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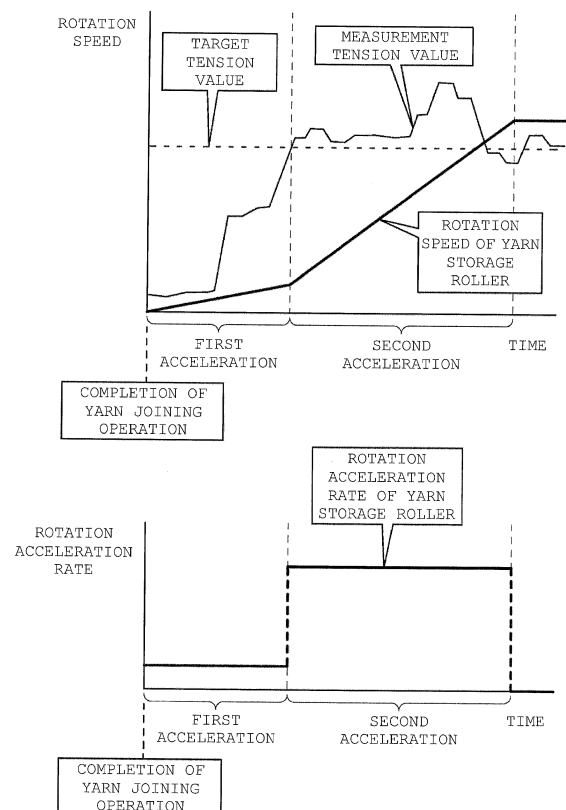
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(54) **YARN WINDING DEVICE AND TEXTILE MACHINE**

(57) A winding unit (2) includes a yarn supplying section (7), a yarn storage section (5), a package forming section (8), a yarn joining device (14), a tension applying section (12), and a control section (25). The yarn storage section (5) winds and stores a yarn (20) supplied by the yarn supplying section (7) around a yarn storage roller (32). The package forming section (8) pulls out the yarn (20) from the yarn storage section (5) and winds the pulled out yarn (20) to form a package (30). The yarn joining device (14) connects the yarns when the yarn (20) is disconnected between the yarn supplying section (7) and the yarn storage section (5). The tension applying section (12) is arranged between the yarn supplying section (7) and the yarn storage section (5), and is adapted to apply tension to the yarn (20). After completion of the yarn joining operation by the yarn joining device (14), the control section (25) performs a control to rotate the yarn storage roller (32) from a stopped state while changing the acceleration rate in the winding direction of the yarn storage roller (32).

FIG. 4



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention mainly relates to a yarn winding device including a yarn storage section and a tension applying section.

2. Description of the Related Art

[0002] Conventionally, there is known a yarn winding device adapted to unwind a yarn from a yarn supplying bobbin and temporarily store the yarn on a yarn storage section, and wind the stored yarn by a package forming section to form a package. Such a yarn winding device includes a yarn joining device arranged between the yarn supplying bobbin and the yarn storage section, and is configured to carry out a yarn joining operation by the yarn joining device when the yarn is cut or when the yarn is broken during unwinding of the yarn from the yarn supplying bobbin. In such a yarn winding device, even when the yarn joining operation is carried out by the yarn joining device, the package forming section winds the yarn stored on the yarn storage section, and thus the yarn winding operation can be continuously carried out without being stopped.

[0003] WO 2012/127939 A1 discloses a winding unit of an automatic winder adapted to temporarily store the yarn unwound from the yarn supplying bobbin in an accumulator including a rotatable drum, and wind the yarn stored in the accumulator into a package.

[0004] In the winding unit of WO 2012/127939 A1, a gate type tension applying device, for example, is provided to apply a predetermined tension to the travelling yarn. WO 2012/127939 A1 orderly winds and stores the yarn in the accumulator by applying a constant tension to the yarn with the tension applying device.

[0005] In the yarn winding device described in WO 2012/127939 A1, the drum of the yarn storage section is required to be stopped or reversely rotated when there is a need to carry out the yarn joining operation by the yarn joining device. Since the yarn of the yarn storage section is pulled out and wound in the package forming section during this time, a yarn storage amount of the yarn storage section is reduced during the yarn joining operation. Therefore, the yarn storage amount of the yarn storage section is small immediately after completion of the yarn joining operation. Since it is difficult to know when the need to carry out the next yarn joining operation arises, the yarn storage amount reduced in the yarn joining operation needs to be recovered at an early stage.

[0006] However, if the stopped drum of the yarn storage section starts to be rotated rapidly, a portion of the yarn from the yarn supplying bobbin to the yarn storage section is pulled with a strong force, and thus the tension applying device that makes contact with the yarn to apply

tension is flipped by the yarn and shows a moving-around behavior. The tension of the yarn thus may become unstable. The yarn may break at the portion of the tension applying device in an extreme case, and thus the yarn joining operation by the yarn joining device may be required again, the yarn storage amount may be further reduced, and efficiency of the winding operation may be lowered.

BRIEF SUMMARY OF THE INVENTION

[0007] The present invention has been made in view of the above circumstances, and an object thereof is to provide a configuration in which a rotation speed of a rotary body can be appropriately raised while tension of a yarn wound around the rotary body of the yarn storage section is stabilized after completion of the yarn joining operation.

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

[0009] According to 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 section, a package forming section, a yarn joining device, a tension applying section, and a control section. The yarn supplying section is configured to supply a yarn. The yarn storage section is adapted to wind and store the yarn of the yarn supplying section by rotating a rotary body at a predetermined winding speed in a winding direction. The package forming section is adapted to pull out the yarn from the yarn storage section and wind the pulled out yarn to form a package. The yarn joining device is adapted to connect, when the yarn is disconnected between the yarn supplying section and the yarn storage section, a disconnected yarn from the yarn supplying section and the yarn from the yarn storage section. The tension applying section is arranged between the yarn supplying section and the yarn storage section, and adapted to make contact with the yarn supplied from the yarn supplying section to apply tension to the yarn. The control section controls the rotation of the rotary body. The control section performs an acceleration rate changing control of controlling the rotation of the rotary body so as to change an acceleration rate in the winding direction of the rotary body while accelerating the rotary body from a stopped state to the predetermined winding speed after completion of the yarn joining operation by the yarn joining device.

[0010] Thus, after the completion of the yarn joining operation, the rotation of the stopped rotary body can be started while the tension of the yarn wound around the rotary body is stabilized in relation to the tension applying section.

[0011] The above-described yarn winding device preferably has the following configurations. Specifically, the control section rotates the rotary body in the winding di-

rection at first acceleration, and then rotates the rotary body in the winding direction at second acceleration after the completion of the yarn joining operation. An acceleration rate in the first acceleration is smaller than an acceleration rate in the second acceleration.

[0012] Thus, the rotary body is accelerated at a small acceleration rate immediately after the completion of the yarn joining operation, whereby the yarn is rapidly tensed between the yarn supplying section and the yarn storage section, and the tension applying section can be prevented from moving around. After the tension of the yarn is stabilized, the rotation of the rotary body is accelerated at a large acceleration rate, so that the yarn storage amount of the yarn storage section can be rapidly recovered.

[0013] In the above-described yarn winding device, the acceleration rate of the first acceleration and the acceleration rate of the second acceleration are preferably both constant.

[0014] Thus, parameters become simple, so that setting and management of the acceleration rate in the first acceleration and the acceleration rate in the second acceleration can be facilitated.

[0015] The above-described yarn winding device preferably has the following configurations. Specifically, the acceleration rate of the first acceleration linearly increases to the acceleration rate of the second acceleration with elapse of time. The acceleration rate of the second acceleration is constant.

[0016] In this case, the acceleration rate of the rotary body immediately after the start of rotation (immediately after the start of first acceleration) can be suppressed, so that the tension applying section can be prevented from moving around. Furthermore, since the acceleration rate does not discontinuously change when the first acceleration is shifted to the second acceleration, the tension of the yarn can be prevented from becoming unstable due to the switching of the acceleration.

[0017] In the above-described yarn winding device, after the rotation speed of the rotary body reaches a target speed set in advance, the control section preferably performs a control to rotate the rotary body at the target speed.

[0018] Thus, after the rotation speed of the rotary body reaches the target speed, the rotary body is rotated at a constant speed, whereby the speed control can be simplified. Furthermore, the control of the yarn storage amount of the yarn storage section is also simplified.

[0019] In the above-described yarn winding device, the rotary body preferably includes a cylindrical portion adapted to wind and store the yarn around a peripheral surface. A yarn supplying bobbin for supplying the yarn is held on the yarn supplying section.

[0020] Thus, the length of the yarn to be wound around the rotary body can be easily calculated from the diameter of the cylindrical portion, and hence the calculation of the tension to be applied to the yarn with the acceleration of the rotary body is also facilitated. Therefore, the control

of the tension applied to the yarn by the tension applying section can be simplified at the first acceleration and the second acceleration.

[0021] The above-described yarn winding device preferably includes a setting section through which an operator sets at least one of the acceleration rate of the first acceleration and the acceleration rate of the second acceleration.

[0022] Even if the type of yarn to be wound in the yarn winding device and the winding conditions are variously changed, such a situation can be easily handled by the operator setting the acceleration rate of the rotary body suitable for the situation.

[0023] According to an aspect of the present invention, a textile machine having the following configuration is provided. Specifically, the textile machine includes a plurality of the yarn winding devices. In addition, the textile machine includes a collective setting section through which an operator can collectively set at least one of the acceleration rate of the first acceleration and the acceleration rate of the second acceleration for the plurality of yarn winding devices.

[0024] The setting of the acceleration rate of the rotary body thus can be easily carried out with respect to the plurality of yarn winding devices arranged in the textile machine. Therefore, an operation burden of the operator can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025]

FIG. 1 is a simple front view illustrating an overall configuration of an automatic winder including a winding unit according to one embodiment of the present invention;

FIG. 2 is a schematic side view of the winding unit; FIG. 3 is an enlarged view illustrating in detail a configuration of a periphery of a yarn storage device; FIG. 4 is a graph describing a control of a rotation speed of a yarn storage roller; and

FIG. 5 is a graph describing a control of a rotation speed of a yarn storage roller according to an alternative embodiment.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0026] Embodiments of the present invention will be hereinafter described with reference to the drawings. FIG. 1 is a front view illustrating an overall configuration of an automatic winder 1 including a winding unit 2 according to the present embodiment.

[0027] The automatic winder (textile machine) 1 illustrated in FIG. 1 includes a plurality of winding units (yarn winding devices) 2 arranged in a row, a machine control device (collective setting section) 3, a doffing device 4, and a blower box (not illustrated) as main components.

[0028] The winding unit 2 includes a yarn supplying section 7, a yarn storage section 5, and a 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 supplied to the yarn supplying section 7, temporarily store the unwound yarn 20 on the yarn storage section 5, and then wind the yarn 20 around a winding bobbin 22 to form a package 30 in the package forming section 8.

[0029] The machine control device 3 is configured as a microcomputer, and includes a display 65 and an input key 66. The machine control device 3 is configured to be able to communicate with each of the winding units 2. The operator of the automatic winder 1 appropriately operates the machine control device 3 to control the plurality of winding units 2.

[0030] When the package 30 is fully wound (state where a prescribed amount of the yarn 20 is wound) in the winding unit 2, the doffing device 4 travels to the position of the target winding unit 2 to detach the fully-wound package 30 and insert an empty winding bobbin 22. The operation of the doffing device 4 is controlled by the machine control device 3.

[0031] Next, with reference to FIG. 2, a description will be made on a configuration of the winding unit 2. FIG. 2 is a schematic side view of the winding unit 2.

[0032] As described above, the winding unit 2 includes the yarn supplying section 7, the yarn storage section 5, and the package forming section 8.

[0033] FIG. 2 illustrates a state of the winding unit 2 during normal winding. "Normal winding" refers to a state where the yarn 20 is continuous between the yarn supplying bobbin 21 and the package 30, and a state where the yarn 20 is unwound from the yarn supplying bobbin 21 and the yarn 20 is wound into the package 30. In the following description, "upstream" and "downstream" respectively refer to an upstream side and a downstream side when seen in a travelling direction of the yarn 20 during the normal winding.

[0034] The yarn supplying section 7 holds the yarn supplying bobbin 21 adapted to supply the yarn 20 in a substantially upright state, and unwinds the yarn 20 from the yarn supplying bobbin 21 and supplies the yarn 20. The yarn supplying section 7 is configured such that when all the yarn 20 is unwound from the set yarn supplying bobbin 21, the yarn supplying section 7 discharges the empty yarn supplying bobbin 21, and receives supply of a new yarn supplying bobbin 21 from a magazine type bobbin supplying device 26 arranged on the front side of the winding unit 2. In FIG. 1, the illustration of the bobbin supplying device 26 is omitted so that a yarn travelling path from the yarn supplying section 7 to the package forming section 8 is illustrated in an easily understandable manner.

[0035] The yarn storage section 5 is arranged between the yarn supplying section 7 and the package forming section 8 as illustrated in FIG. 2, and is configured to temporarily store the yarn 20 supplied from the yarn sup-

plying section 7 and supply the yarn 20 to the package forming section 8. The yarn storage section 5 includes a yarn storage roller (rotary body) 32 around which the yarn 20 can be wound, and a roller drive motor 33 adapted to rotatably drive the yarn storage roller 32.

[0036] The roller drive motor 33 can rotate the yarn storage roller 32 in a direction of winding the yarn 20 from the yarn supplying section 7, and can also rotate the yarn storage roller 32 in the opposite direction. In the following description, with respect to the rotation of the yarn storage roller 32, the rotation in the direction of winding the yarn 20 from the yarn supplying section 7 may be referred to as a forward direction, and the rotation in the opposite direction may be referred to as a reverse rotation.

[0037] The package forming section 8 includes a cradle 23 into which the winding bobbin 22 can be inserted, and a traverse drum 24 adapted to traverse the yarn 20 and drive the winding bobbin 22.

[0038] The traverse drum 24 is arranged facing the winding bobbin 22, and when the traverse drum 24 is rotatably driven by an electric motor (not illustrated), the winding bobbin 22 rotates accompanying the rotation of the traverse drum 24. Thus, the yarn 20 stored on the yarn storage section 5 can be unwound and pulled out, and then wound around the winding bobbin 22. A traverse groove (not illustrated) 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. According to the above configuration, the yarn 20 can be wound around the winding bobbin 22 while traversing the yarn 20, and the package 30 having a predetermined shape and a predetermined length can be formed.

[0039] The winding unit 2 includes various types of devices in the yarn travelling path from the yarn supplying section 7, through the yarn storage section 5, and to the package forming section 8. Specifically, an unwinding assisting device 10, a lower yarn blow-up section 11, a tension applying section 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, and an upper yarn pull-out section 48 are arranged in this order from the yarn supplying section 7 towards the yarn storage section 5 on the yarn travelling path.

[0040] The unwinding assisting device 10 assists the unwinding of the yarn 20 by bringing a movable member 40 into contact with a balloon formed at an upper part of the yarn supplying bobbin 21 by swinging the yarn 20 unwound from the yarn supplying bobbin 21 to control the balloon to an appropriate size.

[0041] The lower yarn blow-up section 11 is an air sucker device arranged immediately downstream of the unwinding assisting device 10, and is configured to blow up a lower yarn from the yarn supplying bobbin 21 towards the yarn joining device 14 by compressed air. According to such a configuration, when the yarn 20 is disconnected between the yarn supplying bobbin 21 and the yarn storage section 5, the yarn 20 from the yarn supplying bobbin

21 is blown up by the lower yarn blow-up section 11 to guide the yarn 20 to the yarn joining device 14 (yarn trap 15).

[0042] The tension applying section 12 applies a predetermined tension to the travelling yarn 20. The tension applying section 12 of the present embodiment is configured as a gate type in which movable comb teeth are arranged with respect to fixed comb teeth, and is configured to apply a predetermined resistance by causing the yarn 20 to travel with the comb teeth making contact with the yarn 20 (causing the yarn 20 to travel between the comb teeth). The movable comb teeth are configured to be movable by a solenoid, for example, so that the meshed state of the comb teeth can be adjusted, whereby the tension to be applied to the yarn 20 can be adjusted. However, the configuration of the tension applying section 12 is not limited thereto, and for example, the disc type tension applying device may be adopted.

[0043] The upper yarn catching section 13 is arranged immediately upstream of the yarn joining device 14. The upper yarn catching section 13 is connected to a negative pressure source (not illustrated), and generates a suction airflow during the yarn joining operation to suck and catch the yarn 20 from the yarn storage section 5.

[0044] The yarn joining device 14 joins the yarn 20 from the yarn supplying bobbin 21 and the yarn 20 from the yarn storage section 5 when the yarn 20 between the yarn supplying bobbin 21 and the yarn storage section 5 is disconnected, for example, when a yarn defect is detected by the clearer 17 and the yarn 20 is cut by the cutter 16, when the yarn 20 unwound from the yarn supplying bobbin 21 breaks, when replacing the yarn supplying bobbin 21, and the like. The yarn joining device 14 may be a type that uses fluid such as compressed air or a mechanical-type.

[0045] The yarn trap 15 is arranged upstream of the cutter 16 and immediately downstream of the yarn joining device 14. The yarn trap 15 is formed as a tubular member connected to the negative pressure source (not illustrated), and is provided close to the travelling path of the yarn 20. According to such a configuration, when the yarn 20 is disconnected between the yarn supplying bobbin 21 and the yarn storage section 5, the yarn 20 from the yarn supplying bobbin 21 blown up by the lower yarn blow-up section 11 can be sucked and caught by the yarn trap 15.

[0046] The clearer 17 is configured to monitor the thickness and the like of the yarn 20 to detect the yarn defect such as slub, mixing of foreign substances, and the like. When the defect of the yarn is detected, the clearer 17 transmits a yarn defect detection signal to a control section 25, to be described later, for controlling the winding unit 2. The cutter 16 adapted to immediately cut the yarn 20 according to the yarn defect detection signal is arranged in proximity to the clearer 17.

[0047] The upper yarn pull-out section 48 is an air sucker device arranged immediately upstream of the yarn storage section 5, and is configured to blow the upper

yarn from the yarn storage section 5 downward towards the yarn joining device 14 by the compressed air. Specifically, the upper yarn pull-out section 48 is provided with a blow port of the yarn 20, and a yarn guiding member 60 which is a curved tubular member is provided in proximity to the blow port. An opening is formed at both ends in a longitudinal direction of the yarn guiding member 60. The yarn guiding member 60 is arranged such that the opening on one end faces the blow port of the upper yarn pull-out section 48 and the opening on the other end faces the upper yarn catching section 13. Furthermore, a guiding path that connects the openings at both ends so as to detour the yarn joining device 14 and the like is formed inside the yarn guiding member 60.

[0048] According to such a configuration, when the yarn 20 is disconnected between the yarn supplying bobbin 21 and the yarn storage section 5, the upper yarn pull-out section 48 pulls out the yarn 20 from the yarn storage section 5 so as to blow and feed the yarn 20 along the guiding path of the yarn guiding member 60, enabling the upper yarn catching section 13 to catch the yarn 20. A pass-through slit (not illustrated) is formed over the entire length of the yarn guiding member 60, so that the yarn 20 can be pulled out from the inside of the yarn guiding member 60 while the yarn 20 is caught by the upper yarn catching section 13. Accordingly, the yarn 20 from the yarn storage section 5 can be blown down by the upper yarn pull-out section 48 and guided to the yarn joining device 14 (upper yarn catching section 13).

[0049] Next, a description will be made on a configuration of the winding unit 2.

[0050] As illustrated in FIG. 2, each winding unit 2 includes a control section 25. The control section 25 includes hardware such as CPU, ROM, and RAM (not illustrated), and the RAM stores software such as a control program. Each section of the winding unit 2 is controlled by a cooperative operation of the hardware and the software.

[0051] Specifically, the control section 25 carries out a control to drive a roller drive motor 33 to forwardly rotate the yarn storage roller 32, unwind the yarn 20 from the yarn supplying bobbin 21 set in the yarn supplying section 7, and store the yarn 20 on the yarn storage section 5. In this case, the control section 25 controls the unwinding assisting device 10 to assist the unwinding of the yarn 20, and also controls the tension applying section 12 to apply an appropriate tension to the yarn 20. Furthermore, the control section 25 controls an electric motor (not illustrated) adapted to drive the traverse drum 24, and controls to wind the yarn 20 around the winding bobbin 22 to form the package 30.

[0052] In the process of the yarn winding operation, the control section 25 changes the speed at which the roller drive motor 33 forwardly rotates the yarn storage roller 32 to carry out a control such that a constant storage amount of the yarn 20 on the yarn storage section 5 is ensured (details will be described later). Furthermore, the control section 25 controls to operate the cutter 16

when the yarn defect detection signal is input from the clearer 17.

[0053] When the yarn 20 is disconnected between the yarn supplying section 7 and the yarn storage section 5, the control section 25 appropriately controls the lower yarn blow-up section 11, the yarn trap 15, the upper yarn pull-out section 48, the upper yarn catching section 13, and the yarn joining device 14 to join the yarn 20 from the yarn supplying section 7 and the yarn 20 from the yarn storage section 5.

[0054] The control section 25 arranged in each of the winding units 2 is configured to be able to communicate with the machine control device 3. Thus, the operation of the plurality of winding units 2 can be controlled by the machine control device 3.

[0055] Next, a description will be made on the yarn joining operation in the automatic winder 1 (winding unit 2) of the present embodiment.

[0056] Specifically, when the yarn 20 from the yarn storage section 5 and the yarn 20 from the yarn supplying bobbin 21 are disconnected due to yarn breakage, cutting of the yarn 20 by the cutter 16, the replacement of the yarn supplying bobbin 21, and the like, the yarn joining operation is carried out by the yarn joining device 14.

[0057] This will be specifically described below. The control section 25 first blows the yarn 20 from the yarn supplying bobbin 21 upward by the lower yarn blow-up section 11. The blown-up yarn 20 is sucked and caught by the yarn trap 15. The yarn 20 from the yarn supplying bobbin 21 thus can be guided to the yarn joining device 14.

[0058] Before or after this operation, the control section 25 blows the yarn 20 stored on the yarn storage section 5 by the upper yarn pull-out section 48 while reversely rotating the yarn storage roller 32 of the yarn storage section 5. The yarn 20 is fed along the yarn guiding member 60, and sucked and caught by the upper yarn catching section 13. The yarn 20 from the yarn storage section 5 thus can be guided to the yarn joining device 14. When the yarn from the yarn storage section 5 is introduced to the yarn joining device 14, the control section 25 stops the reverse rotation of the yarn storage roller 32.

[0059] In this state, the control section 25 controls to operate the yarn joining device 14 and connects the yarn 20 from the yarn supplying bobbin 21 and the yarn 20 from the yarn storage section 5. After the yarn joining operation is completed, the control section 25 resumes the forward rotation of the yarn storage roller 32 to resume the winding of the yarn on the yarn storage section 5.

[0060] Even if the yarn 20 between the yarn supplying bobbin 21 and the yarn storage section 5 is disconnected as described above, the winding of the yarn 20 to the package 30 in the package forming section 8 can be continued without being interrupted. In other words, in the automatic winder 1 of the present embodiment, the yarn storage section 5 is interposed between the yarn supplying section 7 and the package forming section 8, and a

constant amount of yarn 20 is stored on the yarn storage section 5, as described above. The package forming section 8 is configured to wind the yarn 20 stored in the yarn storage section 5. Therefore, even if the supply of the yarn 20 from the yarn supplying bobbin 21 is interrupted for some reason (e.g., when the yarn joining operation is carried out), the winding of the yarn 20 to the package 30 can be continued.

[0061] Thus, since the winding operation in the package forming section 8 is not interrupted by the yarn joining operation and the like, the package 30 can be stably produced at high speed. Furthermore, since the yarn storage section 5 is interposed between the yarn supplying bobbin 21 and the package forming section 8, the winding in the package forming section 8 can be carried out without being affected by variation of tension at the time of unwinding the yarn 20 from the yarn supplying bobbin 21.

[0062] Next, a description will be made on the yarn storage section 5 of the present embodiment with reference to FIG. 3. FIG. 3 is an enlarged view illustrating the configuration of the periphery of the yarn storage section 5 in detail.

[0063] As described above, the yarn storage section 5 includes the yarn storage roller 32 and the roller drive motor 33.

[0064] The yarn storage roller 32 is formed as a substantially cylindrical member, and is adapted to wind the yarn 20 around the outer peripheral surface thereof to store the yarn 20. The roller drive motor 33 can rotatably drive the yarn storage roller 32 with the axis line as the center. Hereinafter, an end of the yarn storage roller 32 on a side where the roller drive motor 33 is arranged is referred to as a basal end, and the end on the opposite side is referred to as a distal end.

[0065] As illustrated in FIG. 3, a basal end side tapered portion 32a having a tapered shape in which the diameter increases towards the end is formed at the basal end of the yarn storage roller 32. A distal end side tapered portion 32b having a tapered shape in which the diameter increases towards the end is formed at the distal end of the yarn storage roller 32. A cylindrical portion 32c, which is a portion formed in a cylindrical shape (portion having a substantially constant diameter) is arranged between the basal end side tapered portion 32a and the distal end side tapered portion 32b. The yarn 20 is prevented from slipping out from the end of the yarn storage roller 32 by forming such tapered portions.

[0066] The upper yarn pull-out section 48 is arranged in proximity to the boundary portion of the basal end side tapered portion 32a and the cylindrical portion 32c of the yarn storage roller 32. The upper yarn pull-out section 48 is formed as a tubular member, and the yarn 20 from the yarn supplying bobbin 21 is passed through the inner side of the upper yarn pull-out section 48 and pulled out towards the surface of the yarn storage roller 32 during the normal winding.

[0067] The yarn storage section 5 can apply tension to the yarn 20 from the upstream (from the yarn supplying

bobbin 21) of the yarn storage section 5 by forwardly rotating the yarn storage roller 32 at a predetermined winding speed in a state where the yarn 20 is wound around the yarn storage roller 32. Thus, the yarn 20 can be unwound from the yarn supplying bobbin 21, and the yarn 20 can be wound around the surface of the yarn storage roller 32. As illustrated in FIG. 3, the yarn 20 is guided to the boundary portion of the basal end side tapered portion 32a and the cylindrical portion 32c, and hence the yarn 20 is sequentially wound so as to push away the yarn layer from the basal end side towards the distal end side of the cylindrical portion 32c. As a result, the yarn 20 on the yarn storage roller 32 (cylindrical portion 32c) is pushed by the newly wound yarn 20, and is sequentially fed towards the distal end side at the surface of the cylindrical portion 32c. Thus, the yarn 20 is regularly wound from the basal end side so as to be spirally aligned on the outer peripheral surface of the yarn storage roller 32.

[0068] The yarn 20 wound around the cylindrical portion 32c is eventually pulled out towards the downstream (distal end side, package forming section 8 side) in a direction along the axial direction at the position in the middle in the axial direction of the cylindrical portion 32c. The yarn 20 is passed through a pull-out guide 37 arranged on the extended line of the center axis line of the yarn storage roller 32 when the yarn 20 is pulled out in the above manner. Thus, by pulling out the yarn 20 towards the extended line of the center axis line of the yarn storage roller 32, the yarn 20 can be pulled out from the yarn storage roller 32 regardless of the rotating state of the yarn storage roller 32. In other words, whether the yarn storage roller 32 is rotated in a forward direction or a reverse direction, or whether the rotation is stopped, the package forming section 8 can unwind the yarn 20 from the yarn storage roller 32 and wind the yarn 20 into the package 30.

[0069] In the present embodiment, a rubber band (elastic ring member, pull-out yarn guiding member) 32d is hooked on the yarn storage roller 32. The rubber band 32d is formed in an O-ring shape, and is arranged at the boundary portion of the cylindrical portion 32c and the distal end side tapered portion 32b. The yarn 20 is passed between the rubber band 32d and the surface of the yarn storage roller 32, and is pulled out from the yarn storage roller 32. Since the yarn storage roller 32 includes the distal end side tapered portion 32b, the rubber band 32d does not drop off from the yarn storage roller 32 by moving with the yarn 20.

[0070] According to the above-described configuration, an appropriate tension is applied to the yarn 20 unwound from the yarn storage roller 32 by tightening the rubber band 32d on the yarn storage roller 32, so that the formation of the balloon by swinging of the yarn 20 can be suppressed and the unwinding of the yarn 20 can be stabilized. Furthermore, since the yarn 20 can be unwound by untangling the clump of the yarn 20, a phenomenon (sloughing) in which the yarn 20 on the yarn

storage roller 32 is removed all at once as a clump can be prevented.

[0071] Next, a description will be made on the control of the storage amount of the yarn 20 on the yarn storage section 5.

[0072] In proximity to the yarn storage roller 32, there are arranged a lower limit sensor 35 adapted to detect that the yarn 20 on the yarn storage roller 32 is smaller than a predetermined lower limit amount, and an upper limit sensor (yarn detection sensor) 36 adapted to detect that the yarn 20 is greater than or equal to the predetermined upper limit amount. The lower limit sensor 35 and the upper limit sensor 36 can be configured as, for example, optical sensors. The detection results of the lower limit sensor 35 and the upper limit sensor 36 are output to the control section 25.

[0073] When detecting that the yarn on the yarn storage roller 32 is smaller than the lower limit amount, the control section 25 appropriately controls the roller drive motor 33 to increase the rotation speed of the yarn storage roller 32. Thus, the speed at which the yarn 20 is wound around the yarn storage roller 32 increases. Since the rotation speed of the traverse drum 24 is substantially constant during the normal winding, the speed at which the yarn 20 on the yarn storage roller 32 is unwound towards the package 30 side is substantially constant. The control section 25 controls the roller drive motor 33 so that the speed at which the yarn 20 is wound around the yarn storage roller 32 becomes greater than the speed at which the yarn 20 is unwound from the yarn storage roller 32, so that the storage amount of the yarn 20 on the yarn storage roller 32 can be gradually increased.

[0074] When detecting that the yarn on the yarn storage roller 32 is greater than or equal to the upper limit amount, the control section 25 appropriately controls the roller drive motor 33 to reduce the rotation speed of the yarn storage roller 32. Thus, the speed at which the yarn 20 is wound around the yarn storage roller 32 is reduced. The control section 25 controls the roller drive motor 33 so that the speed at which the yarn 20 is wound around the yarn storage roller 32 becomes smaller than the speed at which the yarn 20 is unwound from the yarn storage roller 32, so that the amount of the yarn 20 on the yarn storage roller 32 can be gradually reduced. According to such a control, the storage amount of the yarn 20 on the yarn storage roller 32 can be maintained to be greater than or equal to the lower limit amount and smaller than the upper limit amount.

[0075] Next, a description will be made on the operation of the yarn storage section 5 after the yarn joining operation by the yarn joining device 14 is completed.

[0076] As described above, when the yarn 20 in the disconnected state is joined by the yarn joining device 14, the control section 25 resumes the forward rotation of the yarn storage roller 32 to resume the winding of the yarn 20 on the yarn storage section 5.

[0077] The yarn storage roller 32 of the yarn storage

section 5 is stopped or reversely rotated, as described above, while the yarn joining operation by the yarn joining device 14 is being carried out. The winding of the yarn 20 is continued as usual in the package forming section 8. Therefore, when the yarn joining operation by the yarn joining device 14 is carried out, the storage amount of the yarn 20 on the yarn storage section 5 is reduced.

[0078] If the storage amount of the yarn 20 on the yarn storage section 5 is small, the storage amount may become zero if the yarn 20 breaks again or if the yarn 20 is cut by the cutter 16 due to the detection of the yarn defect by the clearer 17, and thus the winding of the yarn 20 in the package forming section 8 may not be continued. Therefore, it is preferable, from the viewpoint of rapidly recovering the yarn storage amount, to rotate the yarn storage roller 32 at a speed as high as possible immediately after the completion of the yarn joining operation by the yarn joining device 14.

[0079] However, if the rise in the speed at which the yarn storage roller 32 forwardly rotates is too sharp, the upstream yarn 20 rapidly becomes tense, and hence the movable comb teeth making contact with the yarn 20 may be flipped by the yarn 20 in the tension applying section 12 and show a moving-around behavior. Such moving around of the tension applying section 12 becomes a cause that the tension of the yarn 20 to be wound around the yarn storage roller 32 becomes unstable. If the tension applying section 12 moves around excessively, the yarn 20 may be broken and the yarn joining operation may be required to be carried out again.

[0080] In the winding unit 2 of the present embodiment, the control section 25 carries out an acceleration control of two stages, as illustrated with a graph of FIG. 4. FIG. 4 illustrates a relationship between a time from the terminating time point of the yarn joining operation and the rotation speed as well as the rotation acceleration rate of the yarn storage roller 32.

[0081] This will be specifically described below. The control section 25 controls the roller drive motor 33 so that the yarn storage roller 32 starts the rotation at a predetermined small acceleration rate immediately after the completion of the yarn joining operation. In the following description, the acceleration rate based on such small acceleration may be referred to as first acceleration.

[0082] The control section 25 controls the roller drive motor 33 so that the acceleration rate of the rotation of the yarn storage roller 32 becomes greater after the first acceleration is carried out for a predetermined time. In the following description, the acceleration after the acceleration rate is switched to the large acceleration rate may be referred to as second acceleration.

[0083] The control section 25 continues the second acceleration while monitoring the rotation speed of the yarn storage roller 32, and stops the acceleration of the yarn storage roller 32 when the rotation speed of the yarn storage roller 32 reaches a predetermined target speed, and shifts to the usual control of the yarn storage amount. The target speed is the speed for gradually increasing

the storage amount of the yarn 20 on the yarn storage roller 32 as described above, and is set in advance in the control section 25.

[0084] Thus, the control section 25 controls the roller drive motor 33 to carry out the first acceleration at the small acceleration rate and the second acceleration at the large acceleration rate to forwardly rotate the stopped yarn storage roller 32 at a predetermined target speed (predetermined winding speed). According to such a control (acceleration rate changing control) of changing the acceleration rate, the tension applying section 12 can be prevented from moving around while the yarn storage amount of the yarn storage section 5 can be rapidly recovered.

[0085] In the present embodiment, as illustrated in the graph of FIG. 4, each of the acceleration rate in the first acceleration and the acceleration rate in the second acceleration are constant. Therefore, the parameters are simple, and hence the setting and the control associated with the speed of the yarn storage roller 32 can be simplified.

[0086] The yarn storage roller 32 includes a cylindrical portion 32c having a substantially constant diameter, and the yarn 20 is wound and stored around the cylindrical portion 32c. Therefore, the length the yarn 20 wound around the cylindrical portion 32c can be easily calculated from the diameter of the cylindrical portion 32c. Furthermore, in the present embodiment, the control is carried out such that the speed of the yarn storage roller 32 increases linearly (linear functionally). Therefore, increasing/reducing tendency of the tension of the yarn 20 during the winding can be assumed relatively easily while the yarn storage roller 32 accelerates the rotation. Thus, the tension to be applied to the yarn 20 by the tension applying section 12 can be easily controlled.

[0087] In the graph on the upper side of FIG. 4, the changes in a tension value (target tension value), which is a control target of the tension applying section 12, and an actually measured tension value (measurement tension value) are also illustrated in addition to the change in speed of the yarn storage roller 32 after the completion of the yarn joining operation.

[0088] According to this graph, it can be seen that the measurement tension value can be stably controlled by the tension applying section 12 such that, although it is a low value immediately after the start of acceleration of the yarn storage roller 32, but it becomes a value close to the target tension value around the time when the first acceleration is completed. Furthermore, an unstable behavior such as the measurement tension value becoming zero or rapidly increasing to the upper side is not shown immediately after the yarn joining operation is completed and the yarn storage roller 32 starts the acceleration, and the measurement tension value gradually changes to a certain extent. Therefore, the tension applying section 12 can be prevented from moving around.

[0089] In the above-described example, the first acceleration is shifted to the second acceleration when an

elapsed time from the start of the first acceleration reaches a predetermined time. However, the conditions for switching from the first acceleration to the second acceleration can be variously set, and for example, the conditions may include the rotation speed of the yarn storage roller 32 reaching a predetermined speed, a control value indicating a meshing degree of the comb teeth of the tension applying section 12 satisfying a predetermined condition, and the tension measurement value detected by a tension measurement section (not illustrated) arranged in the winding unit 2 satisfying a predetermined condition.

[0090] The acceleration rate of the first acceleration and the acceleration rate of the second acceleration are stored in a storage section 25a of the control section 25 as part of the parameters of the winding conditions. The control section 25 also includes a setting section 25b for allowing the operator to set the acceleration rate stored in the storage section 25a. Specifically, the setting section 25b updates each set value of the acceleration rate stored in the storage section 25a when the operator operates a setting key (not illustrated) arranged in the winding unit 2 to input two acceleration rates in the form of numerical values, for example. Therefore, the acceleration rate can be flexibly set according to the type of yarn 20 and the like, and the appropriate acceleration control can be carried out.

[0091] The two acceleration rates described above can also be collectively set for the plurality of winding units 2. Specifically, the operator displays a setting screen on a display 65 by operating an input key 66 of the machine control device (collective setting section) 3, and sets the two acceleration rates in the form of numerical values, respectively. Thus, the machine control device 3 communicates with each of the control sections 25 of all the winding units 2, and updates the set values of the two acceleration rates stored in the storage section 25a to the values input by the operator. The work burden of the operator thus can be effectively reduced.

[0092] As described above, the winding unit 2 of the present embodiment includes the yarn supplying section 7, the yarn storage section 5, the package forming section 8, the yarn joining device 14, the tension applying section 12, and the control section 25. The yarn supplying section 7 supplies the yarn 20. The yarn storage section 5 winds and stores the yarn 20 of the yarn supplying section 7 by forwardly rotating the yarn storage roller 32. The package forming section 8 pulls out the yarn 20 from the yarn storage section 5 and winds the pulled-out yarn 20 to form the package 30. When the yarn 20 is disconnected between the yarn supplying section 7 and the yarn storage section 5, the yarn joining device 14 connects the disconnected yarn 20 from the yarn supplying section 7 and the yarn 20 from the yarn storage section 5. The tension applying section 12 is arranged between the yarn supplying section 7 and the yarn storage section 5, and is brought into contact with the yarn 20 supplied from the yarn supplying section 7 to apply a tension to the yarn

20. The control section 25 controls the rotation of the yarn storage roller 32. After the completion of the yarn joining operation by the yarn joining device 14, the control section 25 forwardly rotates the yarn storage roller 32 from the stopped state by the acceleration rate changing control of controlling the rotation of the yarn storage roller 32 so as to change the acceleration rate of the forward rotation of the yarn storage roller 32.

[0093] Thus, after the completion of the yarn joining operation, the rotation of the stopped yarn storage roller 32 can be started while the tension of the yarn 20 wound around the yarn storage roller 32 is stabilized in relation to the tension applying section 12.

[0094] Furthermore, in the winding unit 2 of the present embodiment, after the completion of the yarn joining operation by the yarn joining device 14, the control section 25 forwardly rotates the yarn storage roller 32 at the first acceleration, and thereafter, forwardly rotates the yarn storage roller 32 at the second acceleration. The acceleration rate in the first acceleration is smaller than the acceleration rate in the second acceleration.

[0095] Thus, the yarn storage roller 32 is accelerated at a small acceleration rate immediately after the completion of the yarn joining operation, whereby the yarn 20 is rapidly tensed on the upstream and the tension applying section 12 can be prevented from moving around. After the tension of the upstream yarn 20 is stabilized, the rotation of the yarn storage roller 32 is accelerated at a large acceleration rate, so that the yarn storage amount of the yarn storage section 5 can be rapidly recovered.

[0096] Furthermore, in the winding unit 2 of the present embodiment, the acceleration rate of the first acceleration and the acceleration rate of the second acceleration are respectively constant.

[0097] Thus, the parameters become simple, so that the setting and the management by the operator, for example, can be facilitated for the acceleration rate in the first acceleration and the acceleration rate in the second acceleration.

[0098] Moreover, in the winding unit 2 of the present embodiment, the control section 25 carries out the control to rotate the yarn storage roller 32 at the target speed (predetermined winding speed) after the rotation speed of the yarn storage roller 32 reaches the target speed set in advance.

[0099] The speed control of the yarn storage roller 32 thus can be simplified. Since the speed at which the yarn storage section 5 winds the yarn 20 from the yarn supplying section 7 and the speed at which the yarn 20 of the yarn storage section 5 is pulled out by the package forming section 8 are easily balanced, the control of the storage amount of the yarn 20 on the yarn storage section 5 is simplified.

[0100] In the winding unit 2 of the present embodiment, the yarn storage roller 32 includes the cylindrical portion 32c adapted to wind and store the yarn 20 around the peripheral surface.

[0101] Thus, the length the yarn 20 wound around the yarn storage roller 32 can be easily calculated from the diameter of the cylindrical portion 32c, and hence the calculation of the tension to be applied to the yarn 20 with the acceleration of the yarn storage roller 32 is also facilitated. Therefore, the control of the tension applied to the yarn 20 by the tension applying section 12 can be simplified at the first acceleration and the second acceleration.

[0102] Furthermore, the winding unit 2 of the present embodiment includes the setting section 25b through which the operator can set the acceleration rate of the first acceleration and the acceleration rate of the second acceleration.

[0103] Even if the type of yarn to be wound in the winding unit 2 and the winding conditions are variously changed, such a situation can be easily handled by the operator setting the acceleration rate of the yarn storage roller 32 suitable for the situation.

[0104] The automatic winder 1 of the present embodiment includes a plurality of winding units 2. The automatic winder 1 includes the machine control device 3 through which the operator can collectively set the acceleration rate of the first acceleration and the acceleration rate of the second acceleration for the plurality of winding units 2.

[0105] Thus, the setting of the acceleration rate of the yarn storage roller 32 can be easily carried out with respect to the plurality of winding units 2 arranged in the automatic winder 1. Therefore, the work burden of the operator can be reduced.

[0106] Next, a description will be made on an alternative embodiment of the above-described embodiment. In the description of this alternative embodiment, the same reference numerals are denoted in the figures for the members same as or similar to the above-described embodiment, and the description thereof will be omitted.

[0107] In other words, in the above-described embodiment (FIG. 4), the acceleration rate of the first acceleration and the acceleration rate of the second acceleration are respectively set constant, and step-like acceleration is carried out. On the contrary, in this alternative embodiment, the control is carried out such that the acceleration rate of the first acceleration is linearly increased from zero to the acceleration rate of the second acceleration, and the acceleration rate of the second acceleration is constant, as illustrated in FIG. 5.

[0108] In the configuration of this alternative embodiment, the acceleration of the yarn storage roller 32 immediately after the completion of the yarn joining operation is suppressed compared to the above-described embodiment. Therefore, the tension applying section 12 can be reliably prevented from moving around. Furthermore, since the acceleration rate of the first acceleration is smoothly shifted to the acceleration rate of the second acceleration, the unstableness of the tension can be prevented.

[0109] As described above, in the winding unit of this

alternative embodiment, the acceleration rate of the first acceleration linearly increases to the acceleration rate of the second acceleration with elapse of time. The acceleration rate of the second acceleration is constant.

[0110] Thus, the acceleration rate immediately after the start of rotation of the yarn storage roller 32 (immediately after the start of first acceleration) can be kept low, so that the tension applying section 12 can be prevented from moving around. Furthermore, since the acceleration rate does not discontinuously change when transitioning from the first acceleration to the second acceleration, the tension of the yarn can be prevented from becoming unstable with the switching of the acceleration.

[0111] The preferred embodiment and the alternative embodiment of the present invention have been described above, but the above-described configurations may be modified as below.

[0112] In the present embodiment and the above-described alternative embodiment, the yarn storage roller 32, which is in the stopped state after the completion of the yarn joining operation, is forwardly rotated to the target speed by two accelerations having different acceleration rates. However, third acceleration may be carried out after the second acceleration, for example, and the acceleration in three stages may be realized. The acceleration may be in four or more stages.

[0113] In the above-described alternative embodiment (FIG. 5), the acceleration rate in the first acceleration linearly increases from zero to the acceleration rate in the second acceleration. However, the acceleration rate in the first acceleration may be linearly increased from the acceleration rate other than zero to the acceleration rate in the second acceleration. The acceleration rate may not be increased linearly, but may be increased along a smooth curved line.

[0114] In the present embodiment and the alternative embodiment described above, the acceleration rate of the first acceleration and the acceleration rate of the second acceleration can be set by the setting section 25b of the control section 25. However, only one of the two acceleration rates may be set. Furthermore, for example, a condition for switching from the first acceleration to the second acceleration may be set in addition to the two acceleration rates.

[0115] In the present embodiment and the alternative embodiment described above, the package forming section 8 is controlled to wind the yarn 20 from the yarn storage section 5 at a substantially constant speed. However, the winding speed of the package forming section 8 may be decelerated during the yarn joining operation by the yarn joining device 14, and the winding speed of the package forming section 8 may be accelerated in conjunction with the acceleration of the rotation of the yarn storage roller 32.

[0116] In the winding unit 2 of the present embodiment and the alternative embodiment described above, the second tension applying section is further arranged between the package forming section 8 and the yarn stor-

age section 5, and is configured to apply an appropriate tension to the yarn 20 wound by the package forming section 8.

[0117] In the present embodiment and the alternative embodiment described above, the winding unit 2 is configured to supply the yarn supplying bobbin 21 by the magazine type bobbin supplying device 26. However, the configuration may be changed to a configuration of conveying the tray set with the yarn supplying bobbin 21 along an appropriate path to supply the yarn supplying bobbin 21 to the winding unit 2.

[0118] In the present embodiment and the alternative embodiment described above, the package forming section 8 is configured to traverse the yarn 20 by the traverse drum 24. However, the yarn 20 may be traversed by an arm type traversing mechanism.

[0119] In the present embodiment and the alternative embodiment described above, when the yarn 20 is disconnected, the yarn 20 is blown and fed to the yarn joining device 14 using the airflow by the lower yarn blow-up section 11 and the upper yarn pull-out section 48. However, the present invention is not limited thereto, and the yarn 20 from the yarn supplying bobbin 21 and the yarn 20 from the yarn storage roller 32 may be sucked and caught, and the caught yarn may be guided to the yarn joining device 14 by an appropriate driving means.

[0120] The present invention is not limited to the winding unit 2 of the automatic winder 1, and can also be applied to the yarn winding device (e.g., spinning unit of spinning machine) of other textile machines including the yarn storage section and the tension applying section.

Claims

1. A yarn winding device (2) comprising:

a yarn supplying section (7) adapted to supply a yarn;
a yarn storage section (5) adapted to wind and store the yarn of the yarn supplying section (7) by rotating a rotary body at a predetermined winding speed in a winding direction;
a package forming section (8) adapted to pull out the yarn from the yarn storage section (5) and wind the pulled out yarn to form a package;
a yarn joining device (14) adapted to connect, when the yarn is disconnected between the yarn supplying section (7) and the yarn storage section (5), a disconnected yarn from the yarn supplying section (7) and the yarn from the yarn storage section (5);
a tension applying section (12) arranged between the yarn supplying section (7) and the yarn storage section (5), and adapted to make contact with the yarn supplied from the yarn supplying section (7) to apply tension to the yarn; and

a control section (25) adapted to control the rotation of the rotary body, **characterized in that** the control section (25) performs an acceleration rate changing control of controlling the rotation of the rotary body so as to change an acceleration rate in the winding direction of the rotary body while accelerating the rotary body from a stopped state to the predetermined winding speed after completion of the yarn joining operation by the yarn joining device (14).

2. The yarn winding device (2) according to claim 1, **characterized in that** the control section (25) rotates the rotary body in the winding direction at a first acceleration, and then rotates the rotary body in the winding direction at a second acceleration after the completion of the yarn joining operation; and an acceleration rate in the first acceleration is smaller than an acceleration rate in the second acceleration.

3. The yarn winding device (2) according to claim 1 or 2, **characterized in that** the acceleration rate of the first acceleration and the acceleration rate of the second acceleration are both constant.

4. The yarn winding device (2) according to claim 1 or 2, **characterized in that** the acceleration rate of the first acceleration linearly increases to the acceleration rate of the second acceleration with elapse of time, and the acceleration rate of the second acceleration is constant.

5. The yarn winding device (2) according to claim 3 or 4, **characterized in that** after a rotation speed of the rotary body reaches a target speed set in advance, the control section (25) performs a control to rotate the rotary body at the target speed.

6. The yarn winding device (2) according to any one of claims 1 to 5, **characterized in that** the rotary body includes a cylindrical portion (32c) adapted to wind and store the yarn around a peripheral surface.

7. The yarn winding device (2) according to any one of claims 1 to 7, **characterized in that** the yarn supplying section (7) holds a yarn supplying bobbin (21) adapted to supply the yarn.

8. The yarn winding device (2) according to any one of claims 1 to 7, **characterized by** further comprising:

a setting section (25b) through which an operator sets at least one of the acceleration rate of the first acceleration and the acceleration rate

of the second acceleration.

9. A textile machine **characterized by** comprising:

a plurality of the yarn winding devices (2) according to any one of claims 1 to 7, wherein the textile machine further includes a collective setting section (3) through which an operator collectively sets at least one of the acceleration rate of the first acceleration and the acceleration rate of the second acceleration for the plurality of yarn winding devices (2).
Proposed additional method Claims:

10. Method for operating a yarn winding device (2) comprising the following steps:

a yarn supplying section (7) supplies a yarn;
a yarn storage section (5) winds and stores the yarn of the yarn supplying section (7) by rotating a rotary body at a predetermined winding speed in a winding direction;
a package forming section (8) pulls out the yarn from the yarn storage section (5) and winds the pulled out yarn to form a package;
a yarn joining device (14) connects, when the yarn is disconnected between the yarn supplying section (7) and the yarn storage section (5), a disconnected yarn from the yarn supplying section (7) and the yarn from the yarn storage section (5);
a tension applying section (12) arranged between the yarn supplying section (7) and the yarn storage section (5) makes contact with the yarn supplied from the yarn supplying section (7) and applies tension to the yarn; and
a control section (25) controls the rotation of the rotary body, **characterized in that** the control section (25) performs an acceleration rate changing control by controlling the rotation of the rotary body so as to change an acceleration rate in the winding direction of the rotary body while accelerating the rotary body from a stopped state to the predetermined winding speed after completion of the yarn joining operation by the yarn joining device (14).

11. The method according to claim 10, **characterized in that**

the control section (25) rotates the rotary body in the winding direction at a first acceleration, and then rotates the rotary body in the winding direction at a second acceleration after the completion of the yarn joining operation; and
an acceleration rate in the first acceleration is smaller than an acceleration rate in the second acceleration.

12. The method according to claim 10 or 11, **character-**

ized in that

the acceleration rate of the first acceleration and the acceleration rate of the second acceleration are both constant.

13. The method according to claim 10 or 11, **characterized in that**

the acceleration rate of the first acceleration linearly increases to the acceleration rate of the second acceleration with elapse of time, and the acceleration rate of the second acceleration is constant.

14. The method according to claim 12 or 13, **characterized in that**

after a rotation speed of the rotary body reaches a target speed set in advance, the control section (25) performs a control to rotate the rotary body at the target speed.

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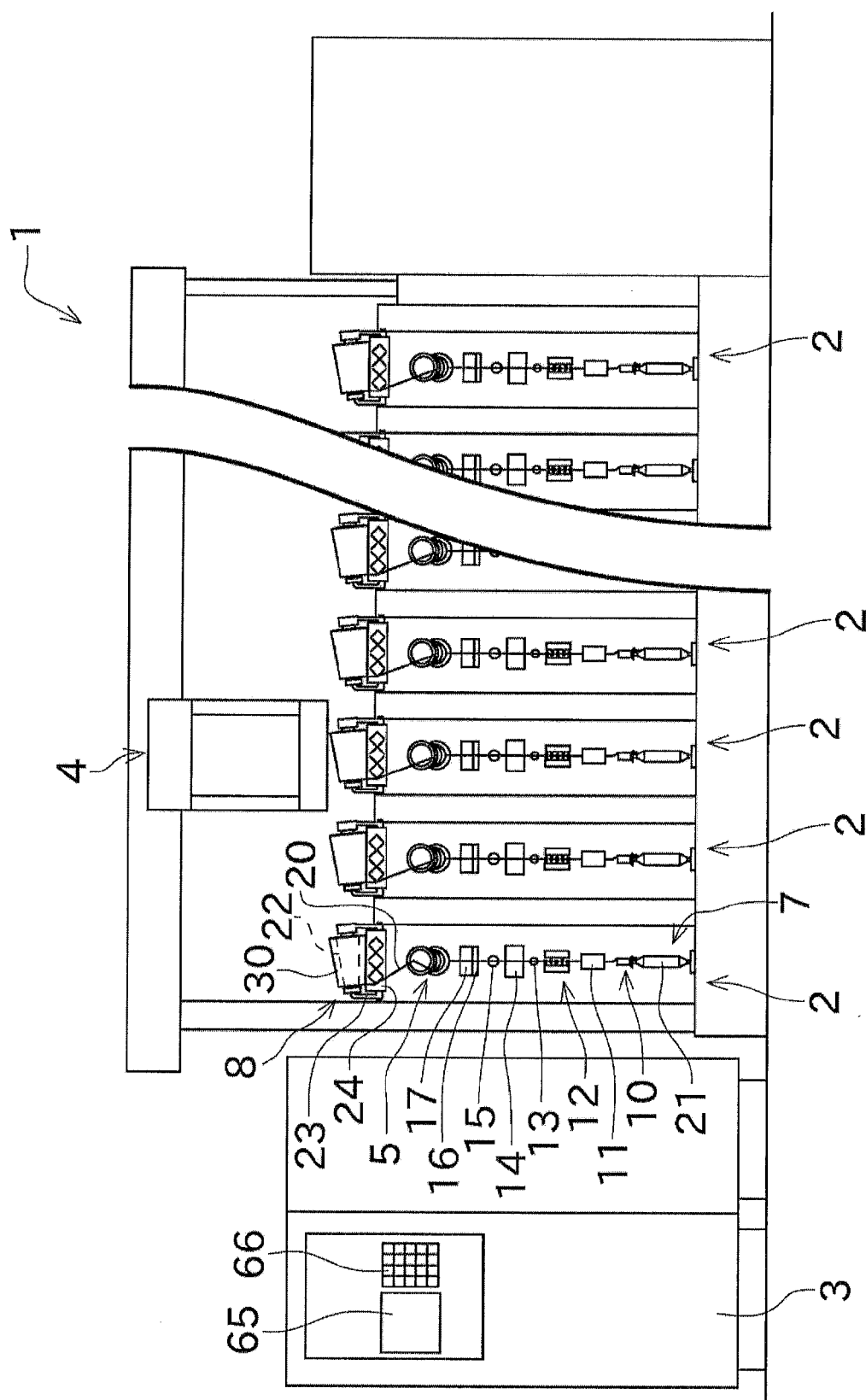


FIG. 2

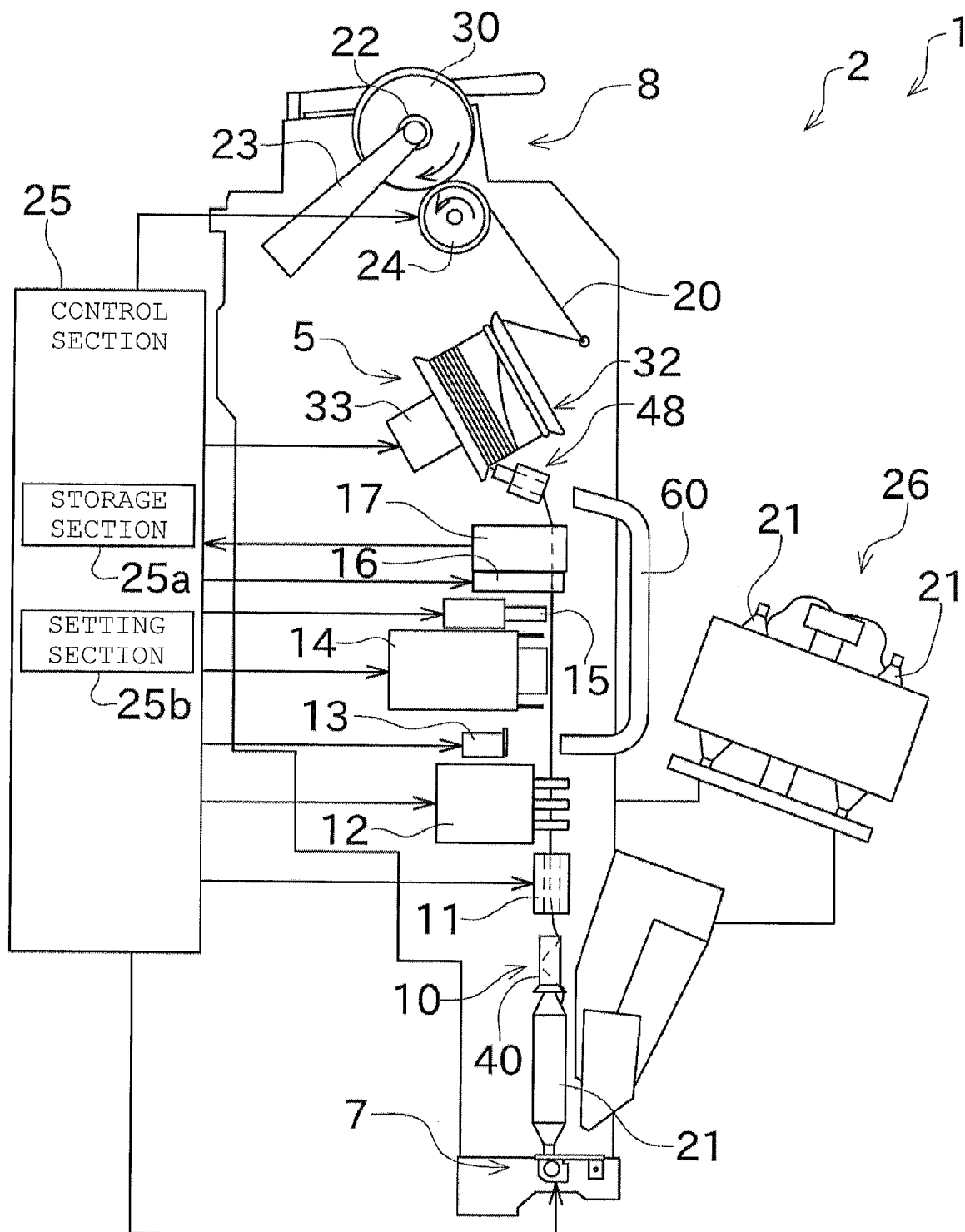


FIG. 3

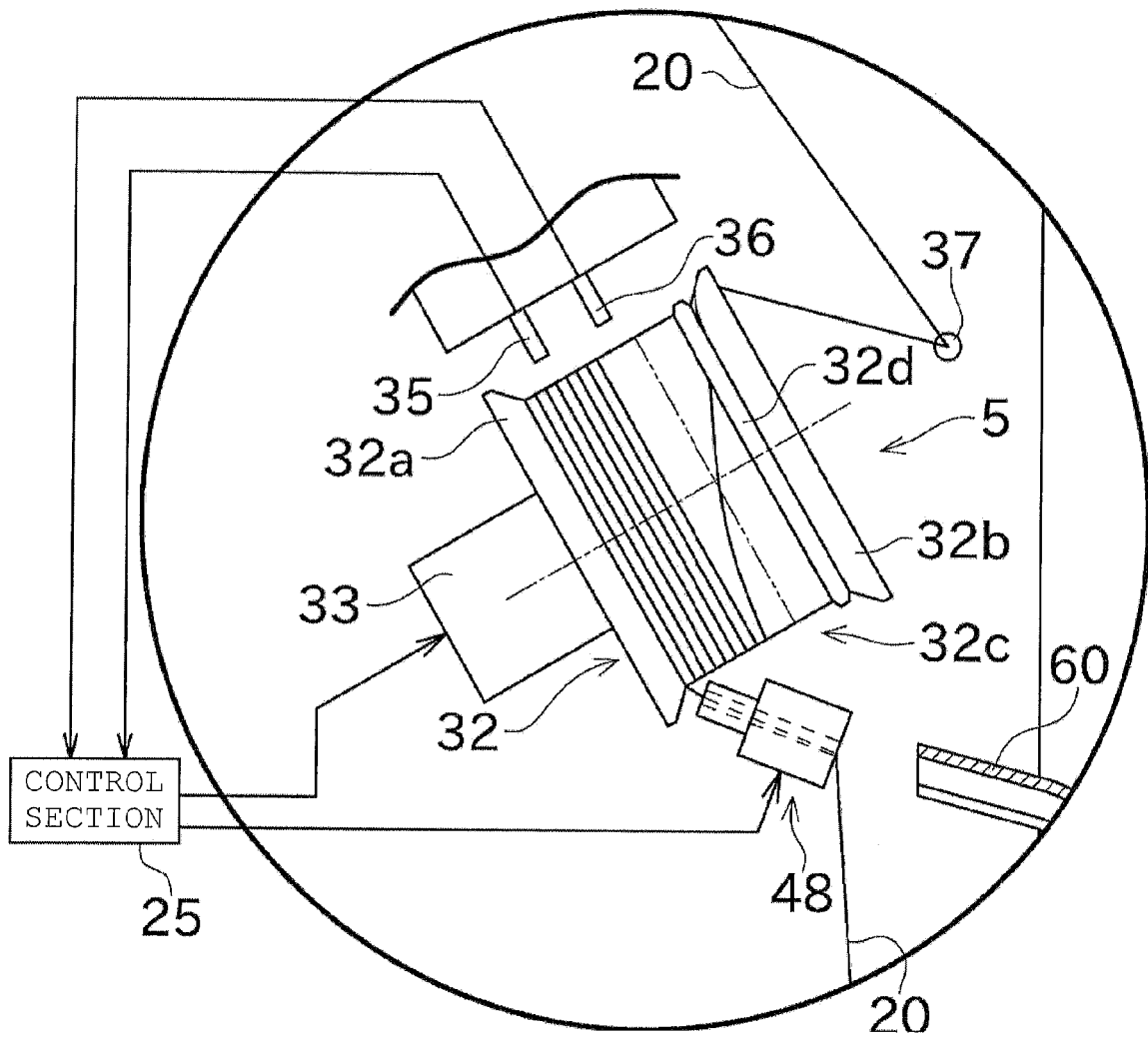


FIG. 4

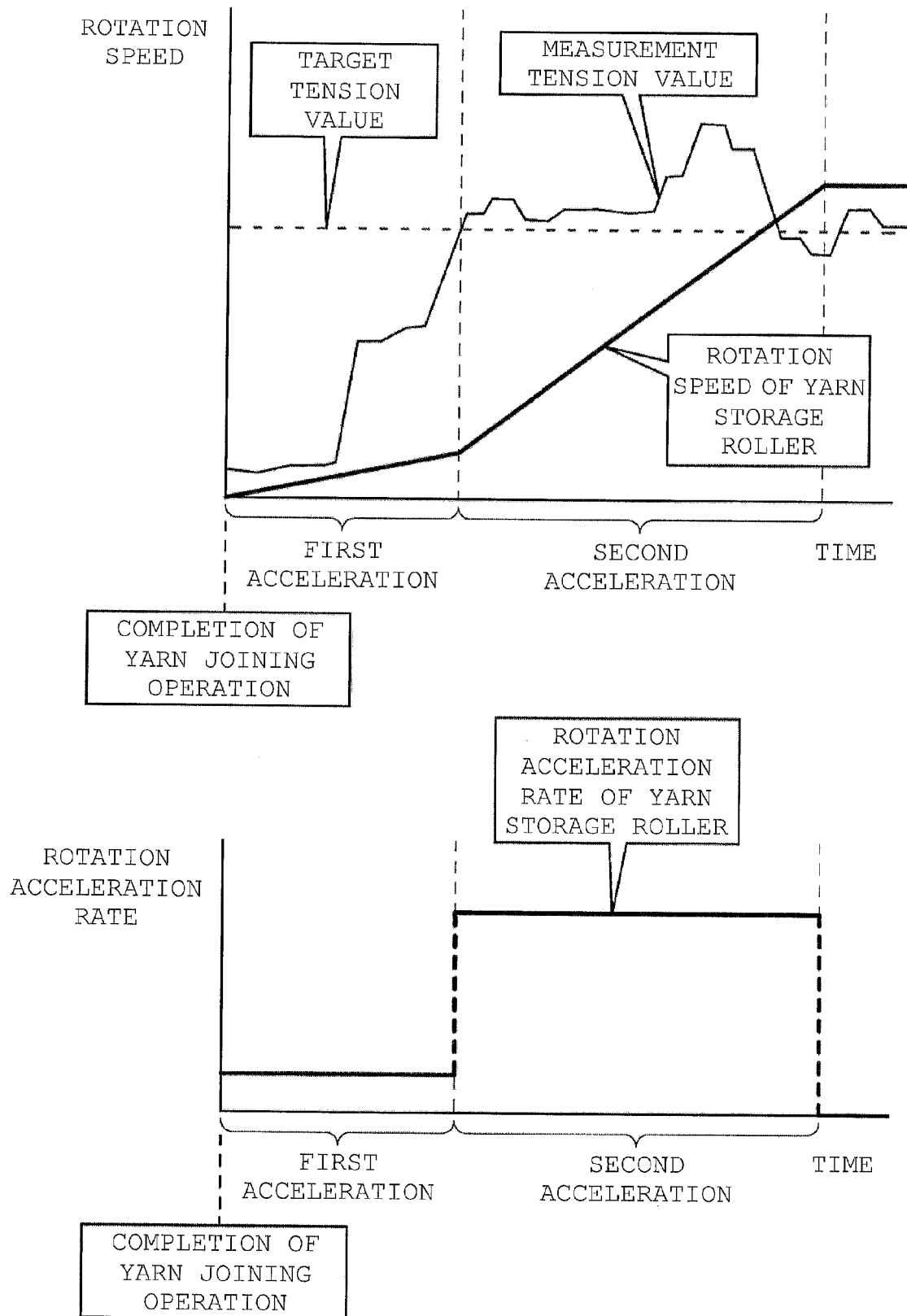
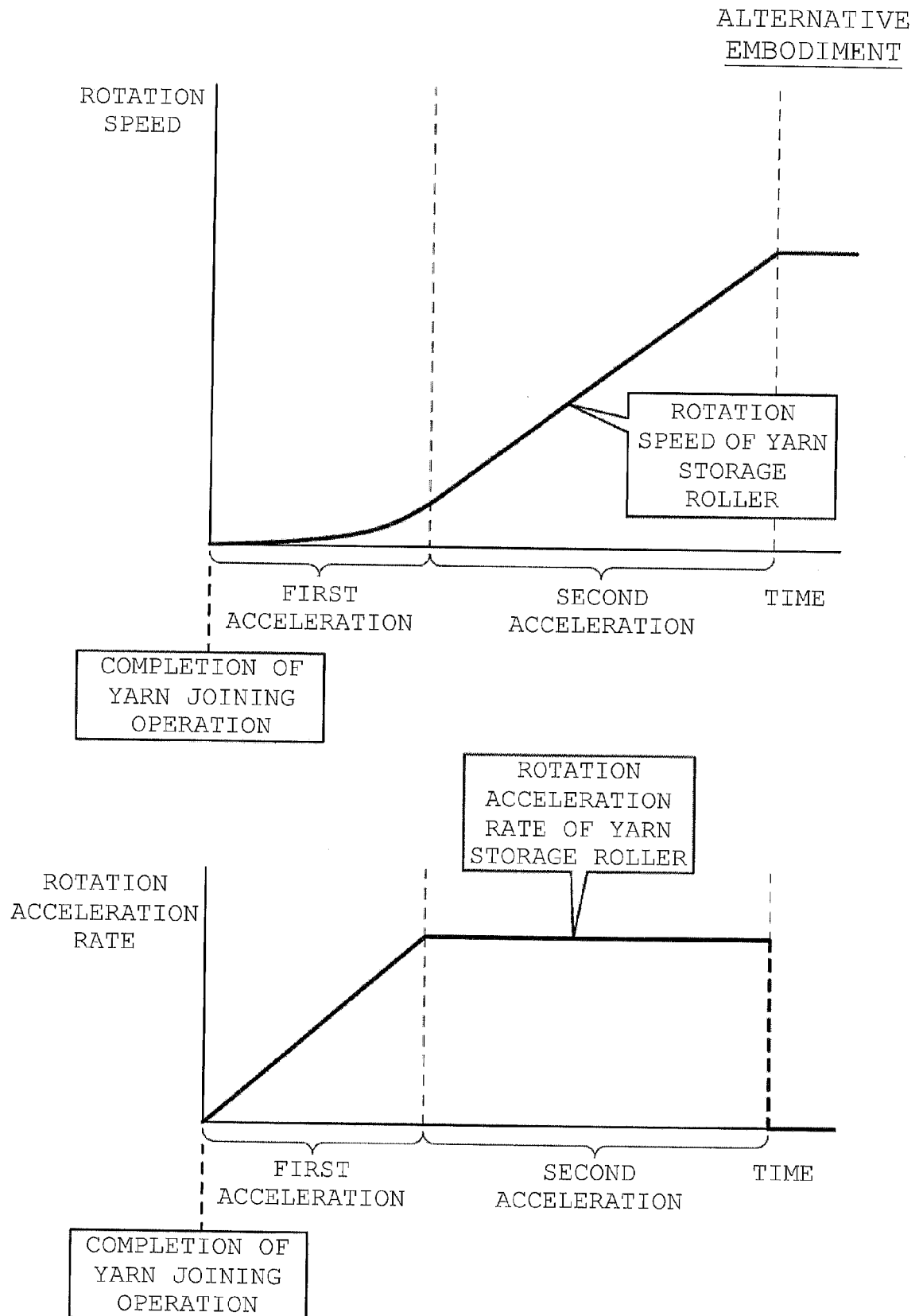


FIG. 5





EUROPEAN SEARCH REPORT

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			B65H
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		19 February 2016	Lemmen, René
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