. Thus, in contrast to the conventional device, in which one or more rolls (normally two to three rolls) of tail yarn wound around the tail yarn winding portion remains on the tail yarn winding portion after the doffing, and in which the amount of remnant yarn increases as doffing is repeated, making it necessary to frequently perform remnant yarn treatment, there is no need to perform such tail yarn treatment.

(4) The yarn Y is held between the tail yarn cutting member 11 detached from the cop 41 and the spindle base portion 10b, and the spindle is rotated, with the cop 41 being held by the doffing device 38 and the spindle 1 being capable of relative rotation with respect to the cop 41, thereby enlarging the angle at which the yarn Y of the oblique winding 41a formed on the cop 41 abuts the cutter portion 13. Thereafter, the cop 41 is further raised by the doffing device 38, and the yarn Y is cut. Thus, it is possible to cut the yarn Y more reliably at a position corresponding to the cutter portion 13.

(5) After the cop 41 is pulled up from the spindle 1 by the doffing device 38, the lappet 24 is returned to the spinning position, whereby the yarn Y connected from the lappet 24 to the traveler T while wound around the spindle 1 is straightened, and then the empty bobbin is fitted onto the spindle 1, with the lappet 24 moved to the retracted position again. Thus, it is possible to prevent the yarn Y extending from the lappet 24 to the traveler T from being caught by the empty bobbin, making it possible for the taking up of the yarn Y to be started in the normal fashion at the re-starting of the machine.

(6) The yarn Y is grasped in a state in which it is bent by the plurality of radially extending protrusions 16a and 16b and recesses 17a and 17b provided on the lower end portion of the tail yarn cutting member 11 and the upper end portion of the spindle base portion 10b opposed to the above-mentioned lower end portion. Thus, even when the force with which the tail yarn cutting member 11 is pressurized toward the spindle base portion 10b is so small as not to interfere with the operation of the doffing device 38, it is possible to grasp the yarn Y reliably.

(7) The lower surfaces of the protrusions 16a and the bottom surfaces of the recesses 17a, constituting the lower end portion of the tail yarn cutting member 11, are formed so as to constitute a part of the slope of an imaginary cone whose rotation center is the spindle 1 and whose apex is situated above a plane including the outer periphery of the lower end portion and perpendicular to the spindle 1. When a force to pull out the yarn from the grasping portion is applied to the yarn Y wound around the spindle 1 in a roll or less, a radially and outwardly directed force is applied to the yarn Y. When, on that occasion, the lower surfaces of the protrusions 16a and the bottom surfaces of the recesses 17a, constituting the grasping surface, are downwardly in-

clined, the resistance offered to the yarn Y at the edges of the protrusions 16a and the recesses 17a is larger than that in the case in which the grasping of the yarn Y is effected in a horizontal plane, and the yarn is not easily pulled out. As a result, the requisite pressurizing force of the tail yarn cutting member 11 for grasping the yarn Y can be smaller as compared to the case in which the grasping surface is horizontal.

(8) There is provided an aligning means for securing coaxiality of the tail yarn cutting member 11 with respect to the spindle base portion 10b. Thus, due to the action of the aligning means, the tail yarn cutting member 11 is rotated coaxially with the spindle 1, so that oscillation is not easily generated during rotation, making it possible to realize a stable rotation even in the case of high speed rotation.

(9) The spindle base portion 10b is formed of resin, and the portion of the tail yarn cutting member 11 engaged with the spindle base portion 10b is formed of metal. If both the spindle base portion 10b and the tail yarn cutting member 11 are formed of metal, the tail yarn cutting member 11 is detached from the cop 41 and is dropped; in the case of thin yarn, there is a fear of the yarn Y being cut by the end portion of the grasping portion due to the impact applied from the grasping portion when the yarn Y is grasped between the grasping portion and the spindle base portion 10b. However, since the spindle base portion 10b is formed of resin, it is possible, even in the case of thin yarn, to prevent the yarn Y from being cut by the end portion of the grasping portion as a result of the grasping impact.

[0054] The above-described embodiment should not be construed restrictively. For example, the present invention allows the following modifications:

[0055] The construction of the tail yarn cutting member 11 is not restricted to the one in which the protrusions 16a and the recesses 17a are formed on the surface thereof opposed to the spindle base portion 10b. Further, the construction of the cutter portion 13 is not restricted to the one in which the edge member 13a is a separate component. For example, as shown in Fig. 9, it is also possible to integrally form, as the tail yarn cutting member 11, a disc-like edge portion 12b at the lower end of the bobbin fitting portion 12 . The outer configuration of the edge portion 12b is not restricted to the circular one; it may also be of a saw-tooth-like configuration.

[0056] The change of the draft ratio when forming the oblique winding 41a is in many cases effected without changing the number of twists. However, in the case of thin or weak yarn, the number of twists is increased to prevent yarn breakage upon changing the draft ratio, and, in the case of strong yarn like thick yarn or synthetic fiber, the number of twists is reduced, facilitating the cutting of the yarn due to the synergetic effect obtained by the change of the draft ratio.

[0057] To reduce the number of twists, it is possible to increase the rotating speed of the front bottom roller 32 or reduce the rotating speed of the spindle 1 or adopt both of these methods. When the number of twists is reduced, the yarn strength is reduced, and, when performing doffing by the doffing device 38, it is possible to reliably cut the yarn Y at the cutter portion 13 so as to attain a state in which the resultant yarn end is short.

[0058] When performing doffing operation by the doffing device 38, it is also possible to raise the cop 41 by the doffing device 38 to cut the yarn Y without changing the angle at which the yarn Y of the oblique winding 41a formed on the cop 41 abuts the cutter portion 13 after the yarn Y is held between the tail yarn cutting member 11 detached from the cop 41 and the spindle base portion 10b.

[0059] The method of increasing the draft ratio is not restricted to the one in which the rotating speeds of both the middle bottom roller 34 and the back bottom roller 36 are reduced; it is also possible to reduce solely the rotating speed of the back bottom roller 36.

[0060] The number of draft rollers is not restricted to three; it may also be four or more. It is also possible to drive the bottom rollers from the middle bottom roller onward respectively by independent drive motors. Further, instead of connecting the drive motors directly to the bottom rollers, it is possible to provide speed reduction mechanisms between the drive motors and the bottom rollers.

[0061] It is only necessary for the drafting device 31 to allow draft ratio change without involving gear replacement, and its construction is not restricted to the one in which all the bottom rollers 32, 34, and 36 can be independently driven by motors. For example, it is also possible to adopt a construction in which all the bottom rollers from the middle bottom roller 34 onward are connected by gears and are driven by a single motor, with the front bottom roller 32 being driven by another motor. Further, it is also possible to adopt a construction in which the back bottom roller 36 constituting the drafting device 31 and the other bottom rollers (the front bottom roller 32 and the middle bottom roller 34) aredriven-byseparatemotors. In these constructions, it is also possible for the front bottom roller 32 and the spindle 1 to be driven by a single motor.

[0062] While in the above embodiment it is ascertained from the position of the doffing bar 39 that the tail yarn cutting member 11 has been detached from the cop 41 halfway through the doffing of the cop 41 by the doffing device 38 and that the detached tail yarn cutting member 11 has been lowered to the position where the yarn Y connected from the cop 41 to the traveler T is grasped, this can also be ascertained by some other method. For example, it is possible to ascertain it from the period of time that has elapsed from the grasping of the cop 41 and the starting of the pulling up. It is also possible to provide a sensor for each spindle 1.

[0063] It is also possible to form both the spindle base portion 10b and the tail yarn cutting member 11 of metal.

[0064] The end surfaces of the protrusions 16a and 16b and the bottom surfaces of the recesses 17a and 17b are not necessarily inclined outwardly and downwardly; they may also be horizontal. However, when a force to pull out the grasped yarn Y is applied, the resistance to the pulling-out of the yarn is larger in the case of the downwardly inclined configuration, making it harder for the yarn to be pulled out.

[0065] The fitting force enhancing means is not restricted to the rubber ring 21; itmayalsobe aplate-like or linear spring material. The spring material is not restricted to a completely ring-like one; it is also possible to adopt a spring in the form of a partially cut-outring. Further, it is also possible to accommodate a spring member in a recess formed in the outer surface of the bobbin fitting portion 12 such that its arcuate portion protrudes. It is also possible to provide a button urged by a spring.

[0066] The construction of the grasping member capable of grasping the yarn Y connected from the traveler T to the cop 41 in cooperation with the spindle base portion 10b during doffing is not restricted to the one which, as in the case of the tail yarn cutting member 11, descends to grasp the yarn Y after having risen integrally with the cop 41. For example, it is also possible to adopt a construction in which, as in the case of JP 10-317233 A, the yarn connected from the traveler to the cop is grasped by a stationary under-winding collar provided in the lower portion of the spindle and a sleeve ascending and descending below the same. Further, instead of providing the cutter portion 13, it is also possible to provide an edge portion, causing the yarn Y to abut the edge portion during the doffing of the cop 41 to be torn off.

[0067] The present invention is applicable to a case in which, during suspension for doffing, the yarn is held, with one or more rolls of tail yarn being wound around the base portion of the spindle and in which, during doffing, the yarn connected to the cop is cut by the cutter portion.

[0068] As the system for driving the spindle 1, it is also possible to adopt, instead of the construction in which the spindle 1 is driven by a tangential belt, a construction in which the spindle is driven by a spindle tape wrapped around a tin pulley. Further, it is also possible to adopt a so-called single spindle drive system in which a motor is provided for each spindle.

Claims

1. A method of performing operation during suspension for doffing in a ring spinning machine in which a spindle is equipped with a tail yarn cutting portion and in which yarn take-up is automatically effected when re-starting the machine after an empty bobbin is fitted onto a spindle from which cop has been pulled up by a doffing device, the method comprising the steps of:

   providing a drafting device allowing draft ratio change independently of a driving of a spindle drive system; and
   changing a draft ratio of the drafting device so as to be larger than a draft ratio of spinning conducted until then to perform the operation during suspension for doffing prior to forming an oblique winding on the cop during suspension for doffing.

2. An operation method according to Claim 1, wherein the drafting device has a front bottom roller, a middle bottom roller, and a back bottom roller,
   the changing of the draft ratio being effected by reducing rotating speeds of the middle bottom roller and the back bottom roller.

3. An operation method according to Claim 1, wherein the drafting device has a front bottom roller, a middle bottom roller, and a back bottom roller,
   the changing of the draft ratio being effected by reducing a rotating speed of the back bottom roller.

4. An operation method according to Claim 1, wherein the spindle is equipped with a tail yarn cutting member capable of ascending and descending within a predetermined range along a blade extending upwardly from a spindle base portion and capable of grasping between the tail yarn cutting member and the spindle base portion yarn connected from a traveler to the cop, the tail yarn cutting member being equipped with a bobbin fitting portion onto which a bobbin is fitted and a cutter portion provided below the bobbin fitting portion, the method further comprising the step of:

   drive-controlling a lifting drive system and the spindle drive system such that, at the time of stopping doffing, a ring rail is stopped, with the yarn connected to the cop by way of the traveler passing a position below a position where the tail yarn cutting member and the spindle base portion are in contact with each other, and that the spindle is stopped, with one roll or less of yarn wound at a position below the position where the tail yarn cutting member and the spindle base portion are in contact with each other.

5. A method of cutting yarn during suspension for doffing in a ring spinning machine, the method comprising the steps of:

   starting doffing by a doffing device after opera-

tion stop is effected in the method of per forming operation during suspension for doffing in a ring spinning machine according to Claim 4;
pulling up the cop by the doffing device;
raising the tail yarn cutting member with the cop halfway through the pulling up of the cop;
guiding the yarn connected to the traveler from the cop to a position between the tail yarn cutting member and the spindle base portion;
grasping the yarn between the tail yarn cutting member detached from the cop and the spindle base portion by regulating ascent of the tail yarn cutting member with a regulating means;
grasping the cop by the doffing device;
enlarging an angle at which the yarn of the oblique winding formed on the cop abuts the cutter portion by rotating the spindle, with the spindle being capable of relative rotation with respect to the cop; and
raising the cop further by the doffing device to cut the yarn.

6. A cutting method according to Claim 5, the method further comprising the steps of:

straightening yarn that is connected from the lappet to the traveler while wound around the spindle, by returning the lappet to a spinning position after pulling up the cop from the spindle with the doffing device; and
moving the lappet to a retracted position to fit the empty bobbin onto the spindle.

7. A cutting method according to Claim 5, further comprising the step of rotating the spindle by a predetermined amount, with the spindle being capable of relative rotation with respect to the cop.

8. A cutting method according to Claim 5, wherein the tail yarn cutting member is urged toward the spindle base portion.

FIG. 1

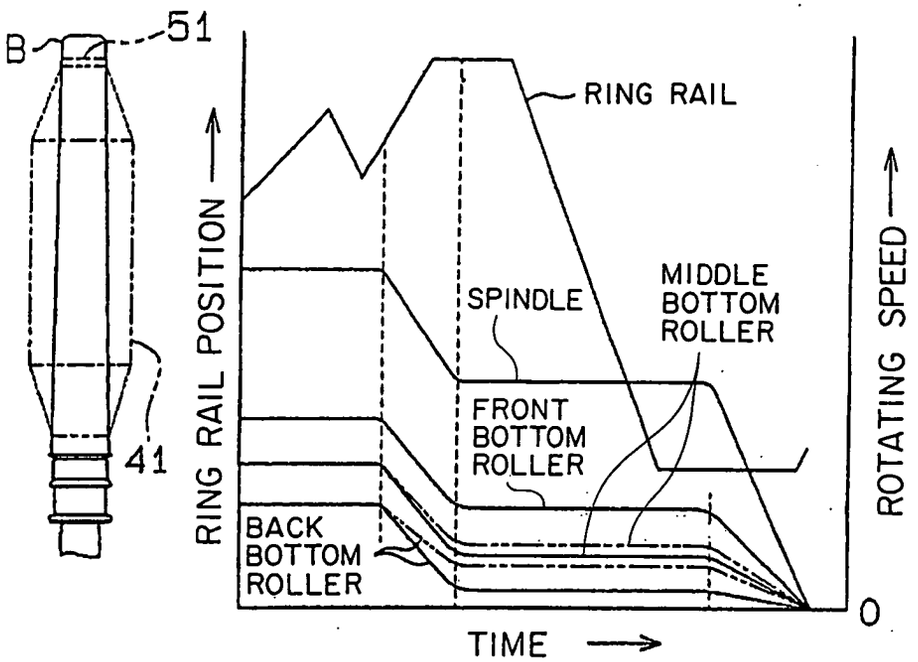
B
51
41
RING RAIL POSITION
RING RAIL
SPINDLE
MIDDLE BOTTOM ROLLER
FRONT BOTTOM ROLLER
BACK BOTTOM ROLLER
ROTATING SPEED
0
TIME

FIG. 2

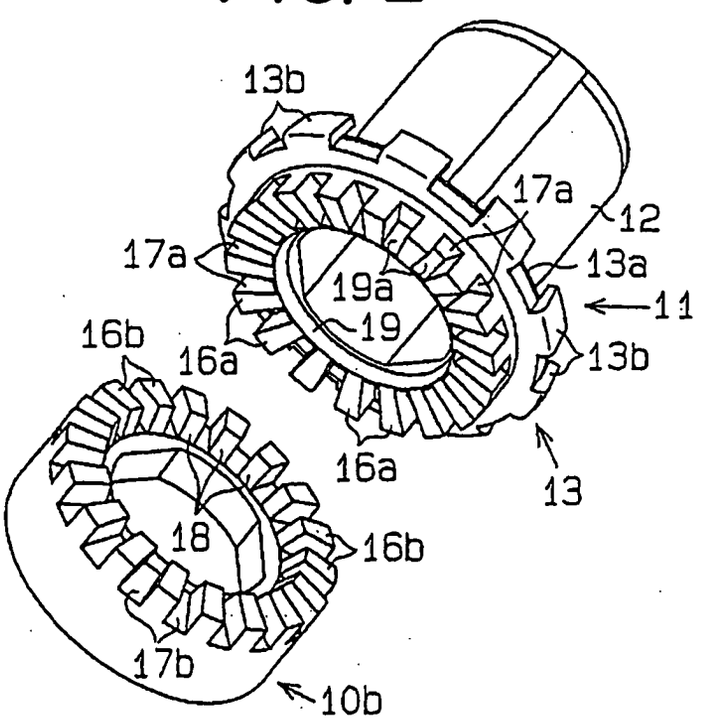
13b
17a
12
17a
13a
19a
11
19
16b
16a
13b
16a
13
18
16b
17b
10b

FIG. 3

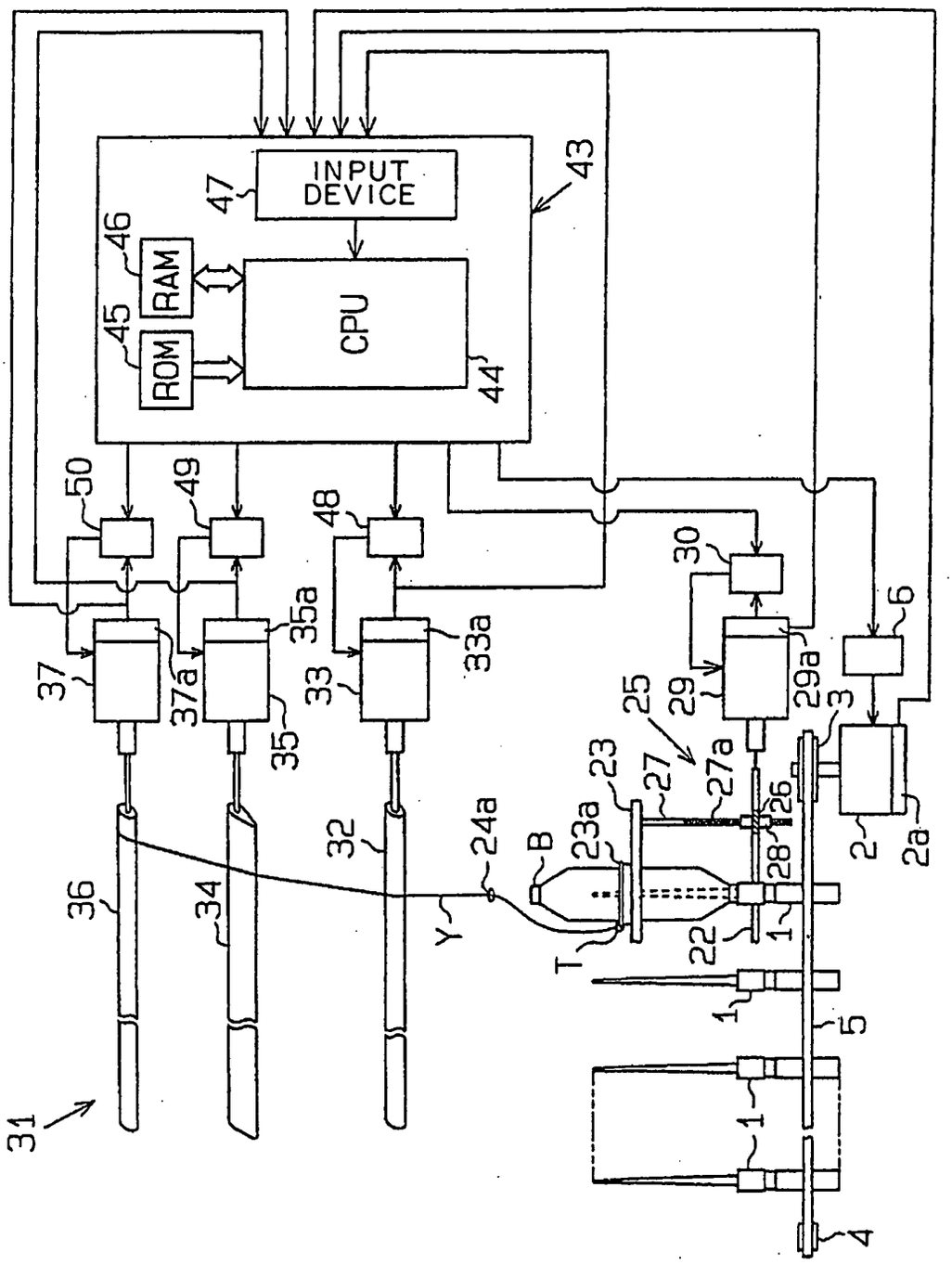
INPUT DEVICE
47
43
46
RAM
45
ROM
CPU
44
50
49
48
30
6
37
37a
35a
33
33a
35
29
29a
25
3
23
27
27a
26
23a
24a
B
32
28
2
2a
36
34
Y
T
22
1
5
4
31

FIG. 4A

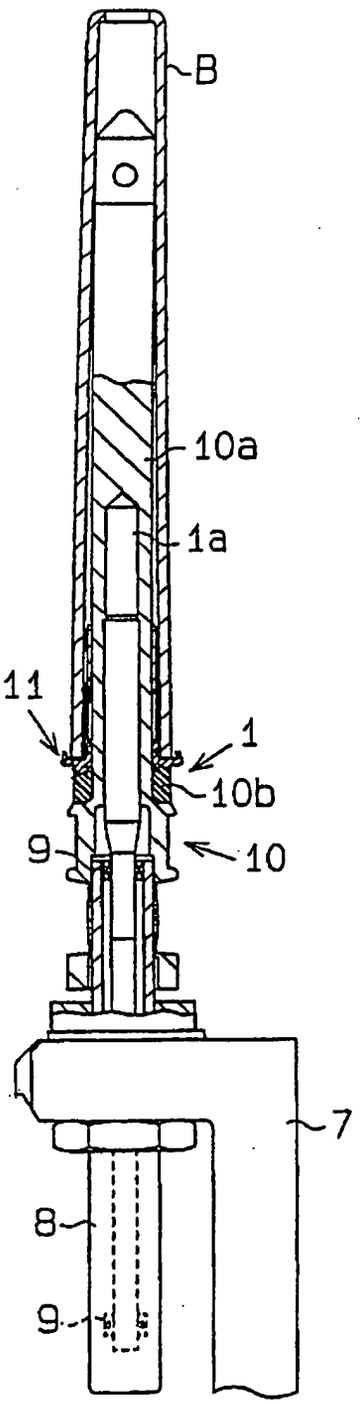
B
10a
1a
11
1
10b
9
10
7
8
9

FIG. 4B

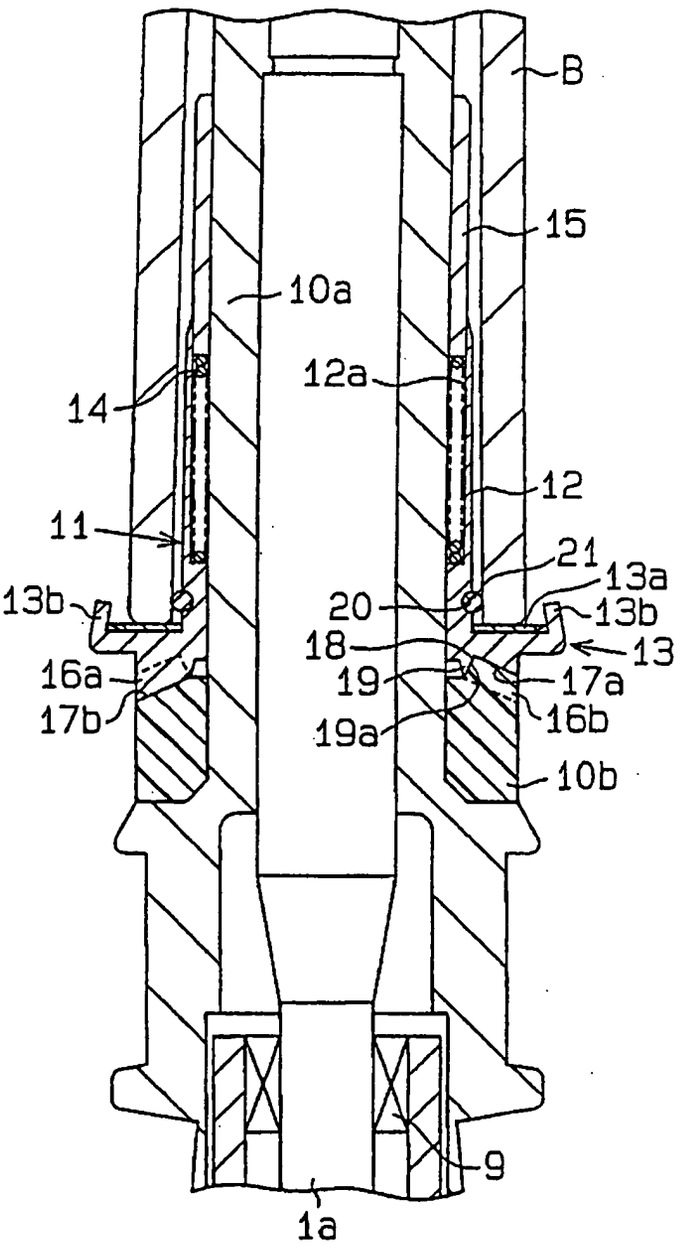
B
15
10a
12a
14
12
11
21
13a
13b
20
13b
18
13
16a
19
17a
17b
19a
16b
10b
9
1a

FIG. 5A

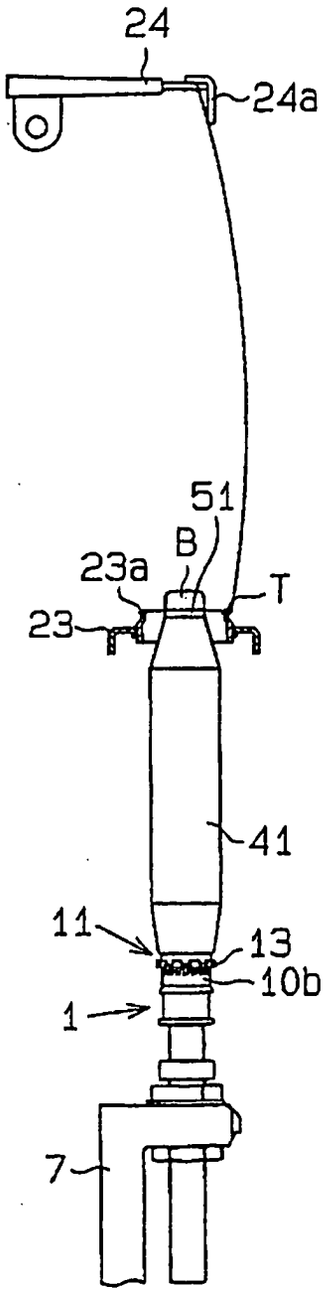
24
24a
51
B
23a
T
23
41
11
13
10b
1
7

FIG. 5B

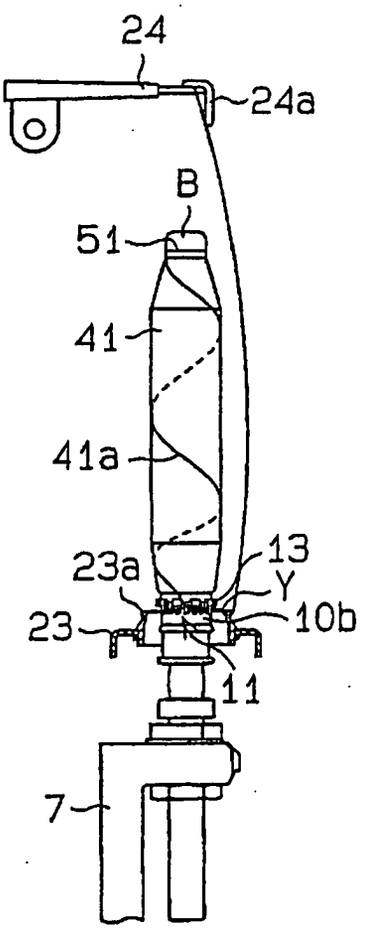
24
24a
B
51
41
41a
23a
13
Y
23
10b
11
7

FIG. 6C

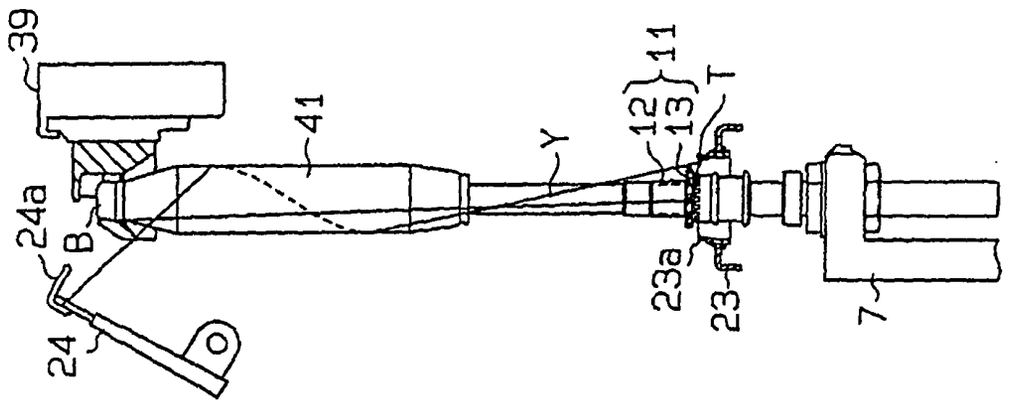

FIG. 6B

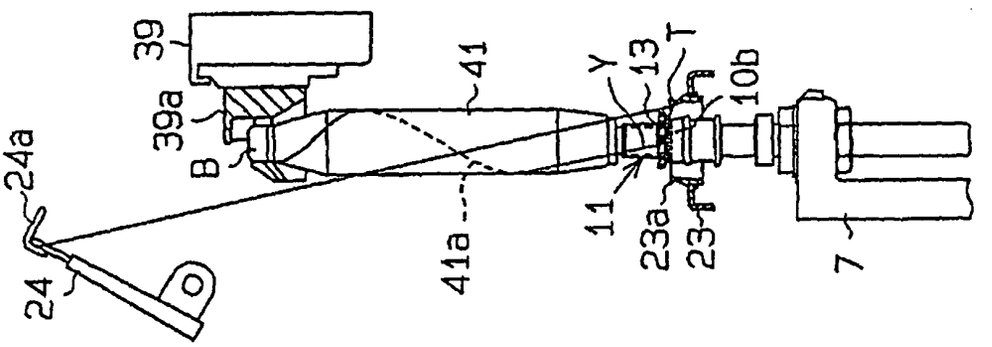

FIG. 6A

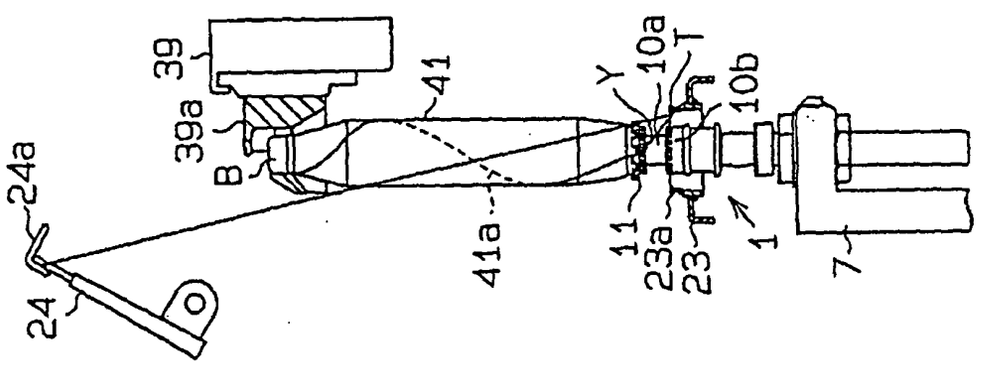

FIG. 7C

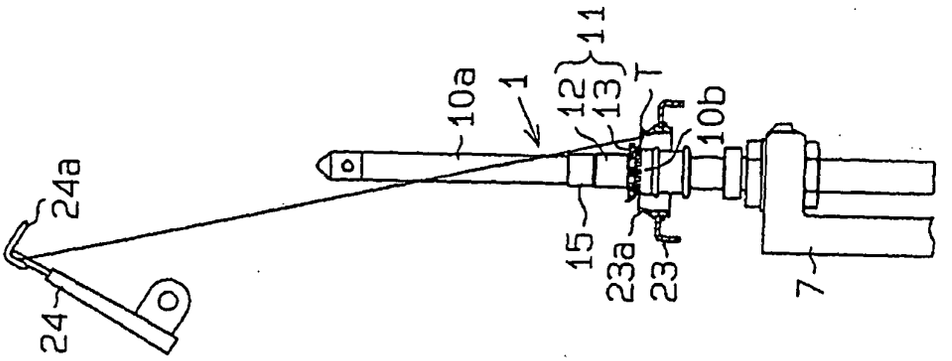

FIG. 7B

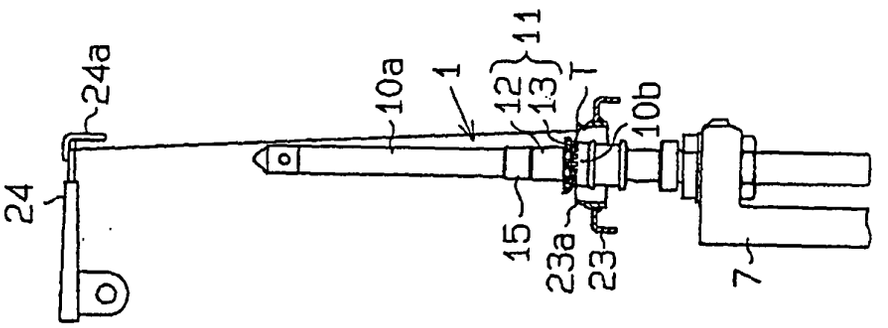

FIG. 7A

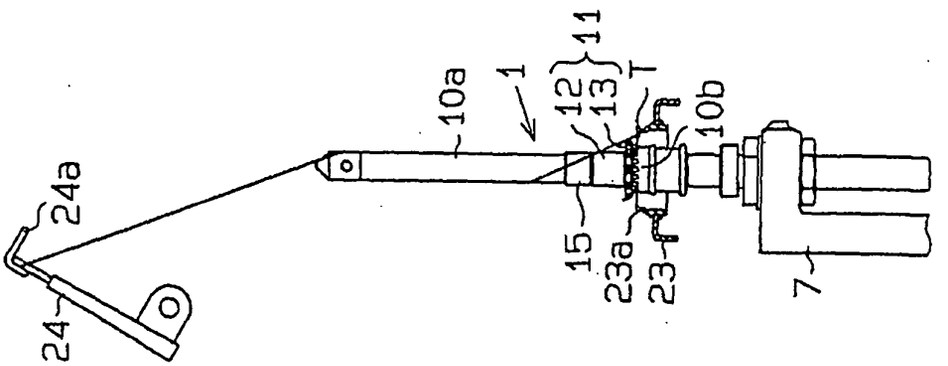

FIG. 8A

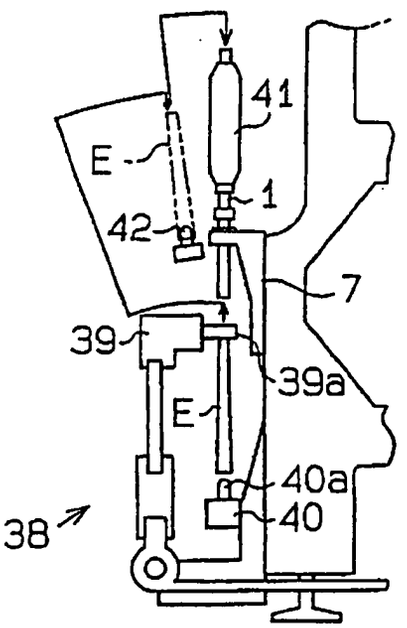

FIG. 8B

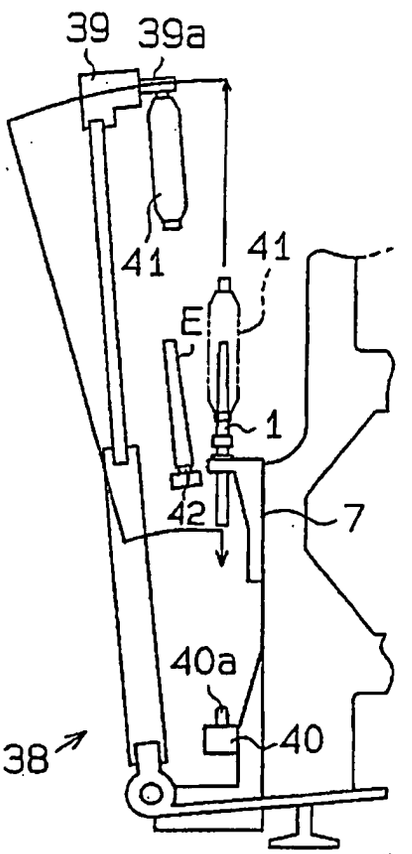

FIG. 9

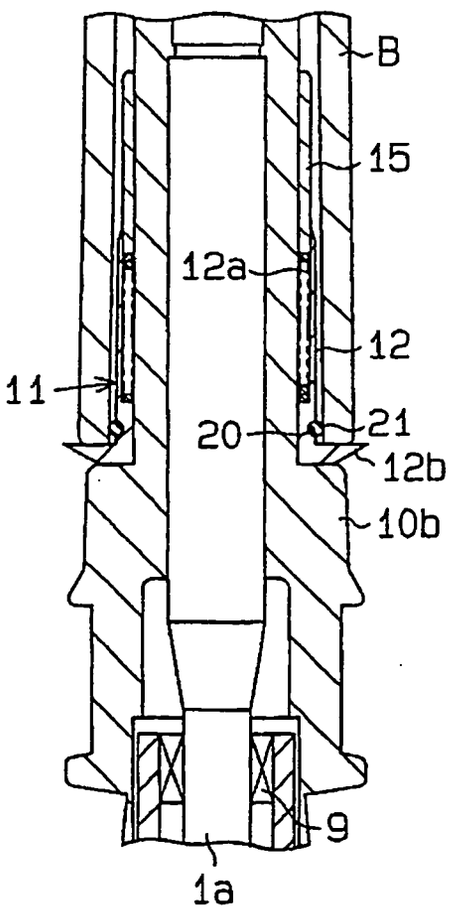

FIG. 10C

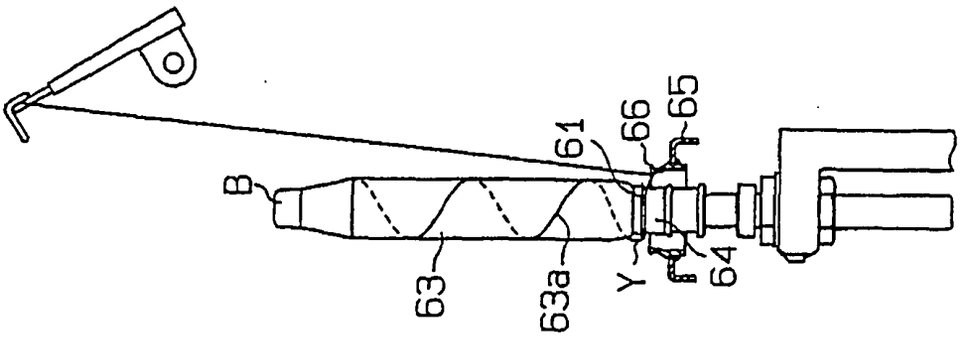

FIG. 10B

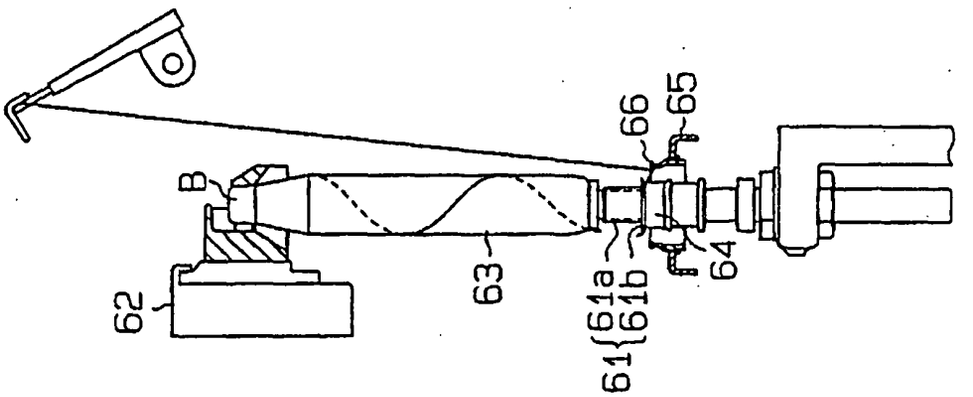

FIG. 10A