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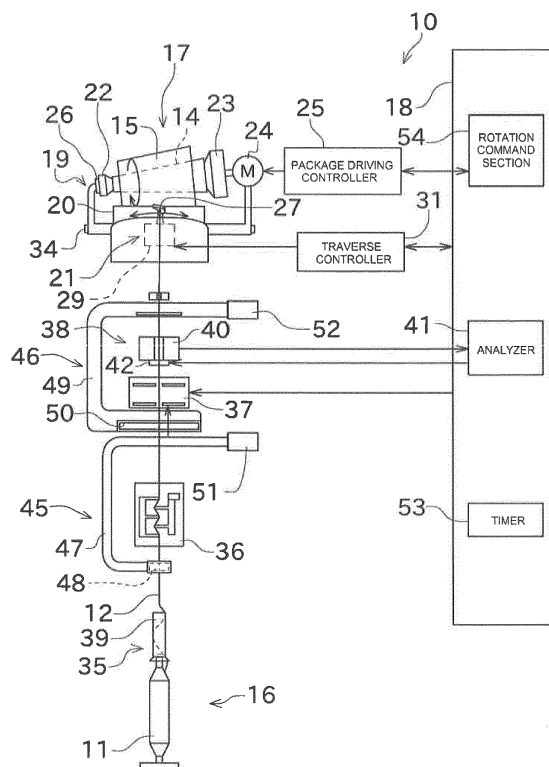
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(54) **Yarn winding machine and yarn winding method**

(57) An automatic winder includes a package driving motor (24), a yarn guide (27), and a unit controller (18). The package driving motor (24) drives and rotates a package (15) into which a yarn (12) is wound and that has been in a stopped state. The yarn guide (27) traverses the yarn (12) by being driven to perform reciprocating movements while guiding the yarn (12) that is to be wound into the package (15). The unit controller (18) controls the package driving motor (24) and the yarn guide (27) such that the yarn guide (27) does not perform the reciprocating movements while the rotation of the package (15) is stopped and the yarn guide (27) starts the reciprocating movements after the rotation of the package (15) in a winding direction is started.

FIG.1



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a structure that controls driving of a yarn guide in a yarn winding machine that winds a yarn while traversing the yarn with the yarn guide that is driven to reciprocate.

2. Description of the Related Art

[0002] The yarn winding machines of this type are disclosed in Japanese Unexamined Patent Publication No. 2009-508782 and Japanese Patent Application Laid-open No. 2007-210776. The yarn winding machine winds a yarn supplied from a yarn supplying section (a spinning cop in Japanese Unexamined Patent Publication No. 2009-508782 and a supply bobbin in Japanese Patent Application Laid-open No. 2007-210776) around a periphery of a winding bobbin (a cross-wound bobbin in Japanese Unexamined Patent Publication No. 2009-508782) that is driven to rotate. The winding bobbin with the yarn wound around its periphery is particularly referred to as a "package".

[0003] The yarn winding machines disclosed in Japanese Unexamined Patent Publication No. 2009-508782 and Japanese Patent Application Laid-open No. 2007-210776 include a traversing device that traverses the yarn that is to be wound into the package. This traversing device has an elongated arm member and a yarn guide arranged at a free end of the arm member. The yarn guide hooks and guides the yarn. The fixed end of the arm member is fixed to an output shaft of a driving motor (driving device). This driving motor drives the arm member to reciprocate in a winding width direction of the package.

[0004] In the yarn winding machine of this type, as necessary, the rotation of the package is stopped before performing certain operations. When performing such operations, the traversing device temporarily moves the yarn guide to a non-interrupting position where the yarn guide would not engage with the yarn. That is, in the non-interrupting position, the yarn guide is in a state of the yarn being disengaged therewith. Consequently, if the rotation of the package is to be resumed in a state where the yarn guide is in the non-interrupting position, a task of hooking the yarn onto the yarn guide (i.e., engaging the yarn with the yarn guide) is required so that the yarn guide can guide the yarn. The task of hooking the yarn onto the yarn guide is sometimes referred to as "threading".

[0005] In the conventional yarn winding machine, threading needs to be performed before starting the rotation of the package at the latest. This is because, if the package is rotated without traversing the yarn, a package defect called "straight winding" is formed. The "straight winding" occurs when the yarn is wound continuously at

a certain position in the winding width direction of the package. The threading needs to be performed to traverse the yarn with the yarn guide. Among those skilled in the art, it has therefore been commonly known that the threading needs to be performed before starting the rotation of the package at the latest.

[0006] However, in the conventional yarn winding machine, which performs the threading before starting the rotation of the package, the threading tends to fail. This is because a track of the yarn is not stable before or at the time of starting the rotation of the package, with the yarn not being held under a sufficient tension. This often results in the yarn from being not smoothly hooked onto the yarn guide.

[0007] If the threading fails, the yarn cannot be traversed as desired, and therefore the quality of the package is deteriorated. If such threading failures often happen, the entire production efficiency of the yarn winding machine is lowered. Consequently, there has been a need for a structure that can improve the success rate of the threading to the yarn guide.

[0008] In a structure disclosed in Japanese Unexamined Patent Publication No. 2009-508782, threading is performed with a tension applied to the yarn by causing relative movements between the yarn guide and the yarn. More specifically, an automatic cross-winding machine in Japanese Unexamined Patent Publication No. 2009-508782 reversely rotates the package (the cross-wound bobbin) to catch the yarn by suction with a suction nozzle. At this point, the yarn guide is moved to perform threading, and then yarn joining (a yarn joining process) is performed by a yarn joining device (splicer). Consequently, the threading can be reliably performed with the technique disclosed in Japanese Unexamined Patent Publication No. 2009-508782.

[0009] In this manner, in the technique disclosed in Japanese Unexamined Patent Publication No. 2009-508782, the automatic cross-winding machine sucks the yarn pulled from the package with the suction nozzle and then applies a tension to the yarn pulled out of the package before performing the threading. However, when sectioning the yarn unwound from the package (cross-wound bobbin) with the suction nozzle, "false yarn end finding" tends to occur, where a part of the yarn, which is not the yarn end, on a surface of the package is pulled toward the suction nozzle.

[0010] The automatic cross-winding machine of Japanese Unexamined Patent Publication No. 2009-508782 has a structure that performs the threading to the yarn guide with a suction force acting onto the surface of the package with the suction nozzle. However, the yarn guide may be damaged or the like if the yarn that is causing the false yarn end finding (the yarn on the surface of the package that is being pulled toward the suction nozzle) is entangled with the yarn guide.

SUMMARY OF THE INVENTION

[0011] It is an object of the present invention to provide a yarn winding machine that winds a yarn by traversing the yarn with a yarn guide driven to reciprocate and that can improve reliability of threading to the yarn guide and can also prevent the yarn guide from being broken.

[0012] This object is achieved by a yarn winding machine according to claim 1, and by a yarn winding method of claim 8.

[0013] According to an aspect of the present invention, a yarn winding machine includes a first driving section, a yarn guide, and a control section. The first driving section drives and rotates a package into which a yarn is wound. The yarn guide performs reciprocating movements to traverse and guide the yarn when the yarn is to be wound into the package. The control section controls the first driving section and the yarn guide to stop the reciprocating movements of the yarn guide while rotation of the package is stopped, and to start the reciprocating movements of the yarn guide after the rotation of the package that has been in a stopped state in a winding direction is started.

[0014] According to another aspect of the present invention, a yarn winding method includes driving, traversing, and controlling. In the driving, a package into which a yarn is wound is driven to rotate. In the traversing, the yarn is traversed and guided by causing a yarn guide to perform reciprocating movements when the yarn is to be wound into the package. In the controlling, the yarn guide is controlled to stop the reciprocating movements of the yarn guide while rotation of the package is stopped, and to start the reciprocating movements after the rotation of the package that has been in a stopped state in a winding direction is started.

[0015] The above and other objects, features, advantages and the technical and industrial significance of this invention will be better understood by reading the following detained description of presently preferred embodiments of the invention, when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

FIG. 1 is a schematic front view and a block diagram of a yarn winding unit included in an automatic winder according to an embodiment of the present invention;

FIG. 2 is a side view of a package and its vicinity;

FIG. 3 is a plan view of a yarn guide;

FIG. 4 is a flowchart of a yarn winding method;

FIG. 5 is a side view of a state where an upper yarn is being suctioned and caught;

FIG. 6 is a side view of a state where false yarn end finding has occurred;

FIG. 7 is a view of the package the rotation of which

has been stopped;

FIG. 8 is a view of the package right after the rotation is started;

FIG. 9 is a view of the yarn guide that is moved to perform threading; and

FIG. 10 is a view of a state where straight winding is formed on the package.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] Exemplary embodiments of the present invention are explained below with reference to the accompanying drawings. In an automatic winder (yarn winding machine) according to a first embodiment, multiple yarn winding units 10 are arranged in a line, each of them having a structure as shown in FIG. 1. The automatic winder according to the present embodiment includes a main controller (not shown) that centrally controls the yarn winding units 10.

[0018] Each yarn winding unit 10 unwinds a yarn 12 from a supply bobbin 11 and winds it around a winding bobbin 14. The winding bobbin 14 with the yarn 12 wound thereon is referred to as a package 15. An "upstream side" and a "downstream side" mentioned in the explanation below refer to the upstream and downstream sides with respect to a running direction of the yarn 12. According to the present embodiment, the yarn 12 that is unwound from the supply bobbin 11 at a yarn supplying section 16 is wound by a winding section 17 as shown in FIG. 1 or the like. The upstream side is therefore the side of the yarn supplying section 16, and the downstream side is the side of the winding section 17.

[0019] Each yarn winding unit 10 includes the yarn supplying section 16, the winding section 17, and a unit controller 18.

[0020] The unit controller 18 includes, for example, a central processing unit (CPU), a random access memory (RAM), a read-only memory (ROM), an input/output (I/O) port, and a communication port. A computer program for controlling the components of the yarn winding unit 10 is stored in the ROM. The components of the yarn winding unit 10 (described later in detail) and the main controller are connected to the I/O port and the communication port. The unit controller 18 carries out communications such as transmission of control information. The unit controller 18 can thereby control the operations of the components of the yarn winding unit 10.

[0021] The yarn supplying section 16 holds the supply bobbin 11, from which the yarn 12 is supplied, at a predetermined position. The winding section 17 winds the yarn 12 supplied from the yarn supplying section 16 around the periphery of the winding bobbin 14 while traversing the yarn 12. More specifically, the winding section 17 includes a cradle 19, a contact roller 20, and a traversing device 21.

[0022] A pair of center bearings 22 and 23 is arranged on the cradle 19. The center bearings 22 and 23 are

rotatable with respect to the cradle 19 around its shaft line and are positioned to face each other in a direction of this shaft line. The cradle 19 supports the winding bobbin 14, with the center bearings 22 and 23 grasping the winding bobbin 14 therebetween in the shaft line. With this arrangement, the cradle 19 can support the package 15 rotatably around its shaft line.

[0023] One of the center bearings 22 and 23 (the center bearing 23 in FIG. 1) is coupled to a rotation output shaft of a package driving motor (first driving section) 24 in a manner not to rotate relative to the package driving motor 24. The package 15 can be directly driven to rotate by driving the package driving motor 24 to rotate, with the center bearings 22 and 23 grasping the package 15 therebetween.

[0024] The yarn winding unit 10 includes a package driving controller 25 that controls operations of the package driving motor 24. The unit controller 18 sends the package driving controller 25 a command value for a rotation frequency of the package driving motor 24 (i.e., the number of rotations per unit time). The unit controller 18 therefore can also be referred to as a rotation command section 54. The package driving controller 25 performs control such that the package driving motor 24 is driven to rotate at a rotation frequency designated by the command value that is received from the rotation command section 54. With this arrangement, the package 15 can be rotated at a desired rotation frequency.

[0025] A package rotation sensor (rotation detecting section) 26 is arranged on the cradle 19 to detect the rotation of the package 15. This package rotation sensor 26 is, for example, an incremental rotary encoder. The package rotation sensor 26 sends a pulse signal to the unit controller 18 every predetermined angular degrees the center bearing 22 rotates (in other words, every predetermined angular degrees the package 15 rotates). In accordance with the pulse signal received from the package rotation sensor 26, the unit controller 18 detects an amount of rotation made by the package 15.

[0026] The traversing device 21 is arranged near the cradle 19. This traversing device 21 is an arm-type traversing device. More specifically, as shown in FIG. 2, the traversing device 21 includes a yarn guide 27, a traverse arm 28, and a traverse driving motor (second driving section) 29.

[0027] As shown in FIG. 3, the yarn guide 27 is arranged at a free end of the traverse arm 28. This yarn guide 27 is shaped into a hook. More specifically, the yarn guide 27 is bent on one side, and has a narrow yarn hooking groove 30 in an inner perimeter of the yarn guide 27 to hook and guide the yarn 12.

[0028] A fixed end of the traverse arm 28 (a side of the traverse arm 28 opposite the yarn guide 27 in a longitudinal direction of the traverse arm 28) is fixed to the driving shaft of the traverse driving motor 29. The traverse driving motor 29 is a servomotor or the like and is arranged to drive and pivot the traverse arm 28. Upon the traverse driving motor 29 producing a reciprocating pivoting

movement in the traverse arm 28, the yarn guide 27 is driven to reciprocate in a traversing width direction (side-to-side direction in FIG. 1). As mentioned before, the yarn guide 27 can guide the yarn 12 by hooking the yarn 12 (i.e., by engaging itself with the yarn 12). Upon driving the yarn guide 27 to reciprocate with the yarn 12 hooked thereon (i.e., with the yarn guide 27 guiding the yarn 12), a track of the yarn 12 can be reciprocated within a predetermined traversing width. The yarn winding unit 10 includes a traverse controller 31 that controls this traverse driving motor 29. The traverse controller 31 controls the traverse driving motor 29 based on a control signal from the unit controller 18.

[0029] The contact roller 20 is arranged near the cradle 19.

[0030] The contact roller 20 is brought into contact with the periphery of the package 15 so that the contact roller 20 can rotate together with the package 15. As shown in FIG. 2, the contact roller 20 is arranged in contact with the yarn 12 that is wound into the package 15. By winding the yarn 12 into the package 15 while causing the yarn 12 to be in contact with the contact roller 20, the track of the yarn 12 can be stabilized. This prevents the yarn 12 from being overly swung by the yarn guide 27.

[0031] With the winding section 17 rotating the package 15 in a winding direction and the traversing device 21 reciprocating the yarn 12 within the traversing width, the yarn 12 can be wound around the surface of the package 15 while being traversed.

[0032] In the automatic winder according to the present embodiment, the traverse driving motor 29 and the package driving motor 24 are provided separately. With such an arrangement, the automatic winder according to the present embodiment can traverse the yarn 12, independent of the rotation of the package 15. This allows for flexible control of traversing start timing and the like.

[0033] As shown in FIG. 3, yarn guiding portions 32 and 33 are formed in the yarn guide 27 so as to be inclined toward the yarn hooking groove 30. This arrangement facilitates hooking of the yarn 12 by the yarn guide 27 (i.e., guiding of the yarn 12 into the yarn hooking groove 30). The yarn hooking groove 30 has one side open in the traversing width direction. By moving the yarn guide 27 in the traversing width direction, the yarn 12 can be easily hooked onto the yarn guide 27. Simply by driving the traversing device 21, the threading can be performed onto the yarn guide 27, and thereby the yarn guide 27 becomes ready to guide the yarn 12.

[0034] As shown in FIG. 2, in the present embodiment, a pivoting shaft of the traverse arm 28 (the output shaft of the traverse driving motor 29) is positioned substantially parallel to the yarn path of the yarn 12 that runs near the yarn guide 27. With this arrangement, the yarn guide 27 is driven to reciprocate on a plane that is substantially orthogonal to the yarn path, and therefore the yarn guide 27 can smoothly traverse the yarn 12.

[0035] The cradle 19 swings around a swing shaft 34 so that an increase in a diameter of the package 15 can

be absorbed as the winding of the yarn 12 proceeds. Because the cradle 19 is swingable, the periphery of the package 15 can be suitably brought into contact with the contact roller 20, regardless of the diameter of the package 15.

[0036] In the yarn winding unit 10, a yarn unwinding assisting device 35, a tension applying device 36, a yarn joining device 37, and a yarn monitoring device 38 are arranged in this order from the side of the yarn supplying section 16 between the yarn supplying section 16 and the winding section 17.

[0037] The yarn unwinding assisting device 35 includes a restricting member 39 that can cap an inner tube of the supply bobbin 11. The restricting member 39 is substantially cylindrical and is arranged in contact with a balloon formed in an upper portion of a yarn layer of the supply bobbin 11. The balloon denotes a portion of the yarn 12 that is unwound from the supply bobbin 11 and centrifugally swung. By bringing the restricting member 39 into contact with this balloon, a tension is applied to the balloon portion of the yarn 12 so that the yarn 12 is prevented from being overly swung. With this arrangement, the yarn 12 can be suitably unwound from the supply bobbin 11.

[0038] The tension applying device 36 applies a predetermined tension to the running yarn 12. The tension applying device 36 according to the present embodiment is a gate-type device in which movable comb teeth and fixed comb teeth are arranged to correspond with one another. The movable comb teeth are urged such that they mesh with the fixed comb. By causing the yarn 12 to meander through the meshed comb teeth, a suitable tension is applied to the yarn 12, and thereby the quality of the package 15 can be improved. The tension applying device 36 is not limited to the gate-type device, but a disk-type device can be employed.

[0039] The yarn monitoring device 38 monitors the running yarn 12. More specifically, the yarn monitoring device 38 includes a clearer head 40 that has a light transmission sensor (not shown) for detecting thickness of the yarn 12 and an analyzer 41 that processes a yarn thickness signal output by this sensor. With the analyzer 41 monitoring the yarn thickness signal output by the sensor, the yarn monitoring device 38 detects a yarn defect included in the yarn 12 (an abnormal portion in the yarn 12). A cutter 42 is arranged on an upstream side of the clearer head 40. The cutter 42 cuts the yarn 12 as soon as the yarn monitoring device 38 detects a yarn defect. The yarn monitoring device 38 is not limited to the light transmission sensor, and a light reflection sensor or a capacitance sensor, for example, can be used to monitor the yarn 12.

[0040] When the yarn 12 is disconnected between the supply bobbin 11 and the package 15 for some reason, the yarn joining device 37 connects (joins) a lower yarn on the supply bobbin 11 side and an upper yarn on the package 15 side. The yarn joining device 37 according to the present embodiment is a splicer that twists yarn

ends together by swirling airflow generated by compressed air. The yarn joining device 37 is not limited to an air splicer; however, it can be a mechanical knotter, for example.

[0041] A lower yarn catching member 45 is arranged below the yarn joining device 37 to catch the yarn end on the supply bobbin 11 side and guide the yarn end to the yarn joining device 37. An upper yarn catching member 46 is arranged above the yarn joining device 37 to catch the yarn end on the package 15 side and guide the yarn end to the yarn joining device 37. The lower yarn catching member 45 includes a lower yarn pipe arm 47 and a lower yarn suction mouth 48 that is formed at a free end of the lower yarn pipe arm 47. The upper yarn catching member 46 includes an upper yarn pipe arm 49 and an upper yarn suction mouth 50 that is formed at a free end of the upper yarn pipe arm 49.

[0042] The lower yarn pipe arm 47 and the upper yarn pipe arm 49 can pivot around pivot shafts 51 and 52, respectively. Suitable negative pressure sources (not shown) are connected to the lower yarn pipe arm 47 and the upper yarn pipe arm 49. With this arrangement, the lower yarn pipe arm 47 and the upper yarn pipe arm 49 can generate suction airflow through the lower yarn suction mouth 48 and the upper yarn suction mouth 50 respectively, and can suction and catch the ends of the lower and upper yarns respectively.

[0043] A yarn winding method with which the rotation of the package 15 is stopped and then the rotation of the package 15 is started by the automatic winder according to the present embodiment is explained below.

[0044] Various reasons can be considered for stopping the rotation of the package 15 that is winding the yarn 12. For example, when the package 15 becomes fully wound, the rotation of the fully wound package 15 is stopped so that the package 15 can be removed from the winding section 17 and a new winding bobbin 14 can be mounted onto the winding section 17. When the yarn 12 breaks between the supply bobbin 11 and the package 15, the rotation of the package 15 is temporarily stopped to perform a yarn joining operation by the yarn joining device 37. Similarly, when the yarn monitoring device 38 detects a yarn defect, the rotation of the package 15 is temporarily stopped to remove the yarn defect. As an example, a situation where a yarn defect is detected by the yarn monitoring device 38 is explained below with reference to the flowchart of FIG. 4.

[0045] The unit controller 18 monitors a detection result obtained by the yarn monitoring device 38. When the yarn monitoring device 38 detects a yarn defect (judgment at Step S101), the unit controller 18 immediately operates the cutter 42 to cut the yarn 12 (Step S102). The downstream yarn 12 with respect to the point where the yarn 12 is cut with the cutter 42 is wound into the package 15. Accordingly, this yarn 12 wound into the package 15 includes a yarn defect detected by the yarn monitoring device 38. The upstream yarn 12 with respect to the point where the yarn 12 is cut with the cutter 42 is

sectioned and caught into the lower yarn suction mouth 48.

[0046] The unit controller 18 stops the rotation of the package 15 at the same time as, or almost in tandem with, the cutting of the yarn 12. The yarn winding unit 10 according to the present embodiment does not include a braking mechanism. The unit controller 18 brings the rotation of the package 15 to a stop by reducing speed of the package driving motor 24.

[0047] Because inertia is acting on the package 15, slipping can occur between the center bearing 23 and the winding bobbin 14 if the package driving motor 24 is suddenly stopped. Accordingly, when the rotation of the package 15 is to be stopped, the rotation command section 54 gradually lowers the command value for the rotation frequency that it sends to the package driving controller 25. Because the package driving motor 24 is thereby gradually slowed down, slipping between the center bearing 23 and the winding bobbin 14 can be prevented, and the rotation of the package 15 can be suitably stopped.

[0048] Almost in tandem with the timing of stopping the rotation of the package 15, the unit controller 18 sends a control signal to the traverse controller 31 to move the yarn guide 27 to a non-interrupting position at which the yarn guide 27 would not be engaged with the yarn 12 (beyond the ends of the traverse width) and hold the yarn guide 27 at this non-interrupting position. The yarn guide 27 therefore would not interrupt the yarn joining operation (described later) or the like. The end of the yarn 12 cut with the cutter 42 (the downstream yarn 12 with respect to the cutter 42) is wound into the package 15. This means that, at Step S103, the yarn 12 is not guided by the yarn guide 27 (the yarn 12 is not engaged with the yarn guide 27, or in other words, the yarn 12 comes off the yarn hooking groove 30).

[0049] Thereafter, the unit controller 18 pivots the upper yarn pipe arm 49 upward (toward the winding section 17) and brings the upper yarn suction mouth 50 close to the surface of the package 15. With this positioning maintained, the unit controller 18 generates the suction airflow through the upper yarn suction mouth 50, and sends the package driving controller 25 the control signal to reversely rotate the package 15 (i.e., to rotate the package 15 in a direction opposite the winding direction, see the positioning in FIG. 5). In this manner, the yarn end wound into the package 15 is pulled out, and sectioned and caught into the upper yarn suction mouth 50 (Step S104). The unit controller 18 causes the package 15 to reversely rotate to a predetermined extent so that the yarn defect detected by the yarn monitoring device 38 can be pulled out of the package 15 and suctioned into the upper yarn suction mouth 50. The yarn defect detected by the yarn monitoring device 38 can be thereby removed from the package 15.

[0050] The unit controller 18 then pivots the upper yarn pipe arm 49 downward, while suctioning and catching the yarn 12 on the package 15 side (the upper yarn) to-

ward the upper yarn suction mouth 50. The upper yarn is thereby guided to the yarn joining device 37. Almost in tandem, the unit controller 18 pivots the lower yarn pipe arm 47 upward, while suctioning and catching the yarn 12 on the supply bobbin 11 side (the lower yarn) toward the lower yarn suction mouth 48. The lower yarn is thereby guided to the yarn joining device 37 (Step S105). After the guiding of the upper yarn to the yarn joining device 37 is completed, the unit controller 18 sends the package driving controller 25 the control signal to stop the reverse rotation of the package 15 (Step S106).

[0051] Upon guiding the upper and lower yarns to the yarn joining device 37, the unit controller 18 operates the yarn joining device 37 to perform the joining operation on the upper and lower yarns. This brings the yarn 12 between the package 15 and the supply bobbin 11 into a continuous state.

[0052] The unit controller 18 monitors whether the package 15 is ready to start its rotation (Step S108). When the package 15 is ready to start the rotation, the unit controller 18 executes a start process (Steps S109 to S111). For example, if the rotation of the package 15 has been stopped due to the yarn joining operation as shown in the flowchart of FIG. 4, the rotation of the package 15 can be resumed when the yarn joining operation is completed by the yarn joining device 37. The unit controller 18 therefore monitors, at Step S108, whether the yarn joining operation is completed by the yarn joining device 37, and executes the start process when completion of the yarn joining operation is detected.

[0053] The start process is explained in detail. First, the unit controller 18 provides control to start driving the package driving motor 24 to rotate the stationary package 15 in the winding direction (start of a package driving process, Step S109).

[0054] Due to the inertia acting on the package 15, slipping can occur between the center bearing 23 and the winding bobbin 14 if the rotation of the package driving motor 24 is suddenly started. Accordingly, when starting the rotation of the package 15 in the winding direction (i.e., starting the driving of the package driving motor 24 in the winding direction), the rotation command section 54 sends the package driving controller 25 a rotation frequency having a relatively small command value. The rotation command section 54 gradually increases the command value for the rotation frequency that it sends to the package driving controller 25 as time passes, until the package driving motor 24 reaches a targeted rotation frequency. The rotational speed of the package driving motor 24 is gradually increased, and therefore the slipping can be prevented between the center bearing 23 and the winding bobbin 14. The rotational speed of the package 15 can be increased to reach the targeted rotational speed.

[0055] The unit controller 18 according to the present embodiment has a timer function for measuring time. The unit controller 18 therefore can also serve as a timer sec-

tion 53. The unit controller 18 monitors time elapsed after starting the rotation of the package 15 (Step S109), based on the timing result obtained by the timer section 53 (timing process, Step S110). When it is detected that a predetermined length of traverse standby time has elapsed after starting the rotation of the package 15, the unit controller 18 sends the traverse controller 31 a control signal to start driving the traversing device 21 (start of a traversing process, Step S111). The yarn 12 is hooked onto the yarn guide 27 (threading), which brings the yarn 12 to a state ready to be guided by the yarn guide 27. Furthermore, the traversing of the yarn 12 is started by the yarn guide 27.

[0056] With the above control, the rotation of the package 15 that has been stopped can be started, and the traversing of the yarn 12 can be started after threading. The winding of the yarn 12 into the package 15 therefore can be suitably started.

[0057] Advantages that can be obtained with the structure of the automatic winder according to the present embodiment are explained in detail below.

[0058] As described above, the conventional yarn winding machine performs threading to the yarn guide 27 when starting the rotation of the package 15 at the latest. In such a situation, however, the threading is performed under an unstable condition where a tension applied to the yarn 12 is insufficient. This can lead to a failure in threading. To improve the reliability in threading to the yarn guide 27, the threading needs to be performed with a sufficient tension applied to the yarn 12.

[0059] The present inventor has realized that, a while after the rotation of the package 15 is started, a sufficient tension comes to be applied to the yarn 12 that is wound into the package 15. In other words, when the winding of the package 15 is started, the rotating package 15 pulls the yarn 12 downstream (upward direction in FIG. 1). This results in application of a certain tension to the yarn 12 (with the yarn 12 being pulled taut).

[0060] The common thought among those skilled in the art has been that it is too late to perform threading once the rotation of the package 15 is started. If the traversing of the yarn 12 is started later than the start of the rotation of the package 15, the yarn 12 would be wound into the package 15 without being traversed. This would result in straight winding 99 produced on the package 15 as shown in FIG. 10, deteriorating the quality of the package 15. For this reason, the threading is performed no later than the start of the rotation of the package 15 in the conventional yarn winding machine.

[0061] After repeating investigations regarding the above point, the present inventor has discovered that it takes a certain length of time, after the rotation of the package 15 is started, to produce the straight winding 99 large enough to cause an adverse effect on the quality of the package 15. The quality of the package 15 is not affected for a while after starting the rotation of the package 15 even if no traversing of the yarn 12 is performed. The experiments conducted by the present inventor have

also revealed that the length of time required for applying a tension sufficient for threading the yarn 12 after the start of the rotation of the package 15 is shorter than the length of time required for producing the straight winding 99 large enough to cause an adverse effect on the quality of the package 15. Therefore, the quality of the package 15 would not be deteriorated even if the threading is waited until the tension applied to the yarn 12 becomes sufficient.

[0062] As explained above, in the automatic winder according to the present embodiment, the yarn guide 27 is moved to the non-interrupting position when the rotation of the package 15 is being stopped, and after the rotation of the package 15 is started, the driving of the traversing device 21 is started after a predetermined traverse standby time is elapsed.

[0063] When the rotation of the package 15 is stopped, no tension is applied to the yarn 12, making the track of the yarn 12 unstable. The yarn guide 27 is therefore moved to a position at which it is not engaged with the yarn 12 (non-interrupting position, see FIG. 7). A tension starts being applied to the yarn 12 once the rotation of the package 15 is started, but the tension in the yarn 12 is still unstable immediately after the rotation of the package 15 is started. The yarn guide 27 is maintained at the non-interrupting position, as shown in FIG. 8, for a predetermined time after the rotation of the package 15 is started (Step S109 as explained above). After waiting for the predetermined traverse standby time from the start of the rotation of the package 15 (Step S110 as explained above), the driving of the traversing device 21 is started (Step S111 as explained above). Only then, the yarn guide 27 is moved in the traversing width direction as shown in FIG. 9. In this manner, a sufficient tension can be applied to the yarn 12, and the threading can be conducted with the track of the yarn 12 being stabilized. The reliability of the threading is thereby improved.

[0064] If the package 15 continues to rotate without driving the traversing device 21, the yarn 12 is continuously wound without being traversed. This would result in the straight winding 99 large enough to deteriorate the quality of the package 15 (FIG. 10). In the automatic winder according to the present embodiment, time is measured by the timer section 53. The driving of the traversing device 21 is started when the traverse standby time is elapsed after the rotation of the package 15 is started. The yarn 12 therefore would be wound into the package 15 without being traversed, no longer than a predetermined period of time. Thus, the traversing of the yarn 12 can be reliably started by the traversing device 21 before any adverse effect is caused to the quality of the package 15.

[0065] A proper value for the traverse standby time varies in accordance with the type and/or winding speed of the yarn 12 and the like. The automatic winder according to the present embodiment can change the traverse standby time as needed. More specifically, the operator can perform an operation of inputting or changing the

traverse standby time on the main controller of the automatic winder so that the traverse standby time can be set for all the yarn winding units 10 of the automatic winder at a time. The traverse standby time can also be set individually for the different yarn winding units 10. The traverse standby time can be automatically set in accordance with winding conditions.

[0066] The automatic winder according to the present embodiment directly drives the package 15, and therefore the driving of the traversing device 21 can be started after reliably starting the rotation of the package 15. Besides direct driving of the package 15 as in the present embodiment, a system of indirectly rotating the package 15 can be employed. The system of indirectly rotating the package 15 includes, for example, driving the contact roller 20 to rotate and causing the package 15 to follow the rotation of the contact roller 20. When the package 15 is rotated in this manner, slipping can occur between the package 15 and the contact roller 20. When this occurs, even if driving of the contact roller 20 for rotation has been started, the rotation of the package 15 may not always be started. According to the present embodiment, because the package 15 is directly driven by the package driving motor 24, the package 15 can be reliably rotated when the driving of the package driving motor 24 is started. Consequently, the threading can be performed while a tension sufficient to perform the threading is reliably applied to the yarn 12.

[0067] When suctioning the upper yarn with the upper yarn suction mouth 50 at Step S104 in FIG. 4, suction force of the upper yarn suction mouth 50 acts on the surface of the package 15. Of the yarn on the surface of the package 15, a portion that is not a yarn end (a middle portion of the yarn wound into the package 15) is unnecessarily sectioned into the upper yarn suction mouth 50, resulting in a state as shown in FIG. 6. Such a state, in which an undesired portion of the yarn on the surface of the package 15 is suctioned and caught by the upper yarn suction mouth 50, is called "false yarn end finding".

[0068] As described above, the yarn winding machine disclosed in Japanese Unexamined Patent Publication No. 2009-508782 moves the yarn guide while suctioning the yarn of the package. If the yarn guide becomes tangled with the undesired portion of the yarn pulled out due to the false yarn end finding, a breakage of the yarn guide can occur.

[0069] In the automatic winder according to the present embodiment, when the upper yarn suction mouth 50 is sectioning the yarn 12 of the package 15, the yarn guide 27 is moved to the non-interrupting position. There is no possibility that the yarn guide 27 is broken by being tangled with the undesired portion of the yarn pulled out due to the false yarn end finding.

[0070] When the upper yarn pipe arm 49 is pivoted downward during the false yarn end finding as shown in FIG. 6, the undesired portion of the yarn can be pulled out of the package 15 and guided to the yarn joining device 37. If the yarn joining device 37 performs the yarn

joining operation in this state, a poor-quality joined portion shall be formed. If the rotation of the package 15 is started in the winding direction under such a condition, the poor-quality joined portion can be wound into the package 15. In the structure disclosed in Japanese Unexamined Patent Publication No. 2009-508782, the threading is completed by the time the yarn joining operation is started. This means that the poor-quality joined portion can pass through the yarn guide when the rotation of the package is started after completion of the yarn joining operation. Then, the poor-quality joined portion can become tangled with the yarn guide and break the yarn guide. Because the yarn guide can catch the yarn during the false yarn end finding, both breakage of the yarn guide and production of a defective package can be incurred.

[0071] In contrast, in the automatic winder according to the present embodiment, the yarn monitoring device 38 detects any poor-quality joined portion when starting the rotation of the package 15 after completion of the yarn joining operation. If the yarn monitoring device 38 detects a poor-quality joined portion, the unit controller 18 immediately operates the cutter 42 to cut the yarn 12. With this arrangement, even if a poor-quality joined portion is formed during the yarn joining operation, the yarn 12 can be immediately cut with the cutter 42. Moreover, the automatic winder according to the present embodiment does not perform the threading before the traverse standby time elapses from the start of the rotation of the package 15. Therefore, it is highly probable that the cutter 42 is operated to cut the yarn 12 before the threading. In this manner, even if a poor-quality joined portion is formed on the yarn 12 during the yarn joining operation, the yarn 12 can be cut before the threading. Consequently, the yarn guide can be prevented from being broken when the poor-quality joined portion is tangled with the yarn guide 27.

[0072] As explained above, the automatic winder according to the present embodiment includes the package driving motor 24, the yarn guide 27, and the unit controller 18. The package driving motor 24 rotates the package 15 that has been brought to a stop and into which the yarn 12 is to be wound. When the yarn guide 27 is driven to reciprocate with the yarn 12 that is to be wound into the package 15 being guided (i.e., with the yarn 12 engaged with the yarn guide 27), the yarn guide 27 traverses the yarn 12. The unit controller 18 stops the driving of the yarn guide 27 when the rotation of the package 15 is stopped, and at such time, the yarn guide 27 does not guide the yarn 12 (i.e., the yarn guide 27 is disengaged from the yarn 12). The unit controller 18 controls the package driving motor 24 and the yarn guide 27 such that the threading to the yarn guide 27 is performed and also the traversing of the yarn guide 27 can be started, by starting the reciprocating movement of the yarn guide 27 after the rotation of the package 15 is started in the winding direction.

[0073] As discussed above, the traversing of the yarn

12 is started after the rotation of the package 15 is started in the winding direction, and therefore the threading to the yarn guide 27 can be performed with a tension applied to the yarn 12. Consequently, the success rate can be improved in threading to the yarn guide 27.

[0074] The automatic winder according to the present embodiment includes the traverse driving motor 29 to drive the yarn guide 27 to reciprocate, separately from the package driving motor 24. The unit controller 18 starts driving the traverse driving motor 29 after starting driving the package driving motor 24.

[0075] By arranging a rotary driving source of the package 15 and a driving source of the traversing device 21 independently from each other, the control can be readily realized such that the threading is performed after the rotation of the package 15 is started.

[0076] The automatic winder according to the present embodiment further includes the timer section 53 that measures the length of time. The unit controller 18 controls the yarn guide 27 such that, when the timer section 53 counts up to the predetermined length of elapsed time, the traversing by the yarn guide 27 is started.

[0077] By performing simple control of starting the traversing of the yarn 12 after the elapse of the predetermined length, the threading can be performed only after a suitable tension is applied to the yarn 12 that is to be wound into the package 15. Because the timing of starting the traversing is controlled by time, the traversing of the yarn 12 can be started within a predetermined length of time. Consequently, the traversing of the yarn 12 can be reliably started before the straight winding large enough to adversely affect the quality of the package 15 is formed.

[0078] In the yarn winding machine according to the present embodiment, the package driving motor 24 directly drives the package 15 to rotate.

[0079] By directly driving the package 15 to rotate, the rotation of the package 15 can be reliably started by starting the driving of the package driving motor 24. Consequently, the threading can be performed after the rotation of the package 15 is reliably started.

[0080] In the automatic winder according to the present embodiment, the yarn guide 27 has the yarn hooking groove 30 that is open on its one end in the traversing direction of the yarn 12.

[0081] Consequently, simply by moving the yarn guide 27 in the traversing direction, the threading can be readily performed.

[0082] The yarn winding method according to the present embodiment includes the package driving process, the traversing process, and the starting process. In the package driving process, the package 15 into which the yarn 12 is wound and that has been in the stopped state is rotated. In the traversing process, the yarn 12 is traversed by driving the yarn guide 27 to reciprocate with the yarn guide 27 guiding the yarn 12 that is to be wound into the package 15. In the starting process, the driving of the yarn guide 27 for the reciprocating movement is

stopped when the rotation of the package 15 is stopped, and the driving of the yarn guide 27 for the reciprocating movement is started after the rotation of the package 15 in the winding direction is started.

[0083] The yarn winding method according to the present embodiment includes the timing process for measuring the length of time. With this yarn winding method, when the predetermined length of elapsed time is measured in the timing process, the traversing process is started.

[0084] A second embodiment of the present invention is now explained. In the explanation according to the present embodiment, the same reference numerals are given to components the same as or similar to the ones in the previous embodiment, and the explanation thereof may be omitted.

[0085] The automatic winder according to the second embodiment starts driving the traversing device 21 from a time point when the amount of rotation of the package 15 reaches a predetermined amount after starting the rotation of the package 15.

[0086] It can be judged, if the amount of rotation of the package 15 after the start of the rotation reaches or exceeds the predetermined amount, that a sufficient tension has been applied to the yarn 12 that is being wound into the package 15. By starting the driving of the traversing device 21 under the condition that the amount of rotation of the package 15 after the start of the rotation reaches the predetermined amount, the reliability of threading to the yarn guide 27 can be improved.

[0087] More specific explanation is given below. The unit controller 18 measures the amount of rotation of the package 15 with the package rotation sensor 26. Because the package rotation sensor 26 outputs a pulse signal every predetermined angular degrees the package 15 rotates, the unit controller 18 can detect how much the package 15 rotates by counting the pulse signals.

[0088] When the rotation of the package 15 is stopped, the unit controller 18 holds the yarn guide 27 on standby at the non-interrupting position. Once the rotation of the package 15 is started, the unit controller 18 starts counting the pulse signals output by the package rotation sensor 26. When the number of pulse signals output by the package rotation sensor 26 reaches a predetermined number after the counting is started, the unit controller 18 judges that the amount of rotation of the package 15 reaches the predetermined amount, and starts the driving of the traversing device 21. With this arrangement, the threading to the yarn guide 27 is performed with a sufficient tension applied to the yarn 12, and therefore the success rate in the threading can be improved.

[0089] As explained above, the automatic winder according to the second embodiment includes the package rotation sensor 26 that detects the rotation of the package 15. When the amount of rotation of the package 15 that is calculated based on the detection result obtained by the package rotation sensor 26 reaches the predetermined value, the unit controller 18 controls the yarn guide

27 such that the traversing by the yarn guide 27 is started.

[0090] The yarn winding method followed by the automatic winder according to the second embodiment includes a rotation detecting process, in which the package rotation sensor 26 detects the rotation of the package 15. With this yarn winding method, the traversing process is started when the amount of rotation of the package 15 that is calculated based on the detection result obtained in the rotation detecting process reaches the predetermined value.

[0091] When the amount of rotation of the package 15 reaches the predetermined value, it can be judged that a sufficient tension is applied to the yarn 12 that is being wound into the package 15. Accordingly, with a simple structure that detects the amount of rotation of the package 15 as described above, the timing of threading can be suitably controlled.

[0092] A modification example of the second embodiment is now explained. In the explanation of this modification example, the same reference numerals are given to components the same as or similar to the ones in the previous embodiments, and the explanation thereof may be omitted.

[0093] According to the above embodiments, the amount of rotation of the package 15 is detected based on the output of the package rotation sensor 26. The automatic winder of this modification example calculates a rotational speed of the package 15 based on the output of the package rotation sensor 26. Because the package rotation sensor 26 outputs a pulse signal every predetermined angular degrees the package 15 rotates, the unit controller 18 can calculate the rotational speed of the package 15 by counting the pulse signals output per unit time by the package rotation sensor 26.

[0094] It can be judged, if the rotational speed of the package 15 reaches a predetermined rotational speed after the package 15 that has been stopped starts rotating, that a sufficient tension is being applied to the yarn 12 that is being wound into the package 15. Consequently, the reliability of the threading to the yarn guide 27 can be improved by starting driving the traversing device 21 when the package 15 reaches the predetermined rotational speed after the rotation of the package 15 is started.

[0095] In contrast, in the modification example, once the package 15 is driven to rotate, the unit controller 18 calculates the rotational speed of the package 15 in real time based on the pulse signals output by the package rotation sensor 26. When detecting that the rotational speed of the package 15 has reached the predetermined rotational speed, the unit controller 18 provides control to start driving the traversing device 21. Consequently, the threading to the yarn guide 27 can be performed with a sufficient tension applied to the yarn 12, and therefore the success rate in the threading can be improved.

[0096] As explained above, in the automatic winder according to the modification example, the unit controller 18 controls the yarn guide 27 such that the traversing by the yarn guide 27 is started when the rotational speed of

the package 15 calculated based on the detection result obtained by the package rotation sensor 26 reaches a predetermined value.

[0097] With the yarn winding method followed by the automatic winder according to the modification example, the traversing process is started when the rotational speed of the package 15 calculated based on the detection result obtained in the rotation detecting process reaches the predetermined value.

[0098] It can be judged, when the rotational speed of the package 15 reaches the predetermined value, that a sufficient tension is applied to the yarn 12 that is being wound to the package 15. Consequently, with a simple structure that detects the rotational speed of the package 15 as described above, the timing of threading can be suitably controlled.

[0099] A third embodiment of the present invention is explained below. In the explanation of the present embodiment, the same reference numerals are given to components the same as or similar to the ones in the previous embodiments, and the explanation thereof may be omitted.

[0100] The automatic winder according to the third embodiment starts driving the traversing device 21 when, after the rotation of the package 15 is started, the command value for the rotation frequency that is output from the rotation command section 54 to the package driving controller 25 reaches or exceeds a predetermined value.

[0101] As explained above, after starting the rotation of the package 15 that has been stopped, the rotation command section 54 gradually increases the command value for the rotation frequency that is to be transmitted to the package driving controller 25. In this manner, the rotation of the package driving motor 24 can be gradually accelerated. Because the package 15 is driven by the package driving motor 24 to rotate, the command value for the rotation frequency that the rotation command section 54 transmits to the package driving controller 25 indicates the current rotational speed (rotation frequency) of the package 15.

[0102] The rotational speed (rotation frequency) of the package 15 can be found out by obtaining the command value for the rotation frequency output by the rotation command section 54. In the third embodiment, once the driving of the rotation of the package 15 is started, the unit controller 18 monitors the command value for the rotation frequency that the rotation command section 54 transmits to the package driving controller 25. Upon detecting that the command value reaches or exceeds the predetermined rotation frequency, the unit controller 18 starts driving the traversing device 21. Consequently, the threading to the yarn guide 27 can be performed with a sufficient tension applied to the yarn 12, and therefore the success rate in the threading can be improved.

[0103] As explained above, the automatic winder according to the third embodiment includes the rotation command section 54 that transmits the command value for the rotation frequency to the package driving control-

ler 25. The unit controller 18 controls the yarn guide 27 such that the traversing by the yarn guide 27 is started when the command value transmitted by the rotation command section 54 reaches the predetermined value.

[0104] The yarn winding method followed by the automatic winder according to the third embodiment includes a rotation command process in which the command value for the rotation frequency is transmitted to the package driving controller 25. With this yarn winding method, the traversing process is started when the command value reaches the predetermined value.

[0105] By performing control based on the command value issued for the package driving controller 25, the control can be realized in accordance with the rotational speed of the package 15, without requiring a sensor such as the package rotation sensor 26 in the second embodiment. Consequently, the control can be readily realized such that the traversing is started when the rotational speed of the package 15 reaches or exceeds the predetermined speed after the start of the rotation of the package 15.

[0106] The exemplary embodiments and modification examples of the present invention have been explained above; however, the above structure can be modified as shown below.

[0107] The structure of the present invention is not limited to the automatic winder; it can be widely applied to, for example, a rewinding machine, a spinning machine (air-jet spinning frame and open-end spinning frame) as well as any other yarn winding machines.

[0108] In the above explanation, the pivoting shaft of the traverse arm 28 is substantially parallel to the yarn path of the yarn 12 that runs near the yarn guide 27, and the yarn guide 27 is driven to reciprocate on a plane substantially orthogonal to the yarn path. The layout of the traversing device 21, however, is not limited thereto. For example, as disclosed in FIG. 4 of Japanese Patent Application Laid-open No. 2010-42904, the layout of the yarn guide can be such that the yarn guide performs the reciprocating movement in a plane substantially parallel to the yarn path.

[0109] The traversing device 21 is not limited to an arm-type traversing device. For example, it can be a belt-type or a rotary-type traversing device.

[0110] The yarn guide 27 is shaped into a hook, but the shape is not limited thereto. For example, as shown in Japanese Unexamined Patent Publication No. 2009-508782, it can be of a finger type with its free end open.

[0111] The yarn winding unit 10 according to the above embodiments does not include any mechanical braking mechanism to stop the package 15; however, the yarn winding unit 10 can include such a braking mechanism.

[0112] According to the second embodiment, the package rotation sensor 26 detects the rotation of the package 15 by detecting the rotation of the center bearing 22 that grips the package 15. The structure of the rotation detecting section is not limited thereto, however. For exam-

ple, the rotation of the package 15 can be detected by detecting the rotation of the center bearing 23, the rotation of the contact roller 20 that rotates in contact with the package 15, and/or the rotation of the package driving motor 24. The rotation detecting section is not limited to the rotary encoder, but can be an angular velocity sensor.

[0113] The rotational speed of the package 15 is calculated in the modification example of the second embodiment. As the rotational speed, for example, an angular velocity, the rotation frequency (number of rotations per unit time), the circumferential velocity of the package 15, and the like can be calculated.

[0114] According to the above embodiments, a certain tension is applied to the yarn 12 by the tension applying device 36. However, if the objective is to produce a loosely wound package (fluffy package), then it can be chosen to apply a low tension (by slightly engaging the teeth of the tension applying device 36 with one another), or to apply no tension (by not operating the tension applying device 36 or omitting the tension applying device 36 from the structure) to wind the yarn 12 (soft winding). Especially in the yarn winding machine that performs soft winding, the tension applied to the yarn tends to be insufficient, which results into a low success rate in the threading. By incorporating the structure of the present invention into the yarn winding machine that performs soft winding, the success rate in the threading can be improved.

[0115] According to the above embodiments, the driving source (package driving motor 24) for rotating the package 15 and the driving source (traverse driving motor 29) for driving the yarn guide 27 to reciprocate are separately arranged. In place of these driving sources, both the package and the yarn guide can be driven by a single driving source. In such a structure, a clutch, for example, is arranged between the yarn guide and the driving source. When the driving source starts the rotation of the package, the clutch is disengaged. After a certain period of time elapses, the clutch is engaged to start driving the yarn guide. With such a structure, the concept of the above embodiments that the threading is performed after starting the rotation of the package can be realized with a single driving source.

[0116] According to the above embodiments, the package driving controller 25 and the traverse controller 31 are both arranged separately from the unit controller 18. However, functions of at least either of the package driving controller 25 and the traverse controller 31 can be combined with those of the unit controller 18.

[0117] According to the above embodiments, the package 15 is driven to rotate directly by the package driving motor 24. However, the yarn winding unit 10 can include a motor that directly drives the contact roller 20 to rotate so that the package 15 can be rotated along with the contact roller 20.

[0118] A yarn winding machine according to an aspect of the present invention includes a first driving section, a yarn guide, and a control section. The first driving section drives a package into which a yarn is wound and that has

been in a stopped state. The yarn guide performs reciprocating movements to traverse and guide the yarn when the yarn is to be wound into the package. The control section controls the first driving section and the yarn guide such that the yarn guide does not perform the reciprocating movements while rotation of the package is stopped, and the yarn guide starts the reciprocating movements after the rotation of the package in a winding direction is started.

[0119] With the above arrangement, because traversing of the yarn is started after the rotation of the package in the winding direction is started, threading to the yarn guide can be performed with a tension applied to the yarn. This improves a success rate in the threading to the yarn guide.

[0120] It is preferable that the yarn winding machine further includes a second driving section that drives the yarn guide to perform the reciprocating movements, separately from the first driving section.

[0121] The structure in which the driving source for the rotation of the package and the driving source for traversing are arranged separately from each other facilitates the control for performing the threading after starting the rotation of the package.

[0122] It is preferable that the yarn winding machine further includes a timer that measures time. The control section controls the yarn guide such that the yarn guide starts traversing when the time measured by the timer elapses a predetermined length of time.

[0123] The threading can be performed after a sufficient tension is applied to the yarn that is to be wound into the package, by simple control of starting the traversing of the yarn after an elapse of a predetermined length of time. Because the traversing start timing is controlled in accordance with time, the traversing of the yarn can be started within the predetermined length of time. Consequently, the traversing of the yarn can be reliably started before straight winding that is large enough to adversely affect the quality of the package is produced.

[0124] It is preferable that the yarn winding machine further includes a rotation detecting section that detects a parameter relating to the rotation of the package. The control section controls the yarn guide such that the yarn guide starts traversing when any one of a rotation amount and a rotational speed of the package that is calculated based on the parameter detected by the rotation detecting section reaches a predetermined value.

[0125] When the amount of rotation or the rotational speed of the package reaches the predetermined value, it can be judged that a sufficient tension is being applied to the yarn that is to be wound into the package. With a simple structure of detecting the amount of rotation or the rotational speed of the package as described above, the timing of threading can be suitably controlled.

[0126] It is preferable that the yarn winding machine further includes a rotation command section that transmits a command value for a rotational speed to the first driving section. The control section controls the yarn

guide such that the yarn guide starts traversing when the command value received from the rotation command section reaches a predetermined value.

[0127] By performing control based on the command value for the rotational speed that is issued to the first driving section, the control in accordance with the rotational speed of the package can be realized without requiring, for example, any additional sensor such as a dedicated sensor for detecting the rotational speed of the package. This facilitates the control for performing the threading when the rotational speed of the package reaches or exceeds a predetermined speed after the rotation of the package is started.

[0128] It is preferable that the first driving section of the yarn winding machine directly drives the package to rotate.

[0129] With the structure that directly drives the package to rotate, the rotation of the package can be reliably started by starting the driving of the first driving section. Therefore, the threading can be performed after the rotation of the package is reliably started.

[0130] It is preferable that the yarn guide of the yarn winding machine includes a yarn hooking groove having one side open in a traversing direction of the yarn.

[0131] With this arrangement, the threading can be readily performed simply by moving the yarn guide in a traversing direction.

[0132] A yarn winding method according to another aspect of the present invention includes driving, traversing, and controlling. In the driving, a package into which a yarn is wound and that has been in a stopped state is driven to rotate. In the traversing, the yarn is traversed and guided by causing a yarn guide to perform reciprocating movements when the yarn is to be wound into the package. In the controlling, the yarn guide is controlled not to perform the reciprocating movements while rotation of the package is stopped, and to start the reciprocating movements after the rotation of the package is started in a winding direction.

[0133] By starting the traversing of the yarn after the rotation of the package in the winding direction is started as described above, the threading to the yarn guide can be performed with a tension applied to the yarn. This improves the success rate in the threading to the yarn guide.

[0134] It is preferable that the yarn winding method further includes measuring time. The traversing is started when the time measured at the measuring elapses a predetermined length of time.

[0135] With the simple method of starting the traversing of the yarn after a predetermined length of elapsed time, the traversing of the yarn by the yarn guide can be started after a sufficient tension is applied to the yarn that is to be wound into the package. Because the traversing start time is controlled in accordance with time, the traversing of the yarn can be started within a predetermined time. Consequently, the traversing of the yarn can be reliably started before straight winding that is large

enough to adversely affect the quality of the package is produced.

[0136] It is preferable that the yarn winding method further includes detecting a parameter relating to the rotation of the package. With this yarn winding method, the traversing is started when at least one of a rotation amount and a rotational speed of the package that is calculated based on the parameter detected at the detecting reaches a predetermined value.

[0137] With the simple structure of detecting the amount of rotation or the rotational speed of the package, the timing of performing the threading can be suitably controlled.

[0138] It is preferable that the yarn winding method further includes transmitting a command value for a rotational speed to a driving section that drives the package to rotate. With the yarn winding method, the traversing is started when the command value reaches a predetermined value.

[0139] By performing the control based on the command value for the rotational speed that is issued to the driving section, the control can be realized in accordance with the rotational speed of the package without requiring, for example, any additional sensor such as a dedicated sensor for detecting the rotational speed of the package. Consequently, the control can be readily realized for performing the threading when the rotational speed of the package reaches or exceeds the predetermined speed after the rotation of the package is started.

[0140] Although the invention has been described with respect to specific embodiments for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art that fairly fall within the basic teaching of the claims.

Claims

1. A yarn winding machine comprising:

a first driving section (24) adapted to drive and rotate a package (15) into which a yarn (12) is wound;

a yarn guide (27) adapted to perform reciprocating movements to traverse and guide the yarn (12) when the yarn (12) is to be wound into the package (15); and

a control section (18, 25, 31) adapted to control the first driving section (24) and the yarn guide (27) to stop the reciprocating movements of the yarn guide (27) while rotation of the package (15) is stopped, and to start the reciprocating movements of the yarn guide (27) after the rotation of the package (15) that has been in a stopped state in a winding direction is started.

2. The yarn winding machine according to Claim 1, further comprising a second driving section (29) adapted to drive the yarn guide (27) to perform the reciprocating movements, separately from the first driving section (24).

3. The yarn winding machine according to Claim 1 or 2, further comprising a timer (53) adapted to measure time, wherein the control section (18, 31) is adapted to control the yarn guide (27) such that the yarn guide (27) starts traversing when the time measured by the timer (53) elapses a predetermined length of time.

4. The yarn winding machine according to Claim 1 or 2, further comprising a rotation detecting section (26) adapted to detect a parameter relating to the rotation of the package (15), wherein the control section (18, 31) is adapted to control the yarn guide (27) such that the yarn guide (27) starts traversing when any one of a rotation amount and a rotational speed of the package (15) that is calculated based on the parameter detected by the rotation detecting section (26) reaches a predetermined value.

5. The yarn winding machine according to Claim 1 or 2, further comprising a rotation command section (54) adapted to transmit a command value for a rotational speed to the first driving section (24), wherein the control section (18, 31) is adapted to control the yarn guide (27) such that the yarn guide (27) starts traversing when the command value received from the rotation command section (54) reaches a predetermined value.

6. The yarn winding machine according to any one of Claims 1 to 5, wherein the first driving section (24) is adapted to directly drive the package (15) to rotate.

7. The yarn winding machine according to any one of Claims 1 to 6, wherein the yarn guide (27) includes a yarn hooking groove (30) having one side open in a traversing direction of the yarn (12).

8. A yarn winding method comprising:

driving a package (15) into which a yarn (12) is wound to rotate;

traversing and guiding the yarn (12) by causing a yarn guide (27) to perform reciprocating movements when the yarn (12) is to be wound into the package (15); and

controlling to stop the reciprocating movements of the yarn guide (27) while rotation of the package (15) is stopped, and to start the reciprocating movements after the rotation of the package

(15) that has been in a stopped state in a winding direction is started.

9. The yarn winding method according to Claim 8, further comprising measuring time, wherein the traversing is started when the time measured at the measuring elapses a predetermined length of time. 5
10. The yarn winding method according to Claim 8, further comprising detecting a parameter relating to the rotation of the package (15), wherein the traversing is started when at least one of a rotation amount and a rotational speed of the package (15) that is calculated based on the parameter detected at the detecting reaches a predetermined value. 10 15
11. The yarn winding method according to Claim 8, further comprising transmitting a command value for a rotational speed to a driving section (24) adapted to drive the package (15) to rotate, wherein the traversing is started when the command value reaches a predetermined value. 20 25

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FIG.1

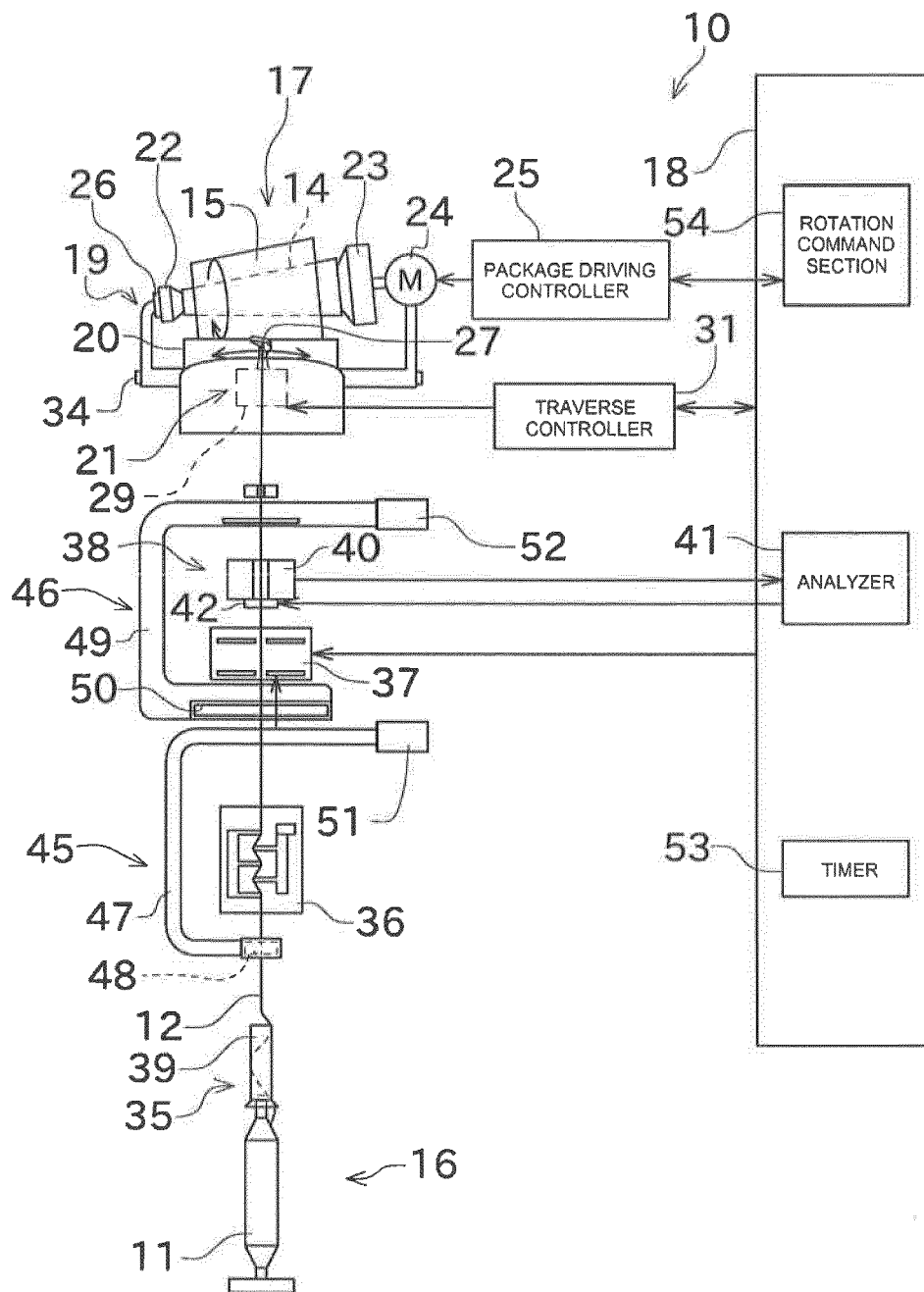


FIG.2

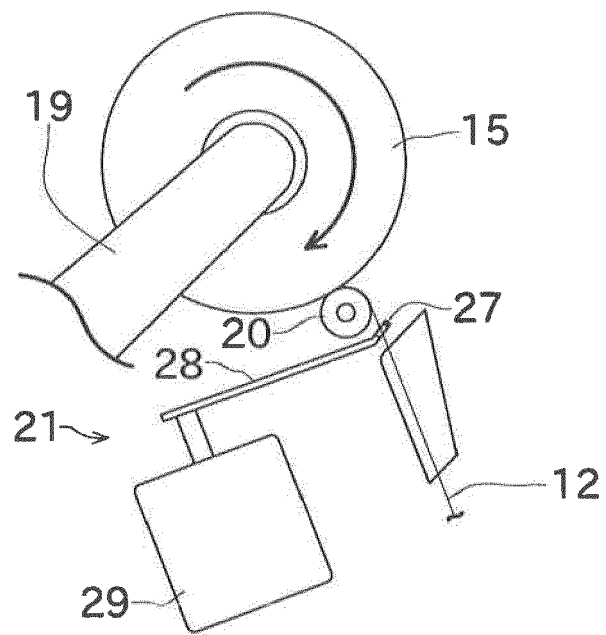


FIG.3

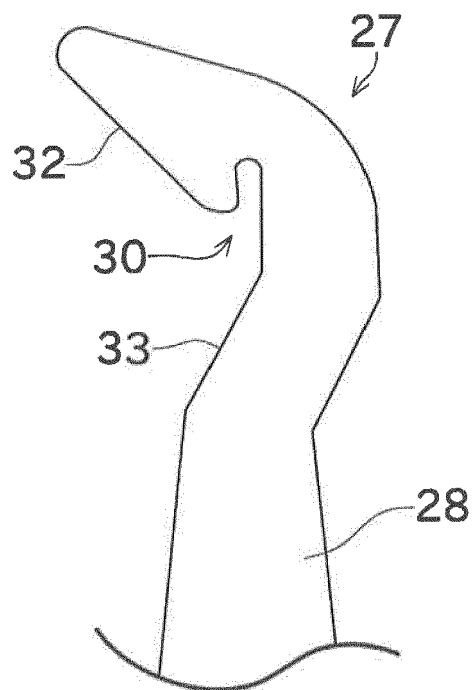


FIG.4

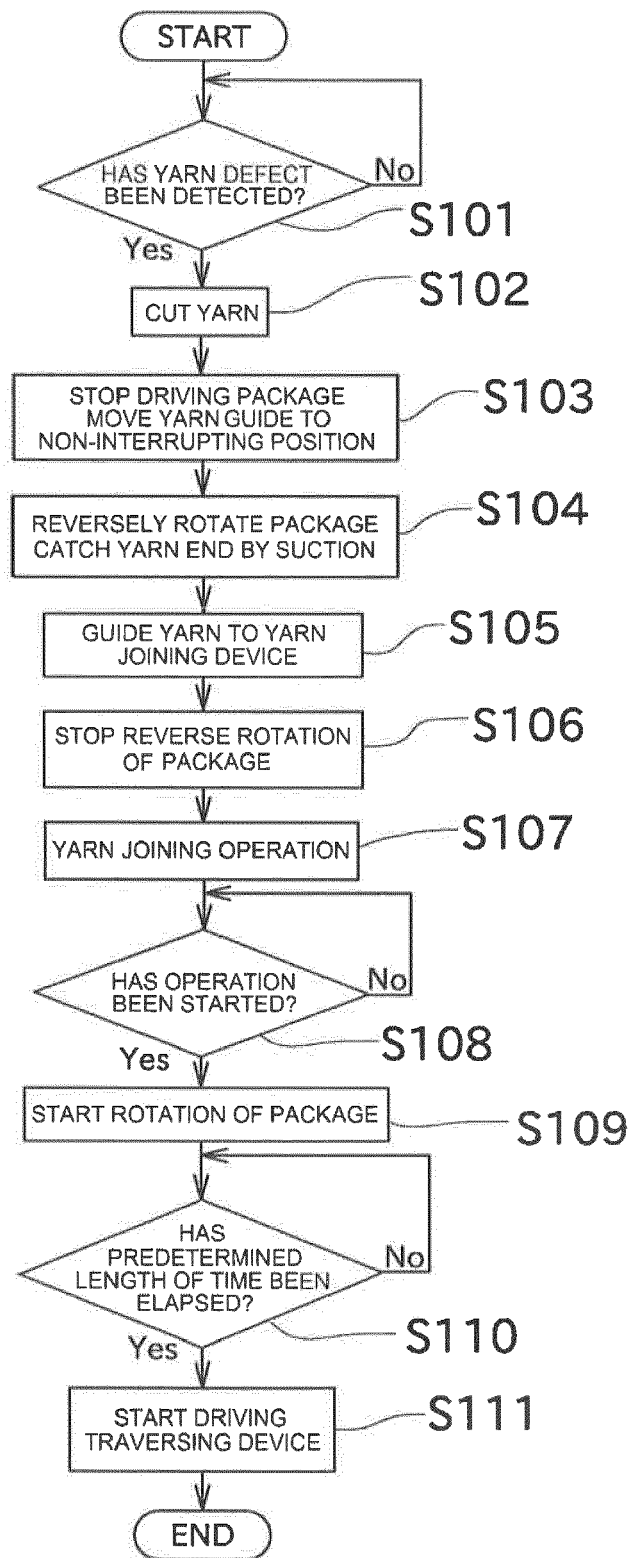


FIG.5

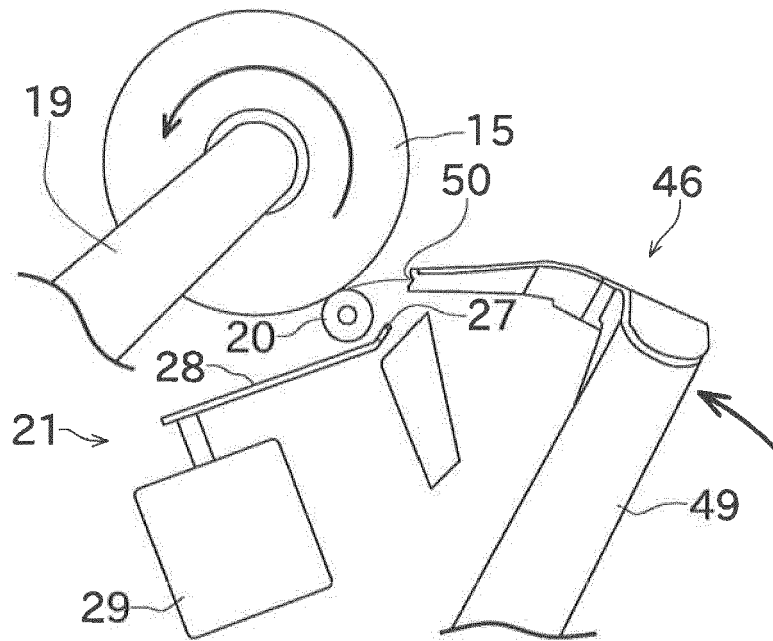


FIG.6

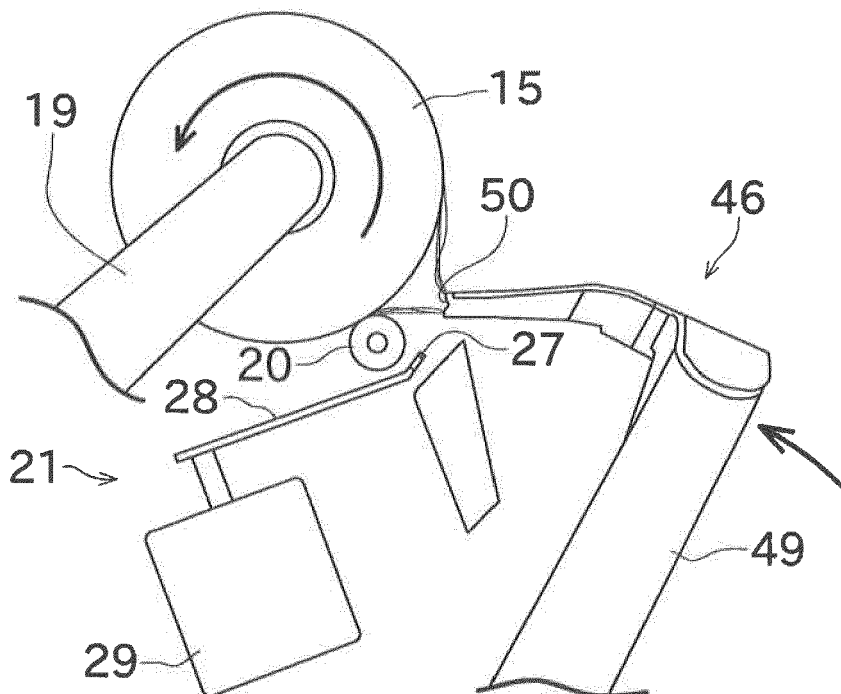


FIG.7

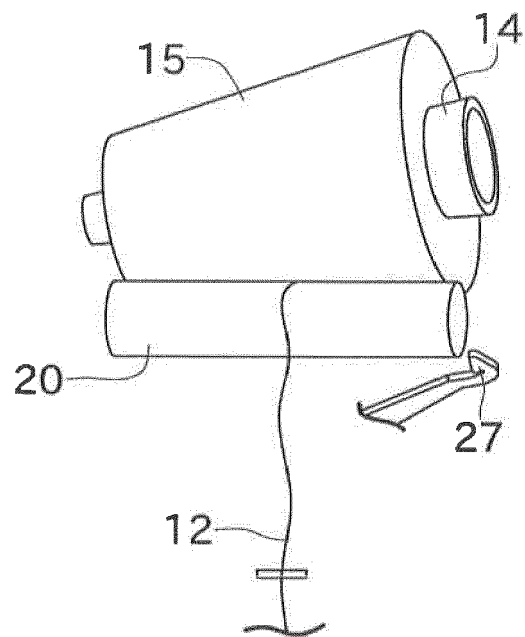


FIG.8

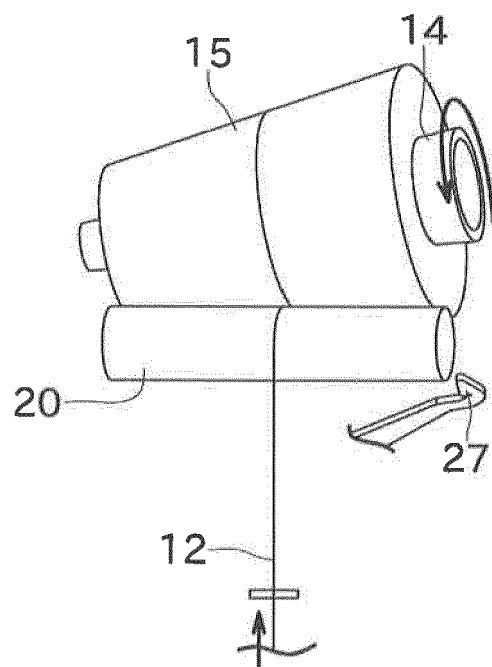


FIG.9

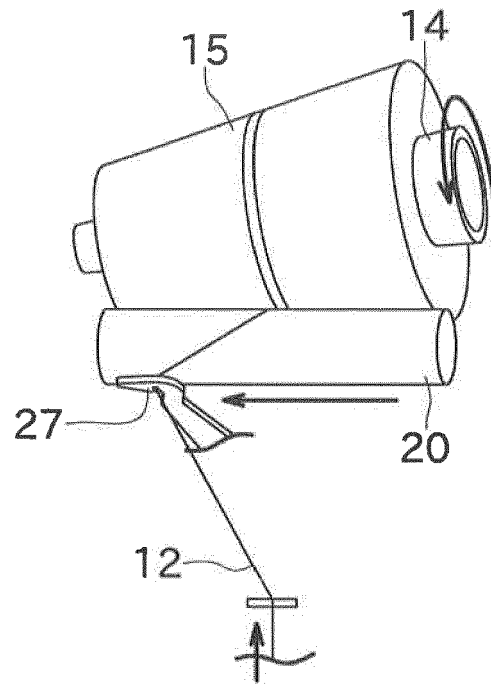
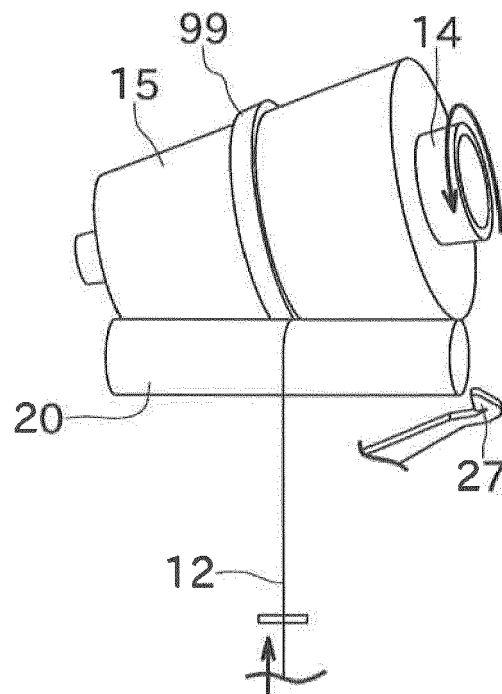


FIG.10



REFERENCES CITED IN THE DESCRIPTION

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