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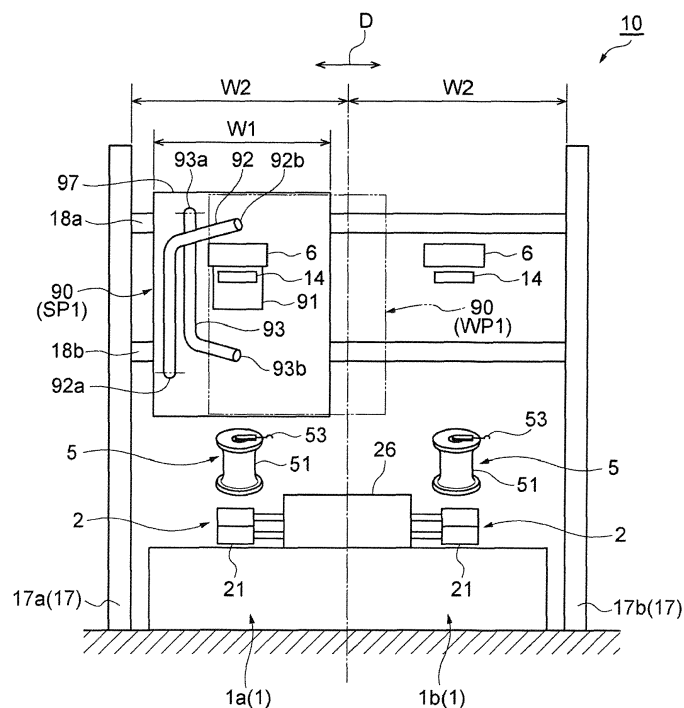
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(54) **Yarn winding machine**

(57) A spinning machine (10) includes a first spinning unit (1a) that forms a first package by winding a first yarn; a second spinning unit (1b) that is arranged adjacent to the first spinning unit (1a) along a predetermined direction (D) and that forms a second package by winding a

second yarn; and a yarn joining device (90) that is arranged in common only for the first spinning unit (1a) and the second spinning unit (1b) and that performs yarn joining in each of the first yarn winding unit (1a) and the second yarn winding unit (1b).

FIG.2



Description**BACKGROUND OF THE INVENTION**

1. Field of the Invention

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

2. Description of the Related Art

[0002] Yarn winding machines having plural yarn winding units that, respectively, form a package by winding a yarn are known in the art. Such a yarn winding machine includes a yarn joining device that joins a supply-side yarn and a package-side yarn when, for example, the yarn is cut to eliminate a yarn defect and the like. In some yarn winding machines, one yarn joining device is arranged for each yarn winding unit, and in other yarn winding machines, one yarn joining device is arranged in common for 20 or more to 40 or less yarn winding units. When one yarn joining device is arranged in common for plural yarn winding units, the yarn joining device is arranged in a movable manner for the 20 or more to 40 or less yarn winding units (for example, see Japanese Patent Application Laid-open No. 2005-330596).

[0003] When one yarn joining device is arranged for each yarn winding unit, if the frequency of the yarn joining performed in each of the yarn winding units is low, the number of yarn joining devices required for the yarn joining operation becomes excessive, leading to degradation in the cost performance. In contrast, when one yarn joining device is arranged in common for 20 or more to 40 or less yarn winding units, if the frequency of the yarn joining performed in each of the yarn winding units is high, the number of yarn joining devices required for the yarn joining operation becomes deficit, leading to degradation in the productivity of the packages.

SUMMARY OF THE INVENTION

[0004] An object of the present invention is to provide a yarn winding machine that can suppress both the degradation in cost performance and the degradation in the productivity of the packages.

[0005] According to an aspect of the present invention, a yarn winding machine includes a first yarn winding unit that forms a first package by winding a first yarn; a second yarn winding unit that is arranged adjacent to the first yarn winding unit along a predetermined direction and that forms a second package by winding a second yarn; and a yarn joining device that is arranged in common only for the first yarn winding unit and the second yarn winding unit and that performs yarn joining in each of the first yarn winding unit and the second yarn winding unit.

BRIEF DESCRIPTION OF THE DRAWINGS**[0006]**

FIG. 1 is a side view of a spinning unit in a spinning machine that is a yarn winding machine according to an embodiment of the present invention; FIG. 2 is a front view of a spinning unit pair in the spinning machine shown in FIG. 1; FIG. 3 is a front view of the spinning unit pair in the spinning machine shown in FIG. 1; FIG. 4 is a side view of the spinning unit when the spinning unit performs a yarn joining operation in the spinning machine shown in FIG. 1; FIG. 5 is a side view of the spinning unit when the spinning unit performs the yarn joining operation in the spinning machine shown in FIG. 1; FIG. 6 is a side view of the spinning unit when the spinning unit performs the yarn joining operation in the spinning machine shown in FIG. 1; and FIG. 7 is a side view of the spinning unit when the spinning unit performs the yarn joining operation in the spinning machine shown in FIG. 1.

DETAILED DESCRIPTION

[0007] Exemplary embodiments of the present invention are explained in detail below with reference to the accompanying drawings. The same reference numerals have been given to the same or similar structural components in the drawings and duplicate explanation thereof has been omitted.

[0008] As shown FIGS. 1, 2, and 3, a spinning machine (yarn winding machine) 10 includes plural spinning units 1 and a not-shown main control device. The spinning units 1 are arranged side-by-side along a predetermined direction D. The main control device centrally manages each of the spinning units 1. Among the plural spinning units 1, only a spinning unit pair including a first spinning unit (a first yarn winding unit) 1a and a second spinning unit (a second yarn winding unit) 1b arranged adjacent to each other in the predetermined direction D is shown in FIGS. 2 and 3. However, in practice, plural pairs of the first spinning unit 1a and the second spinning unit 1b are arranged along the predetermined direction D by using a frame 17. In this embodiment, the first spinning unit 1a and the second spinning unit 1b are sometimes collectively referred to as the spinning unit 1. In FIGS. 2 and 3, some of the components of each of the first spinning unit 1a and the second spinning unit 1b have been omitted.

[0009] As shown in FIG. 1, in the spinning unit 1, a spinning device (a first spinning device and a second spinning device) 3 forms a yarn (a first yarn and a second yarn) Y by spinning a fiber bundle (a first fiber bundle and a second fiber bundle) F supplied by a drafting device (a first drafting device and a second drafting device) 2, and a winding device (a first winding device and a second

winding device) 4 winds the formed yarn Y to form a package (a first package and a second package) P. In the present embodiment, upstream in the running direction of the yarn Y is simply called an upstream side and downstream in the running direction of the yarn Y is simply called a downstream side.

[0010] The spinning unit 1 includes the drafting device 2, the spinning device 3, a yarn pooling device 5, a yarn monitoring device 6, and the winding device 4 arranged in this order from the upstream side on a running path of the yarn Y. Each component of the spinning unit 1 is controlled by a not-shown unit controller arranged in each of the spinning units 1. The first spinning unit 1a and the second spinning unit 1b that constitute a pair of yarn winding units share one yarn joining device 90 (See FIGS. 2 and 3). The yarn joining device 90 is positioned at a joining position (explained later in detail) and performs the yarn joining in each of the first spinning unit 1a and the second spinning unit 1b.

[0011] The drafting device 2 includes total four pairs of draft roller pairs 21, 22, 23, and 24. In an order from the upstream side on the running path of the yarn Y, the four pairs of the draft roller pairs 21, 22, 23, and 24, are a back roller pair, a third roller pair, a middle roller pair, and a front roller pair, respectively. The draft roller pair 21 includes a top roller 21a as a driven roller and a bottom roller 21b as a driving roller. The draft roller pair 22 includes a top roller 22a as a driven roller and a bottom roller 22b as a driving roller. The draft roller pair 23 includes a top roller 23a as a driven roller and a bottom roller 23b as a driving roller. The draft roller pair 24 includes a top roller 24a as a driven roller and a bottom roller 24b as a driving roller. An apron belt 25 is loaded around each of the top roller 23a and the bottom roller 23b of the draft roller pair 23 that is the middle roller. In the drafting device 2, a sliver S supplied from a sliver case is conveyed and stretched while being sandwiched between the four pairs of the draft roller pairs 21, 22, 23, and 24, and the fiber bundle F is formed. As shown in FIGS. 2 and 3, the top rollers 21a, 22a, 23a, and 24a of the drafting device 2 of the first spinning unit 1a and the top rollers 21a, 22a, 23a, and 24a of the drafting device 2 of the second spinning unit 1b are supported by a draft cradle 26 that is arranged in common for the first spinning unit 1a and the second spinning unit 1b.

[0012] As shown in FIG. 1, the spinning device 3 forms the yarn Y by spinning with a swirling air current the fiber bundle F that is formed by the drafting device 2. Concretely, the spinning device 3 includes (although not shown specifically) a fiber guiding section, a swirling current generating nozzle, and a hollow guide shaft member. The fiber guiding section guides the fiber bundle F supplied by the drafting device 2 to a spinning chamber of the spinning device 3. The swirling current generating nozzle is arranged around the path of the fiber bundle F and generates a swirling air current inside the spinning chamber. As a result, in the spinning chamber, the direction of the fiber end is reversed and the fiber end is

swirled. The hollow guide shaft member guides the spun yarn Y from the spinning chamber to the outside of the spinning device 3. The yarn Y formed by the spinning device 3 is nipped between a delivery roller 7 and a nip roller 8 and supplied to the yarn pooling device 5. In an alternative configuration, the delivery roller 7 and the nip roller 8 can be omitted and an arrangement can be made where the yarn pooling device 5 pulls the yarn Y from the spinning device 3.

[0013] The yarn pooling device 5 includes a yarn pooling roller 51, a driving motor 52, and a yarn hooking member 53. The driving motor 52 rotates the yarn pooling roller 51. The yarn hooking member 53 winds the yarn Y on the yarn pooling roller 51. The yarn pooling device 5 temporarily pools the yarn Y by winding the yarn Y on the yarn pooling roller 51. In the spinning unit 1, the direction of the running path of the yarn Y is changed greatly between the upstream side and the downstream side of the yarn pooling device 5. Concretely, on the upstream side of the yarn pooling device 5, the yarn Y is caused to run in a substantially horizontal direction from the front toward the yarn pooling device 5, and on the downstream side of the yarn pooling device 5, the yarn Y is caused to run obliquely in the front-upper direction from the yarn pooling device 5. In the present embodiment, the side on which a passage is arranged for the operator of the spinning machine 10 is referred to as the front side, and the side opposite to the front side is referred to as the rear side. The side that is up in the height direction of the spinning machine 10 is simply referred to as the upper side and the side that is down in the height direction of the spinning machine 10 is simply referred to as the lower side.

[0014] The yarn hooking member 53 is rotatably supported relative to the yarn pooling roller 51. A permanent magnet is attached to one among the yarn pooling roller 51 and the yarn hooking member 53, and a magnetic hysteresis material is attached to the other. Because of those magnetic members, a torque that resists rotation of the yarn hooking member 53 relative to the yarn pooling roller 51 acts on the yarn hooking member 53. Therefore, the yarn hooking member 53 rotates relative to the yarn pooling roller 51 only when a force greater than this torque acts on the yarn hooking member 53 (i.e., when a tension of a predetermined value or higher is applied on the yarn Y), and the yarn Y that has been wound around the yarn pooling roller 51 is unwound. In contrast, when the force applied to the yarn hooking member 53 does not exceed this torque, the yarn hooking member 53 rotates integrally with the yarn pooling roller 51, and the yarn Y is wound around the yarn pooling roller 51.

[0015] In this manner, in the yarn pooling device 5, the yarn Y is unwound when the tension on the yarn Y downstream of the yarn pooling device 5 increases, and the yarn Y is pooled when the tension on the yarn Y downstream of the yarn pooling device 5 decreases (when the yarn Y is about to slack). Accordingly, the yarn pooling device 5 can eliminate the slack of the yarn Y by applying

an appropriate tension on the yarn Y. Furthermore, the yarn pooling device 5 absorbs the variations in the tension of the yarn Y downstream of the yarn pooling device 5 thereby preventing an adverse effect of the variations in the tension on the running of the yarn Y upstream of the yarn pooling device 5.

[0016] A first guide 11 is arranged upstream of and near the yarn pooling device 5. The first guide 11 guides the yarn Y to the yarn pooling device 5. A pair of guides including a second guide 12 and a third guide 13 is arranged downstream of and near the yarn pooling device 5. The second guide 12 and the third guide 13 stabilize the behavior of the yarn Y unwound from the yarn pooling device 5. The first guide 11 and the second guide 12 are arranged in a movable manner such that the first guide 11 and the second guide 12 move and draw the yarn Y to the yarn pooling device 5 when the yarn joining and the like are performed.

[0017] As shown in FIGS. 1 to 3, the yarn joining device 90 is arranged in common only for a pair of yarn winding units including the first spinning unit 1a and the second spinning unit 1b. The yarn joining device 90 performs joining of the yarn Y in each of the first spinning unit 1a and the second spinning unit 1b. That is, when the yarn Y is disconnected between the package P and the spinning device 3 of the first spinning unit 1a for some reason, the yarn joining device 90 joins the yarn Y from the package P and the yarn Y from the spinning device 3 at a first yarn joining position (the position shown by the solid line in FIG. 2) SP1 for the first spinning unit 1a. When the yarn Y is cut between the package P and the spinning device 3 of the second spinning unit 1b for some reason, the yarn joining device 90 joins the yarn Y from the package P and the yarn Y from the spinning device 3 at a second yarn joining position (the position shown by the solid line in FIG. 3) SP2 for the second spinning unit 1b.

[0018] The yarn joining device 90 is arranged so as to be movable along the predetermined direction D in a region between a first frame 17a and a second frame 17b, and the yarn joining device 90 is restricted from moving beyond the region between the first frame 17a and the second frame 17b. The first frame 17a is arranged along an edge of the first spinning unit 1a that is on the opposite side with respect to the position of the second spinning unit 1b, and supports at least a part (the winding device 4 and the like) of the first spinning unit 1a. The second frame 17b is arranged along an edge of the second spinning unit 1b that is on the opposite side with respect to the position of the first spinning unit 1a, and supports at least a part (the winding device 4 and the like) of the second spinning unit 1b.

[0019] In other words, the yarn joining device 90 is movable along the predetermined direction D in a region between the edge of the first spinning unit 1a that is on the opposite side with respect to the position of the second spinning unit 1b and the edge of the second spinning unit 1b that is on the opposite side with respect to the position of the first spinning unit 1a. The yarn joining de-

vice 90, however, is restricted from moving in a region that is beyond the region between the edge of the first spinning unit 1a that is on the opposite side with respect to the position of the second spinning unit 1b and the edge of the second spinning unit 1b that is on the opposite side with respect to the position of the first spinning unit 1a. The reason why the yarn joining device 90 is movable along the predetermined direction D in a region between the first yarn joining position SP1 for the first spinning unit 1a and the second yarn joining position SP2 for the second spinning unit 1b is because a width W1 of the yarn joining device 90 along the predetermined direction D is equal to or less than a width W2 of each of the first spinning unit 1a and the second spinning unit 1b along the predetermined direction D. The width W1 of the yarn joining device 90 along the predetermined direction D is, for example, equal to or more than 210 millimeters (mm) and equal to or less than 260 mm. The width W2 of each of the first spinning unit 1a and the second spinning unit 1b along the predetermined direction D is, for example, equal to or more than 215 mm and equal to or less than 270 mm.

[0020] In the present embodiment, the width W1, when viewed from a direction orthogonal to the predetermined direction D (e.g., when viewed from the front), is "a length of a side along the predetermined direction D" of a rectangle that is the smallest rectangle in which one entire yarn joining device 90 will fit. The width W2, when viewed from the direction orthogonal to the predetermined direction D (e.g., when viewed from the front), is "a length of a side along the predetermined direction D" of a rectangle that is the smallest rectangle in which one entire spinning unit 1 will fit. However, when it is assumed that the yarn joining device 90 is positioned at the same time in each of the two spinning units 1 that are arranged next to each other, the width W1, when viewed from the direction orthogonal to the predetermined direction D, can be regarded as "a width along the predetermined direction D" of a (non-overlapping) portion of one yarn joining device 90 excluding an overlapping portion of the two yarn joining devices 90. The width W2 can also be regarded as a value obtained by dividing a distance between an inner side of the first frame 17a and an inner side of the second frame 17b by the number of the spinning units 1 (two in this embodiment) arranged between those inner sides. The width W2 can also be regarded as a value obtained by dividing a distance between a center of width of the first frame 17a and a center of width of the second frame 17b by the number of the spinning units 1 (two in this embodiment) arranged between those centers. The width W2 can also be regarded as a range having a certain length on each side of the predetermined direction D from the running path of the yarn Y. In this case, the running path of the yarn Y can pass through a center of the width W2, or need not pass through the center of the width W2.

[0021] The yarn joining device 90 includes a yarn joining section 91, an upstream-side yarn conveying section

(yarn conveying section) 92, a downstream-side yarn conveying section (yarn conveying section) 93, a carriage body 97, a driving section 98, and a not-shown controlling section. The carriage body 97 is movable along a pair of rails including rails 18a and 18b that is installed between the first frame 17a and the second frame 17b. Concretely, the carriage body 97 includes guide rollers 94, driven rollers 95, and driving rollers 96. The guide rollers 94 are rotatable in engagement with a groove provided in the upper rail 18a. The driven rollers 95 are rotatable by being in contact with the upper rail 18a from the front side. The driving rollers 96 are rotatable by being in contact with the lower rail 18b from the front side. The driving rollers 96 are rotated by the driving section 98 that is a driving motor mounted on the carriage body 97. The controlling section controls the operation of the yarn joining section 91, the upstream-side yarn conveying section 92, the downstream-side yarn conveying section 93, and the driving section 98.

[0022] The yarn joining section 91 is a splicer device that joins the yarn Y from the package P and the yarn Y from the spinning device 3 by twisting them by using the swirling air current, in each of the first spinning unit 1a and the second spinning unit 1b. However, the yarn joining section 91 is not limited to the splicer device, and it can be a mechanical knotter and the like.

[0023] The yarn joining section 91 is installed in the carriage body 97 so that yarn joining section 91 can move close to and away from the running path of the yarn Y in the first spinning unit 1a, as well as can move close to and away from the running path of the yarn Y in the second spinning unit 1b. When the yarn joining device 90 is positioned at the first yarn joining position SP1, the yarn joining section 91 is moved forward to the running path of the yarn Y or near the running path of the yarn Y in the first spinning unit 1a to perform yarn joining in the first spinning unit 1a. When the yarn joining device 90 is positioned at the second yarn joining position SP2, the yarn joining section 91 is moved forward to the running path of the yarn Y or near the running path of the yarn Y in the second spinning unit 1b to perform yarn joining in the second spinning unit 1b. When the yarn joining device 90 is positioned at a first standby position WP1 (the position indicated by the two-dot chain line in FIG. 2), when the yarn joining device 90 is positioned at a second standby position WP2 (the position indicated by the two-dot chain line in FIG. 3), or when the yarn joining device 90 is moved along the predetermined direction D, the yarn joining section 91 is maintained at a position located away from the running path of the yarn Y or near the running path of the yarn Y in each of the first spinning unit 1a and the second spinning unit 1b.

[0024] When the yarn joining section 91 is to perform the yarn joining in each of the first spinning unit 1a and the second spinning unit 1b, the upstream-side yarn conveying section 92 conveys the yarn Y from the spinning device 3 to the yarn joining section 91. The upstream-side yarn conveying section 92 is pipe-shaped and

mounted on the carriage body 97 so as to be swingable upward or downward with a base end portion 92a as the center. When the upstream-side yarn conveying section 92 is swung downward around the base end portion 92a, a tip portion 92b of the upstream-side yarn conveying section 92 is positioned near downstream of the delivery roller 7 and the nip roller 8, and the upstream-side yarn conveying section 92 can capture the yarn Y from the spinning device 3 by using the suction air current. When the upstream-side yarn conveying section 92 is swung upward around the base end portion 92a, the upstream-side yarn conveying section 92 can convey the yarn Y from the spinning device 3 to the yarn joining section 91. When the yarn Y from the spinning device 3 is captured and conveyed by the upstream-side yarn conveying section 92, the delivery roller 7 and the nip roller 8 may be maintained contacting each other, or the delivery roller 7 and the nip roller 8 may be separated from each other.

[0025] When the yarn joining section 91 is to perform the yarn joining in each of the first spinning unit 1a and the second spinning unit 1b, the downstream-side yarn conveying section 93 conveys the yarn Y from the package P to the yarn joining section 91. The downstream-side yarn conveying section 93 is pipe-shaped and mounted on the carriage body 97 so as to be swingable upward or downward with a base end portion 93a as the center. When the downstream-side yarn conveying section 93 is swung upward around the base end portion 93a as the center, a tip end portion 93b of the downstream-side yarn conveying section 93 is positioned near upstream of the winding device 4, and the downstream-side yarn conveying section 93 can capture the yarn Y from the package P by the suction air current. When the downstream-side yarn conveying section 93 is swung downward around the base end portion 93a as the center, the downstream-side yarn conveying section 93 can convey the yarn Y from the package P to the yarn joining section 91. The yarn joining section 91, the upstream-side yarn conveying section 92, and the downstream-side yarn conveying section 93 can be driven with one driving motor.

[0026] The yarn joining section 91 is then moved forward or backward relative to the running path of the yarn Y by a not-shown driving motor. The upstream-side yarn conveying section 92 and the downstream-side yarn conveying section 93 are coupled by a connecting mechanism such as a cam, and can be swung upward and downward by a not-shown driving motor arranged in common for the upstream-side yarn conveying section 92 and the downstream-side yarn conveying section 93. However, a separate driving motor can be arranged for each of the upstream-side yarn conveying section 92 and the downstream-side yarn conveying section 93.

[0027] When the upstream-side yarn conveying section 92 and the downstream-side yarn conveying section 93 are connected to a suction duct 19, a suction air current is generated in the upstream-side yarn conveying section 92 and the downstream-side yarn conveying sec-

tion 93 (See FIG. 1). The suction duct 19 extends along all the spinning units 1 and along the pair of rails including the rails 18a and 18b. A not-shown shutter is arranged on the suction duct 19 for each of the spinning units 1. A shutter arranged for the first spinning unit 1a is opened only when the yarn joining device 90 is positioned at the first yarn joining position SP1, and the suction duct 19 is connected to a suction connector arranged in the yarn joining device 90. As a result, the suction air current flows in the suction duct 19 from the upstream-side yarn conveying section 92 and the downstream-side yarn conveying section 93. A shutter arranged for the second spinning unit 1b is opened only when the yarn joining device 90 is positioned at the second yarn joining position SP2, and the suction duct 19 is connected to a suction connector arranged in the yarn joining device 90. As a result, the suction air current flows in the suction duct 19 from the upstream-side yarn conveying section 92 and the downstream-side yarn conveying section 93.

[0028] When the yarn joining section 91 is connected to a not-shown air duct (tube) that branches from a not-shown injection duct through which a compressed air current flows, an injection air current is generated in the yarn joining section 91. The injection duct extends along all the spinning units 1 and along the pair of rails including the rails 18a and 18b. When the yarn joining section 91 is to perform the yarn joining operation, the air duct is connected to a not-shown solenoid valve arranged in the yarn joining device 90. The yarn joining section 91 can inject an air current required for the yarn joining by switching the solenoid valve from off to on at an appropriate timing.

[0029] In an alternative configuration, a not-shown shutter is arranged for each of the spinning units 1 on the injection duct. In this configuration, the shutter arranged for the first spinning unit 1a is opened only when the yarn joining device 90 is positioned at the first yarn joining position SP1, and the injection duct is connected to a suction connector arranged in the yarn joining device 90. As a result, the injection air current flows in the yarn joining section 91 from the injection duct. Moreover, a shutter arranged for the second spinning unit 1b is opened only when the yarn joining device 90 is positioned at the second yarn joining position SP2, and the injection duct is connected to a suction connector arranged in the yarn joining device 90. As a result, the injection air current flows in the yarn joining section 91 from the injection duct.

[0030] A valve for opening or closing a flow path of the air current generated in the yarn joining section 91 is arranged in the carriage body 97 of the yarn joining device 90. However, a valve for opening or closing a flow path of an air current generated in each of the upstream-side yarn conveying section 92 and the downstream-side yarn conveying section 93, or a regulator for regulating a pressure of an air current generated in each of the yarn joining section 91, the upstream-side yarn conveying section 92, and the downstream-side yarn conveying section 93 is not arranged in the carriage body 97. A not-shown reg-

ulator that regulates a pressure of air required in the yarn joining device 90 is arranged in a frame (for example, in a motor box) in common to plural yarn joining devices 90 of the spinning machine 10. Downsizing of the carriage body 97 can be achieved with this configuration. If an air current for twisting the yarn is to be generated in the upstream-side yarn conveying section 92 in addition to the suction air current, a valve for opening or closing a flow path of an air current generated in the upstream-side yarn conveying section 92 can be arranged in the carriage body 97.

[0031] As shown in FIG. 1, the yarn monitoring device 6 monitors a thickness of the running yarn Y by using an optical sensor. When the yarn monitoring device 6 detects a yarn defect (place where the thickness and the like of the yarn is anomalous), the yarn monitoring device 6 transmits a yarn-defect detection signal to the unit controller. Upon receiving the yarn-defect detection signal, the unit controller operates a cutter 14 arranged near the yarn monitoring device 6 on the upstream side and causes the cutter 14 to cut the yarn Y. The yarn monitoring device 6 can use an electrostatic capacitance sensor, for example, instead of the optical sensor. The yarn monitoring device 6 can be configured to detect foreign matter contained in the yarn Y. Moreover, the cutter 14 can be integrated in the yarn monitoring device 6 instead of arranging separately from the yarn monitoring device 6. The cutter 14 can even be omitted, and the yarn Y can be cut after stopping the spinning operation being performed by the spinning device 3.

[0032] The winding device 4 forms the package P by winding the yarn Y formed by the spinning device 3. The winding device 4 includes a cradle arm 41, a winding drum 42, and a yarn pulling device 43.

[0033] The cradle arm 41 rotatably supports a winding tube T on which the yarn Y is to be wound. The cradle arm 41 is arranged so as to be swingable upward or downward with a base end portion as the center and is urged so as to be swung downward with the base end as the center. Thus, even when the diameter of the package P gradually increases as the yarn Y is wound around the winding tube T, the cradle arm 41 can cause the package P to contact the winding drum 42 at an appropriate pressure.

[0034] A driving force of a not-shown driving motor is conveyed to the winding drum 42 whereby the winding drum 42 is rotated while being in contact with an outer peripheral surface of the winding tube T or the package P. A traverse groove is formed on an outer peripheral surface of the winding drum 42 to traverse the yarn Y at a predetermined width. Thus, the winding device 4 can form the package P by winding the yarn Y around the winding tube T while traversing the yarn Y. In the present embodiment, a driving motor that rotates the winding drum 42 is arranged separately for each of the spinning units 1. Accordingly, the package P can be rotated in a reverse direction by independently operating the winding drum 42 of the spinning unit 1 in which the yarn joining

becomes necessary.

[0035] The yarn pulling device 43 is arranged near upstream of the winding drum 42. A fourth guide 16 is arranged near the upstream side of the yarn pulling device 43. When performing the yarn joining and the like, the yarn pulling device 43 generates an air current that flows downward along the outer peripheral surface of the package P. With this arrangement, the yarn pulling device 43 can pull the yarn Y from the package P and guide the pulled yarn Y to the fourth guide 16. The downstream-side yarn conveying section 93 is swung upward with the base end portion 93a as the center such that the tip end portion 93b is positioned near the upstream side of the fourth guide 16. Then, the downstream-side yarn conveying section 93 captures the yarn Y from the package P by using the suction air current.

[0036] A yarn joining operation performed in the spinning machine 10 will be explained below by focusing on the spinning unit pair including the first spinning unit 1a and the second spinning unit 1b.

[0037] When the yarn Y is disconnected in the first spinning unit 1a (concretely, when the yarn Y breaks during winding of the package P, or when the yarn Y is cut by the cutter 14), as shown in FIG. 2, the yarn joining device 90 is moved to and stops at the first yarn joining position SP1 for the first spinning unit 1a. Subsequently, as shown in FIG. 4, the winding operation of the package P by the winding device 4, the drafting operation by the drafting device 2, and the spinning operation by the spinning device 3 are stopped, and the first guide 11 and the second guide 12 are moved from a position near the yarn pooling device 5 to a position above the nip roller 8 and the delivery roller 7. In the yarn joining device 90, the yarn joining section 91 is moved forward to the running path of the yarn Y or near the running path of the yarn Y of the first spinning unit 1a.

[0038] Subsequently, the downstream-side yarn conveying section 93 is swung upward, and captures the yarn Y that is pulled from the package P and guided to the fourth guide 16 by the yarn pulling device 43. Then, as shown in FIG. 5, the downstream-side yarn conveying section 93 is swung downward, and conveys the yarn Y from the package P to the yarn joining section 91. At this time, the package P is rotated in the reverse direction by controlling the winding drum 42. Subsequently, as shown in FIG. 4, the upstream-side yarn conveying section 92 is swung downward to a position where the upstream-side yarn conveying section 92 captures the yarn Y from the spinning device 3. Then, the drafting operation by the drafting device 2 and the spinning operation by the spinning device 3 are resumed, and the yarn Y output from the spinning device 3 is captured by the upstream-side yarn conveying section 92. Thereafter, as shown in FIG. 5, the upstream-side yarn conveying section 92 is swung upward, and conveys the yarn Y from the spinning device 3 to the yarn joining section 91. In an alternative configuration, the capturing and the conveying of the yarn Y from the spinning device 3 by the upstream-side yarn

conveying section 92 can be performed prior to the capturing and the conveying of the yarn Y from the package P by the downstream-side yarn conveying section 93.

[0039] Subsequently, as shown in FIG. 6, while capturing the yarn Y from the spinning device 3, the first guide 11 is moved near the upstream side of the yarn pooling device 5. Then, as shown in FIG. 7, while capturing the yarn Y from the spinning device 3, the second guide 12 is moved near the downstream side of the yarn pooling device 5. Then, the yarn joining section 91 performs the yarn joining. By following the above method, it is possible to hook the yarn Y with the yarn hooking member 53 of the yarn pooling device 5 and pool the yarn Y on the yarn pooling roller 51 thereby eliminating a slack in the yarn Y that may be generated during the yarn joining.

[0040] When the yarn joining by the yarn joining section 91 is completed, the winding operation of the package P by the winding device 4 is resumed. Then, as shown in FIG. 2, the yarn joining device 90 is moved to and stopped at the first standby position WP1 that is closer to the first yarn joining position SP1 for the first spinning unit 1a.

[0041] When the yarn Y is disconnected in the second spinning unit 1b, as shown in FIG. 3, the yarn joining device 90 is moved to and stopped at the second yarn joining position SP2 for the second spinning unit 1b, and similar to the above, the yarn joining operation is performed in the second spinning unit 1b. When the yarn joining operation is completed, the yarn joining device 90 is moved to and stopped at the second standby position WP2 that is closer to the second yarn joining position SP2 for the second spinning unit 1b. As explained above, the yarn joining device 90 does not stand by at a central position that bisects the first yarn joining position SP1 and the second yarn joining position SP2. That is, the standby position of the yarn joining device 90 is a position offset from the central position toward the position where the yarn joining operation was performed. Accordingly, when a necessity arises to perform the yarn joining operation in both the first spinning unit 1a and the second spinning unit 1b, the yarn joining device 90 can be moved to a joining position that is closer to the current standby position making it possible to perform the yarn joining operation efficiently.

[0042] As explained above, in the spinning machine 10, the yarn joining device 90 is arranged in common only for the first spinning unit 1a and the second spinning unit 1b. Therefore, even if the frequency of yarn joining in each of the spinning units 1 is low, in comparison with the case where one yarn joining device 90 is arranged for one spinning unit 1, the number of the yarn joining devices 90 required for the yarn joining hardly becomes excessive. Furthermore, even if the frequency of yarn joining in each of the spinning units 1 is high, in comparison with the case where one yarn joining device 90 is arranged in common for 20 or more to 40 or less spinning units 1, the number of the yarn joining devices 90 required for the yarn joining hardly becomes insufficient (in short,

waiting time from generation of a requirement for performing the yarn joining until the yarn joining is actually started is shortened). Therefore, in the spinning machine 10, it is possible to suppress both the reduction of cost performance and the reduction in the productivity of the package P.

[0043] In the spinning machine 10, the movement distance of the yarn joining device 90 is shorter which makes it possible to suppress the stiffness of the carriage body 97 and to downsize the rollers 94, 95, and 96, and the driving section 98. Moreover, the weight of the yarn joining device 90 can be reduced and the working life of the components of the yarn joining device 90 can be prolonged. In addition, attachment and detachment operation of the yarn joining device 90 with respect to the pair of rails including the rails 18a and 18b can be performed easily, thereby facilitating the maintenance of the yarn joining device 90. Furthermore, in the spinning machine 10, as the movement distance of the yarn joining device 90 is shorter, the range of selection of the driving section 98 becomes wider. For example, it is possible to use an actuator, such as an air cylinder, as the driving section 98 instead of a driving motor.

[0044] In the spinning machine 10, the yarn joining device 90 is arranged so as to be movable along the predetermined direction D in the region between the first frame 17a and the second frame 17b, is restricted from moving beyond the region between the first frame 17a and the second frame 17b. As a result, the yarn joining device 90 can be shared between the first spinning unit 1a and the second spinning unit 1b by using a simple structure. Furthermore, as there is no need to secure a dedicated space for movement of the yarn joining device 90, it is possible to increase the flexibility of the layout of the spinning machine 10. Moreover, it is not necessary to prepare openings in the first frame 17a and the second frame 17b for passing the yarn joining device 90. Therefore, in comparison to a case where such openings are prepared, it is possible to ensure sufficient rigidity for the first frame 17a and the second frame 17b even with less material.

[0045] In the spinning machine 10, the width W1 of the yarn joining device 90 in the predetermined direction D is equal to or less than the width W2 of each of the first spinning unit 1a and the second spinning unit 1b in the predetermined direction D. Because of this, the yarn joining device 90 does not protrude to the outside of each of the first spinning unit 1a and the second spinning unit 1b, and it is possible to suppress widening of the installation space of the spinning machine 10. Furthermore, two different yarn joining devices 90 can be simultaneously positioned with respect to the first spinning unit 1a and the second spinning unit 1b that are arranged adjacent to each other via the frame 17 (the first frame 17a and the second frame 17b) and the yarn joining of the yarn Y can be simultaneously performed in each of those first spinning unit 1a and second spinning unit 1b.

[0046] In the spinning machine 10, the yarn joining de-

vice 90 includes the driving section 98 for moving along the predetermined direction D. Therefore, the yarn joining device 90 can be easily moved to an appropriate position.

[0047] In the spinning machine 10, the yarn joining device 90 includes the yarn joining section 91 that performs the yarn joining in each of the first spinning unit 1a and the second spinning unit 1b. Therefore, the yarn joining can be performed properly in each of the first spinning unit 1a and the second spinning unit 1b.

[0048] In the spinning machine 10, the yarn joining section 91 is arranged so that the yarn joining section 91 can move close to and away from the running path of the yarn Y in the first spinning unit 1a, as well as can move close to and away from the running path of the yarn Y in the second spinning unit 1b. With this arrangement, at times other than when the yarn joining is to be performed in each of the first spinning unit 1a and the second spinning unit 1b, the yarn joining section 91 can be moved to such a position where it does not come in the way of other components. Moreover, when performing yarn joining in each of the first spinning unit 1a and the second spinning unit 1b, the yarn joining section 91 can properly perform the yarn joining on the running path of the yarn Y or near the running path of the yarn Y. Furthermore, at times other than when the yarn joining is to be performed in each of the first spinning unit 1a and the second spinning unit 1b, by moving the yarn joining section 91 to such a position where it does not come in the way of other components, it is possible to increase the degree of freedom of movement trajectories of the upstream-side yarn conveying section 92 and the downstream-side yarn conveying section 93.

[0049] In the spinning machine 10, the yarn joining device 90 includes the upstream-side yarn conveying section 92 that conveys the yarn Y from the spinning device 3 to the yarn joining section 91 when performing the yarn joining, and the downstream-side yarn conveying section 93 that conveys the yarn Y from the package P to the yarn joining section 91 when performing the yarn joining. Therefore, when performing the yarn joining, it is possible to properly convey the yarn Y from the spinning device 3 and the yarn Y from the package P to the yarn joining section 91.

[0050] In the spinning machine 10, the top rollers 21a, 22a, 23a, and 24a of the drafting device 2 of the first spinning unit 1a and the top rollers 21a, 22a, 23a, and 24a of the drafting device 2 of the second spinning unit 1b are supported by the draft cradle 26 that is provided in common for the first spinning unit 1a and the second spinning unit 1b. Therefore, the draft cradle 26 can be shared by the first spinning unit 1a and the second spinning unit 1b which makes it possible to simplify the structure of the spinning machine 10.

[0051] Exemplary embodiments of the present invention have been explained above; however, the present invention is not intended to be limited to those embodiments. For example, the width W1 of the yarn joining device 90 in the predetermined direction D may be longer

than the width W2 of each of the first spinning unit 1a and the second spinning unit 1b in the predetermined direction D. In this case, an opening can be arranged in each of the first frame 17a and the second frame 17b (an opening where a part of at least the yarn joining device 90 can be arranged), or a space can be prepared in between the first spinning unit 1a and the first frame 17a and in between the second spinning unit 1b and the second frame 17b. By adopting this configuration, the yarn joining device 90 can be caused to perform the yarn joining in each of the first spinning unit 1a and the second spinning unit 1b.

[0052] A suction mouth having an elongated suction port of a length corresponding to the length of the package P can be used as the downstream-side yarn conveying section 93. If this configuration is adopted, the yarn pulling device 43 and the fourth guide 16 can be omitted. Moreover, at least one of the upstream-side yarn conveying section 92 and the downstream-side yarn conveying section 93 can be arranged in the spinning unit 1. This configuration leads to further reduction in the weight of the yarn joining device 90.

[0053] The yarn joining section 91 is not limited to the one that can move close to and away from the running path of the yarn Y. That is, the yarn joining section 91 can be fixed at a position where it can perform the yarn joining in the yarn joining device 90. Furthermore, a mechanism for operating the first guide 11 and the second guide 12 can be included in the yarn joining device 90. Moreover, a configuration required for performing the yarn joining operation can be included in the yarn joining device 90. The draft cradle 26 can be arranged in each of the spinning units 1.

[0054] The yarn winding machine according to the present invention is not to be limited to a spinning machine. That is, the yarn winding machine can be any other yarn winding machine such as an automatic winder. Furthermore, the first yarn winding unit and the second yarn winding unit according to the present invention are not to be limited to spinning units. That is, the first spinning unit and the second yarn winding unit can be any other yarn winding unit such as a winder unit. Moreover, the first yarn winding unit and the second yarn winding unit according to the present invention can have a configuration in which the yarn runs from up to down in the height direction of the spinning machine 10.

[0055] According to an aspect of the present invention, a yarn winding machine includes a first yarn winding unit that forms a first package by winding a first yarn; a second yarn winding unit that is arranged adjacent to the first yarn winding unit along a predetermined direction and that forms a second package by winding a second yarn; and a yarn joining device that is arranged in common only for the first yarn winding unit and the second yarn winding unit and that performs yarn joining in each of the first yarn winding unit and the second yarn winding unit.

[0056] In the above yarn winding machine, the yarn joining device is arranged in common only for the first

yarn winding unit and the second yarn winding unit. Therefore, even if the frequency of yarn joining in each of the yarn winding units is low, in comparison with the case where one yarn joining device is arranged for one yarn winding unit, the number of the yarn joining devices required for the yarn joining hardly becomes excessive. Furthermore, even if the frequency of yarn joining in each of the yarn winding units is high, in comparison with the case where one yarn joining device is arranged in common for 20 or more to 40 or less yarn winding units, the number of the yarn joining devices required for the yarn joining hardly becomes insufficient. Therefore, in the yarn winding machine, it is possible to suppress both the reduction of cost performance and reduction in the productivity of the package.

[0057] According to another aspect of the present invention, in the yarn winding machine, the yarn joining device can be arranged so as to be movable along a predetermined direction between a first yarn joining position for the first yarn winding unit and a second yarn joining position for the second yarn winding unit. As a result, the yarn joining device can be shared between the first yarn winding unit and the second yarn winding unit by using a simple structure.

[0058] According to still another aspect of the present invention, in the yarn winding machine, the yarn joining device can be restricted from moving in a region that is beyond a region between an edge of the first yarn winding unit that is on an opposite side with respect to a position of the second yarn winding unit and an edge of the second yarn winding unit that is on an opposite side with respect to a position of the first yarn winding unit. As a result, the movement distance of the yarn joining device can be made shorter, and waiting time for the yarn joining in each of the yarn winding units can be shortened.

[0059] According to still another aspect of the present invention, the yarn winding machine further includes a first frame arranged along an edge of the first yarn winding unit that is on the opposite side with respect to the position of the second yarn winding unit, and that supports at least a part of the first yarn winding unit; and a second frame arranged along an edge of the second yarn winding unit that is on the opposite side with respect to the position of the first yarn winding unit, and that supports at least a part of the second yarn winding unit. In the yarn winding machine, the yarn joining device can be arranged so as to be movable along the predetermined direction in a region between the first frame and the second frame, and the yarn joining device can be restricted from moving beyond the region between the first frame and the second frame. As a result, as there is no need to secure a dedicated space for movement of the yarn joining device, it is possible to increase the flexibility of the layout of the spinning machine. Moreover, because it is not necessary to prepare openings in the first frame and the second frame for passing the yarn joining device 90, in comparison to a case where such openings are prepared, it is possible to ensure sufficient rigidity for the

first frame and the second frame even with less material.

[0060] According to still another aspect of the present invention, in the yarn winding machine, a width of the yarn joining device in the predetermined direction can be equal to or less than a width of each of the first yarn winding unit and the second yarn winding unit in the predetermined direction. Because of this, the yarn joining device does not protrude to the outside of each of the first yarn winding unit and the second yarn winding unit and widening of the installation space of the spinning machine can be suppressed.

[0061] According to still another aspect of the present invention, in the yarn winding machine, the yarn joining device can include a driving section that moves the yarn joining device along the predetermined direction. As a result, the yarn joining device can be easily moved to an appropriate position.

[0062] According to still another aspect of the present invention, in the yarn winding machine, the yarn joining device can include a yarn joining section, and the yarn joining section can perform yarn joining of the first yarn and yarn joining of the second yarn. As a result, the yarn joining can be performed properly in each of the first yarn winding unit and the second yarn winding unit.

[0063] According to still another aspect of the present invention, in the yarn winding machine, the yarn joining section can move close to and away from a running path of the first yarn in the first yarn winding unit, and can move close to and away from a running path of the second yarn in the second yarn winding unit. As a result, at times other than when performing the yarn joining of the first yarn and the second yarn, the yarn joining section can be moved to such a position where it does not come in the way of other components, and when performing the yarn joining of the first yarn and the second yarn, the yarn joining section can be moved to a running path or near the running path of each of the first yarn and the second yarn allowing proper yarn joining of the first yarn and the second yarn.

[0064] According to still another aspect of the present invention, in the yarn winding machine, the yarn joining device can further include a yarn conveying section, and the yarn joining device can convey the first yarn to the yarn joining section when the yarn joining is to be performed on the first yarn, and conveys the second yarn to the yarn joining section when the yarn joining is to be performed on the second yarn. As a result, the first yarn and the second yarn can be properly conveyed to the yarn joining section when performing the yarn joining of the first yarn and the second yarn.

[0065] According to still another aspect of the present invention, in the yarn winding machine, the first yarn winding unit can include a first drafting device that forms a first fiber bundle; a first spinning device that forms the first yarn by spinning the first fiber bundle with a swirling air current; and a first winding device that forms the first package by winding the first yarn, and the second yarn winding unit can include a second drafting device that

forms a second fiber bundle; a second spinning device that forms the second yarn by spinning the second fiber bundle with a swirling air current; and a second winding device that forms the second package by winding the second yarn, wherein a top roller of the first drafting device and a top roller of the second drafting device are supported by a draft cradle that is arranged in common for the first yarn winding unit and the second yarn winding unit. As a result, as the draft cradle can be shared between the first yarn winding unit and the second yarn winding unit, it is possible to simplify the structure of the yarn winding machine.

15 Claims

1. A yarn winding machine (10) comprising:

a first yarn winding unit (1a) adapted to form a first package (P) by winding a first yarn (Y) ;
a second yarn winding unit (1b) arranged adjacent to the first yarn winding unit (1a) along a predetermined direction (D) and adapted to form a second package (P) by winding a second yarn (Y); and
a yarn joining device (90) arranged in common only for the first yarn winding unit (1a) and the second yarn winding unit (1b) and adapted to perform yarn joining in each of the first yarn winding unit (1a) and the second yarn winding unit (1b).

2. The yarn winding machine (10) as claimed in Claim 1, wherein the yarn joining device (90) is arranged so as to be movable along the predetermined direction (D) between a first yarn joining position (SP1) for the first yarn winding unit (1a) and a second yarn joining position (SP2) for the second yarn winding unit (1b).

3. The yarn winding machine (10) as claimed in Claim 1 or 2, wherein the yarn joining device (90) is restricted from moving in a region that is beyond a region between an edge of the first yarn winding unit (1a) that is on an opposite side with respect to a position of the second yarn winding unit (1b) and an edge of the second yarn winding unit (1b) that is on an opposite side with respect to a position of the first yarn winding unit (1a).

4. The yarn winding machine (10) as claimed in any one of Claims 1 to 3, further comprising:

a first frame (17a) arranged along an edge of the first yarn winding unit (1a) that is on the opposite side with respect to the position of the second yarn winding unit (1b), and adapted to support at least a part of the first yarn winding

- unit (1a); and
 a second frame (17b) arranged along an edge of the second yarn winding unit (1b) that is on the opposite side with respect to the position of the first yarn winding unit (1b), and adapted to support at least a part of the second yarn winding unit (1b),
 wherein the yarn joining device (90) is arranged so as to be movable along the predetermined direction (D) in a region between the first frame (1a) and the second frame (1b), and the yarn joining device (90) is restricted from moving beyond the region between the first frame (1a) and the second frame (1b).
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5. The yarn winding machine (10) as claimed in any one of Claims 1 to 4, wherein a width (W1) of the yarn joining device (90) in the predetermined direction (D) is equal to or less than a width (W2) of each of the first yarn winding unit (1a) and the second yarn winding unit (1b) in the predetermined direction (D).
 6. The yarn winding machine (10) as claimed in any one of Claims 1 to 5, wherein the yarn joining device (90) includes a driving section (98) adapted to move the yarn joining device (90) along the predetermined direction (D).
 7. The yarn winding machine (10) as claimed in any one of Claims 1 to 6, wherein the yarn joining device (90) includes a yarn joining section (91) adapted to perform yarn joining of the first yarn (Y) and yarn joining of the second yarn (Y).
 8. The yarn winding machine (10) as claimed in Claim 7, wherein the yarn joining section (91) can move close to and away from a running path of the first yarn (Y) in the first yarn winding unit (1a), and can move close to and away from a running path of the second yarn (Y) in the second yarn winding unit (1b).
 9. The yarn winding machine (10) as claimed in Claim 7 or 8, wherein the yarn joining device (90) includes a yarn conveying section (92) adapted to convey the first yarn (Y) to the yarn joining section (91) when the yarn joining is to be performed on the first yarn (Y) and to convey the second yarn (Y) to the yarn joining section (91) when the yarn joining is to be performed on the second yarn (Y).
 10. The yarn winding machine (10) as claimed in any one of Claims 1 to 9, wherein the first yarn winding unit (1a) includes a first drafting device (2) adapted to form a first fiber bundle (F);
 a first spinning device (3) adapted to form the first yarn (Y) by spinning the first fiber bundle (F) with a swirling air current; and
 a first winding device (4) adapted to form the first package (P) by winding the first yarn (Y), and the second yarn winding unit (1b) includes a second drafting device (2) adapted to form a second fiber bundle (F);
 a second spinning device (3) adapted to form the second yarn (Y) by spinning the second fiber bundle (F) with a swirling air current; and
 a second winding device (4) adapted to form the second package (P) by winding the second yarn (Y), wherein a top roller (21a, 22a, 23a, 34a) of the first drafting device (2) and a top roller (21a, 22a, 23a, 34a) of the second drafting device (2) are supported by a draft cradle (26) that is arranged in common for the first yarn winding unit (1a) and the second yarn winding unit (1b).

FIG. 1

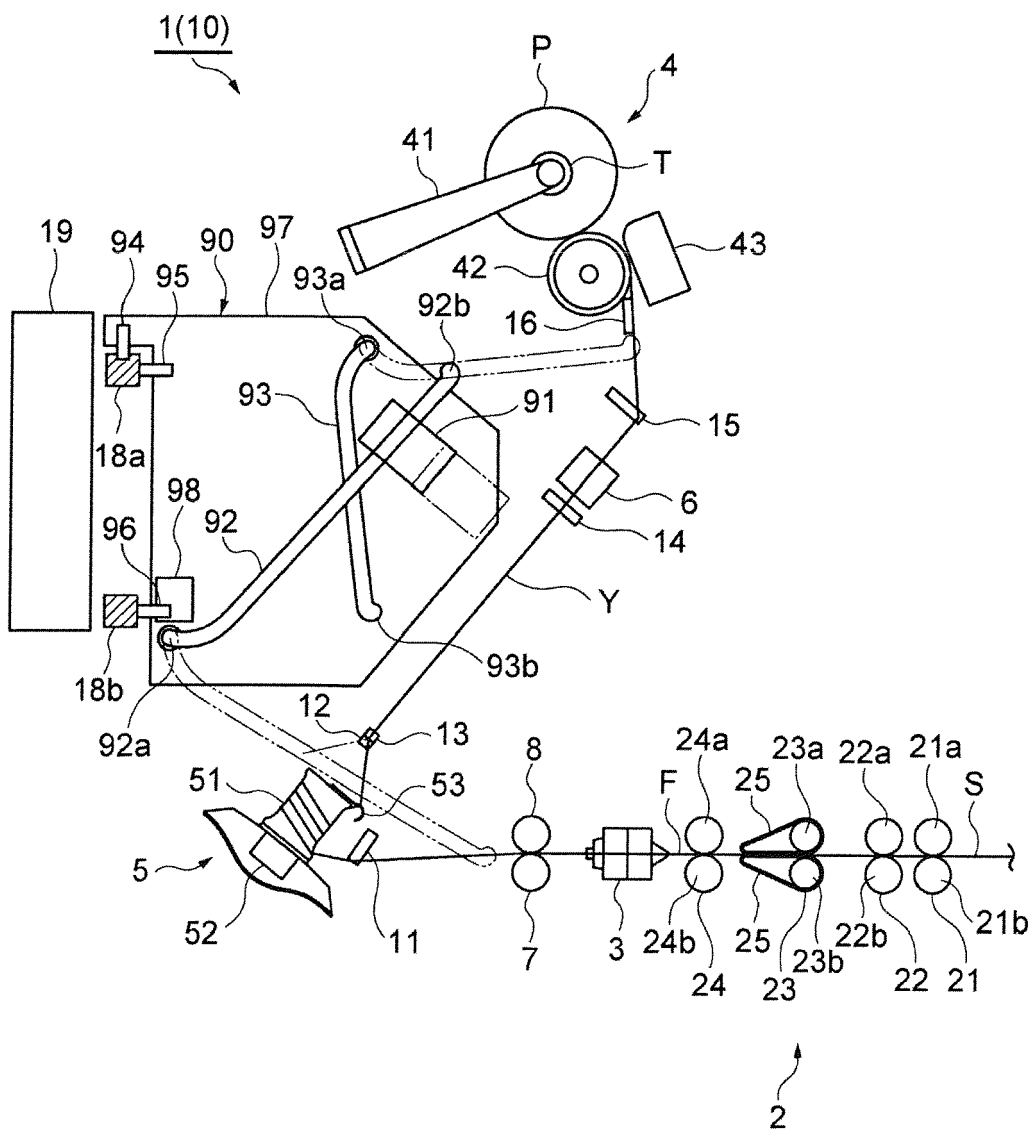


FIG.2

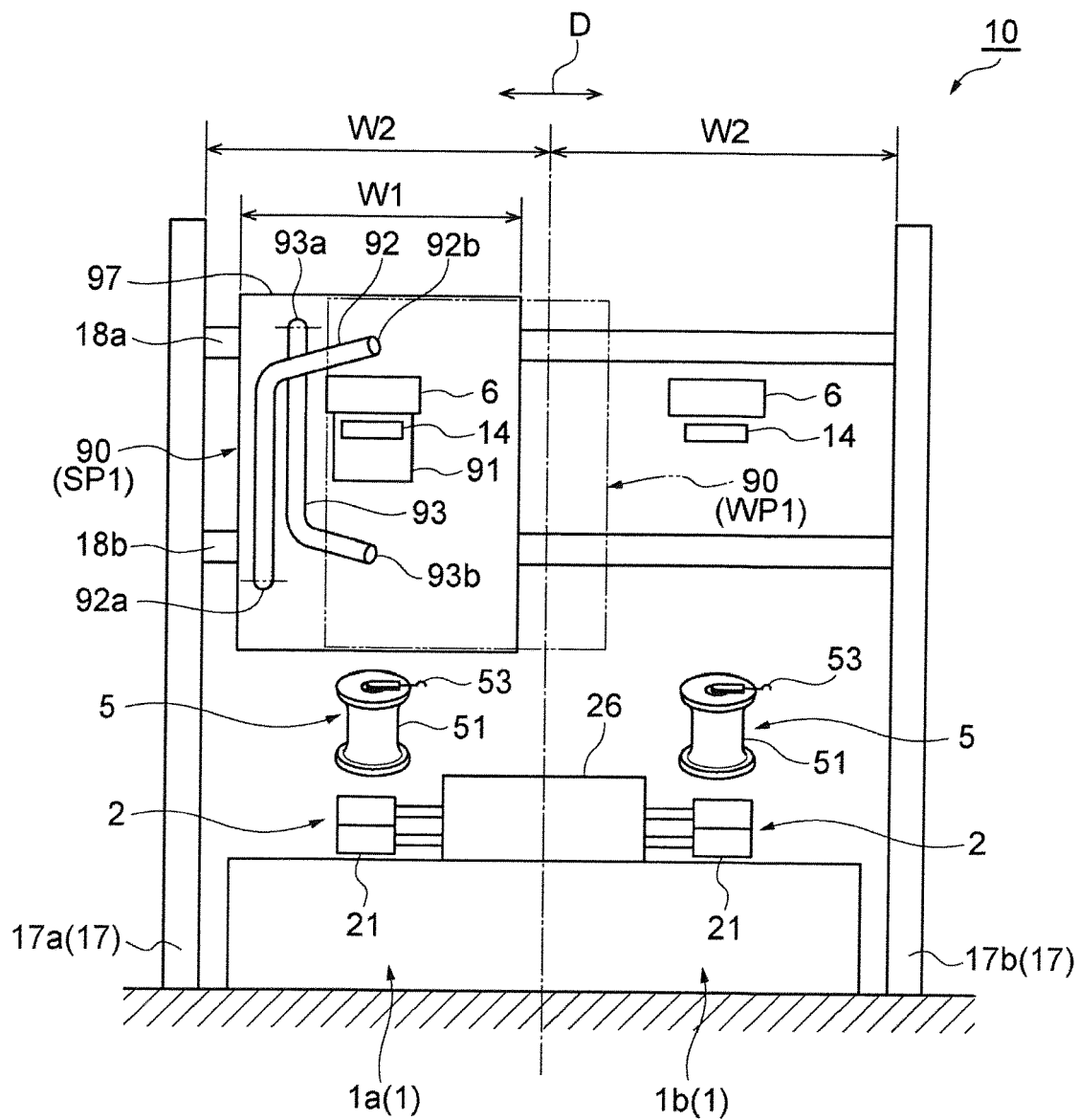


FIG.3

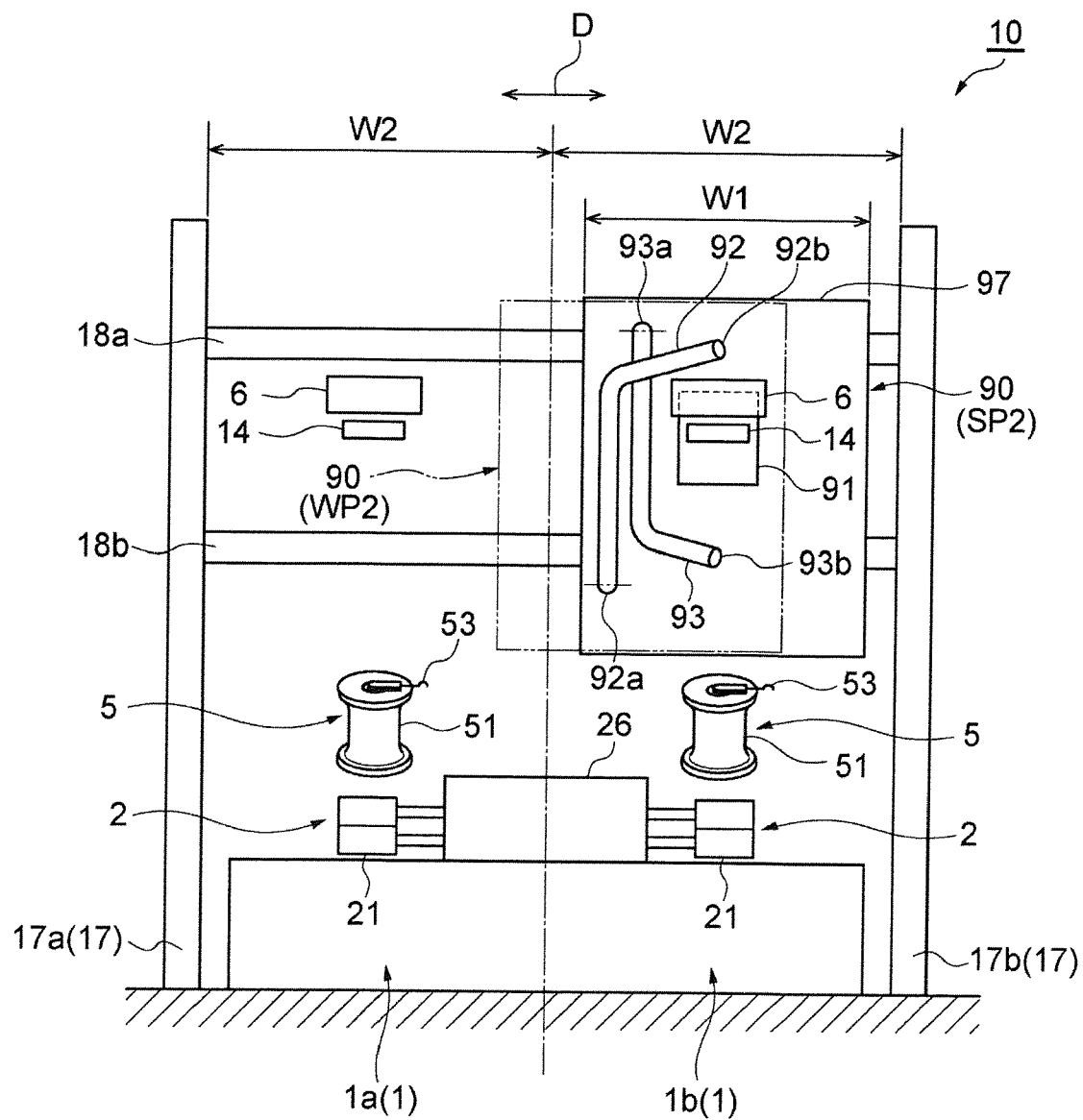


FIG.4

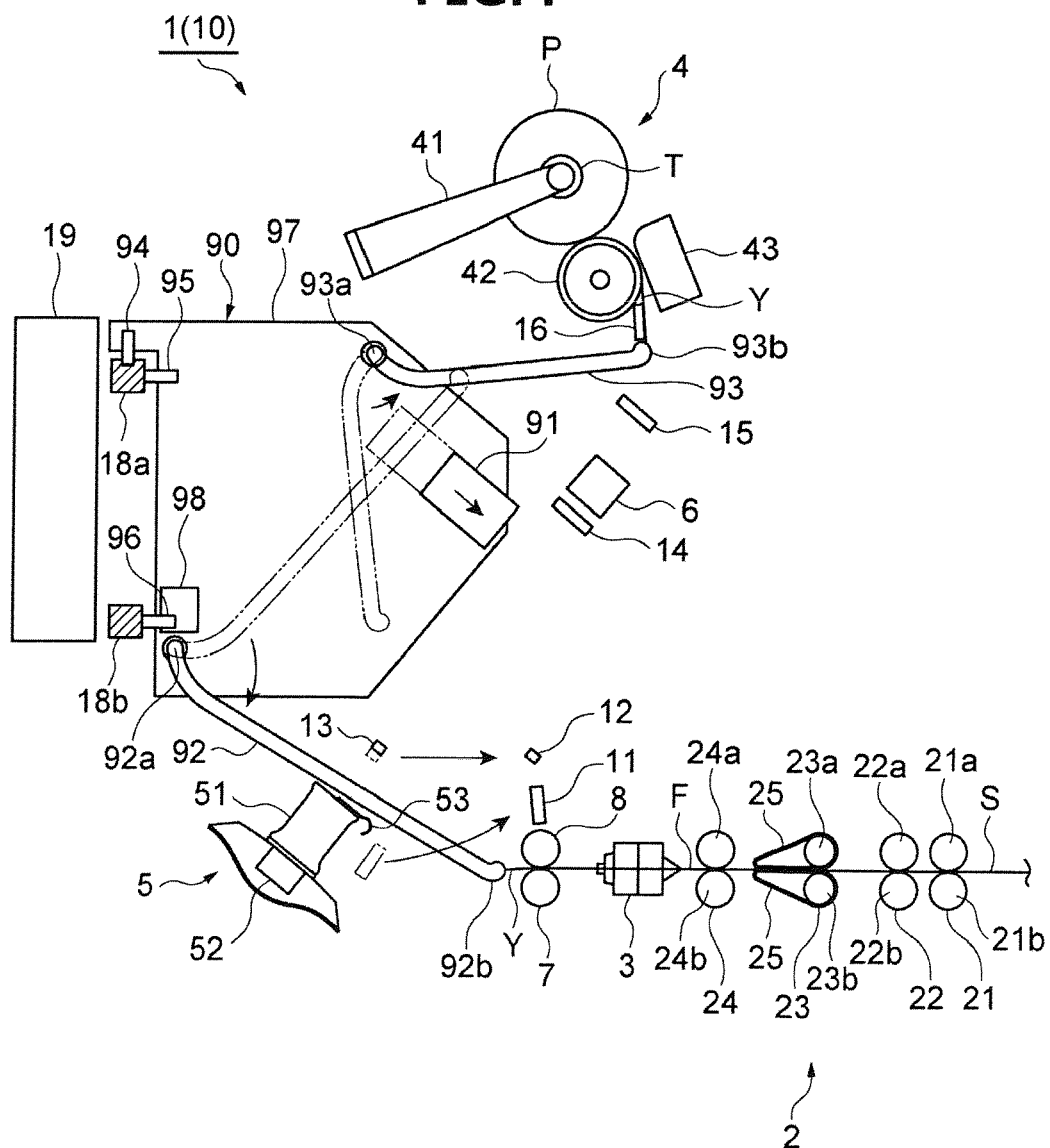


FIG.5

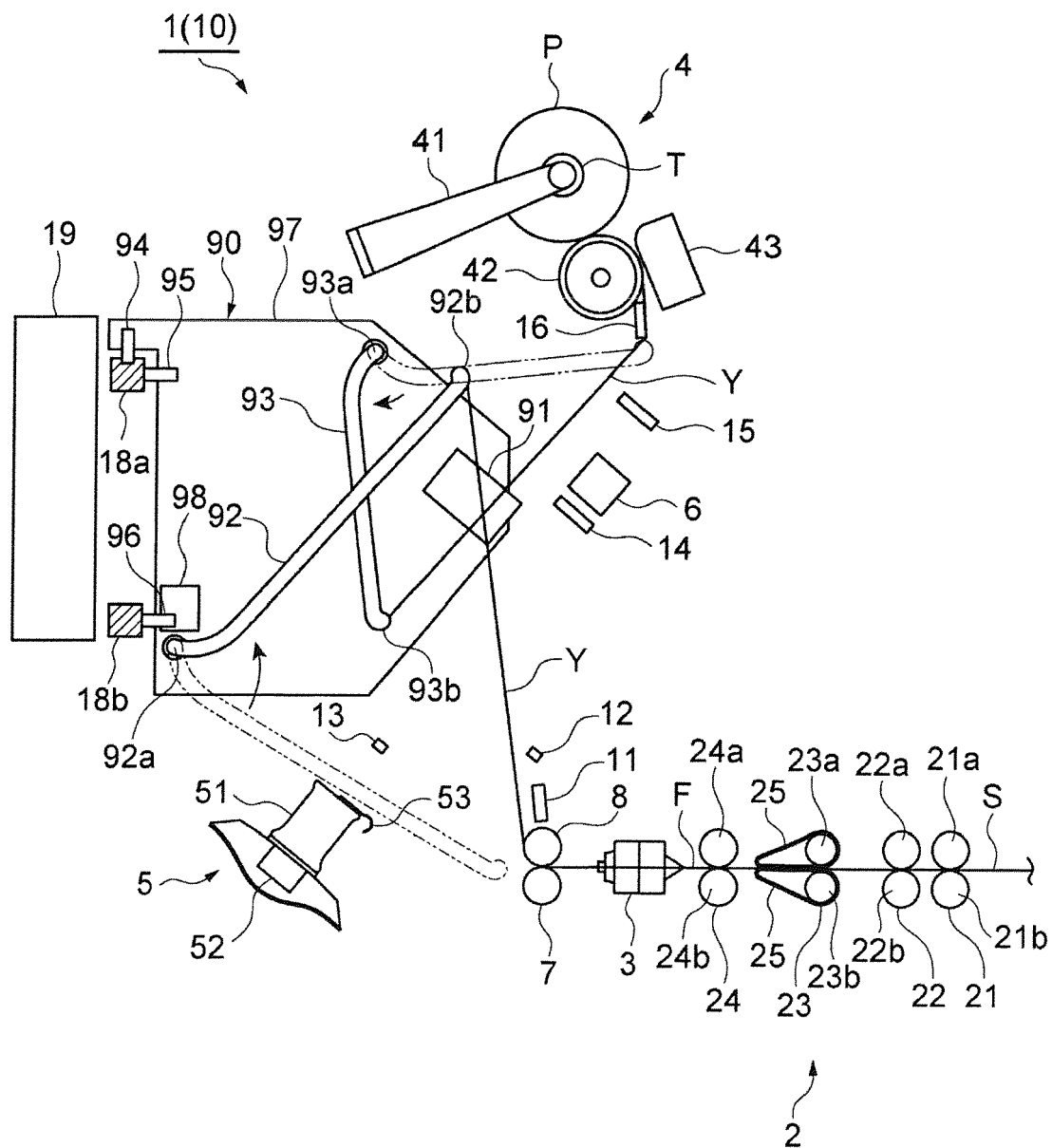


FIG. 6

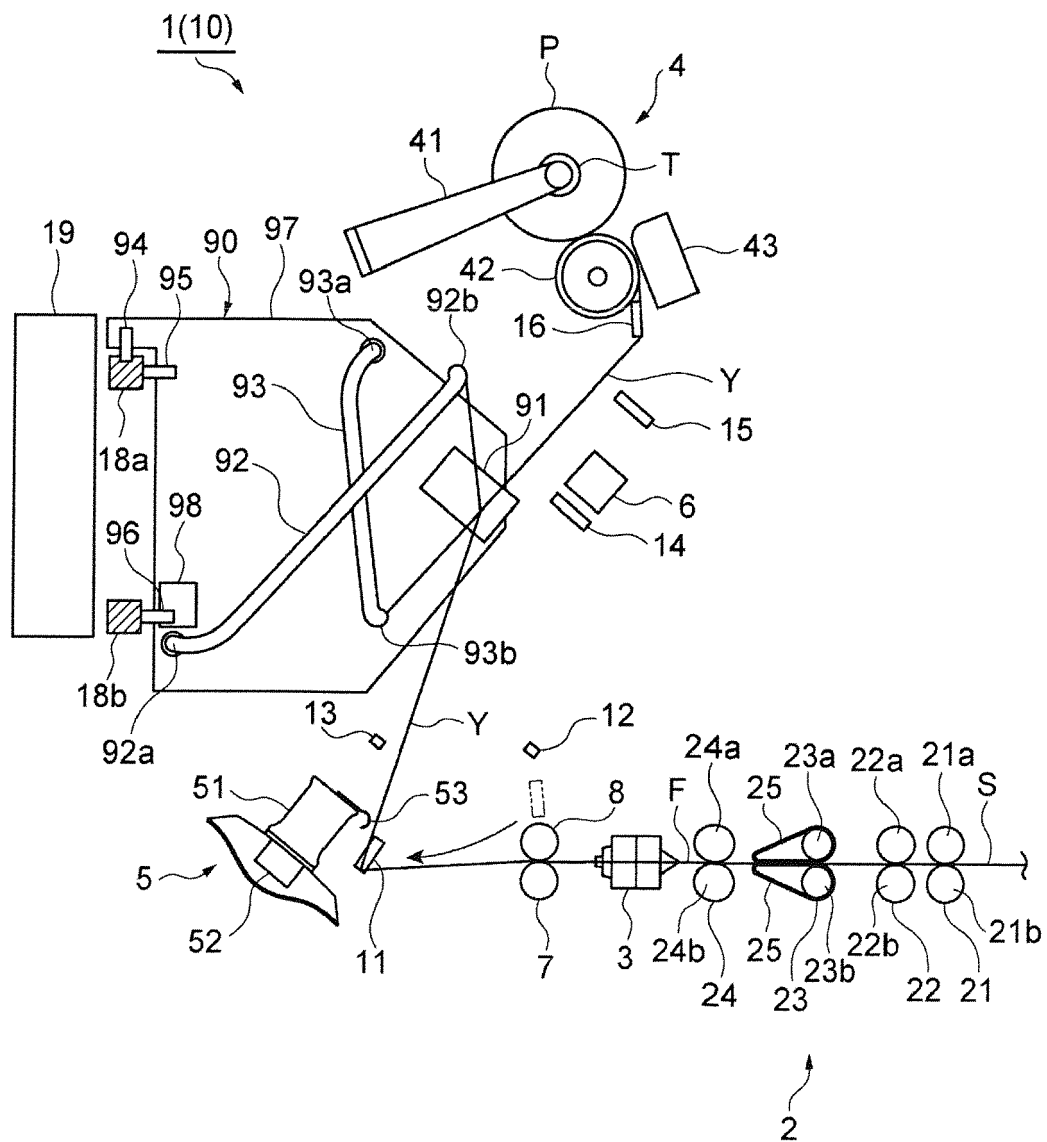
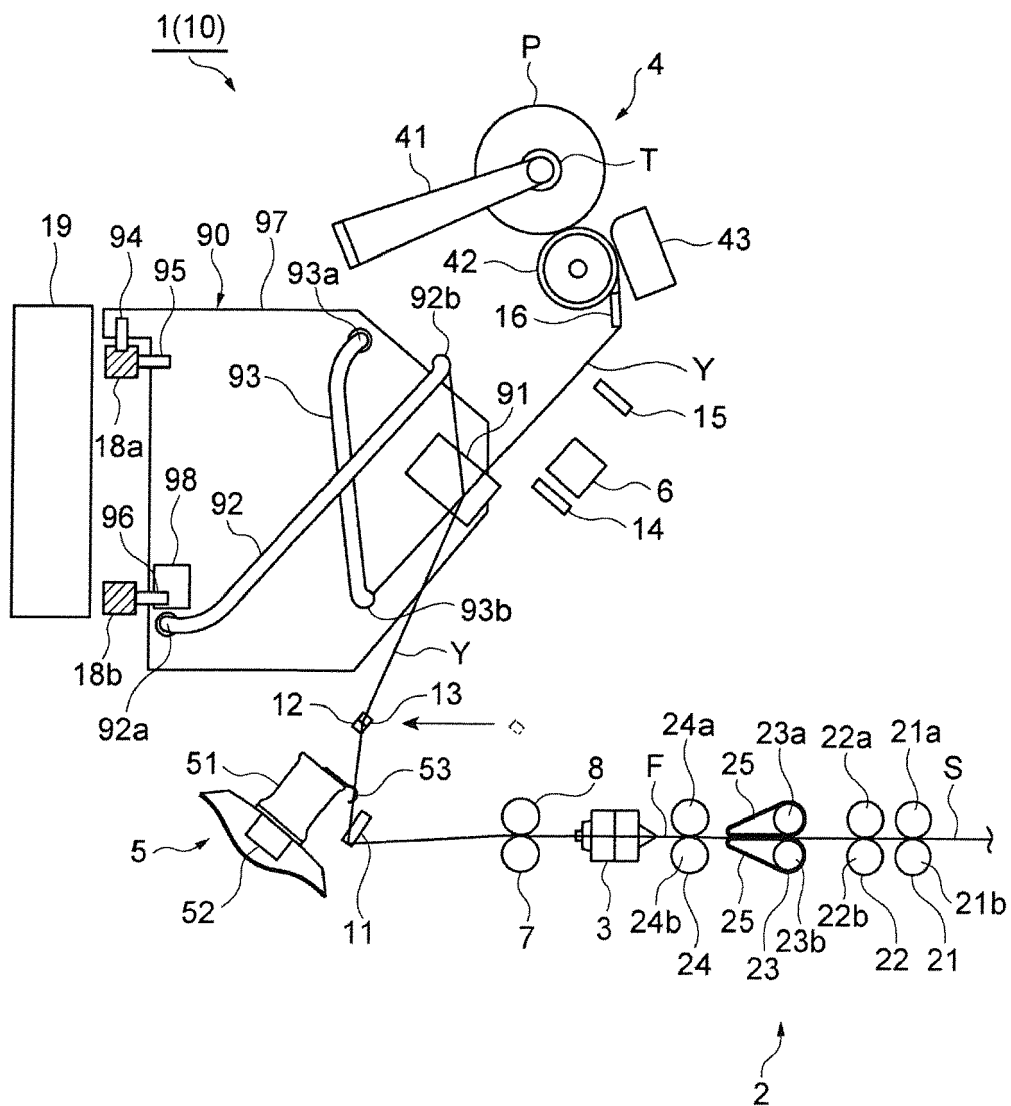


FIG.7





EUROPEAN SEARCH REPORT

Application Number
EP 14 18 4054

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			B65H D01H
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 30 January 2015	Examiner Pussemier, Bart
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			

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

EP 14 18 4054

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The members are as contained in the European Patent Office EDP file on
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30-01-2015

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

REFERENCES CITED IN THE DESCRIPTION

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