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(71) Applicant: **Murata Machinery, Ltd.**
Minami-ku
Kyoto-shi
Kyoto 601-8326 (JP)

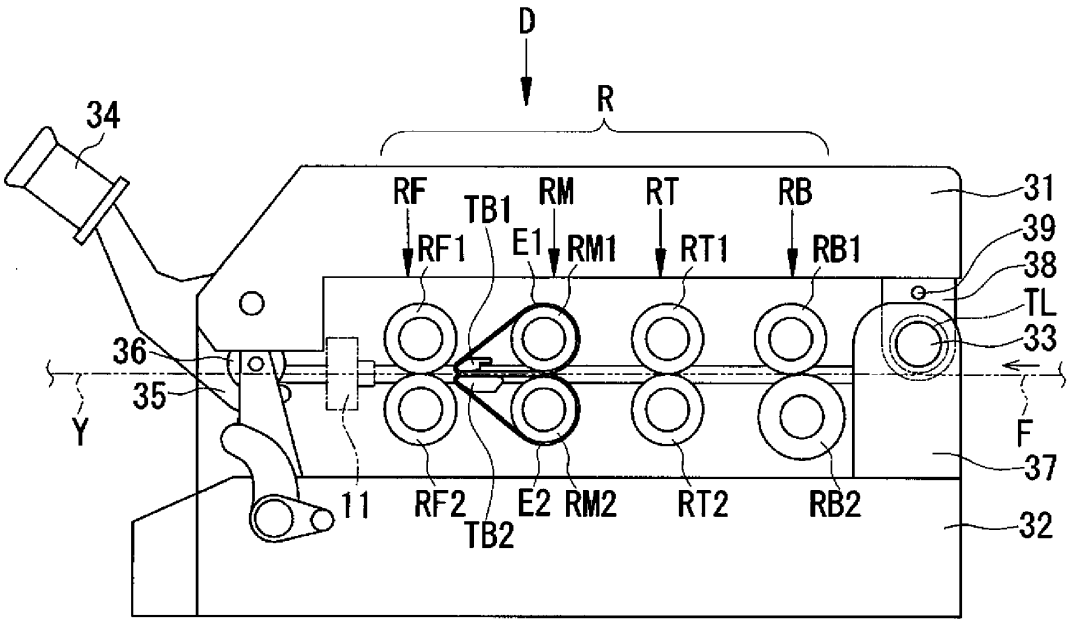
(72) Inventor: **Sakamoto, Naotaka**
Kyoto, Kyoto 612-8686 (JP)

(74) Representative: **Beck, Alexander**
Hansmann & Vogeser
Patent- und Rechtsanwälte
Maximilianstrasse 4b
82319 Starnberg (DE)

(54) Draft device and spinning machine

(57) A draft device includes a cradle (31) adapted to rotatably support a plurality of top rollers, a swing shaft (33) adapted to enable swinging of the cradle (31) to a contacting position where the plurality of the top rollers make contact with a plurality of bottom rollers, and a separated position where at least one of the plurality of the top rollers is moved away from the bottom rollers, and a holding section (TL) adapted to hold the cradle (31) at any separated position accompanying a stop of the cradle (31) after a swinging movement to any separated position.

FIG. 3



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a draft device, and a spinning machine provided with the draft device.

2. Description of the Related Art

[0002] Conventionally, as described in Japanese Unexamined Patent Publication No. 2008-45222, for example, there are known a spinning unit and a spinning machine adapted to draft a fiber bundle by a draft device and twist the drafted fiber bundle to produce a spun yarn.

[0003] The draft device includes a plurality of roller pairs such as a back roller pair, a middle roller pair, and a front roller pair, which are arranged in this order from upstream towards downstream in a draft direction of the fiber bundle. Each of the roller pairs includes a bottom roller, which is a driving roller, and a top roller, which makes contact with the bottom roller and rotates accompanying rotation of the bottom roller. Each of the top rollers is integrally held by a draft cradle (hereinafter simply referred to as a cradle). Each of the bottom rollers is integrally held by a device frame.

[0004] The cradle can be swung with respect to the device frame with a swing shaft as a center. When the cradle is swung, each top roller makes contact with or moves away from each bottom roller. A position where the cradle is closed and each top roller makes contact with each bottom roller is referred to as a contacting position. A position where the cradle is opened for maintenance or the like and each top roller is located away from each bottom roller is referred to as a separated position.

[0005] The cradle includes a holding section on the swing shaft to stop the cradle at the separated position. There is also known a technique which uses a latch mechanism for the holding section to enable the cradle to be stopped at a plurality of separated positions of different open angles (see e.g., Japanese Unexamined Patent Publication No. 2008-45222).

[0006] However, in the conventional cradle, since the latch mechanism is activated only at the separated position of a predetermined open angle, the cradle cannot be stopped at a separated position of an arbitrary open angle. The cradle may not be stopped at a separated position of an open angle suitable for an operation content such as maintenance, and operability is low.

[0007] In order to stop the cradle at the separated position, the cradle is required to be swung to a predetermined open angle at which the latch mechanism is activated. Even if the operator swings the cradle in an opening direction and assumes that the latch mechanism is activated, the cradle may not have actually reached the predetermined open angle and the latch mechanism may not be activated. When the operator releases the cradle, the cradle is closed. The operator is required to perform a swinging operation of the cradle while checking whether the latch mechanism is activated.

[0008] When the maintenance or the like is finished and the cradle is to be returned from the separated position to the contacting position, the latch mechanism is required to be released. In order to release the latch mechanism, the cradle is required to be once swung in the opening direction. Since this operation, although being an operation for closing the cradle, is an operation of swinging the cradle in the opening direction which is an opposite direction, the operation is an unnatural operation for an operator.

[0009] Once the latch mechanism is released, the latch mechanism will not be activated unless the cradle is returned to the contacting position. If the cradle is to be changed from the separated position of a large open angle to the separated position of a small open angle, the latch mechanism is not activated if the cradle is merely swung directly in a closing direction, and the cradle cannot be stopped at the separated position. In such a case, the swinging operation is required to be performed in which the cradle is once returned from the separated position of a large open angle to the contacting position, and then the cradle is opened again to the separated position of a small open angle.

BRIEF SUMMARY OF THE INVENTION

[0010] An object of the present invention is to provide a draft device and a spinning machine capable of stopping a cradle at any separated position.

[0011] A draft device according to a first aspect of the invention includes a plurality of roller pairs adapted to draft a fiber bundle, each draft roller pair including a top roller and a bottom roller, the draft device further including a cradle, a swing shaft, and a holding section. The cradle is adapted to rotatably support a plurality of top rollers. The swing shaft is adapted to enable swinging of the cradle to a contacting position where the plurality of the top rollers make contact with a plurality of bottom rollers, and a separated position where at least one of the plurality of the top rollers is moved away from the bottom rollers. The holding section is adapted to hold the cradle at any separated position accompanying a stop of the cradle when the cradle is stopped at any separated position after a swinging movement.

[0012] The cradle can be stopped at any separated position, and operability is high. The holding section is activated to stop the cradle regardless of a position where the operator releases a hand from the cradle. It is not necessary to check whether or not the holding section is activated as in the case of the latch mechanism. When returning the cradle from the separated position to the contacting position, the cradle is merely swung in a closing direction. The cradle can be opened and closed by an operation natural to the operator.

[0013] A draft device according to a second aspect of

the invention relates to the draft device according to the first aspect. The holding section is adapted to permit the movement of the cradle against a force stronger than a force of the cradle to move to the contacting position by gravity.

[0014] When changing the separated position of the cradle in a direction in which an open angle of the cradle becomes larger, the cradle is swung in an opening direction to be stopped at any separated position, and the cradle can be stopped at such a separated position. Even when changing the separated position of the cradle in a direction in which the open angle of the cradle becomes smaller, the cradle is swung in the closing direction to be stopped at any separated position, and the cradle can be stopped at such a separated position.

[0015] A draft device according to a third aspect of the invention relates to the draft device according to the first or second aspect. The holding section is a torque limiter.

[0016] With a simple configuration, the cradle can be stopped at any separated position.

[0017] A draft device according to a fourth aspect of the invention relates to the draft device according to the third aspect. The torque limiter includes a sleeve, a collar, an inner spring, and an outer spring. The sleeve is fixed on an outer periphery of the swing shaft. The collar is arranged at an outer periphery of the sleeve. The inner spring is arranged between the collar and the sleeve. The outer spring is arranged outside the collar and connected to the cradle. The torque limiter is configured such that when the cradle is moved from the contacting position or any separated position towards a direction to move away from the contacting position, the outer spring loosens and movement of the collar is prohibited. The torque limiter is configured such that when the cradle is moved from any separated position towards the contacting position, the outer spring contracts, the inner spring loosens with respect to the sleeve by a force being applied on the collar, and the inner spring and the collar move.

[0018] By the torque limiter having a simple configuration, the cradle can be reliably stopped at any separated position.

[0019] A draft device according to a fifth aspect of the invention relates to the draft device according to any one of the first to fourth aspects. The cradle is adapted to support the top rollers of two rows of draft roller pairs, each row of the draft roller pairs being adapted to independently draft the fiber bundle.

[0020] In the configuration of drafting two rows of fiber bundles, the top rollers can be simultaneously stopped at any position between the contacting position and the separated position.

[0021] A spinning machine according to a sixth aspect of the invention relates to a spinning machine including the draft device according to any one of the first to fifth aspects, and an air-jet spinning device. The air-jet spinning device is adapted to produce a spun yarn by spinning the fiber bundle, drafted by the draft device, by whirling airflow.

[0022] In the spinning machine including the air-jet spinning device, a draft speed is generally fast and a frequency of opening and closing the cradle for maintenance and the like is relatively high. Accordingly, by arranging the cradle that can be reliably stopped at any separated position, the operability of maintenance and the like is improved and operation efficiency of the spinning machine is improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

FIG. 1 is a front view of a spinning machine according to an embodiment of the present invention;
FIG. 2 is a schematic side view of a spinning unit;
FIG. 3 is a side view of a draft device at a contacting position according to the embodiment of the present invention;
FIG. 4 is a partially broken schematic plan view of the draft device;
FIG. 5 is an exploded view of a torque limiter;
FIG. 6 is a cross-sectional view describing an operation state of the torque limiter; and
FIG. 7A is a cross-sectional view taken along line A-A in FIG. 4 and is a view illustrating a state in which the cradle is at a contacting position, and FIG. 7B is a cross-sectional view taken along line A-A in FIG. 4 and is a view illustrating a state in which the cradle is at a separated position.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0024] A draft device D and a spinning machine M according to a first embodiment of the present invention will be described with reference to FIG. 1 to FIG. 7.

[0025] An outline of the spinning machine M will be described. "Upstream" and "downstream" respectively refer to upstream and downstream in a travelling direction of a fiber bundle F and a spun yarn Y in a spinning unit U.

[0026] The spinning machine M includes a plurality of spinning units U arranged in line, a yarn joining cart 3, a blower box 4, and a motor box 5. Each spinning unit U includes a draft device D, a spinning device 11, a yarn clearer 12, a yarn slack eliminating device 13, and a winding device 21.

[0027] The draft device D drafts a fiber bundle (sliver) F supplied through a trumpet T from a can (not illustrated) arranged at a back of the spinning unit U. The draft device D of the present embodiment includes a plurality of roller pairs R in which a feeding speed gradually becomes faster from the upstream towards the downstream in the travelling direction of the fiber bundle F. Each roller pair R includes a top roller RB1, RT1, RM1, and RF1, and a bottom roller RB2, RT2, RM2, and RF2 (see FIG. 3). The draft device D will be specifically described later.

[0028] The spinning device 11 uses whirling airflow to

apply a twist to the fiber bundle F to produce the spun yarn Y. Although detailed description and illustration will be omitted, the spinning device 11 includes a fiber guiding section, a whirling airflow generating nozzle, and a hollow guide shaft body. The fiber guiding section guides the fiber bundle F fed from the draft device D to a spinning chamber formed inside the spinning device 11. The whirling airflow generating nozzle is arranged at a periphery of a path of the fiber bundle F to generate the whirling airflow in the spinning chamber. This whirling airflow causes fiber ends of the fiber bundle F in the spinning chamber to be reversed and to whirl. The hollow guide shaft body guides the spun yarn Y from the spinning chamber to outside the spinning device 11. Driving and stopping of the spinning device 11 are controlled by a unit controller (not illustrated). The spinning device 11 may be an air-jet spinning device in which a needle-like member is not provided but a function of the needle-like member is realized by a downstream end of the fiber guiding section, or an air-jet spinning device including a pair of air-jet nozzles for applying twists in directions opposite to each other.

[0029] The yarn clearer 12 monitors the thickness of the spun yarn Y fed from the spinning device 11. When a yarn defect of the spun yarn Y is detected, the yarn clearer 12 transmits a yarn defect detection signal to the unit controller. The yarn clearer 12 may detect presence or absence of foreign substances contained in the spun yarn Y as the yarn defect.

[0030] The yarn slack eliminating device 13 applies a predetermined tension on the spun yarn Y to pull out the spun yarn Y from the spinning device 11. The yarn slack eliminating device 13 adjusts the tension such that a fluctuation of tension from the winding device 21 is not transmitted towards the spinning device 11. During the operation by the yarn joining cart 3, the yarn slack eliminating device 13 accumulates the spun yarn Y fed from the spinning device 11 to prevent slackening of the spun yarn Y.

[0031] The winding device 21 winds the spun yarn Y fed from the spinning device 11 to form a package P. The winding device 21 includes a cradle arm 22, a winding drum 23, and a traverse device 24. The cradle arm 22 rotatably supports the package P (a bobbin). The winding drum 23 makes contact with an outer peripheral surface of the package P (the bobbin) to rotate the package P (the bobbin). The traverse device 24 traverses the spun yarn Y. The winding device 21 rotates the winding drum 23 while traversing the spun yarn Y by the traverse device 24 to rotate the package P (the bobbin) and wind the spun yarn Y. In FIG. 1, the winding device 21 is illustrated to wind the spun yarn Y into a cheese-shaped package P, but may also wind the spun yarn Y into a conical package.

[0032] When receiving the yarn defect detection signal from the yarn clearer 12, the unit controller immediately cuts the spun yarn Y with a cutter 14, and stops the draft device D, the spinning device 11, and the like. The unit controller transmits a control signal to the yarn joining cart 3, and the yarn joining cart 3 travels to the front of the spinning unit U. Thereafter, the unit controller drives the spinning device 11 or the like again, the yarn joining cart 3 performs a yarn joining operation, and winding is resumed. Instead of using the cutter 14, the spinning unit U may stop the supply of air to the spinning device 11 and cut the spun yarn Y by stopping the production of the spun yarn Y.

[0033] The yarn joining cart 3 includes a cart section 25, and a splicer 26, a suction pipe 27, and a suction mouth 28 which are mounted on the cart section 25. When yarn breakage or yarn cut occurs in a spinning unit U, the yarn joining cart 3 travels to the relevant spinning unit U. The suction pipe 27 sucks and catches a yarn end fed from the spinning device 11 and guides the yarn end to the splicer 26. The suction mouth 28 sucks and catches a yarn end from the package P and guides the yarn end to the splicer 26. The splicer 26 joins the guided yarn ends.

[0034] The blower box 4 includes therein a blower (suction source) (not illustrated). A main piping (not illustrated) which is a common suction transportation pipe for the spinning units U is connected to the blower box 4. The main piping is arranged at a rear portion of the spinning units U (upstream in the draft direction). The blower box 4 sucks, transports, and collects the fiber dusts or the like generated in each spinning unit U through the main piping.

[0035] Although not illustrated, the motor box 5 includes therein a motor as an electric motor of the spinning machine M, a decelerator for transmitting power to each section of the spinning machine M, and the like.

[0036] Next, the draft device D will be described in detail. As illustrated in FIG. 3 and FIG. 4, the draft device D includes a plurality of roller pairs R, a cradle 31, and a device frame 32.

[0037] In the present embodiment, the plurality of roller pairs R include a back roller pair RB, a third roller pair RT, a middle roller pair RM, and a front roller pair RF. The roller pairs RB, RT, RM, and RF are arranged at a predetermined interval from the upstream towards the downstream in the travelling direction of the fiber bundle F. Each of the roller pairs RB, RT, RM, and RF respectively includes top rollers RB1, RT1, RM1, and RF1 on an upper side, and bottom rollers RB2, RT2, RM2, and RF2 on a lower side. The bottom rollers RB2, RT2, RM2, and RF2 are driving rollers. The top rollers RB1, RT1, RM1, and RF1 are driven rollers that make contact with the bottom roller RB2, RT2, RM2, and RF2 and rotate accompanying the rotation of the bottom rollers RB2, RT2, RM2, and RF2. A rotation speed of each of the roller pairs RB, RT, RM, and RF gradually increases from the upstream towards the downstream. The spinning device 11 is arranged downstream of the front roller pair RF.

[0038] The back top roller RB1, the third top roller RT1, the middle top roller RM1, and the front top roller RF1 are integrally and swingably attached to the cradle 31. Each of the top rollers RB1, RT1, RM1, and RF1 for two

adjacent spinning units U is attached to the cradle 31. The cradle 31 supports each of the top rollers RB1, RT1, RM1, and RF1 of two rows of roller pairs, each row of the roller pairs being capable of independently drafting the fiber bundle F. The back bottom roller RB2, the third bottom roller RT2, the middle bottom roller RM2, and the front bottom roller RF2 are respectively provided in the device frame 32 in correspondence with each of the top rollers RB1, RT1, RM1, and RF1 of the cradle 31. Each of the bottom rollers RB2, RT2, RM2, and RF2 for two adjacent spinning units U is also provided in the device frame 32.

[0039] A tensor bar TB1 is arranged between the middle top roller RM1 and the front top roller RF1. The tensor bar TB1 regulates a tension and a position of an apron belt E1 wound around the tensor bar TB1 and the middle top roller RM1. The tensor bar TB1 is provided in the cradle 31.

[0040] A tensor bar TB2 is arranged between the middle bottom roller RM2 and the front bottom roller RF2. The tensor bar TB2 regulates a tension and a position of an apron belt E2 wound around the tensor bar TB2 and the middle bottom roller RM2. The tensor bar TB2 is supported by the device frame 32.

[0041] The cradle 31 is swingable with respect to the device frame 32 with a swing shaft 33 as a center. The swing shaft 33 is provided in an upstream portion of the cradle 31. When the cradle 31 is swung, each of the top rollers RB1, RT1, RM1, and RF1 moves closer to or moves away from each of the bottom rollers RB2, RT2, RM2, and RF2. A position where the cradle 31 is closed and each of the top rollers RB1, RT1, RM1, and RF1 makes contact with each of the bottom rollers RB2, RT2, RM2, and RF2 is a contacting position. A position where the cradle 31 is opened for maintenance or the like and each of the top rollers RB1, RT1, RM1, and RF1 is separated from each of the bottom rollers RB2, RT2, RM2, and RF2 is a separated position.

[0042] A torque limiter TL as a holding section is attached to the swing shaft 33. The torque limiter TL stops the cradle 31 at any separated position. The torque limiter TL and an opening and closing mechanism at the periphery of the swing shaft 33 will be specifically described later.

[0043] The operator operates a handle 34 to perform a swinging operation of the cradle 31. When closing the cradle 31 to the contacting position, a hook section 35 at a tip-end of the handle 34 is engaged with a fixed roller 36 on the device frame 32 side. A pressure contacting state of each of the top rollers RB1, RT1, RM1, and RF1, and each of the bottom rollers RB2, RT2, RM2, and RF2 is maintained.

[0044] Since a distance between each of the roller pairs RB, RT, RM, and RF is determined by a fiber length of the fiber bundle (the sliver) F to be drafted, the distance is reviewed every time a type of the fiber bundle (the sliver) F as a material is changed. The middle bottom roller RM2 and the front bottom roller RF2 are fixed to the device frame 32. A position of the back bottom roller RB2 and the third bottom roller RT2 is respectively changeable to the upstream and/or the downstream with respect to the device frame 32.

[0045] Next, the torque limiter TL and the opening and closing mechanism at the periphery of the swing shaft 33, on which the torque limiter TL is arranged, will be described.

[0046] As illustrated in FIG. 3 and FIG. 4, a first supporting section 37 for supporting and fixing the swing shaft 33 is provided on the device frame 32. A second supporting section 38 is provided on the cradle 31. The second supporting section 38 is swingably attached with respect to the swing shaft 33. By the first supporting section 37, the second supporting section 38, and the swing shaft 33, the cradle 31 is swingably supported with respect to the device frame 32.

[0047] The torque limiter TL is attached to the swing shaft 33. A supporting shaft 39 is fixed to the second supporting section 38 on the cradle 31. Details will be described later, but the torque limiter TL is engaged with the supporting shaft 39 of the second supporting section 38. Against a swinging torque by a weight of the cradle 31, the torque limiter TL stops the cradle 31 at any separated position. When swinging torque larger than the swinging torque by the weight of the cradle 31 is applied, the torque limiter TL permits the cradle 31 to swing in a direction in which the swinging torque is applied.

[0048] Next, a structure of the torque limiter TL will be described in detail. As illustrated in FIG. 5 and Fig. 6, the torque limiter TL includes a sleeve 41, a collar 51, an inner spring 61, and an outer spring 71.

[0049] The sleeve 41 is attached and fixed on an outer periphery of the swing shaft 33. The sleeve 41 is configured by a tube portion 42 and a flange portion 43. A shaft hole 44 for attaching the tube portion 42 to the swing shaft 33 is formed on an inner side of the tube portion 42. An inner diameter of the shaft hole 44 is substantially equal to an outer diameter of the swing shaft 33. The flange portion 43 is formed at one end of the tube portion 42. The shaft hole 44 for inserting the swing shaft 33 is also formed in the flange portion 43. A screw hole 45 is formed on the flange portion 43 in a radial direction. When a screw 46 is screwed into the screw hole 45 with the sleeve 41 attached to the swing shaft 33, the sleeve 41 is fixed to the swing shaft 33. A position where the sleeve 41 is fixed to the swing shaft 33 is substantially a central part of the swing shaft 33 (see FIG. 4). A groove 47 for locking an inner retaining ring 82 is formed on an outer periphery of the other end of the tube portion 42.

[0050] The collar 51 is arranged on an outer periphery of the sleeve 41. The collar 51 is configured by a tube portion 52 and a bottom portion 53. A shaft hole 54 having a diameter larger than the outer diameter of the flange portion 43 of the sleeve 41 is formed on an inner side of the tube portion 52. A space between the shaft hole 54 and the sleeve 41 is an inner spring chamber 56 adapted to accommodate the inner spring 61. The bottom portion

53 is formed at one end of the tube portion 52. A shaft hole 55 for inserting the swing shaft 33 is formed through the bottom portion 53. A cutout 58 is formed at the other end of the tube portion 52. The cutout 58 has a substantially U-shape that is long in an axial direction of the tube portion 52. A projection 62 of the inner spring 61, to be described later, is engaged with the cutout 58. A groove 57 for locking an outer retaining ring 81 is formed on an outer periphery of each end of the tube portion 52. As illustrated in FIG. 5, after the inner spring 61 is attached to the sleeve 41, the collar 51 is attached to the outer periphery of the sleeve 41.

[0051] The inner spring 61 is arranged in the inner spring chamber 56 formed between the collar 51 and the sleeve 41. The inner spring 61 is a coil spring. An inner diameter of the inner spring 61 is a diameter to enable the inner spring 61 to be attached to the outer periphery of the tube portion 42 of the sleeve 41. The projection 62 projecting outward in a radial direction is formed at one end of the inner spring 61. In FIG. 6, a winding direction of the inner spring 61 is a direction in which the diameter becomes larger when a force in a closing direction is applied on the projection 62 and the diameter becomes smaller when a force in an opening direction is applied on the projection 62. As illustrated in FIG. 6, after the inner spring 61 is attached to the sleeve 41, the collar 51 is attached to the outer periphery of the sleeve 41 and the inner spring 61. The projection 62 of the inner spring 61 is engaged with the cutout 58 of the collar 51. After the collar 51 is attached, the inner retaining ring 82 is attached to the groove 47 of the sleeve 41 to prevent the collar 51 from falling off from the sleeve 41.

[0052] The outer spring 71 is arranged at an outer periphery of the collar 51. The outer spring 71 is a coil spring. An inner diameter of the outer spring 71 is a diameter to enable the outer spring 71 to be attached to the outer periphery of the tube portion 52 of the collar 51. An engagement portion 72 bent to an annular shape is formed at one end of the outer spring 71. As illustrated in FIG. 6, the engagement portion 72 is engaged with the supporting shaft 39 of the cradle 31. A winding direction of the outer spring 71 is a direction opposite to the winding direction of the inner spring 61, and is a direction in which the diameter becomes smaller when the force in the closing direction is applied on the engagement portion 72 and the diameter becomes larger when the force in the opening direction is applied on the engagement portion 72. After the outer spring 71 is attached to the outer periphery of the collar 51, one outer retaining ring 81 is set to each of the grooves 57 on both ends of the collar 51 to prevent the outer spring 71 from falling off from the collar 51.

[0053] Next, an operation of the torque limiter TL when the cradle 31 is swung with respect to the device frame 32 will be described with reference to FIG. 6, FIG. 7A, and FIG. 7B.

[0054] First, a case will be described in which the operator operates and swings a handle 34 of the cradle 31 to move the cradle 31 from the contacting position (FIG. 7A) to the separated position (FIG. 7B). In this case, as illustrated in FIG. 6, the engagement portion 72 of the outer spring 71 that is engaged with the supporting shaft 39 of the cradle 31 receives the force in the opening direction by an operation force of the operator. When the force in the opening direction is applied on the engagement portion 72, the diameter of the outer spring 71 becomes larger. When the diameter of the outer spring 71 becomes larger, a frictional force between the outer spring 71 and the collar 51 is reduced. Slippage occurs between the outer spring 71 and the collar 51, and the cradle 31 can be moved in the opening direction.

[0055] When the operator operates the cradle 31 in the opening direction, the outer spring 71 slides with respect to the collar 51, the inner spring 61, and the sleeve 41, and the cradle 31 can be swung in the opening direction with respect to the device frame 32.

[0056] Next, suppose that the operator stops the swinging operation of the cradle 31 at any separated position (FIG. 7B), and releases the hand from the handle 34. The cradle 31 attempts to swing in the closing direction by gravity. In this case, as illustrated in FIG. 6, the engagement portion 72 of the outer spring 71 that is engaged with the supporting shaft 39 of the cradle 31 receives the force in the closing direction by the weight of the cradle 31. When the force in the closing direction is applied on the engagement portion 72, the diameter of the outer spring 71 becomes smaller. When the diameter of the outer spring 71 becomes smaller, the frictional force between the outer spring 71 and the collar 51 increases, and the outer spring 71 and the collar 51 are integrated.

[0057] The projection 62 of the inner spring 61 is engaged with the collar 51. The inner spring 61 receives the force in the closing direction from the collar 51. When the force in the closing direction is applied on the projection 62, the diameter of the inner spring 61 becomes larger. When the diameter of the inner spring 61 becomes larger, a frictional force between the inner spring 61 and the sleeve 41 is reduced. Slippage does not occur between the inner spring 61 and the sleeve 41 with the force in the closing direction by the weight of the cradle 31. Thus, the inner spring 61 and the sleeve 41 remain integrated.

[0058] Even if the operator stops the swinging of the cradle 31 at any separated position and releases the hand from the handle 34, the outer spring 71, the collar 51, the inner spring 61, and the sleeve 41 do not slide with respect to one another, and hence the cradle 31 can be stopped at any separated position.

[0059] Next, a case will be described in which the operator operates and swings the handle 34 of the cradle 31 to move the cradle 31 from the separated position (FIG. 7B) to the contacting position (FIG. 7A). As illustrated in FIG. 6, the engagement portion 72 of the outer spring 71 that is engaged with the supporting shaft 39 of the cradle 31 receives the force in the closing direction

by the operation force of the operator in addition to the weight of the cradle 31.

[0060] When the force in the closing direction is applied on the engagement portion 72, the diameter of the outer spring 71 becomes smaller. When the diameter of the outer spring 71 becomes smaller to tighten the collar 51, the frictional force between the outer spring 71 and the collar 51 increases. The outer spring 71 and the collar 51 attempt to integrally swing in the closing direction.

[0061] The projection 62 of the inner spring 61 is engaged with the collar 51. The inner spring 61 receives the force in the closing direction from the collar 51. When the force in the closing direction is applied on the projection 62, the diameter of the inner spring 61 becomes larger. When the diameter of the inner spring 61 becomes larger and the inner spring 61 becomes loose with respect to the sleeve 41, the frictional force between the inner spring 61 and the sleeve 41 is reduced. When the inner diameter of the inner spring 61 becomes greater than the diameter of the sleeve 41, the inner spring 61 slides with respect to the sleeve 41.

[0062] When the operator performs the swinging operation of the cradle 31 in the closing direction, the outer spring 71, the collar 51, and the inner spring 61 are swung with respect to the sleeve 41, and the cradle 31 can be rotated in the closing direction with respect to the device frame 32.

[0063] Even when the cradle 31 is moved from the state in which the cradle 31 is stopped at a separated position of a certain open angle to a separated position of a different open angle, similarly to the above, if the operator releases the hand from the handle 34, the cradle 31 can be stopped at any separated position.

[0064] The draft device D and the spinning machine M according to the present embodiment described above have the following effects.

[0065] The draft device D includes the torque limiter TL serving as a holding section adapted to hold the cradle 31 at a separated position accompanying the stop of the cradle 31 when the cradle 31 is stopped at any separated position after the swinging movement. Since the cradle 31 can be stopped at any separated position with a simple configuration, operability is high. Regardless of the position at which the operator releases the hand from the cradle 31, the torque limiter TL is activated to stop the cradle 31. It is not necessary to check whether or not the holding section is activated as in the case of the latch mechanism. When returning the cradle 31 from the separated position to the contacting position, the cradle 31 is merely swung in the closing direction. The cradle 31 can be opened and closed with an operation natural to the operator.

[0066] The torque limiter TL slides with respect to a force stronger than a force at which the cradle 31 moves to the contacting position by gravity. When changing the separated position of the cradle 31 in a direction in which the open angle of the cradle 31 becomes larger, the cradle 31 is swung in the opening direction to be stopped at any separated position, and the cradle 31 can be stopped at such a separated position. Even when the separated position of the cradle 31 is changed in the direction in which the open angle of the cradle 31 becomes smaller, the cradle 31 is swung in the closing direction to be stopped at any separated position, and the cradle 31 can be stopped at such a separated position.

[0067] The torque limiter TL includes the sleeve 41, the collar 51, the inner spring 61, and the outer spring 71. The torque limiter TL is configured such that when the cradle 31 moves from the contacting position or any separated position in the direction of separating away from the contacting position, the outer spring 71 becomes loose and the collar 51 does not move. When the cradle 31 is moved from any separated position towards the contacting position, the outer spring 71 contracts, the inner spring 61 loosens with respect to the sleeve 41 by a force being applied on the collar 51, and the inner spring 61 and the collar 51 move. By the torque limiter TL having a simple configuration, the cradle 31 can be reliably stopped at any separated position.

[0068] The cradle 31 supports the top rollers RB1, RT1, RM1, and RF1 of two rows of the roller pairs, each row of the roller pair being adapted to independently draft the fiber bundle F. In the draft device D for drafting two rows of fiber bundles F, the top rollers RB1, RT1, RM1, and RF1 can be simultaneously stopped at any position between the contacting position and the separated position.

[0069] The spinning machine M includes the draft device D and the air-jet spinning device 11. In the spinning machine M including the air-jet spinning device 11, a draft speed is generally fast and a frequency of opening and closing the cradle 31 for maintenance and the like is relatively high. By providing the cradle 31 that can be reliably be stopped at any separated position in the spinning machine M, the operability of maintenance and the like is improved, and operation efficiency of the spinning machine M is improved.

[0070] The embodiments of the present invention have been described, but the present invention is not limited to the above embodiments and various modifications may be made. For example, in the present embodiment, the spinning unit U of the spinning machine M pulls out the spun yarn Y from the spinning device 11 by the yarn slack eliminating device 13, but the present invention is not limited to such a configuration. A delivery roller and a nip roller may be arranged between the spinning device 11 and the yarn slack eliminating device 13, and the spun yarn Y may be pulled out with these rollers.

[0071] In the present embodiment, the spinning machine M has been described, but the present invention is not limited to a spinning machine, and may be a ring spinning machine, a roving frame, a drawing frame, or the like as long as the draft device D is provided.

Claims

1. A draft device comprising a plurality of roller pairs adapted to draft a fiber bundle, each draft roller pair including a top roller and a bottom roller, the draft device comprising:

   a cradle (31) adapted to rotatably support a plurality of top rollers (RF1, RM1, RT1, RB1),
   a swing shaft (33) adapted to enable swinging of the cradle (31) to a contacting position where the plurality of the top rollers (RF1, RM1, RT1, RB1) make contact with a plurality of bottom rollers (RF2, RM2, RT2, RB2), and a separated position where at least one of the plurality of the top rollers (RF1, RM1, RT1, RB1) is moved away from the bottom rollers (RF2, RM2, RT2, RB2), **characterized by**
   a holding section (TL) adapted to hold the cradle (31) at any separated position accompanying a stop of the cradle (31) after a swinging movement.

2. The draft device according to claim 1, **characterized in that** the holding section (TL) is adapted to permit the movement of the cradle (31) against a force stronger than a force of the cradle (31) to move to the contacting position by gravity.

3. The draft device according to claim 1 or claim 2, **characterized in that** the holding section (TL) is a torque limiter.

4. The draft device according to claim 3, **characterized in that** the torque limiter includes:

   a sleeve (41) fixed on an outer periphery of the swing shaft (33),
   a collar (51) arranged at an outer periphery of the sleeve (41),
   an inner spring (61) arranged between the collar (51) and the sleeve (41), and
   an outer spring (71) arranged outside the collar (51) and connected to the cradle (31),
   wherein when the cradle (31) moves from the contacting position or any separated position towards a direction to move away from the contacting position, the outer spring (71) loosens and movement of the collar (51) is prohibited, and
   when the cradle (31) is moved from any separated position towards the contacting position, the outer spring (71) contracts, the inner spring (61) loosens with respect to the sleeve (41) by a force being applied on the collar (51), and the inner spring (61) and the collar (51) move.

5. The draft device according to any one of claim 1 through claim 4, **characterized in that** the cradle (31) is adapted to support the top rollers (RF1, RM1, RT1, RB1) of two rows of draft roller pairs, each row of the roller pair being adapted to independently draft the fiber bundle (F).

6. A spinning machine comprising:

   the draft device (D) according to any one of claim 1 through claim 5, and
   an air-jet spinning device (11) adapted to produce a spun yarn (Y) by spinning the fiber bundle (F), drafted by the draft device (D), by whirling airflow.

FIG. 1

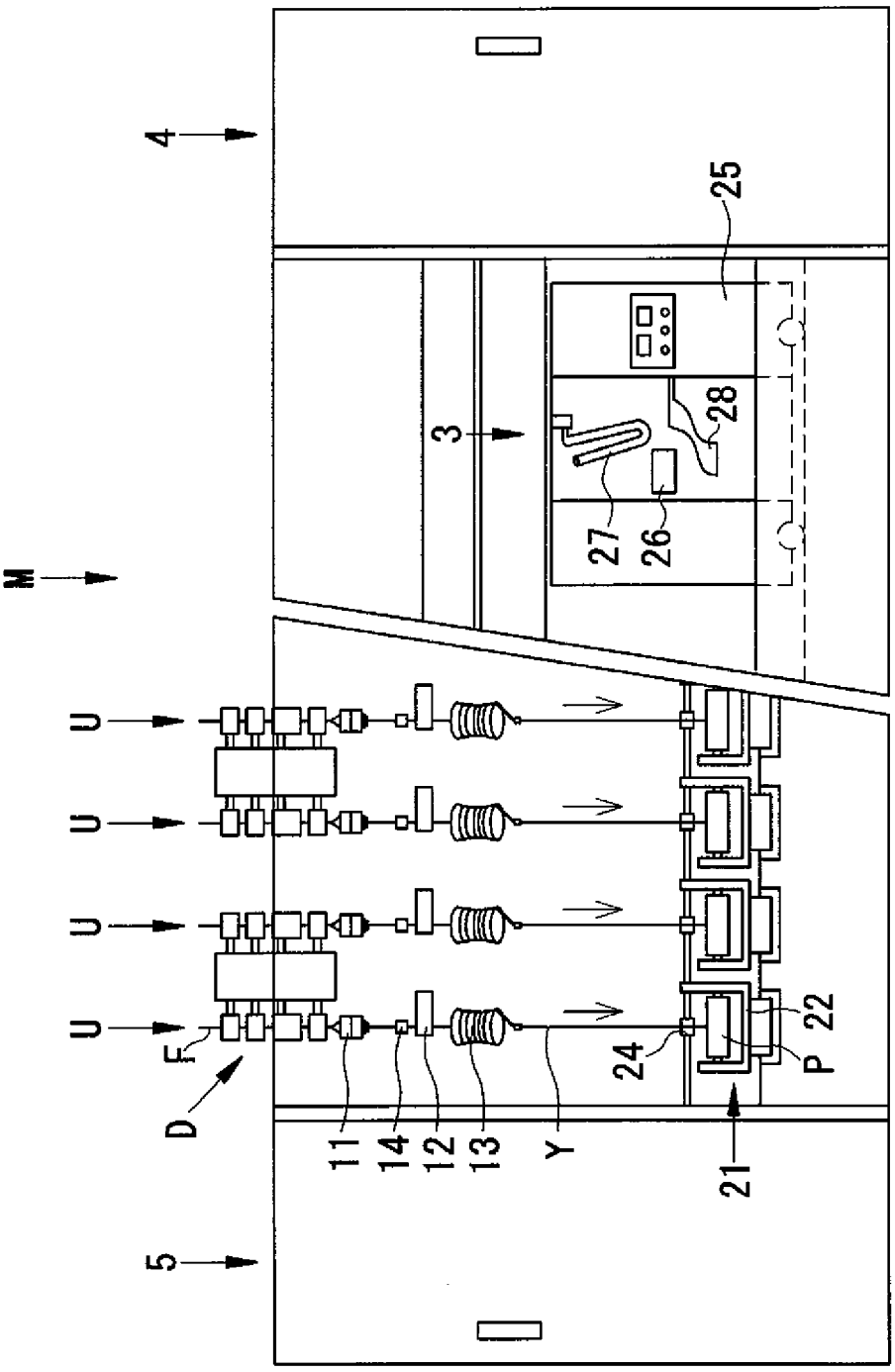


FIG. 2

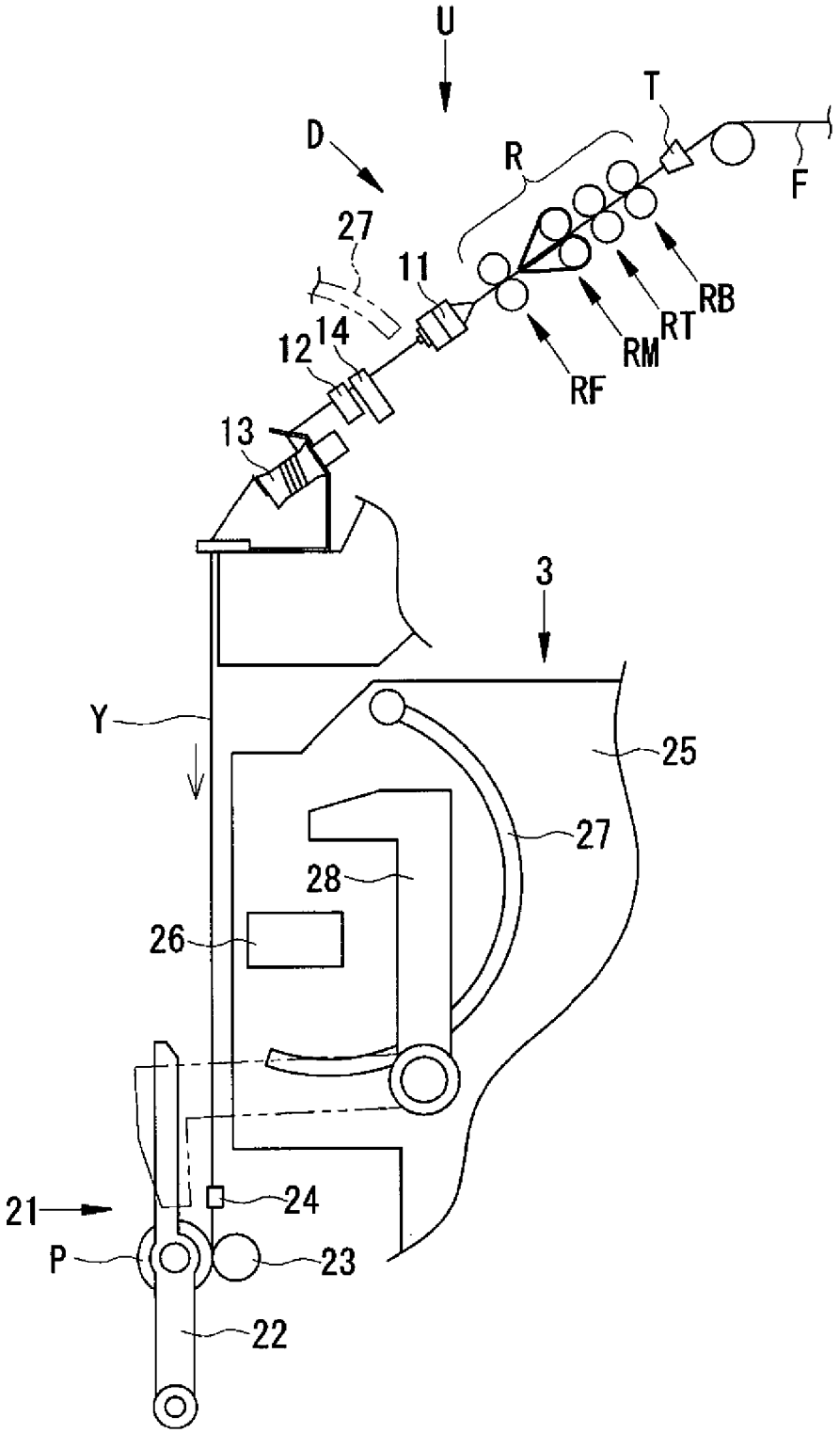


FIG. 3

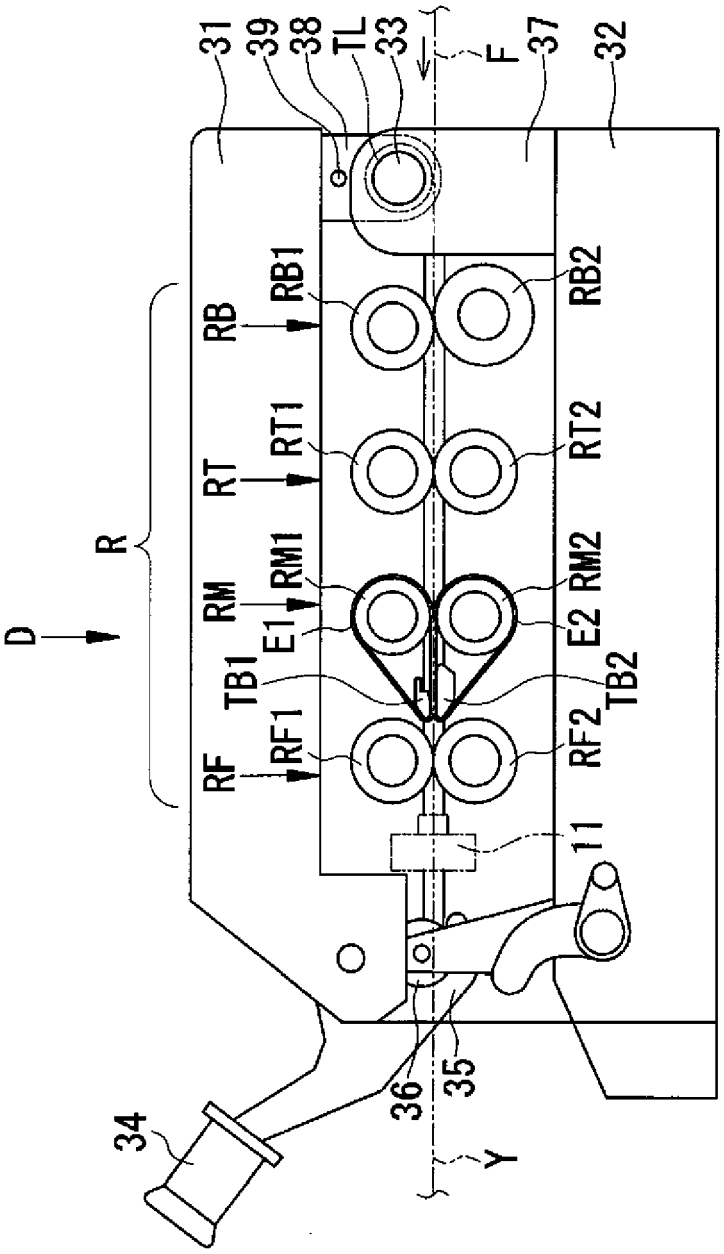
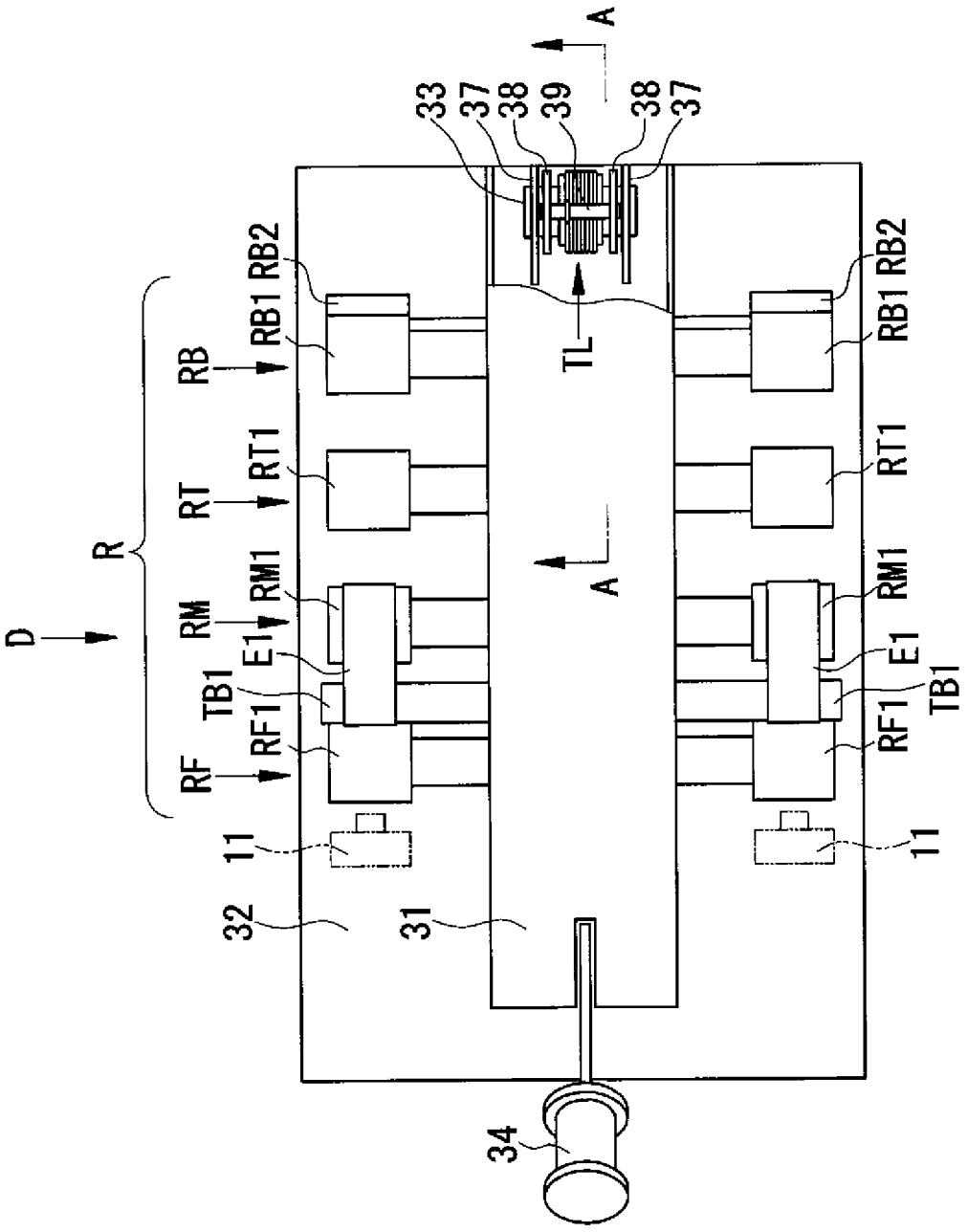

31
39
38
TL
33
F
37
32
RB1
RB
RB2
RT1
RT
RT2
RM1
RM
E1
E2
RM2
TB1
TB2
RF1
RF
RF2
R
D
11
34
36
35
Y

FIG. 4



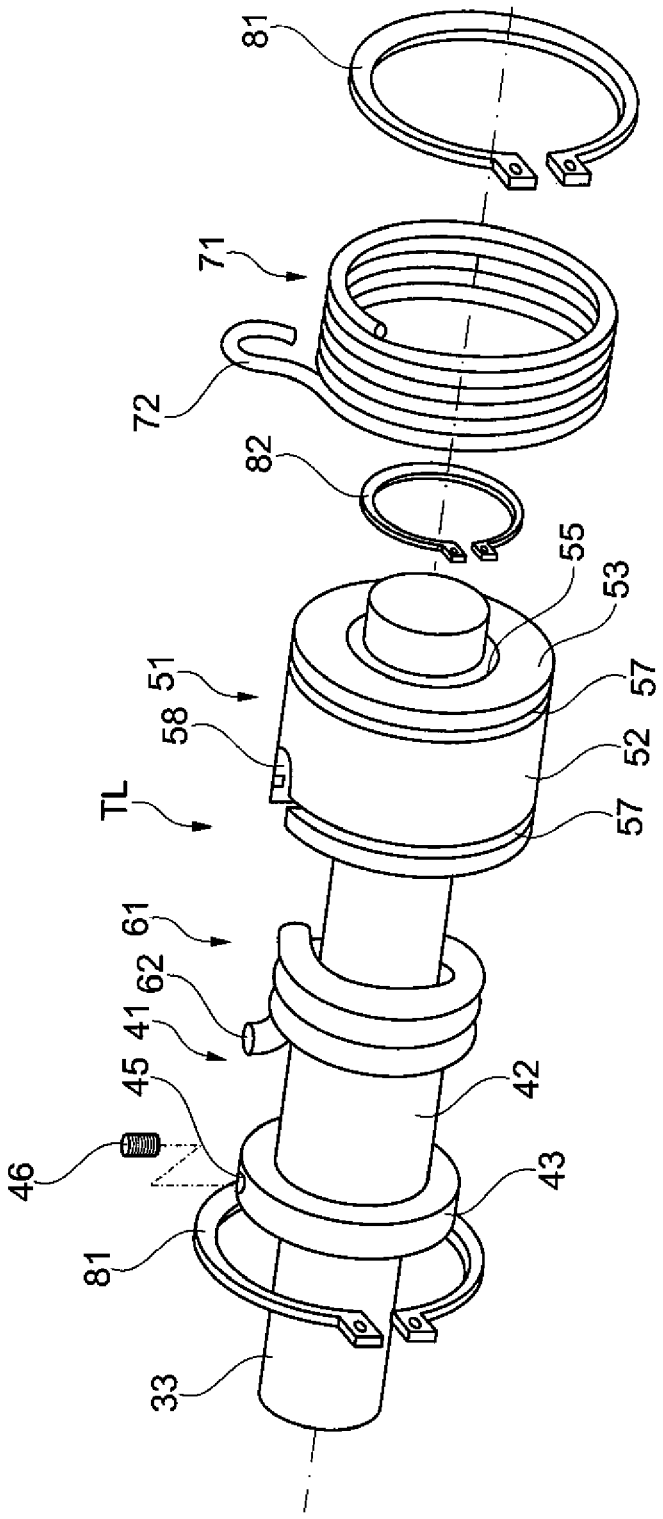
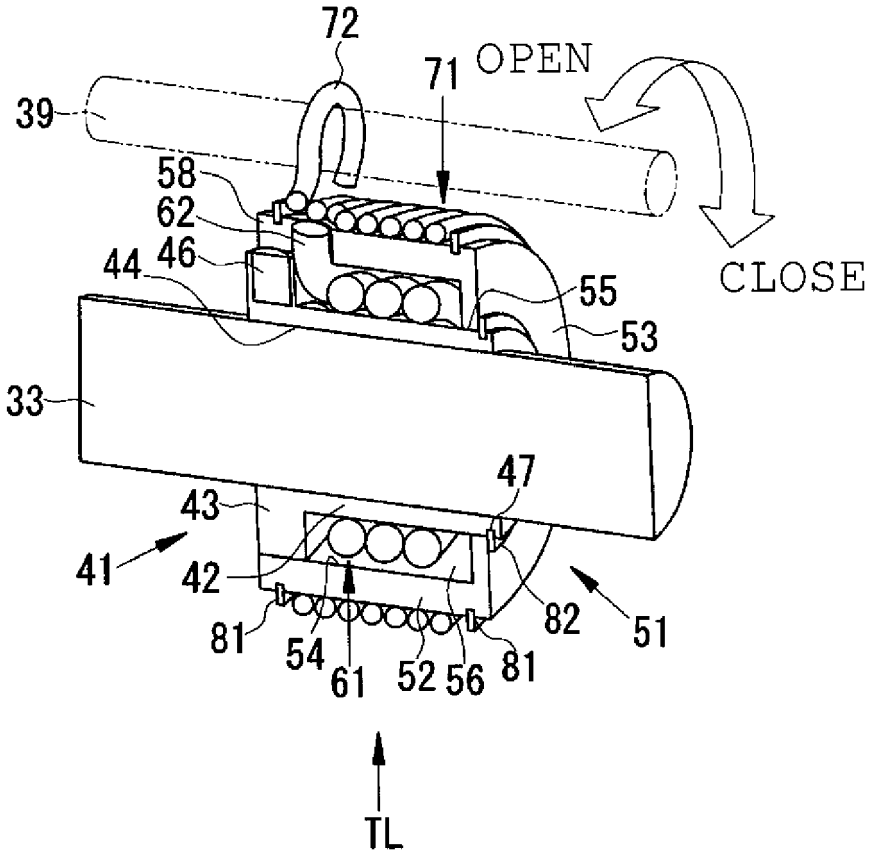


Fig. 5

FIG. 6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62
44
46
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CLOSE
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61
52
56
81
TL

FIG. 7A

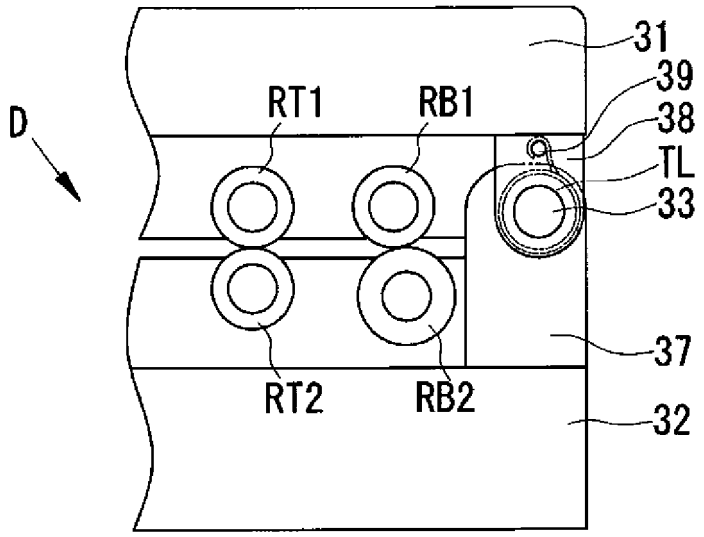
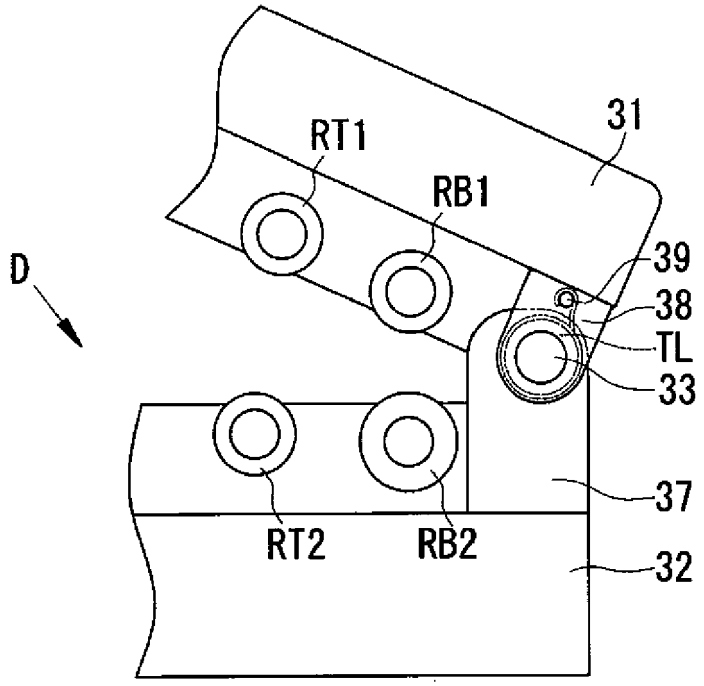

D
RT1
RB1
31
39
38
TL
33
37
RT2
RB2
32

FIG. 7B


D
RT1
RB1
31
39
38
TL
33
37
RT2
RB2
32

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2008045222 A **[0002] [0005]**