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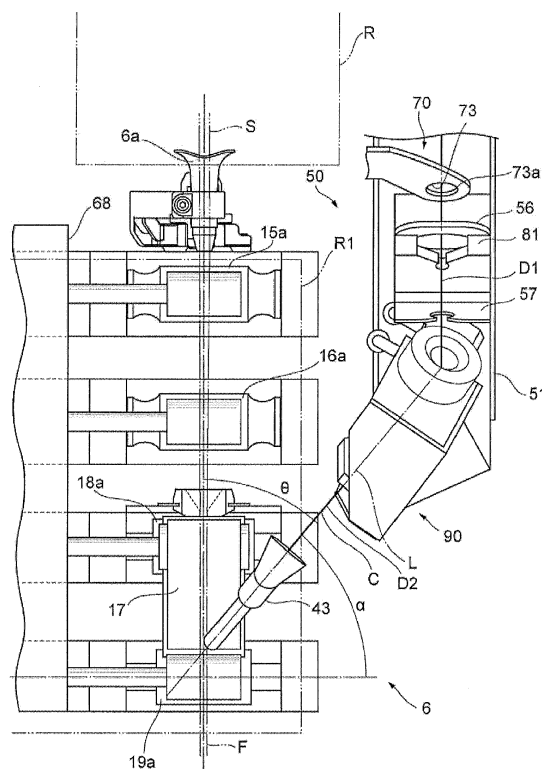
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(54) **CORE YARN SUPPLYING UNIT, CORE YARN SUPPLYING DEVICE, AND SPINNING MACHINE**

(57) A core yarn supplying unit (50) adapted to supply a core yarn (c) includes a tension applying section (60) adapted to apply a tension to the core yarn (C); and a core yarn feeding section (90) adapted to feed the core

yarn (C) towards a front top roller 19a, wherein a feeding path of the core yarn (C) in the core yarn feeding section (90) is arranged on a straight line connecting an inlet region and an outlet region of the feeding path.

FIG. 8



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a core yarn supplying unit, a core yarn supplying device, and a spinning machine.

2. Description of the Related Art

[0002] Conventionally, there is known a core yarn supplying device including a core yarn feeding section adapted to feed a core yarn to a draft device (see e.g., Japanese Unexamined Patent Publication No. 2012-131591 (Patent Document 1)). The core yarn supplying device is required to supply the core yarn to a predetermined position of the draft device. Thus, for example, in the core yarn supplying device described in Patent Document 1, a feeding direction of the core yarn is controlled by arranging a bent pipe at a downstream end in a core yarn feeding direction of the core yarn feeding section.

[0003] For example, in the core yarn supplying device described in Patent Document 1, the core yarn travels while being pushed against an inner peripheral surface of the pipe at a bent portion of the pipe. Oil solution attached to the core yarn may easily accumulate in the pipe. Thus, it is desired to prevent the oil solution from accumulating in the feeding path of the core yarn in the core yarn feeding section.

BRIEF SUMMARY OF THE INVENTION

[0004] It is an object of the present invention to provide a core yarn supplying unit, a core yarn supplying device, and a spinning machine capable of preventing the oil solution attached to the core yarn from being accumulated.

[0005] According to one aspect of the present invention, a core yarn supplying unit adapted to supply a core yarn includes a tension applying section adapted to apply a tension to the core yarn; and a core yarn feeding section adapted to feed the core yarn, wherein a feeding path of the core yarn in the core yarn feeding section is arranged on a straight line connecting an inlet region and an outlet region of the feeding path.

[0006] In the core yarn supplying unit, the feeding path is not bent in the core yarn feeding section, and thus the core yarn feeding section can feed the core yarn in a straight line. Thus, in the feeding path of the core yarn in the core yarn feeding section, the oil solution attached to the core yarn can be prevented from accumulating.

[0007] The core yarn feeding section may include a path forming portion adapted to form the feeding path, and an inner diameter of the path forming portion may be at least 1 millimeter and at most 10 millimeters. Thus, at the time of maintenance of the core yarn feeding sec-

tion, a checking operation, a cleaning operation, and the like of an inside of the path forming portion can be easily carried out.

[0008] A travelling direction of the core yarn in a first yarn path of the core yarn formed between the tension applying section and the core yarn feeding section may be different from a travelling direction of the core yarn in a second yarn path of the core yarn fed by the core yarn feeding section. As a result, a degree of freedom in arranging positions of the tension applying section and the core yarn feeding section can be improved. For example, while the core yarn feeding section is arranged so as to feed the core yarn towards a core yarn supplying destination, the tension applying section and the core yarn feeding section can be arranged to avoid interference with other members.

[0009] According to another aspect of the present invention, a core yarn supplying device includes the core yarn supplying unit described above; and a tubular core yarn guiding section adapted to guide the core yarn fed from the core yarn feeding section, wherein a travelling region of the core yarn is formed in the core yarn guiding section so as to include the straight line connecting the inlet region and the outlet region.

[0010] Thus, the core yarn guiding section can guide the core yarn fed from the core yarn feeding section without bending the travelling path. With the arrangement of the core yarn guiding section, the core yarn can be more reliably supplied to the core yarn supplying destination.

[0011] According to still another aspect of the present invention, a spinning machine includes the core yarn supplying unit or the core yarn supplying device described above; a draft device adapted to draft a fiber bundle; and a spinning device adapted to produce a spun yarn by applying twists to the fiber bundle with the core yarn as a core, wherein the draft device includes a draft cradle adapted to support rollers and arranged to be swingable to a drafting position and a non-drafting position, the rollers being adapted to draft the fiber bundle, and the core yarn supplying unit is arranged outside of a swinging region of the draft cradle.

[0012] Thus, the position of the core yarn supplying unit is not required to be changed when swinging the draft cradle, and operation efficiency can be improved.

[0013] In the spinning machine, the feeding path is directed to a peripheral surface of a most-downstream roller arranged most downstream in a running direction of the fiber bundle in the draft device, and when viewed from a direction orthogonal to both a rotational axis of the most-downstream roller and a running path of the fiber bundle, the straight line connecting the inlet region and the outlet region may be inclined with respect to the rotational axis of the most-downstream roller. In this case, a yarn end of the core yarn fed to the peripheral surface of the most-downstream roller easily follows the rotating most-downstream roller. That is, the core yarn can be reliably merged into the fiber bundle.

[0014] In the spinning machine, when viewed from the

direction orthogonal to both the rotational axis of the most-downstream roller and the running path of the fiber bundle, an angle formed by the straight line connecting the inlet region and the outlet region and the rotational axis of the most-downstream roller may be at least 20 degrees and at most 80 degrees. In this case, the core yarn can be reliably merged into the fiber bundle.

[0015] In the spinning machine, when viewed along the rotational axis of the most-downstream roller, an angle formed by the straight line connecting the inlet region and the outlet region and the running path of the fiber bundle in the draft device may be at least 30 degrees and at most 80 degrees. In this case, the core yarn can be reliably merged into the fiber bundle.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

FIG. 1 is a front view of a spinning machine according to one embodiment of the present invention;

FIG. 2 is a side view of a spinning unit of the spinning machine of FIG. 1;

FIG. 3 is a perspective view of a core yarn supplying unit of the spinning unit of FIG. 2;

FIG. 4 is a side view of the core yarn supplying unit and a peripheral portion in the spinning unit of FIG. 2;

FIG. 5 is a side view of the core yarn supplying unit and the peripheral portion in the spinning unit of FIG. 2;

FIGS. 6A and 6B are side views of a tension applying section of the core yarn supplying unit of FIG. 3;

FIG. 7 is a partial cross-sectional view of a core yarn feeding section of the core yarn supplying unit of FIG. 3;

FIG. 8 is a view illustrating a positional relationship of a draft device and the core yarn supplying unit in the spinning unit of FIG. 2;

FIG. 9 is a side view of the core yarn supplying unit and the peripheral portion in the spinning unit of FIG. 2; and

FIG. 10 is a side view of the core yarn supplying unit and the peripheral portion in the spinning unit of FIG. 2.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0017] Preferred embodiments of the present invention will be hereinafter described in detail with reference to the drawings. In the drawings, the same reference numerals are denoted for the same or corresponding portions, and redundant description will be omitted.

[0018] As illustrated in FIG. 1, a spinning machine 1 includes a plurality of spinning units 2, a yarn joining cart 3, a blower box 4, and a motor box 5. The plurality of spinning units 2 are arranged in a line. Each spinning unit 2 produces a spun yarn Y from a sliver S and a core

yarn C, and winds the spun yarn Y into a package P. The yarn joining cart 3 performs a yarn joining operation in the spinning unit 2 in which the spun yarn Y is disconnected. The blower box 4 accommodates an air supply source and the like for generating a suction flow, a whirling airflow, or the like at each section of the spinning unit 2. The motor box 5 accommodates a motor and the like for supplying power to each section of the spinning unit 2.

[0019] In the following description, in a travelling path of the sliver S and the spun yarn Y, a side on which the sliver S is supplied is referred to as upstream, and a side on which the spun yarn Y is wound is referred to as downstream. A side on which the spun yarn Y travels with respect to the yarn joining cart 3 is referred to as a front side, and a side opposite to the front side is referred to as a back side. In the present embodiment, a work passage (not illustrated) extending in a direction in which the plurality of spinning units 2 are arranged is provided on the front side of the spinning machine 1. Therefore, the operator can perform operation, monitoring, and the like of each spinning unit 2 from the work passage.

[0020] As illustrated in FIGS. 1 and 2, each spinning unit 2 includes a draft device 6, a core yarn supplying device 40, a pneumatic spinning device (spinning device) 7, a spun yarn monitoring device 8, a tension sensor 9, a yarn storage device 14, a waxing device 11, and a winding device 12 in this order from the upstream. These devices are directly or indirectly supported by a machine frame 13 such that the upstream is an upper side in a machine height direction of the spinning machine 1 (i.e., downstream is a lower side in the machine height direction). In the spinning unit 2, the devices excluding the core yarn supplying device 40 are referred to as a main body unit 30. That is, the main body unit 30 is configured by the draft device 6, the pneumatic spinning device 7, the spun yarn monitoring device 8, the tension sensor 9, the yarn storage device 14, the waxing device 11, the winding device 12, and the machine frame 13.

[0021] The draft device 6 is adapted to draft a sliver S to produce a fiber bundle F. The draft device 6 includes a back roller pair 15, a third roller pair 16, a middle roller pair 18 provided with an apron belt 17 on each roller, and a front roller pair 19 in this order from the upstream. Each of the roller pairs 15, 16, 18, 19 causes the sliver S supplied from a can (not illustrated) to travel from the upstream towards the downstream while drafting.

[0022] As illustrated in FIG. 5, the back roller pair 15 is configured by a back top roller 15a and a back bottom roller 15b. The back top roller 15a is arranged above the back bottom roller 15b. The third roller pair 16 is configured by a third top roller 16a and a third bottom roller 16b. The third top roller 16a is arranged above the third bottom roller 16b. The middle roller pair 18 is configured by a middle top roller 18a and a middle bottom roller 18b. The middle top roller 18a is arranged above the middle bottom roller 18b. The front roller pair 19 is configured by a front top roller (most-downstream roller) 19a and a front bottom roller 19b. The front top roller 19a is arranged

above the front bottom roller 19b.

[0023] The back top roller 15a, the third top roller 16a, the middle top roller 18a, and the front top roller 19a are rotatably supported by a draft cradle 68 of the draft device 6. Each top roller 15a, 16a, 18a, 19a makes contact with the corresponding bottom roller 15b, 16b, 18b, 19b at a predetermined pressure, and rotates accompanying rotation of the corresponding bottom roller 15b, 16b, 18b, 19b. The draft cradle 68 is arranged to be swingable with a supporting shaft 69 as a center to a position (drafting position) where each top roller 15a, 16a, 18a, 19a makes contact with the corresponding bottom roller 15b, 16b, 18b, 19b at a predetermined pressure, and a position (non-drafting position) where each top roller 15a, 16a, 18a, 19a is moved away from the corresponding bottom roller 15b, 16b, 18b, 19b. In other words, the draft cradle 68 is openable/closable with respect to a draft base 29 of the draft device 6 by being swung with the supporting shaft 69 as the center. The draft cradle 68 is swung using a handle (not illustrated) arranged on the draft cradle 68.

[0024] As illustrated in FIGS. 1 and 2, the core yarn supplying device 40 unwinds the core yarn C from a core yarn package CP, and supplies the core yarn C to the draft device 6. More specifically, the core yarn supplying device 40 supplies the core yarn C to a running path of the fiber bundle F between the middle roller pair 18 and the front roller pair 19. The core yarn C is thus supplied to the pneumatic spinning device 7 together with the fiber bundle F.

[0025] The pneumatic spinning device 7 produces the spun yarn Y by applying twists to the fiber bundle F with the core yarn C as a core. More specifically (although not illustrated), the pneumatic spinning device 7 includes a spinning chamber, a fiber core yarn guide, a whirling airflow generating nozzle, and a hollow guide shaft body. The fiber core yarn guide guides the fiber bundle F supplied from the draft device 6 and the core yarn C to the spinning chamber. The whirling airflow generating nozzle is arranged at a periphery of a running path of the fiber bundle F and a travelling path of the core yarn C, and is adapted to generate the whirling airflow in the spinning chamber. This whirling airflow causes a fiber end of the fiber bundle F guided into the spinning chamber to be reversed and to whirl. The hollow guide shaft body is adapted to guide the spun yarn Y from the spinning chamber to outside the pneumatic spinning device 7.

[0026] The spun yarn monitoring device 8 is adapted to monitor the travelling spun yarn Y between the pneumatic spinning device 7 and the yarn storage device 14. When a yarn defect is detected in the spun yarn Y, the spun yarn monitoring device 8 transmits a yarn defect detection signal to a unit control device 10. The spun yarn monitoring device 8 detects, for example, a thickness abnormality of the spun yarn Y and/or foreign substance contained in the spun yarn Y as the yarn defect. The tension sensor 9 measures a tension of the travelling spun yarn Y between the pneumatic spinning device 7 and the yarn storage device 14, and transmits a tension

measurement signal to the unit control device 10. The waxing device 11 is adapted to apply wax on the travelling spun yarn Y between the yarn storage device 14 and the winding device 12. The unit control device 10 is provided for each spinning unit 2, and is adapted to control operation of the spinning unit 2 under control of a machine control device 20, which is a high-order controller.

[0027] The yarn storage device 14 is adapted to store the travelling spun yarn Y between the pneumatic spinning device 7 and the winding device 12. The yarn storage device 14 has a function of stably pulling out the spun yarn Y from the pneumatic spinning device 7, a function of storing the spun yarn Y fed from the pneumatic spinning device 7 to prevent the spun yarn Y from slackening during the yarn joining operation by the yarn joining cart 3 or the like, and a function of adjusting the tension of the spun yarn Y at downstream of the yarn storage device 14 to prevent a fluctuation in the tension of the spun yarn Y at the downstream from being transmitted towards the pneumatic spinning device 7.

[0028] The winding device 12 is adapted to wind the spun yarn Y produced by the pneumatic spinning device 7 around a bobbin B to form the package P. The winding device 12 includes a cradle arm 21, a winding drum 22, and a traverse device 23. The cradle arm 21 rotatably supports the bobbin B. The cradle arm 21 is swingably supported by a supporting shaft 24, and causes a surface of the bobbin B or a surface of the package P to make contact with a surface of the winding drum 22 at an appropriate pressure. The winding drum 22 is driven by an electric motor (not illustrated) provided in each spinning unit 2 to rotate the bobbin B or the package P making contact with the winding drum 22. The traverse device 23 is driven by a shaft 25 shared among the plurality of spinning units 2, and traverses the spun yarn Y over a prescribed width with respect to the rotating bobbin B or the package P.

[0029] The yarn joining cart 3 travels to the spinning unit 2 in which the spun yarn Y is disconnected to perform the yarn joining operation in the target spinning unit 2. The yarn joining cart 3 includes a yarn joining device 26, a first yarn catching and guiding device 27, and a second yarn catching and guiding device 28. The first yarn catching and guiding device 27 is swingably supported by a supporting shaft 27a, and is adapted to suck and catch a yarn end of the spun yarn Y from the pneumatic spinning device 7 to guide the yarn end to the yarn joining device 26. The second yarn catching and guiding device 28 is swingably supported by a supporting shaft 28a, and is adapted to suck and catch a yarn end of the spun yarn Y from the winding device 12 to guide the yarn end to the yarn joining device 26. The yarn joining device 26 is a splicer, for example, and joins the guided yarn ends.

[0030] As illustrated in FIG. 2, the core yarn supplying device 40 includes a core yarn package holding section 41, a core yarn supplying unit 50, and a core yarn guiding section 43. The core yarn package holding section 41 holds the core yarn package CP with an axis of the core

yarn package CP extended in a horizontal and front-back direction. A mono-filament yarn or a false-twisted yarn, for example, is wound as the core yarn C in the core yarn package CP. The mono-filament yarn is a yarn having high rigidity. The false-twisted yarn is a yarn having high stretchability. The core yarn supplying unit 50 has a function of applying a tension to the core yarn C supplied from the core yarn package CP via a guide roller 42, a function of applying slackening to the core yarn C, and a function of feeding the yarn end of the core yarn C. The core yarn guiding section 43 is a tubular member adapted to guide the core yarn C to the draft device 6. A travelling region of the core yarn C is formed inside the core yarn guiding section 43 so as to include a straight line. In the following description, in the travelling path of the core yarn C in the core yarn supplying unit 50, a side on which the core yarn C is supplied from the core yarn package CP to the core yarn supplying unit 50 is referred to as upstream, and a side on which the core yarn C is supplied from the core yarn supplying unit 50 to the draft device 6 is referred to as downstream.

[0031] As illustrated in FIG. 5, the core yarn guiding section 43 is configured by a tapered portion 43a and a straight pipe portion 43b. The straight pipe portion 43b is a tubular member. The straight pipe portion 43b is coupled to a downstream end of the tapered portion 43a. The tapered portion 43a is formed in a tubular shape, and an inner diameter of the tapered portion 43a is larger towards the upstream. The tapered portion 43a and the straight pipe portion 43b are connected to one another. As described above, a travelling region of the core yarn C is formed inside the tapered portion 43a and the straight pipe portion 43b so as to include a straight line. A downstream end of the straight pipe portion 43b is directed towards the peripheral surface of the front top roller 19a.

[0032] As illustrated in FIG. 3, the core yarn supplying unit 50 includes a unit base 51, a tension applying section 60, a slack applying section 70, a core yarn monitoring section 81, and a core yarn feeding section 90. The unit base 51 supports the tension applying section 60, the slack applying section 70, the core yarn monitoring section 81, and the core yarn feeding section 90. A core yarn guide 55 is arranged most upstream of the unit base 51. Between the core yarn guide 55 and the slack applying section 70, the tension applying section 60 applies a tension to the core yarn C to be supplied to the draft device 6. The slack applying section 70 applies slack to the core yarn C between the tension applying section 60 and the core yarn monitoring section 81. The core yarn monitoring section 81 detects a presence and/or an absence of the core yarn C between the slack applying section 70 and the core yarn feeding section 90. The core yarn feeding section 90 feeds the yarn end of the core yarn C to the draft device 6 through the core yarn guiding section 43 at downstream of the core yarn monitoring section 81. Note that, a description "feeding the yarn end of the core yarn C" refers to an operation in which the core yarn feeding section 90 feeds the yarn end of the core yarn C

to the main body unit 30. A description "supply the core yarn C" refers to an operation in which the core yarn supplying device 40 continuously supplies the core yarn C to the main body unit 30 (i.e., the operation when spinning is carried out).

[0033] As illustrated in FIG. 4, the core yarn supplying unit 50 further includes a supporting member 52, a first holding member 53, and a second holding member 54. The supporting member 52 swingably supports the unit base 51 with respect to the draft device 6. More specifically, the supporting member 52 is detachably attached to a draft base 29 of the draft device 6. A distal end portion 52a of the supporting member 52 is swingably attached to one end of a swing shaft 51a arranged on the unit base 51. That is, one end of the supporting member 52 supports the swing shaft 51a. The draft base 29 is a base shared between the draft devices 6 of the pair of adjacent spinning units 2, and supports each bottom roller 15b, 16b, 18b, 19b of the draft devices 6. The draft base 29 is provided with a first hole 29a, a bent portion 29b, and a plurality of second holes 29c. The plurality of second holes 29c are formed between the first hole 29a and the bent portion 29b.

[0034] The first holding member 53 holds the unit base 51 at a core yarn supplying position. More specifically, the first holding member 53 is fixed to the unit base 51. The first holding member 53 holds the unit base 51 at the core yarn supplying position by engaging a distal end portion 53a of the first holding member 53 to the first hole 29a. Note that the core yarn supplying position is a position where the core yarn supplying unit 50 is held when the core yarn supplying unit 50 supplies the core yarn C to the draft device 6.

[0035] As illustrated in FIG. 5, the second holding member 54 holds the unit base 51 at one of a plurality of retreated positions. More specifically, the second holding member 54 is swingably supported by a supporting shaft 51b arranged on the unit base 51. The second holding member 54 holds the unit base 51 at the retreated position by engaging a distal end portion 54a of the second holding member 54 to the bent portion 29b. Furthermore, the second holding member 54 holds the unit base 51 at one of other plurality of retreated positions by engaging the distal end portion 54a to one of the plurality of second holes 29c. Note that the retreated position is a position where the core yarn supplying unit 50 is held when the core yarn supplying unit 50 does not supply the core yarn C to the main body unit 30, and is the position where the core yarn feeding section 90 is located away from the draft device 6. This means that the distance from the draft device 6 to the core yarn feeding section 90 of the core yarn supplying unit 50 at the retreated position is greater than the distance from the draft device 6 to the core yarn feeding section 90 of the core yarn supplying unit 50 at the core yarn supplying position.

[0036] As illustrated in FIGS. 6A and 6B, the tension applying section 60 includes a tension applying mechanism 61 and an operating mechanism 62. As illustrated

in FIG. 6A, the tension applying mechanism 61 applies a tension to the core yarn C by guiding the core yarn C in a zigzag manner by a fixed piece 63 and a movable piece 64. The fixed piece 63 is fixed to the unit base 51. A plurality of shafts 63a, on which the core yarn C is to be hooked, is arranged on the fixed piece 63.

[0037] The movable piece 64 is supported to be openable/closable with respect to the fixed piece 63 by a supporting shaft (not illustrated) arranged on the fixed piece 63. The movable piece 64 is urged in an opening direction with respect to the fixed piece 63 by a spring (not illustrated) arranged on the fixed piece 63. The movable piece 64 includes a plurality of protrusions 64a so as to project out with respect to the plurality of shafts 63a. As illustrated in FIG. 6B, each protrusion 64a is arranged on the movable piece 64 such that each protrusion 64a is alternately located with each shaft 63a under a state where the movable piece 64 is closed with respect to the fixed piece 63. A hole 64b, through which the core yarn C is inserted, is formed at a distal end portion of each protrusion 64a.

[0038] As illustrated in FIG. 6A, a first tension is applied to the core yarn C under a state where the core yarn C is passed through the fixed piece 63 and the movable piece 64, and the movable piece 64 is opened with respect to the fixed piece 63. A state of the tension applying mechanism 61 in this case is referred to as a tension applying state. As illustrated in FIG. 6B, a second tension smaller than the first tension is applied to the core yarn C under a state where the core yarn C is passed through the fixed piece 63 and the movable piece 64, and the movable piece 64 is closed with respect to the fixed piece 63. A state of the tension applying mechanism 61 in this case is referred to as a tension non-applying state. The second tension also includes a case in which the tension applied to the core yarn C is zero.

[0039] As illustrated in FIG. 6A, the operating mechanism 62 includes an operation member 65 and an air cylinder 66. The operation member 65 is arranged such that a distal end portion 65a of the operation member 65 makes contact with the movable piece 64 from a side opposite to the fixed piece 63. The movable piece 64 urged in the opening direction with respect to the fixed piece 63 is opened/closed with respect to the fixed piece 63 when the operation member 65 is moved by the air cylinder 66. Thus, the operating mechanism 62 switches the tension applying mechanism 61 to the tension applying state and the tension non-applying state.

[0040] As illustrated in FIG. 3, the slack applying section 70 includes an arm 71 and an air cylinder 72. The arm 71 is swingably supported by a supporting shaft 51c arranged on the unit base 51. A hole 73, through which the core yarn C is inserted, is formed at a distal end portion of the arm 71. The hole 73 includes an edge 73a of a closed annular shape (circular shape in the present embodiment). A material excellent in wear resistance such as ceramic, for example, is used for the edge 73a. The arm 71 is swung to a normal position and a standby position by the air cylinder 72. The normal position is a

position where the hole 73 is located on the travelling path of the core yarn C (position of solid line in FIG. 3), and the standby position is a position where the hole 73 is located away from the travelling path of the core yarn C to the side opposite to the unit base 51 (position of chain double dashed line in FIG. 3).

[0041] The core yarn monitoring section 81 detects a presence and/or an absence of the core yarn C between the slack applying section 70 and the core yarn feeding section 90. Core yarn guides 56 and 57 adapted to guide the core yarn C are arranged upstream and downstream of the core yarn monitoring section 81, respectively.

[0042] As illustrated in FIG. 7, the core yarn feeding section 90 includes an air sucker 91 and a clamp cutter 92. A travelling region of the core yarn C is formed inside the core yarn feeding section 90 so as to form a straight line. The air sucker 91 includes a core yarn feeding nozzle block 93, a core yarn feeding nozzle 94, and a tube body (path forming portion) 95. The core yarn feeding nozzle 94, which becomes a part of the travelling path of the core yarn C, is arranged inside the core yarn feeding nozzle block 93. A tube body 95 is arranged below the core yarn feeding nozzle 94. A feeding path of the core yarn C is formed inside the tube body 95. The feeding path of the core yarn C is arranged on a straight line connecting an inlet region and an outlet region of the tube body 95. The inlet region is a region surrounded by an opening edge at an upstream end of the tube body 95. The outlet region is a region surrounded by an opening edge at a downstream end of the tube body 95. An inner diameter of the tube body 95 is preferably at least 1 millimeter and at most 10 millimeters. The feeding path formed by the tube body 95 becomes a part of the travelling path of the core yarn C in the core yarn feeding section 90. Between the core yarn feeding nozzle 94 and the tube body 95, compressed air is supplied from outside to the travelling path of the core yarn C. By action of the compressed air, the core yarn feeding section 90 feeds the core yarn C to the core yarn guiding section 43 through the feeding path formed by the tube body 95. Note that the feeding path is not a path of a portion where the core yarn C is introduced (pulled in) to the core yarn feeding section 90 as in the core yarn feeding nozzle 94, but is a path of a portion downstream of the position where the compressed air acts, the portion being the portion where the core yarn C is fed (pushed out) by the compressed air.

[0043] The clamp cutter 92 includes a clamp member 96, a cutter 97, and an air cylinder 98. The clamp member 96 is operated by the air cylinder 98 to clamp the core yarn C at the downstream of the air sucker 91. The cutter 97 is operated by the air cylinder 98 to cut the core yarn C at downstream of the clamp member 96. The clamp cutter 92 is configured such that a timing to cut the core yarn C is after a timing to clamp the core yarn C.

[0044] As illustrated in FIG. 8, the core yarn supplying unit 50 is arranged outside of a work region R for setting the sliver (the fiber bundle) S to the draft device 6. The

work region R is a region on a back side (upstream) of the draft device 6, and is the region for inserting the sliver S to a tubular guiding member 6a arranged in the draft device 6. A travelling direction of the core yarn C in a yarn path (first yarn path) D1 of the core yarn C formed between the tension applying section 60 and the core yarn feeding section 90 is different from a travelling direction of the core yarn C in a yarn path (second yarn path) D2 of the core yarn C fed by the core yarn feeding section 90. The core yarn supplying unit 50 is arranged outside of a swinging region R1 of the draft cradle 68.

[0045] Under a state where the core yarn supplying unit 50 is located at the core yarn supplying position, the core yarn feeding section 90 is arranged such that the feeding path formed by the tube body 95 faces the peripheral surface of the front top roller 19a, which becomes the supplying destination of the core yarn C. Under a state where the core yarn supplying unit 50 is located at the core yarn supplying position, the core yarn feeding section 90 and the core yarn guiding section 43 are arranged such that the feeding path of the core yarn C in the tube body 95 of the core yarn feeding section 90 and the travelling region of the core yarn C in the core yarn guiding section 43 include the same straight line L. In other words, the core yarn feeding section 90 and the core yarn guiding section 43 are arranged such that the travelling region of the core yarn C in the core yarn guiding section 43 includes the straight line L connecting the inlet region and the outlet region of the tube body 95.

[0046] An angle θ formed by the straight line L and the running path of the fiber bundle F in the draft device 6 is at least 10 degrees and at most 70 degrees (preferably, at least 30 degrees and at most 50 degrees), when seen from a direction orthogonal to both a rotation axis of each roller constituting each roller pair 15, 16, 18, 19 and the running path of the fiber bundle F in the draft device 6. That is, the travelling path of the core yarn C in the core yarn feeding section 90 (the tube body 95) and the core yarn guiding section 43 merges with the running path of the fiber bundle F between the middle roller pair 18 and the front roller pair 19 from a direction inclined by at least 10 degrees and at most 70 degrees (preferably, at least 30 degrees and at most 50 degrees) with respect to the running path of the fiber bundle F in the draft device 6.

[0047] In other words, the straight line L in the travelling region of the core yarn C in each of the core yarn feeding section 90 (the tube body 95) and the core yarn guiding section 43 is inclined with respect to the rotation axis of the front top roller 19a when seen from a direction orthogonal to both the rotation axis of each roller constituting each roller pair 15, 16, 18, 19 and the running path of the fiber bundle F in the draft device 6. Specifically, an angle α formed by the straight line L in the travelling region of the core yarn C in each of the core yarn feeding section 90 (the tube body 95) and the core yarn guiding section 43 and the rotation axis of the front top roller 19a is at least 20 degrees and at most 80 degrees (preferably, at least 40 degrees and at most 60 degrees), when seen

from a direction orthogonal to both a rotation axis of each roller constituting each roller pair 15, 16, 18, 19 and the running path of the fiber bundle F in the draft device 6.

[0048] As illustrated in FIG. 4, an angle β formed by the straight line L in the travelling region of the core yarn C in each of the core yarn feeding section 90 (the tube body 95) and the core yarn guiding section 43 and a straight line LF along the running path of the fiber bundle F in the draft device 6 is at least 30 degrees and at most 80 degrees (preferably, at least 45 degrees and at most 65 degrees), when seen along the rotation axis of each roller constituting each roller pair 15, 16, 18, 19.

[0049] As illustrated in FIG. 3, the core yarn supplying unit 50 further includes a first air supply tube 82, a second air supply tube 83, a relay substrate (substrate, board, circuit board) 84, and a multi-core cable 85. The first air supply tube 82 is pulled out to the outside of the unit base 51, and is removably connected to an air supply tube (not illustrated) of the main body unit 30. The first air supply tube 82 is connected to the air sucker 91 via a pipe (not illustrated) arranged in the unit base 51. The compressed air is thereby supplied from the air supply source of the blower box 4 to the air sucker 91 through the air supply tube of the main body unit 30.

[0050] The second air supply tube 83 is pulled out to the outside of the unit base 51, and is removably connected to the air supply tube of the main body unit 30. The second air supply tube 83 is connected to each of the air cylinder 66 of the tension applying section 60, the air cylinder 72 of the slack applying section 70, and the air cylinder 98 of the clamp cutter 92 via a plurality of pipes (not illustrated) arranged in the unit base 51. The compressed air is thereby supplied from the air supply source of the blower box 4 to each of the air cylinders 66, 72, and 98 through the air supply tube of the main body unit 30.

[0051] The relay substrate 84 is supported by the unit base 51. The relay substrate 84 is electrically connected to an electromagnetic valve for operation of the air sucker 91 of the core yarn feeding section 90, an electromagnetic valve for operation of the air cylinder 66 of the tension applying section 60, an electromagnetic valve for operation of the air cylinder 72 of the slack applying section 70, an electromagnetic valve for operation of the air cylinder 98 of the clamp cutter 92, and the core yarn monitoring section 81 via a plurality of wires (not illustrated) arranged in the unit base 51.

[0052] The multi-core cable 85 is pulled out to the outside of the unit base 51, and is removably connected to a multi-core cable (not illustrated) of the main body unit 30 via a connector (not illustrated), for example. The multi-core cable 85 is a cable in which a plurality of wires are bundled to input/output electric signals to each section of the core yarn supplying unit 50, and is connected to the relay substrate 84. Each section of the core yarn supplying unit 50 is thus controlled by the unit control device 10 of the main body unit 30.

[0053] When the core yarn C is supplied to the main

body unit 30 and the spun yarn Y is produced from the sliver S and the core yarn C (i.e., when the spinning is carried out), the core yarn supplying unit 50 is located at the core yarn supplying position and the tension applying section 60 causes the tension applying mechanism 61 to be in the tension applying state to apply the first tension to the core yarn C, as illustrated in FIG. 4. In this case, the arm 71 of the slack applying section 70 is located at the normal position (i.e., the position where the hole 73 is located on the travelling path of the core yarn C). Thus, the core yarn supplying unit 50 supplies the core yarn C to the draft device 6 while applying the first tension to the core yarn C unwound from the core yarn package CP.

[0054] When a yarn defect is detected by the spun yarn monitoring device 8 and the spinning is interrupted (or when the spinning is terminated), the clamp cutter 92 is operated to clamp and cut the core yarn C, as illustrated in FIG. 9. The yarn end of the core yarn C pulled out from the core yarn package CP is thereby clamped by the clamp cutter 92. Thereafter, the arm 71 of the slack applying section 70 is swung to the standby position, the core yarn C inserted through the hole 73 is pulled up, and the core yarn C is unwound from the core yarn package CP by an amount in which the core yarn C is pulled up.

[0055] When the spinning is resumed, the clamp cutter 92 is operated to release the clamping of the yarn end of the core yarn C, as illustrated in FIG. 10. The arm 71 of the slack applying section 70 is then swung to the normal position. The tension applying section 60 changes the tension applying mechanism 61 to the tension non-applying state, so that the tension applying mechanism 61 applies the second tension smaller than the first tension to the core yarn C. The air sucker 91 is operated under this state. The yarn end of the core yarn C is thereby fed towards the peripheral surface of the front top roller 19a of the draft device 6 through the core yarn guiding section 43. The yarn end fed to the peripheral surface of the front top roller 19a follows the rotation of the front top roller 19a, and merges with the fiber bundle F from the upstream of the front roller pair 19. Therefore, in the tension applying section 60, the tension applying mechanism 61 is in the tension non-applying state when the core yarn feeding section 90 feeds the yarn end of the core yarn C to the draft device 6 (i.e., when the supplying of the core yarn C to the pneumatic spinning device 7 is started).

[0056] After the spinning is resumed, the state returns to the state illustrated in FIG. 3. That is, the clamp cutter 92 and the air sucker 91 are not operated, and the tension applying section 60 causes the tension applying mechanism 61 to be under the tension applying state to apply the first tension to the core yarn C. When interrupting the spinning and carrying out simple cleaning, the core yarn supplying unit 50 is to be held at the retreated position using the second holding member 54, as illustrated in FIG. 5, without detaching the core yarn supplying unit 50. When resuming the spinning after the cleaning, the

holding by the second holding member 54 is released and the core yarn supplying unit 50 is set to the core yarn supplying position using the first holding member 53.

[0057] The present embodiment is configured as above, and the feeding path of the core yarn C in the tube body 95 of the core yarn feeding section 90 includes the straight line connecting the inlet region and the outlet region of the tube body 95. In other words, the core yarn feeding section 90 can feed the core yarn C in a straight line since the feeding path is not bent in the core yarn feeding section 90. Thus, in the feeding path of the core yarn C in the core yarn feeding section 90, the oil solution attached to the core yarn C can be prevented from accumulating. The tension applying section 60 applies the tension to the core yarn C at least during a period (during the spinning) after the core yarn feeding section 90 has fed the core yarn C.

[0058] The inner diameter of the tube body 95 is preferably at least 1 millimeter and at most 10 millimeters. Thus, at the time of the maintenance of the core yarn feeding section 90, the checking operation, the cleaning operation, and the like of the inside of the tube body 95 can be easily carried out. The core yarn feeding section 90 feeds the core yarn C to the core yarn guiding section 43 by the action of the compressed air. A straight advancing property of the air flowing through the tube body 95 can be improved by forming the inner diameter of the tube body 95 to at least 1 millimeter and at most 10 millimeters. Thus, the core yarn C can be accurately fed towards the front top roller 19a by the air with improved straight advancing property. The travelling path of the core yarn C travelling through the tube body 95 can be stabilized by forming the inner diameter of the tube body 95 to at least 1 millimeter and at most 10 millimeters. The core yarn C thus can be accurately fed towards the front top roller 19a. When the inner diameter of the tube body 95 is formed to be at least 3 millimeters and at most 6 millimeters, the straight advancing property of the air and the stability of the travelling path of the core yarn C can be further improved.

[0059] A travelling direction of the core yarn C in the yarn path D1 of the core yarn C formed between the tension applying section 60 and the core yarn feeding section 90 is different from a travelling direction of the core yarn C in the yarn path D2 of the core yarn C fed by the core yarn feeding section 90. As a result, the degree of freedom in the arranging positions of the tension applying section 60 and the core yarn feeding section 90 can be improved. Therefore, the core yarn C can be fed to the front top roller 19a while arranging the core yarn supplying unit 50 outside of the work region R for setting the sliver (the fiber bundle) S in the draft device 6.

[0060] The travelling region of the core yarn C is formed inside the core yarn guiding section 43 for guiding the core yarn C so as to include the straight line L connecting the inlet region and the outlet region of the tube body 95 of the core yarn feeding section 90. Thus, the core yarn feeding section 90 can guide the core yarn C to the front

top roller 19a without bending the travelling path. With the arrangement of the core yarn guiding section 43, the core yarn C can be more reliably supplied to the front top roller 19a. The tapered portion 43a of the core yarn guiding section 43 is formed such that the inner diameter becomes greater towards the upstream in the travelling direction of the core yarn C. Thus, the core yarn C fed from the core yarn feeding section 90 can be reliably received, and guided towards the front top roller 19a.

[0061] The core yarn supplying unit 50 is arranged outside of a swinging region R1 of the draft cradle 68. Thus, the position of the core yarn supplying unit 50 is not required to be changed when swinging the draft cradle 68, and the operation efficiency can be improved.

[0062] The straight line L in the travelling path of the core yarn C in the core yarn feeding section 90 is inclined with respect to the rotation axis of the front top roller 19a when seen from a direction orthogonal to both the rotation axis of each roller constituting each roller pair 15, 16, 18, 19 and the running path of the fiber bundle F in the draft device 6. In this case, the yarn end of the core yarn C fed to the peripheral surface of the front top roller 19a easily follows the rotating front top roller 19a. That is, the core yarn C can be reliably merged into the fiber bundle F. Furthermore, since the core yarn feeding section 90 feeds the core yarn C by the compressed air, the compressed air may bounce back at the front top roller 19a and the compressed air may blow away the fiber bundle F in proximity to the front top roller 19a. However, in the present embodiment, the core yarn feeding section 90 is arranged as described above, and thus the merging of the core yarn C into the fiber bundle F can be prevented from being inhibited by the bouncing back of the compressed air.

[0063] More specifically, the angle α formed by the straight line L in the travelling path of the core yarn C in the core yarn feeding section 90 and the rotation axis of the front top roller 19a is at least 20 degrees and at most 80 degrees when seen from a direction orthogonal to both the rotation axis of each roller constituting each roller pair 15, 16, 18, 19 and the running path of the fiber bundle F in the draft device 6. In this case, the core yarn C can be more reliably merged into the fiber bundle F. More preferably, directions and the like of the core yarn feeding section 90 and the core yarn guiding section 43 are set such that the angle α becomes at least 40 degrees and at most 60 degrees, and thus the core yarn C can be more reliably merged into the fiber bundle F.

[0064] The angle β formed by the straight line L in the travelling region of the core yarn C in each of the tube body 95 of the core yarn feeding section 90 and the core yarn guiding section 43 and the straight line LF along the running path of the fiber bundle F in the draft device 6 is at least 30 degrees and at most 80 degrees when seen along the rotation axis of each roller constituting each roller pair 15, 16, 18, 19 (see FIG. 4). In this case, the core yarn C can be more reliably merged into the fiber bundle F. More preferably, the directions and the like of

the core yarn feeding section 90 and the core yarn guiding section 43 are set such that the angle β becomes at least 45 degrees and at most 65 degrees, and thus the core yarn C can be more reliably merged into the fiber bundle F.

[0065] One embodiment of the present invention has been described above, but the present invention is not limited to the above embodiment. The unit control device 10 and the machine control device 20 merely need to be control devices that directly or indirectly control at least each section of the core yarn supplying unit 50, and arranging positions and the like are not limited. The unit control device 10 may be arranged, not for each spinning unit 2, but for each group of the plurality of spinning units 2.

[0066] The edge 73a of the slack applying section 70 is not limited to a circular shape, and may be a polygonal shape, for example. Furthermore, the shape of the edge 73a is not limited to an annular shape, and may be a C-shape, for example. The material of the edge 73a is not limited to ceramic, and may be metal.

[0067] The type of the core yarn C may be other than the mono-filament yarn or the false-twisted yarn. For example, the core yarn C may be a multi-filament yarn having lower rigidity than the mono-filament yarn or may be a yarn having lower crimping property than the false-twisted yarn. Furthermore, the core yarn C may be a textured yarn, an air textured yarn (e.g., yarn in which elastic yarn and textured yarn are interlaced, yarn having similar crimping property as the textured yarn), or spun yarn (generally-used spun yarn).

[0068] In the spinning machine 1, each device is arranged such that the spun yarn Y supplied on the upper side is wound on the lower side, but each device may be arranged such that the yarn supplied on the lower side is wound on the upper side. Furthermore, in the spinning machine 1, each roller pair of the draft device 6 and the traverse mechanism of the traverse device 23 are driven by the power from the motor box 5 (i.e., commonly driven for the plurality of spinning units 2). However, each section of the spinning unit 2 (e.g., the draft device 6, the pneumatic spinning device 7, the winding device 12, or the like) may be independently driven for each spinning unit 2.

[0069] The pneumatic spinning device 7 may further include a needle held by the fiber core yarn guide and arranged to project out into a spinning chamber to prevent the twists of the fiber bundle F from being propagated towards the upstream of the pneumatic spinning device 7. In place of the needle, the pneumatic spinning device 7 may prevent the twists of the fiber bundle F from being propagated towards the upstream of the pneumatic spinning device 7 by a downstream end of the fiber core yarn guide. Moreover, the pneumatic spinning device 7 may include a pair of air jet nozzles adapted to apply twists in opposite directions from each other.

[0070] In the travelling direction of the spun yarn Y, the tension sensor 9 may be arranged upstream of the spun

yarn monitoring device 8. In the spinning machine 1, the yarn storage device 14 has a function of pulling out the spun yarn Y from the pneumatic spinning device 7, but the spun yarn Y may be pulled out by a delivery roller and a nip roller. The waxing device 11, the tension sensor 9, and the spun yarn monitoring device 8 may not be arranged in the spinning unit 2.

[0071] Instead of being driven by a driving motor arranged for each spinning unit 2, the winding device 12 may be driven by a common driving source for the plurality of spinning units 2. In this case, when reversely rotating the package P, the cradle arm 21 is moved by an air cylinder (not illustrated) such that the package P moves away from the winding drum 22, and the package P is reversely rotated by a reverse rotation roller (not illustrated) arranged in the yarn joining cart 3.

Claims

1. A core yarn supplying unit (50) adapted to supply a core yarn (C), the core yarn supplying unit (50) comprising:

a tension applying section (60) adapted to apply a tension to the core yarn (C); and
a core yarn feeding section (90) adapted to feed the core yarn (C),

characterized in that a feeding path of the core yarn (C) in the core yarn feeding section (90) is arranged on a straight line (L) connecting an inlet region and an outlet region of the feeding path.

2. The core yarn supplying unit (50) according to claim 1, **characterized in that** the core yarn feeding section (90) includes a path forming portion (95) adapted to form the feeding path, and an inner diameter of the path forming portion (95) is at least 1 millimeter and at most 10 millimeters.

3. The core yarn supplying unit (50) according to claim 1 or claim 2, **characterized in that** a travelling direction of the core yarn (C) in a first yarn path (D1) of the core yarn (C) formed between the tension applying section (60) and the core yarn feeding section (90) is different from a travelling direction of the core yarn (C) in a second yarn path (D2) of the core yarn (C) fed by the core yarn feeding section (90).

4. The core yarn supplying unit (50) according to any one of claim 1 through claim 3, **characterized in that** the tension applying section (60) is adapted to apply the tension to the core yarn (C) at least during a period of time after the core yarn feeding section (90) has fed the core yarn (C).

5. A core yarn supplying device (40) comprising:

the core yarn supplying unit (50) according to any one of claim 1 through claim 4; and
a tubular core yarn guiding section (43) adapted to guide the core yarn (C) fed from the core yarn feeding section (90),

characterized in that a travelling region of the core yarn (C) is formed in the core yarn guiding section (43) so as to include the straight line (L) connecting the inlet region and the outlet region.

6. A spinning machine (1) comprising:

the core yarn supplying unit (50) according to any one of claim 1 through claim 4, or the core yarn supplying device (40) according to claim 5; a draft device (6) adapted to draft a fiber bundle (F); and

a spinning device (7) adapted to produce a spun yarn (Y) by applying twists to the fiber bundle (F) with the core yarn (C) as a core,

characterized in that the draft device (6) includes a draft cradle (68) adapted to support rollers (15, 16, 18, 19) and arranged to be swingable to a drafting position and a non-drafting position, the rollers (15, 16, 18, 19) being adapted to draft the fiber bundle (F), and
the core yarn supplying unit (50) is arranged outside of a swinging region (R1) of the draft cradle (68).

7. The spinning machine (1) according to claim 6, **characterized in that** the feeding path is directed to a peripheral surface of a most-downstream roller (19) arranged most downstream in a running direction of the fiber bundle (F) in the draft device (6), and when viewed from a direction orthogonal to both a rotational axis of the most-downstream roller (19) and a running path of the fiber bundle (F), the straight line (L) connecting the inlet region and the outlet region is inclined with respect to the rotational axis of the most-downstream roller (19).

8. The spinning machine (1) according to claim 7, **characterized in that** when viewed from the direction orthogonal to both the rotational axis of the most-downstream roller (19) and the running path of the fiber bundle (F), an angle (θ) formed by the straight line (L) connecting the inlet region and the outlet region and the rotational axis of the most-downstream roller (19) is at least 20 degrees and at most 80 degrees.

9. The spinning machine (1) according to claim 7 or claim 8, **characterized in that** when viewed along the rotational axis of the most-downstream roller (19), an angle (α) formed by the straight line (L) connecting the inlet region and the outlet region and the running path of the fiber bundle (F) in the draft device

(6) is at least 30 degrees and at most 80 degrees.

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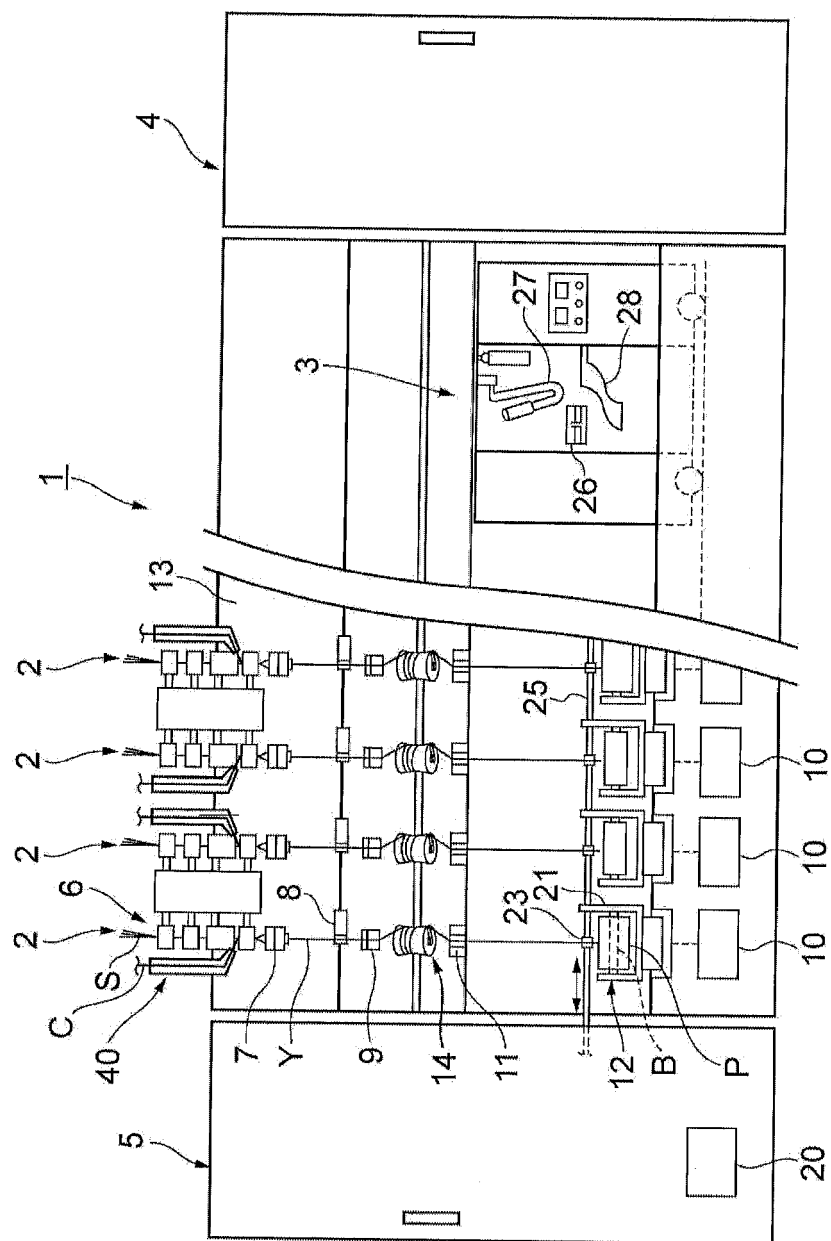


FIG. 2

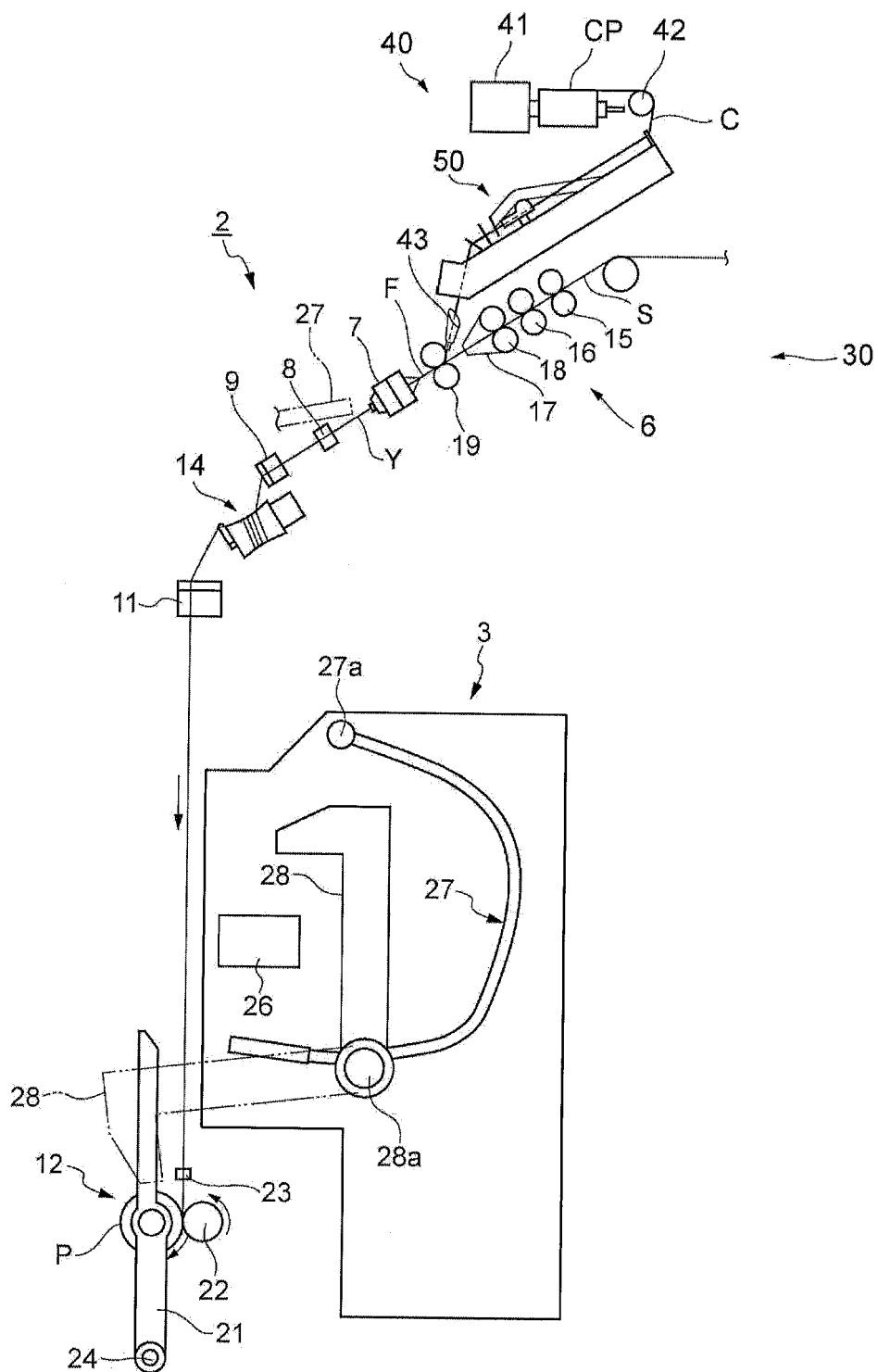


FIG. 3

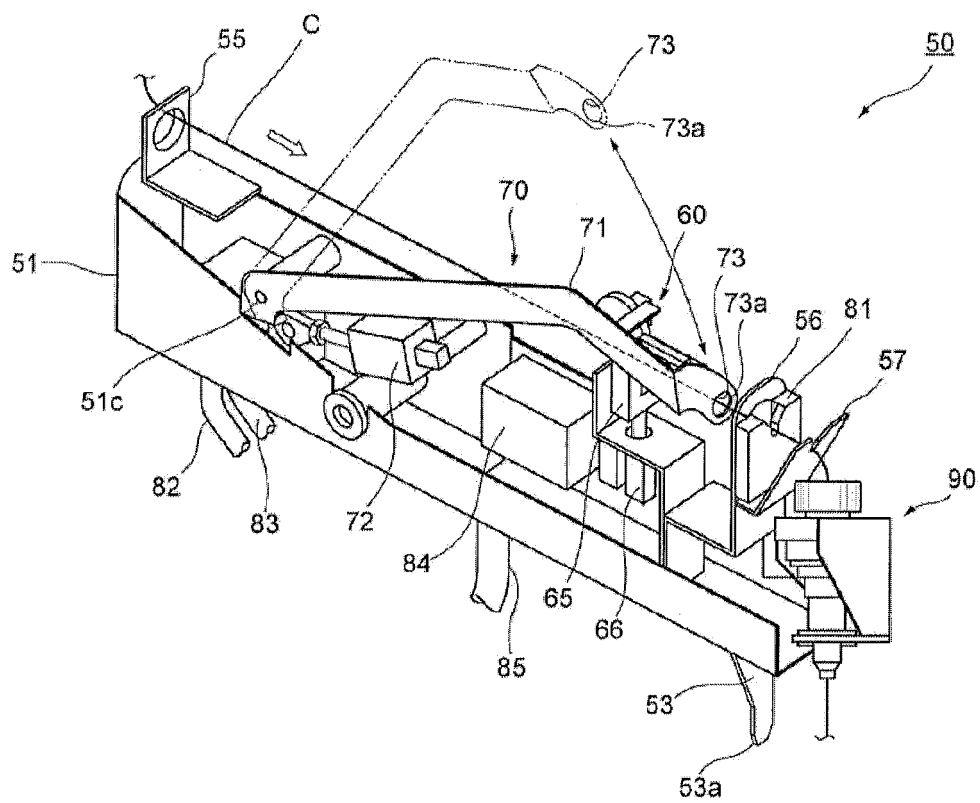


FIG. 4

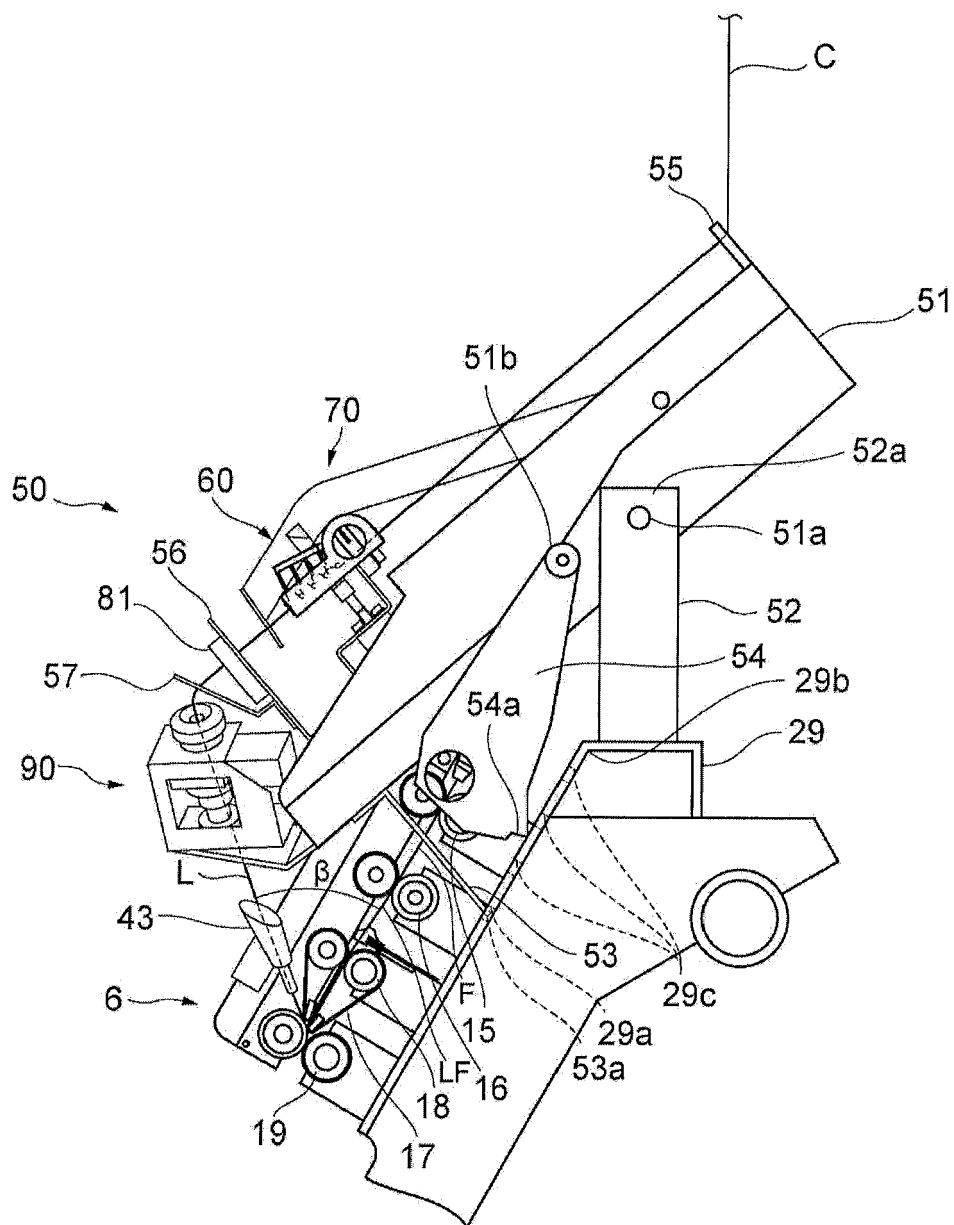


FIG. 5

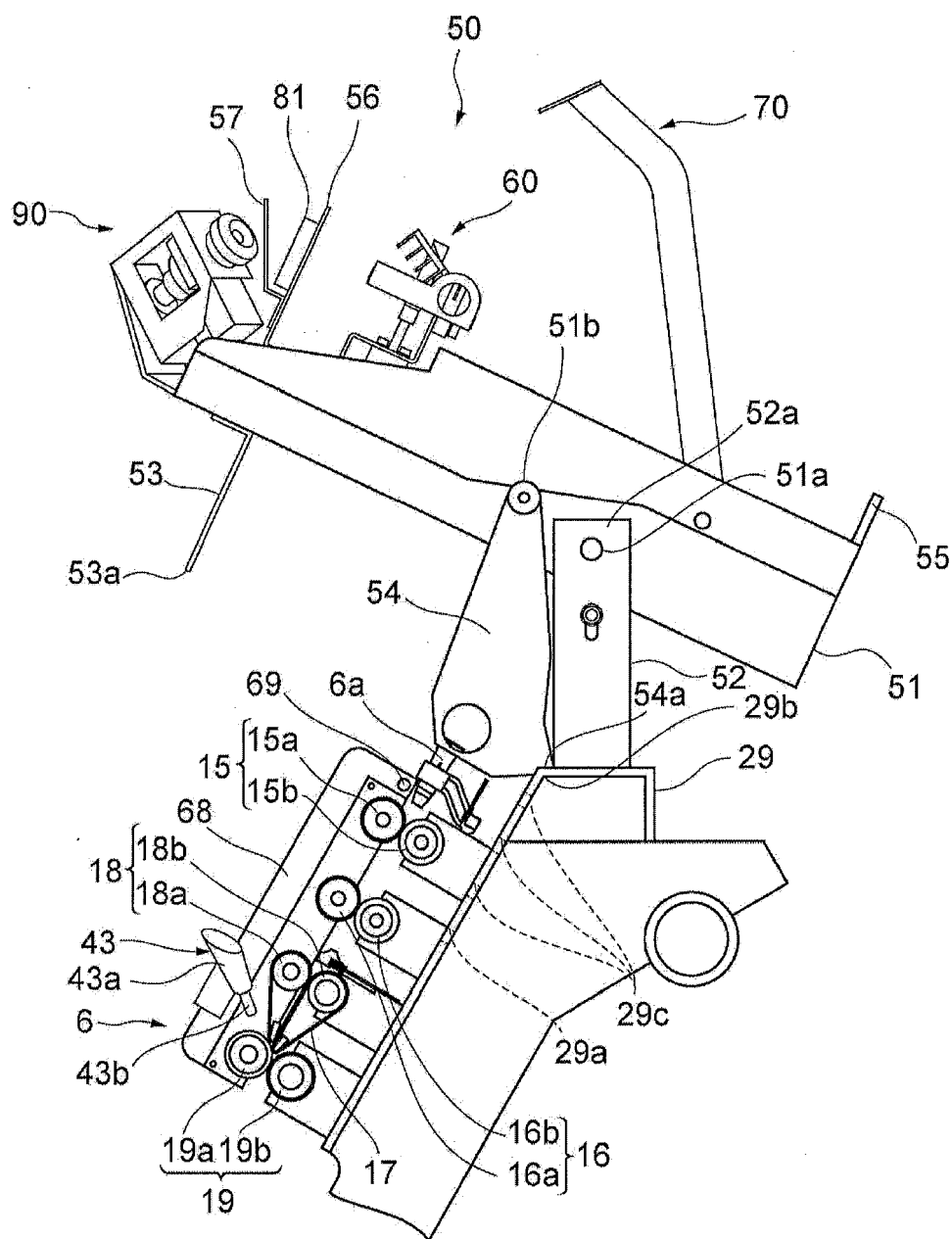


FIG. 6A

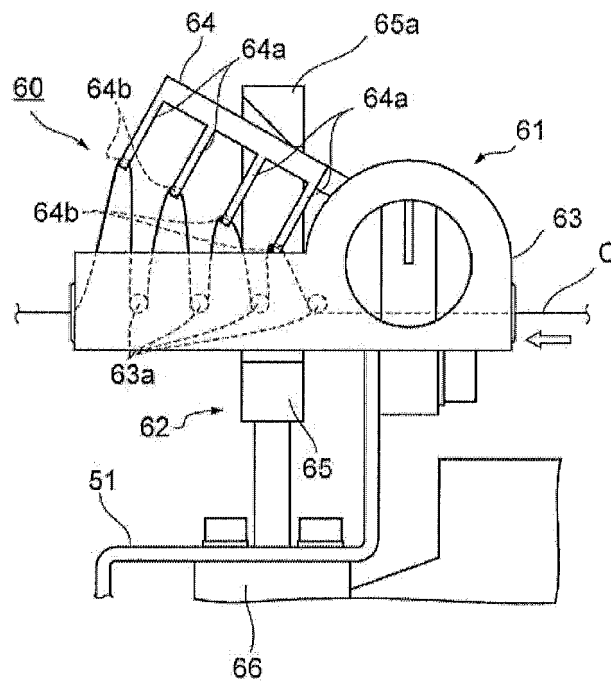


FIG. 6B

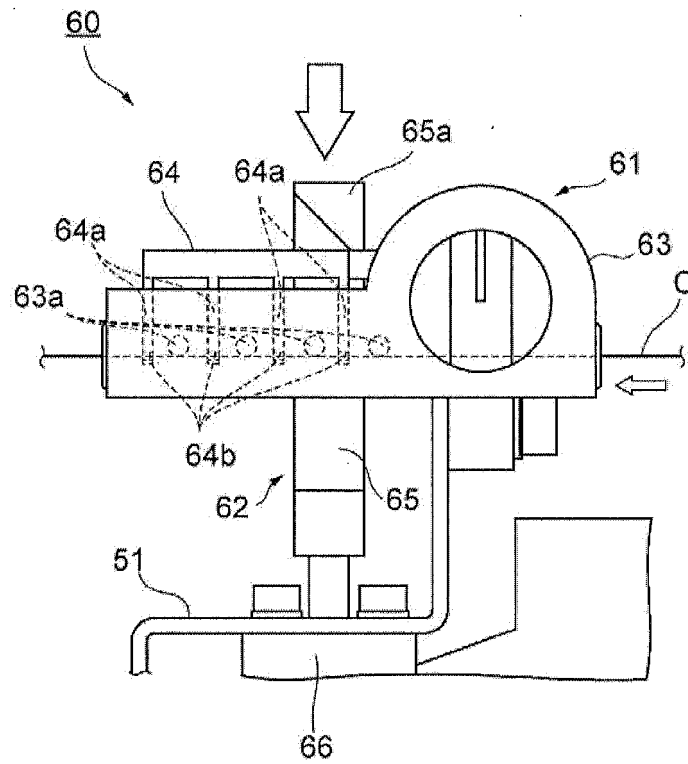


FIG. 7

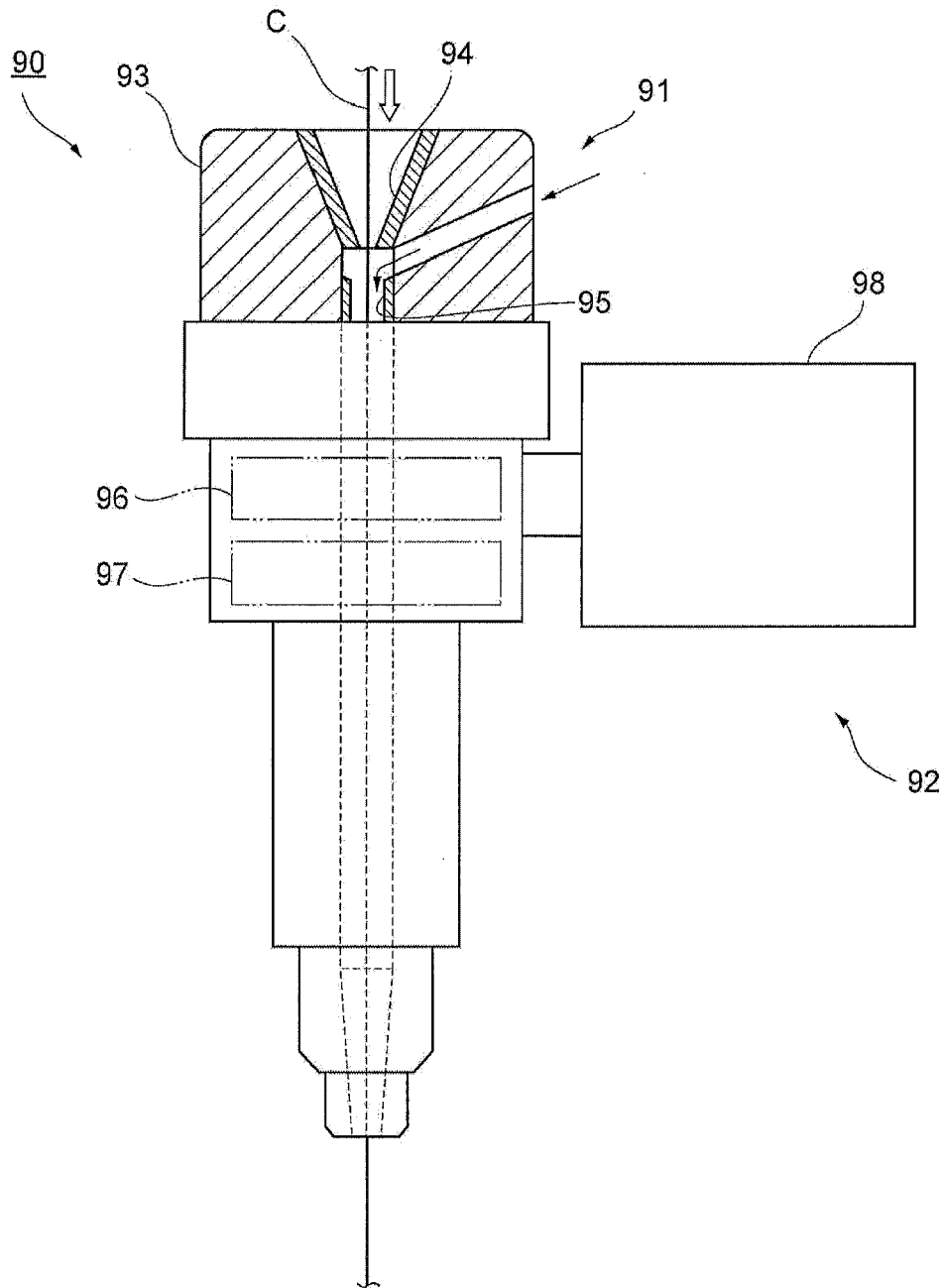


FIG. 8

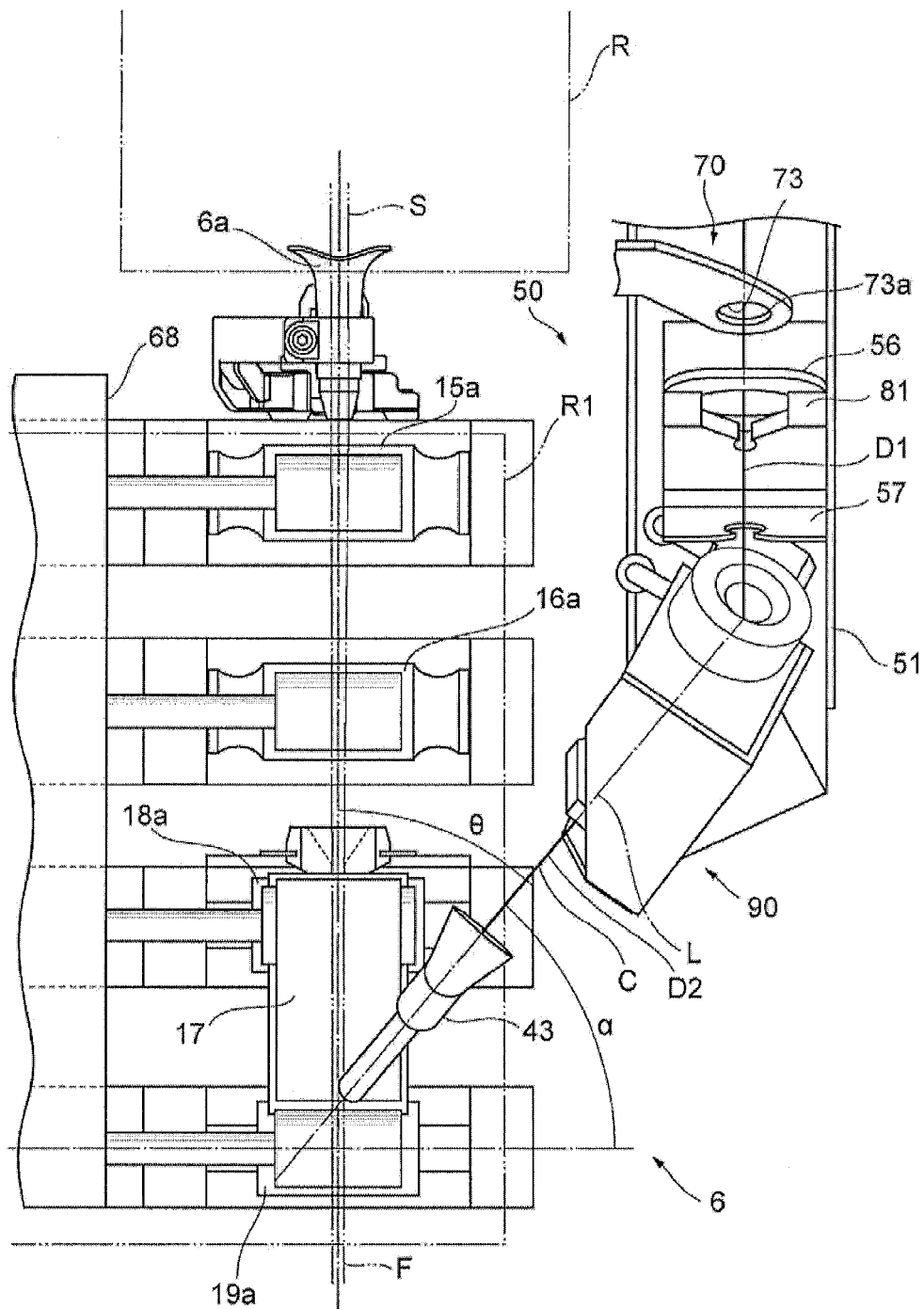


FIG. 9

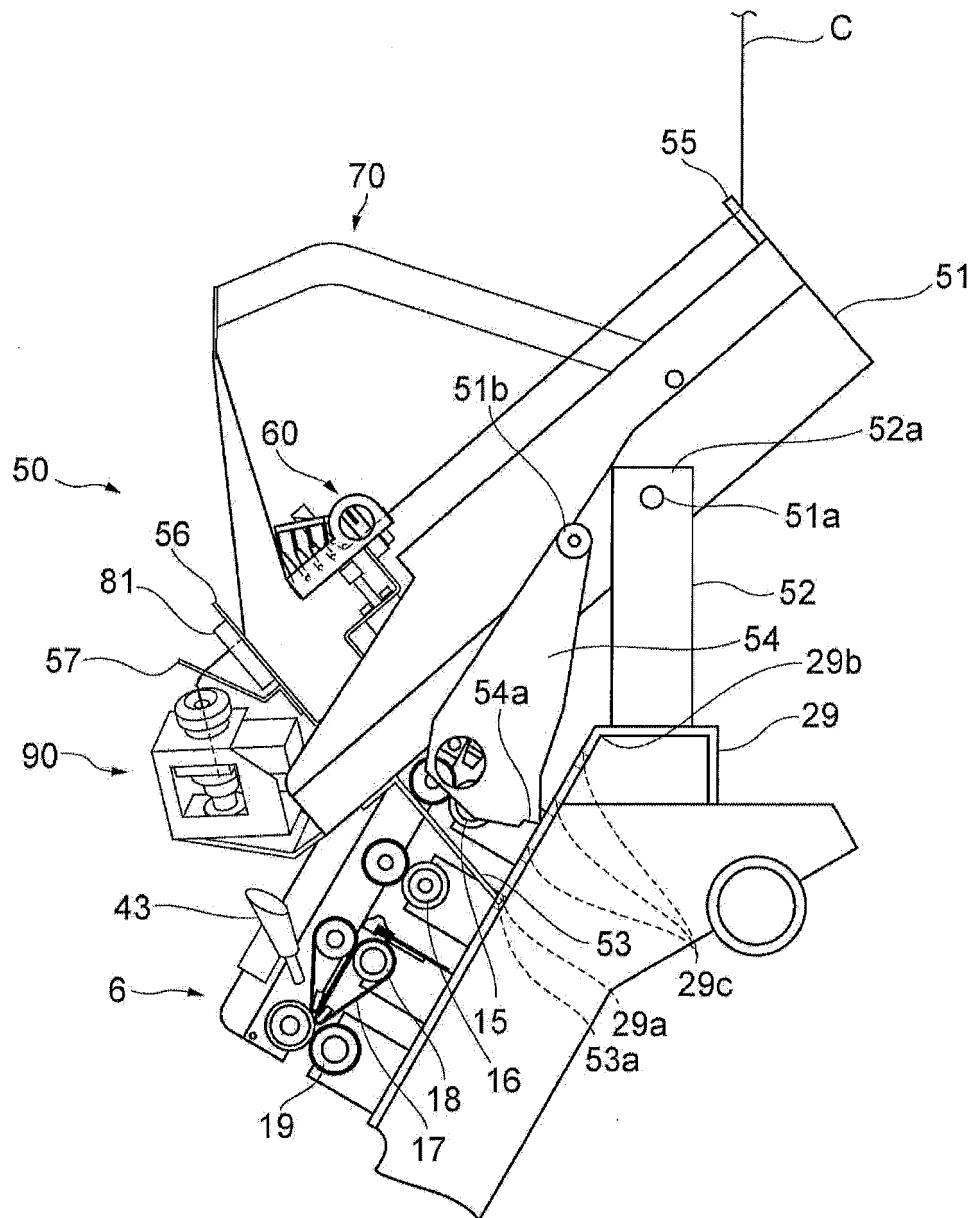
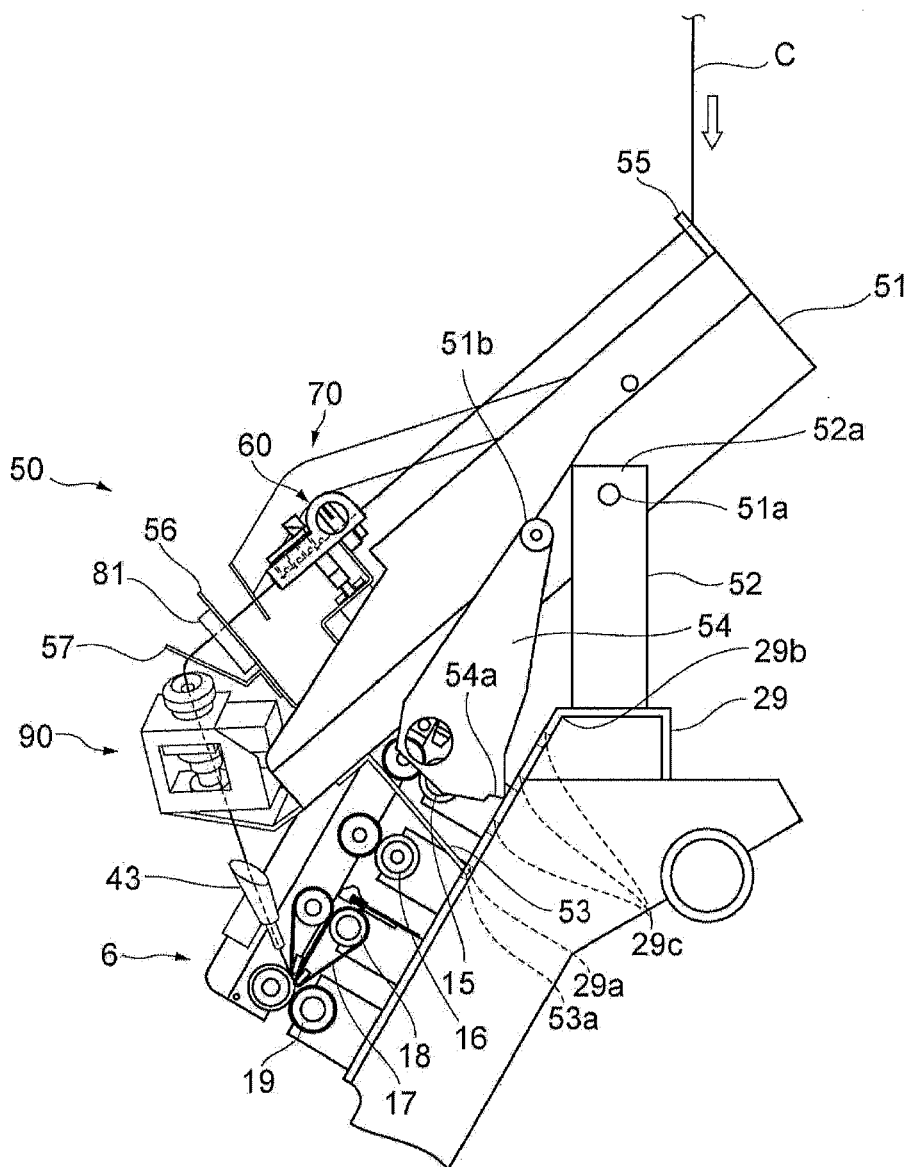


FIG. 10



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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