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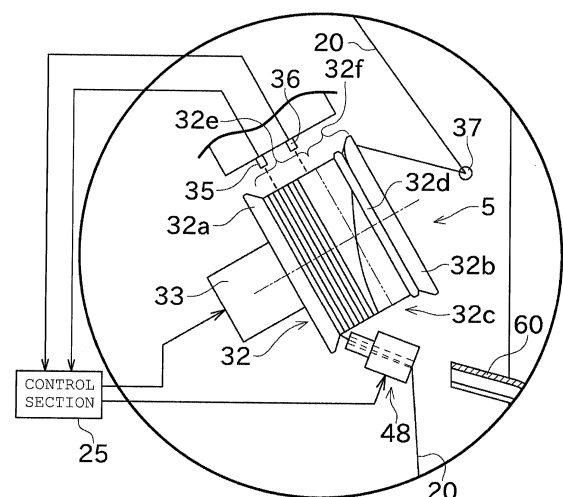
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(54) **YARN STORAGE DEVICE AND YARN WINDING DEVICE EQUIPPED WITH YARN STORAGE DEVICE**

(57) Provided is a configuration for reliably obtaining the fluff laying effect in a yarn winding machine including a yarn storage device (5). An automatic winder includes a yarn supplying section, a yarn storage device (5), and a package forming section. The yarn storage device (5) winds and stores a yarn (20) of the yarn supplying section. The package forming section winds the yarn (20) pulled out from the yarn storage device (5) to form a package. The yarn storage device (5) includes a yarn storage roller (32) around which the yarn (20) is wound. An outer circumferential surface of the yarn storage roller (32) includes a storage region surface (32e) in which the yarn (20) is wound in an aligned manner, and a pull-out region surface (32f) through which the yarn (20) passes when the yarn (20) wound in the storage region surface (32e) is pulled out toward the package forming section side. A surface roughness of the pull-out region surface, which is a surface that the yarn (20) passing the pull-out region surface (32f) contacts, is greater than a surface roughness of the storage region surface (32e), which is a surface that the yarn (20) wound in the storage region surface (32e) contacts.

FIG. 2



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a yarn winding device equipped with a yarn storage device. Specifically, the present invention relates to a configuration of a surface of a yarn storage device for enhancing fluff laying effect in the yarn storage device.

2. Description of the Related Art

[0002] Conventionally, in a yarn winding device adapted to wind a spun yarn and the like to form a package, when a yarn breakage occurs or when the yarn is cut, a yarn pulled out from the package side and a yarn pulled out from a yarn supplying side are joined with a yarn joining device.

[0003] In the yarn winding device having such a configuration, when the yarn is disconnected for some reason, a yarn end is wound toward the package side, whereby the winding of the yarn needs to be once stopped and the yarn end needs to be pulled out from the package side.

[0004] WO 2011/040545 A discloses a yarn winding device capable of continuously winding a yarn from the start of winding to the end of winding of the package. In the yarn winding device of WO 2011/040545 A, the yarn storage device is arranged between the yarn supplying section and the yarn winding section, and the spun yarn stored in the yarn storage device is wound by the yarn winding section. In the configuration of WO 2011/040545 A, even if the yarn is disconnected, the yarn joining operation can be carried out while winding the yarn stored in the yarn storage device by the yarn winding section, so that the yarn winding operation can be continuously carried out without being interrupted.

[0005] In the yarn winding device of WO 2011/040545 A, the yarn storage device includes a rotary storage drum driven by a motor, and has a means for controlling the rotation speed of the motor. Furthermore, in the yarn storage device, the spun yarn is not wound around a portion on a yarn unwinding side (side on which the yarn is pulled out and unwound by the yarn winding section) with respect to a predetermined middle position of the rotary storage drum. According to such a configuration, when unwound from the rotary storage drum and traveled toward the yarn winding section, the spun yarn wound around the rotary storage drum travels while rolling on a surface of the relevant portion of the rotary storage drum. WO 2011/040545 A thus proposes to lay down fluff of the spun yarn.

[0006] As described above, WO 2011/040545 A has an effect of fluff laying by making the spun yarn roll on the surface of the rotary storage drum. The inventors of the present application used an automatic winder includ-

ing a yarn storage roller serving as a rotary storage drum to examine the effect of fluff laying of what extent is actually obtained through experiments.

[0007] If buffing is carried out on the entire surface of the yarn storage roller, it is difficult to stably obtain the effect of fluff laying. Specifically, the automatic winder including the yarn storage roller reduces fluffing by about 30 % compared to the automatic winder without the yarn storage device in some cases, but barely obtains the fluff laying effect in some other cases. Thus, in the conventional yarn winding device, the variation in the effect of fluff laying is large, and the fluff laying effect is difficult to reliably exhibit.

BRIEF SUMMARY OF THE INVENTION

[0008] The present invention has been made in view of the above circumstances, and an object thereof is to provide a configuration which can reliably obtain the fluff laying effect in a yarn winding device including the yarn storage device.

[0009] The problem to be solved by the present invention is as described above, and the means for solving the problem and the effect thereof will be described next.

[0010] According to an aspect of the present invention, a yarn storage device having the following configuration, and a yarn winding device including the yarn storage device are provided. In other words, a yarn storage device includes a rotating body around which a yarn is wound, the rotating body includes a storage region surface in which the yarn is wound in an aligned manner, and a pull-out region surface through which the yarn passes when the yarn wound in the storage region surface is pulled out, and a surface roughness of the pull-out region surface is greater than a surface roughness of the storage region surface. The yarn winding device includes a yarn supplying section, the yarn storage device, and a package forming section. The yarn supplying section is adapted to supply a yarn. The package forming section winds the yarn from the yarn storage device to form a package. The yarn storage device winds and stores the yarn from the yarn supplying section on the rotating body.

[0011] Thus, since the surface is smooth in the storage region surface in which the yarn is wound at high density, the yarn smoothly flows downstream, and since the surface is rough in the pull-out region surface the yarn is rolled without sliding, so that the fluff laying is effectively carried out. Therefore, in the yarn storage device, the fluff laying can be effectively realized while smoothly carrying out the storage of the yarn.

[0012] In the above-described yarn winding device, when compared in the arithmetic average roughness, the surface roughness of the pull-out region surface is greater than or equal to 5 times and smaller than or equal to 50 times of the surface roughness of the storage region surface.

[0013] Thus, a difference in the surface roughness appropriately is generated between the pull-out region sur-

face and the storage region surface, and thus the smoothness of the storage of the yarn and the enhancement of the fluff laying effect can be both satisfied.

[0014] The above-described yarn winding device preferably has the following configuration. In other words, the package forming section can pull out the yarn from the yarn storage device at a speed of greater than or equal to 1000 m and smaller than or equal to 2000 m per minute. The surface roughness of the pull-out region surface is greater than or equal to 1 and smaller than or equal to 2 in the arithmetic average roughness.

[0015] Thus, the yarn appropriately rolls on the pull-out region surface, and thus the fluff laying can be effectively realized.

[0016] The above-described yarn winding device preferably has the following configuration. In other words, the yarn winding device includes a yarn detection sensor adapted to detect the yarn stored in the yarn storage device. The yarn detection sensor detects proximity of a boundary of the storage region surface and the pull-out region surface in the storage region surface.

[0017] Thus, control is reliably made by the yarn detection sensor so that the yarn is wound in an aligned manner in the storage region surface having a smooth surface. Therefore, the storage of the yarn can be smoothly carried out. Since the location detected by the yarn detection sensor is in the storage region surface, the control (e.g., control of rotation speed of the rotating body) for adjustment of the storage amount can be carried out in advance at a stage before the yarn wound in the storage region surface reaches the pull-out region surface.

[0018] The above-described yarn winding device preferably includes a pull-out yarn guiding member adapted to guide the yarn so as to make contact with the pull-out region surface when the yarn wound in the storage region surface is pulled out.

[0019] Thus, the pull-out yarn guiding member can prevent the yarn unwound from the storage region surface from lifting up from the pull-out region surface due to the influence of centrifugal force and the like. Therefore, the yarn is reliably rolled on the pull-out region surface, and the fluff laying can be carried out.

[0020] In the above-described yarn winding device, the pull-out yarn guiding member can be configured as an elastic ring member.

[0021] In this case, the pulled-out yarn is sandwiched between the elastic ring member and the rotating body, so that the yarn can be reliably brought into contact with the pull-out region surface and the fluff laying can be carried out.

[0022] In the above-described yarn winding device, the pull-out yarn guiding member can be configured as a rod-shaped resistance member attached to be relatively rotatable with respect to the rotating body around which the yarn is wound.

[0023] In this case, for the fluff laying, the yarn can be reliably brought into contact with the pull-out region sur-

face. Furthermore, as the yarn storage roller can be rotated with the yarn making contact with the rod-shaped resistance member, the operation of winding the yarn around the rotating body can be automatically carried out.

[0024] The above-described yarn winding device preferably has the following configuration. In other words, the rotating body includes a tapered portion having a tapered shape in which a diameter increases toward an end in an axial direction. The pull-out region surface includes a surface of the tapered portion in a pull-out direction of the yarn.

[0025] Thus, the surface of the tapered portion that easily makes contact with the yarn pulled out from the storage region surface becomes the pull-out region surface, and thus the yarn reliably rolls on the pull-out region surface and the fluff laying can be carried out.

[0026] In the above-described yarn winding device, one of a knurling process, a shot blast process, formation of lathe by a lathe process, and surface chemical processing is preferably carried out on at least one of the pull-out region surface and the storage region surface.

[0027] Thus, the surface roughness as described above can be easily realized for the pull-out region surface and the storage region surface.

[0028] In the above-described yarn winding device, the yarn supplying section preferably includes a supporting section adapted to support a yarn supplying bobbin around which the yarn spun with a ring spinning machine is wound.

[0029] Therefore, in the yarn winding device that supports the yarn supplying bobbin and winds the yarn of the yarn supplying bobbin while storing, the effective fluff laying of the spun yarn can be carried out.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030]

FIG. 1 is a schematic side view of a winding unit configuring an automatic winder according to an embodiment of the present invention. FIG. 2 is an enlarged view illustrating in detail a configuration of the periphery of a yarn storage device.

FIG. 3 is a side view of a yarn storage roller.

FIG. 4 is a graph illustrating a fluff generated amount in the automatic winder of the present embodiment in comparison with the automatic winder without the yarn storage device.

FIG. 5 is an enlarged view illustrating the periphery of a yarn storage device according to an alternative embodiment.

FIG. 6 is a side view of a yarn storage roller according to the alternative embodiment.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0031] An embodiment of the present invention will be

described below. FIG. 1 is a schematic side view of a winding unit (yarn winding device) 2 configuring an automatic winder 1 serving as a yarn winding machine according to an embodiment of the present invention.

[0032] The automatic winder 1 of the present embodiment has a configuration in which a plurality of winding units 2 are arranged in a line. The automatic winder 1 includes a machine management device (not illustrated) for intensively managing the winding unit 2 and a blower box (not illustrated) including a compressed air source and a negative pressure source.

[0033] As illustrated in FIG. 1, the winding unit 2 mainly includes a yarn supplying section 7, a yarn storage device 5, and a package forming section 8. The winding unit 2 is configured to unwind a yarn (spun yarn) 20 of a yarn supplying bobbin 21 supported by the yarn supplying section 7, and wind the unwound yarn 20 around a winding bobbin 22 to form a package 30.

[0034] FIG. 1 illustrates a state of the winding unit 2 at the time of normal winding. Herein, "at the time of normal winding" refers to a state where the yarn 20 is in continuation between a yarn supplying bobbin 21 and the package 30, and 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 upstream and downstream when seen in a travelling direction of the yarn 20.

[0035] The yarn supplying section 7 includes a bobbin supporting peg (supporting section) 9 for holding the yarn supplying bobbin 21 in a substantially upright state. The bobbin supporting peg 9 is configured as an upward projection-shaped member that can be inserted into a core tube of the yarn supplying bobbin 21. The yarn 20 spun by a ring fine spinning machine (not illustrated) is wound around the yarn supplying bobbin 21. According to such a configuration, the yarn supplying section 7 can unwind and supply the yarn 20 from the yarn supplying bobbin 21 supported by the bobbin supporting peg 9. Furthermore, 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 the 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.

[0036] The yarn storage device 5 is arranged between the yarn supplying section 7 and the package forming section 8, and is configured to temporarily store the yarn 20 supplied from the yarn supplying section 7 and then supply the yarn 20 to the package forming section 8. The yarn storage device 5 includes a yarn storage roller (rotating 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.

[0037] 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, the rotation in the direction of winding the

yarn 20 from the yarn supplying section 7 is sometimes referred to as forward rotation and the rotation in the opposite direction is sometimes referred to as reverse rotation with respect to the rotation of the yarn storage roller 32.

[0038] The package forming section 8 includes a cradle 23 configured to detachably attach the winding bobbin 22, and a traverse drum 24 adapted to traverse the yarn 20 and to drive the winding bobbin 22.

[0039] The traverse drum 24 is arranged facing the winding bobbin 22, and when the traverse drum 24 is rotatably driven with an electric motor (not illustrated), the winding bobbin 22 is rotated accompanying rotation of the motor. The yarn 20 stored on the yarn storage device 5 can be unwound and pulled out, and wound by the winding bobbin 22. A traverse groove (not illustrated) is formed on the outer circumferential surface of the traverse drum 24, so that the yarn 20 can be traversed at a predetermined width by the traverse groove. 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 to a predetermined length.

[0040] In the present embodiment, the package forming section 8 can pull out and wind the yarn 20 from the yarn storage device 5 at a speed (e.g., 1500 m/min.) of greater than or equal to 1000 m and smaller than or equal to 2000 m per one minute. However, the speed at which the yarn 20 is wound is not limited to the range described above, and can be appropriately defined.

[0041] The winding unit 2 includes various types of devices on a yarn travelling path from the yarn supplying section 7 to the package forming section 8 passing through the yarn storage device 5. Specifically, an unwinding assisting device 10, a lower yarn blow-up section 11, a tension applying device 12, an upper yarn catching section 13, a yarn joining device 14, a yarn trap 15, a cutter 16, a clearer (yarn defect detecting device) 17, and an upper yarn pull-out section 48 are arranged on the yarn travelling path in order from the yarn supplying section 7 towards the yarn storage device 5.

[0042] The unwinding assisting device 10 causes a movable member 40 to make contact with a balloon formed at an upper part of the yarn supplying bobbin 21 when the yarn 20 unwound from the yarn supplying bobbin 21 is swung around, and appropriately controls the size of the balloon to assist the unwinding of the yarn 20.

[0043] 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 the lower yarn from the yarn supplying bobbin 21 toward the yarn joining device 14 with the compressed air. According to such a configuration, when the yarn 20 is disconnected between the yarn supplying bobbin 21 and the yarn storage device 5, the yarn 20 is blown up toward the yarn supplying bobbin 21 by the lower yarn blow-up section 11 to guide the yarn 20 to the yarn joining device 14 (yarn trap 15).

[0044] The tension applying device 12 applies a predetermined tension on the travelling yarn 20. The 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, and is adapted to apply a predetermined resistance by travelling the yarn 20 between the comb teeth. The comb teeth on the movable side 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. As a matter of course, the configuration of the tension applying device 12 is not limited thereto, and a disc-type tension applying device can be adopted, for example.

[0045] 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 at the time of the yarn joining operation to suck and catch the yarn 20 from the yarn storage device 5.

[0046] The yarn joining device 14 joins the yarn 20 from the yarn supplying bobbin 21 and the yarn 20 from the yarn storage device 5 when the yarn 20 between the yarn supplying bobbin 21 and the yarn storage device 5 is disconnected such as in a case in which a yarn defect is detected by the clearer 17 and the yarn 20 is cut with the cutter 16, the yarn 20 being unwound from the yarn supplying bobbin 21 breaks, or the yarn supplying bobbin 21 is replaced. The yarn joining device 14 may be a type that uses fluid such as compressed air or a mechanical-type.

[0047] 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 arranged 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 device 5, the yarn 20, blown up by the lower yarn blow-up section 11, from the yarn supplying bobbin 21 can be sucked and caught by the yarn trap 15.

[0048] The clearer 17 is configured to detect a yarn defect such as slub and foreign substance mixture by monitoring the thickness of the yarn 20 and the like. When detecting the defect of the yarn, the clearer 17 controls the winding unit 2, and transmits a yarn defect detection signal to the control section 25, to be described later. The cutter 16 for immediately cutting the yarn 20 in response to the yarn defect detection signal is arranged in proximity to the clearer 17.

[0049] The upper yarn pull-out section 48 is an air sucker device arranged immediately upstream of the yarn storage device 5, and is configured to blow down the upper yarn from the yarn storage device 5 toward the yarn joining device 14 with the compressed air. Specifically, a blowing port of the yarn 20 is formed in the upper yarn pull-out section 48, and a yarn guiding member 60,

which is a curved tubular member, is arranged in proximity to the blowing 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 an opening on one end side faces the blowing port of the upper yarn pull-out section 48 and an opening on the other end side faces the upper yarn catching section 13. A guiding path that connects the openings on both ends so as to circumvent the yarn joining device 14 and the like is formed inside the yarn guiding member 60.

[0050] According to such a configuration, when the yarn 20 is disconnected between the yarn supplying bobbin 21 and the yarn storage device 5, the upper yarn pull-out section 48 pulls out the yarn 20 from the yarn storage device 5 so as to blow away the yarn along the guiding path of the yarn guiding member 60, and causes the upper yarn catching section 13 to catch the yarn 20. A pass-through slit (not illustrated) is formed over the entire length in the yarn guiding member 60, so that the yarn 20 can be pulled out from the interior of the yarn guiding member 60 while the yarn 20 is caught by the upper yarn catching section 13. Therefore, the yarn 20 from the yarn storage device 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).

[0051] Next, a description will be made on a configuration for controlling the winding unit 2.

[0052] Each of the winding units 2 includes a control section 25. The control section 25 is configured by a hardware such as a CPU, a ROM, a RAM, and the like (not illustrated), and software such as a control program stored in the RAM. Each configuration of the winding unit 2 is controlled by the cooperative operation of the hardware and the software.

[0053] Specifically, the control section 25 carries out a control to drive the roller drive motor 33 to forward rotate the yarn storage roller 32, and unwind the yarn 20 from the yarn supplying bobbin 21 set in the yarn supplying section 7 to store the yarn 20 in the yarn storage device 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 device 12 to apply an appropriate tension on the yarn 20. The control section 25 also controls an electric motor (not illustrated) for driving the traverse drum 24, and carries out a control to wind the yarn 20 around the winding bobbin 22 to form the package 30.

[0054] In the yarn winding operation, the control section 25 changes the speed at which the roller drive motor 33 forward rotates the yarn storage roller 32 to carry out a control such that the storage amount of the yarn 20 in the yarn storage device 5 is ensured by a certain extent (details will be described later). Furthermore, the control section 25 controls the cutter 16 to operate when the yarn defect detection signal is input from the clearer 17.

[0055] When the yarn 20 is disconnected between the yarn supplying section 7 and the yarn storage device 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 device 5.

[0056] The control section 25 of each winding unit 2 is configured to communicate with the machine management device. The operation of the plurality of winding units 2 can be intensively managed in the machine management device.

[0057] Next, a description will be made on the yarn joining operation in the automatic winder 1 (winding unit 2) of the present embodiment.

[0058] In other words, when the yarn 20 from the yarn storage device 5 and the yarn 20 from the yarn supplying bobbin 21 are disconnected due to the yarn breakage, the cutting of the yarn 20 by the cutter 16, the replacement of the yarn supplying bobbin 21, and the like, the yarn joining operation by the yarn joining device 14 is carried out.

[0059] This will be specifically described below. The control section 25 first blows the yarn 20 from the yarn supplying bobbin 21 upward with 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.

[0060] Before and after this, the control section 25 blows away the yarn 20 stored in the yarn storage device 5 with the upper yarn pull-out section 48 while reverse rotating the yarn storage roller 32 of the yarn storage device 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 device 5 thus can be guided to the yarn joining device 14. When the yarn from the yarn storage device 5 is introduced to the yarn joining device 14, the control section 25 stops the reverse rotation of the yarn storage roller 32.

[0061] The control section 25 activates the yarn joining device 14 in this state to join the yarn 20 from the yarn supplying bobbin 21 and the yarn 20 from the yarn storage device 5. When the yarn joining operation is terminated, the control section 25 resumes the forward rotation of the yarn storage device 5 to resume the winding of the yarn to the yarn storage device 5.

[0062] When the yarn 20 between the yarn supplying bobbin 21 and the yarn storage device 5 is disconnected, the winding of the yarn 20 into 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 device 5 is interposed between the yarn supplying section 7 and the package forming section 8, as described above, and a constant amount of yarn 20 is stored on the yarn storage device 5. The package forming section 8 is configured to wind the yarn 20 stored on the yarn storage device 5. Therefore, even if the supply of yarn 20 from the yarn supplying bobbin 21 is interrupted for some reasons (e.g.,

when yarn joining operation is carried out), the winding of the yarn 20 into the package 30 can be continued.

[0063] Thus, the winding operation in the package forming section 8 is not interrupted by the yarn joining operation, and the like, so that the package 30 can be stably produced at high speed. Furthermore, since the yarn storage device 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 subjected to the influence of tension fluctuation of when unwinding the yarn 20 from the yarn supplying bobbin 21.

[0064] Next, a description will be made on the yarn storage device 5 of the present embodiment with reference to FIGS. 2 and 3. FIG. 2 is an enlarged view illustrating, in detail, the configuration of the periphery of the yarn storage device 5. FIG. 3 is a side view of the yarn storage roller 32.

[0065] As described above, the yarn storage device 5 includes the yarn storage roller 32 and the roller drive motor 33.

[0066] The yarn storage roller 32 is formed as a substantially cylindrical member, and is configured to store the yarn 20 by winding the yarn 20 around the outer circumferential surface thereof. The roller drive motor 33 is configured to rotatably drive the yarn storage roller 32 with an axis line thereof as the center. Hereinafter, an end of the yarn storage roller 32 on the side the roller drive motor 33 is arranged is referred to as basal end and the end on the opposite side is referred to as distal end.

[0067] As illustrated in FIG. 2, the basal end of the yarn storage roller 32 includes a tapered basal tapered portion 32a in which the diameter increases toward the end. The distal end of the yarn storage roller 32 includes a tapered distal tapered portion 32b in which the diameter increases toward the end. A cylindrical portion 32c, which is the portion formed into a cylindrical shape (portion having a substantially constant diameter) is arranged between the basal tapered portion 32a and the distal tapered portion 32b. The yarn 20 is prevented from slipping off from the end of the yarn storage roller 32 by forming the tapered portions 32a, 32b.

[0068] The upper yarn pull-out section 48 is arranged in proximity to the boundary portion of the basal tapered portion 32a and the cylindrical portion 32c of the yarn storage roller 32. The upper yarn pull-out section 48 is configured as a hollow cylindrical member, where 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 toward the surface of the yarn storage roller 32 during the normal winding.

[0069] When the yarn storage roller 32 is forward rotated with the yarn 20 wound around the yarn storage roller 32, the yarn storage device 5 can apply tension on the yarn 20 located upstream (on the yarn supplying bobbin 21 side) of the yarn storage device 5. The yarn 20 thus 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. The yarn 20 is guided to the boundary portion of the basal tapered portion 32a and the cylindrical portion 32c as illustrated in FIG. 2, so that the yarn 20 is sequentially wound so as to push away the yarn layer from the basal end side toward the distal end side of the cylindrical portion 32c. As a result, the yarn 20 on the yarn storage roller 32 (on the cylindrical portion 32c) is pushed by a newly wound yarn 20, and sequentially fed toward the distal end side on the surface of the cylindrical portion 32c. The yarn 20 is thus aligned in a spiral form and wound in an orderly manner from the basal end side on the outer circumferential surface of the yarn storage roller 32.

[0070] The yarn 20 wound around the cylindrical portion 32c is pulled out toward the downstream (distal end side, package forming section 8 side) along the axial direction at the position in the middle of the cylindrical portion 32c in the axial direction. The position where the yarn 20 aligned in the yarn storage roller 32 is pulled out toward the downstream differs depending on the storage amount of the yarn 20 at the time.

[0071] When being pulled out, the yarn 20 is to pass through a pull-out guide 37 arranged on an extended line of the center axis line of the yarn storage roller 32. Thus, with the configuration of pulling out the yarn 20 toward 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 rotation state of the yarn storage roller 32. In other words, even if the rotating direction of the yarn storage roller 32 is forward or backward, or even if 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.

[0072] In the yarn storage roller 32 of the present embodiment, a region of one part of the basal end side on the surface of the cylindrical portion 32c is a storage region surface 32e for aligning and winding the yarn 20 in the manner described above. The remaining region (region on distal end side) on the surface of the cylindrical portion 32c and the surface of the distal tapered portion 32b are a pull-out region surface 32f where the yarn 20 pulled out from the storage region surface 32e passes.

[0073] Therefore, the outer circumferential surface (rotating surface) of the yarn storage roller 32 includes the storage region surface 32e and the pull-out region surface 32f. The pull-out region surface 32f is the region surface for passing the yarn 20, and the yarn 20 is neither aligned nor wound in the pull-out region surface 32f.

[0074] In the present embodiment, buffing is performed on the surface of the storage region surface 32e, and an appropriate surface process (a lathe process in the present embodiment) is performed on the surface of the pull-out region surface 32f to actively make the surface rough.

[0075] As a result, the surface roughness of the storage region surface 32e is greater than or equal to 0.04 and smaller than or equal to 0.2 in arithmetic average

roughness, and the surface roughness of the pull-out region surface 32f is greater than or equal to 1 and smaller than or equal to 2 in arithmetic average roughness. Therefore, comparing the arithmetic average roughness, the surface roughness of the pull-out region surface 32f is greater than or equal to 5 times and smaller than or equal to 50 times the surface roughness of the storage region surface 32e.

[0076] The arithmetic average roughness in the present specification is obtained by obtaining an average line from a roughness curve, and then, extracting only a reference length (1) in a direction of the average line from the roughness curve, and representing a value R_a obtained by the following equation (1) in micrometer (μm) when the roughness curve is expressed as $y=f(x)$ with x-axis taken in the direction of the average line of the extracted portion and y-axis taken in the direction perpendicular thereto.

[Equation 1]

$$R_a = \frac{1}{l} \int_0^l |f(x)| dx \quad \dots(1)$$

[0077] If the surface roughness on the pull-out region surface 32f is smaller than 1 in the arithmetic average roughness, the yarn 20 does not roll on the pull-out region surface 32f and tends to easily slide. If the surface roughness of the pull-out region surface 32f is greater than 2 in the arithmetic average roughness, the fuzz of the yarn 20 may worsen. Therefore, the surface roughness in the pull-out region surface 32f is suitably greater than or equal to 1 and smaller than or equal to 2 in the arithmetic average roughness.

[0078] Thus, the yarn 20 can easily roll on the surface of the yarn storage roller 32 when the yarn 20 passes the yarn storage roller 32 by differentiating the surface roughness between the storage region surface 32e and the pull-out region surface 32f. In other words, the yarn smoothly flows downstream since the surface roughness is small in the storage region surface 32e, and the yarn is rolled without sliding since the surface roughness is large in the pull-out region surface 32f, so that the fluff laying is effectively carried out.

[0079] In the present embodiment, the pull-out region surface 32f also includes the surface of the distal tapered portion 32b, and the surface roughness is adjusted to be greater than or equal to 1 and smaller than or equal to 2 in the arithmetic average roughness by the lathe process. The distal tapered portion 32b has a tapered shape in which the diameter increases toward the end, so that the surface easily makes contact with the yarn 20 pulled out from the storage region surface 32e toward the distal end side. As a result, the yarn 20 is satisfactorily rolled on the pull-out region surface 32f, and the fluff laying effect can be enhanced.

[0080] In the present embodiment, a rubber band

(elastic ring member, pull-out yarn guiding member) 32d is hooked to an appropriate location in the pull-out region surface 32f of the yarn storage roller 32. Specifically, the rubber band 32d is formed into an O-ring shape, and is arranged at the boundary portion of the cylindrical portion 32c and the distal tapered portion 32b. The yarn 20 is passed between the rubber band 32d and the surface of the yarn storage roller 32, and pulled out from the yarn storage roller 32. The distal tapered portion 32b is formed in the yarn storage roller 32, and thus the rubber band 32d moves with the yarn 20 and does not drop from the yarn storage roller 32. According to the above configuration, an appropriate tension is applied on the yarn 20 unwound from the yarn storage roller 32 by the tightening of the rubber band 32d with respect to the yarn storage roller 32, so that the formation of the balloon by the swinging of the yarn 20 can be suppressed and the unwinding of the yarn 20 can be stabilized. Furthermore, since the clump of yarn 20 can be resolved and the yarn 20 can be unwound, a phenomenon (sluffing) in which the yarn 20 on the yarn storage roller 32 is removed all at once in a clump can be prevented. Furthermore, the yarn 20 is held between the rubber band 32d and the yarn storage roller 32, and is rolled while being appropriately pushed against the surface of the pull-out region surface 32f by the rubber band 32d, so that the fluff laying effect can be enhanced.

[0081] Next, a description will be made on the control of the storage amount of the yarn 20 in the yarn storage device 5.

[0082] A lower limit sensor 35 adapted to detect that the yarn 20 on the yarn storage roller 32 is smaller than a lower limit amount and an upper limit sensor (yarn detection sensor) 36 adapted to detect that the yarn is greater than or equal to a predetermined upper limit amount are arranged in proximity to the yarn storage roller 32. The lower limit sensor 35 and the upper limit sensor 36 can be configured, for example, as an optical sensor. The detection results of the lower limit sensor 35 and the upper limit sensor 36 are output to the control section 25.

[0083] When detecting that the yarn 20 on the yarn storage roller 32 is less than the lower limit amount, the control section 25 appropriately controls the roller drive motor 33 and increases the rotation speed of the yarn storage roller 32. The speed at which the yarn 20 is wound around the yarn storage roller 32 thus increases. During the normal winding, the rotation speed of the traverse drum 24 is assumed to be substantially constant, and thus the speed at which the yarn 20 on the yarn storage roller 32 is unwound toward the package 30 is substantially constant. The control section 25 controls the roller drive motor 33 such 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.

[0084] On the other hand, when detecting that the yarn

20 on the yarn storage roller 32 is more than or equal to the upper limit amount, the control section 25 appropriately controls the roller drive motor 33 and decreases the rotation speed of the yarn storage roller 32. The speed at which the yarn 20 is wound around the yarn storage roller 32 thus decreases. The control section 25 controls the roller drive motor 33 such 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 yarn 20 on the yarn storage roller 32 can be gradually reduced. According to such 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.

[0085] In the present embodiment, the upper limit sensor 36 is configured to detect the yarn 20 near the boundary of the storage region surface 32e and the pull-out region surface 32f in the storage region surface 32e. Thus, the yarn 20 wound, in an aligned manner, in the storage region surface 32e can be controlled to be pulled out downstream before being pushed to the pull-out region surface 32f having a rough surface, so that the yarn 20 can be smoothly stored. The upper limit sensor 36 detects the yarn 20 not at a boundary of the storage region surface 32e and the pull-out region surface 32f, but in a location with a margin of a certain extent toward the storage region surface 32e from the boundary. Therefore, even if the deceleration of the yarn storage roller 32 is delayed by the inertia of rotation, the delay in control of the roller drive motor 33, and the like regardless of the detection of the yarn 20 by the upper limit sensor 36, the portion where the yarn 20 is wound in an aligned manner can be reliably kept in the storage region 32e having a smooth surface.

[0086] The storage amount of the yarn 20 on the yarn storage roller 32 can be controlled by changing the rotation speed of the traverse drum 24 in accordance with the detection of the lower limit sensor 35 and the upper limit sensor 36 with the speed of the yarn storage roller 32 being constant.

[0087] The inventors of the present application conducted an experiment of winding different types of yarn with the automatic winder and actually measuring the generated amount of fluff to check the fluff laying effect by the configuration of the present embodiment. In this experiment, the yarn storage roller 32 in which the surface roughness of the pull-out region surface 32f is greater than or equal to 1 and smaller than or equal to 2 in the arithmetic average roughness, and the surface roughness of the storage region surface 32e is smaller is used.

[0088] FIG. 4 is a graph comparing the fluff generated amount of the automatic winder 1 of the present embodiment and the fluff generated amount of the conventional automatic winder. In FIG. 4, when the fluff generated amount of the automatic winder (not including yarn storage device) of the conventional art is 100%, the fluff generated amount in the automatic winder 1 of the present

embodiment is illustrated with a bar graph for every type of yarn.

[0089] According to the graph, in the automatic winder 1 of the present embodiment, the fluff generated amount can be reduced at least by about 10% or greater, and about 30% or greater in a satisfactory case, compared to the automatic winder of the conventional art (without yarn storage device). Therefore, it is apparent that the yarn 20 appropriately rolls on the surface of the yarn storage roller 32 and enhances the fluff laying effect by having the surface roughness of the pull-out region surface 32f to be greater than or equal to 1 and smaller than or equal to 2 in the arithmetic average roughness.

[0090] As described above, the automatic winder 1 of the present embodiment includes the yarn supplying section 7, the yarn storage device 5, and the package forming section 8. The yarn supplying section 7 can supply the yarn 20. The yarn storage device 5 winds and stores the yarn 20 from the yarn supplying section 7. The package forming section 8 winds the yarn 20 pulled out from the yarn storage device 5 to form the package 30. The yarn storage device 5 includes the yarn storage roller 32 around which the yarn 20 is wound. The outer circumferential surface of the yarn storage roller 32 includes the storage region surface 32e and the pull-out region surface 32f. The storage region surface 32e is a region where the yarn 20 is wound in an aligned manner. The pull-out region surface 32f is a region where the yarn 20 wound in the storage region surface 32e is pulled out toward the package forming section 8. The surface roughness of the pull-out region surface 32f is greater than the surface roughness of the storage region surface 32e.

[0091] Thus, since the surface is smooth in the storage region surface 32e in which the yarn 20 is wound at high density, the yarn 20 smoothly flows downstream, and since the surface is rough in the pull-out region surface 32f the yarn 20 is rolled without sliding. Thus, the fluff laying is effectively carried out. Therefore, in the yarn storage device 5, the fluff laying can be effectively realized while smoothly carrying out the storage of the yarn 20.

[0092] In the automatic winder 1 of the present embodiment, the surface roughness of the pull-out region surface 32f is greater than or equal to 5 times and smaller than or equal to 50 times of the surface roughness of the storage region surface 32e when compared in the arithmetic average roughness.

[0093] Thus, a difference in the surface roughness appropriately is generated between the surface of the pull-out region surface 32f and the surface of the storage region surface 32e, and thus smoothness of the storage of the yarn 20 and the enhancement of the fluff laying effect can be both satisfied.

[0094] In the automatic winder 1 of the present embodiment, the package forming section 8 can pull out the yarn 20 at a speed of greater than or equal to 1000 m and smaller than or equal to 2000 m per minute. The

surface roughness of the pull-out region surface 32f is greater than or equal to 1 and smaller than or equal to 2 in the arithmetic average roughness.

[0095] Thus, the yarn 20 appropriately rolls on the surface of the pull-out region surface 32f, and thus the fluff laying effect can be effectively realized.

[0096] The automatic winder 1 of the present embodiment includes the upper limit sensor 36 for detecting the yarn 20 stored in the yarn storage device 5. The upper limit sensor 36 detects the vicinity of the boundary of the storage region surface 32e and the pull-out region surface 32f in the storage region surface 32e.

[0097] Thus, control is reliably made by the upper limit sensor 36 so that the yarn 20 is wound in an aligned manner in the storage region surface 32e having a smooth surface. Therefore, the storage of the yarn 20 can be smoothly carried out. Since the location detected by the upper limit sensor 36 is in the storage region surface 32e, the control (e.g., control of decelerating rotation of yarn storage roller 32) for adjustment of the storage amount can be carried out in advance at a stage before the yarn 20 wound around the storage region surface 32e reaches the pull-out region surface 32f.

[0098] The automatic winder 1 of the present embodiment includes the rubber band 32d for guiding the yarn 20 so as to make contact with the surface of the pull-out region surface 32f when pulling out the yarn 20 wound in the storage region surface 32e.

[0099] Thus, the rubber band 32d prevents the yarn 20 unwound from the storage region surface 32e from lifting up from the surface of the pull-out region surface 32f due to the influence of centrifugal force, and the like. Therefore, the yarn 20 is reliably rolled on the surface of the pull-out region surface 32f, and the fluff laying can be carried out.

[0100] In the automatic winder 1 of the present embodiment, the rubber band 32d guides the yarn 20 so as to make contact with the surface of the pull-out region surface 32f when pulling out the yarn 20 wound in the storage region surface 32e.

[0101] Thus, the pulled-out yarn 20 is sandwiched with the rubber band 32d, so that the yarn 20 can be reliably brought into contact with the surface of the pull-out region surface 32f and the fluff laying can be carried out.

[0102] In the automatic winder 1 of the present embodiment, the yarn storage roller 32 includes the tapered basal tapered portion 32a and distal tapered portion 32b in which the diameter increases toward the end in the axial direction. The surface of the pull-out region surface 32f includes the surface of the distal tapered portion 32b arranged in the pull-out direction of the yarn 20.

[0103] Thus, the surface of the distal tapered portion 32b that easily makes contact with the yarn 20 pulled out from the storage region surface 32e becomes the pull-out region surface 32f, and thus the yarn 20 reliably rolls on the surface of the pull-out region surface 32f and the fluff laying can be carried out.

[0104] In the automatic winder 1 of the present embod-

iment, the lathe process is performed on the surface of the pull-out region surface 32f.

[0105] Thus, the surface roughness as described above can be easily realized for the pull-out region surface 32f.

[0106] In the automatic winder 1 of the present embodiment, the yarn supplying section 7 includes the bobbin supporting peg 9 for supporting the yarn supplying bobbin 21 around which the yarn 20 spun by the ring spinning machine is wound.

[0107] In the automatic winder 1 that supports the yarn supplying bobbin 21 and winds the yarn of the yarn supplying bobbin 21 while storing, the effective fluff laying of the spun yarn can be carried out.

[0108] Next, a description will be made on an alternative embodiment of the above-described embodiment with reference to FIGS. 5 and 6. In the description of the present alternative embodiment, the same reference numerals are denoted in the drawings for the members same as or similar to those in the embodiment described above, and the description thereof will be omitted.

[0109] The yarn storage device 5 of the alternative embodiment illustrated in FIGS. 5 and 6 includes a flyer (rod-shaped resistance member, pull-out yarn guiding member) 32g that can relatively rotate with respect to the yarn storage roller 32, in place of the rubber band 32d of the above-described embodiment. The flyer 32g is arranged proximate to the end face of the distal end portion of the yarn storage roller 32, and is configured to be rotatable with the rotation axis of the yarn storage roller 32 as a center. The yarn 20 is pulled out from the storage region surface 32e of the yarn storage roller 32, and then hooked to the distal end portion of the flyer 32g, and pulled out toward downstream through the pull-out guide 37.

[0110] The yarn 20 pulled out toward the distal end from the storage region surface 32e is guided by the flyer 32g to make contact with the surface of the pull-out region surface 32f (includes surface of distal end tapered portion 32b).

[0111] The rotation resistance with respect to the yarn storage roller 32 is applied on the flyer 32g by, for example, magnetic means. Therefore, when the load with respect to the flyer 32g is a constant value or smaller, the flyer 32g integrally rotates with the yarn storage roller 32. When the load with respect to the flyer 32g is greater than the constant value, the flyer 32g rotates independent from the yarn storage roller 32, and the yarn stored in the yarn storage roller 32 is wound out.

[0112] In the alternative embodiment, the tension of the yarn 20 pulled out from the yarn storage roller 32 can be appropriately adjusted by the flyer 32g. Since the yarn storage roller 32 can be rotated with the yarn 20 hooked to the flyer 32g, the yarn 20 can be easily wound around the yarn storage roller 32.

[0113] In the description made above, in the automatic winder 1 of the present alternative embodiment, the flyer 32g guides the yarn 20 so as to make contact with the surface of the pull-out region surface 32f when pulling

out the yarn 20 wound in the storage region surface 32e.

[0114] Thus, the yarn 20 can be reliably brought into contact with the surface of the pull-out region surface 32f to carry out fluff laying. Furthermore, since the yarn storage roller 32 can be rotated with the yarn 20 hooked to the flyer 32g, the operation of winding the yarn 20 around the yarn storage roller 32 can be automatically carried out.

[0115] The preferable embodiment and the alternative embodiment of the present invention have been described above, but the above-described configuration can be modified as below.

[0116] In the embodiment described above, the surface roughness is realized by performing the lathe process on the pull-out region surface 32f. However, this method is not the sole case, and a knurling process, a shot blast process, surface chemical processing, and the like may be carried out. The surface roughness as described above can be easily realized even with such methods. The surface processing such as a lathe process, a knurling process, and the like can be performed not only on the pull-out region surface 32f, but also on the storage region surface 32e.

[0117] The surface roughness may not be discontinuously switched at the boundary of the storage region surface 32e and the pull-out region surface 32f. In other words, the surface roughness may gradually change at the boundary portion of the storage region surface 32e and the pull-out region surface 32f.

[0118] In the embodiment and the alternative embodiment described above, the automatic winder is not the sole case, and the present invention may be applied to other yarn winding devices (e.g., spinning machine such as fine spinning machine, etc.) including the yarn storage device.

Claims

1. A yarn storage device (5) comprising a rotating body (32) around which a yarn (20) is wound, **characterized in that** the rotating body (32) includes a storage region surface (32e) in which the yarn (20) is wound in an aligned manner, and a pull-out region surface (32f) through which the yarn (20) passes when the yarn (20) wound in the storage region surface (32e) is pulled out, and a surface roughness of the pull-out region surface (32f) is greater than a surface roughness of the storage region surface (32e).
2. A yarn winding device (2) **characterized by** comprising:
 - the yarn storage device (5) according to claim 1;
 - a yarn supplying section (7) adapted to supply the yarn (20); and

- a package forming section (8) adapted to wind the yarn (20) from the yarn storage device (5) to form a package (30), wherein the yarn storage device (5) winds and stores the yarn (20) from the yarn supplying section (7) on the rotating body (32). 5
3. The yarn winding device (2) according to claim 2, **characterized in that** the surface roughness of the pull-out region surface (32f) is greater than or equal to 5 times and smaller than or equal to 50 times the surface roughness of the storage region surface when compared in an arithmetic average roughness. 10
4. The yarn winding device (2) according to claim 2, **characterized in that** the package forming section (8) pulls out the yarn (20) from the yarn storage device (5) at a speed of greater than or equal to 1000 m and smaller than or equal to 2000 m per minute; and the surface roughness of the pull-out region surface (32f) is greater than or equal to 1 μm and smaller than or equal to 2 μm in the arithmetic average roughness. 20 25
5. The yarn winding device (2) according to any one of claims 2 to 4, **characterized by** further comprising a yarn detection sensor (36) adapted to detect the yarn (20) stored in the yarn storage device (5), wherein the yarn detection sensor (36) detects the yarn (20) in proximity of a boundary of the storage region surface (32e) and the pull-out region surface (32f) in the storage region surface (32e). 30 35
6. The yarn winding device (2) according to any one of claims 2 to 5, **characterized by** further comprising a pull-out yarn guiding member (32d, 32g) adapted to guide the yarn (20) so as to make contact with the pull-out region surface (32f) when the yarn (20) wound in the storage region surface (32e) is pulled out. 40
7. The yarn winding device (2) according to claim 6, **characterized in that** the pull-out yarn guiding member (32d) is an elastic ring member. 45
8. The yarn winding device (2) according to claim 6, **characterized in that** the pull-out yarn guiding member (32g) is a rod-shaped resistance member attached to be relatively rotatable with respect to the rotating body (32) around which the yarn (20) is wound. 50 55
9. The yarn winding device (2) according to any one of claims 2 to 8, **characterized in that** the rotating body (32) includes a tapered portion (32b) having a tapered shape in which a diameter increases toward an end in an axial direction; and the pull-out region surface (32f) includes a surface of the tapered portion (32b) in a pull-out direction of the yarn.
10. The yarn winding device (2) according to any one of claims 2 to 9, **characterized in that** one of a knurling process, a shot blast process, formation of lathe by a lathe process, and surface chemical processing is carried out on at least one of the pull-out region surface (32f) and the storage region surface (32e).
11. The yarn winding device (2) according to any one of claims 2 to 10, **characterized in that** the yarn supplying section (7) includes a supporting section (9) adapted to support a yarn supplying bobbin (21) around which the yarn (20) spun by a ring spinning machine is wound.

FIG. 1

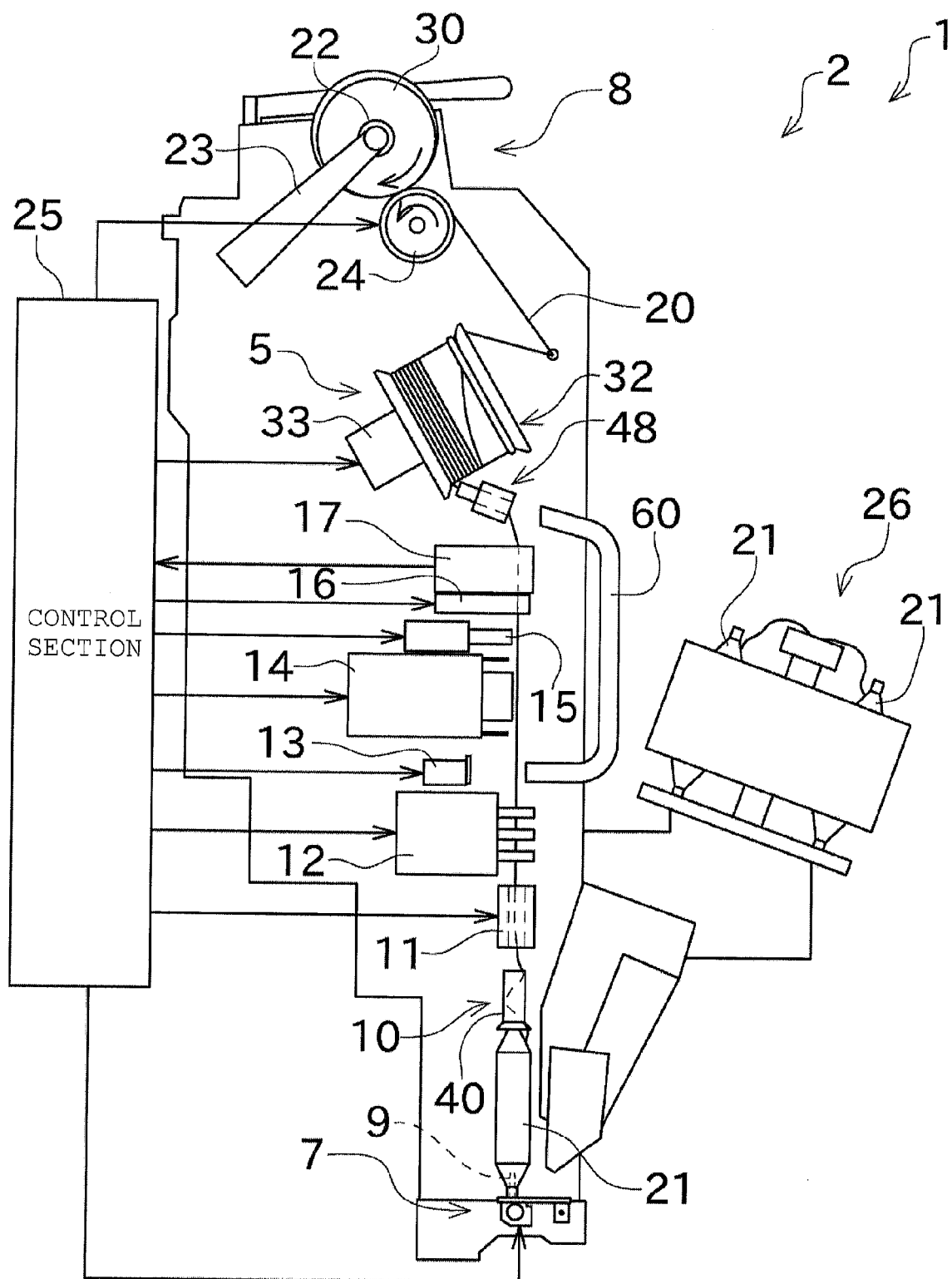


FIG. 2

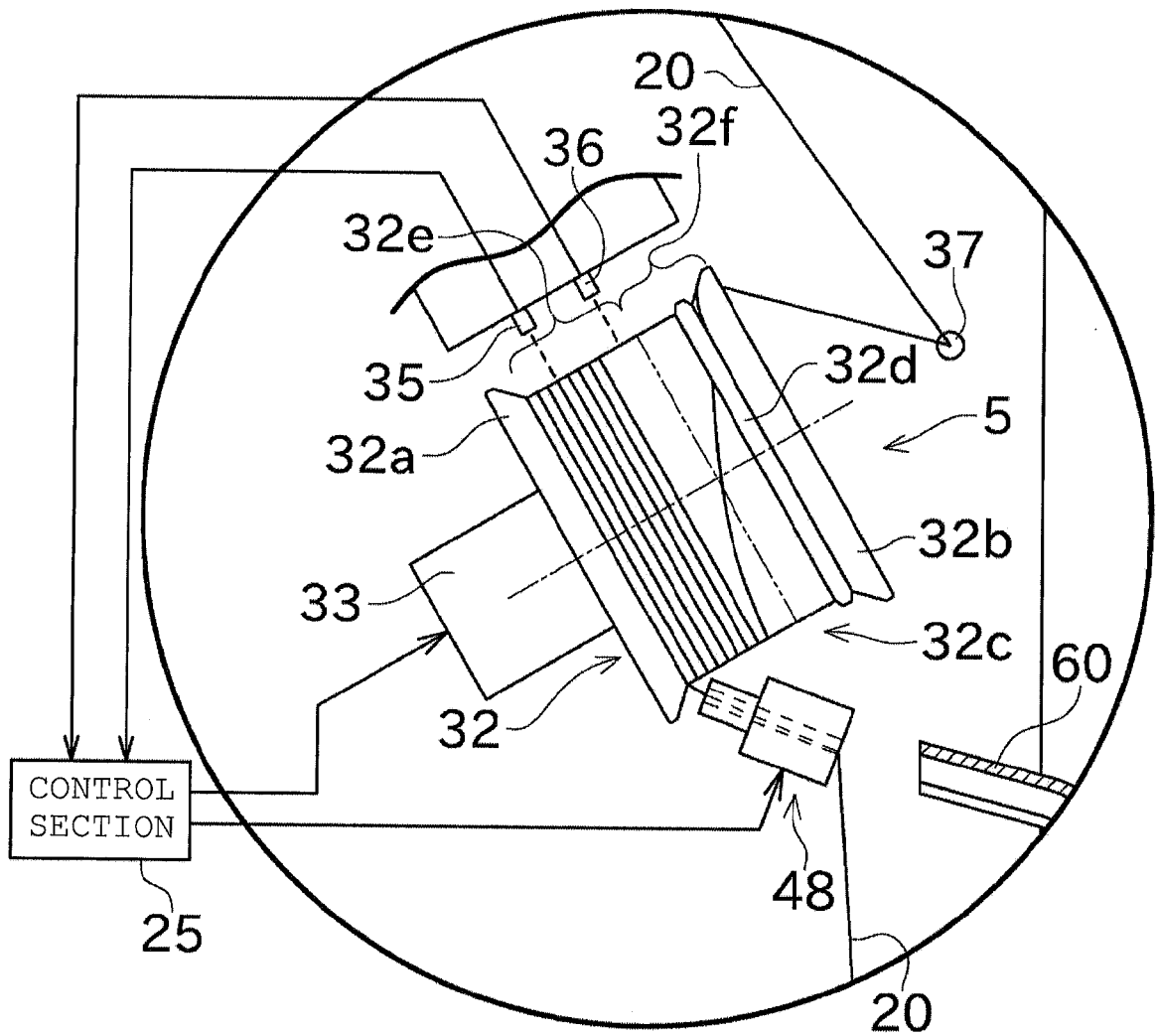


FIG. 3

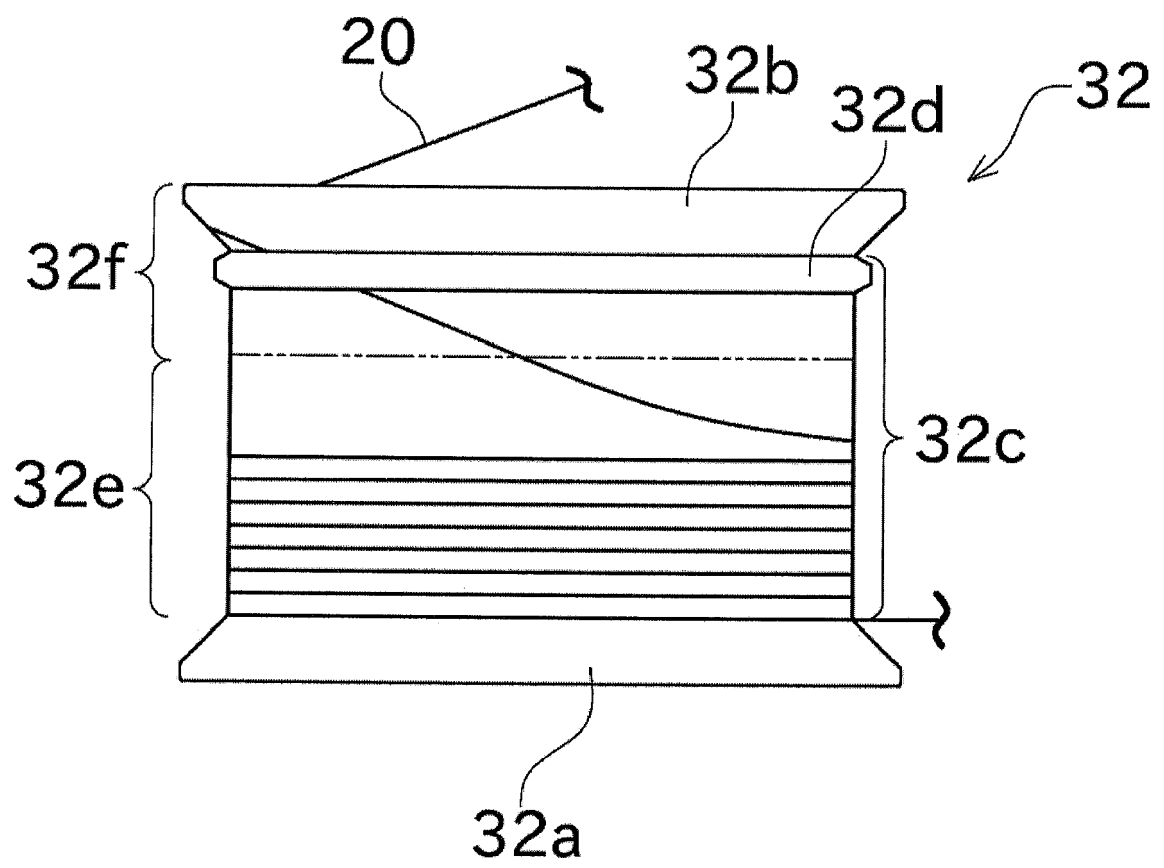


FIG. 4

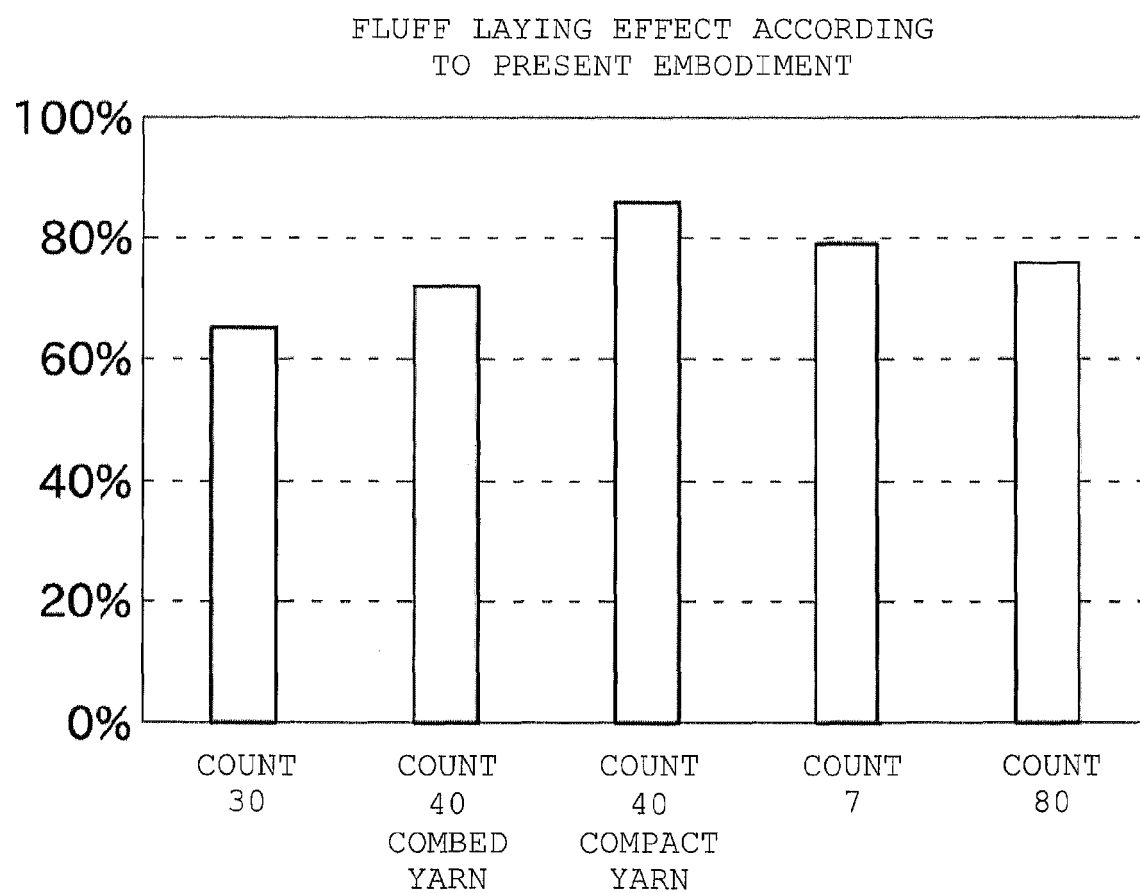


FIG. 5

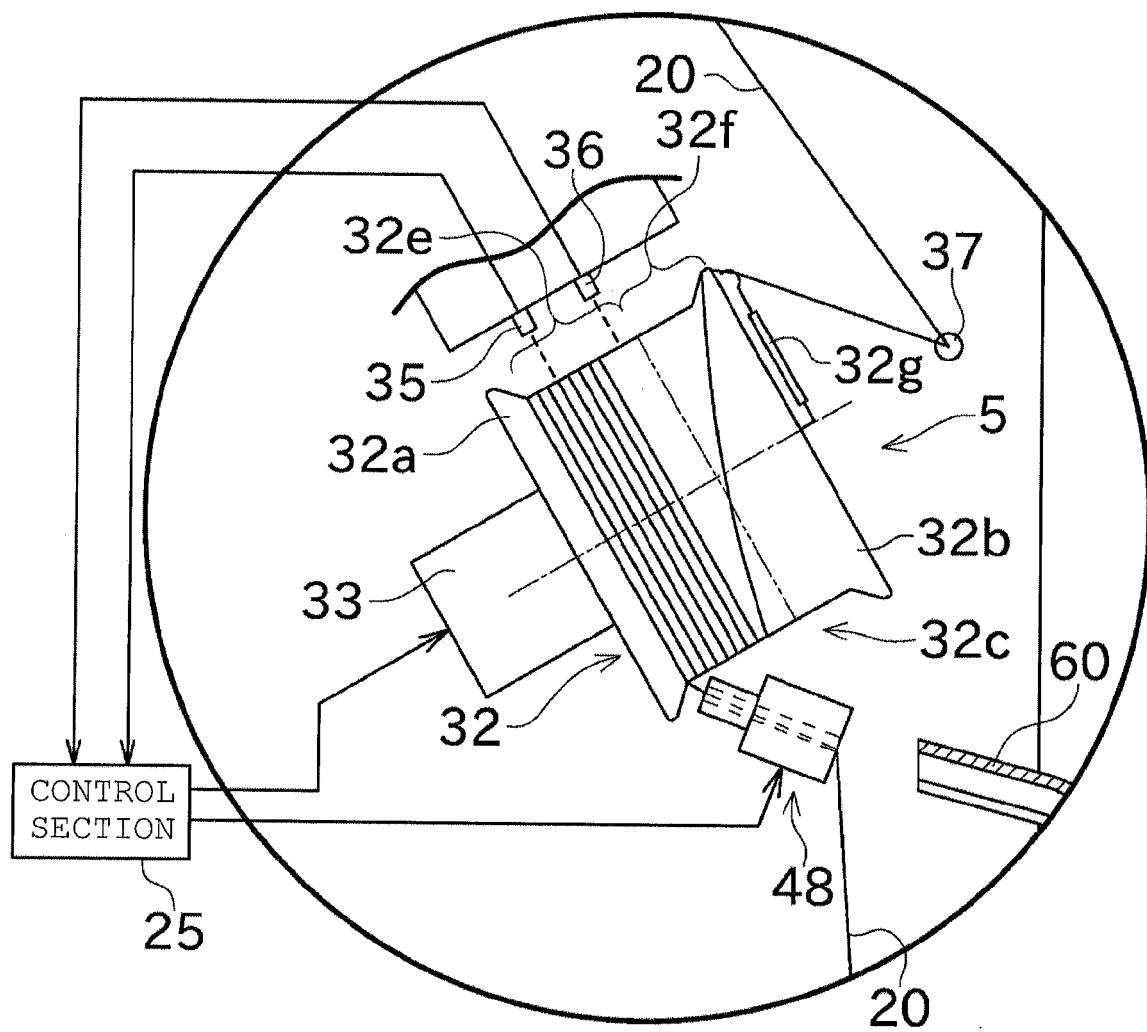
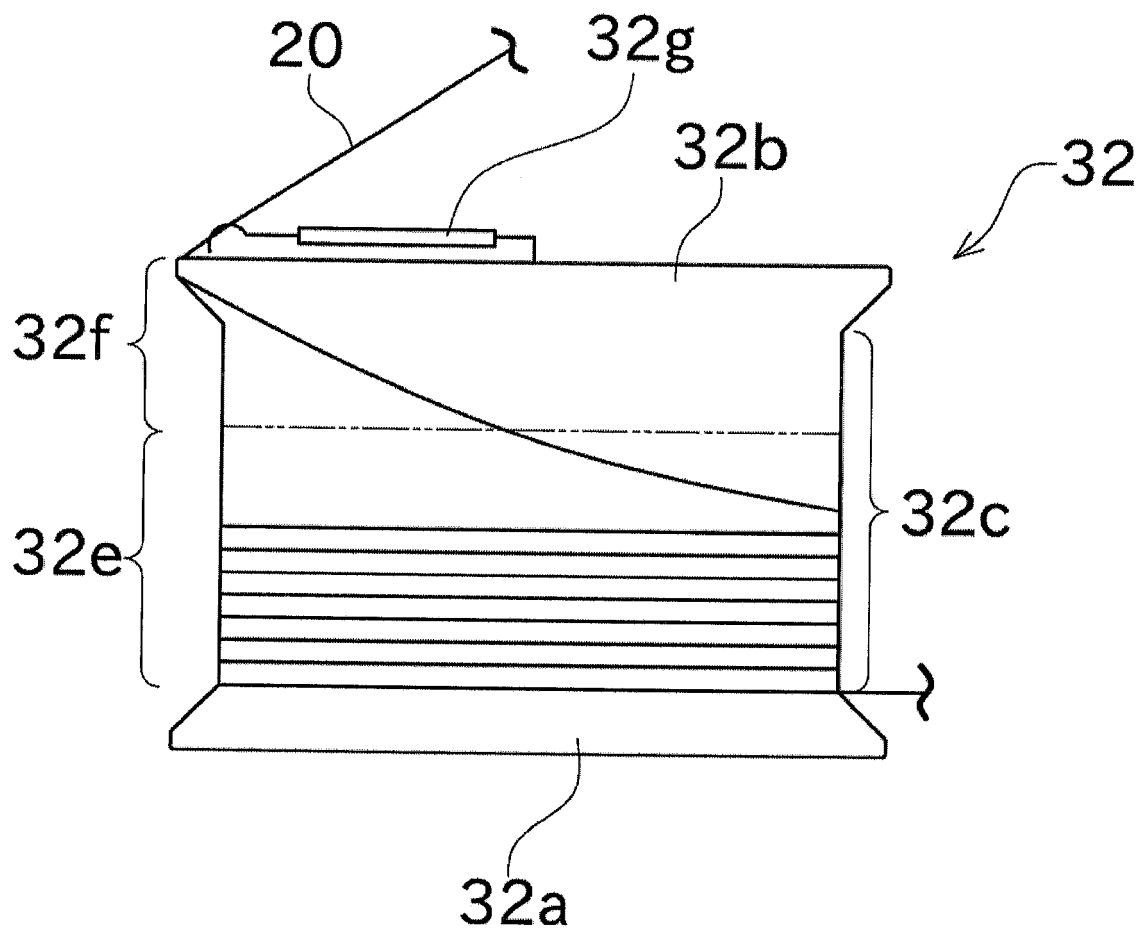


FIG. 6





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Place of search		Date of completion of the search	Examiner
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