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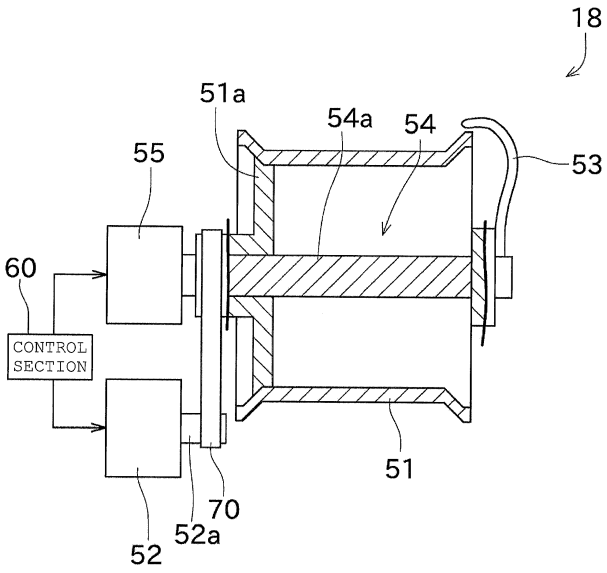
(54) YARN WINDING DEVICE

(57) A yarn winding device includes a yarn storage roller (51), a tension measuring device, a yarn hooking arm (53), an arm driving section (55), and a control section (60). The yarn storage roller (51) stores a yarn on a surface by being rotatably driven by a roller driving section (52). The tension measuring device measures tension of the yarn pulled out from the yarn storage roller (51). The yarn hooking arm (53) is arranged downstream in a yarn travelling direction of the yarn storage roller (51), and makes contact with the yarn to apply tension to the yarn. The arm driving section (55) rotatably drives the yarn hooking arm (53). The control section (60) feedback controls the arm driving section (55) based on a measurement result of the tension measuring device to adjust an amount of tension applied by the yarn hooking arm (53).

FIG. 2



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a yarn winding device including a yarn storage roller.

2. Description of the Related Art

[0002] Conventionally, in a yarn winding device such as an automatic winder, a spinning machine, and the like, there is known a configuration of winding a yarn around a periphery of a rotating yarn storage roller to temporarily store the yarn. The yarn winding device including this type of yarn storage roller is disclosed in Japanese Unexamined Patent Publication No. 2014-20000.

[0003] The yarn winding device of Japanese Unexamined Patent Publication No. 2014-20000 includes a yarn feeding device, a drum (yarn storage roller), an arm (tension applying section), and a winding section. The drum stores the yarn pulled out from the yarn supplying device. The arm is arranged in proximity to the drum to apply tension to the yarn supplied from the drum to the winding section. The drum and the arm are driven with different motors, and are independently controlled. Specifically, the motor that drives the arm controls the arm to rotate at a constant torque.

[0004] However, in Japanese Unexamined Patent Publication No. 2014-20000, a sensor adapted to detect the tension of the yarn is not disclosed, and the tension of the yarn is not taken into consideration in the control of the motor that drives the arm. In Japanese Unexamined Patent Publication No. 2014-20000 described above, the arm is merely rotated at a constant torque, and thus the arm may not be controlled in accordance with a state of the yarn as a yarn speed becomes faster.

[0005] As a result, the tension applied to the yarn becomes difficult to be held at an optimum value, and the yarn may be broken when the tension applied to the yarn becomes strong. In particular, in the automatic winder and the like in which the speed of the yarn is high, a fluctuation in the tension generated by the traversing of the yarn is large, and this fluctuation easily causes yarn breakage. In this case, the yarn joining operation needs to be carried out by the yarn joining device and the like. Furthermore, when the tension applied to the yarn becomes weak, the yarn may be detached from the arm. In this case, the yarn wound around the drum is loosened, and the yarn wound around the drum may bulge out to an outer side of the drum. When such a phenomenon occurs, the operator needs to carry out the task of removing the yarn from the drum.

[0006] Thus, in the method for controlling the arm (tension applying section) of Japanese Unexamined Patent Publication No. 2014-20000, the winding is easily interrupted particularly when the yarn is wound at high speed, and hence production efficiency of the package may be lowered. As the tension to be applied to the yarn fluctuates, quality of the package is also lowered.

BRIEF SUMMARY OF THE INVENTION

[0007] The present invention has been made in view of the above circumstances, and it is a main object of the present invention to provide a configuration of carrying out a control to apply a desired tension to a yarn to be wound in a winding device including a yarn storage roller.

[0008] The problems to be solved by the present invention are as described above, and the means for solving such problems and the effects thereof will be described below.

[0009] According to an aspect of the present invention, a yarn winding device having the following configuration is provided. In other words, the yarn winding device includes a yarn supplying section, a yarn storage roller, a package forming section, a tension measuring device, a tension applying section, a second driving section, and a control section. The yarn supplying section is adapted to supply the yarn. The yarn storage roller is adapted to pull out the yarn from the yarn supplying section and wind the yarn around an outer circumferential surface to store the yarn when the yarn storage roller is rotatably driven by the first driving section. The package forming section is adapted to pull out the yarn stored on the yarn storage roller to form a package. The tension measuring device is adapted to measure a tension of the yarn pulled out from the yarn storage roller by the package forming section. The tension applying section is arranged downstream in a yarn travelling direction of the yarn storage roller and adapted to make contact with the yarn to apply tension to the yarn. The second driving section is adapted to rotatably drive the tension applying section. The control section is adapted to feedback control the second driving section based on a measurement result of the tension measuring device to adjust an amount of tension applied by the tension applying section.

[0010] Therefore, the tension on the downstream of the yarn storage roller is measured and the second driving section is controlled based on such a measurement result, and hence a desired tension can be applied to the yarn to be wound into the package. Thus, the quality of the package can be improved while the interruption of the winding of the yarn is prevented.

[0011] The yarn winding device described above preferably has the following configuration. In other words, the yarn winding device includes a first guide section and a second guide section. The first guide section is arranged downstream of the yarn storage roller and adapted to converge the yarn pulled out from the yarn storage roller. The second guide section is arranged downstream of the first guide section and adapted to form a traverse supporting point of the yarn wound by the package forming section. The tension measuring device is arranged on a yarn path between the first guide section and the

second guide section.

[0012] Thus, the fluctuation in the tension of the yarn between the first guide section and the second guide section is small, and the tension can be accurately measured.

[0013] In the yarn winding device described above, the control section preferably adjusts the amount of tension applied by the tension applying section by adjusting a torque of the second driving section based on the measurement result of the tension measuring device.

[0014] The fluctuation in the tension thus can be more reliably suppressed compared to the configuration of controlling the position (rotation angle) of the tension applying section by the feedback control.

[0015] The yarn winding device described above preferably has the following configuration. In other words, the yarn storage roller rotates with a yarn storage roller rotation shaft as a center. The tension applying section rotates with the yarn storage roller rotation shaft as the center.

[0016] Thus, the yarn storage roller and the tension applying section are coaxially controlled, so that the fluctuation in the tension of the yarn can be prevented with a simple control.

[0017] The yarn winding device described above preferably includes a resistance torque generating section adapted to generate a torque against a relative rotation of the yarn storage roller and the tension applying section.

[0018] Thus, for example, at the time of low speed when the tension is less likely to fluctuate or when the speed is not changed, the yarn storage roller and the tension applying section can be integrally rotated with a simple control.

[0019] The yarn winding device described above preferably has the following configuration. In other words, the yarn winding device includes a transmission mechanism adapted to transmit a driving force of the second driving section to the tension applying section. The transmission mechanism includes a clutch adapted to switch transmission or cutting of the driving force from the second driving section to the tension applying section.

[0020] Thus, a state of integrally rotating the arm and the yarn storage roller and a state of independently rotating the arm and the yarn storage roller by the driving force of the second driving section can be easily switched.

[0021] The yarn winding device described above preferably has the following configuration. In other words, the yarn winding device includes a transmission mechanism adapted to transmit a driving force of the second driving section to the tension applying section. The transmission mechanism includes a torque limiter adapted to prevent an excessive driving force from being transmitted from the second driving section to the tension applying section.

[0022] Thus, an excessive tension can be more reliably prevented from being applied to the yarn and breaking the yarn.

[0023] The yarn winding device described above preferably has the following configuration. In other words, the yarn supplying section is supported such that the yarn is supplied from a yarn supplying bobbin, around which the yarn produced by a spinning device is wound. A yarn defect removing device adapted to remove a yarn defect of the yarn supplied from the yarn supplying section is arranged between the yarn supplying section and the yarn storage roller.

[0024] Thus, even when the rotation of the yarn storage roller is stopped to remove the yarn defect contained in the yarn supplying bobbin, the winding of the package can be continued at an optimum tension while measuring the tension of the yarn wound into the package. Furthermore, even if an unwinding resistance of the yarn supplying bobbin becomes large and a rotation speed of the yarn storage roller is low, the winding of the package can be continued at an optimum tension.

[0025] The yarn winding device described above preferably has the following configuration. In other words, the yarn supplying section is a spinning section adapted to spin a yarn. A yarn defect removing device adapted to remove a yarn defect of the yarn supplied from the yarn supplying section is arranged between the yarn supplying section and the yarn storage roller.

[0026] Thus, even in the case of winding the yarn spun by the spinning section, a desired tension can be applied to the yarn.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027]

FIG. 1 is a schematic side view of a winding unit arranged in an automatic winder according to one embodiment of the present invention;

FIG. 2 is a schematic view illustrating a configuration of a yarn storage device;

FIG. 3 is a control block diagram for feedback control of a roller driving section based on the tension;

FIG. 4 is a schematic view illustrating a configuration of a yarn storage device according to a first alternative embodiment;

FIG. 5 is a schematic view illustrating a configuration of a yarn storage device according to a second alternative embodiment; and

FIG. 6 is a schematic view illustrating a configuration of a yarn storage device according to a third alternative embodiment.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0028] Embodiments of the invention will be described below. First, an outline of an automatic winder (yarn winding device) will be described with reference to FIG. 1. The automatic winder has a configuration in which a plurality of winding units 2 are arranged in line. The auto-

matic winder includes a machine management device (not illustrated) adapted to collectively manage the winding units 2, and a blower box (not illustrated) including a compressed air source and a negative pressure source.

[0029] As illustrated in FIG. 1, the winding unit 2 mainly includes a bobbin supporting section (yarn supplying section) 7 and a winding section (package forming section) 8. The winding unit 2 is configured to unwind a yarn (spun yarn) 20 of a yarn supplying bobbin 21 supported by the bobbin supporting section 7 and rewind a package 30.

[0030] The bobbin supporting section 7 is configured to be able to hold the yarn supplying bobbin 21 in a substantially upright state. The bobbin supporting section 7 is configured to be able to discharge the empty yarn supplying bobbin 21. The winding section 8 includes a cradle 23 configured to be able to attach the winding bobbin 22, and a traverse drum 24 for traversing the yarn 20 and driving the winding bobbin 22.

[0031] The traverse drum 24 is arranged facing the winding bobbin 22, and the winding bobbin 22 is rotated by driving and rotating the traverse drum 24. The yarn 20 stored in a yarn storage device 18, to be described later, thus can be wound around the winding bobbin 22. A traverse groove (not illustrated) is formed on an outer circumferential surface of the traverse drum 24, and the yarn 20 is traversed by the traverse groove at a predetermined width. According to the configuration described above, the yarn 20 can be wound around the winding bobbin 22 while being traversed, and the package 30 having a predetermined length and a predetermined shape can be obtained. In the following description, "upstream" and "downstream" refers to the upstream and the downstream when viewed in a travelling direction of the yarn.

[0032] The winding unit 2 includes an unwinding assisting device 10, a lower yarn blow-up section 11, a gate type tension applying device 12, an upper yarn catching section 13, a yarn joining device 14, a yarn trap 15, a cutter 16, a clearer (yarn defect detection device) 17, an upper yarn pull-out section 35, and the yarn storage device 18 arranged in this order from the bobbin supporting section 7 towards the winding section 8 on a yarn travelling path between the bobbin supporting section 7 and the winding section 8.

[0033] The unwinding assisting device 10 causes a movable member 10a to make contact with a balloon formed at an upper part of the yarn supplying bobbin 21 when the yarn 20 unwound from the yarn supplying bobbin 21 is swung around, and controls the balloon to an appropriate size to assist the unwinding of the yarn 20.

[0034] The lower yarn blow-up section 11 is an air sucker device arranged between the bobbin supporting section 7 and the yarn joining device 14, and is configured to feed a lower yarn from the yarn supplying bobbin 21 towards the yarn joining device 14 during the yarn joining operation.

[0035] The gate type tension applying device 12 applies a predetermined tension to the travelling yarn 20. The gate type tension applying device 12 of the present embodiment is configured as a gate type in which movable comb teeth are arranged with respect to fixed comb teeth. The comb teeth on the movable side are configured to be swingable by a rotary solenoid so that the comb teeth can be in the meshed state or the released state. The configuration of the gate type tension applying device 12 is not limited thereto, and may be a disc type tension applying device, for example.

[0036] The upper yarn catching section 13 is arranged between the yarn joining device 14 and the bobbin supporting section 7. The upper yarn catching section 13 is connected to a negative pressure source (not illustrated), and can generate a suction airflow during the yarn joining operation.

[0037] The yarn trap 15 is arranged between the yarn joining device 14 and the yarn storage device 18. The distal end of the yarn trap 15 is formed as a tubular member and is arranged close to the travelling path of the yarn 20, and is connected to the negative pressure source (not illustrated). According to such a configuration, the suction airflow can be generated at the distal end of the yarn trap 15 to suck and remove contaminants such as fluffs attached to the travelling yarn 20.

[0038] The clearer 17 is configured to detect the yarn defect such as slub by monitoring a yarn thickness of the yarn 20. When detecting the yarn defect, the clearer 17 transmits a disconnecting signal instructing the cutting and removal of the yarn defect to a control section 60 and the like. A cutter 16 for immediately cutting the yarn 20 according to the disconnecting signal is arranged in proximity to the clearer 17.

[0039] The yarn joining device 14 joins the lower yarn from the yarn supplying bobbin 21, and the upper yarn from the yarn storage device 18, when the yarn 20 between the yarn supplying bobbin 21 and the package 30 is in the disconnected state after yarn breakage in which the clearer 17 detects the yarn defect and the cutter 16 cuts the yarn 20, after yarn breakage during unwinding of the yarn 20 from the yarn supplying bobbin 21, or at the time of replacing the yarn supplying bobbin 21. The yarn joining device 14 may be a type that uses a fluid such as compressed air, or may be a mechanical type.

[0040] The upper yarn pull-out section 35 is an air sucker device, and pulls out the upper yarn from the yarn storage device 18 and feeds the upper yarn towards a deflection guide member 36.

[0041] When carrying out the yarn joining operation in replacing the yarn supplying bobbin 21, the upper yarn from the yarn storage device 18 is fed to the deflection guide member 36 by the upper yarn pull-out section 35. The deflection guide member 36 discharges the fed upper yarn from the lower end portion. The yarn discharged by the deflection guide member 36 is sucked by the upper yarn catching section 13. The upper yarn can be taken out from a slit (not illustrated) formed in the deflection guide member 36 as the upper yarn catching section 13 sucks the upper yarn, so that the upper yarn can be guid-

ed to the yarn joining device 14.

[0042] The lower yarn fed by the lower yarn blow-up section 11 is sucked by the yarn trap 15. The lower yarn is thereby guided to the yarn joining device 14. The yarn joining operation is carried out in such a manner. In the present embodiment, the yarn defect is removed mainly by the clearer 17, the upper yarn catching section 13, the yarn trap 15, and the yarn joining device 14, and hence such devices correspond to "yarn defect removing device".

[0043] The yarn storage device 18 is configured to be able to temporarily store the yarn 20 unwound from the yarn supplying bobbin 21. Since the yarn storage device 18 is interposed between the bobbin supporting section 7 and the winding section 8, and a prescribed amount of the yarn 20 is stored on the yarn storage device 18, the winding section 8 can wind the yarn 20 stored on the yarn storage device 18 even if the unwinding of the yarn from the yarn supplying bobbin 21 is interrupted (e.g., during yarn joining operation) for some reason. Thus, the winding of the yarn 20 into the package 30 can be continued.

[0044] Thus, since the winding operation in the winding section 8 is not interrupted by the yarn joining operation and the like, the package 30 can be produced stably at high speed. Furthermore, since the yarn 20 is not sucked and caught from the package 30 for each yarn joining operation as in the conventional yarn winding device, disturbance can be prevented from occurring at the surface of the package 30. Moreover, since the occurrence of yarn breakage in the winding section 8 is reduced, falling of the yarn 20 onto the end face of the package 30 or occurrence of a failure in the winding shape can be prevented.

[0045] A first guide section 41, a second guide section 42, and a tension measuring device 43 are arranged on the downstream of the yarn storage device 18.

[0046] The first guide section 41 converges the yarn 20 pulled out from the yarn storage device 18 so as to guide the yarn 20 to one area. The second guide section 42 is arranged downstream of the first guide section 41. The second guide section 42 forms a traverse supporting point of the yarn 20 to be wound in the winding section 8.

[0047] The tension measuring device 43 is arranged between the first guide section 41 and the second guide section 42. The tension measuring device 43 is configured as a load cell type sensor. If the yarn 20 travels while being pushed against the contacting portion of the tension measuring device 43, distortion occurs in the load cell portion according to the tension of the yarn 20 and an electric signal corresponding to the distortion is output from a distortion gauge.

[0048] A magazine type bobbin supplying device 26 is arranged on the front side of the winding unit 2. The bobbin supplying device 26 includes a rotary magazine part 27. The magazine part 27 is configured to be able to hold a plurality of spare yarn supplying bobbins 21. The bobbin supplying device 26 intermittently rotatably drives the magazine part 27 to supply a new yarn supplying bobbin 21 to the bobbin supporting section 7.

[0049] Next, with reference to FIG. 2, the yarn storage device 18 will be described in detail. The yarn storage device 18 includes a yarn storage roller 51, a roller driving section (first driving section) 52, a yarn hooking arm (tension applying section) 53, a transmission mechanism 54, and an arm driving section (second driving section) 55.

[0050] The yarn storage roller 51 is formed as a substantially cylindrical member, and is configured to store the yarn 20 by winding the yarn 20 around the outer circumferential surface thereof.

[0051] The roller driving section 52 rotatably drives the yarn storage roller 51 with a center axis line thereof as a center. Specifically, a belt 70 is wound around an output shaft 52a of the roller driving section 52 and a coupling member 51a fixed to the inner surface of the yarn storage roller 51, and the yarn storage roller 51 can be rotated by rotating the output shaft 52a. The operation of the roller driving section 52 is controlled by the control section 60. The roller driving section 52 is a servo motor, a stepping motor, or the like.

[0052] The arm driving section 55 rotatably drives the yarn hooking arm 53 when the driving force is transmitted by the transmission mechanism 54. The transmission mechanism 54 of the present embodiment mainly includes a shaft 54a (yarn storage roller rotation shaft), and the shaft 54a transmits the driving force. According to such a configuration, the yarn hooking arm 53 can be rotatably driven around the same rotation axis as the yarn storage roller 51. The operation of the arm driving section 55 is controlled independently from the roller driving section 52 by the control section 60. Therefore, in the present embodiment, the rotation speeds of the yarn storage roller 51 and the yarn hooking arm 53 can be differed. The arm driving section 55 is a servo motor, a stepping motor, or the like.

[0053] Next, a description will be made on the control carried out by the control section 60 on the arm driving section 55 with reference to FIG. 3.

[0054] Each winding unit 2 includes the control section 60. The control section 60 is configured by hardware such as a CPU, a ROM, and a RAM (not illustrated), and software such as the control program stored in the RAM. The hardware and the software cooperatively operate to control each configuration of the winding unit 2. As illustrated in FIG. 3, the control section 60 includes, as a configuration for controlling the arm driving section 55, a deviation calculating section 61, a PID control value determining section 62, and a limiter 63.

[0055] The deviation calculating section 61 of the control section 60 is input with a tension measurement value measured by the tension measuring device 43. Furthermore, a tension target value derived from the winding conditions such as the type of yarn 20 and the yarn travelling speed is input to the deviation calculating section 61. The deviation calculating section 61 calculates the deviation of the two input values, and outputs the calculated deviation to the PID control value determining sec-

tion 62.

[0056] The PID control value determining section 62 calculates a control value for controlling the torque of the arm driving section 55 by a known PID control based on a deviation, time integral of the deviation, and time derivative of the deviation. The control value may be calculated based only on the deviation, and the control value may be calculated based only on the deviation and the time integral thereof. The feedback control other than the PID may be used. The PID control value determining section 62 outputs the control value calculated as above to the limiter 63.

[0057] The limiter 63 defines an upper limit of the control value of the arm driving section 55. When the control value input from the PID control value determining section 62 is greater than or equal to a predetermined threshold, the limiter 63 outputs the relevant threshold to the arm driving section 55 as the control value. When the control value input from the PID control value determining section 62 is smaller than the predetermined threshold, the limiter 63 outputs the input value as it is.

[0058] The control value calculated as above is input to the arm driving section 55, and the torque of the arm driving section 55 is adjusted based on the control value. The control section 60 carries out the feedback control as necessary, so that even if the travelling speed of the yarn is high, the yarn hooking arm 53 can apply a desired tension to the yarn 20.

[0059] As described above, the yarn winding device of the present embodiment includes the bobbin supporting section 7, the yarn storage roller 51, the winding section 8, the tension measuring device 43, the yarn hooking arm 53, the arm driving section 55, and the control section 60. The bobbin supporting section 7 can supply the yarn 20. The yarn storage roller 51 is rotatably driven by the roller driving section 52, so that the yarn 20 is pulled out from the yarn supplying bobbin 21 of the bobbin supporting section 7 and the yarn 20 is stored on the surface. The winding section 8 pulls out the yarn 20 stored on the yarn storage roller 51 to form the package 30. The tension measuring device 43 measures the tension of the yarn 20 pulled out from the yarn storage roller 51. The yarn hooking arm 53 is arranged downstream in the yarn travelling direction of the yarn storage roller 51, and makes contact with the yarn 20 to apply tension to the yarn 20. The arm driving section 55 rotatably drives the yarn hooking arm 53. The control section 60 feedback controls the arm driving section 55 based on the measurement result of the tension measuring device 43 to adjust the amount of tension applied by the yarn hooking arm 53. The yarn travelling direction of the yarn storage roller 51 in the present invention is a direction in which the yarn wound around the outer circumferential surface of the yarn storage roller 51 advances by being pushed by the newly wound yarn, and is the same direction as the axial direction of the shaft 54a.

[0060] Since the tension on the downstream of the yarn storage roller 51 is measured, and the arm driving section 55 is controlled based on such a measurement result, the tension of the yarn 20 to be wound into the package 30 becomes the desired tension. Thus, the quality of the package 30 can be improved while the interruption of the winding of the yarn 20 is prevented.

[0061] Next, a description will be made on a first alternative embodiment of the above described embodiment with reference to FIG. 4. In the description of the first alternative embodiment and the subsequent alternative embodiments, the same reference numerals are denoted in the drawings on the members same as or similar to the embodiment described above, and the description thereof may be omitted.

[0062] A yarn storage device 18a of the first alternative embodiment includes a resistance torque generating section 56. The resistance torque generating section 56 is a load such as a torque limiter attached between a shaft 54a and at least an inner surface of the yarn storage roller 51.

[0063] The resistance torque generating section 56 thereby generates a torque against the relative rotation of the yarn storage roller 51 and the yarn hooking arm 53, and integrally rotates. The yarn hooking arm 53 can be relatively rotated with respect to the yarn storage roller 51 by driving the arm driving section 55 at greater than or equal to the above torque.

[0064] For example, when the fluctuation of the tension is small, the operation of the arm driving section 55 is stopped and the yarn storage roller 51 and the yarn hooking arm 53 are integrally rotated by the torque of the resistance torque generating section 56. When the fluctuation of the tension is large, the fluctuation of the tension can be prevented by driving the arm driving section 55 and relatively rotating the yarn hooking arm 53.

[0065] Next, a description will be made on a second alternative embodiment with reference to FIG. 5.

[0066] A yarn storage device 18b of the second alternative embodiment includes the resistance torque generating section 56, similarly to the first alternative embodiment. The transmission mechanism 54 includes a clutch 54b in addition to the shaft 54a. The clutch 54b is a constituent element of the transmission mechanism 54. The clutch 54b switches the transmission or cutting of the driving force from the arm driving section 55 to the yarn hooking arm 53.

[0067] Thus, the yarn storage roller 51 and the yarn hooking arm 53 can be integrally rotated without stopping the drive of the arm driving section 55 as in the first alternative embodiment. Therefore, for example, the yarn hooking arm 53 can be immediately decelerated by rotating the shaft 54a at a rotation speed slightly lower than the yarn storage roller 51 and connecting the clutch 54b when desiring to decelerate the yarn hooking arm 53.

[0068] Next, a description will be made on a third alternative embodiment with reference to FIG. 6.

[0069] The transmission mechanism 54 of the yarn storage device 18c of the third alternative embodiment includes a torque limiter 54c in addition to the shaft 54a.

The torque limiter 54c is attached to connect the shaft 54a divided in half. The two shafts 54a integrally rotate when a torque smaller than a predetermined value is applied by the torque limiter 54c, and the two shafts 54a relatively rotate when a torque greater than or equal to the predetermined value is applied.

[0070] Thus, an excessive tension can be more reliably prevented from being applied on the yarn 20 and breaking the yarn 20.

[0071] The preferred embodiment and the alternative embodiments of the present invention have been described above, but the above-described configurations may be modified as below.

[0072] In the description made above, the roller driving section 52 and the arm driving section 55 have at least one part arranged inside the yarn storage roller 51, but the roller driving section 52 and the arm driving section 55 may be arranged outside the yarn storage roller 51. The yarn hooking arm 53 may be arranged outside the yarn storage device 18.

[0073] The tension measuring device 43 may be, for example, a tension sensor using a spring and/or a piezoelectric element, instead of a load cell type.

[0074] In the description made above, the control section 60 adjusts the torque of the arm driving section 55 based on the measured tension, but the position (rotation angle) and the speed (rotation speed) may be adjusted instead of the torque.

[0075] In the description made above, an example of applying the present invention to an automatic winder has been described, but the present invention may be applied to other yarn winding devices such as a spinning machine. When the present invention is applied to the spinning machine, a spinning section adapted to spin the spun yarn from the sliver corresponds to the yarn supplying section.

[0076] In the description made above, an example of supplying the yarn supplying bobbin 21 from the magazine type bobbin supplying device 26 has been described, but a yarn winding device including a tray type bobbin supplying device may be adopted.

Claims

1. A yarn winding device comprising:

a yarn supplying section (7) adapted to supply a yarn;
a yarn storage roller (51) adapted to pull out the yarn from the yarn supplying section (7) and wind the yarn around an outer circumferential surface to store the yarn when the yarn storage roller (51) is rotatably driven by a first driving section (52);
a package forming section (8) adapted to pull out the yarn stored on the yarn storage roller (51) to form a package;
a tension applying section (53) arranged downstream in a yarn travelling direction of the yarn storage roller (51) and adapted to make contact with the yarn to apply tension to the yarn;
a second driving section (55) adapted to rotatably drive the tension applying section (53); **characterized by**
a tension measuring device (43) adapted to measure a tension of the yarn pulled out from the yarn storage roller (51) by the package forming section (8);
and
a control section (60) adapted to feedback control the second driving section (55) based on a measurement result of the tension measuring device (43) to adjust an amount of tension applied by the tension applying section (53).

2. The yarn winding device according to claim 1, **characterized by** further comprising:

a first guide section (41) arranged downstream of the yarn storage roller (51) and adapted to converge the yarn pulled out from the yarn storage roller (51); and
a second guide section (42) arranged downstream of the first guide section (41) and adapted to form a traverse supporting point of the yarn wound by the package forming section (8), wherein
the tension measuring device (43) is arranged on a yarn path between the first guide section (41) and the second guide section (42).

3. The yarn winding device according to claim 1 or 2, **characterized in that**
the control section (60) adjusts the amount of tension applied by the tension applying section (53) by adjusting a torque of the second driving section (55) based on the measurement result of the tension measuring device (43).

4. The yarn winding device according to any one of claims 1 to 3, **characterized in that**
the yarn storage roller (51) rotates with a yarn storage roller rotation shaft (54a) as a center, and
the tension applying section (53) rotates with the yarn storage roller rotation shaft (54a) as the center.

5. The yarn winding device according to claim 4, **characterized by** further comprising:

a resistance torque generating section (56) adapted to generate a torque against a relative rotation of the yarn storage roller (51) and the tension applying section (53).

6. The yarn winding device according to claim 5, **char-**

acterized by further comprising:

a transmission mechanism (54) adapted to transmit a driving force of the second driving section (55) to the tension applying section (53), wherein
the transmission mechanism (54) includes a clutch (54b) adapted to switch transmission or cutting of the driving force from the second driving section (55) to the tension applying section (53).

7. The yarn winding device according to any one of claims 1 to 4, **characterized by** further comprising:

a transmission mechanism (54) adapted to transmit a driving force of the second driving section (55) to the tension applying section (53), wherein
the transmission mechanism (54) includes a torque limiter (54c) adapted to prevent an excessive driving force from being transmitted from the second driving section (55) to the tension applying section (53).

8. The yarn winding device according to any one of claims 1 to 7, **characterized in that**
the yarn supplying section (7) is supported such that the yarn is supplied from a yarn supplying bobbin, around which the yarn produced by a spinning device is wound, and
a yarn defect removing device (13, 14, 15, 17) adapted to remove a yarn defect of the yarn supplied from the yarn supplying section (7) is arranged between the yarn supplying section (7) and the yarn storage roller (51).

9. The yarn winding device according to any one of claims 1 to 7, **characterized in that**
the yarn supplying section (7) is a spinning section adapted to spin a yarn, and
a yarn defect removing device (13, 14, 15, 17) adapted to remove a yarn defect of the yarn supplied from the yarn supplying section (7) is arranged between the yarn supplying section (7) and the yarn storage roller (51).

FIG. 1

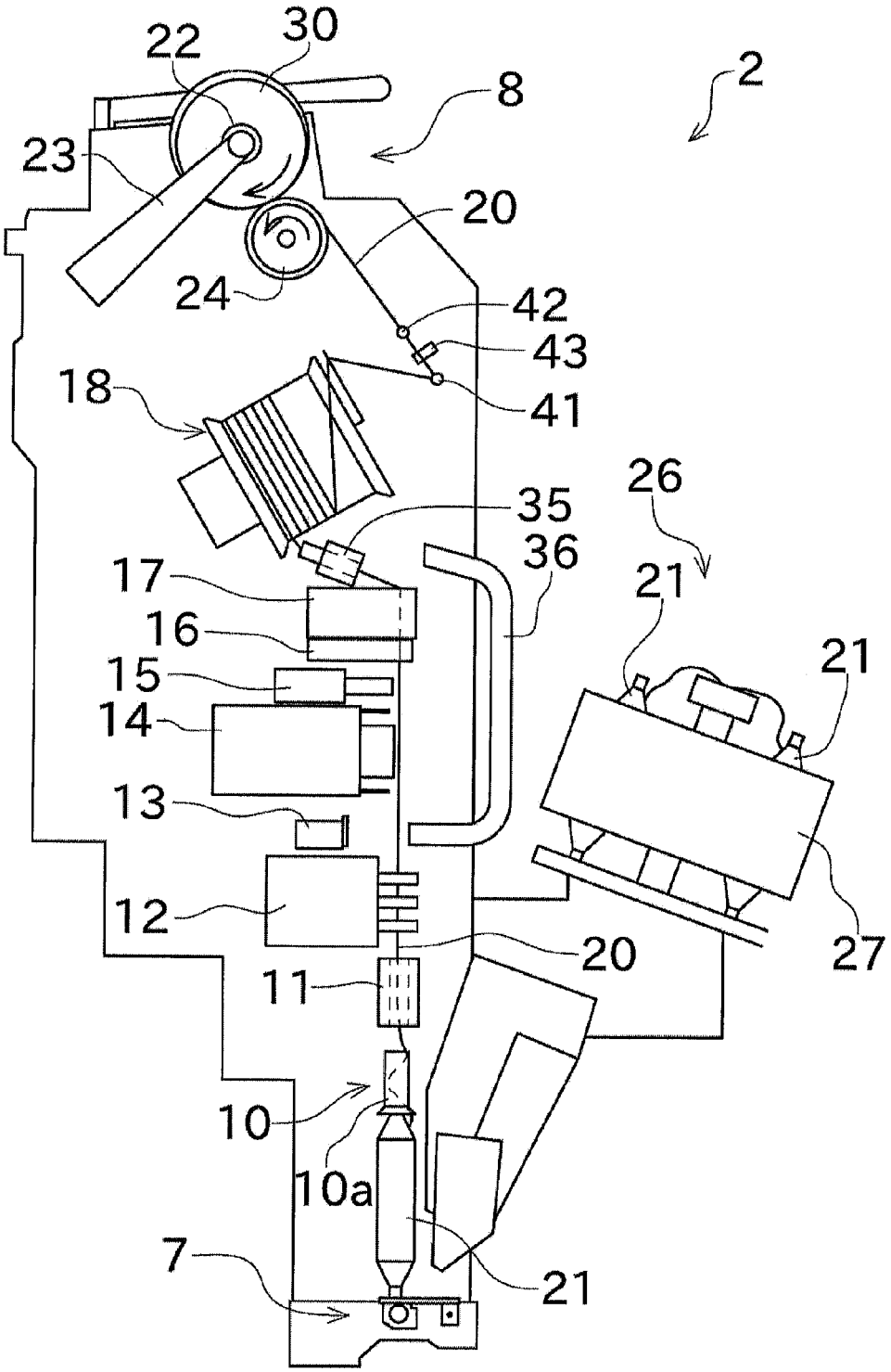
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FIG. 2

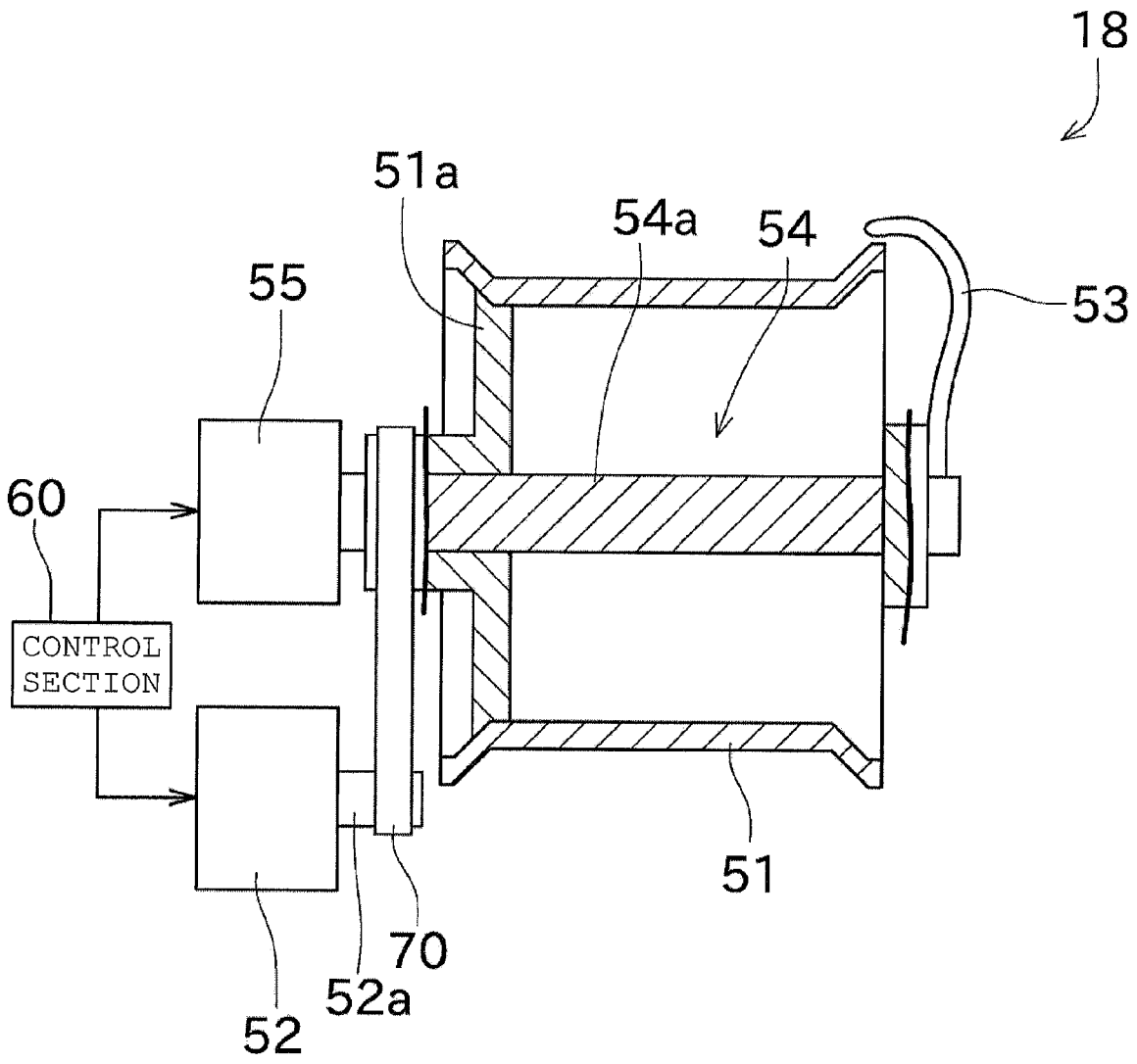


FIG. 3

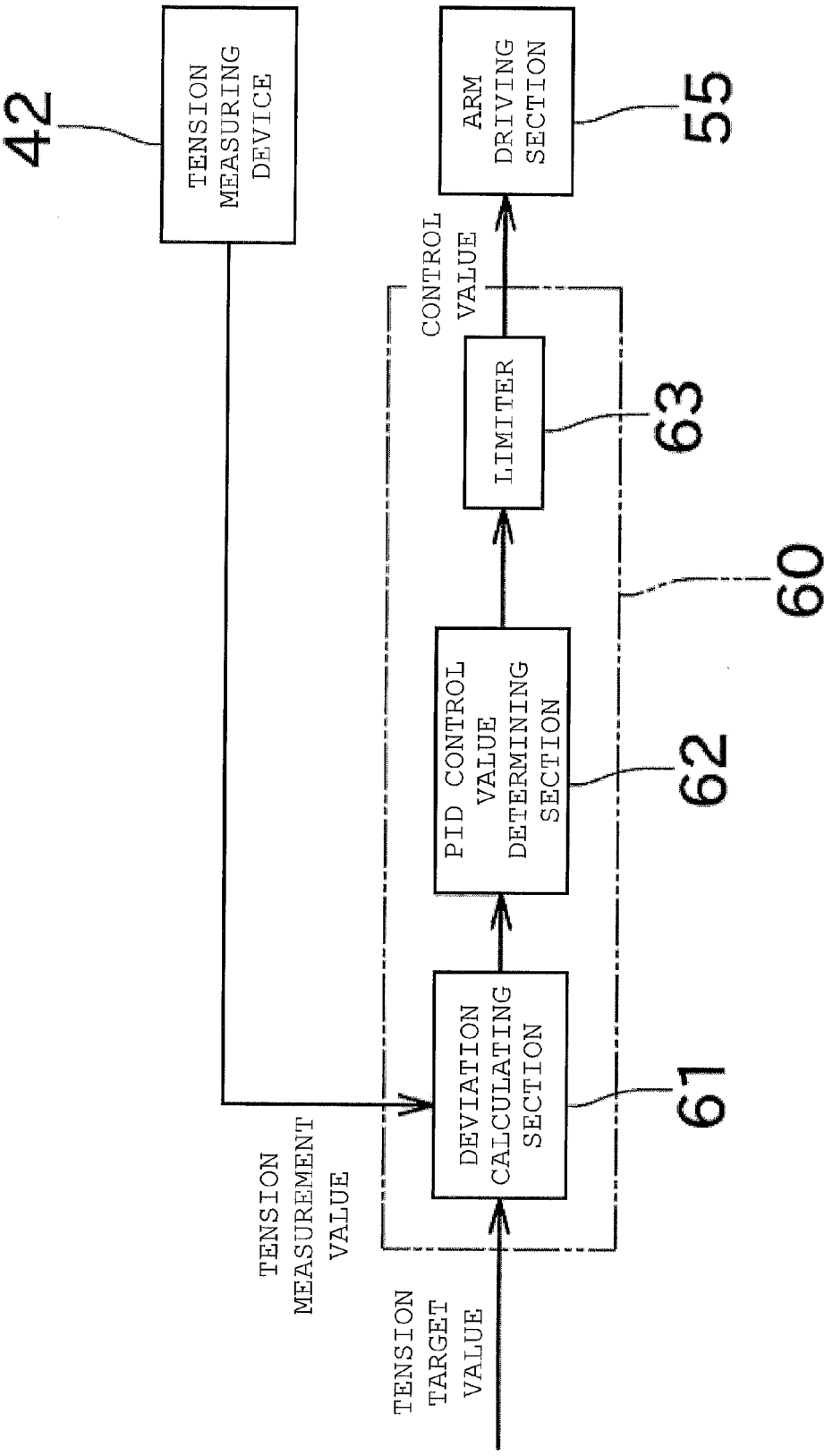

42
TENSION MEASURING DEVICE
ARM DRIVING SECTION
55
CONTROL VALUE
LIMITER
63
60
PID CONTROL VALUE DETERMINING SECTION
62
DEVIATION CALCULATING SECTION
61
TENSION MEASUREMENT VALUE
TENSION TARGET VALUE

FIG. 4

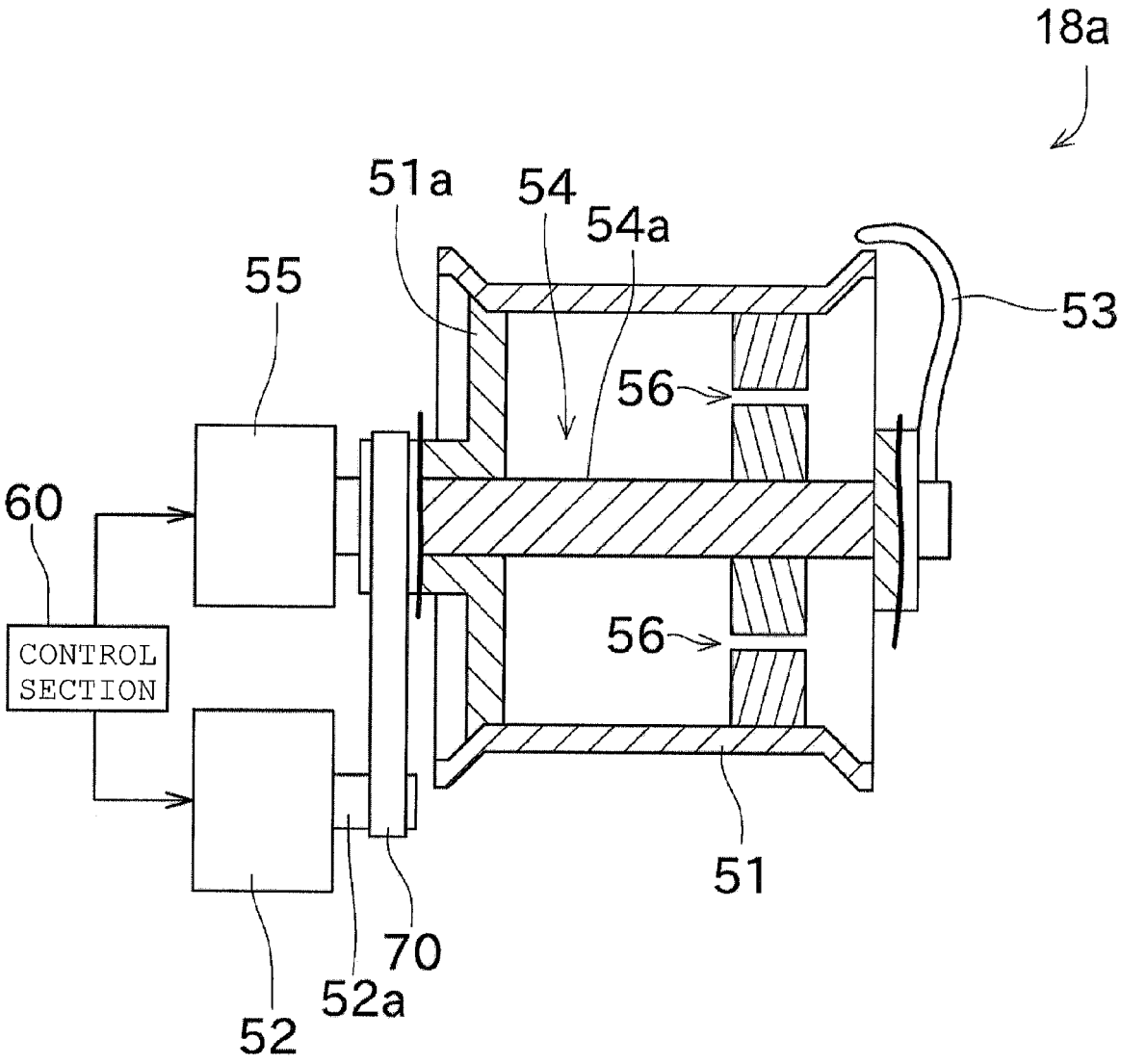


FIG. 5

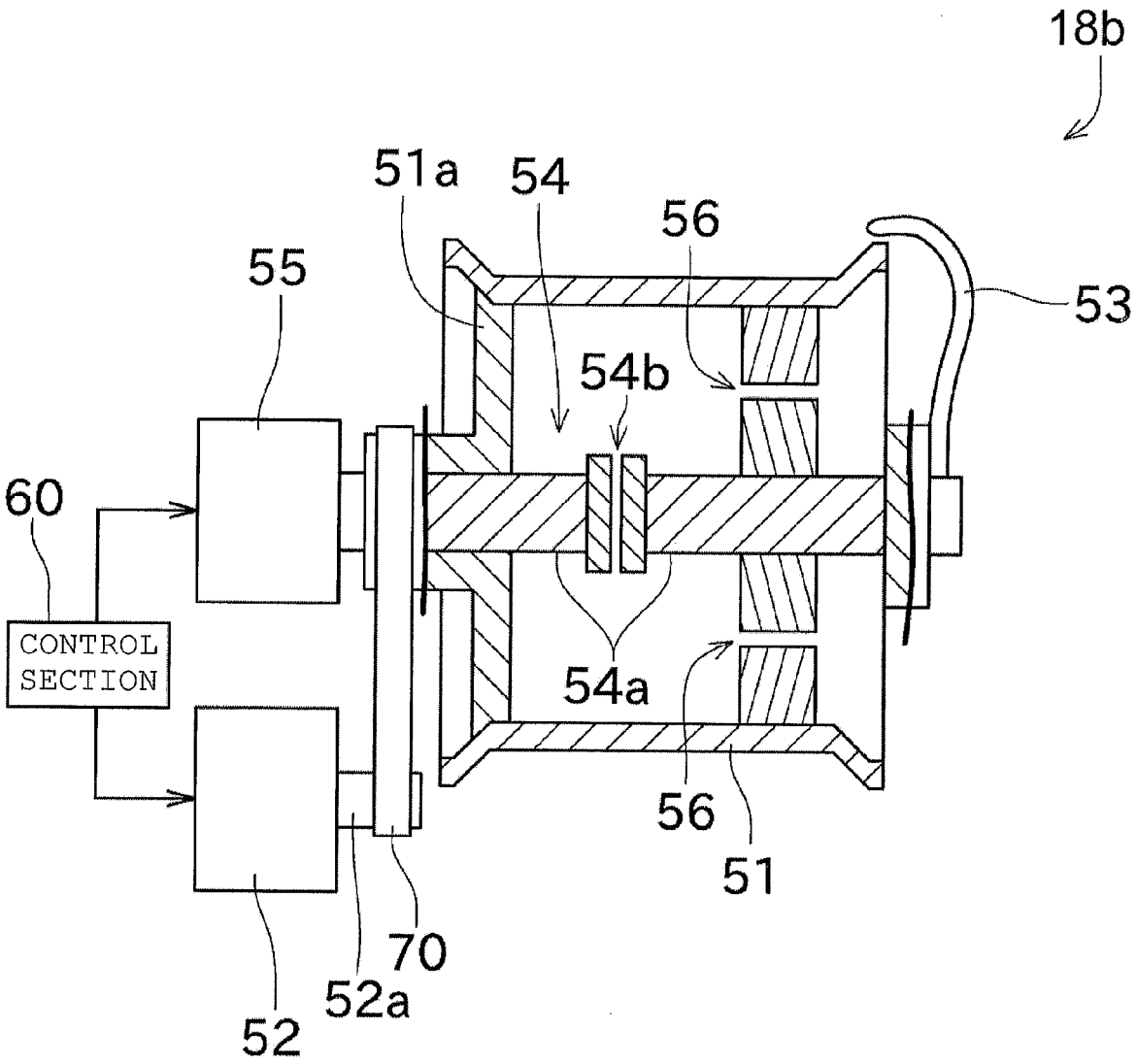
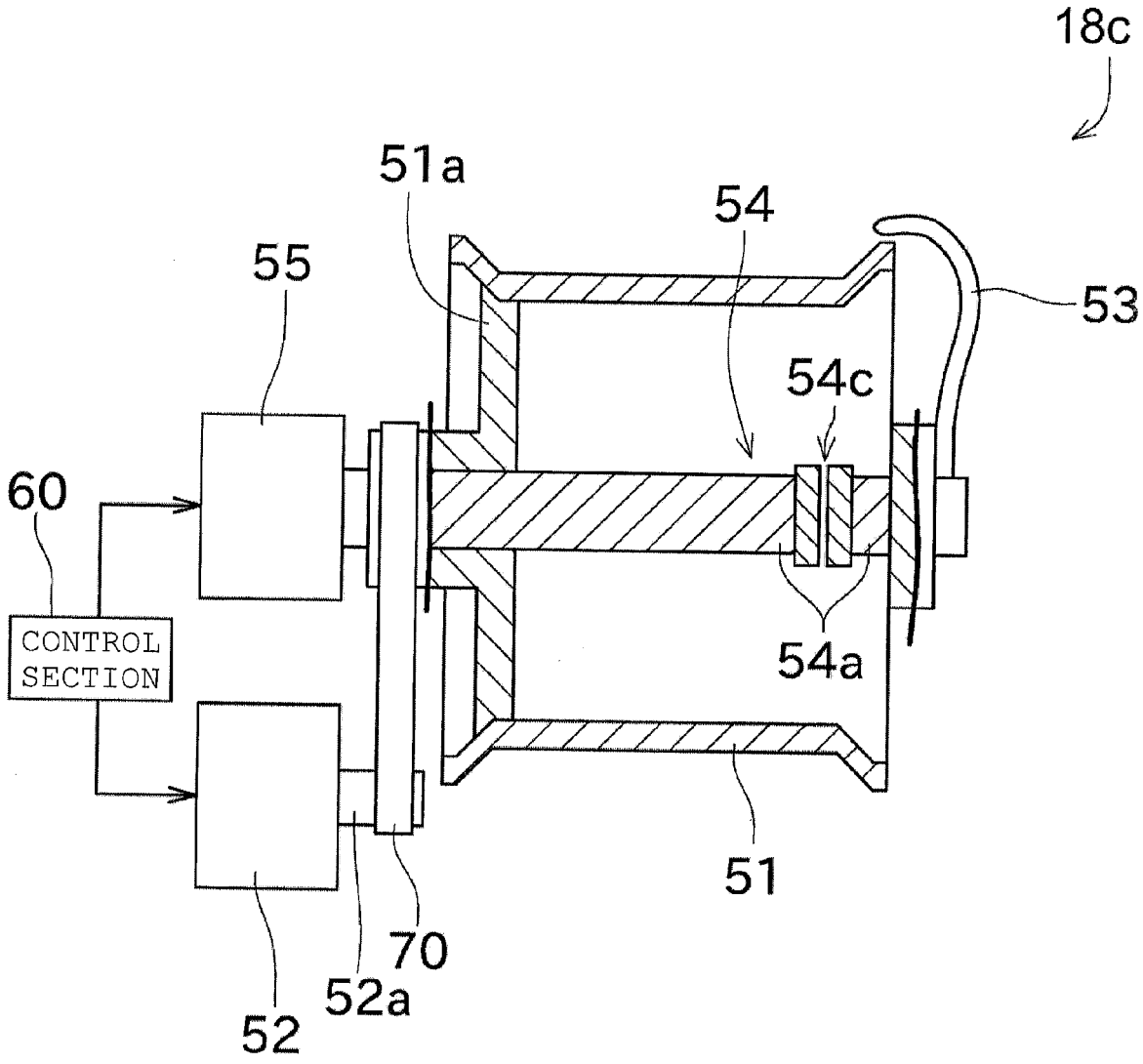


FIG. 6



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EUROPEAN SEARCH REPORT

Application Number
EP 15 16 9247

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
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