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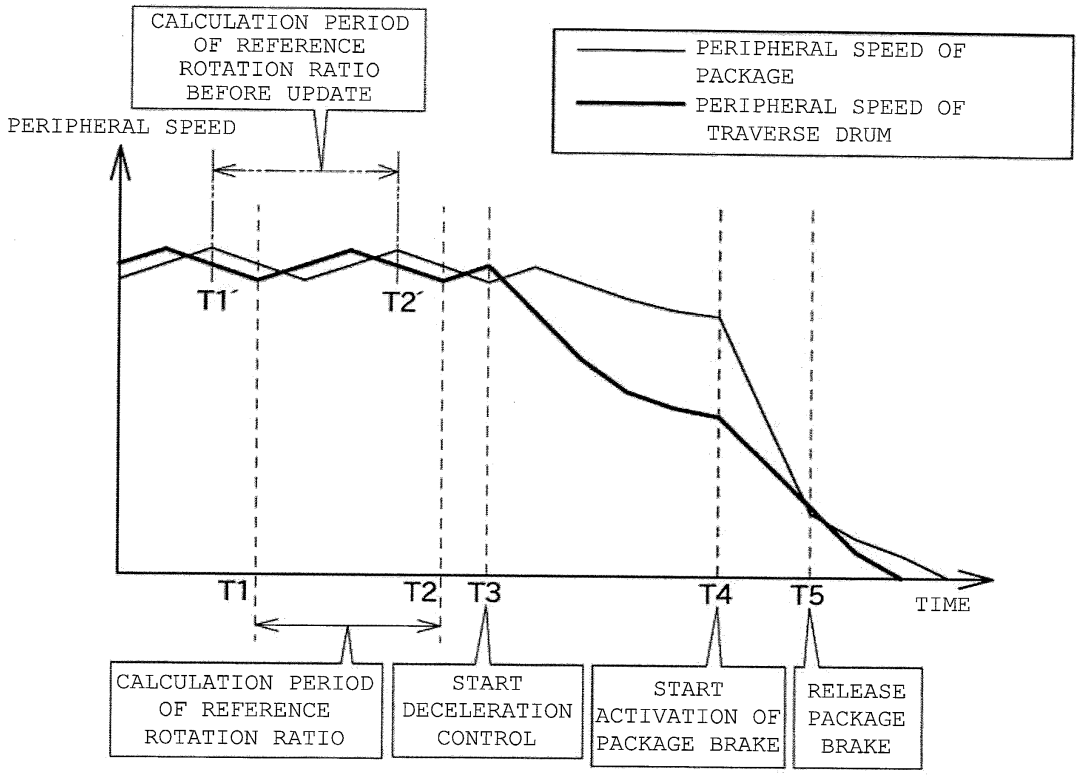
(54) YARN WINDING DEVICE AND PACKAGE DECELERATING METHOD

(57) The control section (50) carries out a deceleration control of decelerating the traverse drum (24) while adjusting such that a difference in peripheral speeds of the package (30) and the traverse drum (24) is smaller than or equal to a predetermined value in a state where the yarn (20) is connected between the yarn storage device (19) and the winding section (8) and in a state where the package (30) and the traverse drum (24) are brought into contact with each other based on a detection result of the package rotation sensor (47) and a rotation speed of the traverse drum (24).

FIG. 6



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a control carried out when decelerating a package in a yarn winding device including a yarn storage device.

2. Description of the Related Art

[0002] Conventionally, there is known a yarn winding device adapted to wind a yarn from a yarn storage device to form a package while temporarily storing the yarn unwound from a yarn supplying bobbin in the yarn storage device. The yarn winding device including the yarn storage device can continue to form the package even when the yarn joining operation is carried out. WO 2012/127939 A1 discloses this type of yarn winding device.

[0003] WO 2012/127939 A1 discloses a yarn winding device having a configuration of rotating the package by rotating a winding drum (contact roller) brought into contact with the package. The yarn winding device carries out a control of changing a rotation speed of a winding drum based on a storage amount of the yarn storage device. Specifically, the yarn winding device lowers the rotation speed of the winding drum when the storage amount of the yarn storage device is smaller than or equal to a predetermined amount to lower the rotation speed of the package or to stop the rotation of the package. Such a control is carried out to prevent the yarn stored in the yarn storage device from running out.

[0004] Similarly to WO 2012/127939 A1, JP H7-187506 A discloses a yarn winding device having a configuration of rotating the package by rotating a yarn guiding drum (contact roller) brought into contact with the package. The yarn winding device carries out a control of causing a slip between the yarn guiding drum and the package when lowering the rotation speed of the package. Such a control is carried out to prevent ribbon winding (yarn newly wound into the package is overlapped on the already wound yarn).

[0005] In the yarn winding device including the yarn storage device as described in WO 2012/127939 A1, a large slip occurs between the contact roller and the package when the rotation speed of the contact roller is rapidly lowered. When a large slip occurs, the yarn is not traversed in accordance with the operation of the traverse device, and the yarn may fall off from the end face of the package (stitching). When the package is rotated at high speed or the package is heavy, the inertia force of the rotating package becomes large and hence a large slip easily occurs.

[0006] When the rotation speed of the contact roller is gradually lowered, a great amount of yarn is unwound from the yarn storage device before the rotation speed of the package reaches the target speed, and the storage amount of the yarn storage device is greatly reduced. Therefore, when gradually lowering the rotation speed of the contact roller, the package needs to be frequently stopped to ensure the storage amount of the yarn storage device. However, if the package is frequently stopped, the winding efficiency is lowered, and furthermore, the yarn falls off from the end face of the package and is wound around the winding bobbin when the package is stopped, and thus yarn breakage may occur. Therefore, it is not preferable to gradually lower the rotation speed of the contact roller without resistance to inertia.

[0007] The yarn winding device of JP H7-187506 A has a configuration of intentionally causing the slip of the package. JP H7-187506 A does not disclose the configuration including the yarn storage device.

BRIEF SUMMARY OF THE INVENTION

[0008] The present invention has been made in view of the above circumstances, and a main object thereof is to provide a configuration of decelerating a package in a short period of time while suppressing a slip of the package in a yarn winding device including a yarn storage device.

[0009] The problems to be solved by the present invention are as described above, and the means and effects for solving such problems will be described next.

[0010] According to a first aspect of the present invention, a yarn winding device having the following configuration is provided. Specifically, the yarn winding device includes a yarn supplying section, a yarn storage device, a package forming section, and a control section. The yarn supplying section is adapted to supply a yarn. The yarn storage device is adapted to pull out the yarn from the yarn supplying section and temporarily store the yarn. The package forming section is adapted to pull out the yarn from the yarn storage device and wind the yarn around a winding bobbin to form a package. The control section is adapted to control the package forming section. The package forming section includes a package supporting section, a package rotation detecting section, a contact roller, and a roller drive source. The package supporting section is adapted to rotatably support the package. The package rotation detecting section is adapted to detect a rotation amount of the package. The contact roller is adapted to rotate while making contact with the package supported by the package supporting section to rotate the package. The roller drive source is adapted to rotatably drive the contact roller. The control section carries out a deceleration control of decelerating the contact roller while adjusting such that a difference in peripheral speeds of the package and the contact roller is smaller than or equal to a predetermined value in a state where the yarn is connected between the yarn storage device and the package forming section and in a state where the contact roller is brought into contact with the package based on a detection result of the package

rotation detecting section and a rotation speed of the contact roller.

[0011] Thus, the slip that occurs between the contact roller and the package can be suppressed without gradually decelerating the contact roller. Therefore, the storage amount of the yarn storage device can be increased while preventing occurrence of stitching.

[0012] In the above-described yarn winding device, the control section preferably carries out the deceleration control to stop the contact roller in a state where the yarn is connected between the yarn storage device and the package forming section and in a state where the contact roller and the package are brought into contact with each other.

[0013] Thus, even when stopping the package, the slip (furthermore, the occurrence of stitching) that occurs between the contact roller and the package can be prevented.

[0014] In the above-described yarn winding device, after stopping the contact roller, the control section preferably resumes the winding of the yarn to the package supported by the package supporting section.

[0015] Thus, the occurrence of the stitching can be prevented by stopping the package with the deceleration control of the present invention, whereby the winding of the package can be resumed without causing any problems in terms of quality.

[0016] In the above-described yarn winding device, the control section preferably carries out the deceleration control when the amount of yarn stored in the yarn storage device is smaller than a predetermined amount.

[0017] The slip that occurs between the contact roller and the package thus can be suppressed even when recovering the reduced storage amount.

[0018] In the above-described yarn winding device, the control section preferably calculates a reference value of a difference in peripheral speeds of the package and the contact roller based on the rotation speed of the contact roller and the detection result of the package rotation detecting section in a predetermined period before start of the deceleration control, and carries out the deceleration control using the reference value.

[0019] In other words, since a diameter of the package changes according to the winding amount, a slip amount cannot be accurately obtained only by the rotation speed of the package and the rotation speed of the contact roller. In this regard, the slip amount during the deceleration control can be easily estimated by using the rotation speeds of the package and the contact roller before the deceleration control (before the occurrence of slip).

[0020] The above-described yarn winding device preferably has the following configuration. Specifically, the yarn winding device includes a package yarn amount detecting section adapted to detect the amount of yarn wound into the package. The control section determines a set value of the deceleration control in view of the detection result of the package yarn amount detecting section.

[0021] Thus, the diameter and the weight of the package can be calculated based on the amount of yarn wound into the package, and hence the set value (initial value, control parameter, or the like) can be determined in view of the magnitude of the inertia force of the package. Therefore, the slip that occurs between the contact roller and the package can be more reliably suppressed.

[0022] The above-described yarn winding device preferably has the following configuration. Specifically, the yarn winding device further includes a package brake adapted to make contact with the winding bobbin or the package and apply brake force to the package. The control section activates the package brake based on the deceleration of the contact roller to decelerate the package.

[0023] The rotation speed of the package thus can be forcibly lowered, and hence the rotation speed of the package can be brought close to a desired value in a short period of time.

[0024] The above-described yarn winding device further includes a package brake adapted to make contact with the winding bobbin or the package and apply brake force to the package, wherein the control section activates the package brake to decelerate the package when the storage amount detecting section detects that the amount of yarn wound around the storage roller is smaller than or equal to a predetermined amount.

[0025] The yarn stored in the yarn storage device thus can be prevented from running out.

[0026] The control section calculates a difference in peripheral speeds of the package and the contact roller based on the rotation speed of the contact roller and the detection result of the package rotation detecting section while activating the package brake and decelerating the package when the storage amount detecting section detects that the amount of yarn wound around the storage roller is smaller than or equal to a predetermined amount, and immediately stops the rotation of the package by the package brake and notifies an alarm warning when the difference in the peripheral speeds is greater than or equal to a predetermined value.

[0027] The operator thus can find the occurrence of the stitching at an early stage and can unwind the yarn in which the stitching occurred and rewind the yarn to a package without stitching.

[0028] In the above-described yarn winding device, the yarn supplying section is a yarn supplying bobbin supporting section adapted to support a yarn supplying bobbin around which a yarn spun by a spinning machine is wound, and the contact roller is a traverse drum provided with a traverse groove for traversing a yarn wound into the package.

[0029] Thus, although the surface of the package may be damaged if a large slip occurs between the traverse drum and the package, such damage can be prevented by carrying out the deceleration control of the present invention.

[0030] The above-described yarn winding device pref-

erably has the following configuration. Specifically, the yarn winding device includes a yarn joining device arranged between the yarn supplying section and the yarn storage device, and adapted to join a disconnected yarn when the yarn is disconnected. The control section performs the deceleration control when detecting that the yarn joining operation by the yarn joining device is not possible.

[0031] If the yarn joining operation is not possible, the yarn of the yarn storage device may run out shortly. Therefore, by carrying out the deceleration control as described above, the storage amount of the yarn storage device can be increased while suppressing the slip that occurs between the contact roller and the package.

[0032] According to a second aspect of the present invention, a package decelerating method is provided as follows. Specifically, the package decelerating method includes a package rotation detecting step, and a decelerating step. In the package rotation detecting process, a rotation amount of a package formed by winding a yarn around a winding bobbin with a package forming section is detected. In the decelerating process, the contact roller is decelerated while adjusting such that a difference in peripheral speeds of the package and the contact roller is smaller than or equal to a predetermined value in a state where the yarn is connected between the package forming section and a yarn storage device, which is adapted to wind the yarn from a yarn supplying section and temporarily store the yarn, and in a state where the package and the contact roller are brought into contact with each other based on a detection result of the package rotation detecting process and a rotation speed of the contact roller adapted to rotate while making contact with the package to rotate the package.

[0033] Thus, the package can be decelerated while suppressing the slip that occurs between the contact roller and the package without gradually decelerating the contact roller. Therefore, the storage amount of the yarn storage device can be increased while preventing the occurrence of stitching.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034]

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

FIG. 2 is a front view illustrating a configuration of the vicinity of a winding section;

FIG. 3 is a flowchart illustrating a process of controlling a rotation of a traverse drum based on a storage amount of a yarn storage device;

FIG. 4 is a flowchart illustrating a preliminary process of a deceleration control, and a process immediately after the deceleration control is started;

FIG. 5 is a flowchart illustrating a process carried out after the deceleration control is started; and

FIG. 6 is a graph illustrating an example of a time change in peripheral speeds of a package and a traverse drum when the deceleration control is carried out.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0035] An embodiment of the present invention will be described below. First, an outline of an automatic winder (yarn winding device) will be described with reference to FIGS. 1 and 2. The automatic winder has a configuration in which a plurality of winding units 2 are arranged in a row. The automatic winder includes a machine management device (not illustrated) for intensively managing the winding units 2 and a blower box (not illustrated) including a compressed air source and a negative pressure source.

[0036] As illustrated in FIG. 1, the winding unit 2 includes a control section 50, a yarn supplying bobbin supporting section (yarn supplying section) 7, and a winding section (package forming section) 8 as main components. The winding unit 2 is configured to unwind a yarn (spun yarn) 20 of a yarn supplying bobbin 21 supported by the yarn supplying bobbin supporting section 7, and wind the unwound yarn 20 into a package 30. In the following description, upstream and downstream when seen in a travelling direction of the yarn are simply referred to as "upstream" and "downstream", respectively.

[0037] The control section 50 is configured by a hardware such as a CPU, a ROM, and a RAM (not illustrated), and software such as a control program stored in the RAM. With the cooperative operation of the hardware and the software, each section of the winding unit 2 is controlled. The control section 50 of each winding unit 2 is able to communicate with the machine management device. The operation of the plurality of winding units 2 in the automatic winder thus can be intensively managed in the machine management device.

[0038] The yarn supplying bobbin supporting section 7 holds the yarn supplying bobbin 21 in a substantially upright state. Furthermore, the yarn supplying bobbin supporting section 7 can discharge the empty yarn supplying bobbin 21. A magazine type bobbin supplying device 26 is arranged on a 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 yarn supplying bobbin supporting section 7.

[0039] The winding section 8 includes a cradle 23 configured to detachably attach the winding bobbin 22, and a traverse drum (contact roller) 24 adapted to traverse the yarn 20 and to drive the winding bobbin 22.

[0040] As illustrated in FIG. 2, the cradle 23 includes a pair of left and right arms swingable with a swing shaft 43 as a center, the swing shaft 43 being arranged parallel

to a rotational axis of the traverse drum 24 and with a predetermined spacing with the traverse drum 24. An increase in a yarn layer diameter of the package 30 accompanying the winding of the yarn 20 can be absorbed by the swinging of the cradle 23.

[0041] A swing angle sensor (package yarn amount detecting section) 46 adapted to detect a swing angle of the cradle 23 is attached to the swing shaft 43. The swing angle sensor 46 includes, for example, a rotary encoder, and outputs the swing angle of the cradle 23 to the control section 50. The control section 50 can calculate a package diameter of the package 30 based on the swing angle of the cradle 23 acquired from the swing angle sensor 46.

[0042] Rotation holders (package supporting sections) 44, 45 are rotatably attached to the distal end of the arm of the cradle 23. The rotation holders 44, 45 are arranged to face each other. The winding bobbin 22 is attached so as to be sandwiched between the two rotation holders 44, 45.

[0043] A package brake 80 for applying brake force to the rotation of the package 30 is arranged in proximity to the rotation holder 44. The package brake 80 includes a piston housing 81, and a brake piston 82.

[0044] The piston housing 81 is incorporated at a distal end portion of the cradle 23, and the brake piston 82 is air-tightly fitted into the interior of the piston housing 81. The brake piston 82 is slidable with respect to the piston housing 81, and is slidable with respect to a shaft 44a that rotates with the rotation holder 44.

[0045] The piston housing 81 is continuous with an electromagnetic valve (not illustrated) controlled by the control section 50 to switch between supply and stop of a flow of compressed airinto an internal space of the piston housing 81. According to such a configuration, the rotation holder 44 can freely rotate with respect to the brake piston 82 in a state where the compressed air is not supplied to the interior of the piston housing 81.

[0046] When the compressed air is supplied to the interior of the piston housing 81, the advancing brake piston 82 moves, thus generating a friction resistance with respect to the rotation of the rotation holder 44. Thus, the rotation of the winding bobbin 22 (package 30) is controlled. The package brake is not limited to the pneumatic configuration described above, and may have a configuration of applying brake force to the rotation of the rotation holder 44 by hydraulic pressure or electromagnetic force.

[0047] A package rotation sensor (package rotation detecting section) 47 is attached to a distal end portion on an opposite side of the cradle 23. The package rotation sensor 47 is adapted to detect the rotation amount of the winding bobbin 22 (package 30) attached to the cradle 23. The package rotation sensor 47 outputs a pulse signal to the control section 50 each time the package 30 is rotated by a predetermined angle. The control section 50 can calculate the rotation speed of the package 30 by measuring the number of pulses per time.

[0048] The traverse drum 24 is arranged to face the winding bobbin 22. The traverse drum 24 is rotatably driven by a traverse drum drive motor (roller drive source) 41 illustrated in FIG. 2. The presence/absence of rotation, the rotation speed, and the like of the traverse drum drive motor 41 are controlled by the control section 50. When the traverse drum 24 is rotatably driven, the winding bobbin 22 and the package 30 are rotated accompanying the rotation of the traverse drum 24. The yarn 20 stored in the yarn storage device 19, to be described later, thus can be wound into the package 30.

[0049] A traverse groove 24a illustrated in FIG. 2 is formed on an outer peripheral surface of the traverse drum 24, and the yarn 20 can be traversed at a predetermined width by the traverse groove 24a. According to such a configuration, the yarn 20 can be wound around the winding bobbin 22 while traversing, and the package 30 having a predetermined shape can be formed.

[0050] Furthermore, a traverse drum rotation sensor 42 is attached to the traverse drum 24. The traverse drum rotation sensor 42 is configured as, for example, a rotary encoder, and outputs the pulse signal to the control section 50 each time the traverse drum 24 rotates a predetermined angle. The control section 50 can calculate the rotation speed of the traverse drum 24 by measuring the number of pulses per time.

[0051] In the winding unit 2, 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 yarn monitoring device 17, an upper yarn pull-out section 18, and the yarn storage device 19 are arranged in this order from the yarn supplying bobbin supporting section 7 toward the winding section 8 in the yarn travelling path between the yarn supplying bobbin supporting section 7 and the winding section 8.

[0052] The unwinding assisting device 10 brings a movable member 10a into contact with a balloon formed at the upper part of the yarn supplying bobbin 21 when the yarn 20 unwound from the yarn supplying bobbin 21 is swung. The size of the balloon thus can be appropriately controlled, and the unwinding of the yarn 20 can be assisted.

[0053] The lower yarn blow-up section 11 is an air sucker device arranged between the yarn supplying bobbin supporting section 7 and the yarn joining device 14, and feeds the lower yarn from the yarn supplying bobbin 21 toward the yarn joining device 14 when replacing the yarn supplying bobbin 21.

[0054] The gate type tension applying device 12 applies a predetermined tension on the travelling yarn 20. The gate type tension applying device 12 of the present embodiment is a gate type tension applying device in which movable comb teeth are arranged with respect to fixed comb teeth. The movable comb teeth can be swung by a rotary solenoid so that the movable comb teeth are engaged with or released from the fixed comb teeth. In place of the gate type tension applying device 12, for example, a disc type tension applying device may be

arranged.

[0055] The upper yarn catching section 13 is arranged between the yarn joining device 14 and the yarn supplying bobbin supporting section 7. The upper yarn catching section 13 is connected to a negative pressure source (not illustrated), and is able to generate a suction airflow at the time of the yarn joining operation.

[0056] The yarn trap 15 is arranged between the yarn joining device 14 and the yarn storage device 19. A 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. The yarn trap 15 is connected to the negative pressure source (not illustrated) and generates a suction airflow at the distal end to suck and remove contaminants such as fly waste attached to the travelling yarn 20.

[0057] The yarn monitoring device 17 is configured to detect a yarn defect such as a slub by monitoring the yarn thickness of the yarn 20. When a yarn defect is detected, the yarn monitoring device 17 transmits a signal instructing the cutting and the removal of the relevant yarn defect to the cutter 16. The cutter 16 is arranged in proximity to the yarn monitoring device 17 to immediately cut the yarn 20 in response to the signal.

[0058] The yarn joining device 14 joins the disconnected lower yarn from the yarn supplying bobbin 21 and upper yarn from the yarn storage device 19 after the yarn defect is detected by the yarn monitoring device 17 and the yarn 20 is cut by the cutter 16, after the yarn 20 unwound from the yarn supplying bobbin 21 is broken, after the yarn supplying bobbin 21 is replaced, and the like. The yarn joining device 14 may be a type that uses fluid such as compressed air or a mechanical-type.

[0059] The upper yarn pull-out section 18 is an air sucker device arranged immediately upstream of the yarn storage device 19, and is configured to feed the upper yarn from the yarn storage device 19 toward the yarn guiding pipe 36 with compressed air.

[0060] When carrying out the yarn joining operation, the upper yarn from the yarn storage device 19 is fed to the yarn guiding pipe 36 by the upper yarn pull-out section 18. The yarn guiding pipe 36 discharges the fed upper yarn from the lower end portion. The yarn discharged by the yarn guiding pipe 36 is sucked by the upper yarn catching section 13. When the upper yarn is sucked by the upper yarn catching section 13, the upper yarn is taken out from a slit (not illustrated) formed along the longitudinal direction of the yarn guiding pipe 36 and is guided to the yarn joining device 14.

[0061] When carrying out the yarn joining operation, on the other hand, the lower yarn blow-up section 11 feeds the lower yarn toward the upper side. The lower yarn is sucked by the yarn trap 15. The lower yarn is thereby guided to the yarn joining device 14. The yarn joining device 14 carries out the yarn joining operation on the guided upper yarn and lower yarn. The disconnected yarns can be joined in the above manner.

[0062] The yarn storage device 19 is configured to temporarily store the yarn 20 unwound from the yarn supplying bobbin 21. As illustrated in FIG. 1, the yarn storage device 19 includes a storage roller 61, a storage roller drive motor 62, and an annular member 63 as main components.

[0063] The storage roller 61 is formed as a substantially cylindrical member, and is configured to store the yarn 20 by winding the yarn 20 around the outer peripheral surface thereof. The storage roller drive motor 62 is configured to rotatably drive the storage roller 61 with a center axis line thereof as the center. The operation of the storage roller drive motor 62 is controlled by the control section 50.

[0064] Since a prescribed amount of the yarn 20 is stored in the yarn storage device 19, even if the unwinding of the yarn 20 from the yarn supplying bobbin 21 is interrupted for some reason (e.g., when carrying out the yarn joining operation), the winding unit 2 can wind the yarn 20 stored in the yarn storage device 19. Thus, even if the unwinding of the yarn 20 is interrupted, the winding of the yarn 20 to the package 30 can be continued.

[0065] The annular member 63 is arranged in proximity to the end on the downstream side of the storage roller 61. The yarn 20 stored in the yarn storage device 19 is pulled out toward the downstream through a space between the annular member 63 and the surface of the storage roller 61. With the above configuration, an appropriate tension can be applied on the yarn 20 unwound from the storage roller 61, and hence the unwinding of the yarn 20 from the yarn storage device 19 can be stabilized.

[0066] A lower limit sensor 64 and an upper limit sensor 65 are attached in proximity to the storage roller 61. The lower limit sensor 64 detects whether or not the amount of yarn 20 greater than or equal to a predetermined lower limit amount is stored on the storage roller 61. The amount of yarn 20 greater than or equal to the predetermined lower limit amount is the yarn amount required until the control section 50 controls the rotation speed of the traverse drum 24 or the storage roller 61 and the storage amount of the storage roller 61 starts to increase when the amount of yarn is less than the lower limit amount detected by the lower limit sensor 64, and is appropriately determined by the yarn type and the like. The upper limit sensor 65 detects whether or not the amount of yarn 20 greater than or equal to a predetermined upper limit amount is stored on the storage roller 61. The detection results of the lower limit sensor 64 and the upper limit sensor 65 are output to the control section 50. The lower limit sensor 64 and the upper limit sensor 65 configure a storage amount detecting section.

[0067] Next, a description will be made on a control of adjusting the storage amount of the storage roller 61 by controlling the rotation speed of the traverse drum 24 with reference to FIG. 3.

[0068] First, the control section 50 determines whether or not there is a possibility that the storage amount of the yarn storage device 19 is zero (S101). This determination is based on whether or not the storage amount of the

yarn storage device 19 is smaller than or equal to the lower limit amount based on the detection result of the lower limit sensor 64, for example. When determining that there is a possibility the storage amount of the yarn storage device 19 is zero, the control section 50 decelerates the traverse drum drive motor 41 and stops the traverse drum 24 to prevent the storage amount of the yarn storage device 19 from being zero (S102).

[0069] When the traverse drum 24 is decelerated as described above, slip (hereinafter referred to as package slip) may occur between the traverse drum 24 and the package 30. In the present embodiment, since the traverse drum 24 is decelerated by carrying out the deceleration control described below, the package slip can be suppressed.

[0070] Since the winding unit 2 includes the yarn storage device 19, the control section 50 stops the traverse drum 24 in a state where the yarn 20 is connected between the yarn storage device 19 and the winding section 8. Furthermore, the control section 50 stops the traverse drum 24 with the traverse drum 24 and the package 30 in contact with each other and without separating the traverse drum 24 from the package 30.

[0071] When determining that there is no possibility (or there is low possibility) that the storage amount of the yarn storage device 19 is zero in the determination of step S101, the control section 50 determines whether or not the storage amount of the yarn storage device 19 is greater than or equal to an upper limit amount based on the detection result of the upper limit sensor 65 (S103).

[0072] If the yarn 20 is not detected by the upper limit sensor 65, the control section 50 determines that the storage amount of the yarn storage device 19 is smaller than the upper limit amount. In this case, the reduction of the storage amount of the yarn storage device 19 needs to be prevented, and thus the control section 50 rotates the traverse drum 24 at a first rotation speed, which is a relatively low speed (S104). When lowering the rotation speed of the traverse drum 24 to the first rotation speed, the control section 50 carries out the deceleration control to be described later.

[0073] When determining that the yarn 20 is detected by the upper limit sensor 65 in the determination of step S103, the control section 50 determines that the storage amount of the yarn storage device 19 is greater than or equal to the upper limit amount. In this case, the storage amount of the yarn storage device 19 is sufficient, and hence the control section 50 rotates the traverse drum 24 at a second rotation speed, which is a relatively high speed (S105). The control section 50 stops the rotation of the traverse drum 24 or changes the rotation speed based on the storage amount of the yarn storage device 19, and then again carries out the processes of step S101 and subsequent steps. Thus, the storage amount can be adjusted by controlling the traverse drum 24 in accordance with the storage amount of the yarn storage device 19.

[0074] Next, a description will be made on the deceleration control carried out by the control section 50 with reference to FIGS. 4 to 6.

[0075] The control section 50 calculates the rotation speed (peripheral speed of the package 30) of the package 30 of a predetermined period, and a rotation speed of the traverse drum 24 (peripheral speed of the traverse drum 24) before carrying out the deceleration control (S201). The rotation speed of the package 30 is calculated based on the detection result of the package rotation sensor 47. The rotation speed of the traverse drum 24 is calculated based on the detection result of the traverse drum rotation sensor 42. The rotation speed of the traverse drum 24 may be calculated based on the command value of the control section 50. The predetermined period is arbitrary, and for example, is one cycle of a disturb control.

[0076] Next, the control section 50 calculates a reference rotation ratio based on the acquired rotation speed of the package 30 and the rotation speed of the traverse drum 24. The reference rotation ratio is a reference value for estimating the package slip described above. Specifically, the control section 50 first calculates an average value of the rotation speeds of the package 30 and the traverse drum 24 in the predetermined period. A ratio (reference rotation ratio) of the average rotation speed of the package 30 and the average rotation speed of the traverse drum 24 (S202) is then calculated and updated.

[0077] Before carrying out the deceleration control, the package slip greater than the package slip within a tolerable range generated for the driven rotation does not occur (peripheral speed is substantially equal). Thus, it can be assumed that, when the ratio of the rotation speeds of the package 30 and the traverse drum 24 matches the reference rotation ratio after the start of the deceleration control, the package slip does not occur. In the package 30, the diameter increases with the winding of the yarn 20, and thus the peripheral speed becomes larger with the advancement of the winding even at the same rotation speed. In view of this, the reference rotation ratio is periodically calculated and continuously updated before carrying out the deceleration control in the present embodiment.

[0078] The control section 50 determines whether or not the starting condition of the deceleration control is satisfied while carrying out the process of updating the reference rotation ratio (S203). As described above, when the storage amount of the yarn storage device 19 is reduced, the starting condition of the deceleration control is satisfied. For example, the starting condition of the deceleration control is satisfied even in a case where the yarn joining operation cannot be carried out. The case where the yarn joining operation cannot be carried out includes a case where a trouble occurs in the yarn joining device 14, a case where the control section 50 and the yarn joining device 14 cannot communicate, a case where the yarn supplying bobbin supporting section 7 does not support the yarn supplying bobbin 21, and the like. In such cases, the yarn joining operation cannot be

carried out, and hence the storage amount of the yarn storage device 19 cannot be increased. Furthermore, even in the case where the yarn joining operation can be carried out, the deceleration control is carried out, and the winding of the package 30 may be continued at the low speed until the yarn joining operation is completed.

[0079] When determining that the starting condition of the deceleration control is satisfied, the control section 50 stops the update of the reference rotation ratio, and outputs a set value of the deceleration of the traverse drum 24 (reduction amount of rotation speed or peripheral speed per unit time) (S204). The set value may be a value input by the operator in advance, or may be a value stored in advance in the control section 50, and the like.

[0080] In the process of step S204, calculation can be performed based on the package diameter and the like instead of using the value set in advance. The package diameter is calculated based on the detection result of the swing angle sensor 46. The control section 50 reduces the initial value of the deceleration as the package diameter is great (i.e., gradually reduces the rotation speed). The inertia force is greater as the package diameter is greater, and thus the package slip easily occurs. The initial value of the deceleration may be continuously changed depending on the package diameter, and may be changed in a step-wise manner.

[0081] The control section 50 then controls the traverse drum drive motor 41 using the output set value of the deceleration, to start the deceleration of the traverse drum 24 (S205). Next, the control section 50 calculates a slip amount of the package from a difference in the peripheral speeds of the package 30 and the traverse drum 24 based on the reference rotation ratio. The control section 50 determines whether or not the calculated package slip amount is greater than or equal to an upper limit amount (upper limit slip amount) set in advance (S206). When the calculated package slip amount is smaller than the upper limit slip amount, in particular, the control section 50 does not carry out the control of changing the deceleration. When the calculated package slip amount is greater than or equal to the upper limit slip amount, the control section 50 detects which one of the peripheral speeds of the package 30 and the traverse drum 24 is greater (S207).

[0082] Immediately after the deceleration control, the package 30 may not follow deceleration of the traverse drum 24, and the package slip may occur. In this case, the peripheral speed of the package 30 is slower than that of the traverse drum 24. Therefore, in this case (i.e., Yes in S207), the control section 50 reduces the deceleration of the traverse drum 24 (more gradually decelerates the traverse drum 24, S208).

[0083] Next, the control section 50 determines whether or not the deceleration of the traverse drum 24 is smaller than the lower limit amount defined in advance (S209). When the deceleration of the traverse drum 24 is greater than or equal to the lower limit amount, the control section 50 determines whether or not the rotation speed of the traverse drum 24 has reached the target rotation speed (e.g., 0, first rotation speed, second rotation speed) (S211). When determining that the rotation speed of the traverse drum 24 has not reached the target rotation speed, the control section 50 again carries out the processes of step S206 and the subsequent steps.

[0084] When the control section 50 carries out the process of step S208 over several times, the deceleration of the traverse drum 24 is lowered. The deceleration of the traverse drum 24 thus may become lower than the lower limit amount. When the deceleration of the traverse drum 24 is lowered to an amount smaller than the lower limit amount, time is required to stop the traverse drum 24 and the storage amount of the yarn storage device 19 may be greatly reduced. Thus, in this case (i.e., Yes in step S209), the control section 50 activates the package brake 80 (S210). Thus, even if the package 30 cannot follow the deceleration of the traverse drum 24, the package 30 can be more rapidly decelerated.

[0085] When the package brake 80 is activated, the peripheral speed of the package 30 is greatly reduced, and hence the peripheral speed of the package 30 may become smaller than the peripheral speed of the traverse drum 24. In this case (i.e., No in S207), the control section 50 increases the deceleration of the traverse drum 24 (more rapidly decelerates the traverse drum 24, S212).

[0086] An upper limit amount is set in advance for the deceleration of the traverse drum 24, and the control section 50 determines whether or not the deceleration of the traverse drum 24 has reached the upper limit amount of the deceleration of the traverse drum 24 (S213). When the deceleration of the traverse drum 24 exceeds the upper limit amount and determination is made that the package brake 80 is under activation (S214), the control section 50 releases the package brake 80 (S215). Thereafter, the control section 50 determines whether or not the rotation speed of the traverse drum 24 has reached the target rotation speed (S211). When the rotation speed of the traverse drum 24 has not reached the target rotation speed, the control section 50 carries out the processes of S206 and the subsequent steps. Therefore, the activation and release of the package brake 80 may be repeated.

[0087] By repeatedly carrying out the above control, the traverse drum 24 can be decelerated in a short period of time while adjusting such that the difference in the peripheral speeds of the traverse drum 24 and the package 30 (i. e. , package slip amount) becomes smaller than or equal to a predetermined value. Furthermore, when the storage amount of the yarn storage device 19 is increased after the rotation speed of the traverse drum 24 has reached the target rotation speed, the control section 50 again resumes the rotation of the traverse drum 24 or accelerates the rotation to a new target rotation speed.

[0088] Next, a description will be briefly made on the change in the peripheral speeds of the package 30 and

the traverse drum 24 when the deceleration control is carried out, using the graph with reference to FIG. 6.

[0089] As described above, the control section 50 calculates and updates the reference rotation ratio (S202). In the example illustrated in FIG. 6, the control section 50 updates the reference rotation ratio calculated using a predetermined period (time T1' to time T2') to the reference rotation ratio obtained using the subsequent period (time T1 to time T2).

[0090] Thereafter, the starting condition of the deceleration control is assumed to be satisfied at time T3. In this case, the reference rotation ratio obtained in the latest predetermined period (time T1 to time T2) is used. First, the package 30 cannot follow the deceleration of the traverse drum 24, and thus the peripheral speed is greater in the package 30. Thus, the peripheral speed of the traverse drum 24 is lowered by carrying out the process of step S208.

[0091] Thereafter, the control section 50 activates the package brake 80 at the timing (time T4) at which the deceleration of the traverse drum 24 becomes smaller than the lower limit amount (S210). The package 30 is thereby rapidly decelerated. The package brake 80 is released at the timing (time T5) at which the deceleration of the package 30 exceeds the deceleration of the traverse drum 24 (S207). Thereafter, the rotation speed of the traverse drum 24 reaches the target rotation speed, and the deceleration control is completed.

[0092] As described above, the automatic winder of the present embodiment includes the yarn supplying bobbin supporting section 7, the yarn storage device 19, the winding section 8, and the control section 50. The yarn supplying bobbin supporting section 7 can supply the yarn 20. The yarn storage device 19 winds and temporarily stores the yarn 20 from the yarn supplying bobbin 21 supported by the yarn supplying bobbin supporting section 7. The winding section 8 pulls out the yarn 20 from the yarn storage device 19, and winds the yarn 20 around the winding bobbin 22 to form the package 30. The control section 50 controls the winding section 8. The winding section 8 includes the rotation holders 44, 45, the package rotation sensor 47, the traverse drum 24, and the traverse drum drive motor 41. The rotation holders 44, 45 rotatably support the package 30. The package rotation sensor 47 detects the rotation amount of the package 30. The traverse drum 24 rotates while making contact with the package 30 supported by the rotation holders 44, 45 to rotate the package 30. The traverse drum drive motor 41 rotatably drives the traverse drum 24. The control section 50 carries out the deceleration control of decelerating the traverse drum 24 while adjusting such that the difference in the peripheral speeds of the package 30 and the traverse drum 24 becomes smaller than or equal to a predetermined value in a state where the yarn 20 is connected between the yarn storage device 19 and the winding section 8 and in a state where the package 30 and the traverse drum 24 are brought into contact with each other based on the detection result of the package rotation sensor 47 and the rotation speed of the traverse drum 24.

[0093] The package slip can be suppressed without gradually decelerating the traverse drum 24. Therefore, the reduction in the storage amount of the yarn storage device 19 can be suppressed while preventing the occurrence of stitching.

[0094] In the automatic winder of the present embodiment, the control section 50 carries out the deceleration control and stops the traverse drum 24 with the yarn 20 connected between the yarn storage device 19 and the winding section 8, and the traverse drum 24 and the package 30 brought into contact with each other.

[0095] Thus, even when stopping the package 30, the package slip (furthermore, the occurrence of stitching) can be prevented.

[0096] Furthermore, in the automatic winder of the present embodiment, the control section 50 resumes the winding of the yarn 20 to the package supported by the rotation holders 44, 45 after stopping the traverse drum 24.

[0097] The occurrence of the stitching thus can be prevented by stopping the package 30 with the deceleration control of the present invention, and thus the winding of the package 30 can be resumed without any problem.

[0098] In the automatic winder of the present embodiment, the control section 50 carries out the deceleration control when the amount of yarn 20 stored in the yarn storage device 19 becomes smaller than a predetermined amount (lower limit amount of the lower limit sensor 64).

[0099] The package slip can be suppressed even when recovering the reduced storage amount.

[0100] In the automatic winder of the present embodiment, the control section 50 calculates a reference value (reference rotation ratio) of a difference in the peripheral speeds of the package 30 and the traverse drum 24 based on the rotation speed of the traverse drum 24 and the detection result of the package rotation sensor 47 in a predetermined period before the start of the deceleration control, and carries out the deceleration control using the reference rotation ratio.

[0101] Thus, the package slip amount during the deceleration control can be easily estimated by using the ratio of the rotation speeds of the package 30 and the traverse drum 24 of before the deceleration control (i.e., before the occurrence of the package slip).

[0102] The automatic winder of the present embodiment includes the swing angle sensor 46 adapted to detect the amount of the yarn 20 wound into the package 30. The control section 50 may determine an initial value of the deceleration of the deceleration control in view of the detection result of the swing angle sensor 46.

[0103] Thus, the initial value of the deceleration can be determined in view of the magnitude of the inertia force of the package 30, and thus the package slip can be more reliably suppressed.

[0104] The automatic winder of the present embodi-

ment includes the package brake 80 that makes contact with the winding bobbin 22 and applies brake force on the package 30. The control section 50 activates the package brake 80 based on the deceleration of the traverse drum 24 to decelerate the package 30.

[0105] The rotation speed of the package 30 thus can be forcibly lowered, and hence the rotation speed of the package 30 can be brought close to a desired value in a short period of time.

[0106] The preferred embodiment of the present invention has been described above, but the above-described configuration may be modified as below.

[0107] In the above-described embodiment, the initial value of the deceleration is determined based on the package diameter at the start of the deceleration control, but the initial value may, for example, be determined based on the package rotation speed at the start of the deceleration control. Specifically, since the inertia force becomes larger as the rotation speed of the package 30 is faster, and the package slip easily occurs, the initial value of the deceleration is preferably reduced (i.e., gradually decelerates the traverse drum 24). In view of the package diameter and the rotation speed of the package 30, not only the initial value, but also the amount of change in the deceleration may be controlled.

[0108] In the above-described embodiment, the traverse drum drive motor 41 is controlled by the control section 50 for carrying out a versatile control, but may be controlled by a motor control section arranged separately from the control section 50. In the above-described embodiment, the deceleration control is carried out by the control section 50 arranged for each winding unit 2, but the process carried out by the deceleration control may be partially or entirely carried out by the machine control device.

[0109] In the above-described embodiment, the yarn amount of the package 30 is detected by the swing angle sensor 46 adapted to detect the swing angle of the cradle 23, but the yarn amount of the package 30 may be detected with a sensor adapted to detect the length of the wound yarn 20.

[0110] In the above-described embodiment, the traverse drum rotation sensor 42 and the package rotation sensor 47 have a configuration of outputting the pulse signal corresponding to the rotation to the control section 50, but the rotation speed may be calculated and output to the control section 50.

[0111] In the above-described embodiment, an example of supplying the yarn supplying bobbin 21 by the magazine type bobbin supplying device 26 has been described, but the yarn winding device including the tray type bobbin supplying device may be adopted.

[0112] The configuration of the present invention is not limited to the automatic winder, and can also be applied to other types of yarn winding devices including the yarn storage device and the contact roller.

[0113] In the above-described embodiment, the control section 50 activates the package brake 80 based on the deceleration of the traverse drum 24 to decelerate the package 30, but this is not the sole case. When the amount of yarn stored in the yarn storage device 19 becomes smaller than or equal to the lower limit amount as detected by the lower limit sensor 64 configuring the storage amount detecting section, the control section 50 determines that there is a possibility the storage amount of the yarn storage device 19 is zero, and activates the package brake 80 and decelerates and stops the package 30 to prevent the storage amount of the yarn storage device 19 from being zero. In this case, preventing the storage of the yarn storage device 19 from being zero is prioritized over the control of the difference in the peripheral speeds of the traverse drum 24 and the package 30. Thus, the difference in the peripheral speeds of the traverse drum 24 and the package 30 (package slip amount) may become greater than or equal to the upper limit slip amount. When the package slip amount becomes greater than or equal to the upper limit slip amount, the control section 50 suddenly stops the package 30 by the package brake 80 and activates the alarm warning at the same time, and suggests the possibility of the occurrence of stitching to the operator. The operator thus can find the occurrence of the stitching at an early stage, unwind the yarn in which the stitching has occurred, and rewind the yarn into a package without the stitching.

[0114] Furthermore, when the winding of the package is stopped as the amount of yarn stored in the yarn storage device 19 becomes smaller than or equal to the lower limit amount as detected by the lower limit sensor 64 configuring the storage amount detecting section, the amount of yarn stored in the yarn storage device 19 becomes smaller than or equal to the lower limit amount when resuming the winding the next time. In this case, when the next winding operation is started, that is, when the winding of the yarn to the package and the winding of the yarn 20 from the yarn supplying bobbin 21 by the yarn storage device 19 are started, the winding speed of the yarn to the package is set to low speed (e.g., 200 to 300 m/min) until the amount of yarn stored in the yarn storage device 19 becomes greater than or equal to the lower limit amount. The deficiency of storage yarn caused by the winding of the yarn to the package thus can be prevented.

Claims

1. A yarn winding device comprising:

a yarn supplying section (7) adapted to supply a yarn (20);
a yarn storage device (19) adapted to pull out the yarn (20) from the yarn supplying section (7) and temporarily store the yarn (20) ;
a package forming section (8) adapted to pull out the yarn (20) from the yarn storage device

(19) and wind the yarn (20) around a winding bobbin (22) to form a package (30); and
a control section (50) adapted to control the package forming section (8),
wherein the package forming section (8) includes

a package supporting section (44, 45) adapted to rotatably support the package (30),
a package rotation detecting section (47) adapted to detect a rotation amount of the package (30),
a contact roller (24) adapted to rotate while making contact with the package (30) supported by the package supporting section (44, 45) to rotate the package (30), and
a roller drive source (41) adapted to rotatably drive the contact roller (24), **characterized in that**

the control section (50) carries out a deceleration control of decelerating the contact roller (24) while adjusting such that a difference in peripheral speeds of the package (30) and the contact roller (24) is smaller than or equal to a predetermined value in a state where the yarn (20) is connected between the yarn storage device (19) and the package forming section (8) and in a state where the package (30) and the contact roller (24) are brought into contact with each other based on a detection result of the package rotation detecting section (47) and a rotation speed of the contact roller (24).

2. The yarn winding device according to claim 1, **characterized in that**
the control section (50) carries out the deceleration control to stop the contact roller (24) in a state where the yarn (20) is connected between the yarn storage device (19) and the package forming section (8) and in a state where the contact roller (24) and the package (30) are brought into contact with each other.

3. The yarn winding device according to claim 1 or 2, **characterized in that**
after stopping the contact roller (24), the control section (50) resumes the winding of the yarn (20) to the package (30) supported by the package supporting section (44, 45).

4. The yarn winding device according to any one of claims 1 to 3, **characterized in that**
the yarn storage device (19) includes a storage roller (61) adapted to wind and store the yarn (20), and
a storage amount detecting section (64, 65) adapted to detect an amount of yarn (20) wound around the storage roller (61), and
the control section (50) carries out the deceleration control when the storage amount detecting section (64, 65) detects that the amount of yarn (20) stored in the yarn storage device (19) is smaller than a predetermined amount.

5. The yarn winding device according to any one of claims 1 to 4, **characterized in that**
the control section (50) calculates a reference value of a difference in peripheral speeds of the package (30) and the contact roller (24) based on the rotation speed of the contact roller (24) and the detection result of the package rotation detecting section (47) in a predetermined period before start of the deceleration control, and carries out the deceleration control using the reference value.

6. The yarn winding device according to any one of claims 1 to 5, **characterized by** further comprising
a package yarn (20) amount detecting section (46) adapted to detect the amount of yarn wound into the package (30),
wherein the control section (50) determines a set value of the deceleration control in view of the detection result of the package yarn amount detecting section (46).

7. The yarn winding device according to any one of claims 1 to 6, **characterized by** further comprising
a package brake (80) adapted to make contact with the winding bobbin (22) or the package (30) and to apply brake force to the package (30),
wherein the control section (50) activates the package brake (80) based on deceleration of the contact roller (24) to decelerate the package (30).

8. The yarn winding device according to claim 4, **characterized by** further comprising
a package brake (80) adapted to make contact with the winding bobbin (22) or the package (30) and to apply brake force to the package (30),
wherein the control section (50) activates the package brake (80) to decelerate the package (30) when the storage amount detecting section (64, 65) detects that the amount of yarn (20) wound around the storage roller (61) is smaller than or equal to a predetermined amount.

9. The yarn winding device according to claim 8, **characterized in that**
the control section (50) calculates a difference in peripheral speeds of the package (30) and the contact roller (24) based on the rotation speed of the contact roller (24) and the detection result of the package rotation detecting section (47) while activating the package brake (80) and decelerating the package (30) when the storage amount detecting section (64, 65) detects that the amount of yarn (20) wound

around the storage roller (61) is smaller than or equal to a predetermined amount, and immediately stops the rotation of the package (30) by the package brake (80) and produces an alarm warning when the difference in the peripheral speeds is greater than or equal to a predetermined value.

10. The yarn winding device according to any one of claims 1 to 9, **characterized in that**
the yarn supplying section (7) is a yarn supplying bobbin supporting section (7) adapted to support a yarn supplying bobbin (21) around which a yarn (20) spun by a spinning machine is wound, and
the contact roller (24) is a traverse drum (24) provided with a traverse groove (24a) for traversing a yarn (20) wound into the package (30).

11. The yarn winding device according to any one of claims 1 to 10, **characterized by** further comprising:

a yarn joining device (14) arranged between the yarn supplying section (7) and the yarn storage device (19), and adapted to join a disconnected yarn (20) when the yarn (20) is disconnected; and
the control section (50) performs the deceleration control when detecting that the yarn joining operation by the yarn joining device (14) is not possible.

12. A package decelerating method comprising:

a package rotation detecting step of detecting a rotation amount of a package (30) formed by winding a yarn (20) around a winding bobbin (22) with a package forming section (8); and
a decelerating step of decelerating the contact roller (24) **characterized by** adjusting such that a difference in peripheral speeds of the package (30) and the contact roller (24) is smaller than or equal to a predetermined value in a state where the yarn (20) is connected between the package forming section (8) and a yarn storage device (19), which is adapted to wind the yarn (20) from a yarn supplying section (7) and temporarily store the yarn (20), and in a state where the package (30) and the contact roller (24) are brought into contact with each other based on a detection result of the package rotation detecting step and a rotation speed of the contact roller (24) adapted rotate while making contact with the package (30) to rotate the package (30).

FIG. 1

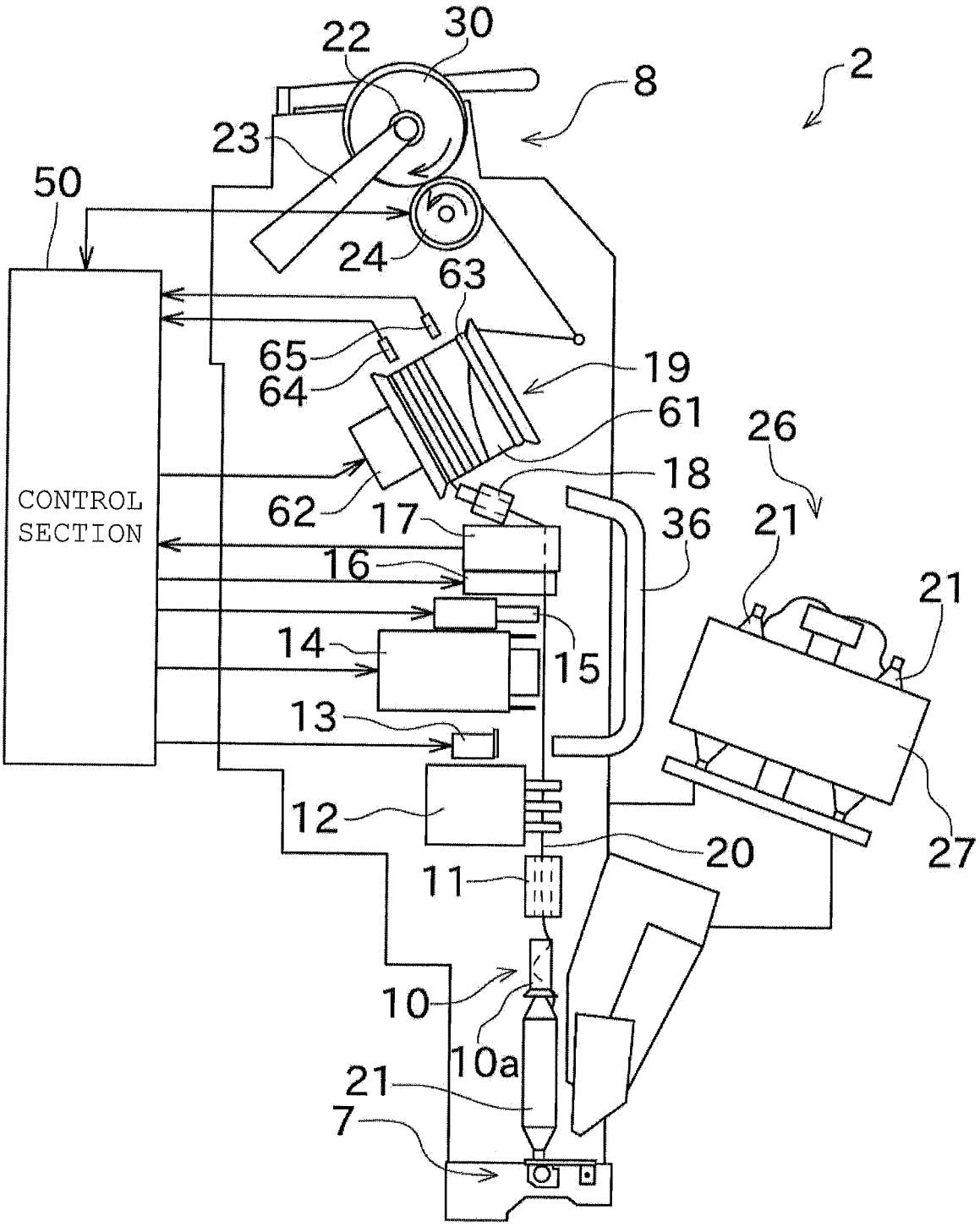

22
30
2
8
23
50
24
63
65
64
19
61
26
18
CONTROL
SECTION
62
17
36
21
16
21
14
15
13
12
20
27
11
10
10a
21
7

FIG. 2

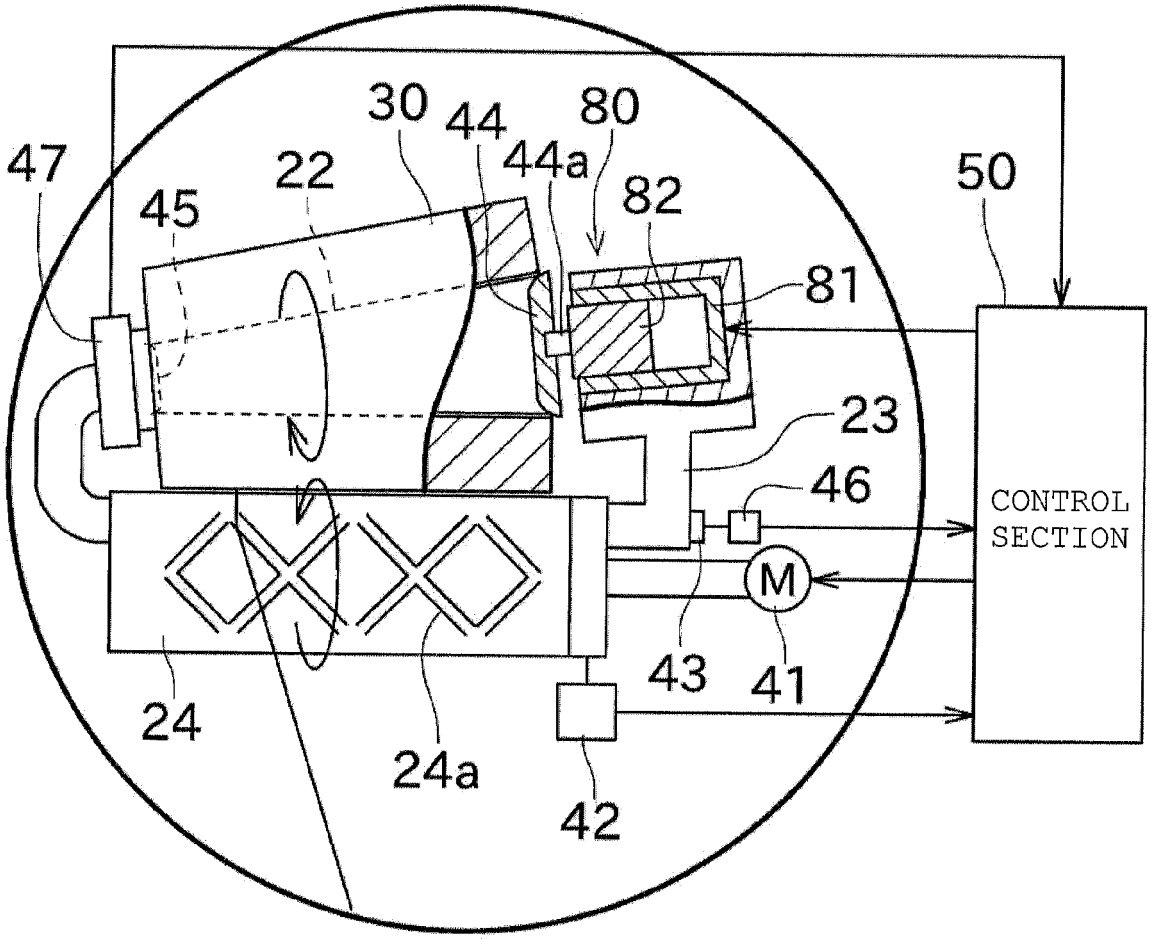

47
45
22
30
44
44a
80
82
81
50
23
46
CONTROL SECTION
M
43
41
24
24a
42

FIG. 3

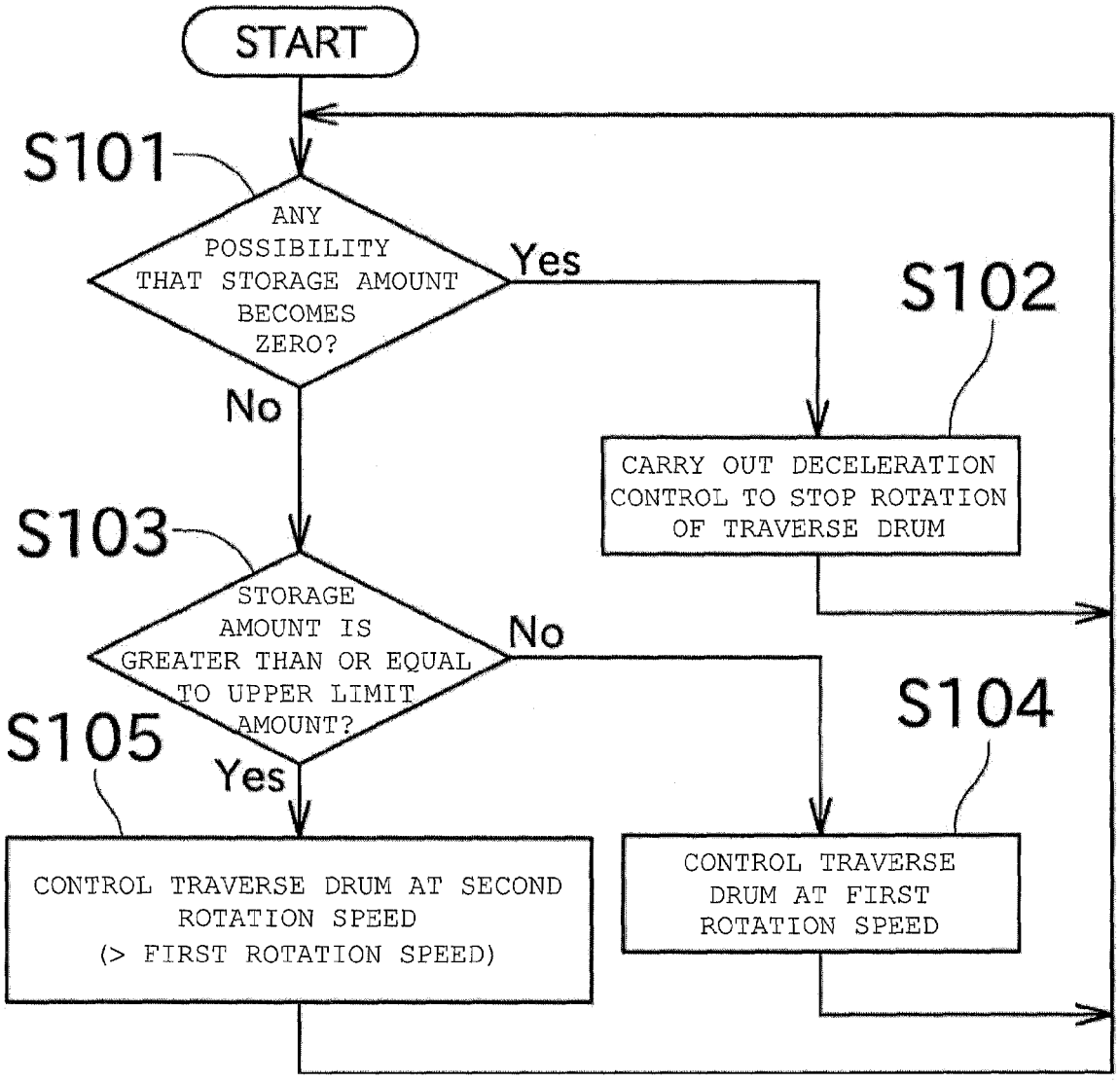

START
S101
ANY POSSIBILITY THAT STORAGE AMOUNT BECOMES ZERO?
Yes
No
S102
CARRY OUT DECELERATION CONTROL TO STOP ROTATION OF TRAVERSE DRUM
S103
STORAGE AMOUNT IS GREATER THAN OR EQUAL TO UPPER LIMIT AMOUNT?
No
Yes
S104
CONTROL TRAVERSE DRUM AT FIRST ROTATION SPEED
S105
CONTROL TRAVERSE DRUM AT SECOND ROTATION SPEED (> FIRST ROTATION SPEED)

FIG. 4

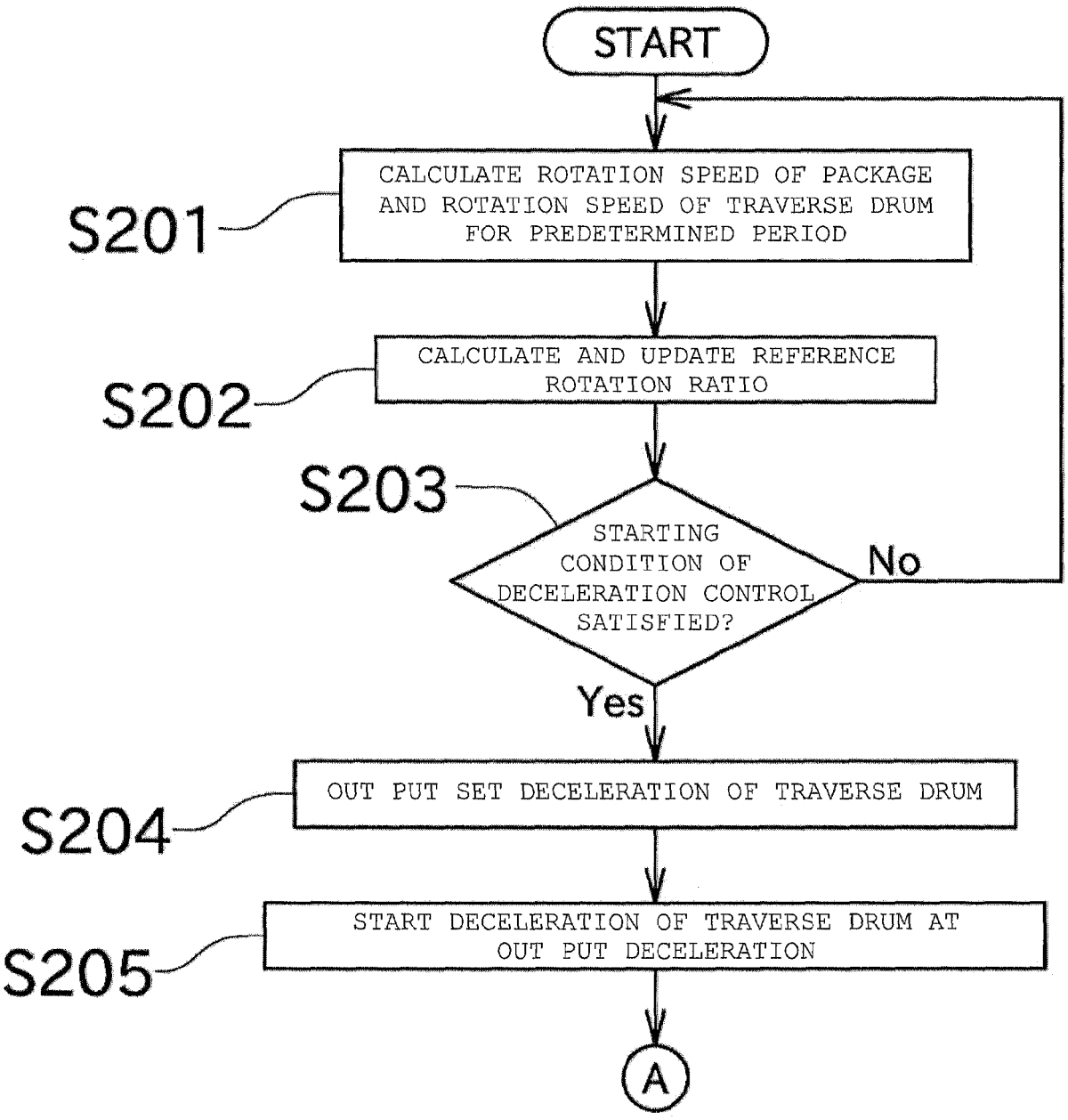

START
CALCULATE ROTATION SPEED OF PACKAGE AND ROTATION SPEED OF TRAVERSE DRUM FOR PREDETERMINED PERIOD
S201
CALCULATE AND UPDATE REFERENCE ROTATION RATIO
S202
S203
STARTING CONDITION OF DECELERATION CONTROL SATISFIED?
No
Yes
OUT PUT SET DECELERATION OF TRAVERSE DRUM
S204
START DECELERATION OF TRAVERSE DRUM AT OUT PUT DECELERATION
S205
A

FIG. 5

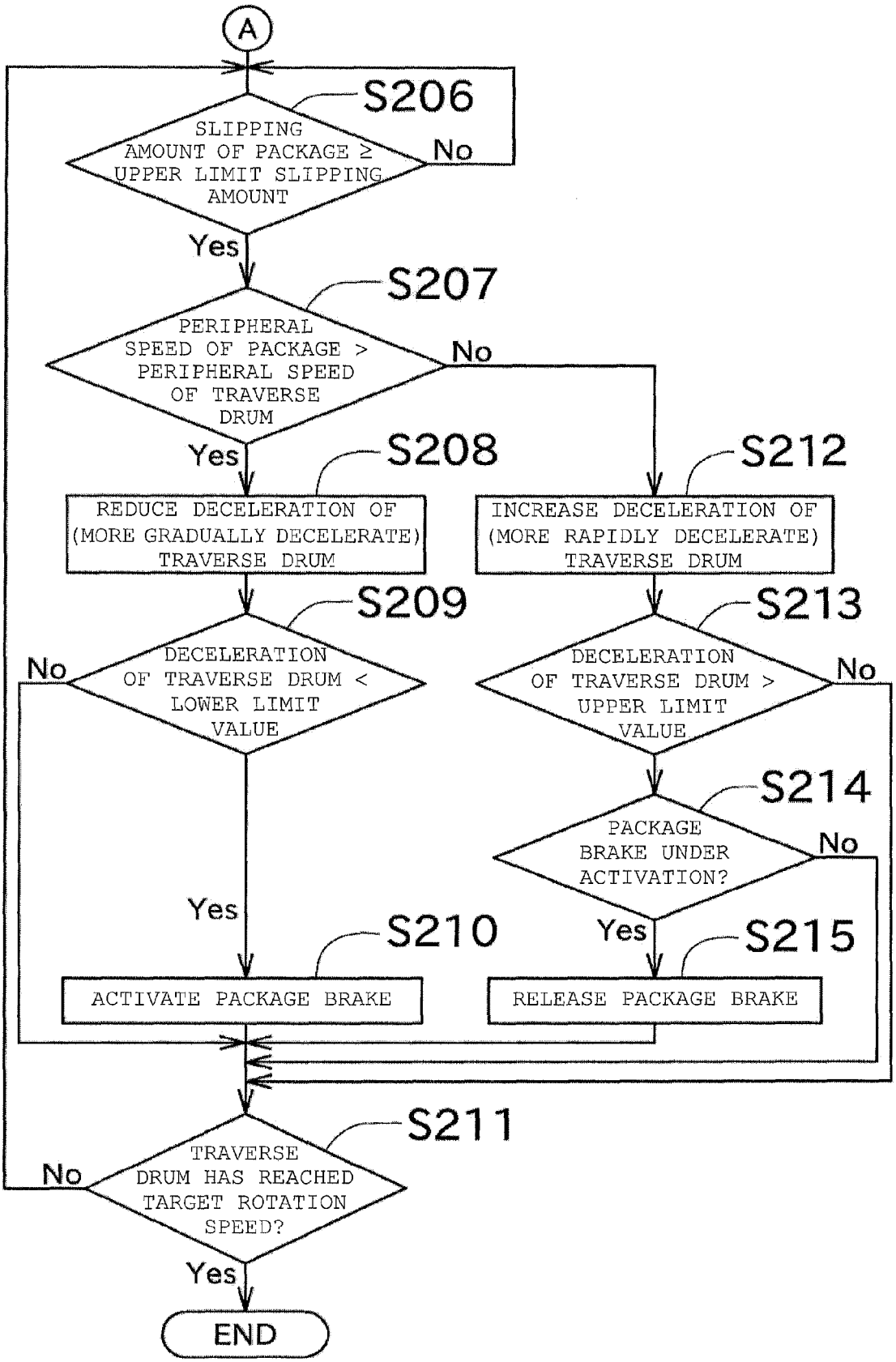
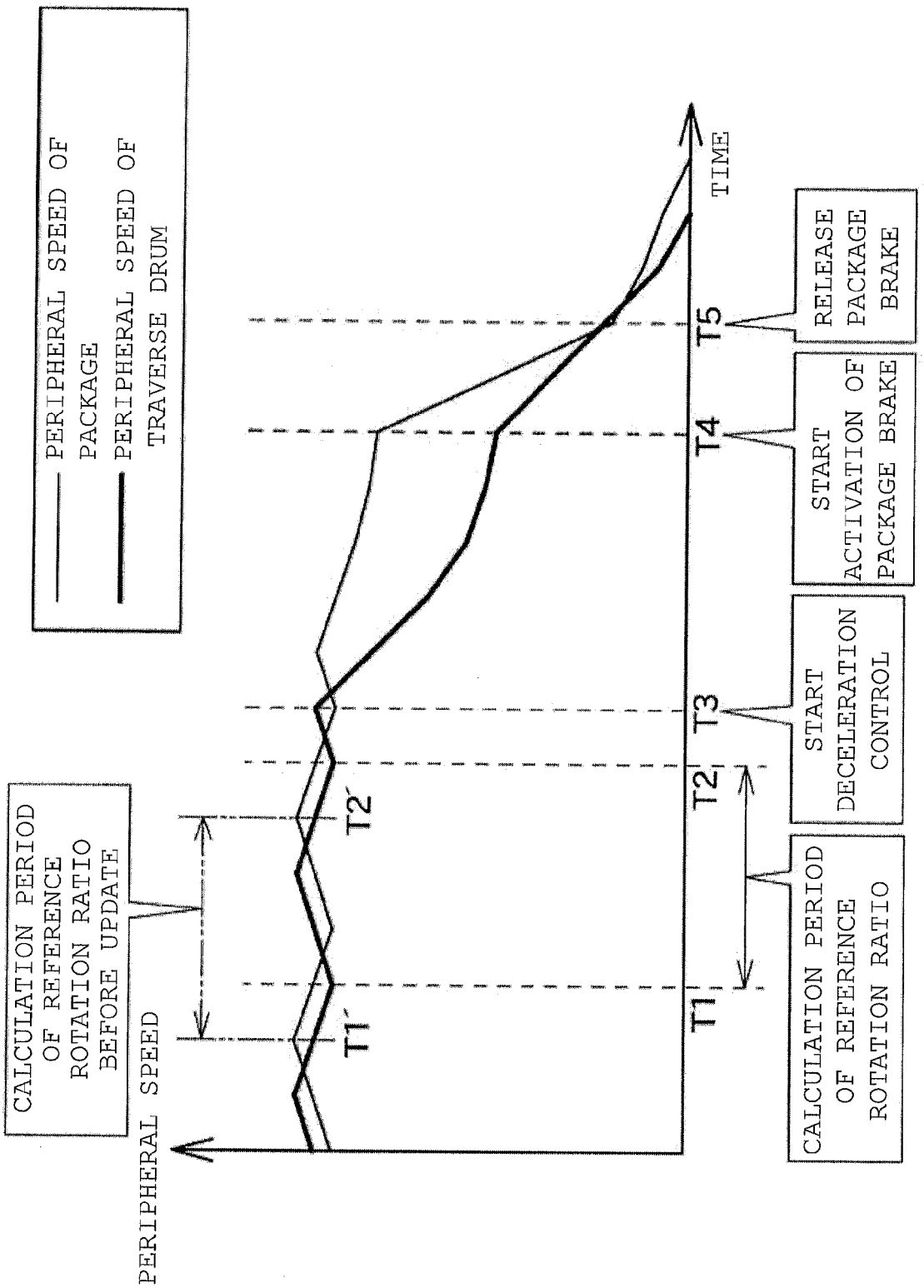

A
S206
SLIPPING AMOUNT OF PACKAGE ≥ UPPER LIMIT SLIPPING AMOUNT
No
Yes
S207
PERIPHERAL SPEED OF PACKAGE > PERIPHERAL SPEED OF TRAVERSE DRUM
No
Yes
S208
REDUCE DECELERATION OF (MORE GRADUALLY DECELERATE) TRAVERSE DRUM
S212
INCREASE DECELERATION OF (MORE RAPIDLY DECELERATE) TRAVERSE DRUM
S209
DECELERATION OF TRAVERSE DRUM < LOWER LIMIT VALUE
No
S213
DECELERATION OF TRAVERSE DRUM > UPPER LIMIT VALUE
No
S214
PACKAGE BRAKE UNDER ACTIVATION?
No
Yes
S210
ACTIVATE PACKAGE BRAKE
Yes
S215
RELEASE PACKAGE BRAKE
S211
TRAVERSE DRUM HAS REACHED TARGET ROTATION SPEED?
No
Yes
END

FIG. 6


PERIPHERAL SPEED OF PACKAGE
PERIPHERAL SPEED OF TRAVERSE DRUM
CALCULATION PERIOD OF REFERENCE ROTATION RATIO BEFORE UPDATE
PERIPHERAL SPEED
TIME
T1´
T2´
T1
T2
T3
T4
T5
CALCULATION PERIOD OF REFERENCE ROTATION RATIO
START DECELERATION CONTROL
START ACTIVATION OF PACKAGE BRAKE
RELEASE PACKAGE BRAKE

Europäisches Patentamt
European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 15 18 5097

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Y	DE 10 2009 007448 A1 (OERLIKON TEXTILE GMBH & CO KG [DE]) 5 August 2010 (2010-08-05) * paragraphs [0010], [0012] - [0020] *	1-4,7,8, 10-12	

A,D	JP H07 187506 A (SCHLAFHORST & CO W) 25 July 1995 (1995-07-25) & US 5 595 351 A (HAASEN ROLF [DE]) 21 January 1997 (1997-01-21) * claims 1-10 *	1-12	

			TECHNICAL FIELDS SEARCHED (IPC) B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	1 March 2016	Pussemier, Bart

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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L : document cited for other reasons

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 18 5097

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01-03-2016

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JP H07187506 A	25-07-1995	DE 4339217 A1	24-05-1995
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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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- JP H7187506 A **[0004] [0007]**