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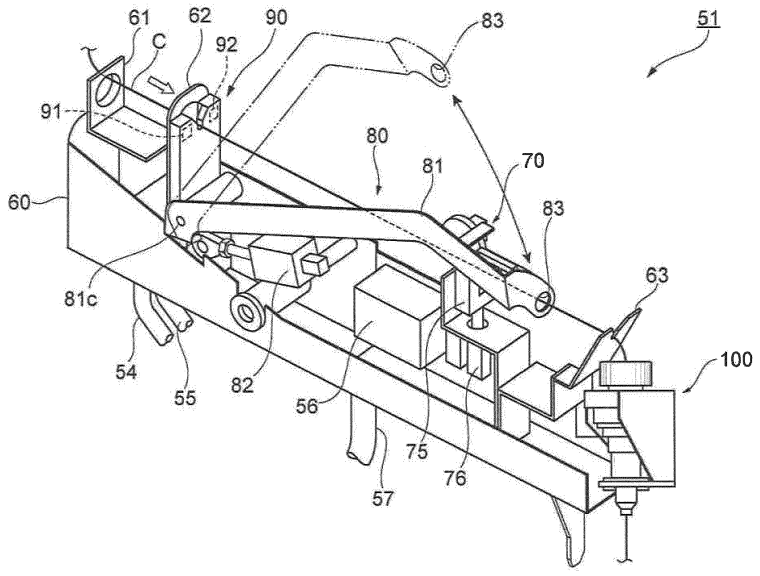
## (54) CORE YARN SUPPLYING DEVICE, SPINNING MACHINE, AND METHOD OF SUPPLYING CORE YARN

(57) A core yarn supplying unit (51) includes a tension applying section (70) adapted to apply tension to a core yarn (C); a slack applying section (80) adapted to apply slack to the core yarn (C); a core yarn feeding unit (100) adapted to feed the core yarn (C) at downstream of the tension applying section (70) and the slack applying section (80) in a travelling direction of the core yarn (C); and a detecting section (90) adapted to detect status of the core yarn (C) at upstream of the tension applying section (70) in the travelling direction of the core yarn C.

FIG. 3

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## Description

### BACKGROUND OF THE INVENTION

1. Field of the Invention

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

2. Description of the Related Art

**[0002]** As a conventional core yarn supplying device, there is known a core yarn supplying device including a tension applying section adapted to apply tension to a core yarn, a slack applying section adapted to apply slack to the core yarn, and a core yarn feeding section adapted to feed the core yarn at downstream of the tension applying section and the slack applying section in a travelling direction of the core yarn (see e.g., Japanese Unexamined Patent Publication No. 2012-131591). Such a core yarn supplying device may include a detecting section adapted to detect status of the core yarn (e.g., presence or absence of the core yarn, and the like).

### BRIEF SUMMARY OF THE INVENTION

**[0003]** However, in the core yarn supplying device described above, the status of the core yarn may not be accurately detected depending on a type of core yarn.

**[0004]** It is an object of the present invention to provide an improved core yarn supplying device. This object is achieved by a core yarn supplying device of claim 1 or a spinning machine including the core yarn supplying device of claim 9 or a method of claim 10. Embodiments of the present invention have that advantage that they are capable of supplying a core yarn of various types and are capable of stably detecting a status of a core yarn.

**[0005]** A core yarn supplying device of the present invention includes a tension applying section adapted to apply tension to a core yarn; a slack applying section adapted to apply slack to the core yarn; a core yarn feeding section adapted to feed the core yarn at downstream of the tension applying section and the slack applying section in a travelling direction of the core yarn; and detecting section adapted to detect status of the core yarn at upstream of the tension applying section in the travelling direction.

**[0006]** In embodiments of the above-described core yarn supplying device, the slack is applied to the core yarn by the slack applying section when the core yarn is fed by the core yarn feeding section. Thus, even a thin core yarn such as a mono-filament yarn can be reliably fed to a feeding destination such as a draft device. The core yarn fed to the feeding destination is supplied to the feeding destination while being applied with tension by the tension applying section. In this case, when high tension is applied to the thin core yarn such as the mono-filament yarn, possibility that the status of the core yarn may not be accurately detected increases. However, in the above-described core yarn supplying device, the status of the core yarn is detected by the detecting section at a position upstream of a position where the tension is applied by the tension applying section. Thus, even the status of the thin core yarn such as the mono-filament yarn can be stably detected. Therefore, according to the embodiments of the core yarn supplying device, various types of core yarns can be supplied, and the status of the core yarn can be stably detected.

**[0007]** In embodiments of the core yarn supplying device of the present invention, the detecting section includes a casing having a groove with one end opened. The core yarn supplying device further includes a first core yarn guide having a closed portion at least at an end portion located at a same side as the opened one end of the groove. The first core yarn guide is arranged with respect to the casing. Thus, the core yarn can be prevented from being displaced from the detecting section, and the core yarn can be reliably detected by the detecting section.

**[0008]** Embodiments of the core yarn supplying device of the present invention further include a second core yarn guide arranged upstream of the first core yarn guide and adapted to guide the core yarn. Thus, a yarn path of the core yarn to be guided to the detecting section is stabilized, and the core yarn can be reliably detected by the detecting section.

**[0009]** Embodiments of the core yarn supplying device of the present invention may further include a clamping section adapted to clamp the core yarn at downstream of the core yarn feeding section in the travelling direction. Thus, by clamping the core yarn when the supply of the core yarn is interrupted or terminated and releasing the clamping of the core yarn when the core yarn is fed, the core yarn can be more reliably fed to the feeding destination such as the draft device.

**[0010]** In embodiments of the core yarn supplying device of the present invention, the detecting section may be an optical sensor having a light emitting section adapted to emit light to the core yarn and a light receiving section adapted to receive the light. Thus, the status of the core yarn can be accurately detected with a simple configuration.

**[0011]** In embodiments of the core yarn supplying device of the present invention, the optical sensor is arranged within a region located between an inner surface of the casing and a downstream surface of a plate-like member of the first core yarn guide. Thus, light of illumination light in a textile factory where the core yarn supplying device is installed, for example, can be prevented from affecting the optical sensor. As a result, the detecting section can accurately detect the core yarn.

**[0012]** Embodiments of the core yarn supplying device of the present invention may further include a unit base adapted to support the tension applying section, the slack applying section, the core yarn feeding section, and the detecting section. Thus, each section can be handled as

one unit, and attachment/detachment with respect to the feeding destination such as the draft device can be easily carried out.

**[0013]** Embodiments of the core yarn supplying device of the present invention may further include a package supporting section arranged upstream of the slack applying section and the detecting section in the travelling direction, and adapted to support a package around which the core yarn is wound. The core yarn thus can be stably supplied to the feeding destination such as the draft device.

**[0014]** A spinning machine of the present invention includes the above-described core yarn supplying device; a draft device adapted to draft a fiber bundle; a pneumatic spinning device adapted to form a yarn by applying twists to the fiber bundle with the core yarn as a core; and a winding device adapted to wind the yarn to form a package.

**[0015]** In embodiments of the above-described spinning machine, the yarn including the core yarn can be stably produced since the core yarn supplying device is arranged.

## 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;
FIGS. 4A and 4B are side views of a tension applying section of the core yarn supplying unit of FIG. 3;
FIG. 5 is a partial cross-sectional view of a core yarn feeding unit of the core yarn supplying unit of FIG. 3;
FIGS. 6A and 6B are partial cross-sectional'views illustrating operations of a clamping section of the core yarn feeding unit of FIG. 5;
FIG. 7 is a side view of the core yarn supplying unit when the core yarn is supplied; and
FIG. 8 is a side view of the core yarn supplying unit when the supply of the core yarn is interrupted.

## DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

**[0017]** An embodiment of the present invention will be hereinafter described in detail with reference to the accompanying drawings. The same reference numerals are denoted on the same or corresponding portions throughout the drawings, 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 doffing cart (not illustrated), a first end frame 4, and a second end frame 5. The plurality of spinning units 2 are arranged in a row. Each spinning unit 2 is adapted to produce a spun yarn (yarn) Y and wind the spun yarn Y into a package P. The yarn joining cart 3 is adapted to perform a yarn joining operation in a spinning unit 2 after the spun yarn Y is cut, or is broken for some reason in such a spinning unit 2. The doffing cart is adapted to doff the package P and to supply a new bobbin B to the spinning unit 2 when the package P is fully-wound in a spinning unit 2. The first end frame 4 accommodates, for example, a collecting device adapted to collect fiber waste, yarn waste, and the like generated in the spinning units 2.

**[0019]** The second end frame 5 accommodates an air supplying section adapted to adjust air pressure of compressed air (air) to be supplied to the spinning machine 1 and to supply the air to each section of the spinning machine 1, a drive motor adapted to supply power to each section of the spinning unit 2, and the like. The second end frame 5 is provided with a machine control device 41, a display screen 42, and an input key 43. The machine control device 41 is adapted to intensively manage and control each section of the spinning machine 1. The display screen 42 is capable of displaying information relating to set contents and/or status, or the like of the spinning units 2. An operator can perform a setting operation of the spinning units 2 by performing an appropriate operation with the input key 43.

**[0020]** In the following description, on a travelling path of a sliver S, a fiber bundle F (see FIG. 2), 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.

**[0021]** As illustrated in FIGS. 1 and 2, each spinning unit 2 includes a draft device 6, a core yarn supplying device 200, a pneumatic spinning device 7, a yarn monitoring device 8, a tension sensor 9, a yarn storage device 11, a waxing device 12, and a winding device 13 in this order from upstream in a travelling direction of the spun yarn Y. A unit controller 10 is provided for every predetermined number of the spinning units 2 and is adapted to control operations of the spinning units 2.

**[0022]** The draft device 6 is adapted to draft a sliver (fiber bundle) S. The draft device 6 includes a pair of back rollers 14, a pair of third rollers 15, a pair of middle rollers 16, and a pair of front rollers 17 in this order from upstream in a travelling direction of the sliver S. Each pair of rollers 14, 15, 16, and 17 includes a bottom roller and a top roller. The bottom roller is rotationally driven by the drive motor provided in the second end frame 5 or by a drive motor provided in each spinning unit 2. An apron

belt 18a is provided with respect to the bottom roller of the middle rollers 16. An apron belt 18b is provided with respect to the top roller of the middle rollers 16.

**[0023]** The core yarn supplying device 200 unwinds a core yarn C from a core yarn package CP, and supplies the core yarn C to the pneumatic spinning device 7. More specifically, the core yarn supplying device 200 supplies the core yarn C to the travelling path of the fiber bundle F from between the pair of middle rollers 16 and the pair of front rollers 17 of the draft device 6. The core yarn supplying device 200 thereby supplies the core yarn C to the pneumatic spinning device 7.

**[0024]** The pneumatic spinning device 7 is adapted to produce the spun yarn Y by twisting the fiber bundle F, which has been drafted by the draft device 6, with a whirling airflow, with the core yarn C supplied from the core yarn supplying device 200 as a core. More specifically (however, not illustrated), the pneumatic spinning device 7 includes a spinning chamber, a fiber guiding section, a whirling airflow generating nozzle and a hollow guide shaft body. The fiber guiding section is adapted to guide the core yarn C supplied from the upstream core yarn supplying device 200 and the fiber bundle F supplied from the upstream draft device 6 into the spinning chamber. The whirling airflow generating nozzle is arranged at a periphery of a travelling path of the core yarn C and the fiber bundle F, and is adapted to generate a whirling airflow in the spinning chamber. With the whirling airflow, each fiber end of a plurality of fibers that form the fiber bundle F is reversed and whirled. The hollow guide shaft body is adapted to guide the spun yarn Y from the spinning chamber to an outside of the pneumatic spinning device 7.

**[0025]** The yarn monitoring device 8 is adapted to monitor information on the travelling spun yarn Y between the pneumatic spinning device 7 and the yarn storage device 11, and to detect presence or absence of a yarn defect based on the information acquired by the monitoring. When detecting the yarn defect, the yarn monitoring device 8 transmits a yarn defect detection signal to the unit controller 10. The yarn monitoring device 8 detects a thickness abnormality of the spun yarn Y and/or a foreign substance included in the spun yarn Y, for example, as the yarn defect. The yarn monitoring device 8 also detects yarn breakage (the presence or absence of the spun yarn Y). The tension sensor 9 is adapted to measure tension of the travelling spun yarn Y between the pneumatic spinning device 7 and the yarn storage device 11, and to transmit a tension measurement signal to the unit controller 10. When the unit controller 10 determines presence of an abnormality based on a detection result of the yarn monitoring device 8 and/or the tension sensor 9, the spun yarn Y is cut in the spinning unit 2. Specifically, by stopping air supply to the pneumatic spinning device 7 to interrupt the production of the spun yarn Y, the spun yarn Y is cut. Alternatively, the spun yarn Y may be cut with a cutter separately provided.

**[0026]** The waxing device 12 is adapted to apply wax to the spun yarn Y between the yarn storage device 11 and the winding device 13.

**[0027]** The yarn storage device 11 is adapted to eliminate slack of the spun yarn Y between the pneumatic spinning device 7 and the winding device 13. The yarn storage device 11 has a function of stably pulling out the spun yarn Y from the pneumatic spinning device 7, a function of preventing the spun yarn Y from slackening by accumulating the spun yarn Y fed from the pneumatic spinning device 7 at the time of the yarn joining operation or the like by the yarn joining cart 3, and a function of preventing variation in the tension of the spun yarn Y at downstream of the yarn storage device 11 from being propagated to the pneumatic spinning device 7.

**[0028]** The winding device 13 is adapted to wind the spun yarn Y around a bobbin B to form the package P. The winding device 13 includes a cradle arm 21, a winding drum 22, and a traverse guide 23. The cradle arm 21 is adapted to rotatably support the bobbin B. The cradle arm 21 is swingably supported by a supporting shaft 24 and is adapted to bring a surface of the bobbin B or a surface of the package P into contact with a surface of the winding drum 22 under appropriate pressure. A drive motor (not illustrated) provided in the second end frame 5 is adapted to simultaneously drive the winding drums 22 each provided in the plurality of the spinning units 2. Accordingly, in each spinning unit 2, the bobbin B or the package P is rotated in a winding direction. The traverse guide 23 of each spinning unit 2 is provided on a shaft 25 shared by the plurality of spinning units 2. By the drive motor in the second end frame 5 driving the shaft 25 to reciprocate in a direction of a rotational axis of the winding drum 22, the traverse guide 23 traverses the spun yarn Y in a predetermined width with respect to the rotating bobbin B or package P.

**[0029]** After the spun yarn Y is cut, or is broken for some reason in a spinning unit 2, the yarn joining cart 3 travels to such a spinning unit 2 to perform the yarn joining operation. The yarn joining cart 3 includes a yarn joining device 26, a suction pipe 27, and a suction mouth 28. The suction pipe 27 is swingably supported by a supporting shaft 31, and is adapted to catch the spun yarn Y from the pneumatic spinning device 7 and to guide the caught spun yarn Y to the yarn joining device 26. The suction mouth 28 is swingably supported by a supporting shaft 32, and is adapted to catch the spun yarn Y from the winding device 13 and to guide the caught spun yarn Y to the yarn joining device 26. The yarn joining device 26 is adapted to join the guided spun yarns Y together. The yarn joining device 26 is a splicer using the compressed air, a piecer using a seed yarn, a knotter adapted to join the spun yarns Y together in a mechanical manner, or the like.

**[0030]** When the yarn joining cart 3 performs the yarn joining operation, the package P is rotated in an unwinding direction (reversely rotated). At this time, the cradle arm 21 is moved by an air cylinder (not illustrated) such that the package P is located away from the winding drum

22, and the package P is reversely rotated by a reversely-rotating roller (not illustrated) provided in the yarn joining cart 3.

**[0031]** The core yarn supplying device 200 described above will be more specifically described. As illustrated in FIG. 2, the core yarn supplying device 200 includes a package supporting section 50, a core yarn supplying unit 51, and a core yarn guiding section 52.

**[0032]** The package supporting section 50 is adapted to support the core yarn package CP formed by winding the core yarn C around a core yarn bobbin CB. The package supporting section 50 supports the core yarn package CP at the upstream of the core yarn supplying unit 51 in the travelling direction of the core yarn C. The core yarn supplying unit 51 supplies the core yarn C while applying the tension to the core yarn C unwound from the core yarn package CP and guided via a guide roller 53. The core yarn guiding section 52 guides the core yarn C supplied from the core yarn supplying unit 51 to a position between the pair of middle rollers 18 and the pair of front rollers 19 of the draft device 6.

**[0033]** The core yarn supplying device 200 can supply various types of core yarns C. The core yarn C that can be supplied is, for example, a mono-filament yarn and a multi-filament yarn. The mono-filament yarn is formed by one thin filament single yarn (e.g., single yarn having a thickness smaller than or equal to 30 denier). The multi-filament yarn is formed by bundling a plurality of filament single yarns.

**[0034]** As illustrated in FIG. 3, the core yarn supplying unit 51 includes a unit base 60, a tension applying section 70, a slack applying section 80, a core yarn feeding unit 100, and a core yarn detection device (detecting section) 90. In the following description, a side on which the package supporting section 50 is located in the travelling direction of the core yarn C is referred to as upstream, and a side on which the core yarn guiding section 52 is located is referred to as downstream.

**[0035]** The unit base 60 supports the core yarn detection device 90, the slack applying section 80, the tension applying section 70, and the core yarn feeding unit 100 in this order from the upstream in the travelling direction of the core yarn C. A core yarn guide (second guide) 61 adapted to guide the core yarn C is arranged most upstream of the unit base 60. In the present embodiment, the travelling direction of the core yarn C that passed the guide roller 53 is changed by the core yarn guide 61.

**[0036]** A core yarn guide 63 is arranged between the tension applying section 70 and the core yarn feeding unit 100. A balloon, as illustrated in FIG. 2, is formed when the core yarn C is unwound from the core yarn package CP. Movement of the core yarn C thus may vary. However, the core yarn guide 61 arranged at the above-described position regulates the movement of the core yarn C, and the movement of the core yarn C is stabilized at the downstream of the core yarn guide 61. Thus, the yarn path of the core yarn C between the core yarn guide 61 and the core yarn guide 63 is stabilized to a substantially linear form when the core yarn C is being supplied, and hence detection accuracy of the core yarn detection device 90 can be improved.

**[0037]** The tension applying section 70 is adapted to apply tension to the core yarn C at the downstream of the core yarn guide 61. As illustrated in FIG. 4A, the tension applying section 70 includes a tension applying mechanism 71 and an operating mechanism 72.

**[0038]** The tension applying mechanism 71 includes a fixed piece 73 and a movable piece 74. The movable piece 74 is swingably supported with respect to the fixed piece 73 by a supporting shaft (not illustrated) arranged on the fixed piece 73. The movable piece 74 is urged in an opening direction with respect to the fixed piece 73 by a spring (not illustrated) arranged on the fixed piece 73.

**[0039]** More specifically, in the fixed piece 73, a plurality of shafts 73a are arranged at predetermined intervals along the travelling direction of the core yarn C. The movable piece 74 includes a plurality of protrusions 74a projecting out towards the fixed piece 73. Each protrusion 74a is alternately located with each shaft 73a along the travelling direction of the core yarn C under a state where the movable piece 74 is closed with respect to the fixed piece 73 (state of FIG. 4B). A hole 74b, through which the core yarn C is inserted, is formed at a distal end portion of each protrusion 74a.

**[0040]** The core yarn C is alternately hooked to each shaft 73a and each hole 74b. Thus, as illustrated in FIG. 4A, the core yarn C is bent a plurality of times when the movable piece 74 is opened with respect to the fixed piece 73. When the core yarn C is pulled towards the downstream by the draft device 6 and the pneumatic spinning device 7 under this state (i.e., when the travelling of the core yarn C is started), tension is applied to the core yarn C at the downstream of the tension applying section 70 (including the tension applying section 70). A state of the tension applying section 70 in this case is referred to as a tension applying state.

**[0041]** A portion of the core yarn C located upstream of the tension applying section 70 is in a state before the tension is applied by the tension applying section 70. The tension applied to the core yarn C from the guide roller 53 and the core yarn guide 61 is small. Thus, the tension applied to the core yarn C at the upstream of the tension applying section 70 is small compared to the tension applied to the core yarn C at the downstream of the tension applying section 70 including the tension applying section 70. Therefore, no significant difference is found between a thickness of the core yarn C wound in the core yarn package CP and a thickness of the core yarn C located between the core yarn package CP and an upstream end portion of the tension applying section 70. In other words, the core yarn C located between the core yarn package CP and the upstream end portion of the tension applying section 70 has not become too thin due to the influence of application of tension by the tension applying section 70. Furthermore, since the movement of the core yarn C

located between the core yarn package CP and the upstream end portion of the tension applying section 70 is not restricted by the tension applying section 70, the relevant portion of the core yarn C may move.

**[0042]** As illustrated in FIG. 4B, when the movable piece 74 is closed with respect to the fixed piece 73, the core yarn C becomes substantially linear. Thus, the tension applied to the core yarn C at the downstream of the tension applying section 70 including the tension applying section 70 is released (or the tension becomes close to zero). A state of the tension applying section 70 in this case is referred to as a tension non-applying state.

**[0043]** The operating mechanism 72 acts on the movable piece 74 to open or close the movable piece 74 with respect to the fixed piece 73. As illustrated in FIGS. 4A and 4B, the operating mechanism 72 includes an operation member 75 and an air cylinder 76.

**[0044]** The operation member 75 is moved by the air cylinder 76 to make contact with or separate from the movable piece 74. More specifically, the operation member 75 includes a distal end portion 75a that makes contact with the movable piece 74 from a side opposite to the fixed piece 73. When air is supplied to the air cylinder 76, the distal end portion 75a is moved downward (direction in which the movable piece 74 is closed with respect to the fixed piece 73). When the supply of air to the air cylinder 76 is stopped, the distal end portion 75a is separated from the movable piece 74 and moved upward (direction in which the movable piece 74 is opened with respect to the fixed piece 73).

**[0045]** When the distal end portion 75a is moved downward, the movable piece 74 is pushed by the distal end portion 75a and is closed with respect to the fixed piece 73. As a result, the tension applying section 70 is switched to the tension non-applying state. When the distal end portion 75a is moved upward, the movable piece 74 is opened with respect to the fixed piece 73 by an urging force of the spring. As a result, the tension applying section 70 is switched to the tension applying state.

**[0046]** As illustrated in FIG. 3, the slack applying section 80 applies slack to the core yarn C at the downstream of the tension applying section 70. The slack applying section 80 includes an arm 81 and an air cylinder 82. The arm 81 is swingably supported by a supporting shaft 81c attached to the unit base 60. The slack applying section 80 is swung by the air cylinder 82.

**[0047]** More specifically, a guide hole 83, through which the core yarn C is inserted, is formed at a distal end portion of the arm 81. When air is supplied to the air cylinder 82, the guide hole 83 is moved to a position away from the travelling path of the core yarn C (a position of a chain double dashed line in FIG. 3). When the supply of air to the air cylinder 82 is stopped, the guide hole 83 is moved to the travelling path of the core yarn C (a position of a solid line in FIG. 3).

**[0048]** When the guide hole 83 is moved from the travelling path of the core yarn C (the position of the solid line in FIG. 3) to the position away from the travelling path of the core yarn C (the position of the chain double dashed line in FIG. 3), the core yarn C is pulled upward. The core yarn C is unwound from the core yarn package CP by an amount in which the core yarn C is pulled up, and hence the slack is applied to the core yarn C. A state of the slack applying section 80 when the guide hole 83 is located away from the travelling path of the core yarn C (state where the arm 81 is at the position of the chain double dashed line as in FIG. 3) is referred to as a slack applying state. A state of the slack applying section 80 when the guide hole 83 is located on the travelling path of the core yarn C (state where the arm 81 is at the position of the solid line as in FIG. 3) is referred to as a slack non-applying state.

**[0049]** The core yarn feeding unit 100 has a function of feeding the core yarn C to the draft device 6, a function of clamping the core yarn C, and a function of cutting the core yarn C. As illustrated in FIG. 5, the core yarn feeding unit 100 includes a core yarn feeding section 101, and a clamp cutter 102.

**[0050]** The core yarn feeding section 101 feeds the core yarn C to the draft device 6 at the downstream of the tension applying section 70 and the slack applying section 80. The core yarn feeding section 101 includes a core yarn feeding nozzle block 103, a core yarn feeding nozzle 104, and a tube body 105. The core yarn feeding nozzle 104 and the tube body 105 are arranged inside the core yarn feeding nozzle block 103, and form the travelling path of the core yarn C. Air is injected from outside to the travelling path of the core yarn C through a nozzle 103a. With the injected air, the core yarn feeding section 101 thereby feeds the core yarn C located in the core yarn feeding nozzle 104 and the tube body 105 to the draft device 6.

**[0051]** Herein, "feeding the core yarn C" refers to an operation in which the core yarn feeding section 101 feeds the core yarn C (a yarn end of the core yarn C) to the draft device 6 when the supply of the core yarn C is started (resumed). "Supplying the core yarn C" refers to an operation in which the core yarn supplying device 200 continuously supplies the core yarn C to the draft device 6 while applying tension to the core yarn C after the supply of the core yarn C is started (resumed) (i.e., operation during spinning).

**[0052]** The clamp cutter 102 has a function of clamping the core yarn C and a function of cutting the core yarn C. The clamp cutter 102 includes a clamping section 106, a cutter section 107, and an air cylinder 108.

**[0053]** The clamping section 106 clamps the core yarn C (the yarn end of the core yarn C) at the downstream of the core yarn feeding section 101. The clamping section 106 includes a clamp pin 106a, and a clamp block 106b.

**[0054]** As illustrated in FIGS. 6A and 6B, the clamp block 106b is relatively moved with respect to the clamp pin 106a by the air cylinder 108. More specifically, when the supply of air to the air cylinder 108 is stopped, the clamp block 106b is moved away towards a side opposite

to the clamp pin 106a with a travelling region of the core yarn C therebetween (the state of FIG. 6A). When air is supplied to the air cylinder 108, the clamp block 106b is moved to cross the travelling region of the core yarn C to be located closer to the clamp pin 106a (the state of FIG. 6B). The clamping section 106 thereby clamps the core yarn C. The state of the clamping section 106 in this case (the state of FIG. 6B) is referred to as a clamping state. The state of the clamping section 106 when the clamp block 106b is spaced apart from the clamp pin 106a (the state of FIG. 6A) is referred to as a non-clamping state.

**[0055]** The cutter section 107 cuts the core yarn C at the downstream of the clamping section 106. The cutter section 107 is operated in conjunction with the clamping section 106 by the air cylinder 108. The cutter section 107 cuts the core yarn C when the clamping section 106 is switched from the non-clamping state to the clamping state.

**[0056]** As illustrated in FIG. 3, the core yarn detection device 90 detects the status of the core yarn C at the upstream of the tension applying section 70 (more specifically, upstream of the supporting shaft 81c). For example, the core yarn detection device 90 detects the presence or absence of the core yarn C as the status of the core yarn C. The core yarn detection device 90 thus is able to detect yarn breakage of the core yarn C and/or running out of the core yarn C of the core yarn package CP. A core yarn guide (first guide) 62 adapted to guide the core yarn C is arranged upstream of the core yarn detection device 90.

**[0057]** The core yarn detection device 90 is an optical sensor including a light emitting section 91 and a light receiving section 92. The light emitting section 91 emits light on the core yarn C passing through the core yarn detection device 90. The light emitting section 91 is, for example, configured by a light emitting diode. The light emission of the light emitting section 91 is controlled by the unit controller 10. A yarn passage is formed between the light emitting section 91 and the light receiving section 92. The core yarn detection device 90 contactlessly detects the status of the core yarn C travelling through the yarn passage.

**[0058]** The light receiving section 92 receives light from the light emitting section 91 transmitted through (shielded by) the core yarn C (so-called transmissive light receiving section). The light receiving section 92 is, for example, a photodiode, and converts an intensity of the received light to an electrical signal and outputs such an electrical signal to the unit controller 10. The light receiving section 92 may receive light from the light emitting section 91 reflected by the core yarn C (so-called reflective light receiving section).

**[0059]** The core yarn detection device 90 includes a casing having a substantially U-shaped groove with one end (upper end) opened. The yarn passage of the core yarn C is set to pass the groove. The groove is arranged between the light emitting section 91 and the light receiving section 92. The core yarn guide 62 is arranged upstream of the core yarn detection device 90. Of the end portions of the core yarn guide 62, an opened portion is not formed at least at the end portion located at the same side as the opened one end of the core yarn detection device 90. In the present embodiment, the core yarn guide 62 is a plate-like member with a hole. Thus, even when the movement of the core yarn C is not stable, the core yarn C can be prevented from being displaced from the groove and not returning to the groove, and the core yarn detection device 90 can reliably detect the core yarn C. In FIG. 3, the core yarn guide 62 is arranged upstream of the core yarn detection device 90, but the core yarn guide 62 may be arranged downstream of the core yarn detection device 90.

**[0060]** A downstream surface of the core yarn guide 62 is arranged so as to make contact with an upstream end portion or an upstream end face of a casing of the core yarn detection device 90. In other words, the light emitting section 91 and the light receiving section 92 are arranged in a region between the inner surface of the casing and the downstream surface of the plate-like member of the core yarn guide 62. Thus, for example, the light of the illumination light in the textile factory where the core yarn supplying unit 51 is installed, for example, can be prevented from affecting the optical sensor. As a result, the detection accuracy of the core yarn detection device 90 can be further improved.

**[0061]** As illustrated in FIG. 3, the core yarn supplying unit 51 further includes a first air supply tube 54, a second air supply tube 55, a relay substrate 56, and a multi-core cable 57.

**[0062]** The first air supply tube 54 relays an air supply tube (not illustrated) connected to an air supply source of the first end frame 4, and a plurality of air supply tubes (not illustrated) respectively connected with air cylinders 76, 82, 108. Thus, the air is supplied from the first end frame 4 to each air cylinder 76, 82, 108 through the first air supply tube 54.

**[0063]** A first electromagnetic valve (not illustrated) is attached to the first air supply tube 54. The first electromagnetic valve switches supply and stop of air supplied from the first end frame 4 to each air cylinder 76, 82, 108. When the first electromagnetic valve is opened, the tension applying section 70 is switched to the tension non-applying state, the slack applying section 80 is switched to the tension applying state, and the clamping section 106 is switched to the clamping state. When the first electromagnetic valve is closed, the tension applying section 70 is switched to the tension applying state, the slack applying section 80 is switched to the tension non-applying state, and the clamping section 106 is switched to the non-clamping state.

**[0064]** The second air supply tube 55 relays an air supply tube (not illustrated) connected to the air supply source of the first end frame 4, and an air supply tube (not illustrated) connected to the core yarn feeding section 101. Thus, the air is supplied from the first end frame

4 to the core yarn feeding section 101 through the second air supply tube 55.

**[0065]** A second electromagnetic valve (not illustrated) is attached to the second air supply tube 55. The second electromagnetic valve switches supply and stop of air supplied from the first end frame 4 to the core yarn feeding section 101. When the second electromagnetic valve is opened, the air is injected to the travelling path of the core yarn C in the core yarn feeding section 101, and thus the core yarn C is fed from the core yarn feeding section 101. When the second electromagnetic valve is closed, the injection of air to the travelling path of the core yarn C in the core yarn feeding section 101 is stopped, and thus the feeding operation of the core yarn C by the core yarn feeding section 101 is also stopped.

**[0066]** The relay substrate 56 is electrically connected to the core yarn detection device 90, the first electromagnetic valve, and the second electromagnetic valve.

**[0067]** The multi-core cable 57 electrically relays the relay substrate 56, and the multi-core cable (not illustrated) connected to the unit controller 10. The unit controller 10 thus can control the core yarn detection device 90, the first electromagnetic valve, and the second electromagnetic valve.

**[0068]** The operation of the above-described core yarn supplying device 200 will now be described. As illustrated FIG. 7, when the core yarn C is being supplied, the core yarn C travels towards the downstream in the travelling direction of the core yarn C by being pulled by the draft device 6 and the pneumatic spinning device 7. The tension applying section 70 is held in the tension applying state in this case, and the core yarn C travels towards the draft device 6 while being applied with tension at the downstream of the tension applying section 70 (including the tension applying section 70). The core yarn detection device 90 detects the status of the core yarn C at the upstream of the tension applying section 70. When the core yarn C is being supplied, the state of the slack applying section 80 is held in the slack non-applying state, and the clamping section 106 is held in the non-clamping state.

**[0069]** Then, as illustrated in FIG. 8, when presence of the yarn defect or absence of the yarn (the core yarn C or the spun yarn Y) is detected by the core yarn detection device 90, the yarn monitoring device 8, and/or the tension sensor 9, a control signal for interrupting the supply of the core yarn C is transmitted from the unit controller 10 to the relay substrate 56 and the supply of the core yarn C is interrupted. Specifically, the first electromagnetic valve is opened, and the clamping section 106 is switched to the clamping state. The cutter section 107 is operated in conjunction therewith, and the core yarn C at the downstream of the clamping section 106 is cut. The state of the tension applying section 70 is switched to the tension non-applying state, and the state of the slack applying section 80 is switched to the slack applying state. The application of tension to the core yarn C is thereby released, and the slack is applied to the core yarn C. Note that, even when the spinning by the spinning unit 2 is normally terminated, a control signal for terminating the supply of the core yarn C is transmitted from the unit controller 10 to the relay substrate 56, and an operation similar to the above is carried out.

**[0070]** At the start of the supply of the core yarn C, the first electromagnetic valve is closed, the state of the clamping section 106 is switched to the non-clamping state, the state of the tension applying section 70 is switched to the tension applying state, and the state of the slack applying section 80 is switched to the slack non-applying state. The second electromagnetic valve is opened, and the core yarn C, to which the slack is applied by the slack applying section 80, is fed to the draft device 6 by the core yarn feeding section 101. The supply of the core yarn C is thereby started.

**[0071]** As described above, in the core yarn supplying device 200, the slack is applied to the core yarn C by the slack applying section 80 before the core yarn C is fed by the core yarn feeding section 101. The core yarn C thus can be reliably fed to the draft device 6. In other words, since the slack is applied to the core yarn C, even the core yarn C such as the mono-filament yarn, which is difficult to be carried by a flow of air, can be reliably fed to the draft device 6 by the action of air. The core yarn C fed to the draft device 6 is supplied to the draft device 6 while being applied with tension by the tension applying section 70. When high tension is applied to the thin core yarn C such as the mono-filament yarn, the possibility that the status of the core yarn C may not be accurately detected increases. However, in the core yarn supplying device 200, the status of the core yarn C is detected by the core yarn detection device 90 at a position upstream of a position where the tension is applied by the tension applying section 70. Thus, the status of the core yarn C can be stably detected. The detection accuracy of the core yarn detection device 90 is not affected by the setting of the tension applying section 70. Therefore, according to the core yarn supplying device 200, various types of core yarns C can be supplied, and the status of the core yarn C can be stably detected.

**[0072]** The core yarn supplying device 200 includes the clamping section 106. Thus, by clamping the core yarn C when interrupting or terminating the supply of the core yarn C and releasing the clamping of the core yarn C when feeding the core yarn C, the core yarn C can be more reliably fed to the feeding destination such as the draft device 6.

**[0073]** The core yarn detection device 90 is an optical sensor including the light emitting section 91 and the light receiving section 92. Thus, the status of the core yarn C can be accurately detected with a simple configuration.

**[0074]** The core yarn supplying unit 51 further includes the unit base 60 adapted to support the tension applying section 70, the slack applying section 80, the core yarn feeding section 101, and the core yarn detection device 90. Thus, each section can be handled as one unit, whereby the attachment/detachment with respect to the

draft device 6 and the like, for example, can be easily carried out. The attachment/detachment target of the unit base 60 is not limited to the draft device 6, and for example, may be a main body frame (not illustrated) to which each device such as the draft device 6, the pneumatic spinning device 7, the winding device 13, and the like is attached.

**[0075]** The core yarn supplying device 200 includes the package supporting section 50 adapted to support the core yarn package CP. The core yarn C thus can be stably supplied to the feeding destination such as the draft device 6.

**[0076]** According to the spinning unit 2, since the core yarn supplying device 200 is provided, the spun yarn Y including the core yarn C can be stably produced.

**[0077]** One embodiment of the present invention has been described above, but the present invention is not limited to the above-described embodiment.

**[0078]** The core yarn detection device 90 detects the status of the core yarn C at the upstream of the supporting shaft 81c, but the core yarn detection device 90 may detect the status of the core yarn C at any position as long as the position is at the upstream of the tension applying section 70. For example, the core yarn detection device 90 may detect the status of the core yarn C between the supporting shaft 81c and the tension applying section 70.

**[0079]** The core yarn detection device 90 is the optical sensor, but for example, the core yarn detection device 90 may be a capacitance sensor including a pair of electrodes arranged facing each other with the travelling core yarn C therebetween.

**[0080]** The tension applying section 70 is a so-called gate type tensor including the fixed piece 73 and the movable piece 74, but the tension applying section 70 may be a device having other configuration such as a disc tensor.

**[0081]** In the core yarn supplying unit 51, the unit base 60 collectively supports the tension applying section 70, the slack applying section 80, the core yarn feeding section 101, and the core yarn detection device 90, but each section may not be collectively supported by the unit base 60. For example, each section may be directly or indirectly supported by the main body frame (not illustrated), to which each device such as the draft device 6 is attached. Alternatively, the core yarn detection device 90 may be arranged at the upstream of the core yarn guide 61 or the upstream of the guide roller 53. In other words, the core yarn detection device 90 may be arranged at any position between the core yarn package CP and the tension applying section 70. Even when the core yarn detection device 90 is arranged on the unit base 60, the core yarn detection device 90 may be arranged at the position downstream of the position illustrated in FIG. 3 as long as the position is located upstream of the tension applying section 70.

**[0082]** The slack applying section 80 applies the slack to the core yarn C at the downstream of the tension applying section 70, but the slack applying section 80 may apply the slack to the core yarn C at the upstream of the tension applying section 70 or the core yarn detection device 90. In this case, when the core yarn C is fed by the core yarn feeding section 101, the tension applying section 70 is held in the tension non-applying state so that the core yarn C, to which the slack is applied by the slack applying section 80, is appropriately fed to the draft device 6.

**[0083]** The pneumatic spinning device 7 may further include a needle held by a fiber guiding section and arranged so as to protrude into a spinning chamber to prevent twists of the fiber bundle F from being propagated to the upstream of the pneumatic spinning device 7. Alternatively, such a needle may be omitted, and the pneumatic spinning device 7 may prevent the twists of the fiber bundle F from being propagated to upstream of the pneumatic spinning device 7 by a downstream end portion of the fiber guiding section. Furthermore, instead of the above-described configuration, the pneumatic spinning device 7 may include a pair of air-jet nozzles respectively adapted to twist the fiber bundle F in directions opposite from each other.

**[0084]** In the spinning unit 2, the yarn storage device 11 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 from the pneumatic spinning device 7 with a delivery roller and a nip roller. In a case of pulling out the spun yarn Y from the pneumatic spinning device 7 with the delivery roller and the nip roller, a slack tube adapted to absorb the slack of the spun yarn Y with suction airflow, a mechanic compensator, or the like may be provided instead of the yarn storage device 11.

**[0085]** In the spinning machine 1, each device is arranged such that the spun yarn Y supplied at an upper side is wound at a lower side in a direction of a machine height. However, each device may be arranged such that the spun yarn Y supplied at the lower side is wound at the upper side.

**[0086]** In the spinning machine 1, at least one of the bottom rollers in the draft device 6, and the traverse guide 23 are driven by power from the second end frame 5 (that is, in common with the plurality of spinning units 2). However, each section (for example, the draft device 6, the pneumatic spinning device 7, the winding device 13, or the like) of the spinning unit 2 may be driven independently for each spinning unit 2.

**[0087]** In the travelling direction of the spun yarn Y, the tension sensor 9 may be arranged upstream of the yarn monitoring device 8. The unit controller 10 may be provided for every spinning unit 2. In the spinning unit 2, the waxing device 12, the tension sensor 9, and the yarn monitoring device 8 may be omitted.

**[0088]** FIG. 1 illustrates that the spinning machine 1 winds a cheese package P, but the spinning machine 1 can also wind a conical package P. In a case of the conical package P, a slack of the spun yarn Y occurs by traversing the spun yarn Y, but the slack can be absorbed with the yarn storage device 11.

**[0089]** Although some aspects have been described in the context of an apparatus, it is clear that these aspects also represent a description of the corresponding method, where a block or device corresponds to a method step or a feature of a method step. Analogously, aspects described in the context of a method step also represent a description of a corresponding block or item or feature of a corresponding apparatus.

## Claims

**1.** A core yarn supplying device (200) comprising:

a tension applying section (70) adapted to apply tension to a core yarn (C);
a slack applying section (80) adapted to apply slack to the core yarn (C);
a core yarn feeding section (101) adapted to feed the core yarn (C) at downstream of the tension applying section (70) and the slack applying section (80) in a travelling direction of the core yarn (C) ; and
a detecting section (90) adapted to detect status of the core yarn (C) at upstream of the tension applying section (70) in the travelling direction.

**2.** The core yarn supplying device (200) according to claim 1, wherein the detecting section (90) includes a casing having a groove with one end opened,
the core yarn supplying device (200) further comprising a first core yarn guide (62) having a closed portion at least at an end portion located at a same side as the opened one end of the groove, the first core yarn guide (62) being arranged with respect to the casing.

**3.** The core yarn supplying device (200) according to claim 2, further comprising a second core yarn guide (61) arranged upstream of the first core yarn guide (62) and adapted to guide the core yarn (C).

**4.** The core yarn supplying device (200) according to any one of claim 1 through claim 3, further comprising a clamping section (106) adapted to clamp the core yarn (C) at downstream of the core yarn feeding section (101) in the travelling direction.

**5.** The core yarn supplying device (200) according to any one of claim 1 through claim 4, wherein the detecting section (90) is an optical sensor having a light emitting section (91) adapted to emit light to the core yarn (C) and a light receiving section (92) adapted to receive the light.

**6.** The core yarn supplying device (200) according to claim 5, wherein the first core yarn guide (62) is a plate-like member with a hole, and the optical sensor is arranged within a region located between an inner surface of the casing and a downstream surface of the plate-like member of the first core yarn guide (62).

**7.** The core yarn supplying device (200) according to any one of claim 1 through claim 6, further comprising a unit base (60) adapted to support the tension applying section (70), the slack applying section (80), the core yarn feeding section (101), and the detecting section (90).

**8.** The core yarn supplying device (200) according to any one of claim 1 through claim 7, further comprising a package supporting section (50) arranged upstream of the slack applying section (80) and the detecting section (90) in the travelling direction, and adapted to support a package (CP) around which the core yarn (C) is wound.

**9.** A spinning machine (1) comprising:

the core yarn supplying device (200) according to any one of claim 1 through claim 8;
a draft device (6) adapted to draft a fiber bundle (F);
a pneumatic spinning device (7) adapted to form a yarn (Y) by applying twists to the fiber bundle (F) with the core yarn (C) as a core; and
a winding device (13) adapted to wind the yarn (Y) to form a package (P).

**10.** Method of supplying core yarn, the method comprising:

applying a slack to the core yarn (C) by a slack applying section (80), when feeding the core yarn (C) by a core yarn feeding unit (100) at downstream of the slack applying section (80) in a travelling direction of the core yarn (C); and
applying a tension to the core yarn (C) by a tension applying section (70) and detecting a status of the core yarn (C) at upstream of the tension applying section (70) in the travelling direction, when the core yarn (C) is being supplied to a feeding destination (6).

FIG. 1

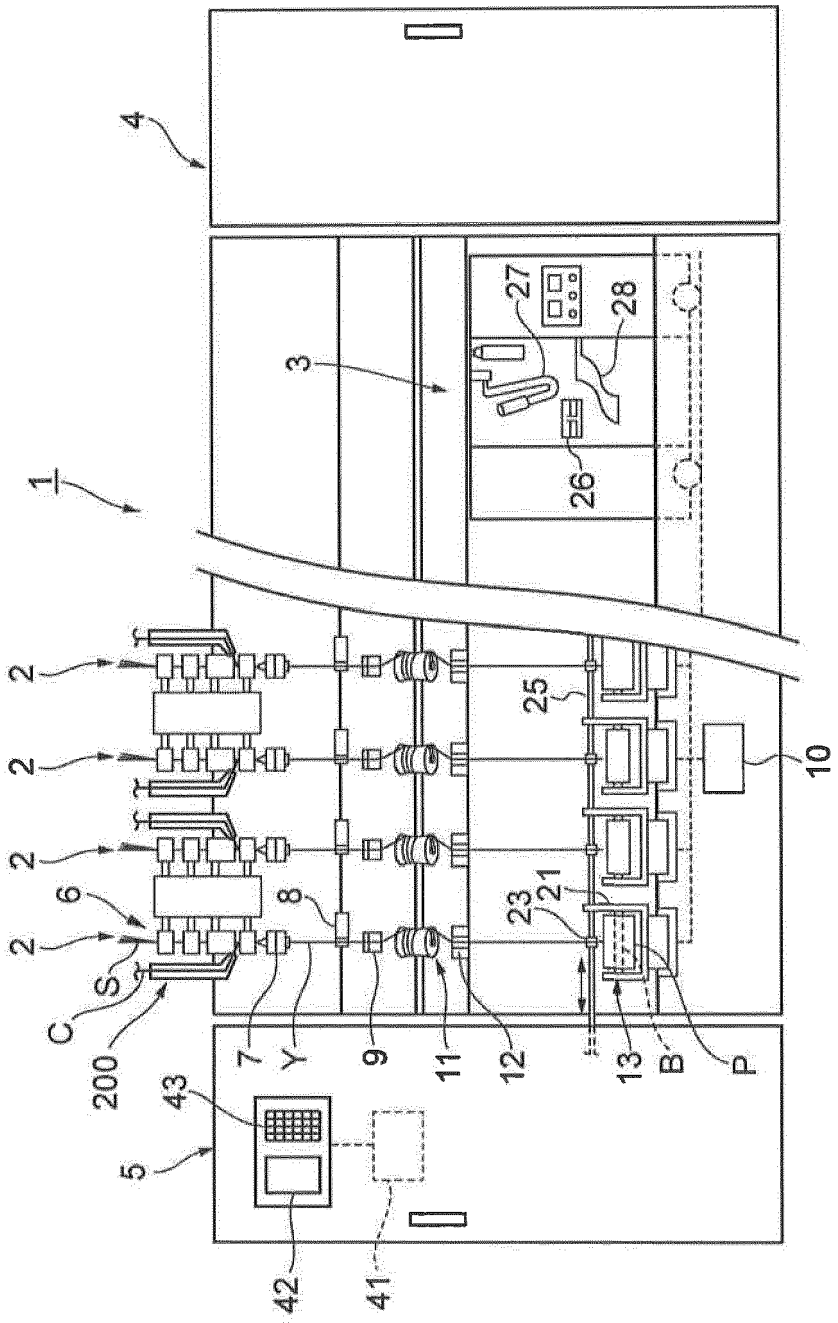


FIG. 2

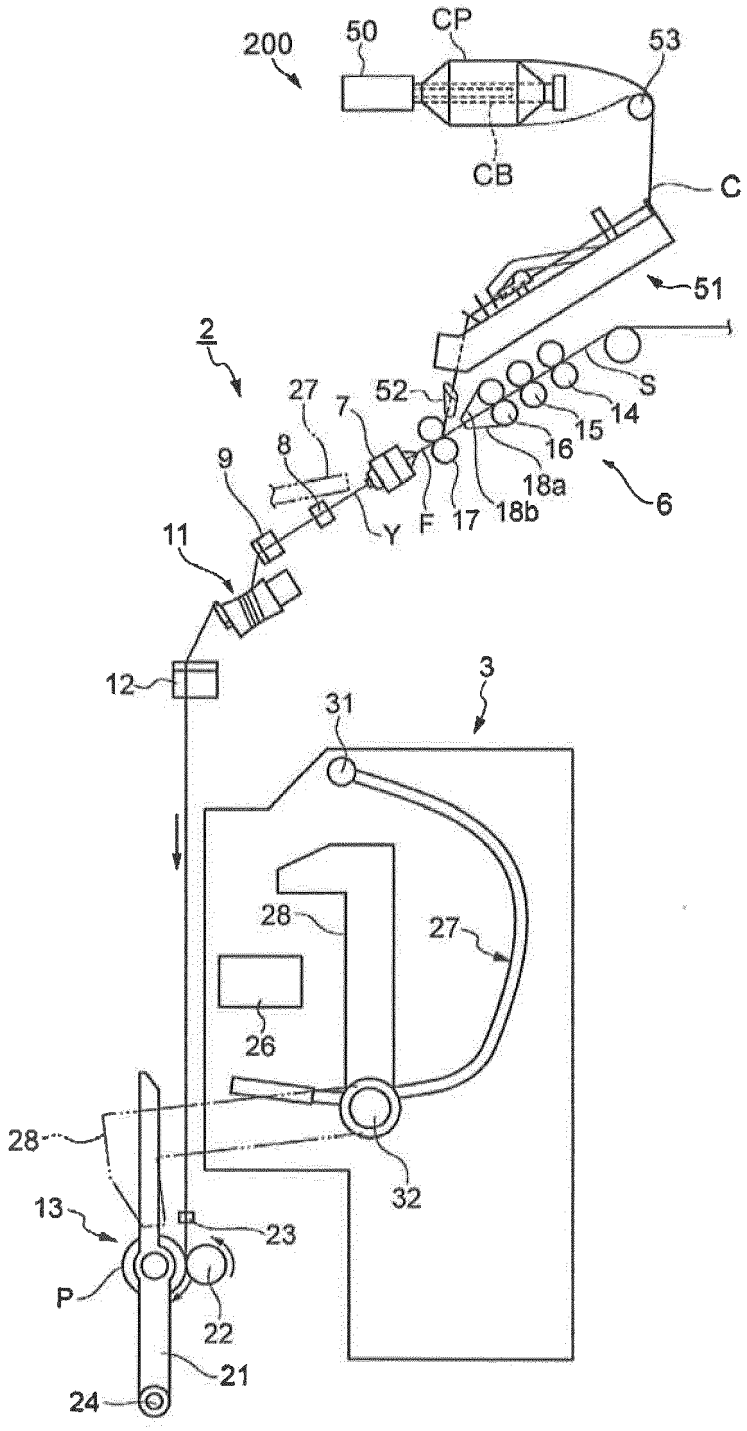

200
50
CP
53
CB
C
51
2
27
7
52
S
14
15
16
8
9
18a
6
Y
F
17
18b
11
12
3
31
28
27
26
28
32
13
23
P
22
21
24

FIG. 3

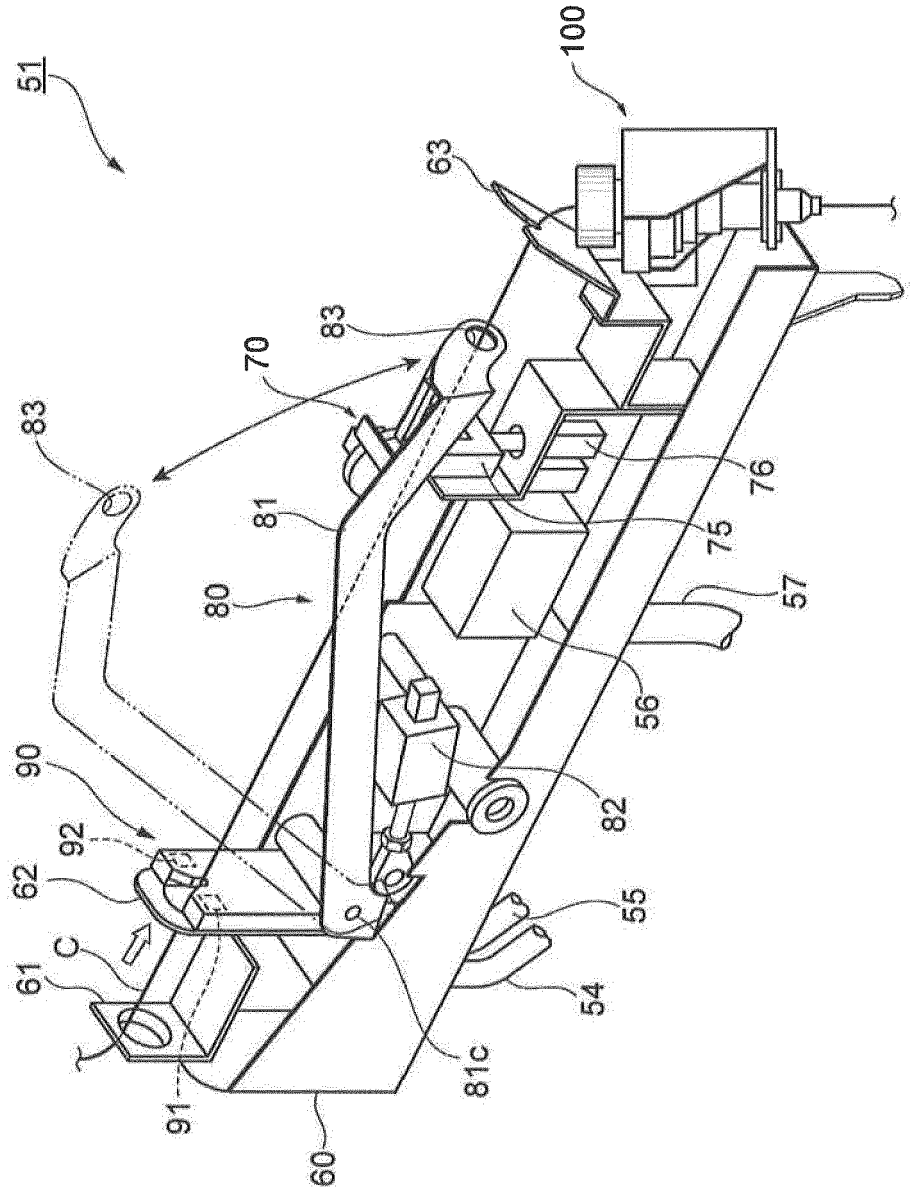


FIG. 4A

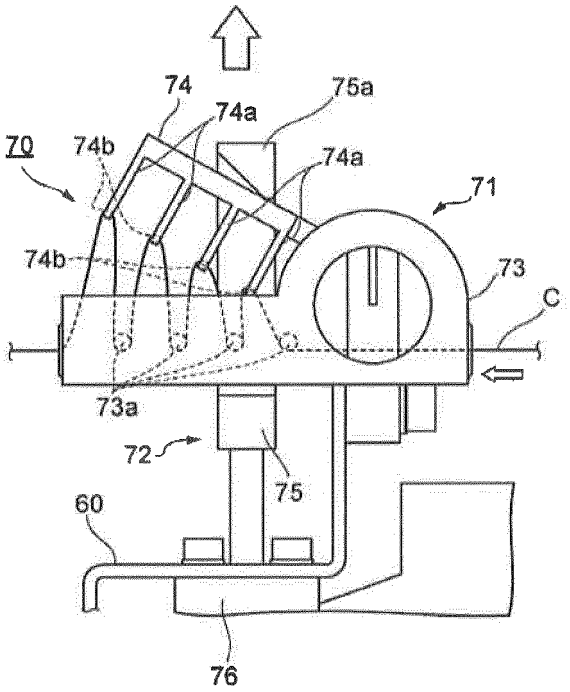
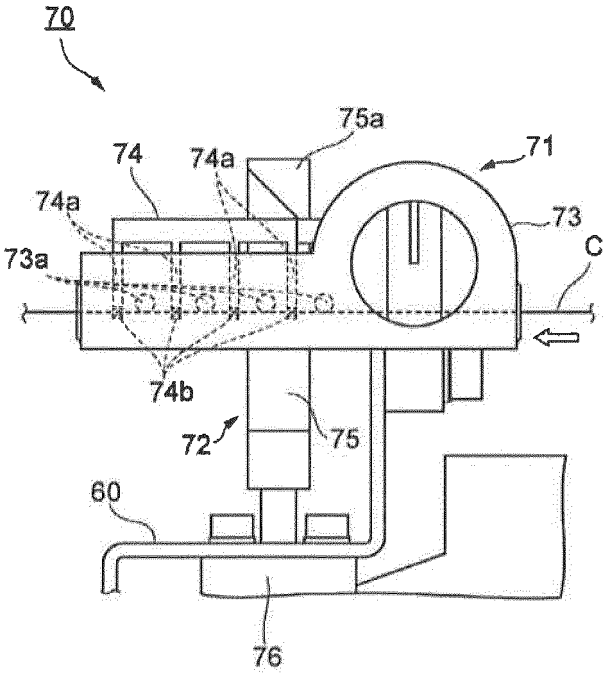

74
75a
74a
70
74b
74a
71
74b
73
C
73a
72
75
60
76

FIG. 4B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75a
74
74a
71
74a
73
C
73a
74b
72
75
60
76

FIG. 5

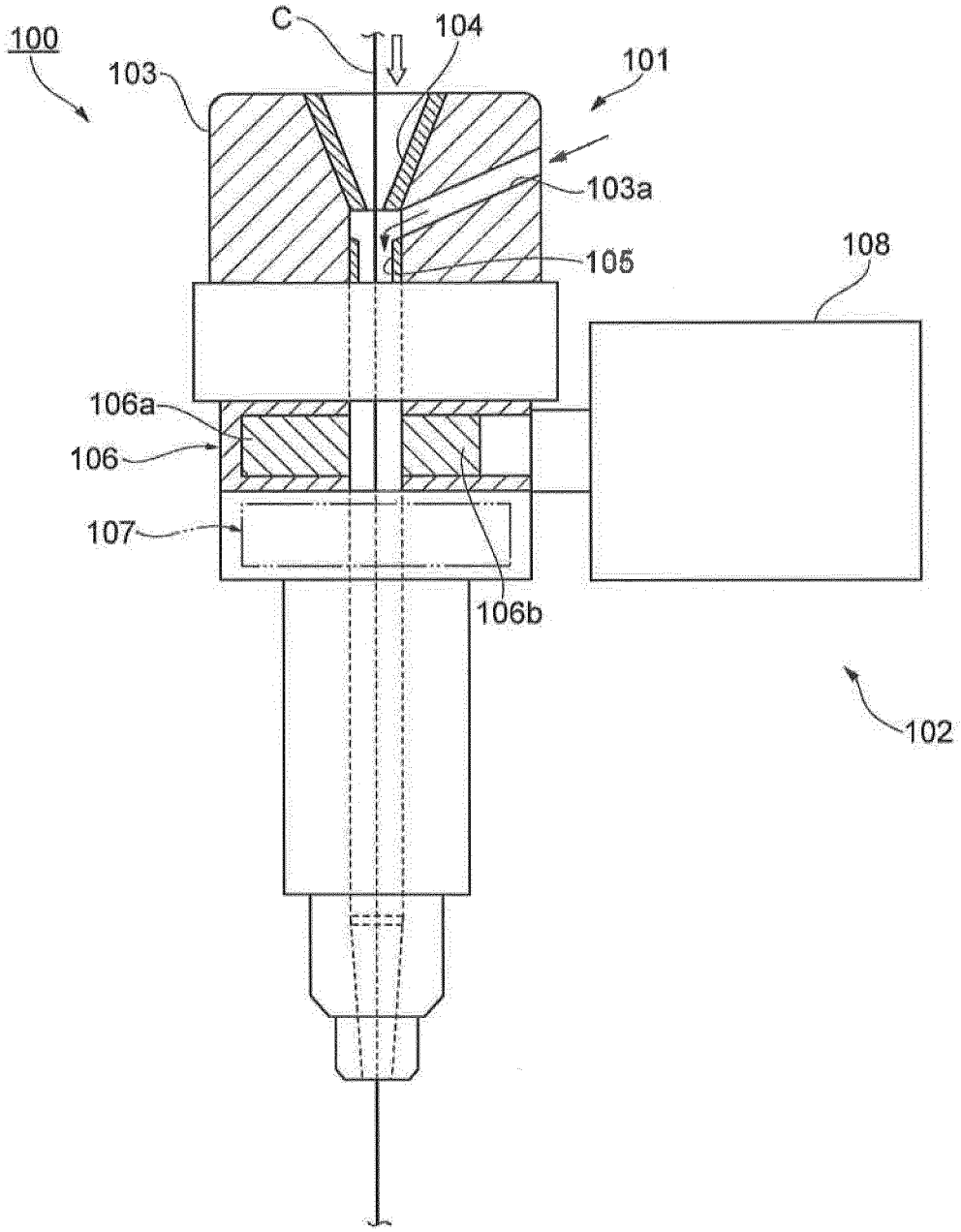


FIG. 6A

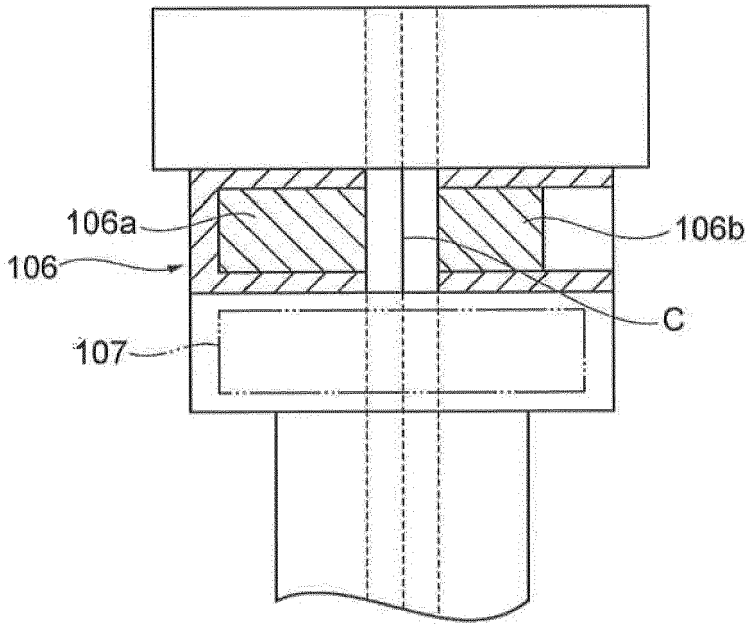



FIG. 6B

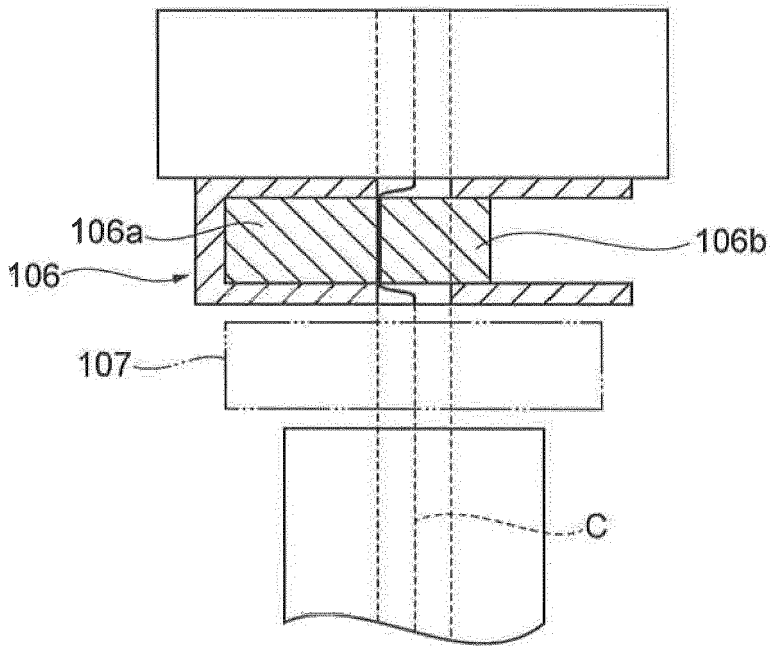


FIG. 7

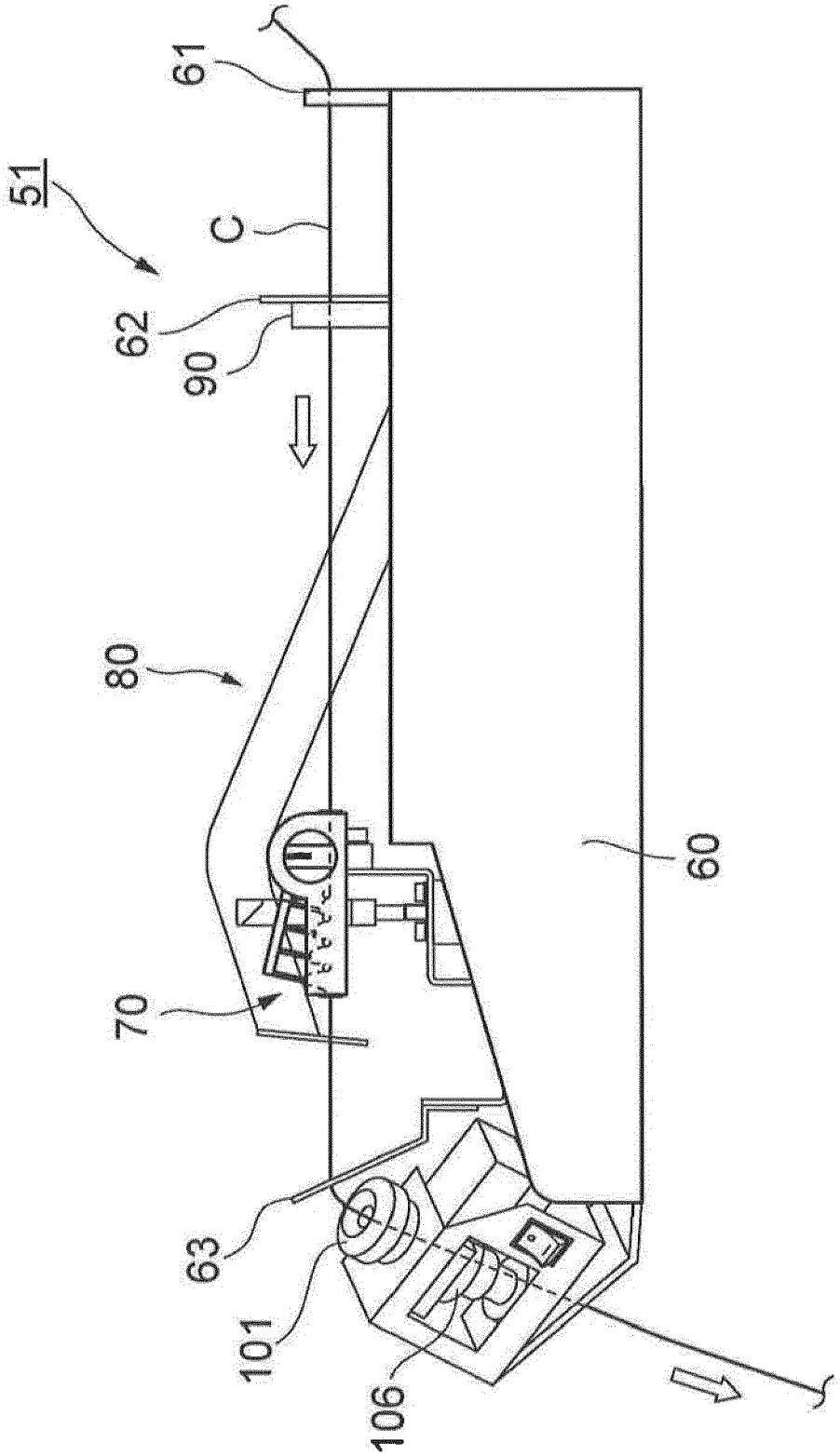
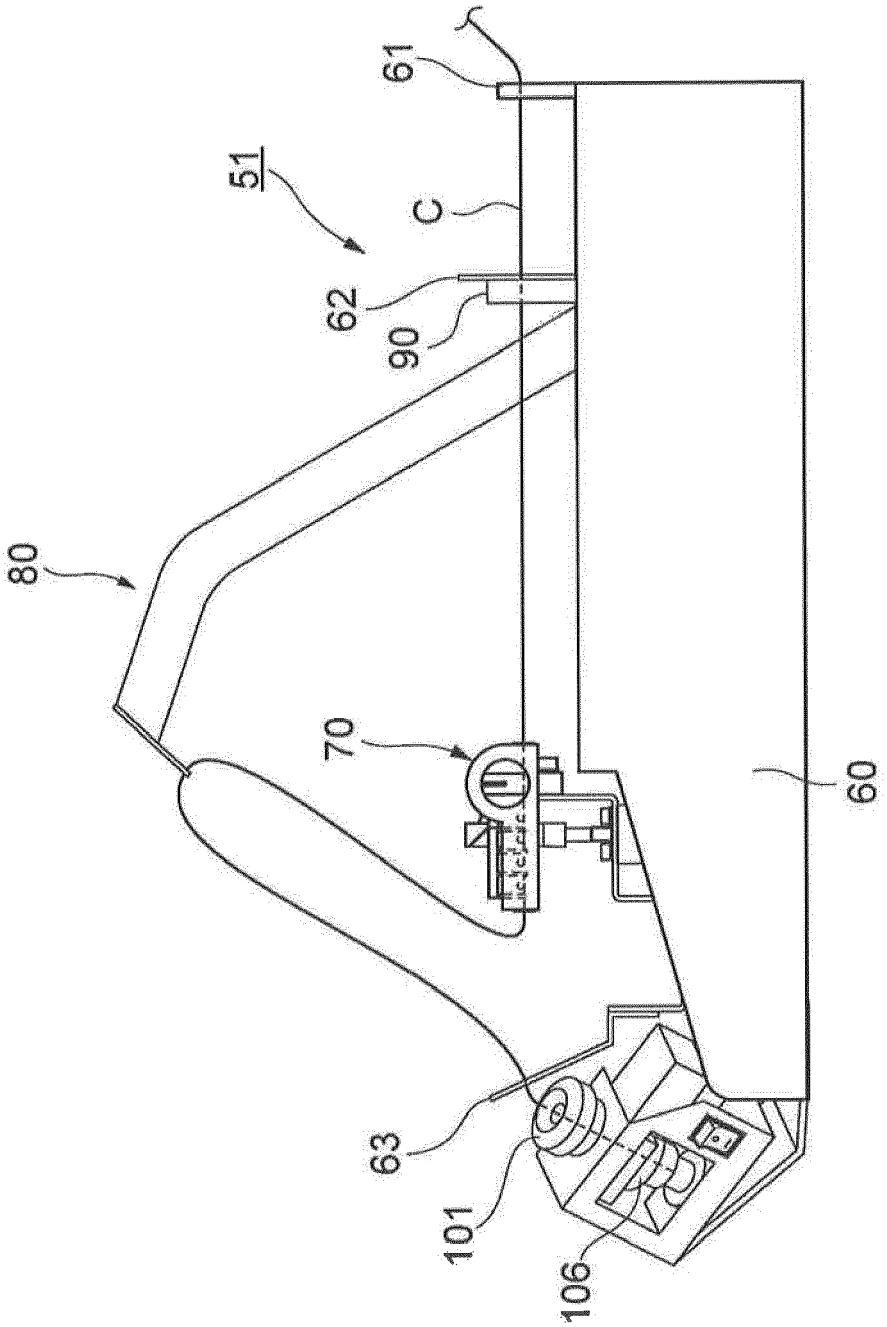


FIG. 8



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# EUROPEAN SEARCH REPORT

Application Number
EP 15 18 6903

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
|---|---|---|---|
| E | EP 2 966 202 A2 (MURATA MACHINERY LTD [JP]) 13 January 2016 (2016-01-13)<br>* paragraph [0047]; figure 3 * | 1-10 | INV.<br>D01H13/04<br>D02G3/36 |
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| A | JP H05 302225 A (MURATA MACHINERY LTD)<br>16 November 1993 (1993-11-16)<br>* abstract; figure 5 * | 1,9,10 | |
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D01H
D02G
B65H

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| Munich | 27 May 2016 | Pollet, Didier |

CATEGORY OF CITED DOCUMENTS

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## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 18 6903

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27-05-2016

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

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