



(12)

EUROPEAN PATENT APPLICATION

- (43) Date of publication:
15.05.2024 Bulletin 2024/20

(51) International Patent Classification (IPC):
B65H 51/22 (2006.01) B65H 67/08 (2006.01)
B65H 69/00 (2006.01)

(21) Application number: 23208942.5

(52) Cooperative Patent Classification (CPC):
B65H 51/22; B65H 67/081; B65H 69/00;
B65H 2701/31

(22) Date of filing: 10.11.2023

- (84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

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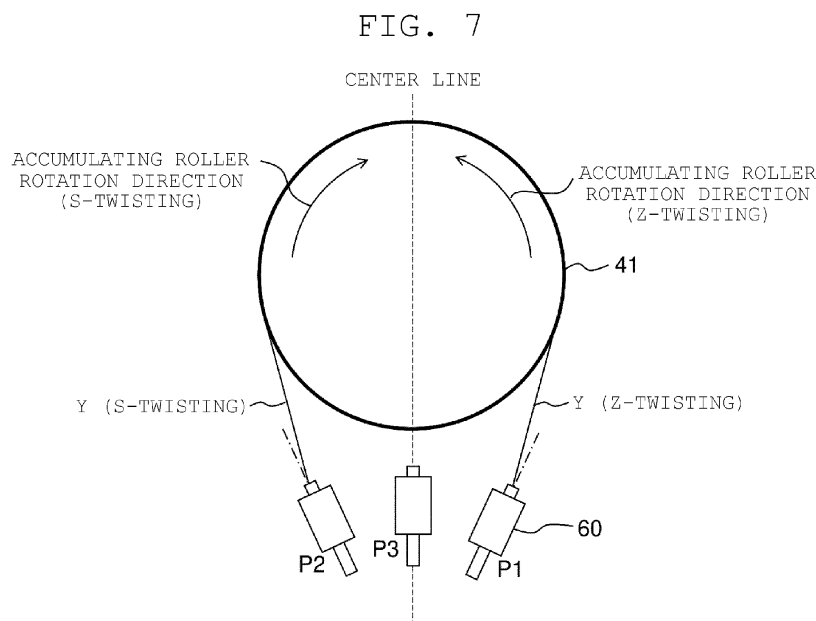
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(30) Priority: 11.11.2022 JP 2022181031

(54) YARN WINDING DEVICE

- (57) A winding unit (2) includes a yarn supplying section (6) configured to supply a yarn (Y), a yarn accumulating device (40) configured to accumulate the supplied yarn (Y), a package forming section (8) configured to wind the yarn (Y) to form a package (30), a yarn joining device (14) configured to perform yarn joining, a yarn ejecting section (60) configured to guide the yarn (Y) to the yarn accumulating device (40) and to guide the yarn (Y) to the yarn joining device (14) by ejecting air in a direction from the yarn accumulating device (40) toward the yarn supplying section (6) and ejecting the yarn (Y) accumulated in the yarn accumulating device (40), and a moving section (90) configured to move the yarn ejecting section (60) to a yarn guiding position which is for guiding the yarn (Y) to the yarn accumulating device (40) and a yarn pull-out position which is for pulling out the yarn (Y) accumulated in the yarn accumulating device (40). The winding unit (2) appropriately guides the yarn (Y) from the yarn accumulating device (40) toward the yarn supplying section (6) side and guides the yarn (Y) to the yarn accumulating device (40).



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

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

2. Description of the Related Art

[0002] Conventionally, there is known a yarn winding device including: a yarn supplying section on which a yarn supplying bobbin is supported; a yarn accumulating device that unwinds a yarn from the yarn supplying bobbin supported by the yarn supplying section and winds the unwound yarn; a yarn joining device that joins a yarn end of a yarn on the yarn supplying bobbin side and a yarn end of a yarn on the yarn accumulating device; and a yarn winding section that winds the yarn to form a package. This yarn winding device is provided with a blow-feeding section (air sucker device) that catches a yarn on the yarn accumulating device side and blows the yarn to a guiding path of the yarn, to pull out the yarn along the guiding path and allow a catching section to catch the yarn, when the yarn is separated (that is divided or not continuous or interrupted) between the yarn supplying bobbin and the yarn accumulating device (see, for example, JP 2017-077949 A).

[0003] The blow-feeding section described above may be used to guide a yarn unwound from the yarn supplying bobbin to the yarn accumulating device. An optimum position of the blow-feeding section at a time of catching the yarn on the yarn accumulating device side and blowing the yarn toward a supplying section side is different from an optimum position at a time of guiding the yarn to the yarn accumulating device. However, in the conventional yarn winding device, the blow-feeding section has been fixed at a predetermined position and has not been movable. Therefore, at a time of catching the yarn on the yarn accumulating device side and blowing the yarn to the guiding path, and/or at a time of guiding the yarn to the yarn accumulating device, the blow-feeding section may not be arranged at the optimum position, and the yarn may not be appropriately guided.

BRIEF SUMMARY OF THE INVENTION

[0004] An object of the present invention is to appropriately guide a yarn from a yarn accumulating device to a supplying section side and guide a yarn to the yarn accumulating device, in the yarn winding device including the yarn accumulating device.

[0005] Hereinafter, a plurality of aspects will be described as means for solving the problem. These aspects can be combined in a freely selected manner as required.

[0006] A yarn winding device according to one aspect of the present invention includes a supplying section, a

yarn accumulating device, a winding section, a yarn joining device, a yarn ejecting section, and a moving section. The supplying section supplies a yarn. The yarn accumulating device accumulates the yarn supplied from the supplying section. The winding section winds the yarn accumulated in the yarn accumulating device to form a package. The yarn joining device joins a yarn on the supplying section side and a yarn on the yarn accumulating device side, when the yarn is separated (divided) between the supplying section and the yarn accumulating device.

[0007] The yarn ejecting section guides the yarn supplied from the supplying section to the yarn accumulating device. Further, the yarn ejecting section guides the yarn to the yarn joining device by ejecting air in a direction from the yarn accumulating device toward the supplying section to pull out the yarn accumulated in the yarn accumulating device, and ejecting the yarn to the supplying section side. The moving section moves the yarn ejecting section to a yarn guiding position and a yarn pull-out position. The yarn guiding position is a position of the yarn ejecting section at a time of guiding the yarn supplied from the supplying section to the yarn accumulating device. The yarn pull-out position is a position of the yarn ejecting section at a time of pulling out the yarn accumulated in the yarn accumulating device and ejecting the yarn to the supplying section side.

[0008] In the yarn winding device described above, the moving section moves the yarn ejecting section to the yarn guiding position which is a position for guiding the yarn supplied from the supplying section to the yarn accumulating device, and the yarn pull-out position which is a position for pulling out the yarn accumulated in the yarn accumulating device and ejecting the yarn to the supplying section side. In this way, in the yarn winding device, the yarn ejecting section can be moved to an optimum position for guiding the yarn supplied from the supplying section to the yarn accumulating device, and an optimum position for pulling out the yarn accumulated in the yarn accumulating device and ejecting the yarn to the supplying section side. Therefore, the yarn can be appropriately guided to the yarn accumulating device and the yarn can be appropriately guided from the yarn accumulating device to the supplying section.

[0009] In the yarn winding device described above, the yarn guiding position may include a first position which is for guiding a Z-twisted yarn to the yarn accumulating device, and a second position which is for guiding an S-twisted yarn to the yarn accumulating device. Consequently, yarns of different types of twisting (Z-twisting and S-twisting) can be appropriately guided to the yarn accumulating device.

[0010] In the yarn winding device described above, the first position and the second position may be in a line symmetrical relationship with respect to a center of the yarn accumulating device. Consequently, the first position and the second position can be appropriately set.

[0011] In the yarn winding device described above, the

yarn pull-out position may be a third position midway between the first position and the second position. Consequently, an appropriate yarn pull-out position can be set.

[0012] In the yarn winding device described above, the yarn pull-out position may include a fourth position which is for pulling out the Z-twisted yarn from the yarn accumulating device, and a fifth position which is for pulling out the S-twisted yarn from the yarn accumulating device. Consequently, an appropriate yarn pull-out position corresponding to twisting of the yarn can be set.

[0013] In the yarn winding device described above, the yarn accumulating device may include an accumulating roller. The accumulating roller winds and accumulates a yarn. In this case, the yarn guiding position may be a position where an end portion of the yarn ejecting section on the yarn accumulating device side is directed outward of the yarn accumulating device, with respect to a tangent line from the end portion to a side surface of the accumulating roller. Consequently, when the yarn is disconnected, the disconnected (separated) yarn can be prevented from hitting the yarn accumulating device (accumulating roller), and the yarn can be appropriately guided.

[0014] In the yarn winding device described above, the moving section may include a cam that is rotatable, and a cam follower that is or can be brought in contact with a cam surface of the cam. The cam follower may be motion-coupled with the yarn ejection section to move it between a plurality of positions including the yarn guiding position and the yarn pull-out position based on a rotation of the cam. According to a preferred embodiment, the moving section may include a cam, a first arm, and a second arm. The cam is rotatable about a first axis. The first arm has one end that comes into contact with a side surface of the cam, and another end that is fixed to be rotatable around a second axis, and the first arm rotates around the second axis in accordance with rotation of the cam. The second arm has one end to which the yarn ejecting section is fixed, and another end that is fixed to be rotatable around the second axis together with the another end of the first arm. The second arm moves the yarn ejecting section to the yarn guiding position and the yarn pull-out position, in accordance with rotation of the first arm. Consequently, the yarn ejecting section can be appropriately moved between the yarn guiding position and the yarn pull-out position.

[0015] In the yarn winding device described above, when one end of the first arm or the cam follower is in contact with an origin position of the cam, the yarn ejecting section may be located at the first position which is for guiding the Z-twisted yarn to the yarn accumulating device. Consequently, control of the yarn ejecting section is facilitated by setting, as an origin, a position where a frequency of moving the yarn ejecting section is relatively high.

[0016] In the yarn winding device described above, the moving section may rotate the cam in a first direction to, thereby, move the yarn ejecting section from the yarn

pull-out position to the first position where the yarn ejecting section guides the Z-twisted yarn to the yarn accumulating device. Further, the moving section may rotate the cam in a second direction opposite to the first direction to, thereby, move the yarn ejecting section from the yarn pull-out position to the second position where the yarn ejecting section guides an S-twisted yarn to the yarn accumulating device. Consequently, control of the yarn ejecting section is facilitated.

[0017] In the yarn winding device described above, the supplying section may supply a yarn unwound from the yarn supplying bobbin. Consequently, in an automatic winder including the yarn accumulating device, the yarn can be appropriately guided to the yarn accumulating device and the yarn can be appropriately guided from the yarn accumulating device to the supplying section side.

[0018] The supplying section may supply a yarn spun by a force of air. Consequently, in a pneumatic spinning machine including the yarn accumulating device, the yarn can be appropriately guided to the yarn accumulating device and the yarn can be appropriately guided from the yarn accumulating device to the supplying section side.

[0019] The supplying section may supply a yarn spun by a rotational force of a rotor. Consequently, in an open-end spinning machine including the yarn accumulating device, the yarn can be appropriately guided to the yarn accumulating device and the yarn can be appropriately guided from the yarn accumulating device to the supplying section side.

[0020] Since the yarn ejecting section can be moved to an optimum position for guiding the yarn supplied from the supplying section to the yarn accumulating device, and an optimum position for pulling out the yarn accumulated in the yarn accumulating device and ejecting the yarn to the supplying section side, the yarn can be appropriately guided to the yarn accumulating device and the yarn can be appropriately guided from the yarn accumulating device to the supplying section.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

FIG. 1 is a view illustrating a configuration of an automatic winder;

FIG. 2 is a view illustrating a configuration of a winding unit;

FIG. 3 is an enlarged view of a yarn accumulating device;

FIG. 4A is a view illustrating an arrangement relationship between the yarn accumulating device and a detection section;

FIG. 4B is a view illustrating an arrangement relationship between the yarn accumulating device and a light emitting section;

FIG. 4C is a view illustrating an arrangement rela-

tionship between the yarn accumulating device and a detection unit;

FIG. 5 is a view illustrating a detailed configuration of a moving section;

FIG. 6 is a view illustrating a state where a first arm rotates in accordance with rotation of a cam;

FIG. 7 is a view illustrating a yarn guiding position and a yarn pull-out position;

FIG. 8 is a view illustrating a yarn path when an S-twisted yarn is guided to the yarn accumulating device in a state where a yarn ejecting section is arranged at a first position; and

FIG. 9 is a flowchart illustrating a forming operation of a package in the winding unit.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

1. First embodiment

(1) Automatic winder

[0022] Hereinafter, a first embodiment will be described in detail. The same reference numerals are denoted on the same or equivalent components in the description of the drawings, and the redundant description will be omitted. "Upstream" and "downstream" respectively refer to upstream and downstream in a travelling direction of a yarn.

[0023] An automatic winder 1 will be described using FIG. 1. FIG. 1 is a view illustrating a configuration of the automatic winder 1. The automatic winder 1 includes a plurality of winding units 2 (one example of a yarn winding device) arranged in line, a machine control device 3, a yarn supplying bobbin supplying device 4, and a doffing device 5. Further, the automatic winder 1 is provided with a blower box (not illustrated).

[0024] The winding unit 2 winds a yarn Y around a winding bobbin 22 to form a package 30. The winding unit 2 unwinds the yarn Y of a yarn supplying bobbin 21, temporarily accumulates the unwound yarn Y with a yarn accumulating device 40, and then pulls out the yarn Y accumulated in the yarn accumulating device 40 and winds the yarn Y around the winding bobbin 22 to form the package 30.

[0025] The machine control device 3 is configured to be able to communicate with each winding unit 2. An operator of the automatic winder 1 can intensively manage the plurality of winding units 2 by appropriately operating the machine control device 3. The machine control device 3 controls operations of the yarn supplying bobbin supplying device 4 and the doffing device 5.

[0026] The yarn supplying bobbin supplying device 4 sets the yarn supplying bobbin 21 one by one on a conveyance tray 26. The yarn supplying bobbin supplying device 4 supplies the yarn supplying bobbin 21 set on the conveyance tray 26 to each of the plurality of winding units 2.

[0027] When the package 30 is fully wound (in a state where a prescribed amount of the yarn Y is wound) in the winding unit 2, the doffing device 5 travels to a position of the winding unit 2 and detaches the fully-wound package 30. The doffing device 5 sets a new winding bobbin 22 around which no yarn Y is wound, for the winding unit 2 from which the package 30 is removed.

(2) Winding unit

(2-1) Schematic configuration of winding unit

[0028] Hereinafter, a configuration of the winding unit 2 will be described. First, a schematic configuration of the winding unit 2 will be described with reference to FIG. 2. FIG. 2 is a view illustrating a configuration of the winding unit 2. The winding unit 2 includes a yarn supplying section 6 (an example of a supplying section), the yarn accumulating device 40, a yarn guiding section 7, a package forming section 8 (an example of a winding section), and a control section 25.

[0029] The yarn supplying section 6 is configured to support the yarn supplying bobbin 21 set on the conveyance tray 26 at a predetermined position, and unwind the yarn Y from the yarn supplying bobbin 21. When all the yarn Y is unwound from the yarn supplying bobbin 21, the yarn supplying section 6 discharges a core tube of the yarn supplying bobbin 21 around which no yarn Y is wound anymore, and receives supply of a new yarn supplying bobbin 21 from the yarn supplying bobbin supplying device 4.

[0030] The yarn accumulating device 40 is arranged on the way of a yarn travelling path formed between the yarn supplying section 6 and the package forming section 8. The yarn accumulating device 40 is provided at a position upstream in the travelling direction of the yarn Y with respect to a wax applying device 70. The yarn accumulating device 40 winds and temporarily accumulates the yarn Y unwound in the yarn supplying section 6. The yarn accumulating device 40 supplies the accumulated yarn Y to the package forming section 8.

[0031] The yarn guiding section 7 is arranged between the yarn supplying section 6 and the yarn accumulating device 40, and guides the yarn Y supplied from the yarn supplying section 6 between the yarn supplying section 6 and the yarn accumulating device 40. In the yarn guiding section 7, when the yarn Y is separated (divided) between the yarn supplying section 6 and the yarn accumulating device 40, a terminal end portion of the yarn Y present on the yarn supplying section 6 side is joined to a terminal end portion of the yarn Y present on the yarn accumulating device 40 side.

[0032] The package forming section 8 winds the yarn Y supplied from the yarn accumulating device 40 around the winding bobbin 22 to form the package 30. The package forming section 8 includes a cradle 23 and a traverse drum 24. The cradle 23 rotatably supports the winding bobbin 22 (or the package 30). The cradle 23 is config-

ured to allow an outer peripheral surface of the supported package 30 to be brought into contact with an outer peripheral surface of the traverse drum 24.

[0033] The traverse drum 24 drives the winding bobbin 22 while traversing the yarn Y. Specifically, the traverse drum 24 is rotatably driven by a driving source (for example, an electric motor or the like) not illustrated, and rotates in a state of being in contact with an outer peripheral surface of the winding bobbin 22 or the package 30, to cause the winding bobbin 22 to rotate. Consequently, the yarn Y accumulated in the yarn accumulating device 40 can be unwound and pulled out, and wound around the winding bobbin 22.

[0034] A traverse groove is formed on the outer peripheral surface of the traverse drum 24, and the yarn Y can be traversed at a predetermined width by the traverse groove. The above configuration allows the yarn Y to be wound around the winding bobbin 22 while being traversed, to form the package 30 of a predetermined shape.

[0035] The control section 25 is a computer system including hardware such as a CPU, a storage device (ROM, RAM, and the like), and various interfaces. The storage device stores software such as a control program. The control section 25 controls each configuration of the winding unit 2 by cooperation of hardware and software. The control section 25 is configured to be able to communicate with the machine control device 3. Consequently, it is possible to intensively control an operation of the plurality of winding units 2 arranged in the automatic winder 1, in the machine control device 3.

[0036] The winding unit 2 includes the wax applying device 70. The wax applying device 70 is arranged between the yarn accumulating device 40 and the package forming section 8. The wax applying device 70 applies wax to the yarn Y travelling from the yarn accumulating device 40 toward the package forming section 8.

(2-2) Yarn accumulating device

[0037] Next, a detailed configuration of the winding unit 2 will be described. First, with reference to FIGS. 2 and 3, a detailed configuration of the yarn accumulating device 40 will be described. FIG. 3 is an enlarged view of the yarn accumulating device 40. The yarn accumulating device 40 includes an accumulating roller 41 around which the yarn Y can be wound, a drive motor 45 that rotatably drives the accumulating roller 41, and a cover 47 (see Fig. 4C). The accumulating roller 41 winds the yarn Y on an accumulation region A of an outer peripheral surface 41d of the accumulating roller 41, to temporarily accumulate the yarn Y. The accumulating roller 41 is supported on a machine (frame) of the automatic winder 1 so as to be rotatable about a rotational axis C1 slightly inclined with respect to a horizontal direction. As illustrated in FIGS. 2 and 3, tapered portions 41a and 41b whose diameters increase toward ends are individually formed on both end portion sides of the accumulating roller 41

in an axial direction. A portion between the two tapered portions 41a and 41b is a cylindrical portion 41c having a constant diameter, and the outer peripheral surface 41d thereof is the accumulation region A around which the yarn Y is wound. The outer peripheral surface 41d of the cylindrical portion 41c is mirror-finished. By the two tapered portions 41a and 41b on both end sides, the yarn Y wound around the cylindrical portion 41c is prevented from falling off.

[0038] Around the outer peripheral surface 41d of the cylindrical portion 41c of the accumulating roller 41, a ring member 42 is wound. The ring member 42 is formed in an annular shape by, for example, rubber. The ring member 42 is attached to a boundary portion between the cylindrical portion 41c and the tapered portion 41b, on a distal end side. The ring member 42 is a tension ring that surrounds the yarn Y pulled out from the accumulating roller 41 by the package forming section 8, and is brought into contact with the yarn Y to apply resistance. The ring member 42 is attached to the cylindrical portion 41c by an elastic force that tightens radially inward. By using the elastic force, the ring member 42 applies resistance to the yarn Y pulled out from the accumulating roller 41. The ring member 42 applies an appropriate tension to the yarn Y pulled out from the accumulating roller 41, to stabilize unwinding of the yarn Y from the accumulating roller 41.

[0039] On the outer peripheral surface 41d of the accumulating roller 41, a first recess (recess) 43a is provided in a region across the attachment position of the ring member 42 in a direction along the rotational axis C1. That is, when viewed from a radially outside of the accumulating roller 41, the first recess 43a is provided so as to pass through the attachment position of the ring member 42 and intersects with the attachment position, and a part of the first recess 43a overlaps with the attachment position. The first recess 43a here constitutes a groove portion extending in the direction along the rotational axis C1 from one end to another end of the accumulating roller 41. The first recess 43a has, for example, the same cross-sectional shape in a longitudinal direction and is formed in a substantially rectangular cross-sectional shape. The outer peripheral surface 41d of the accumulating roller 41 is further provided with a second recess (recess) 43b. The second recess (recess) 43b is a recess (so-called downgauge) to prevent a depression (so-called sink mark), which may be formed when molding a boss for embedding a magnet for sensor or a rib for reinforcement on an inner periphery surface 41g of the cylindrical part 41c.

[0040] The drive motor 45 rotates the accumulating roller 41 in a winding direction of the yarn Y from the yarn supplying section 6. The drive motor 45 can also rotate the accumulating roller 41 in a direction opposite to the winding direction. The drive motor 45 is a position-controllable motor such as a DC brushless motor, a stepping motor, or a servo motor.

[0041] The yarn Y wound around the accumulating roller

er 41 is pulled out from the tapered portion 41b on another end side (an upstream side of the accumulating roller 41) of the accumulating roller 41, and fed to a downstream side (the package forming section 8 side). In the tapered portion 41b, the yarn Y on the accumulating roller 41 is pulled out in the downstream direction via a pull-out guide 37 located on an extension line of the rotational axis C1 of the accumulating roller 41. The yarn Y wound around the accumulating roller 41 is unwound through a space between with the ring member 42 and the cylindrical portion 41c at its distal end, and accordingly, an appropriate tension is applied to the unwound yarn Y.

[0042] A detection section 53 is arranged near the outer peripheral surface 41d of the cylindrical portion 41c of the accumulating roller 41. For example, the detection section 53 can detect that the yarn Y of the accumulating roller 41 becomes greater than or equal to a predetermined upper limit amount and becomes less than a predetermined lower limit amount. The detection section 53 may detect a range from the upper limit amount described above to the lower limit amount described above, as a detection range. Note that the detection range may be a wider range including a portion exceeding the upper limit amount described above to a portion falling below the lower limit amount described above. Consequently, for example, an excess amount with respect to the upper limit value described above can be detected. In the present embodiment, within the detection range, the yarn Y of the accumulating roller 41 is detected to be greater than or equal to the predetermined upper limit amount and to be less than the predetermined lower limit amount. Note that the above-described expression "greater than or equal to" and "less than" may be "greater than" and "equal to or less than", as needed. A detection result obtained by the detection section 53 is acquired by the control section 25. On the basis of the detection result of the detection section 53, the control section 25 controls the drive motor 45 such that an accumulation amount (winding amount) of the accumulating roller 41 falls between the upper limit amount and the lower limit amount.

[0043] The detection section 53 detects the yarn Y wound around the outer peripheral surface 41d of the accumulating roller 41. As illustrated in FIGS. 4A to 4C, the detection section 53 forms a detection unit 50 together with a light emitting section 55 that emits light toward the accumulating roller 41. That is, the detection unit 50 includes the detection section 53 and the light emitting section 55. The detection section 53 and the light emitting section 55 are accommodated in a casing 51, and are fixed to a machine frame of the automatic winder 1. FIG. 4A is a view illustrating an arrangement relationship between the yarn accumulating device 40 and the detection section 53. FIG. 4B is a view illustrating an arrangement relationship between the yarn accumulating device 40 and the light emitting section 55. FIG. 4C is a view illustrating an arrangement relationship between the yarn accumulating device 40 and the detection unit 50.

[0044] The detection section 53 has: a line sensor 53A

that detects presence or absence of the yarn Y in a straight section ST1 connecting an end portion 41f on the upstream side in a travelling direction of the yarn Y and an end portion 41e on the downstream side in the travelling direction of the yarn Y, in the accumulation region A formed on the outer peripheral surface 41d of the cylindrical portion 41c; and a lens 53B that concentrates incident light. An example of the line sensor 53A is a CCD image sensor or a CMOS image sensor that acquires a light amount by using photodiodes arranged in a row. The line sensor 53A receives light via the lens 53B that concentrates incident light. In the present embodiment, the line sensor 53A is provided such that an extending direction of the straight section ST1 is parallel to an extending direction of the rotational axis C1. However, the line sensor 53A may be provided such that the extending direction of the straight section ST1 intersects with the extending direction of the rotational axis C1.

[0045] The light emitting section 55 includes two light sources 55B and 55B and an optical waveguide 55C that converts light emitted from the two light sources 55B and 55B into surface emission and emits the surface emission toward the accumulating roller 41. A part of a constituent element of the optical waveguide 55C includes a diffusion plate such as an acrylic plate that guides light. An example of the two light sources 55B and 55B is a light emitting diode (LED), and is provided on an LED substrate 55A. Note that the number of light sources is not limited to two.

[0046] The line sensor 53A is provided at a position where light that originates from the light emitting section 55 (i.e. that is emitted by the light emitting section 55) and is reflected by the outer peripheral surface 41d of the accumulating roller 41 is not incident, and where light that originates from the light emitting section 55 and is reflected by the yarn Y accumulated in the accumulating roller 41 is incident. For example, as illustrated in FIG. 4C, the line sensor 53A emits light at an irradiation angle θ in a range of 0° to 30° . The statement "The line sensor 53A is arranged such that light that originates from the light emitting section 55 and is reflected by the outer peripheral surface 41d of the accumulating roller 41 is not incident" means that light emitted from the light emitting section 55 at such an angle is totally reflected by the outer peripheral surface 41d of the accumulating roller 41, and the line sensor 53A is arranged at a position where the reflected light is not incident.

[0047] Here, one of straight lines orthogonal to the rotational axis C1 is virtually set as a first straight line L1, and one of straight lines parallel to the first straight line L1 and in contact with the outer peripheral surface 41d of the accumulating roller 41 is virtually set as a second straight line L2. In the present embodiment, in plan view seen from an extending direction of the rotational axis C1 of the accumulating roller 41, the light emitting section 55 is arranged on the first straight line L1 or between the line sensor 53A and the first straight line L1 in an arrangement direction of the first straight line L1 and the second straight line L2. Consequently, the light emitting section

55 can emit light to a part of the accumulating roller 41 located between the first straight line L1 and the second straight line L2. The line sensor 53A is arranged between the second straight line L2 and the first straight line L1. A light receiving direction of the line sensor 53A is substantially parallel to the first straight line L1. In other words, light is incident on the line sensor 53A from a direction substantially parallel to the first straight line L1. The cover 47 is arranged in a region opposite to a side where the first straight line L1 is arranged with respect to the second straight line L2, in the arrangement direction of the first straight line L1 and the second straight line.

[0048] The cover 47 is provided so as to face a part of the outer peripheral surface 41d of the accumulating roller 41. The cover 47 is provided on at least a part of a traveling direction of light that originates from the light emitting section 55 and is reflected by the outer peripheral surface 41d of the accumulating roller 41. The cover 47 may also be provided on at least a part of the traveling direction of light that is from the light emitting section 55 and is not reflected by the outer peripheral surface 41d of the accumulating roller 41. At least a part of a facing surface 47a, which is a portion of the cover 47 on which light from the light emitting section 55 is incident, is formed to have a color (for example, black) that reduces reflectance of the light. By reducing the reflectance in this manner, reflected light from the cover 47 can be prevented from being incident on the accumulating roller 41. Consequently, it is possible to prevent a state where light reflected by the cover 47 is detected by the line sensor 53A to disable appropriate detection of light reflected from the yarn Y.

[0049] Note that it may be possible to configure the periphery of the yarn storage device 40, so that there is no structure that may reflect light from the light emission portion 55 to the light receiving direction of the line sensor 53A, without disposing the cover 47. Even if there is a structure that reflects light from the light emission portion 55 to the light receiving direction of the line sensor 53A, if it is disposed at a position such that the reflected light is sufficiently attenuated when reaching the line sensor 53A, it is possible to prevent the phenomenon that light reflected from the yarn Y cannot be detected appropriately.

(2-3) Yarn guiding section

[0050] Next, with reference to FIG. 2, a detailed configuration of the yarn guiding section 7 that guides the yarn Y between the yarn supplying section 6 and the yarn accumulating device 40 will be described. The yarn guiding section 7 is arranged in a yarn path (yarn travelling path) of the yarn Y, and includes an unwinding assisting device 10, a lower yarn feeler 11, a tension applying section 12, a catching device 13, a yarn joining device 14, a yarn monitoring device 16, a yarn ejecting section 60, and a yarn guiding member 80.

[0051] The unwinding assisting device 10 assists in

unwinding of the yarn Y by bringing a movable member 27 into contact with a balloon that is formed above the yarn supplying bobbin 21 when the yarn Y unwound from the yarn supplying bobbin 21 is swung around, and appropriately controlling a size of the balloon.

[0052] The lower yarn feeler 11 is arranged at a position close to the unwinding assisting device 10 on the downstream side of the unwinding assisting device 10. The lower yarn feeler 11 detects the presence or absence of the yarn Y supplied from the unwinding assisting device 10.

[0053] The tension applying section 12 applies a predetermined tension on the travelling yarn Y. The tension applying section 12 applies a predetermined tension on the yarn Y on the basis of a tension of the yarn Y detected by a tension sensor (not illustrated). The tension applying section 12 is configured as a gate type in which movable comb teeth are arranged with respect to fixed comb teeth, and applies a predetermined resistance by causing the yarn Y to travel between the comb teeth. The movable comb teeth are configured to be movable by, for example, a solenoid such that the comb teeth are in a meshed state or a released state. Consequently, the tension applying section 12 can adjust the tension to be applied to the yarn Y. Note that the configuration of the tension applying section 12 is not particularly limited, and may be, for example, a tension applying section of a disk type.

[0054] The catching device 13 is arranged downstream of the tension applying section 12. The catching device 13 includes a first catching section 13A and a second catching section 13B. In the present embodiment, the first catching section 13A and the second catching section 13B are integrated and configured as one component. Each of the first catching section 13A and the second catching section 13B is connected to a negative pressure source (not illustrated).

[0055] The first catching section 13A is configured as a tubular member in which an opening is formed at a distal end portion. The first catching section 13A sucks and catches the yarn Y on the yarn accumulating device 40 side by generating a suction airflow at a time of yarn joining and suctioning an internal space of the yarn guiding member 80 to be described later.

[0056] The second catching section 13B is configured as a tubular member in which an opening is formed at a distal end portion. The second catching section 13B is swingably provided. The second catching section 13B swings between a catching position (a position indicated by a solid line in FIG. 2) for catching the yarn Y supplied from the unwinding assisting device 10 side and a guiding position (a position indicated by a broken line in FIG. 2) for guiding the yarn Y to the yarn joining device 14. The catching position may also be a standby position of the second catching section 13B.

[0057] At the catching position, the second catching section 13B sucks and catches a yarn end from the yarn supplying bobbin 21 by generating a suction airflow on the distal end side in a state of being close to the yarn

path on the downstream side of the lower yarn feeler 11. When the yarn Y is cut with a cutter 15, the second catching section 13B sucks and catches a yarn end of the cut yarn Y on the yarn supplying bobbin 21 side. Further, the second catching section 13B may be configured to suck and remove fly waste and the like attached to the traveling yarn Y, by generating a suction airflow on the distal end side.

[0058] There is provided an auxiliary blow-feeding section 28 that blows and feeds a yarn end to a position downstream of the lower yarn feeler 11 (a distal end of the second catching section 13B) when the yarn Y is caught by the second catching section 13B immediately after a new yarn supplying bobbin 21 is supplied to the yarn supplying section 6.

[0059] The auxiliary blow-feeding section 28 forms, at a distal end portion of the yarn supplying bobbin 21, an airflow to blow and feed the yarn Y of the yarn supplying bobbin 21 toward the lower yarn feeler 11 side, by ejecting compressed air into the conveyance tray 26 and the yarn supplying bobbin 21 formed in a hollow shape. When the newly supplied yarn supplying bobbin 21 is supported by the yarn supplying section 6, a yarn end on the yarn supplying bobbin 21 side can be reliably fed toward the lower yarn feeler 11 side by operating the auxiliary blow-feeding section 28.

[0060] The yarn joining device 14 joins separated (divided) yarn Y. When the yarn Y between the yarn supplying bobbin 21 and the yarn accumulating device 40 is separated, such as at a time of yarn cutting in which the yarn monitoring device 16 detects a yarn defect and the yarn Y is cut by the cutter 15, at a time of yarn breakage in which the yarn Y being unwound from the yarn supplying bobbin 21 is broken, or at a time of replacement of the yarn supplying bobbin 21, the yarn joining device 14 joins a terminal end portion of the yarn Y on the yarn supplying bobbin 21 side and a terminal end portion of the yarn Y on the yarn accumulating device 40 side. The yarn joining device 14 is arranged at a position slightly retreated from the yarn path. The yarn joining device 14 can connect introduced yarn ends to bring the yarn Y into a continuous state. As the yarn joining device 14, a device using a fluid such as compressed air or a mechanical device can be used.

[0061] The yarn monitoring device 16 detects a yarn defect such as slub and mixing of a foreign substance, by monitoring a thickness and the like of the yarn Y with an appropriate sensor. At a position close to the yarn monitoring device 16 on the upstream side of the yarn monitoring device 16, the cutter 15 is arranged. The cutter 15 immediately cuts the yarn Y when the yarn monitoring device 16 detects a yarn defect. The cutter 15 and the yarn monitoring device 16 are accommodated in a common housing 19. The housing 19 that accommodates the yarn monitoring device 16 is arranged downstream of the yarn joining device 14.

[0062] The yarn ejecting section 60 is arranged near the tapered portion 41a on one end portion side (the up-

stream side of the accumulating roller 41) of the accumulating roller 41, and is configured by a thin tubular member that can allow the yarn Y to pass inside. From a mouth of the yarn ejecting section 60 on the yarn supplying section 6 side, compressed air can be ejected in a direction from the yarn accumulating device 40 toward the yarn supplying section 6. When the yarn Y is separated between the yarn supplying bobbin 21 and the yarn accumulating device 40, the yarn ejecting section 60 sucks and catches a yarn end of the yarn Y on the yarn accumulating device 40 side by ejecting air in a direction from the yarn accumulating device 40 toward the yarn supplying section 6, and blows the yarn end toward the guiding path of the yarn guiding member 80.

[0063] Whereas, during normal yarn winding, the yarn ejecting section 60 guides the yarn Y supplied from the yarn supplying section 6 to the tapered portion 41a on one end side of the accumulating roller 41. When the accumulating roller 41 is rotated in one direction by driving the drive motor 45, the yarn Y guided to the tapered portion 41a on one end side of the accumulating roller 41 by the yarn ejecting section 60 is sequentially wound while pushing up a previous yarn layer from one end side (upstream) of the cylindrical portion 41c. As a result, the yarn Y already wound on the outer peripheral surface 41d of the accumulating roller 41 is pushed by the newly wound yarn Y and sequentially fed to another end side (downstream). Consequently, the yarn Y is spirally aligned and regularly wound from one end side toward another end side, on an outer peripheral surface of the cylindrical portion 41c of the accumulating roller 41.

[0064] Although details will be described later, a moving section 90 enables the yarn ejecting section 60 to move to an optimum position (referred to as a yarn guiding position) for guiding the yarn Y supplied from the yarn supplying section 6 to the accumulating roller 41, and an optimum position (referred to as a yarn pull-out position) for suctioning to pull out the yarn end of the yarn Y accumulated in the yarn accumulating device 40 and guiding the yarn end to the yarn joining device 14 (a guiding path of the yarn guiding member 80).

[0065] The yarn guiding member 80 is a curved tubular member, and openings are individually formed at both ends in a longitudinal direction. One opening of the yarn guiding member 80 is arranged to be close to a mouth of the yarn ejecting section 60 on the yarn supplying section 6 side. Another opening is arranged in a state of facing the first catching section 13A. Inside the yarn guiding member 80, a guiding path is formed. The guiding path connects the openings at both ends of the yarn guiding member 80 so as to detour around the yarn monitoring device 16, the yarn joining device 14, and the like. Over the entire length of the yarn guiding member 80, a slit penetrating up to the guiding path is formed.

[0066] When the yarn Y is separated (divided) between the yarn supplying bobbin 21 and the yarn accumulating device 40, the yarn guiding member 80 guides the yarn Y blown to the guiding path by the yarn ejecting section

60 to the first catching section 13A along the guiding path, and causes the first catching section 13A to catch the guided yarn Y. Since the slit penetrating up to the guiding path is formed over the entire length of the yarn guiding member 80, the yarn guiding member 80 can pull out the yarn Y caught by the first catching section 13A from the guiding path of the yarn guiding member 80, and guide the yarn Y toward the yarn joining device 14 side.

(2-4) Moving section

[0067] Hereinafter, with reference to FIG. 5, a detailed configuration of the moving section 90 that moves the yarn ejecting section 60 will be described. FIG. 5 is a view illustrating a detailed configuration of the moving section 90. The moving section 90 includes a cam 91, a first arm 92, a second arm 93, and a position sensor 94. The cam 91 is provided in a casing CH so as to be rotatable about a first axis A1. Note that the casing CH is fixed on the housing 19 that houses the cutter 15 and the yarn monitoring device 16.

[0068] A first pulley 91A is fixed to the cam 91. A belt 91B is laid on the first pulley 91A. A second pulley 91C is hooked on a side of the belt 91B opposite to a side on which the first pulley 91A is hooked. The second pulley 91C is fixed to an output rotational axis of a motor 91D. When rotation of the output rotational axis of the motor 91D is transmitted to the cam 91 by the second pulley 91C, the belt 91B, and the first pulley 91A, the cam 91 rotates about the first axis A1. The rotation of the motor 91D is controlled by the control section 25.

[0069] In a side surface PH of the cam 91 with which the first arm 92 comes into contact, a distance (that is, a radius of the cam 91) from a reference position (referred to as an origin O) to the first axis A1 increases along the periphery of the cam 91 as a distance from the origin O increases in a counterclockwise direction in FIG. 5.

[0070] The first arm 92 is an elongated member. One end of the first arm 92 that may be denoted as cam follower comes into contact with the outer periphery of the cam 91. Whereas, another end of the first arm 92 is fixed to the casing CH so as to be rotatable about a second axis A2 parallel to the first axis A1. Since a distance between the side surface PH of the cam 91 and the first axis A1 increases as a distance along the outer periphery from the origin O increases, a distance between a contact position between the first arm 92 and the cam 91 and the first axis A1 increases as the cam 91 rotates (clockwise in FIG. 5). As illustrated in FIG. 6, when the distance between the contact position between the first arm 92 and the side surface PH of the cam 91 and the first axis A1 increases in accordance with rotation of the cam 91, the first arm 92 rotates about the second axis A2 in accordance with the rotation of the cam 91. FIG. 6 is a view illustrating a state where the first arm 92 rotates in accordance with rotation of the cam 91.

[0071] The second arm 93 is an elongated member, and the yarn ejecting section 60 is fixed to one end side

thereof. Whereas, another end of the second arm 93 is attached to the first arm 92 so as to be rotatable about the second axis A2. Consequently, the second arm 93 rotates about the second axis A2 in accordance with rotation of the first arm 92. When the second arm 93 rotates about the second axis A2, the yarn ejecting section 60 fixed to one end of the second arm 93 moves.

[0072] The position sensor 94 detects whether or not one end of the first arm 92 is in contact with a position of the origin O of the cam 91, by detecting the second arm 93. When one end of the first arm 92 is made to be in contact with the origin O of the cam 91, the control section 25 moves (rotates) the cam 91 such that one end of the first arm 92 enters a semicircular portion on the origin O side of the cam 91, and determines that one end of the first arm 92 is in contact with the position of the origin O of the cam 91 when the position sensor 94 detects the second arm 93. The position sensor 94 is, for example, a magnet sensor.

(2-5) Position of yarn ejecting section

[0073] Hereinafter, with reference to FIG. 7, a description is given to: the yarn guiding position which is a position of the yarn ejecting section 60 in guiding the yarn Y from the yarn supplying section 6 side to the yarn accumulating device 40; and the yarn pull-out position which is a position of the yarn ejecting section 60 in pulling out the yarn Y from the yarn accumulating device 40. FIG. 7 is a view illustrating the yarn guiding position and the yarn pull-out position.

[0074] First, the yarn guiding position will be described. Guiding of the yarn Y from the yarn supplying section 6 side to the yarn accumulating device 40 is executed by rotation of the cylindrical accumulating roller 41 of the yarn accumulating device 40. When guiding a Z-twisted yarn Y from the yarn supplying section 6 side to the yarn accumulating device 40, the accumulating roller 41 is rotated in a first accumulating roller rotation direction. In the example illustrated in FIG. 7, the first accumulating roller rotation direction is a counterclockwise direction. In this case, the yarn ejecting section 60 is arranged on a right side from a center line of the accumulating roller 41 in the example illustrated in FIG. 7. Further, an end portion of the yarn ejecting section 60 on the yarn accumulating device 40 side is directed outward from the yarn accumulating device 40 (accumulating roller 41) with respect to a tangential line (that is, the yarn path of the Z-twisted yarn Y) from the end portion to a right side surface of the accumulating roller 41. A yarn guiding position in guiding the Z-twisted yarn Y from the yarn supplying section 6 side to the yarn accumulating device 40 is defined as a first position P1.

[0075] Since the first position P1 is a position directed outward of the yarn accumulating device 40 with respect to the tangent line from the end portion of the yarn ejecting section 60 to the side surface of the accumulating roller 41 on the right side from the center line of the yarn ac-

cumulating device 40, when the Z-twisted yarn Y is disconnected (separated), the disconnected yarn Y protrudes from the end portion of the yarn ejecting section 60 and does not collide with the yarn accumulating device 40 (accumulating roller 41). As a result, it is possible to prevent under-passing yarn (a phenomenon in which another portion of the yarn Y enters under the accumulated yarn Y), double lead-out (a phenomenon in which the yarn Y is doubly pulled out), and the like caused by the yarn Y colliding with the yarn accumulating device 40, and the Z-twisted yarn Y can be appropriately guided to the yarn accumulating device 40.

[0076] Note that, in the moving section 90 described with reference to FIGS. 5 and 6, the yarn ejecting section 60 is arranged at the first position P1 when one end of the first arm 92 is in contact with the origin O of the side surface PH of the cam 91 (in the case illustrated in FIG. 5). In the winding unit 2, a frequency of forming the package 30 by using Z-twisted yarn Y is higher than a frequency of forming the package by using S-twisted yarn Y. Therefore, by arranging the yarn ejecting section 60 at the first position P1 which is for guiding the Z-twisted yarn Y to the yarn accumulating device 40 when the first arm 92 is in contact with the origin O of the side surface PH of the cam 91, control of the yarn ejecting section 60 is facilitated. For example, a frequency of moving the yarn ejecting section 60 to a second position P2 to be described later can be reduced.

[0077] Meanwhile, the yarn Y has characteristics such as various materials, thicknesses, and twisting directions. For example, twisting of the yarn Y includes so-called S-twisting (right-twisting) in which twisting is applied to right and Z-twisting (left-twisting) in which twisting is applied to left, and twisting directions are opposite in the right-twisting and the left-twisting. The winding unit 2 can form not only the package 30 of the Z-twisted yarn Y but also the S-twisted yarn Y of a different twisting manner. Whereas, the inventor has found that, in guiding the S-twisted yarn Y from the yarn supplying section 6 side to the yarn accumulating device 40 to form the package 30 of the S-twisted yarn Y, when the accumulating roller 41 is rotated in the first accumulating roller rotation direction described above, service life of the ring member 42 is significantly shortened. In other words, a rotation direction of the accumulating roller 41 should correspond to a twisting manner of the yarn Y. Therefore, in guiding the S-twisted yarn Y from the yarn supplying section 6 side to the yarn accumulating device 40, the accumulating roller 41 is rotated in a direction (in the example illustrated in FIG. 7, the clockwise direction) (referred to as a second accumulating roller rotation direction) opposite to the first accumulating roller rotation direction described above.

[0078] Further, when the accumulating roller 41 is rotated in the second accumulating roller rotation direction to guide the yarn Y to the yarn accumulating device 40 in a state where the yarn ejecting section 60 is arranged at the first position P1, as illustrated in FIG. 8, the yarn

Y is greatly bent and easily damaged (for example, broken and therewith disconnected) on the yarn accumulating device 40 side of the yarn ejecting section 60. FIG. 8 is a view illustrating a yarn path when the S-twisted yarn Y is guided to the yarn accumulating device 40 in a state where the yarn ejecting section 60 is arranged at the first position P1.

[0079] Therefore, in guiding the S-twisted yarn Y to the yarn accumulating device 40, a position of the yarn ejecting section 60 is set to a position different from the first position P1. Specifically, in the example illustrated in FIG. 7, in guiding the S-twisted yarn Y to the yarn accumulating device 40, the yarn ejecting section 60 is arranged on a left side from the center line of the accumulating roller 41. Further, an end portion of the yarn ejecting section 60 on the yarn accumulating device 40 side is directed outward of the yarn accumulating device 40 with respect to a tangent line (that is, the yarn path of the S-twisted yarn Y) from the end portion to a left side surface of the accumulating roller 41. A yarn guiding position in guiding the S-twisted yarn Y from the yarn supplying section 6 side to the yarn accumulating device 40 is defined as the second position P2. The second position P2 and the first position P1 are in a line symmetrical relationship with respect to the center line of the yarn accumulating device 40 (accumulating roller 41).

[0080] Since the second position P2 is a position directed outward of the yarn accumulating device 40 with respect to the tangent line from the end portion of the yarn ejecting section 60 to the side surface of the accumulating roller 41 on the left side from the center line of the yarn accumulating device 40, when the S-twisted yarn Y is disconnected (separated), the disconnected yarn Y protrudes from the end portion of the yarn ejecting section 60 and does not collide with the yarn accumulating device 40 (accumulating roller 41). As a result, it is possible to prevent under-passing yarn, double lead-out, and the like caused by the yarn Y colliding with the yarn accumulating device 40, and the S-twisted yarn Y can be appropriately guided to the yarn accumulating device 40.

[0081] Note that, in the moving section 90 described with reference to FIGS. 5 and 6, the yarn ejecting section 60 is arranged at the second position P2 when one end of the first arm 92 is in contact with a position (referred to as a first outer peripheral position PH1) farthest from the origin O on the side surface PH of the cam 91.

[0082] Next, the yarn pull-out position will be described. As illustrated in FIG. 7, the yarn pull-out position is common for the Z-twisted yarn Y and the S-twisted yarn Y, and is arranged on the center line of the yarn accumulating device 40 (accumulating roller 41). That is, the yarn pull-out position is an intermediate position (referred to as a third position P3) between the first position P1 and the second position P2. By arranging the yarn pull-out position on the center line of the yarn accumulating device 40, a distance between the accumulating roller 41 and an end portion of the yarn ejecting section

60 on the yarn accumulating device 40 side can be reduced. As a result, the yarn ejecting section 60 can easily pull out the yarn Y from the yarn accumulating device 40 by suctioning.

[0083] Note that, in the moving section 90 described with reference to FIGS. 5 and 6, when one end of the first arm 92 is in contact with an intermediate position (referred to as a second outer peripheral position PH2) between the origin O of the side surface PH of the cam 91 and the first outer peripheral position PH1 (in the case illustrated in FIG. 6), the yarn ejecting section 60 is arranged at the third position P3. In addition, a distance from the side surface PH to the first axis A1 is constant before and after the second outer peripheral position PH2 of the side surface PH of the cam 91. Consequently, even if the cam 91 is further rotated in any direction after the cam 91 is rotated to a position where the first arm 92 comes into contact at the second outer peripheral position PH2, the yarn ejecting section 60 can be maintained at the third position P3.

[0084] When the origin O, the first outer peripheral position PH1, and the second outer peripheral position PH2 of the side surface PH of the cam 91 are in the positional relationship described above, by the control section 25 rotating the cam 91 in a first direction (in the examples of FIGS. 5 and 6, the counterclockwise direction), the yarn ejecting section 60 moves from the yarn pull-out position (third position P3) to the first position P1 which is for guiding the Z-twisted yarn Y. Whereas, by rotating the cam 91 in a second direction (in the examples of FIGS. 5 and 6, the clockwise direction) opposite to the first direction, the yarn ejecting section 60 moves from the yarn pull-out position to the second position P2 which is for guiding the S-twisted yarn Y. Consequently, the yarn ejecting section 60 can be moved from the third position P3 to the first position P1 or from the third position P3 to the second position P2 by rotating the cam 91 in opposite directions, so that the control of the yarn ejecting section 60 is facilitated.

(3) Operation of winding unit

[0085] An operation of the winding unit will be described below. When the winding unit 2 is activated, an initial operation for executing formation of the package 30 is carried out in the winding unit 2. In this initial operation, the yarn ejecting section 60 is moved to the origin position. Specifically, the control section 25 rotates the cam 91 such that one end of the first arm 92 comes into contact with the origin O of the side surface PH of the cam 91, to move the yarn ejecting section 60 to the first position P1. Thus, an origin position of the yarn ejecting section 60 is the first position P1.

[0086] After the initial operation, formation of the package 30 is started in the winding unit 2. The formation of the package 30 is executed according to a flowchart illustrated in FIG. 9. FIG. 9 is a flowchart illustrating a forming operation of the package 30 in the winding unit 2.

FIG. 9 illustrates a flowchart when one package 30 is formed.

[0087] When the formation of the package 30 is started, in step S1, the control section 25 determines a type of the yarn Y to be used for the formation of the package 30. The type of the yarn Y to be used for forming the package 30 can be set, for example, by an operator operating the machine control device 3.

[0088] When the type of the yarn Y is the Z-twisted yarn ("Z-twisting" in step S1), the control section 25 moves the yarn ejecting section 60 to the first position P1 in order to guide the Z-twisted yarn Y to the yarn accumulating device 40 (step S2). Specifically, the control section 25 rotates the cam 91 such that one end of the first arm 92 comes into contact with the origin O of the side surface PH of the cam 91, to move the yarn ejecting section 60 to the first position P1. Note that, as described above, in the initial state, the yarn ejecting section 60 is arranged at the first position P1. Therefore, at a time of forming the package 30 first after activation of the winding unit 2, the control section 25 does not move the yarn ejecting section 60 in a state of being arranged at the first position P1 (origin position).

[0089] Whereas, when the type of the yarn Y is the S-twisted yarn ("S-twisting" in step S1), the control section 25 moves the yarn ejecting section 60 to the second position P2 in order to guide the S-twisted yarn Y to the yarn accumulating device 40 (step S3).

[0090] Thereafter, winding of the yarn is started to form the package 30 (step S4). In step S4, the yarn Y unwound from the yarn supplying bobbin 21 is guided to the yarn accumulating device 40 by the yarn guiding section 7, and temporarily accumulated in the yarn accumulating device 40 (accumulating roller 41). The yarn Y accumulated in the yarn accumulating device 40 is wound around the winding bobbin 22 to form the package 30. At this time, the yarn ejecting section 60 is arranged at the first position P1 when the Z-twisted yarn Y is used, and the yarn ejecting section 60 is arranged at the second position P2 when the S-twisted yarn Y is used. Consequently, the yarn Y can be appropriately guided to the yarn accumulating device 40 in accordance with the type of yarn Y to be used.

[0091] Note that, when the yarn Y starts to be accumulated in the yarn accumulating device 40 in step S4, the control section 25 may monitor a tension of the yarn Y guided by the yarn guiding section 7, and stop rotation of the accumulating roller 41 or disconnect the yarn Y when the tension of the yarn Y exceeds a predetermined threshold value. Consequently, for example, occurrence of under-passing can be prevented when the yarn Y is disconnected (separated) by tension breakage that occurs at a start of winding immediately after yarn joining.

[0092] During winding of the yarn Y, in step S5, the control section 25 determines whether or not the yarn Y is separated (divided) due to cutting of the yarn Y by the cutter 15, yarn breakage of the yarn Y being unwound from the yarn supplying bobbin 21, replacement of the

yarn supplying bobbin 21, and the like. When the yarn Y is not separated (not divided or continuous; "No" in step S5), the forming operation of the package 30 proceeds to step S10.

[0093] Whereas, when the yarn Y is separated (divided or not continuous; "Yes" in step S5), the control section 25 interrupts the winding of the yarn Y around the winding bobbin 22 in step S6. Thereafter, in step S7, the control section 25 moves the yarn ejecting section 60 to the third position P3 which is for pulling out the yarn Y from the yarn accumulating device 40. Specifically, the control section 25 rotates the cam 91 such that one end of the first arm 92 comes into contact with the second outer peripheral position PH2 of the side surface PH of the cam 91, to move the yarn ejecting section 60 to the third position P3.

[0094] After movement of the yarn ejecting section 60 to the third position P3, the yarn ejecting section 60 sucks an end portion of the yarn Y on the yarn accumulating device 40 side to pull out the yarn Y from the yarn accumulating device 40, and blows the pulled out yarn Y toward the yarn guiding member 80 (step S8). As a result, the end portion of the yarn Y on the yarn accumulating device 40 side moves along a guiding path in the yarn guiding member 80 to the first catching section 13A, and is caught by the first catching section 13A. Thereafter, the yarn Y inside the yarn guiding member 80 is pulled out from a slit provided in the yarn guiding member 80, and guided to the yarn joining device 14. Further, an end portion of the yarn Y on the yarn supplying section 6 side is caught by the second catching section 13B located at the catching position, and guided to the yarn joining device 14.

[0095] After the end portion of the yarn Y on the yarn accumulating device 40 side and the end portion of the yarn Y on the yarn supplying section 6 side are guided to the yarn joining device 14, the end portions of the yarn Y are joined by the yarn joining device 14 (step S9). After the yarn joining is completed, winding of the yarn Y into the package 30 is restarted. That is, the forming operation of the package 30 returns to step S4.

[0096] At the time of restarting the winding of the yarn Y, if the package 30 is formed using the Z-twisted yarn Y, the control section 25 moves the yarn ejecting section 60 from the third position P3 to the first position P1. Specifically, the control section 25 rotates the cam 91 in the first direction to change the contact position between the first arm 92 and the side surface PH of the cam 91 from the second outer peripheral position PH2 to the origin O, and moves the yarn ejecting section 60 from the third position P3 to the first position P1.

[0097] Whereas, if the package 30 is formed using the S-twisted yarn Y, the control section 25 moves the yarn ejecting section 60 from the third position P3 to the second position P2. Specifically, the control section 25 rotates the cam 91 in the second direction to change the contact position between the first arm 92 and the side surface PH of the cam 91 from the second outer peripheral position PH2 to the first outer peripheral position PH1, and moves the yarn ejecting section 60 from the third position P3 to the second position P2.

[0098] After movement of the yarn ejecting section 60 to the first position P1 (in the case of the Z-twisting) or the second position P2 (in the case of the S-twisting), the control section 25 restarts winding of the yarn Y.

[0099] During winding of the yarn Y, the control section 25 determines in step S10 whether or not a prescribed amount of the yarn Y is wound around the winding bobbin 22 and the formation of the package 30 is finished. If the formation of the package 30 is not finished ("No" in step S10), the control section 25 continues the winding of the yarn Y.

[0100] Whereas, if the formation of the package 30 is finished ("Yes" in step S10), the control section 25 stops the winding of the yarn Y (step S11), and finishes the formation of the package 30. The formed package 30 is detached from the package forming section 8 by the doffing device 5, and conveyed to a predetermined position. Thereafter, at a time of forming another package 30 in the winding unit 2, steps S1 to S11 described above are executed again.

[0101] Thus, in the winding unit 2, the moving section 90 moves the yarn ejecting section 60 to: the yarn guiding position (that is, one of the first position P1 and the second position P2) which is a position for guiding the yarn Y supplied from the yarn supplying section 6 to the yarn accumulating device 40; and the yarn pull-out position (that is, the third position P3) which is a position for pulling out the yarn Y accumulated in the yarn accumulating device 40 and ejecting the yarn Y to the yarn supplying section 6 side. Consequently, in the winding unit 2, the yarn Y is appropriately guided to the yarn accumulating device 40, and the yarn Y is appropriately guided from the yarn accumulating device 40 toward the yarn supplying section 6 side.

[0102] Although one embodiment of the present invention has been described above, the present invention is not limited to the above-described embodiment, and various modifications are possible without departing from the scope of the invention that is defined in the appended claims. In particular, a plurality of embodiments and alternative embodiments described in the present specification can be combined in a freely selected manner as required.

2. Other embodiments

[0102] Although one embodiment of the present invention has been described above, the present invention is not limited to the above-described embodiment, and various modifications are possible without departing from the scope of the invention that is defined in the appended claims. In particular, a plurality of embodiments and alternative embodiments described in the present specification can be combined in a freely selected manner as required.

(A) Processing contents of each step and an execution order of each step in the flowchart of FIG. 9 illustrating the operation of the winding unit 2 can be freely changed without departing from the scope of the invention.

(B) In the first embodiment described above, the pull-out position which is for pulling out the yarn Y from the yarn accumulating device 40 is the third position

P3 common to the Z-twisted yarn Y and the S-twisted yarn Y. Without being limited to this realization, the yarn pull-out position of the Z-twisted yarn Y and the yarn pull-out position of the S-twisted yarn Y may be made different from each other. Specifically, the yarn ejecting section 60 may be moved to a fourth position at a time of pulling out the Z-twisted yarn from the yarn accumulating device 40, and the yarn ejecting section 60 may be moved to a fifth position at a time of pulling out the S-twisted yarn from the yarn accumulating device 40. The fourth position can be, for example, a position slightly closer to the first position P1 than the third position P3. Further, the fifth position can be, for example, a position slightly closer to the second position P2 than the third position P3. Thus, by making a difference between the yarn pull-out position of the Z-twisted yarn Y and the yarn pull-out position of the S-twisted yarn Y, an appropriate yarn pull-out position corresponding to twisting of the yarn Y can be set.

(C) In the first embodiment described above, the yarn supplying section 6 supplies the yarn Y unwound from the yarn supplying bobbin 21. That is, the winding unit 2 of the first embodiment is an automatic winder. Without being limited to this realization, other types of yarn supplying section 6 can be used. The yarn supplying section 6 may be configured to supply the yarn Y spun by a force of air, for example. That is, the winding unit 2 may be a pneumatic spinning machine.

(D) In addition, the yarn supplying section 6 may be configured to supply the yarn Y spun by a rotational force of a rotor. That is, the winding unit 2 may be an open-end spinning machine.

(E) The moving section 90 may have any configuration capable of moving the yarn ejecting section 60, other than the configuration described with reference to FIGS. 5 and 6.

3. Characteristics of embodiment

[0103] The above-described embodiment can also be described as follows.

(1) A yarn winding device (for example, the winding unit 2) includes: a supplying section (for example, the yarn supplying section 6); a yarn accumulating device (for example, the yarn accumulating device 40); a winding section (for example, the package forming section 8); a yarn joining device (for example, the yarn joining device 14); a yarn ejecting section (for example, the yarn ejecting section 60); and a moving section (for example, the moving section 90). The supplying section supplies a yarn (for example, the yarn Y). The yarn accumulating device accumulates the yarn supplied from the supplying section. The winding section winds the yarn accumulated in the yarn accumulating device to form a

package (for example, the package 30). The yarn joining device joins a yarn on the supplying section side and a yarn on the yarn accumulating device side, when the yarn is separated (divided) between the supplying section and the yarn accumulating device.

[0104] The yarn ejecting section guides the yarn supplied from the supplying section to the yarn accumulating device. Further, the yarn ejecting section guides the yarn to the yarn joining device by ejecting air in a direction from the yarn accumulating device toward the supplying section to pull out the yarn accumulated in the yarn accumulating device, and ejecting the yarn to the supplying section side. The moving section moves the yarn ejecting section to a yarn guiding position and a yarn pull-out position. The yarn guiding position is a position of the yarn ejecting section at a time of guiding the yarn supplied from the supplying section to the yarn accumulating device. The yarn pull-out position is a position of the yarn ejecting section at a time of pulling out the yarn accumulated in the yarn accumulating device and ejecting the yarn to the supplying section side.

[0105] In the yarn winding device described above, the moving section moves the yarn ejecting section to the yarn guiding position which is a position for guiding the yarn supplied from the supplying section to the yarn accumulating device, and the yarn pull-out position which is a position for pulling out the yarn accumulated in the yarn accumulating device and ejecting the yarn to the supplying section side. In this way, in the yarn winding device, the yarn ejecting section can be moved to an optimum position for guiding the yarn supplied from the supplying section to the yarn accumulating device, and an optimum position for pulling out the yarn accumulated in the yarn accumulating device and ejecting the yarn to the supplying section side. Therefore, the yarn can be appropriately guided to the yarn accumulating device and the yarn can be appropriately guided from the yarn accumulating device to the supplying section.

[0106] (2) In the yarn winding device of (1) described above, the yarn guiding position may include a first position (for example, the first position P1) which is for guiding a Z-twisted yarn to the yarn accumulating device, and a second position (for example, the second position P2) which is for guiding an S-twisted yarn to the yarn accumulating device. Consequently, yarns of different types of twisting (Z-twisting and S-twisting) can be appropriately guided to the yarn accumulating device.

[0107] (3) In the yarn winding device of (2) described above, the first position and the second position may be in a line symmetrical relationship with respect to a center of the yarn accumulating device. Consequently, the first position and the second position can be appropriately set.

[0108] (4) In the yarn winding device of (2) or (3) described above, the yarn pull-out position may be a third position midway between the first position and the second position. Consequently, an appropriate yarn pull-out

position can be set.

[0109] (5) In the yarn winding device of (1) to (3) described above, the yarn pull-out position may include a fourth position which is for pulling out a Z-twisted yarn from the yarn accumulating device, and a fifth position which is for pulling out an S-twisted yarn from the yarn accumulating device. Consequently, an appropriate yarn pull-out position corresponding to twisting of the yarn can be set.

[0110] (6) In the yarn winding device of (1) to (5) described above, the yarn accumulating device may include an accumulating roller (for example, the accumulating roller 41). The accumulating roller winds and accumulates a yarn. In this case, the yarn guiding position may be a position where an end portion of the yarn ejecting section on the yarn accumulating device side is directed outward of the yarn accumulating device, with respect to a tangent line from the end portion to a side surface of the accumulating roller. Consequently, when the yarn is disconnected, the disconnected (separated) yarn can be prevented from hitting the yarn accumulating device (accumulating roller), and the yarn can be appropriately guided.

[0111] (7) In the yarn winding device of (1) to (6) described above, the moving section may include a cam (for example, the cam 91), a first arm (for example, the first arm 92), and a second arm (for example, the second arm 93). The cam is rotatable about a first axis (for example, the first axis A1). The first arm has one end that comes into contact with a side surface (for example, the side surface PH) of the cam, and another end fixed to be rotatable around a second axis (for example, the second axis A2), and the first arm rotates around the second axis in accordance with rotation of the cam. The second arm has one end to which the yarn ejecting section is fixed, and another end that is fixed to be rotatable around the second axis together with the another end of the first arm. The second arm moves the yarn ejecting section to the yarn guiding position and the yarn pull-out position, in accordance with rotation of the first arm. Consequently, the yarn ejecting section can be appropriately moved between the yarn guiding position and the yarn pull-out position.

[0112] (8) In the yarn winding device of (7) described above, when one end of the first arm is in contact with an origin position (for example, the origin O) of the cam, the yarn ejecting section may be located at the first position which is for guiding a Z-twisted yarn to the yarn accumulating device. Consequently, control of the yarn ejecting section is facilitated by setting, as an origin, a position where a frequency of moving the yarn ejecting section is relatively high.

[0113] (9) In the yarn winding device of (7) to (8) described above, the moving section may rotate the cam in the first direction to, thereby, move the yarn ejecting section from the yarn pull-out position to the first position where the yarn ejecting section guides a Z-twisted yarn to the yarn accumulating device. Further, the moving sec-

tion may rotate the cam in the second direction opposite to the first direction to, thereby, move the yarn ejecting section from the yarn pull-out position to the second position where the yarn ejecting section guides an S-twisted yarn to the yarn accumulating device. Consequently, control of the yarn ejecting section is facilitated.

[0114] (10) In the yarn winding device of (1) to (9) described above, the supplying section may supply a yarn unwound from a yarn supplying bobbin. Consequently, in an automatic winder including the yarn accumulating device, the yarn can be appropriately guided to the yarn accumulating device and the yarn can be appropriately guided from the yarn accumulating device to the supplying section side.

[0115] (11) In the yarn winding device of (1) to (9) described above, the supplying section may supply a yarn spun by a force of air. Consequently, in a pneumatic spinning machine including the yarn accumulating device, the yarn can be appropriately guided to the yarn accumulating device and the yarn can be appropriately guided from the yarn accumulating device to the supplying section side.

[0116] (12) In the yarn winding device of (1) to (9) described above, the supplying section may supply a yarn spun by a rotational force of a rotor. Consequently, in an open-end spinning machine including the yarn accumulating device, the yarn can be appropriately guided to the yarn accumulating device and the yarn can be appropriately guided from the yarn accumulating device to the supplying section side.

[0117] A winding unit (2) includes a yarn supplying section (6) configured to supply a yarn (Y), a yarn accumulating device (40) configured to accumulate the supplied yarn (Y), a package forming section (8) configured to wind the yarn (Y) to form a package (30), a yarn joining device (14) configured to perform yarn joining, a yarn ejecting section (60) configured to guide the yarn (Y) to the yarn accumulating device (40) and to guide the yarn (Y) to the yarn joining device (14) by ejecting air in a direction from the yarn accumulating device (40) toward the yarn supplying section (6) and ejecting the yarn (Y) accumulated in the yarn accumulating device (40), and a moving section (90) configured to move the yarn ejecting section (60) to a yarn guiding position which is for guiding the yarn (Y) to the yarn accumulating device (40) and a yarn pull-out position which is for pulling out the yarn (Y) accumulated in the yarn accumulating device (40). The winding unit (2) appropriately guides the yarn (Y) from the yarn accumulating device (40) toward the yarn supplying section (6) side and guides the yarn (Y) to the yarn accumulating device (40).

INDUSTRIAL APPLICABILITY

[0118] The present invention can be widely applied to a yarn winding device.

DESCRIPTION OF REFERENCE NUMERALS AND SIGNS

[0119]

1: automatic winder
 2: winding unit
 3: machine control device
 4: yarn supplying bobbin supplying device
 5: doffing device
 6: yarn supplying section
 7: yarn guiding section
 8: package forming section
 10: unwinding assisting device
 11: lower yarn feeler
 12: tension applying section
 13: catching device
 13A: first catching section
 13B: second catching section
 14: yarn joining device
 15: cutter
 16: yarn monitoring device
 19: housing
 21: yarn supplying bobbin
 22: winding bobbin
 23: cradle
 24: traverse drum
 25: control section
 26: conveyance tray
 27: movable member
 28: auxiliary blow-feeding section
 30: package
 37: pull-out guide
 40: yarn accumulating device
 41: accumulating roller
 41a: tapered portion
 41b: tapered portion
 41c: cylindrical portion
 41d: outer peripheral surface
 41e: end portion
 41f: end portion
 41g: inner peripheral surface
 42: ring member
 43a: first recess
 43b: second recess
 45: drive motor
 47: cover
 47a: facing surface
 50: detection unit
 51: casing
 53: detection section
 53A: line sensor
 53B: lens
 55: light emitting section
 55A: LED substrate
 55B: light source
 55C: optical waveguide
 60: yarn ejecting section

70: wax applying device
 80: yarn guiding member
 90: moving section
 91: cam
 5 91A: first pulley
 91B: belt
 91C: second pulley
 91D: motor
 92: first arm
 10 93: second arm
 94: position sensor
 A: accumulation region
 A1: first axis
 A2: second axis
 15 C1: rotational axis
 CH: casing
 L1: first straight line
 L2: second straight line
 O: origin
 20 P1: first position
 P2: second position
 P3: third position
 PH: side surface
 PH1: first outer peripheral position
 25 PH2: second outer peripheral position
 ST1: straight section
 Y: yarn

30 Claims**1. A yarn winding device (2) comprising:**

35 a supplying section (6) configured to supply a yarn (Y);
 a yarn accumulating device (40) configured to accumulate the yarn (Y) supplied from the supplying section (6);
 a winding section (8) configured to wind the yarn (Y) accumulated in the yarn accumulating device (40) to form a package (30);
 40 a yarn joining device (14) configured to join the yarn (Y) on the supplying section (6) side and the yarn (Y) on the yarn accumulating device (40) side when the yarn (Y) is separated between the supplying section (6) and the yarn accumulating device (40);
 45 a yarn ejecting section (60) configured to guide the yarn (Y) supplied from the supplying section (6) to the yarn accumulating device (40) in a first operation mode, and to guide the yarn (Y) to the yarn joining device (14) by ejecting air in a direction from the yarn accumulating device (40) toward the supplying section (6) side to pull out the yarn (Y) accumulated in the yarn accumulating device (40) and ejecting the yarn (Y) to the supplying section (6) side in a second operation mode; and

- a moving section (90) configured to move the yarn ejecting section (60) to a yarn guiding position and a yarn pull-out position, the yarn guiding position being for guiding the yarn (Y) supplied from the supplying section (6) to the yarn accumulating device (40) in the first operation mode, and the yarn pull-out position being for pulling out the yarn (Y) accumulated in the yarn accumulating device (40) and ejecting the yarn (Y) to the supplying section (6) side in the second operation mode.
2. The yarn winding device (2) as claimed in claim 1, wherein the yarn guiding position includes a first position (P1) that is for guiding a Z-twisted yarn to the yarn accumulating device (40), and a second position (P2) that is for guiding an S-twisted yarn to the yarn accumulating device (40).
 3. The yarn winding device (2) as claimed in claim 2, wherein the first position (P1) and the second position (P2) are in a line symmetrical relationship with respect to a center of the yarn accumulating device (40).
 4. The yarn winding device (2) as claimed in claim 2 or 3, wherein the yarn pull-out position is a third position (P3) midway between the first position (P1) and the second position (P2).
 5. The yarn winding device (2) as claimed in any one of claims 1 to 3, wherein the yarn pull-out position includes a fourth position (P4) that is for pulling out a Z-twisted yarn from the yarn accumulating device (40), and a fifth position (P5) that is for pulling out an S-twisted yarn from the yarn accumulating device (40).
 6. The yarn winding device (2) as claimed in any one of claims 1 to 5, wherein
 - the yarn accumulating device (40) includes an accumulating roller (41) configured to wind and accumulate the yarn (Y), and
 - the yarn guiding position is a position where an end portion of the yarn ejecting section (60) on the yarn accumulating device (40) side is directed outward of the yarn accumulating device (40) with respect to a tangent line from the end portion to a side surface of the accumulating roller (41).
 7. The yarn winding device (2) as claimed in any one of claims 1 to 6, wherein the moving section (90) includes a cam (91) that is rotatable and a cam follower that is or can be brought in contact with a cam surface of the cam (91), wherein the cam follower is motion-coupled with the yarn ejection section (60) to move it between a plurality of positions including the yarn guiding position and the yarn pull-out position based on a rotation of the cam (91).
 8. The yarn winding device (2) as claimed in any one of claims 1 to 6, wherein the moving section (90) includes:
 - a cam (91) rotatable about a first axis (A1);
 - a first arm (92) having one end in contact with a side surface (PH) of the cam (91) and another end fixed to be rotatable around a second axis (A2), the first arm (92) being configured to rotate around the second axis (A2) in accordance with rotation of the cam (91); and
 - a second arm (93) having one end to which the yarn ejecting section (60) is fixed, and another end fixed to be rotatable around the second axis (A2) together with the another end of the first arm (92), the second arm (93) being configured to move the yarn ejecting section (60) to the yarn guiding position and the yarn pull-out position in accordance with rotation of the first arm (92).
 9. The yarn winding device (2) as claimed in claim 7 or 8, wherein, when one end of the first arm (92) or the cam follower is in contact with an origin position of the cam (91), the yarn ejecting section (60) is located at a first position (P1) that is for guiding a Z-twisted yarn to the yarn accumulating device (40).
 10. The yarn winding device (2) as claimed in one of claims 7 to 9, wherein the moving section (90) is configured
 - to rotate the cam (91) in a first direction to, thereby, move the yarn ejecting section (60) from the yarn pull-out position to the first position (P1) where the yarn ejecting section (60) guides a Z-twisted yarn to the yarn accumulating device (40), and
 - to rotate the cam (91) in a second direction opposite to the first direction to, thereby, move the yarn ejecting section (60) from the yarn pull-out position to a second position (P2) where the yarn ejecting section (60) guides an S-twisted yarn to the yarn accumulating device (40).
 11. The yarn winding device (2) as claimed in any one of claims 1 to 10, wherein the supplying section (6) is configured to supply the yarn (Y) unwound from a yarn supplying bobbin (21).
 12. The yarn winding device (2) as claimed in any one of claim 1 to 10, wherein the supplying section (6) is configured to supply the yarn (Y) spun by a force of air.

13. The yarn winding device (2) as claimed in any one of claim 1 to 10, wherein the supplying section (6) is configured to supply the yarn (Y) spun by a rotational force of a rotor.

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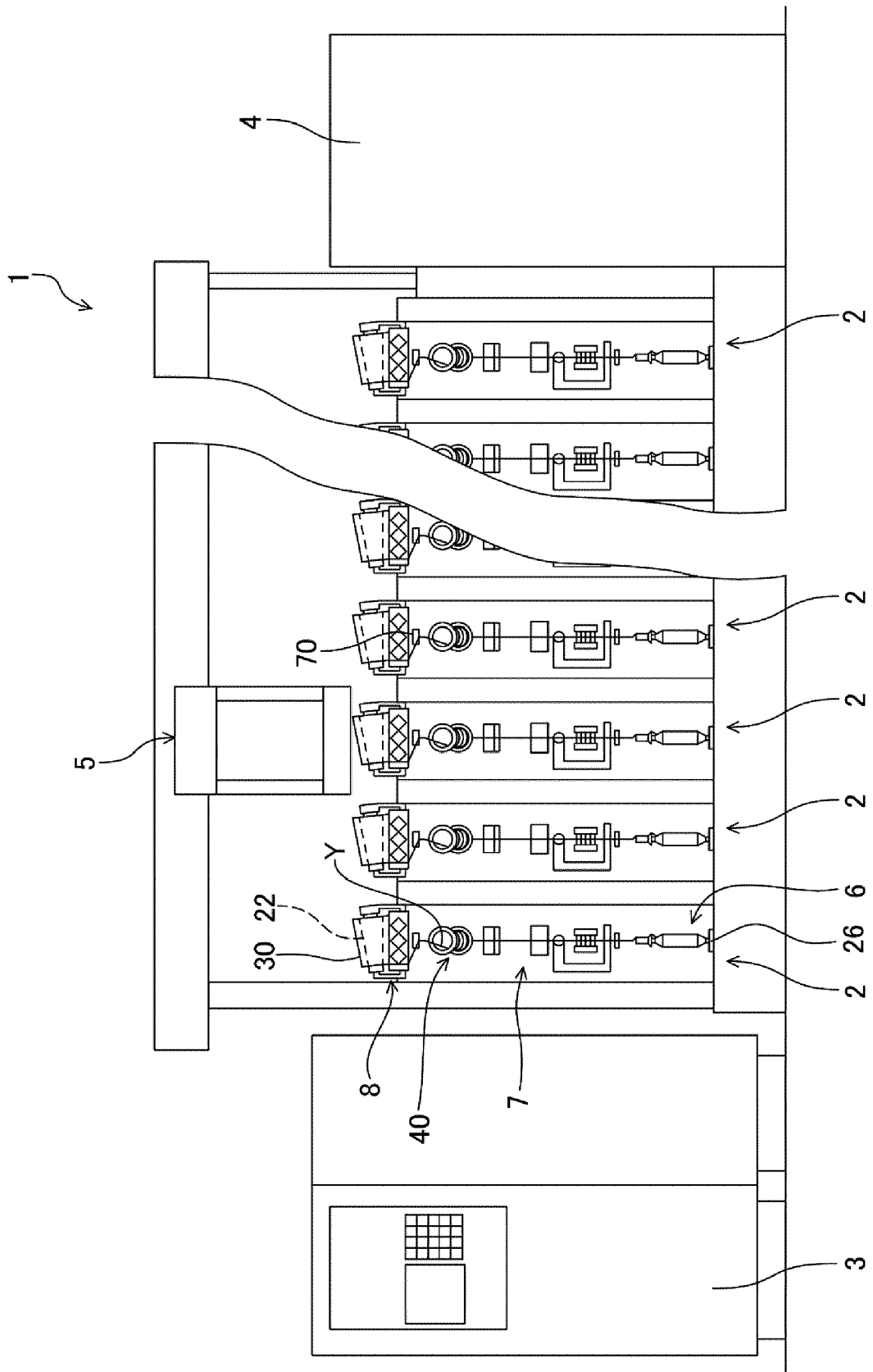


FIG.

FIG. 2

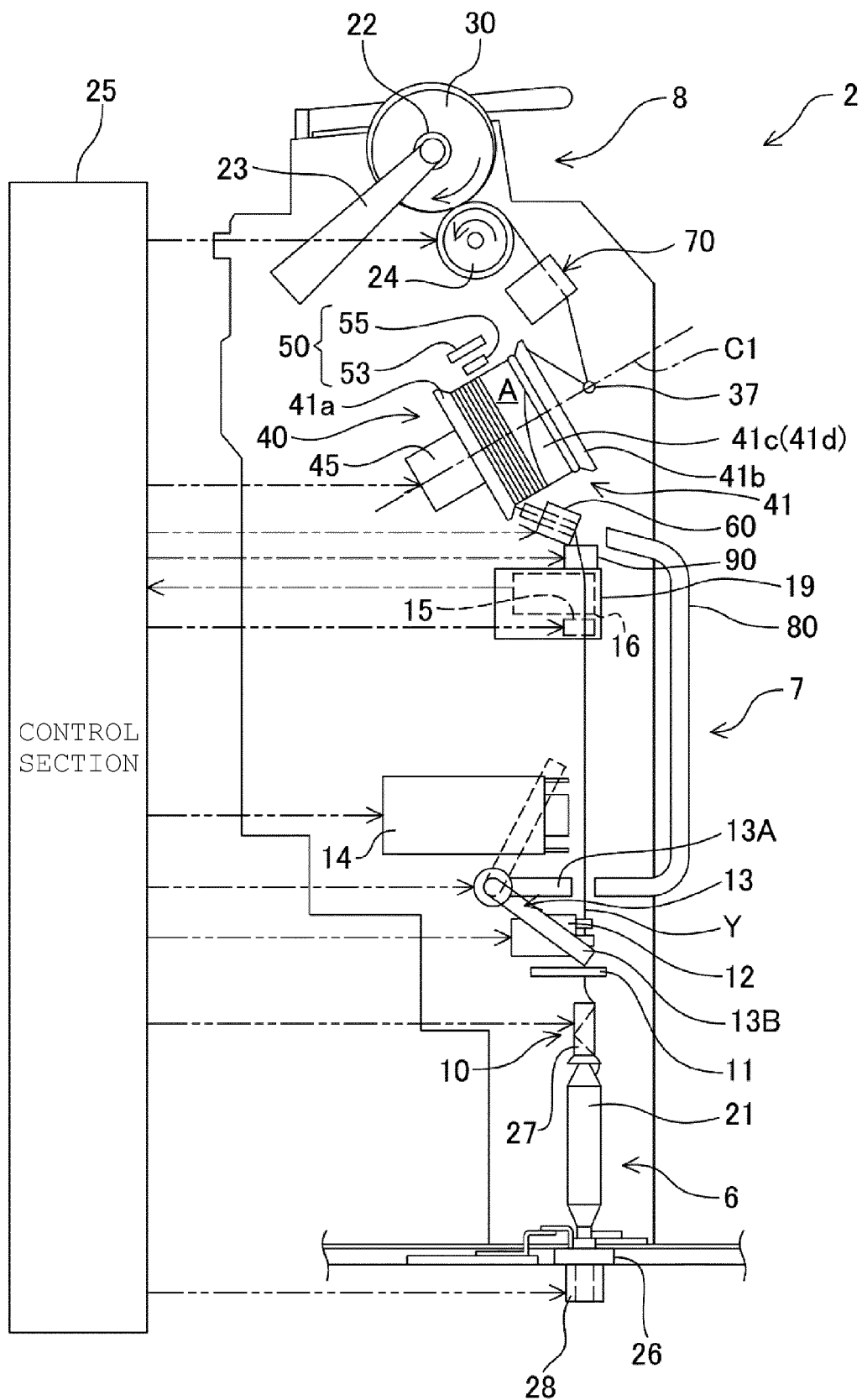


FIG. 3

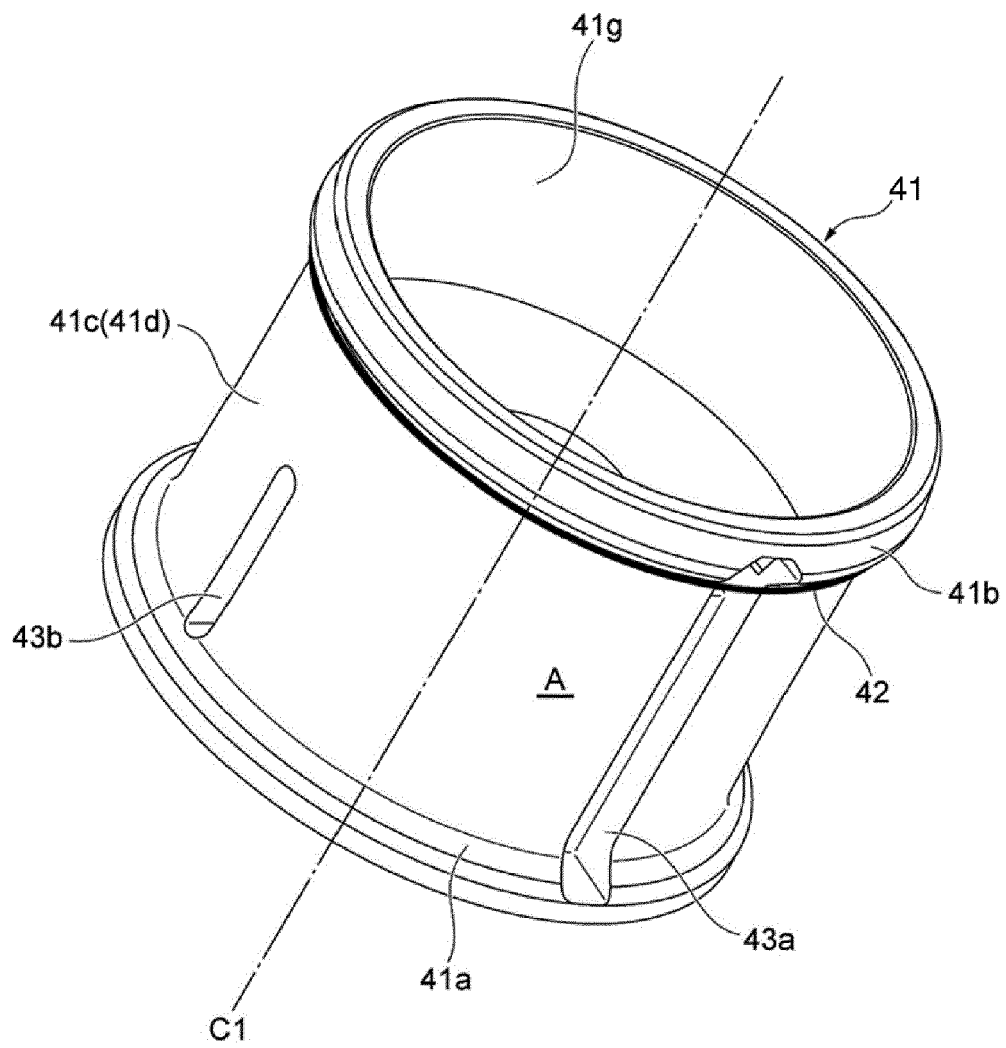


FIG. 4A

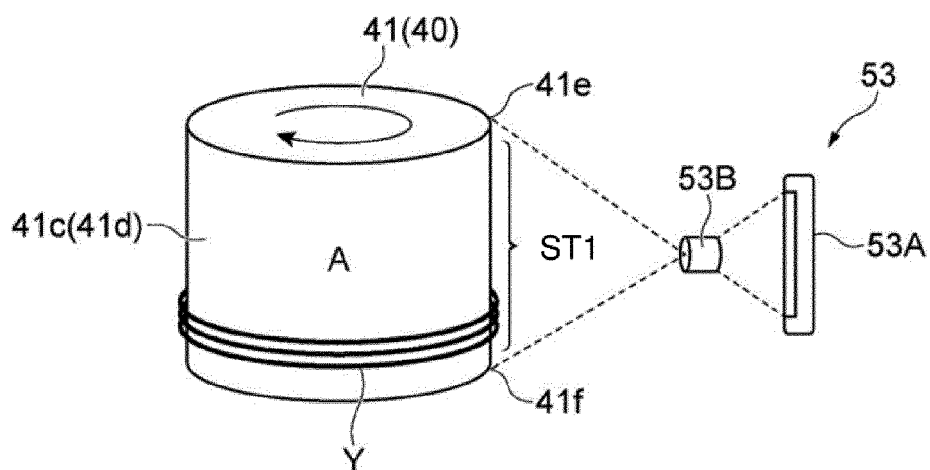


FIG. 4B

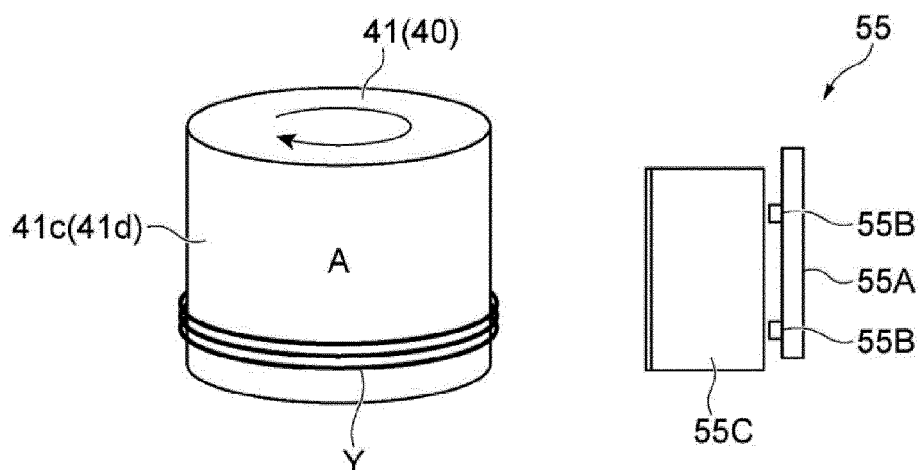


FIG. 4C

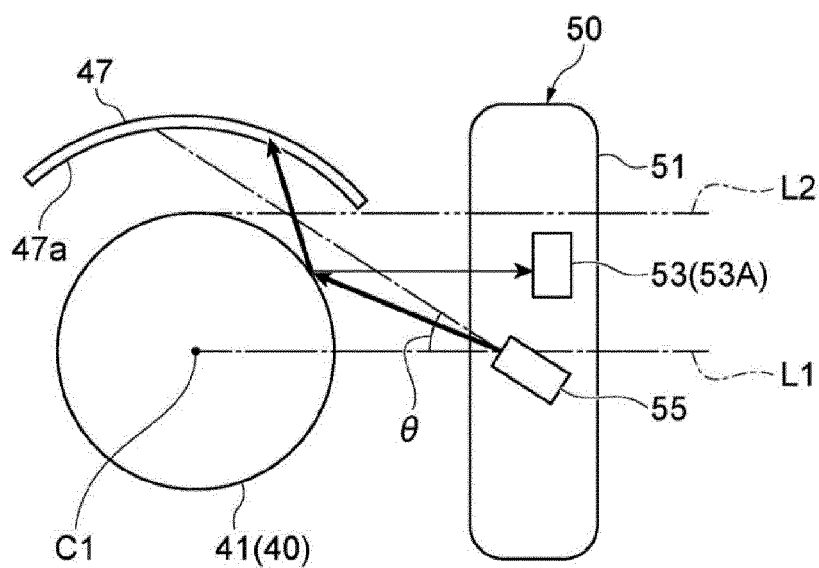


FIG. 5

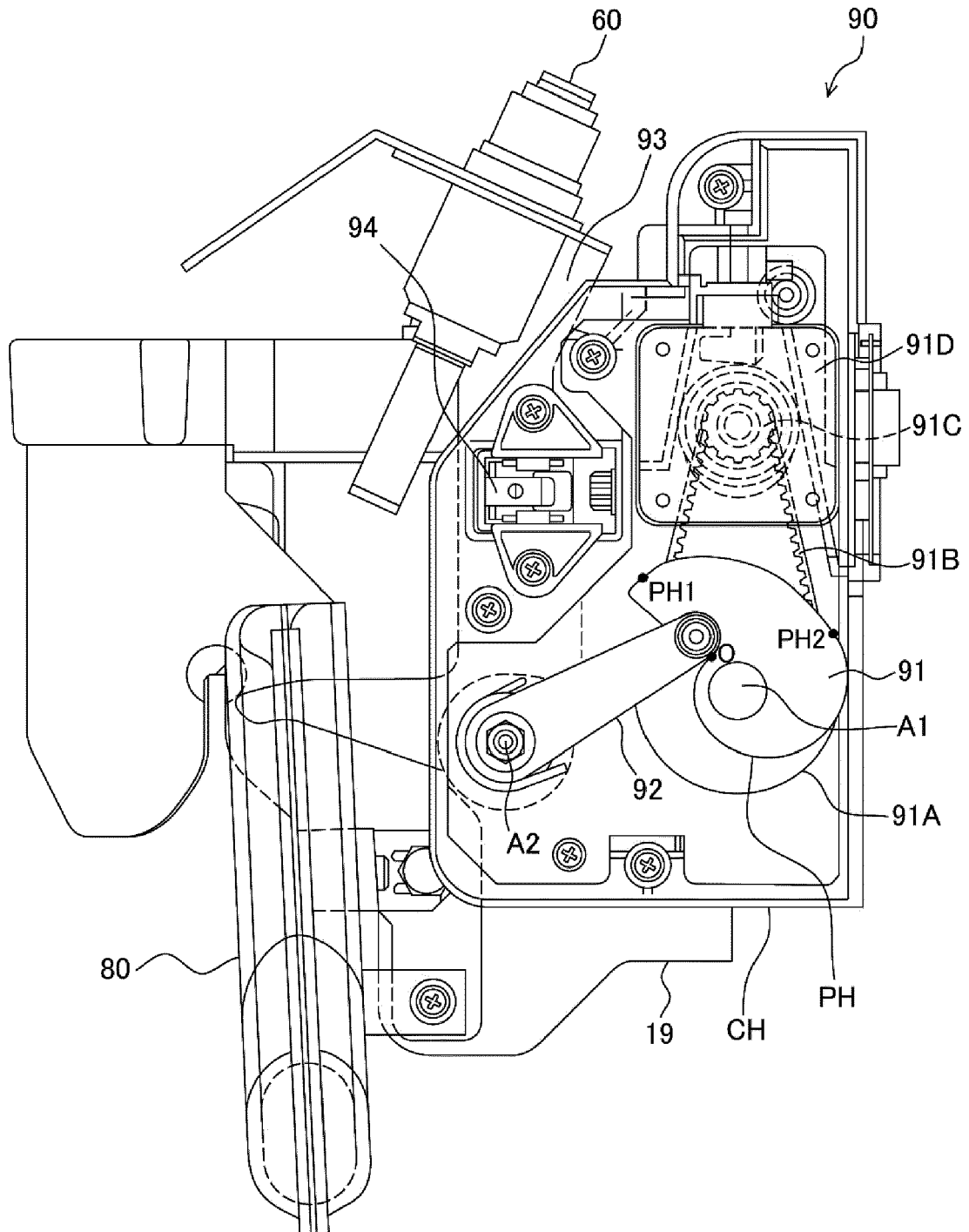
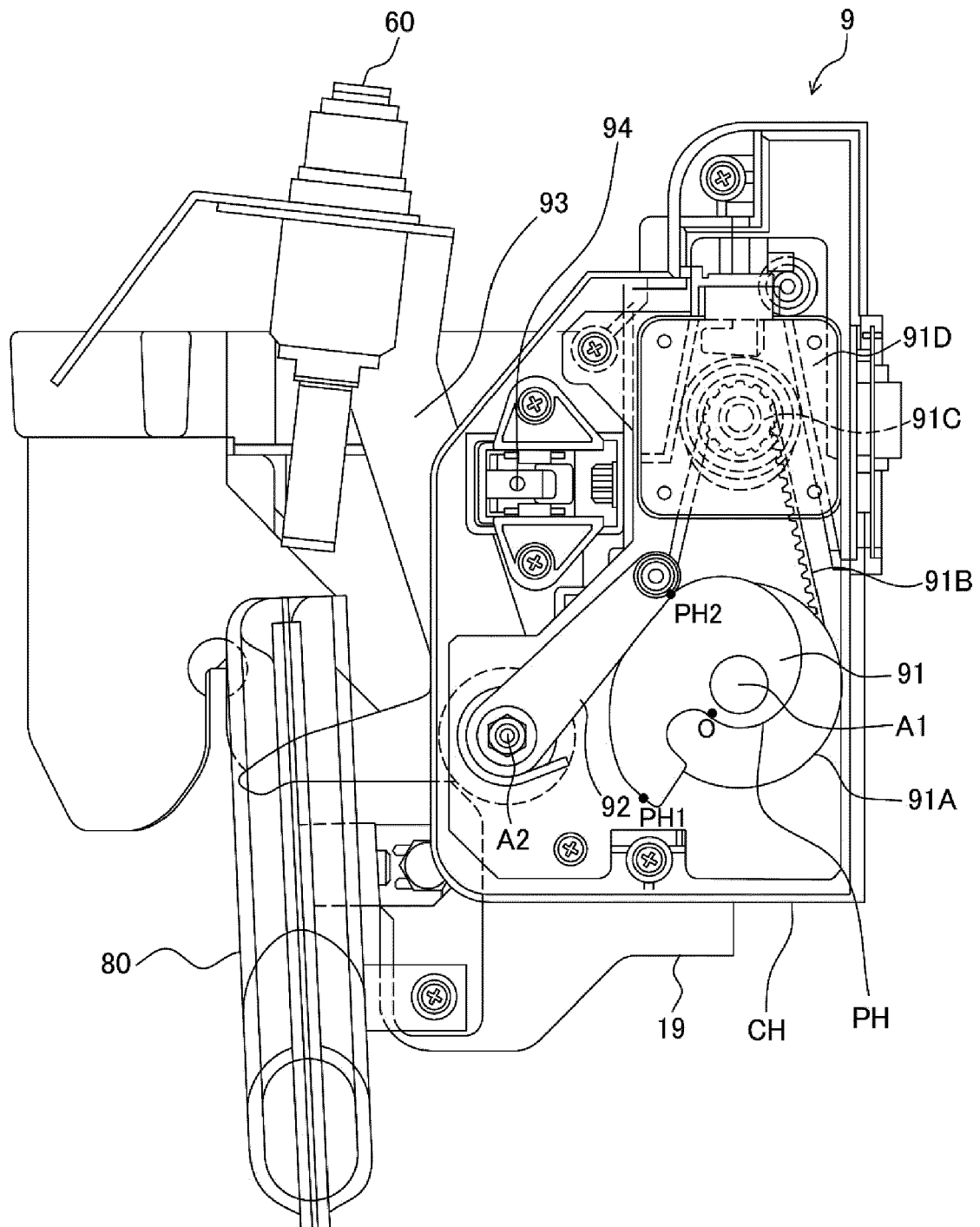


FIG. 6



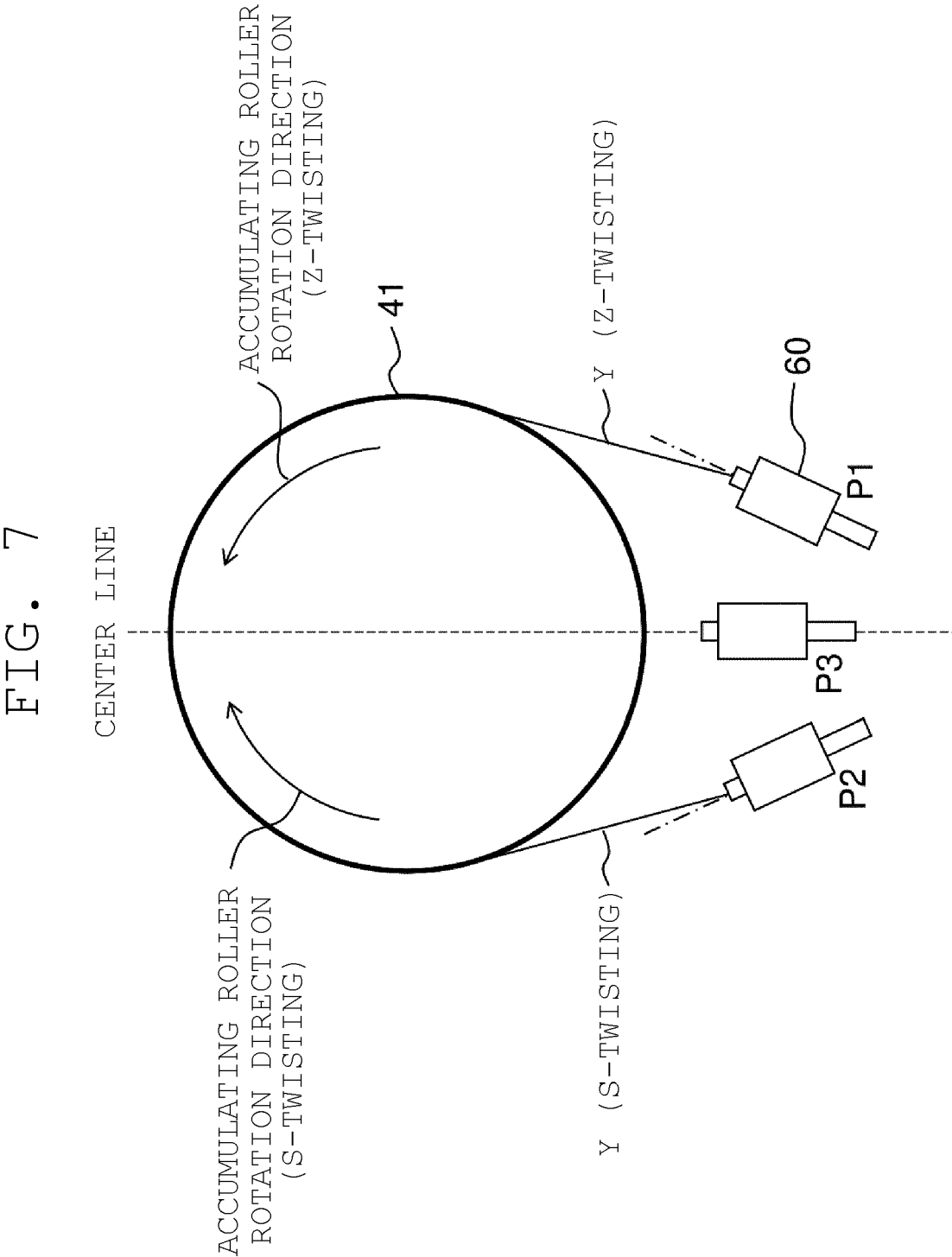


FIG. 8

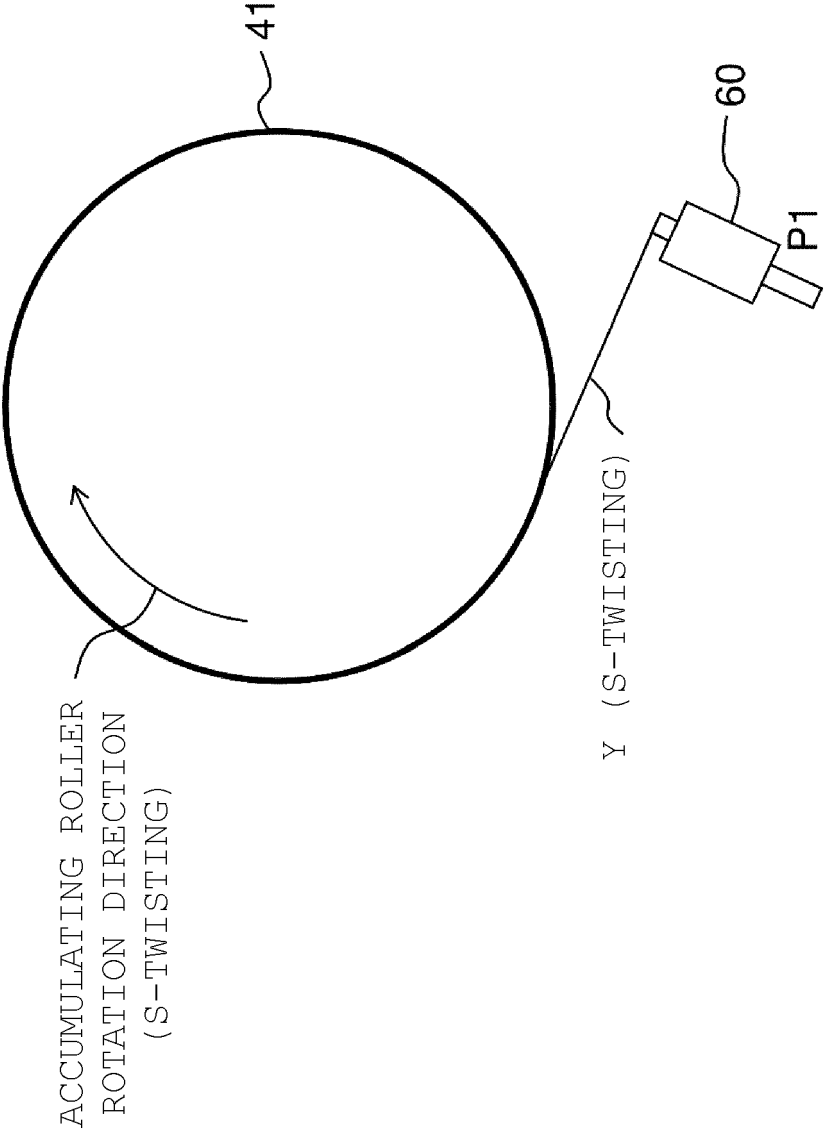
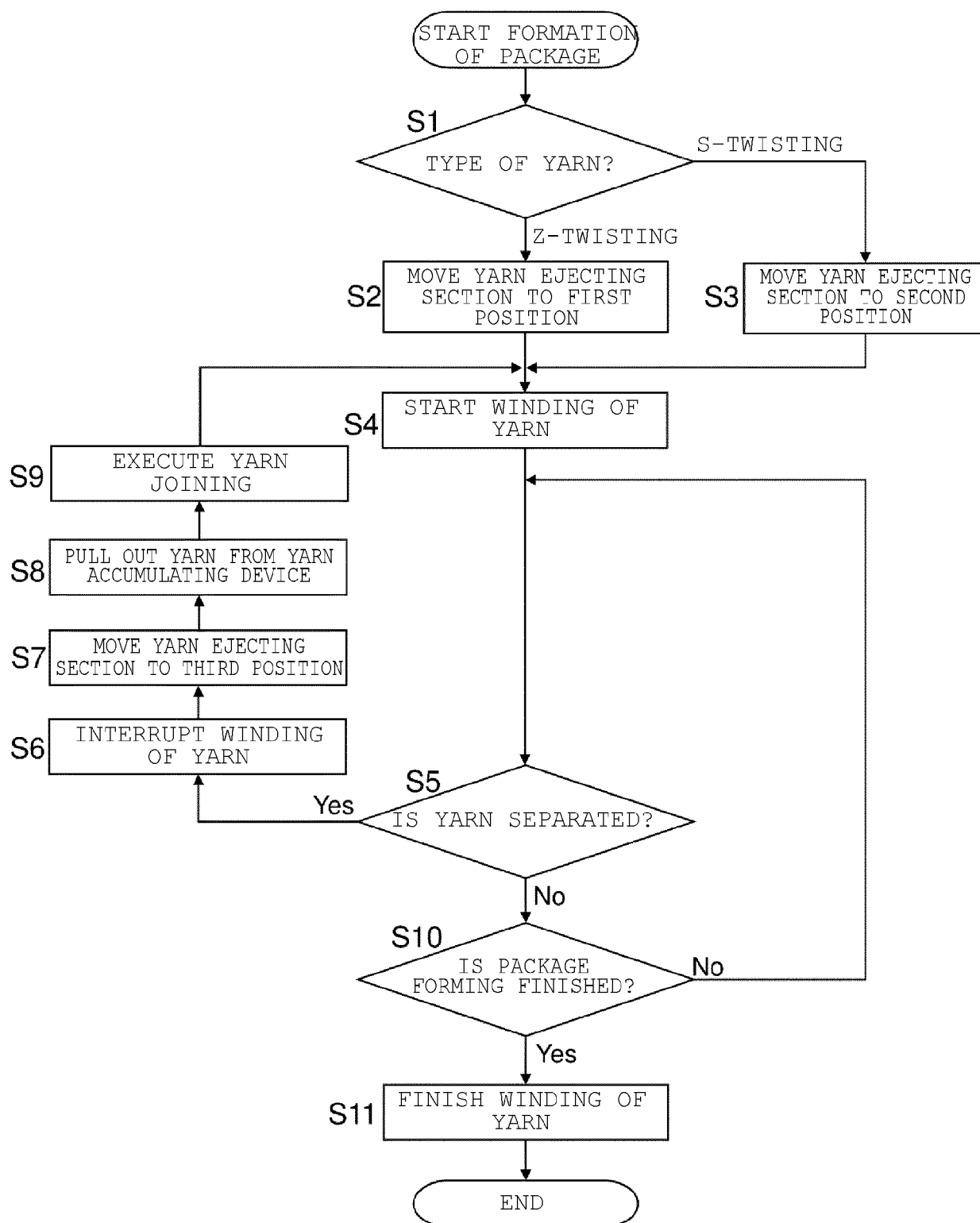


FIG. 9





EUROPEAN SEARCH REPORT

Application Number

EP 23 20 8942

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EPO FORM 1503 03.82 (P04C01)

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			B65H D01H
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 24 February 2024	Examiner Lemmen, René
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 23 20 8942

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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24-02-2024

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