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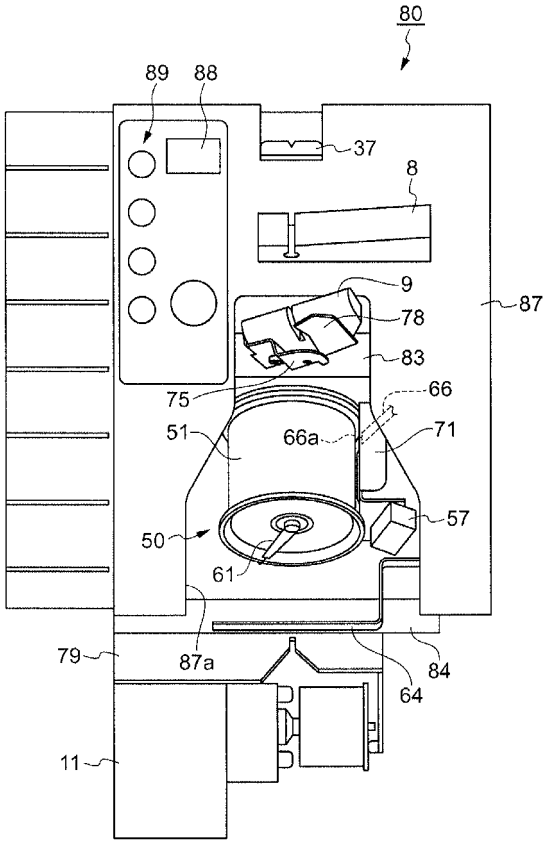
(54) Spinning unit and spinning machine

(57) A spinning unit includes a drafting device and a spinning device that supply a spun yarn, a winding device that winds the spun yarn to form a package, a unit frame that supports the drafting device, the spinning device, and the winding device, and a yarn processing module (80) that is detachably mounted on the unit frame. The yarn processing module (80) includes a yarn pooling device (50) that pools the spun yarn between the drafting device and the spinning device, and the winding device.

FIG.9



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a spinning unit that forms a spun yarn and winds the spun yarn to form a package, and a spinning machine that includes a plurality of such spinning units.

2. Description of the Related Art

[0002] Spinning units that include a yarn supplying device that supplies a spun yarn, a winding device that winds the spun yarn to form a package, and a yarn pooling device that is arranged between the yarn supplying device and the winding device and that pools the spun yarn are known in the art (for example, Japanese Patent Application Laid-open No. 2010-174421).

[0003] However, in the spinning unit such as the one mentioned above, there is a need to improve the efficiency of operations relating to the yarn pooling device, such as, assembling, operation check, and maintenance.

SUMMARY OF THE INVENTION

[0004] It is an object of the present invention to provide a spinning unit in which the operations relating to a yarn pooling device can be performed efficiently and a spinning machine that includes a plurality of such spinning units.

[0005] A spinning unit according to an aspect of the present invention includes a yarn supplying device adapted to supply a spun yarn, a winding device adapted to wind the spun yarn to form a package, a unit frame adapted to support the yarn supplying device and the winding device, and a yarn processing module that is detachably mounted on the unit frame. The yarn processing module includes a yarn pooling device adapted to pool the spun yarn between the yarn supplying device and the winding device.

[0006] A spinning machine according to another aspect of the present invention includes a plurality of the spinning units mentioned above.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007]

FIG. 1 is a front view of a spinning machine according to an embodiment of the present invention;
FIG. 2 is a side view of a spinning unit according to an embodiment of the present invention;
FIG. 3 is a perspective view of a yarn pooling device of the spinning unit shown in FIG. 2;
FIG. 4 is a perspective view of the yarn pooling device during a yarn-defect detection operation;
FIG. 5 is a side view of the spinning unit during the yarn-defect detection operation;
FIG. 6 is another side view of the spinning unit during the yarn-defect detection operation;
FIG. 7 is a side view of the spinning unit when a breakage of a yarn has occurred;
FIG. 8 is a perspective view of the yarn pooling device when a breakage of a yarn has occurred;
FIG. 9 is a front view of a yarn processing module of the spinning unit shown in FIG. 2;
FIG. 10 is a rear view of the yarn processing module shown in FIG. 9;
FIG. 11 is a side view of the yarn processing module shown in FIG. 9; and
FIG. 12 is a front view of a unit frame of the spinning unit shown in FIG. 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0008] Exemplary embodiments of the present invention are explained in detail below with reference to the accompanying drawings. In the drawings, the parts that are identical or equivalent have been assigned the same reference numerals and the description thereof is not repeated.

[0009] As shown in FIG. 1, a spinning machine 1 includes a plurality of spinning units 2, a yarn joining carrier 3, a blower box 4, and a motor box 5. The spinning units 2 are arranged side-by-side, and each spinning unit 2 forms a spun yarn Y and winds the spun yarn Y to form a package P. The yarn joining carrier 3 performs a yarn joining operation in the spinning unit 2 where a breakage of the spun yarn Y has occurred. The blower box 4 houses a not shown air supplying source, and suchlike, that produces a suction flow, a swirling airflow, etc., in various parts of the spinning unit 2. The motor box 5 houses a not shown motor, and suchlike, that supplies power to various parts of the spinning unit 2.

[0010] In the following explanation, the term "upstream side" refers to the side where the spun yarn Y is formed and the term "downstream side" refers to the side where the spun yarn Y is wound in a route in which the spun yarn Y runs (that is, a yarn path). The term "front side" is used for the side relative to the yarn joining carrier 3 where the yarn path is present and the term "backside" is used for the opposite side relative to the yarn joining carrier 3. The front side of the spinning machine 1 has a not shown working passage that extends along an arrangement direction of the spinning units 2. An operator therefore can perform operations on or monitor each of the spinning units 2 from the working passage.

[0011] As shown in FIGS. 1 and 2, each of the spinning units 2 includes, sequentially from the upstream side, a drafting device (yarn supplying device) 6, a spinning device (yarn supplying device) 7, a yarn clearer (yarn-defect detecting device) 8, a tension sensor (tension measuring device) 9, a yarn pooling device 50, a waxing device 11,

and a winding device 12. Each of the devices mentioned above is supported directly or indirectly by or on a frame 13 in such a way that the upstream side is located above (that is, the downstream side is located below). The yarn clearer 8, the tension sensor 9, the yarn pooling device 50, and the waxing device 11 form a yarn processing module 80 that is detachably mounted on the frame 13.

[0012] The drafting device 6 drafts a sliver S to form a fiber bundle F (that is, drafts the fiber bundle F). The drafting device 6 includes a pair of back rollers 14, a pair of third rollers 15, a pair of middle rollers 17 with an apron belt 16 stretched over them, and a pair of front rollers 18. The bottom roller of each of the pairs of the rollers 14, 15, 17, and 18 is driven at different rotational speed by the power from the motor box 5 or a not shown electric motor arranged in each of the spinning units 2. Because of the rotation of the rollers 14, 15, 17, and 18, the drafting device 6 drafts the sliver S supplied from the upstream side to form the fiber bundle F, and supplies the fiber bundle F to the spinning device 7 located on the downstream side.

[0013] The spinning device 7 is an air spinning device that twists the fiber bundle F using a swirling airflow to form the spun yarn Y. More specifically, the spinning device 7 includes the following not shown components: a spinning chamber, a fiber guiding section, a swirling-airflow producing nozzle, and a hollow guide shaft. The fiber guiding section guides the fiber bundle F supplied from the drafting device 6 on the upstream side into the spinning chamber. The swirling-airflow producing nozzle is arranged in the periphery of the route in which the fiber bundle F runs and produces the swirling airflow inside the spinning chamber. The swirling airflow causes yarn ends of the fiber bundle F guided into the spinning chamber to be reversed and whirled. The hollow guide shaft guides the spun yarn Y from inside the spinning chamber to outside of the spinning device 7.

[0014] The yarn clearer 8 monitors the running spun yarn Y between the spinning device 7 and the yarn pooling device 50 for any yarn defect, and sends a yarn-defect detection signal to a unit controller 10 upon detection of the yarn defect. For example, an abnormality in a thickness of the spun yarn Y or a foreign matter that is included in the spun yarn Y is detected as a yarn defect by the yarn clearer 8. The tension sensor 9 measures a tension of the running spun yarn Y between the spinning device 7 and the yarn pooling device 50, and sends a tension signal indicative of the measured tension to the unit controller 10. The waxing device 11 applies wax to the running spun yarn Y between the yarn pooling device 50 and the winding device 12. One unit controller 10 is arranged in each of the spinning units 2 and controls operations of the spinning unit 2.

[0015] The yarn pooling device 50 pools the running spun yarn Y between the spinning device 7 and the winding device 12. The yarn pooling device 50 has functions of stably drawing the spun yarn Y from the spinning device 7, preventing the spun yarn Y from slacking by pooling the spun yarn Y that is coming out of the spinning device 7 during the yarn joining operation by the yarn joining carrier 3, and preventing any variation in the tension of the spun yarn Y on the winding device 12 side from being conveyed to the spinning device 7 side by appropriately controlling the tension on the spun yarn Y on the winding device 12 side.

[0016] The winding device 12 forms a fully wound package P by winding the spun yarn Y into a package P. The winding device 12 includes a cradle arm 21, a winding drum 22, and a traverse device 23. The cradle arm 21 is swingably supported by a support shaft 24. The cradle arm 21 causes a surface of a bobbin B, which is rotatably supported, or a surface of the package P, which is formed by winding the spun yarn Y on the bobbin B, to be in contact with a surface of the winding drum 22 with an appropriate pressure. The winding drum 22 is driven by the not shown electric motor included in each of the spinning units 2. As the winding drum 22 rotates, the bobbin B or the package P that is in contact with the winding drum 22 also rotates. The traverse device 23 is driven by a shaft 25 that is common to a plurality of the spinning units 2, and causes the spun yarn Y to traverse a predetermined width on the spinning bobbin B or the package P.

[0017] The yarn joining carrier 3 moves to the spinning unit 2 where a breakage of the spun yarn Y has occurred and performs the yarn joining operation at the particular spinning unit 2. The yarn joining carrier 3 includes a splicer (yarn joining device) 26, a suction pipe 27, and a suction mouth 28. The suction pipe 27 is pivotably supported by a support shaft 31. The suction pipe 27 holds the end of the spun yarn Y on the spinning device 7 side by suction and guides it to the splicer 26. The suction mouth 28 is pivotably supported by a support shaft 32. The suction mouth 28 holds the end of the spun yarn Y on the winding device 12 side by suction and guides it to the splicer 26. The splicer 26 joins two ends of the spun yarn Y that have been pulled and brought together.

[0018] A structure of the yarn pooling device 50 is explained below. As shown in FIGS. 2 and 3, the yarn pooling device 50 includes a yarn pooling roller 51, an electric motor (driving motor) 55, a pooled-yarn-amount lower limit sensor 56, a pooled-yarn-amount upper limit sensor 57, a yarn hooking member 61, a yarn taking-off member 64, a suction mechanism 65, and a regulating member 71. A first guiding member 78 and a yarn-operation control member 75 are arranged sequentially from the upstream side between the spinning device 7 and the yarn pooling roller 51. A second guiding member 79 is arranged between the yarn pooling roller 51 and the winding device 12.

[0019] The yarn pooling roller 51 is fixed to a drive shaft of the electric motor 55 and is driven by the electric motor 55. The yarn pooling roller 51 includes a yarn pooling section 52, a base-end side tapering section 53, and a tip-end side tapering section 54. The yarn pooling section 52 is a cylindrical component around which the spun yarn

Y is wound and tapers slightly towards the tip end. The base-end side tapering section 53 widens from a base end section 52a of the yarn pooling section 52 where winding starts towards the upstream side. The tip-end side tapering section 54 widens from a tip end section 52b of the yarn pooling section 52 towards the downstream side.

[0020] The base-end side tapering section 53 receives the spun yarn Y being guided from the upstream side to the yarn pooling roller 51 and smoothly guides it to the base end section 52a of the yarn pooling section 52. Thus, the spun yarn Y is wound systematically from the base end side to the tip end side of the yarn pooling section 52. The tip-end side tapering section 54 prevents the spun yarn Y wound around the yarn pooling section 52 to come off all at once when the spun yarn Y is unwound from the yarn pooling roller 51 and smoothly guides the spun yarn Y from the yarn pooling roller 51 to the downstream side.

[0021] The pooled-yarn-amount lower limit sensor 56 is a non-contact sensor that detects presence or absence of the spun yarn Y on the yarn pooling roller 51, and is arranged on the rear side of the yarn pooling roller 51 facing the yarn pooling section 52. The pooled-yarn-amount lower limit sensor 56 sends a pooled-amount lower limit detection signal to the unit controller 10 when an amount of the spun yarn Y wound around the yarn pooling roller 51 reaches a lower limit. The pooled-yarn-amount upper limit sensor 57 is a non-contact sensor that detects presence or absence of the spun yarn Y on the yarn pooling roller 51, and is arranged by the side of the yarn pooling roller 51 facing the tip end section 52b of the yarn pooling section 52. The pooled-yarn-amount upper limit sensor 57 sends a pooled-amount upper limit detection signal to the unit controller 10 when an amount of the spun yarn Y wound around the yarn pooling roller 51 reaches an upper limit.

[0022] The yarn hooking member 61 is arranged on the winding device 12 side with respect to the yarn pooling roller 51, and engages with the spun yarn Y and winds it around the yarn pooling roller 51. The yarn hooking member 61 includes a flier shaft 62 and a flier 63. The flier shaft 62 is supported on the tip end side of the yarn pooling roller 51 so as to rotate relative to and coaxially with the yarn pooling roller 51. The flier 63 is fixed to the tip end of the flier shaft 62 and is bent over the tip-end side tapering section 54 of the yarn pooling roller 51 so as to be able to engage with the spun yarn Y. A magnetic force is caused to act between the yarn pooling roller 51 and the flier shaft 62. In order for the yarn hooking member 61 to rotate relative to the yarn pooling roller 51, the yarn hooking member 61 produces a torque greater than or equal to a predetermined value.

[0023] The yarn taking-off member 64 takes off the spun yarn Y from the yarn hooking member 61, and is arranged near the tip-end side tapering section 54 of the yarn pooling roller 51. The yarn taking-off member 64 is supported so as to be swingable between a descent position and an ascent position. The descent position is a position that is retracted from the yarn path. The ascent position is a position at which the yarn taking-off member 64 pushes up the spun yarn Y in the yarn path to take off the spun yarn Y from the yarn hooking member 61. The yarn taking-off member 64 is normally biased to be in the descent position side by a not shown spring; however, during the yarn joining operation, and suchlike, the yarn taking-off member 64 is moved to the ascent position by a not shown air pressure cylinder provided in the yarn joining carrier 3.

[0024] The suction mechanism 65 produces a suction airflow in a suction vent 66a arranged facing the base-end side tapering section 53 of the yarn pooling roller 51. The suction vent 66a is provided at one end of a pipe-shaped member 66. The other end of the pipe-shaped member 66 is connected via a not shown pipe to a not shown fiber-waste collecting chamber, which is common to the suction pipe 27 and the suction mouth 28. As explained later, when a breakage of the spun yarn Y occurs on the spinning device 7 side, the end of the spun yarn Y sways about on the base end section 52a side of the yarn pooling section 52, and is subjected to the action of the suction airflow produced at the suction vent 66a. Thus, most fiber waste from the yarn end is removed by the suction mechanism 65 and is prevented from being scattered.

[0025] The regulating member 71 is a plate member that is arranged to the side of the yarn pooling roller 51 (facing the yarn pooling section 52), and includes a first regulating section 72, a second regulating section 73, and a third regulating section 74. The first regulating section 72 is located at the upstream of the suction vent 66a in a rotation direction of the yarn pooling roller 51 during winding of the spun yarn Y. The second regulating section 73 is located at the downstream of the suction vent 66a in the above rotation direction. The first regulating section 72 and the second regulating section 73 are arranged facing the base end section 52a of the yarn pooling section 52. The first regulating section 72 and the second regulating section 73 regulate the movement of the end of the spun yarn Y that sways about on the base end section 52a side of the yarn pooling section 52 when a breakage of the spun yarn Y occurs on the spinning device 7 side, such that the swaying end of the spun yarn Y is prevented from being moved to the tip end section 52b side of the yarn pooling section 52 before the spun yarn Y is orderly unwound from the tip end section 52b of the yarn pooling section 52. The third regulating section 74 is arranged facing the yarn pooling section 52. The third regulating section 74 regulates the movement of the end of the spun yarn Y that sways about on the tip end section 52b side of the yarn pooling section 52 when a breakage of the spun yarn Y occurs on the winding device 12 side, such that the swaying end of the spun yarn Y is prevented from being moved to the base end section 52a side of the yarn pooling section 52 before the spun yarn Y is orderly unwound from the base end section 52a of the yarn pooling section 52. The pooled-yarn-amount up-

per limit sensor 57 is mounted at a bottom end of the regulating member 71.

[0026] The yarn operation control member 75 is a plate member mounted at the upstream of the yarn pooling roller 51 (in the present embodiment, on the bottom surface (end face on the downstream side) of the tension sensor 9), and includes a guiding component 76 and a regulating component 77. The guiding component 76 applies tension to the spun yarn Y and guides the spun yarn Y to the base-end side tapering section 53 of the yarn pooling roller 51, and prevents the twisting of the spun yarn Y coming from the spinning device 7 from being conveyed further downstream of the guiding component 76. When there is a breakage of the spun yarn Y on the spinning device 7 side, the regulating component 77 prevents the end of the spun yarn Y from being displaced from the yarn path of the spun yarn Y guided to the yarn pooling device 50 and from moving to the yarn hooking member 61 side by passing over the yarn pooling roller 51.

[0027] The first guiding member 78 is a plate member mounted at the upstream of the yarn pooling roller 51 (in the present embodiment, on the bottom surface (end face on the downstream side) of the tension sensor 9), and guides the spun yarn Y from a slit formed on a casing of the tension sensor 9 to a designated detection position inside the casing. The second guiding member 79 is a plate member mounted on the downstream side of the yarn pooling roller 51 (in the present embodiment, on a module frame 81 of the yarn processing module 80). The second guiding member 79 guides the spun yarn Y to a designated position of the waxing device 11 and regulates a track of the spun yarn Y being swayed about by the rotating yarn hooking member 61, stabilizing the running of the spun yarn Y further downstream of the second guiding member 79.

[0028] An operation of the yarn pooling device 50 is explained below. When the spinning unit 2 is operating normally by forming the spun yarn Y and winding the spun yarn Y to form the package P, the electric motor 55 drives the yarn pooling roller 51 at a substantially constant rotational speed. The yarn hooking member 61 integrally rotates with the yarn pooling roller 51, and the flier 63 engages with the spun yarn Y. The yarn hooking member 61, which is rotating with the spun yarn Y engaged thereon, winds the spun yarn Y around the rotating yarn pooling roller 51.

[0029] Once the spun yarn Y is wound around the yarn pooling roller 51, the unit controller 10 exerts control over the operation of the spinning unit 2. The unit controller 10 exerts this control based on the pooled-amount lower limit detection signal received from the pooled-yarn-amount lower limit sensor 56 and the pooled-amount upper limit detection signal received from the pooled-yarn-amount upper limit sensor 57, so that the pooled amount of the spun yarn Y that is wound around the yarn pooling roller 51 is greater than or equal to the lower limit and less than or equal to the upper limit. When the pooled amount of the spun yarn Y wound around the yarn pooling roller 51 is greater than or equal to the lower limit, the surface area of a contact between the yarn pooling section 52 of the yarn pooling roller 51 and the spun yarn Y increases. Consequently, there is almost no slippage, and suchlike, between the yarn pooling section 52 and the spun yarn Y. Therefore, the yarn pooling device 50 can draw the spun yarn Y stably (that is, while maintaining a substantially constant quality and speed) from the spinning device 7 by the rotation of the yarn pooling roller 51.

[0030] When the tension on the spun yarn Y on the winding device 12 side increases in the state where the spun yarn Y is wound around the yarn pooling roller 51, a force that causes the yarn hooking member 61 to rotate relative to the yarn pooling roller 51 (that is, a force that causes the rotation of the yarn hooking member 61 to stop) acts on the flier 63. When the torque produced in the yarn hooking member 61 increases to a value greater than or equal to a predetermined value as a consequence of the force, the yarn hooking member 61 rotates relative to the yarn pooling roller 51. Consequently, the spun yarn Y is unwound from the yarn pooling roller 51. When the tension on the spun yarn Y on the winding device 12 side decreases and the torque produced in the yarn hooking member 61 reduces to less than the predetermined value, the yarn hooking member 61 rotates integrally with the yarn pooling roller 51. Consequently, the spun yarn Y is wound around the yarn pooling roller 51. In this manner, the yarn pooling device 50 adjusts the tension on the spun yarn Y on the winding device 12 side and thereby prevents the variation in the tension on the spun yarn Y that occurs on the winding device 12 side from being conveyed to the spinning device 7 side.

[0031] An operation of the spinning unit 2 during a yarn-defect detection operation is explained below. When the yarn clearer 8 detects a defect while the spinning unit 2 is operating normally by forming the spun yarn Y and winding the spun yarn Y to form the package P, the yarn clearer 8 sends the yarn-defect detection signal to the unit controller 10. The unit controller 10 stops the operation of the drafting device 6, the spinning device 7, etc., immediately upon receiving the yarn-defect detection signal. Consequently, the fiber bundle F is not subjected to twisting, and the spun yarn Y is cut on the spinning device 7 side.

[0032] Even if the spun yarn Y is cut on the spinning device 7 side, the unit controller 10 causes the rotation of the yarn pooling roller 51 and the winding by the winding device 12 to be continued. Consequently, as shown in FIG. 4, the cut end of the spun yarn Y is wound around the yarn pooling roller 51. While the spun yarn Y is unwound from the yarn pooling roller 51 to the winding device 12, the cut end of the spun yarn Y sways about on the base end section 52a side of the yarn pooling section 52. The swaying end of the spun yarn Y is prevented from moving to the tip end section 52b of the yarn pooling section 52 by the first regulating section 72 of the regulating member 71, and is subjected to the suction airflow

produced by the suction vent 66a. Consequently, the spun yarn Y is smoothly unwound from the yarn pooling roller 51 to the winding device 12 side. While the unwinding of the spun yarn Y is taking place, the fiber waste from the yarn end on the upstream side is removed by the suction mechanism 65 and is prevented from being scattered.

[0033] When the winding device 12 winds the spun yarn Y up to the cut end into the package P, the unit controller 10 sends a control signal that specifies the spinning unit 2 in which the spun yarn Y has been cut to the yarn joining carrier 3. Consequently, the yarn joining carrier 3 moves to a position in front of the specified spinning unit 2, and commences the yarn joining operation.

[0034] As shown in FIG. 5, the suction mouth 28 turns to a position near the surface of the package P and produces the suction airflow while the winding device 12 causes a reverse rotation of the package P. Consequently, the suction mouth 28 draws and holds by suction the end of the spun yarn Y from the surface of the package P. Thereafter, as shown in FIG. 6, the suction mouth 28 turns to its original position (standby position) and guides the end of the spun yarn Y on the winding device 12 side into the splicer 26. During this operation, the winding device 12 stops the rotation of the package P.

[0035] Meanwhile, as shown in FIG. 5, the suction pipe 27 pivots to a position at the downstream of the spinning device 7 and produces the suction airflow. Because during this operation the unit controller 10 restarts the operations of the drafting device 6, the spinning device 7, etc., the suction pipe 27 holds the end of the spun yarn Y that is formed. Thereafter, as shown in FIG. 6, the suction pipe 27 pivots to the original position (standby position), and guides the end of the spun yarn Y on the spinning device 7 side to the splicer 26.

[0036] When the end of the spun yarn Y on the winding device 12 side and the end of the spun yarn Y on the spinning device 7 side are guided into the splicer 26, the yarn hooking member 61 in the yarn pooling device 50 engages with the spun yarn Y on the spinning device 7 side and winds the spun yarn Y around the yarn pooling roller 51 with which the yarn hooking member 61 is integrally rotating. Consequently, almost no slack occurs in the spun yarn Y coming out of the spinning device 7, even if the winding by the winding device 12 is stopped. Thus, during the yarn joining operation, etc., by the yarn joining carrier 3, the yarn pooling device 50 pools the spun yarn Y coming out of the spinning device 7, thereby preventing the spun yarn Y from slacking.

[0037] When the pooled amount of the spun yarn Y wound around the yarn pooling roller 51 reaches the lower limit, almost no slippage, and suchlike, takes place between the yarn pooling section 52 of the yarn pooling roller 51 and the spun yarn Y. Consequently, the spun yarn Y is drawn stably (that is, while maintaining a substantially constant quality and speed) from the spinning device 7. The unit controller 10 causes the yarn taking-off member 64 to move from the descent position to the ascent position where the yarn taking-off member 64 take off the spun yarn Y from the yarn hooking member 61.

[0038] When the spun yarn Y is taken off from the yarn hooking member 61 while the yarn pooling roller 51 is rotating as described above, there is almost no resistance to prevent the unwinding of the spun yarn Y from the yarn pooling roller 51. Consequently, the spun yarn Y that is wound around the yarn pooling roller 51 before the pooled amount of the spun yarn Y reaches the lower limit (that is, the spun yarn Y with an unstable quality) is unwound from the yarn pooling roller 51 and sucked into the suction pipe 27. Even during this operation, because the spun yarn Y is stably drawn from the spinning device 7 and wound around the yarn pooling roller 51, an amount of the pooled spun yarn Y that is greater than or equal to the lower limit can be attained.

[0039] Once the spun yarn Y with an unstable quality is removed by the suction pipe 27, the unit controller 10 causes the yarn taking-off member 64 to move from the ascent position to the descent position. Consequently, the spun yarn Y on the spinning device 7 side is engaged by the yarn hooking member 61, and no unwinding of the spun yarn Y at the downstream of the yarn pooling roller 51 occurs. The splicer 26 joins the end of the spun yarn Y on the winding device 12 side and the end of the spun yarn Y on the spinning device 7 side. Unnecessary yarn ends cut by the splicer 26 are removed by the suction pipe 27 and the suction mouth 28. Once the yarn joining operation by the splicer 26 is completed, the unit controller 10 causes the winding operation by the winding device 12 to restart.

[0040] An operation of the spinning unit 2 when a breakage of the spun yarn Y has occurred is explained next. As shown in FIG. 7, when the spinning unit 2 is operating normally by forming the spun yarn Y and winding the spun yarn Y to form the package P, if a breakage in the spun yarn Y occurs further downstream of the yarn pooling device 50, no spun yarn Y is detected by a not shown yarn detecting sensor arranged at the downstream of the yarn pooling device 50. Based on this, the unit controller 10 judges that a breakage of the spun yarn Y has occurred between the yarn pooling device 50 and the winding device 12, and immediately stops the operations of the drafting device 6, the spinning device 7, etc. Consequently, the fiber bundle F is not subjected to twisting and the spun yarn Y is cut on the spinning device 7 side as well.

[0041] Even if the spun yarn Y is cut on the spinning device 7 side, the unit controller 10 causes the rotation of the yarn pooling roller 51 and the winding by the winding device 12 to be continued. Consequently, the cut end of the spun yarn Y is wound around the yarn pooling roller 51 and sways about on the base end section 52a side of the yarn pooling section 52. The swaying end of the spun yarn Y is prevented from moving to the tip end section 52b side of the yarn pooling section 52 by the first regulating section 72 of the regulating member 71, and is subjected to the suction airflow produced by the suction

vent 66a. Consequently, the fiber waste from the yarn end on the upstream side is removed by the suction mechanism 65 and is prevented from being scattered.

[0042] Because the spun yarn Y that is wound around the yarn pooling roller 51 is cut on the downstream side as well, it does not get unwound from the yarn pooling roller 51 on the downstream side. Consequently, the unit controller 10 causes the yarn pooling roller 51 to stop positive rotation (rotation in the normal direction) and start reverse rotation. The upstream end of the spun yarn Y wound around the yarn pooling roller 51 is prevented from moving to the tip end section 52b side of the yarn pooling section 52 by the second regulating section 73 of the regulating member 71. Consequently, as shown in FIG. 8, the upstream yarn end is reliably held by suction by the suction vent 66a of the suction mechanism 65. Furthermore, the downstream end of the spun yarn Y wound around the yarn pooling roller 51 is prevented from moving to the base end section 52a side of the yarn pooling section 52 by the third regulating section 74 of the regulating member 71. Therefore, the spun yarn Y wound around the yarn pooling roller 51 is smoothly unwound from the base end section 52a side of the yarn pooling section 52 and sucked in by the suction mechanism 65.

[0043] Once the spun yarn Y wound around the yarn pooling roller 51 is removed by the suction mechanism 65, the unit controller 10 causes the yarn pooling roller 51 to stop the reverse rotation and start the positive rotation. The unit controller 10 sends a control signal that specifies the spinning unit 2 in which the spun yarn Y has been cut to the yarn joining carrier 3. Consequently, the yarn joining carrier 3 moves to a position in front of the specified spinning unit 2, and performs the yarn joining operation.

[0044] A structure of the yarn processing module 80 is explained below. The yarn processing module 80 shown in FIGS. 9 and 10 is detachably mounted on a unit frame 40 shown in FIG. 12. As shown in FIG. 12, the unit frame 40 is a part of the frame 13 of the spinning machine 1, and supports the drafting device 6, the spinning device 7, the winding device 12, etc., directly or indirectly.

[0045] As shown in FIGS. 9 and 10, the yarn processing module 80 includes the module frame 81, which includes a pair of side frames 82, a middle frame 83, a bottom frame 84, and a front frame 85. The middle frame 83 extends between the pair of the side frames 82 in the middle portion thereof. The bottom frame 84 extends between the pair of the side frames 82 on the bottom ends thereof. The front frame 85 extends between the pair of the side frames 82 above the middle frame 83. In the following explanation, of the spaces between the pair of the side frames 82, the space above the middle frame 83 will be referred to as an upper space S1, and the space below the middle frame 83 will be referred to as a lower space S2.

[0046] The yarn processing module 80 includes the yarn pooling device 50. Of the components of the yarn pooling device 50, the electric motor 55 is arranged in the upper space S1 and mounted on the middle frame 83 with the drive shaft thereof being projected below the middle frame 83. The yarn pooling roller 51 is arranged in the lower space S2 and fixed to the drive shaft of the electric motor 55. The yarn hooking member 61 is arranged in the lower space S2 and supported to rotate coaxially with the yarn pooling roller 51 on the tip end side of the yarn pooling roller 51. The yarn taking-off member 64 is arranged in the lower space S2 and swingably supported on one side frame 82.

[0047] The regulating member 71 is arranged in the lower space S2, mounted on the middle frame 83, and located to the side of the yarn pooling roller 51. The pooled-yarn-amount lower limit sensor 56 is arranged in the lower space S2 and mounted on the middle frame 83 via a bracket 86. The pooled-yarn-amount upper limit sensor 57 is arranged in the lower space S2 and mounted on the bottom end of the regulating member 71. The regulating member 71 is mounted on the middle frame 83 in such a way as to protrude further behind than the yarn pooling roller 51 (see FIG. 11). This prevents the yarn pooling roller 51 from getting damaged when the yarn processing module 80 is placed on the working passage with its back-face side facing down.

[0048] Of the components of the suction mechanism 65, the pipe-shaped member 66 is arranged in the lower space S2 and the suction vent 66a is mounted on the middle frame 83 in such a way that the suction vent 66a faces the base-end side tapering section 53 of the yarn pooling roller 51. The other end of the pipe-shaped member 66 is connected to one end of a module pipe 34 arranged in the upper space S1. The other end of the module pipe 34 is connected, for example, to a rectangular box-shaped connection member 35. The connection member 35 is arranged in the upper space S1 and mounted on the front frame 85. An opening 36 that communicates with the module pipe 34 is provided on a back-end face 35a of the connection member 35 (connection end of the module pipe) (first connection end).

[0049] The yarn processing module 80 further includes, sequentially from the upstream side, a guiding member 37, the yarn clearer 8, the tension sensor 9, the first guiding member 78, the yarn-operation control member 75, the second guiding member 79, and the waxing device 11. The guiding member 37 guides the spun yarn Y to a predetermined position of the yarn clearer 8 from the front.

[0050] The guiding member 37, the yarn clearer 8, and the tension sensor 9 are mounted on the front frame 85 in such a way that the yarn path runs in front of the front frame 85. The yarn clearer 8 penetrates the front frame 85. A port 8a that electrically connects the yarn clearer 8 with the unit controller 10 is disposed on the backside of the front frame 85. The first guiding member 78 and the yarn operation control member 75 are mounted on the bottom face of the tension sensor 9 in front of the front frame 85. The second guiding member 79 and the

waxing device 11 are mounted on the bottom frame 84 in such a way that the yarn path is disposed in front thereof.

[0051] Circuit boards 38 that control a corresponding component of the yarn processing module 80, including a motor control section that controls the rotation of the electric motor 55, are arranged in the upper space S1. Each of the circuit boards 38 is mounted on the front frame 85. Each of the circuit boards 38 includes a connector 38a that electrically connects the circuit board 38 with the unit controller 10.

[0052] A front panel 87 is mounted in a front portion of the module frame 81. The front panel 87 has a notch 87a that exposes from the front the yarn pooling roller 51, the yarn hooking member 61, and the yarn taking-off member 64 that are arranged in the lower space S2. A display section 88 and an operation section 89 that are electrically connected to the circuit boards 38 are provided on the front panel 87. The display section 88 displays the operation status of the spinning unit 2. The operation section 89 includes a set of operating buttons that can be operated by an operator to give operating instructions for the spinning unit 2.

[0053] As shown in FIG. 11, a guided groove (guided section) 82a that opens to the backside is provided on each one of the pair of the side frames 82. As shown in FIG. 12, a guiding pin (guiding section) 41a that protrudes inward is provided on each one of a pair of vertical frames 41 of the unit frame 40. The module frame 81 is positioned on the unit frame 40 by engaging the guiding pins 41a in the guided grooves 82a. With the module frame 81 positioned on the unit frame 40 in this manner, the bottom frame 84 is secured to a lower horizontal frame 42 of the unit frame 40 with a screw. That is, the module frame 81 of the yarn processing module 80 is detachably secured to the unit frame 40.

[0054] A rectangular box-shaped connection member 44 is mounted on an upper horizontal frame 43 of the unit frame 40. The connection member 44 is connected to the blower box 4 via a unit pipe 45 in which air circulates. An opening 46 that communicates with the unit pipe 45 is provided on a front-end face 44a of the connection member 44 (connection end of the unit pipe) (second connection end). An elastic member 47 of a predetermined thickness is mounted surrounding the opening 46. When the module frame 81 is positioned on the unit frame 40 and secured, the back-end face 35a of the connection member 35 of the yarn processing module 80 faces the front-end face 44a of the connection member 44 and presses down the elastic member 47, thereby connecting the module pipe 34 of the yarn processing module 80 to the unit pipe 45. Thus, the module pipe 34 is detachably connected to the unit pipe 45, and a connecting direction of the module pipe 34 to the unit pipe 45 substantially matches with a guidance direction of the guiding pins 41a in the guided grooves 82a (front to back direction in the present embodiment).

[0055] A wire 48 that is electrically connected to the unit controller 10 extends near the unit frame 40. A connector 48a that is connected to the port 8a of the yarn clearer 8 is provided at the end of the wire 48. Wires 49 that are electrically connected to the unit controller 10 extend near the unit frame 40. A connector 49a that is connected to the connector 38a of each of the circuit boards 38 is provided at the end of each of the wires 49. Consequently, the operator can fit the yarn processing module 80 into or detach the yarn processing module 80 from the unit frame 40 from the side of the working passage provided on the front of the spinning machine 1 by connecting or detaching the port 8a and the connector 48a and connecting or detaching the connectors 38a and the connectors 49a concurrently.

[0056] Thus, as explained above, in the spinning unit 2, the yarn processing module 80 that includes the yarn pooling device 50 is detachably mounted on the unit frame 40. Because the yarn pooling device 50 is arranged in the yarn processing module 80 that is detachably mounted on the unit frame 40, in the spinning unit 2, operations relating to the yarn pooling device 50, such as, assembling, operation check, and maintenance can be performed efficiently. The yarn processing module 80 is fitted on the front of the unit frame 40. Furthermore, the guidance direction of the guiding pins 41a in the guided grooves 82a and the connecting direction of the module pipe 34 to the unit pipe 45 are both front to back. Consequently, the operator can easily access the yarn processing module 80 of each of the spinning units 2 from the working passage provided on the front of the spinning machine 1.

[0057] The yarn pooling device 50 includes the yarn pooling roller 51, the electric motor 55, the circuit board 38, the pooled-yarn-amount lower limit sensor 56, the pooled-yarn-amount upper limit sensor 57, the suction mechanism 65, the yarn hooking member 61, and the yarn taking-off member 64. Consequently, the operations relating to these components of the yarn pooling device 50 can be performed easily and reliably.

[0058] The yarn processing module 80 includes the display section 88, the operation section 89, the yarn clearer 8, the tension sensor 9, and the waxing device 11. Consequently, the operations relating to the yarn pooling device 50 as well as those relating to the display section 88, the operation section 89, the yarn clearer 8, the tension sensor 9, and the waxing device 11 can be performed efficiently.

[0059] One guided groove 82a that opens on the backside is provided in each one of the pair of the side frames 82 of the yarn processing module 80. One guiding pin 41a is provided in each one of the pair of the vertical frames 41 of the unit frame 40. The module frame 81 of the yarn processing module 80 is positioned on the unit frame 40 by the guiding pins 41a being guided in the guided grooves 82a. Consequently, the module frame 81 can be easily and reliably positioned relative to the unit frame 40 when fitting the module frame 81 of the yarn processing module 80 on the unit frame 40.

[0060] The module pipe 34 of the yarn processing module 80 is detachably connected to the unit pipe 45. The connecting direction of the module pipe 34 to the unit pipe 45 substantially matches with the guidance direction (front to back direction in the present embodiment) of the guiding pins 41a in the guided grooves 82a. Consequently, positioning of the module frame 81 relative to the unit frame 40 and positioning of the module pipe 34 relative to the unit pipe 45 can be performed reliably.

[0061] The module pipe 34 is connected to the unit pipe 45 via the elastic member 47 arranged on the front-end face 44a of the connection member 44 that is the connection end of the unit pipe 45. Consequently, the module pipe 34 can be connected to the unit pipe 45 easily and reliably when the module frame 81 of the yarn processing module 80 is fitted on the unit frame 40.

[0062] The yarn supplying device that supplies the spun yarn Y includes the drafting device 6 and the spinning device 7. The spinning device 7 is an air spinning device that forms the spun yarn Y by twisting the fiber bundle F using the swirling airflow. Consequently, a high quality spun yarn Y can be efficiently supplied.

[0063] In the spinning machine 1, one unit of the yarn processing module 80 can be separately attached to and detached from each of the spinning units 2. Therefore, only the operations of the spinning unit 2 that requires attention can be stopped while allowing the other spinning units 2 to continue operations, and the yarn processing module 80 can be removed from the stopped spinning unit 2 for performing operations relating to the yarn pooling device 50, etc.

[0064] Although one embodiment of the present invention is explained above, the present invention is not limited to this embodiment alone. For example, in the spinning machine 1 and the spinning unit 2, the drafting device 6 and the spinning device 7 serve as the yarn supplying devices for supplying the spun yarn. However, any other yarn supplying device, such as, a yarn supplying device that supplies a spun yarn from a bobbin having the spun yarn wound thereon can be used.

[0065] If the spinning device is an air spinning device, a needle that is held by a fiber guiding section to project into the spinning chamber can be further provided to prevent the twisting of the fiber bundle to be conveyed upstream of the spinning device. The twisting of the fiber bundle can be prevented from being conveyed upstream of the spinning device by a downstream end of a fiber guiding section instead of by the needle. Alternatively, the spinning device can include a pair of air-jet nozzles that produce airflows in mutually opposite directions, and can thus spin the fiber bundle in opposite directions at the same time.

[0066] In the spinning machine 1 and the spinning unit 2, the yarn pooling device 50 has a function of drawing the spun yarn Y from the spinning device 7. Alternatively, the spun yarn can be drawn from a yarn supplying device that supplies the spun yarn by a delivery roller and a nip roller.

[0067] In the spinning machine 1 and the spinning unit 2, the spun yarn Y is cut by a stoppage of the swirling airflow in the spinning device 7 during the yarn-defect detection operation. Alternatively, the spun yarn can be cut by a cutter during the yarn-defect detection operation. The cutter can be arranged in the yarn processing module 80. When arranged in the yarn processing module 80, the cutter can be detached from the unit frame 40 along with the yarn pooling device 50, etc.

[0068] In the spinning machine 1 and the spinning unit 2, the devices are arranged so that the spun yarn Y supplied from above is wound below. Alternatively, the devices can be arranged so that the spun yarn supplied from below is wound above.

[0069] In the spinning machine 1 and the spinning unit 2, the bottom rollers of the drafting device 6 and a traverse mechanism of the traverse device 23 are driven by the power of the motor box 5 (that is, concurrently driven in a plurality of the spinning units 2). Alternatively, each section (for example, the drafting device, the spinning device, the winding device, etc.) of the spinning unit can be driven independently in each spinning unit 2.

[0070] The tension sensor 9 can be arranged at the upstream of the yarn clearer 8 in the running direction of the spun yarn Y. A common unit controller 10 can be provided for a plurality of the spinning units 2 instead of one unit controller 10 per spinning unit 2. The winding device 12 can be driven by a common drive source provided for a plurality of the spinning units 2 instead of by a separate driving motor provided for each spinning unit 2. In this case, during the reverse rotation of the package P, the cradle arm 21 is moved by a not shown air cylinder so that the package P is separated from the winding drum 22, and thereafter the package P is reverse-rotated by a not shown reverse roller provided in the yarn joining carrier 3.

[0071] The waxing device 11, the tension sensor 9, the yarn clearer 8, the display section 88, and the operation section 89 need not be provided in the spinning unit 2. Alternatively, the waxing device 11, the tension sensor 9, the yarn clearer 8, the display section 88, and the operation section 89 can be provided directly on the unit frame 40 instead of in the yarn processing module 80.

[0072] In the spinning machine 1 and the spinning unit 2, the guided grooves 82a that are the guiding sections are provided in the module frame 81 of the yarn processing module 80, and the guiding pins 41a that are the guiding sections are provided in the unit frame 40. Alternatively, the guiding sections, such as, the guiding pins, can be provided in the module frame of the yarn processing module, and the guided sections, such as, the guided grooves, can be provided in the unit frame.

[0073] In the spinning machine 1 and the spinning unit 2, the module pipe 34 is connected to the unit pipe 45 via the elastic member 47 arranged on the front-end face 44a of the connection member 44 that is the connection end of the unit pipe 45. Alternatively, the module pipe can be connected to the unit pipe via the elastic member

arranged on the connection end of the module pipe or elastic members arranged on the connection ends of both the module pipe and the unit pipe.

[0074] A spinning unit according to an aspect of the present invention includes a yarn supplying device adapted to supply a spun yarn, a winding device adapted to wind the spun yarn to form a package, a unit frame adapted to support the yarn supplying device and the winding device, and a yarn processing module that is detachably mounted on the unit frame. The yarn processing module includes a yarn pooling device adapted to pool the spun yarn between the yarn supplying device and the winding device.

[0075] In the above spinning unit, the yarn processing module that includes the yarn pooling device is detachably mounted on the unit frame. Consequently, operations relating to the yarn pooling device, such as, assembling, operation check, and maintenance, can be performed efficiently.

[0076] It is preferable that the yarn processing module further includes a display section adapted to display an operation status of the spinning unit and an operation section adapted to be operated by an operator to give operation instructions to the spinning unit.

[0077] In the above spinning unit, operations relating to the yarn pooling device as well as the display section and the operation section can be performed efficiently.

[0078] It is preferable that the yarn processing module further includes a yarn-defect detecting device adapted to detect a defect in the spun yarn between the yarn supplying device and the yarn pooling device.

[0079] In the above spinning unit, operations relating to both the yarn pooling device and the yarn-defect detecting device can be performed efficiently.

[0080] It is preferable that the yarn processing module further includes a waxing device adapted to apply wax to the spun yarn between the yarn pooling device and the winding device.

[0081] In the above spinning unit, operations relating to both the yarn pooling device and the waxing device can be performed efficiently.

[0082] It is preferable that the yarn processing module further includes a tension measuring device adapted to measure a tension on the spun yarn between the yarn supplying device and the yarn pooling device.

[0083] In the above spinning unit, operations relating to both the yarn pooling device and the tension measuring device can be performed efficiently.

[0084] It is preferable that the yarn pooling device includes a yarn pooling roller adapted to wind the spun yarn thereon, a driving motor adapted to drive the yarn pooling roller to rotate, and a motor control unit adapted to control a rotation of the driving motor.

[0085] In the above spinning unit, operations relating to the yarn pooling roller, the driving motor, and the motor control unit can be performed easily and reliably.

[0086] It is preferable that the yarn pooling device further includes a pooled-yarn amount sensor adapted to detect a pooled amount of the spun yarn wound around the yarn pooling roller.

[0087] In the above spinning unit, operations relating to the pooled-yarn amount sensor can be performed easily and reliably.

[0088] It is preferable that the yarn pooling device can further include a suction mechanism adapted to produce a suction airflow at a suction vent arranged facing the yarn pooling roller.

[0089] In the above spinning unit, operations relating to the suction mechanism can be performed easily and reliably.

[0090] It is preferable that the yarn pooling device further includes a yarn hooking member adapted to be engaged with the spun yarn and wind the spun yarn around the yarn pooling roller, and a yarn taking-off member adapted to take off the spun yarn from the yarn hooking member.

[0091] In the above spinning unit, operations relating to the yarn hooking member and the yarn taking-off member can be performed easily and reliably.

[0092] It is preferable that the yarn processing module further includes a module frame that is adapted to be detachably secured to the unit frame. A guiding section adapted to position the module frame on the unit frame is provided in one of the unit frame and the module frame, and a guided section adapted to be guided in the guiding section is provided in the other of the unit frame and the module frame.

[0093] In the above spinning unit, the module frame can be easily and reliably positioned on the unit frame when fitting the module frame of the yarn processing module on the unit frame.

[0094] It is preferable that the spinning unit further includes a unit pipe adapted to circulate air. The yarn processing module further includes a module pipe that is detachably connected to the unit pipe, and a connecting direction of the module pipe to the unit pipe substantially matches with a guidance direction of the guided section in the guiding section.

[0095] In the above spinning unit, when fitting the module frame of the yarn processing module on the unit frame, a positioning of the module frame relative to the unit frame and a positioning of the module pipe relative to the unit pipe can be performed reliably.

[0096] It is preferable that the module pipe be connected to the unit pipe via an elastic member arranged on at least one of a connection end of the module pipe and a connection end of the unit pipe.

[0097] In the above spinning unit, the module pipe can be easily and reliably connected to the unit pipe when the module frame of the yarn processing module is fitted on the unit frame.

[0098] It is preferable that the yarn supplying device includes a drafting device adapted to draft a fiber bundle and a spinning device adapted to twist the fiber bundle to form the spun yarn.

[0099] In the above spinning unit, a high quality spun

yarn can be efficiently supplied.

[0100] It is preferable that the spinning device be an air spinning device adapted to twist the fiber bundle using a swirling airflow to form the spun yarn.

[0101] In the above spinning unit, a further higher quality spun yarn can be efficiently supplied.

[0102] A spinning machine according to another aspect of the present invention includes a plurality of the spinning units mentioned above. In the spinning machine, the yarn processing module can be individually fitted into and detached from each of the spinning units.

[0103] In the above spinning machine, only the operations of the spinning unit that requires attention can be stopped while allowing the other spinning units to continue operations, and the yarn processing module can be removed from the stopped spinning unit for performing operations relating to the yarn pooling device.

Claims

1. A spinning unit comprising:

a yarn supplying device (6, 7) adapted to supply a spun yarn (Y);
a winding device (12) adapted to wind the spun yarn (Y) to form a package (P);
a unit frame (40) adapted to support the yarn supplying device (6, 7) and the winding device (12); and
a yarn processing module (80) that is detachably mounted on the unit frame (40) and that includes a yarn pooling device (50) adapted to pool the spun yarn (Y) between the yarn supplying device (6, 7) and the winding device (12).

2. The spinning unit according to Claim 1, wherein the yarn processing module (80) further includes
a display section (88) adapted to display an operation status of the spinning unit (2); and
an operation section (89 that is adapted to be operated by an operator to give operation instructions to the spinning unit (2).

3. The spinning unit according to Claim 1 or 2, wherein the yarn processing module (80) further includes a yarn-defect detecting device (8) adapted to detect a defect in the spun yarn (Y) between the yarn supplying device (6, 7) and the yarn pooling device (50).

4. The spinning unit according to any one of Claims 1 to 3, wherein the yarn processing module (80) further includes a waxing device (11) adapted to apply wax to the spun yarn (Y) between the yarn pooling device (50) and the winding device (12).

5. The spinning unit according to any one of Claims 1 to 4, wherein the yarn processing module (80) further includes a tension measuring device (9) adapted to measure a tension on the spun yarn (Y) between the yarn supplying device (6, 7) and the yarn pooling device (50).

6. The spinning unit according to any one of Claims 1 to 5, wherein the yarn pooling device (50) includes
a yarn pooling roller (51) adapted to wind the spun yarn (Y) thereon;
a driving motor (55) adapted to drive the yarn pooling roller (51) to rotate; and
a motor control section (38) adapted to control a rotation of the driving motor (55).

7. The spinning unit according to Claim 6, wherein the yarn pooling device (50) further includes a pooled-yarn amount sensor (56, 57) adapted to detect a pooled amount of the spun yarn (Y) wound around the yarn pooling roller (51).

8. The spinning unit according to Claim 6 or 7, wherein the yarn pooling device (50) further includes a suction mechanism (65) adapted to produce a suction airflow at a s0uction vent (66a) arranged facing the yarn pooling roller (51).

9. The spinning unit according to any one of Claims 6 to 8, wherein the yarn pooling device (50) further includes
a yarn hooking member (61) adapted to be engaged with the spun yarn (Y) and wind the spun yarn (Y) around the yarn pooling roller (51); and
a yarn taking-off member (64) adapted to take off the spun yarn (Y) from the yarn hooking member (61).

10. The spinning unit according to any one of Claims 1 to 9, wherein
the yarn processing module (80) further includes a module frame (81) that is adapted to be detachably secured to the unit frame (41),
one of the unit frame (41) and the module frame (81) includes a guiding section (82a) adapted to position the module frame (81) on the unit frame (41), and
other one of the unit frame (41) and the module frame (81) includes a guided section (41a) adapted to be guided in the guiding section (82a).

11. The spinning unit according to Claim 10, further comprising a unit pipe (45) adapted to circulate air,
wherein the yarn processing module (80) further includes a module pipe (34) that is adapted to be detachably connected to the unit pipe (45), and
a connecting direction of the module pipe (34) to the unit pipe (45) substantially matches with a guidance direction of the guided section (41a) in the guiding section (82a).

12. The spinning unit according to Claim 11, wherein the module pipe (34) is connected to the unit pipe (45) via an elastic member (47) that is arranged on at least one of a first connection end (35) and a second connection end (44), the first connection end (35) being a connection end of the module pipe (34) and the second connection end (44) being a connection end of the unit pipe (45).

13. The spinning unit according to any one of Claims 1 to 12, wherein the yarn supplying device (6, 7) includes
a drafting device (6) adapted to draft a fiber bundle (F); and
a spinning device (7) adapted to form the spun yarn (Y) by twisting the fiber bundle (F).

14. The spinning unit according to Claim 13, wherein the spinning device (7) is an air spinning device that is adapted to form the spun yarn (Y) by twisting the fiber bundle (F) by a swirling airflow.

15. A spinning machine comprising a plurality of the spinning units (2) according to any one of Claims 1 to 14.

FIG.1

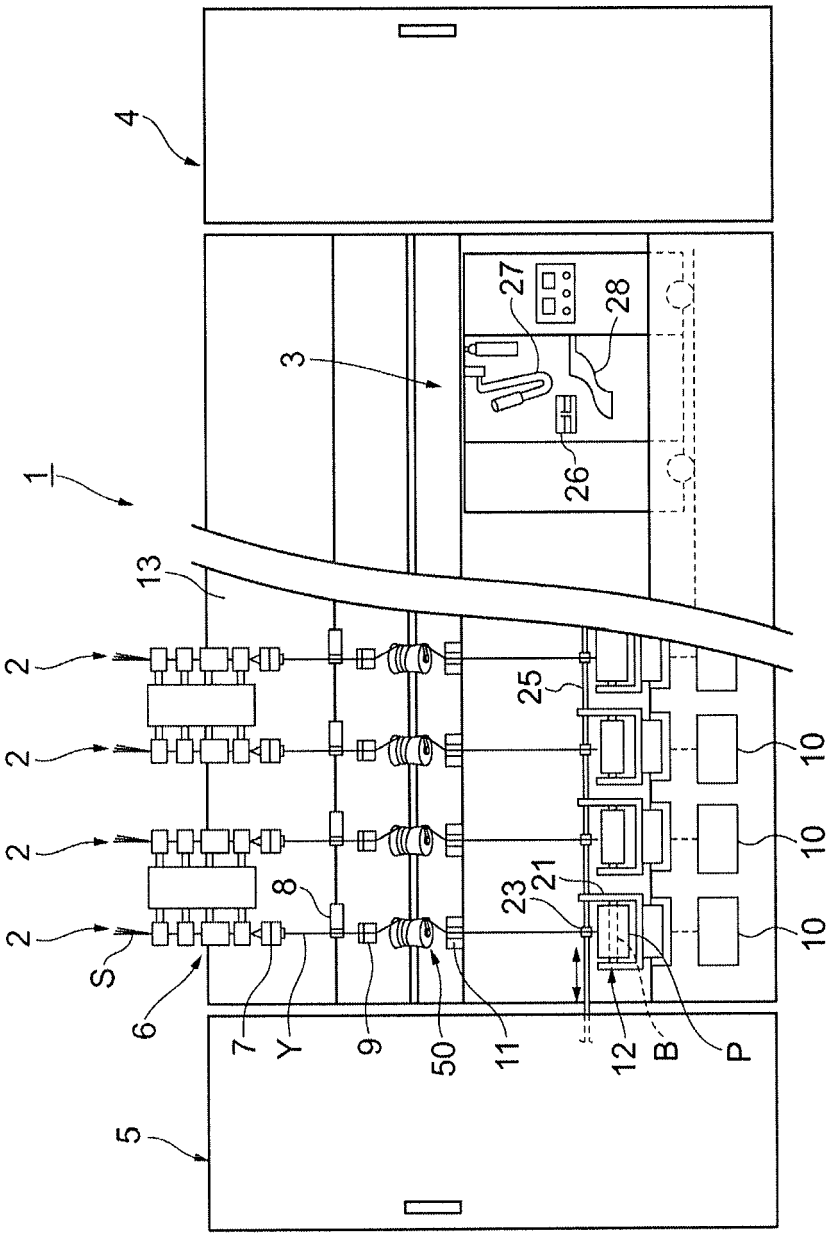
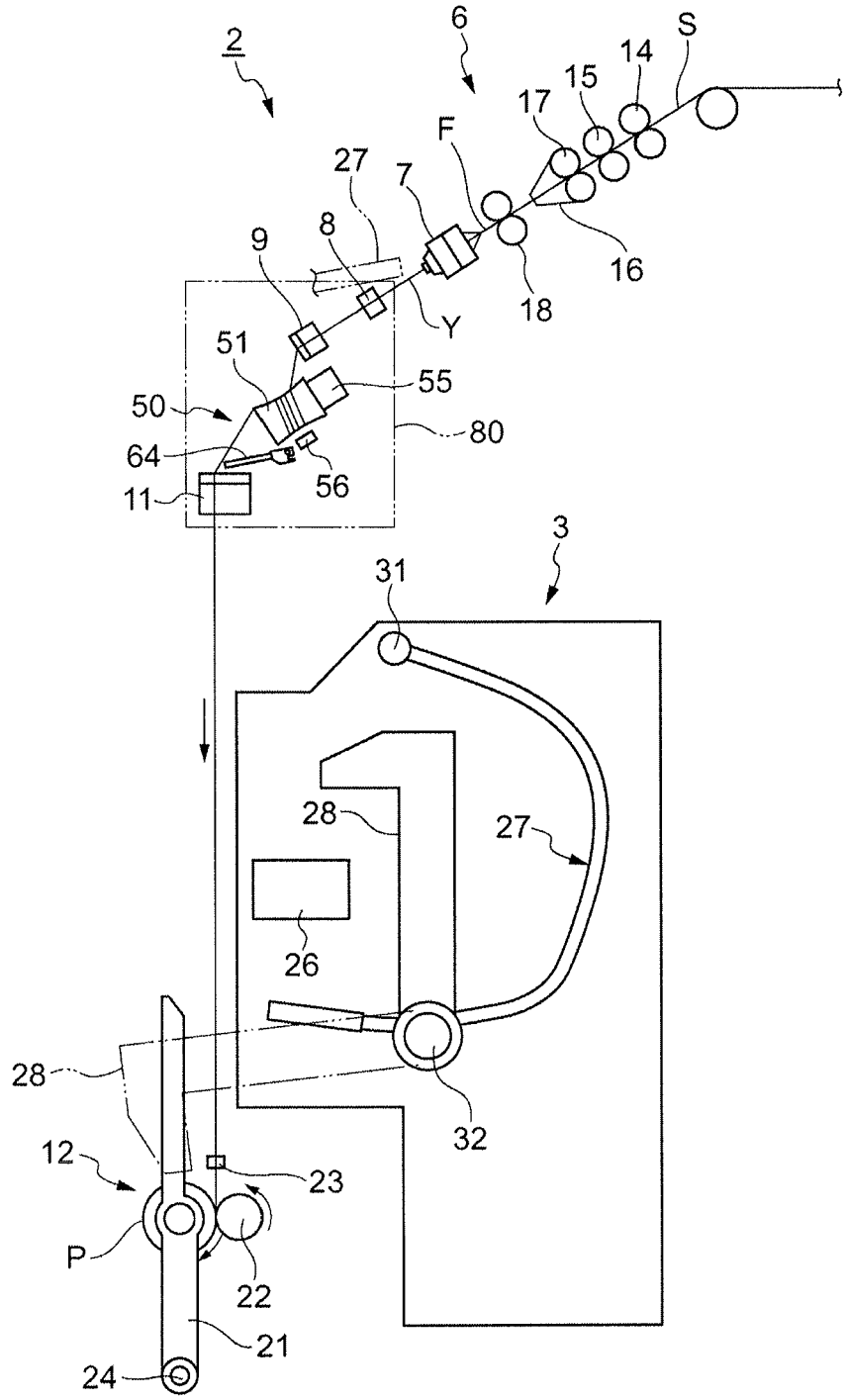


FIG.2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Y
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FIG.3

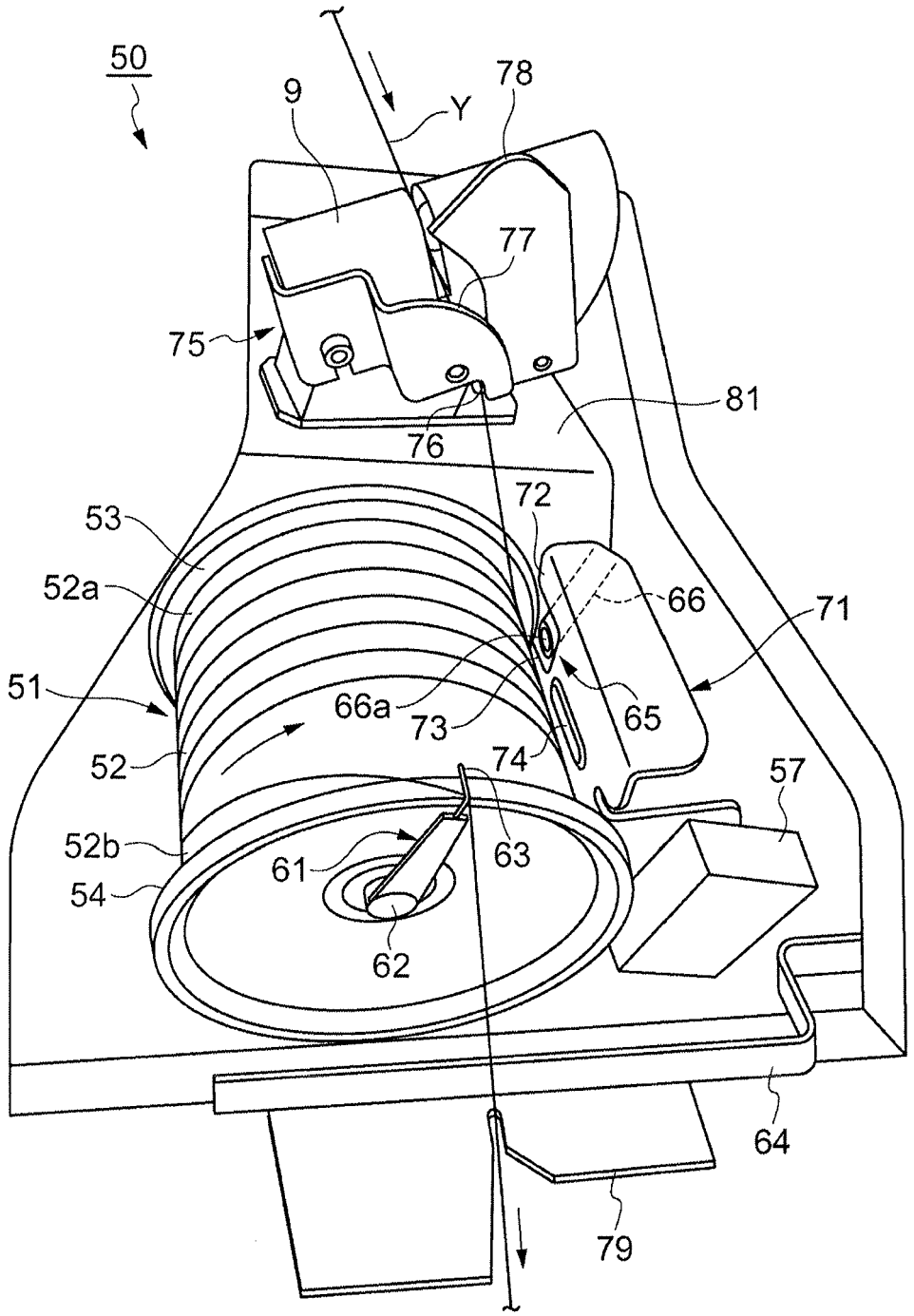
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FIG.4

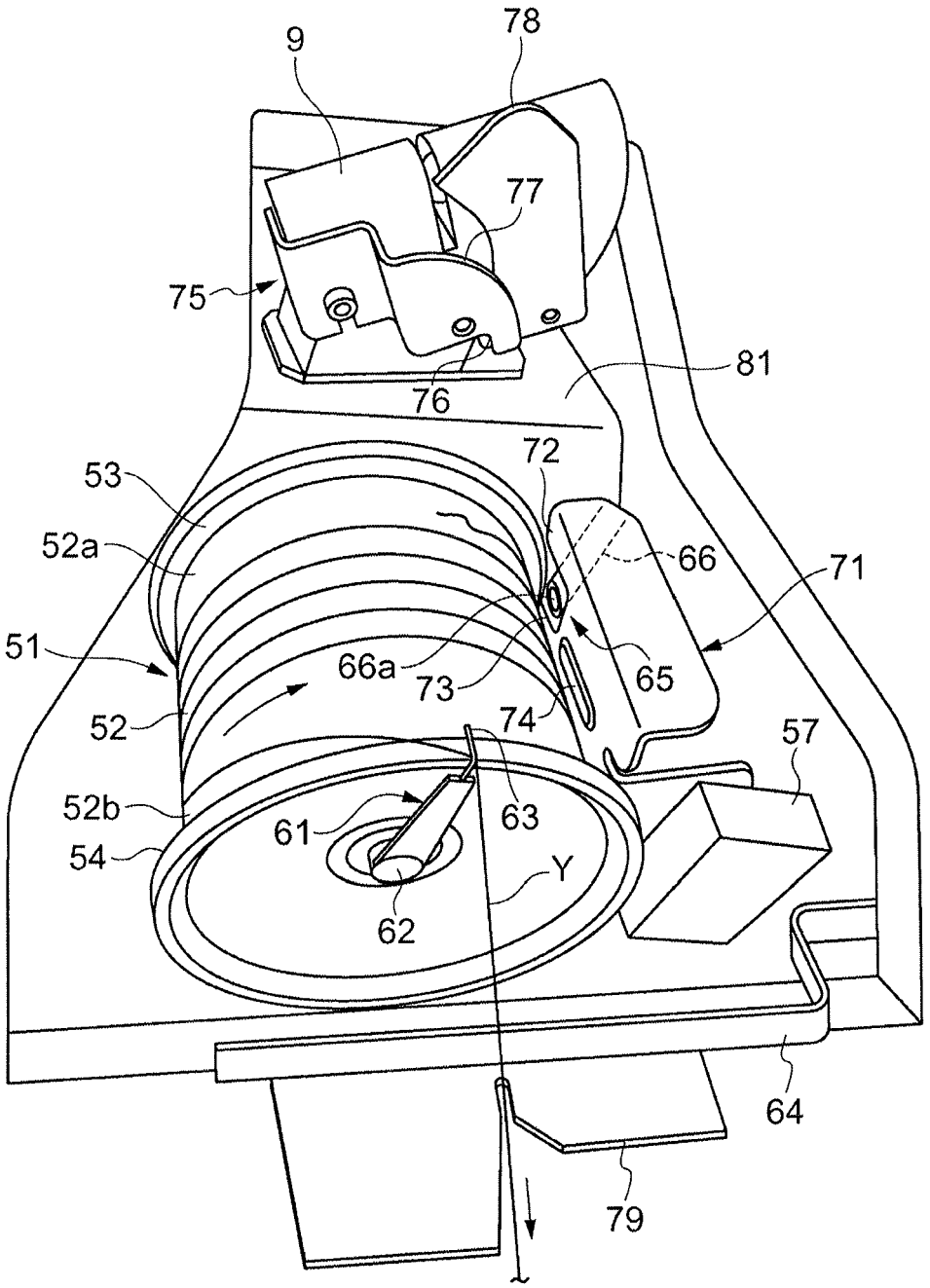
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FIG.5

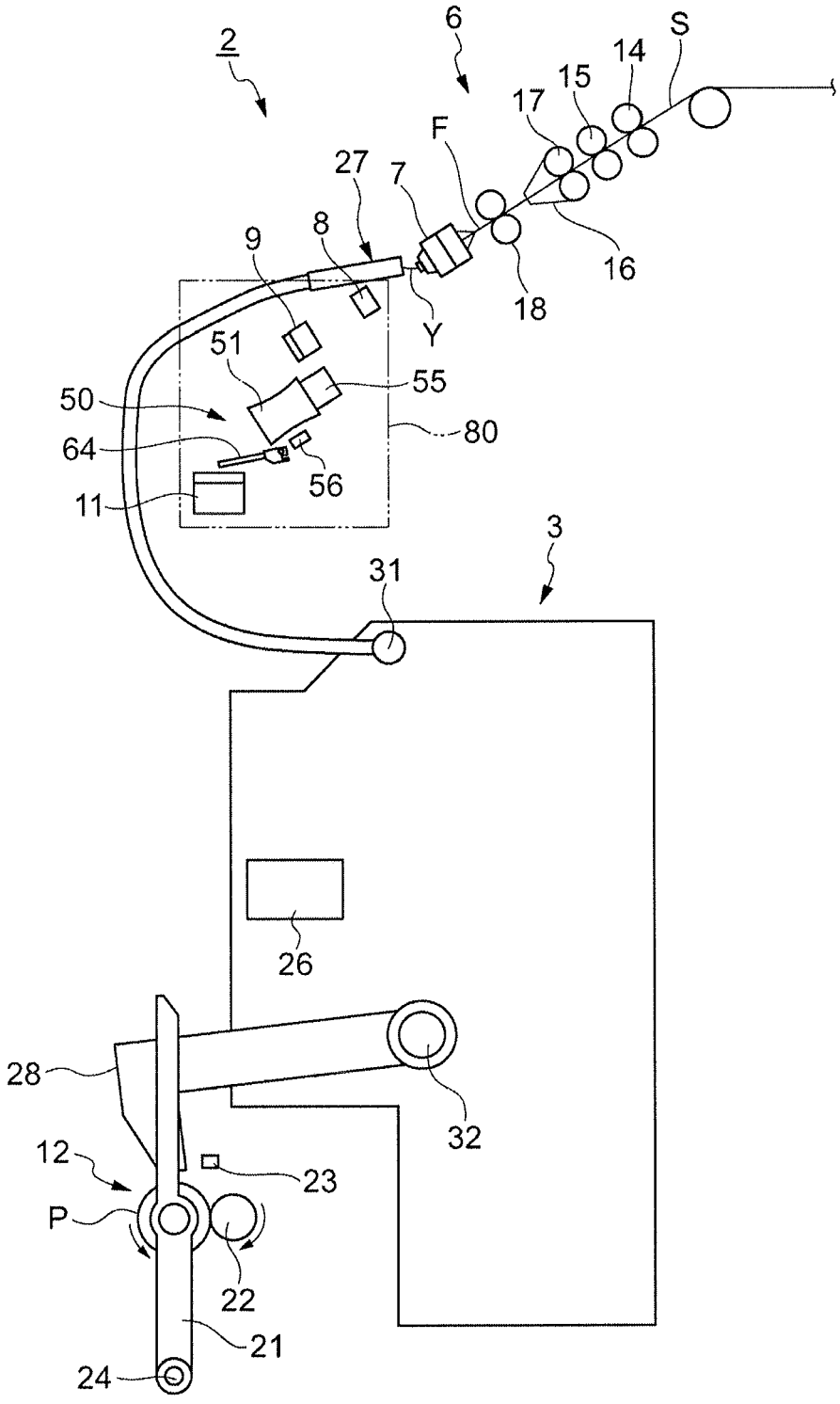
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FIG.6

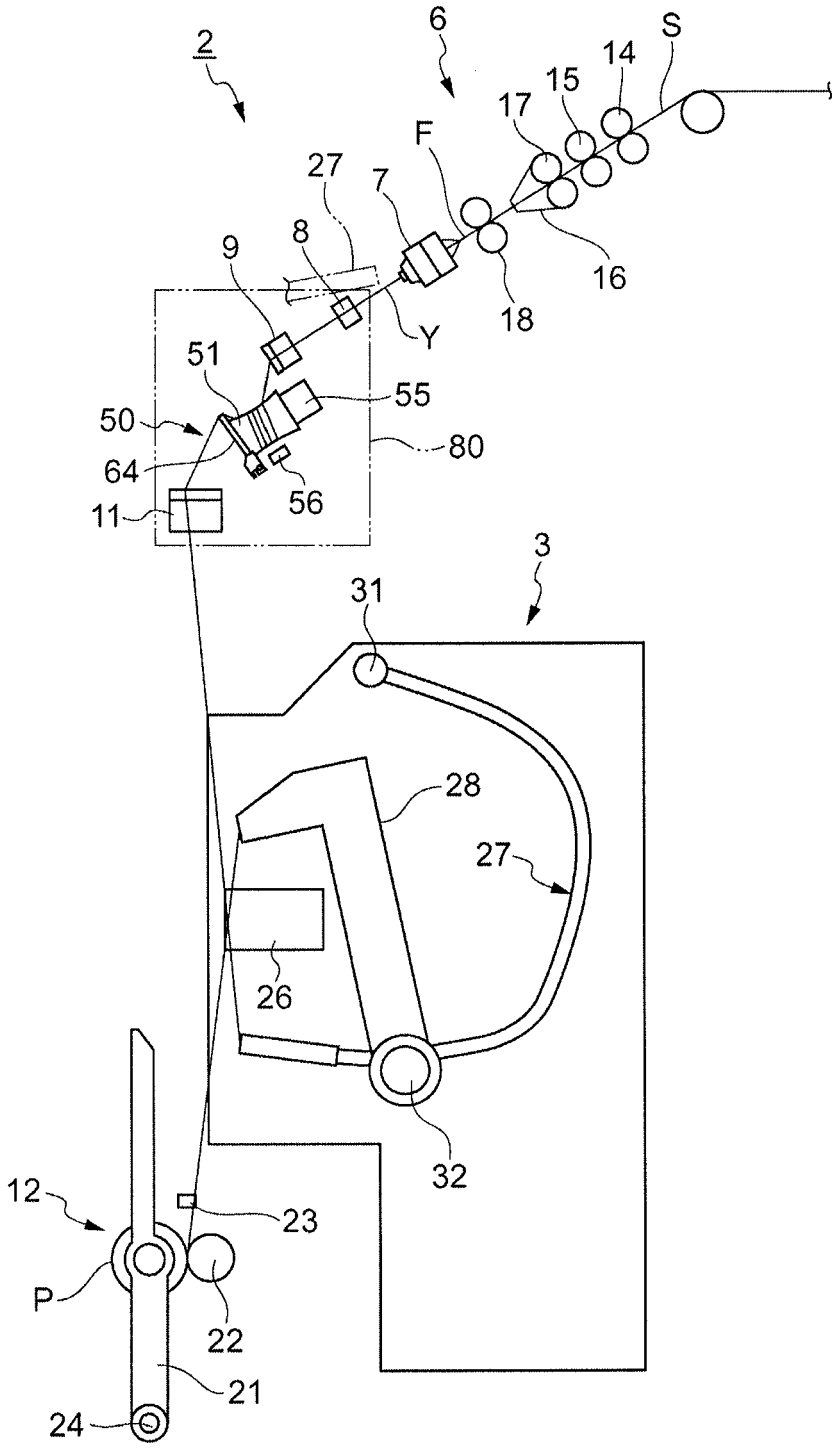
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FIG.7

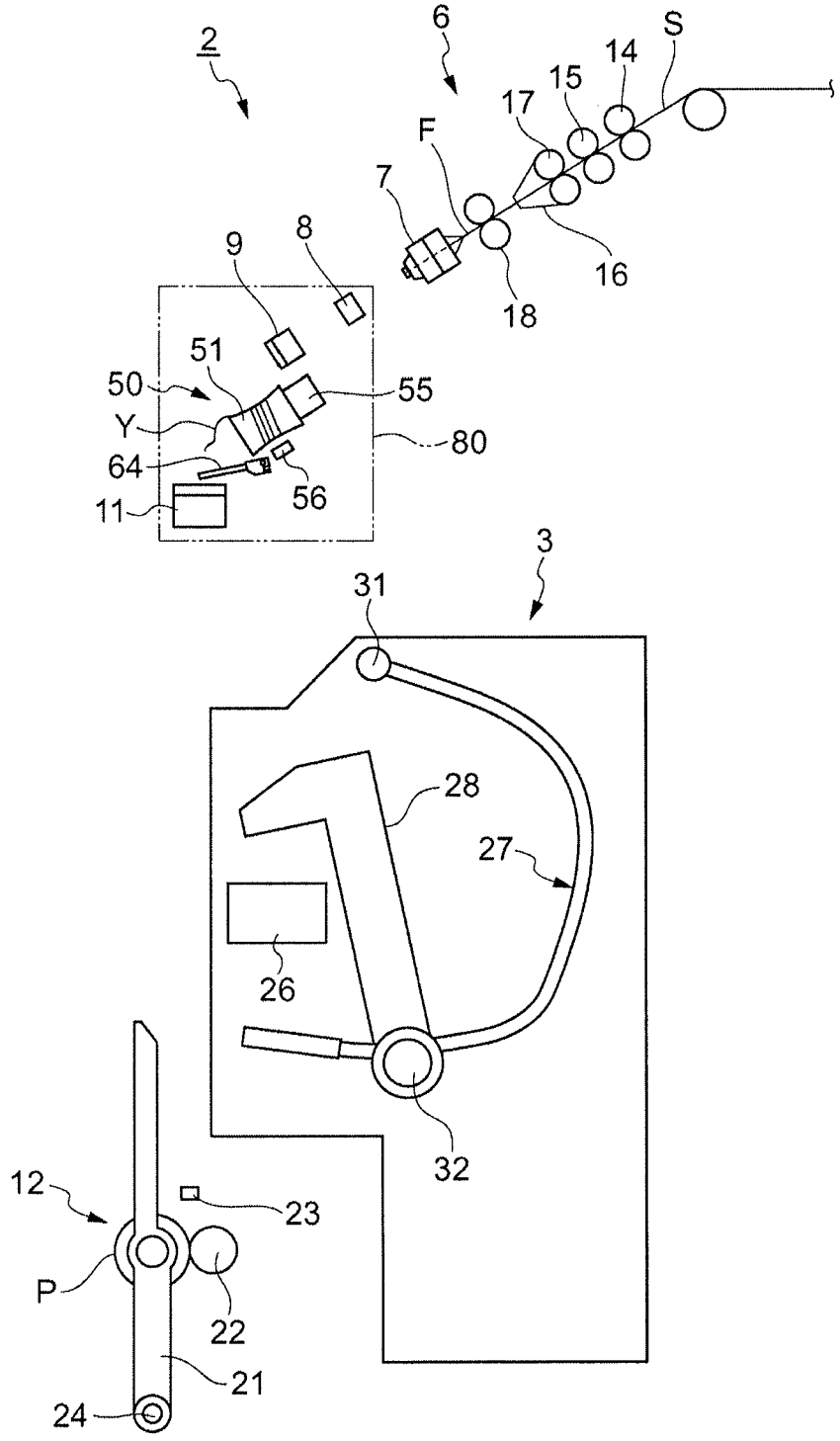
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FIG.8

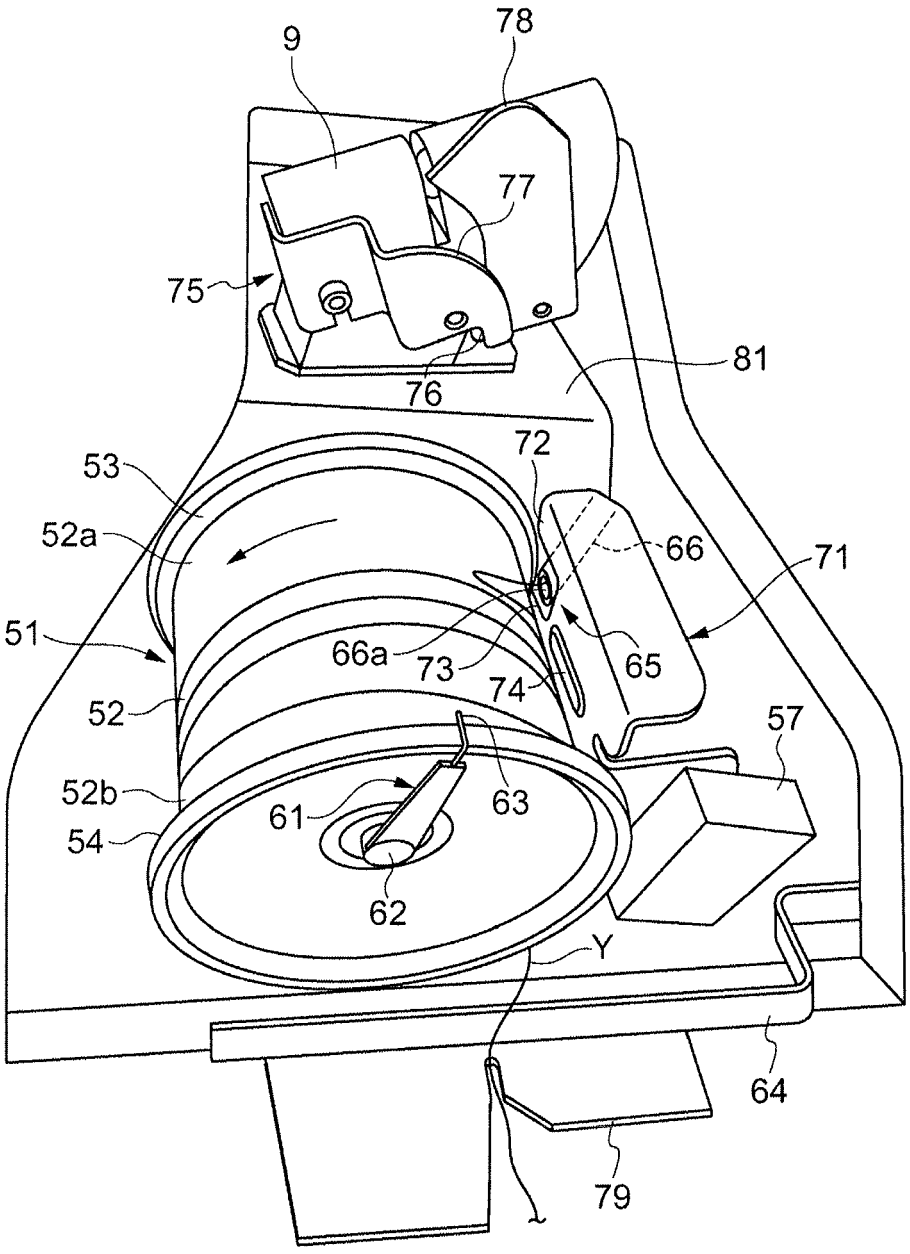
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FIG.9

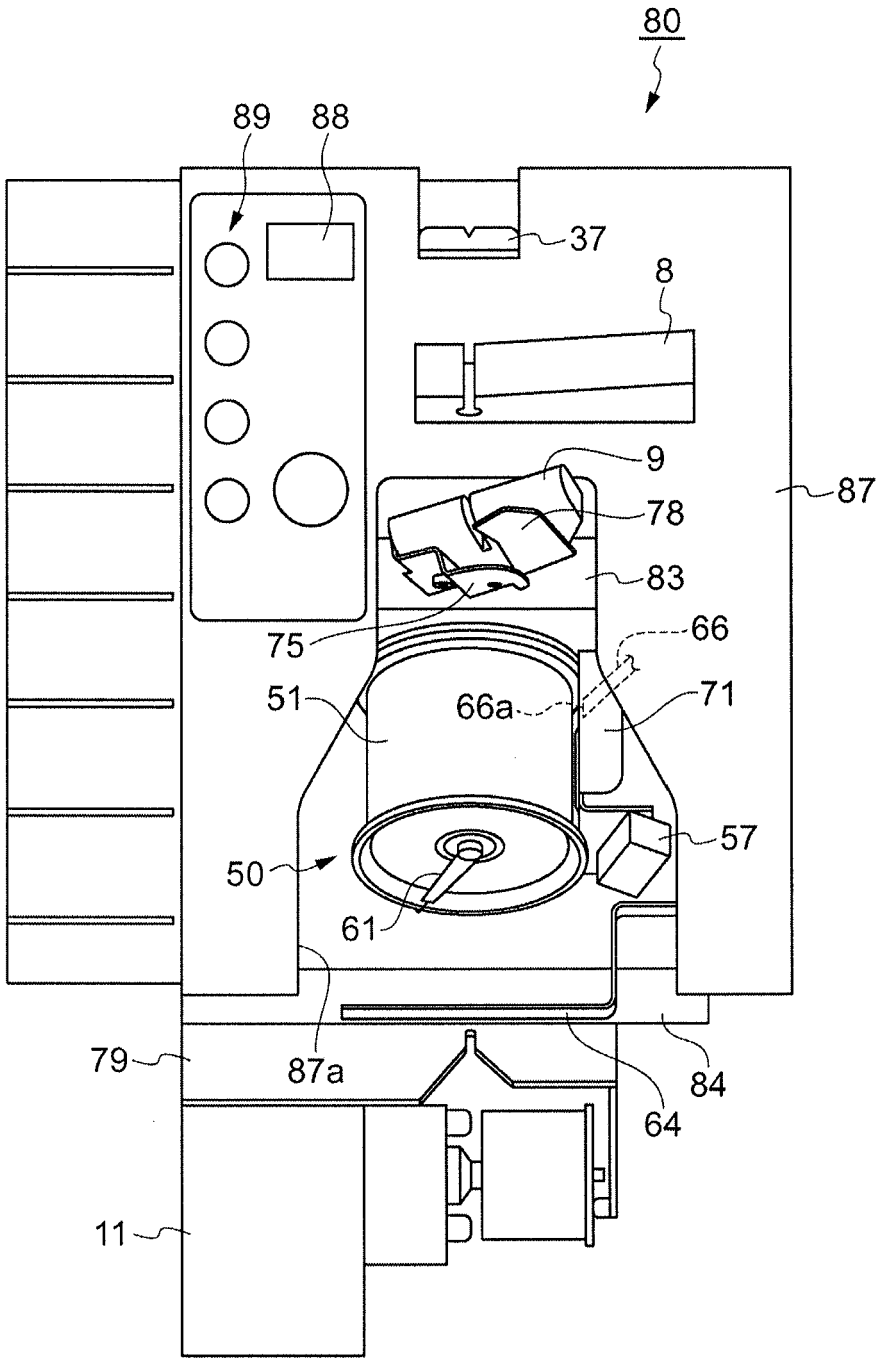
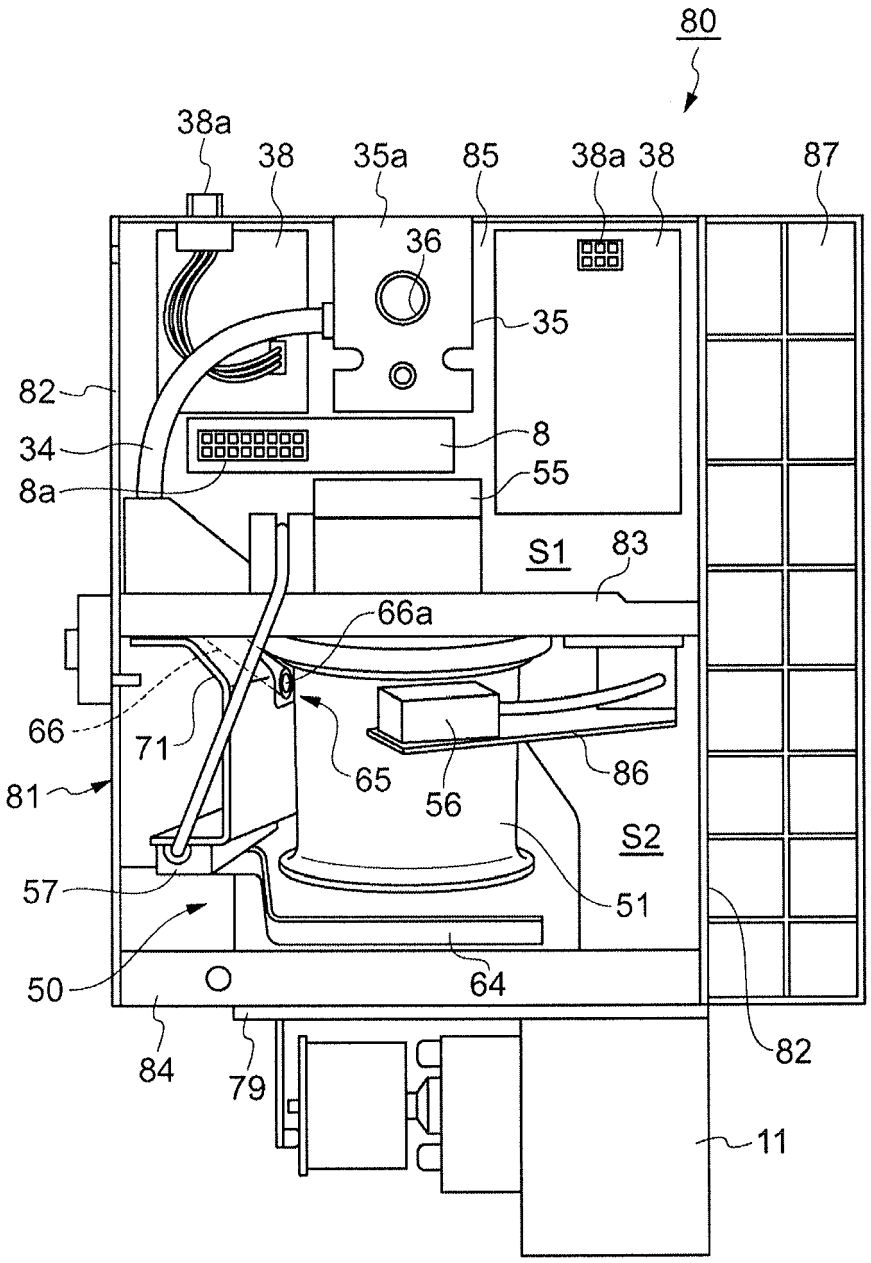


FIG.10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11

FIG.11

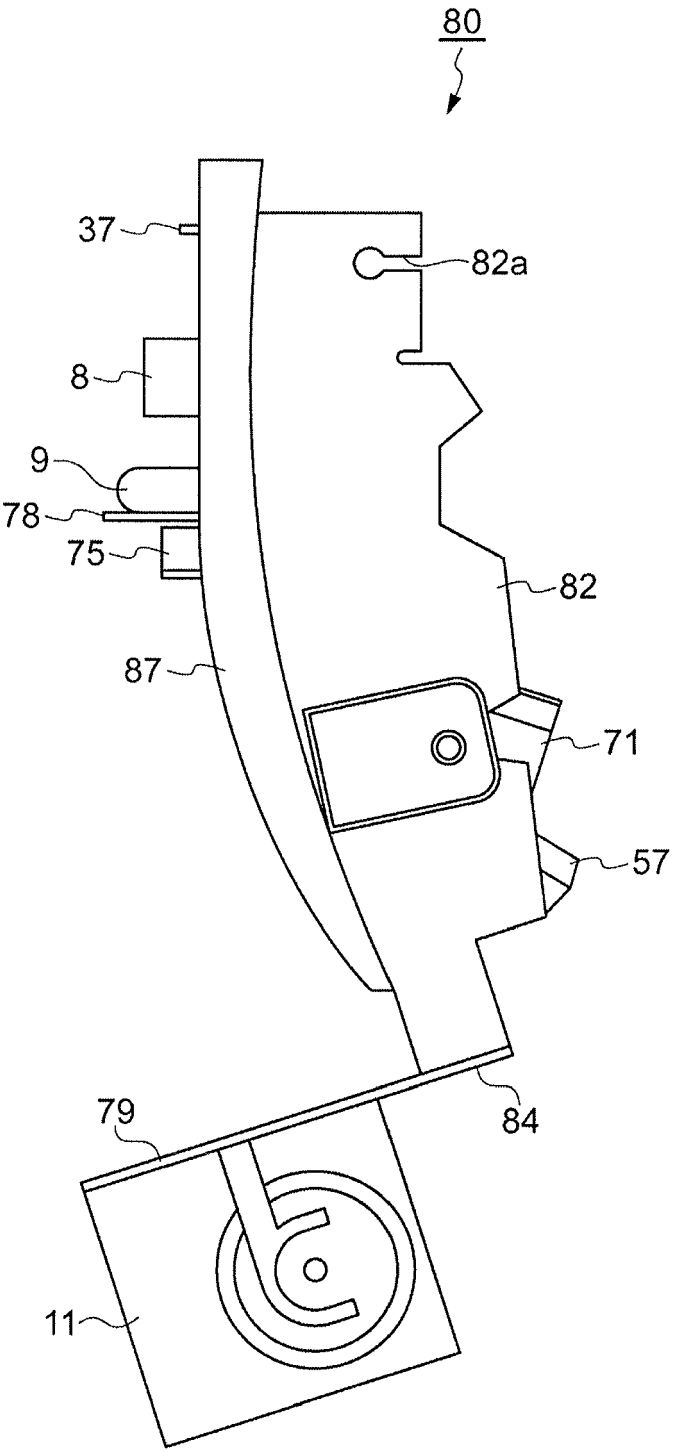
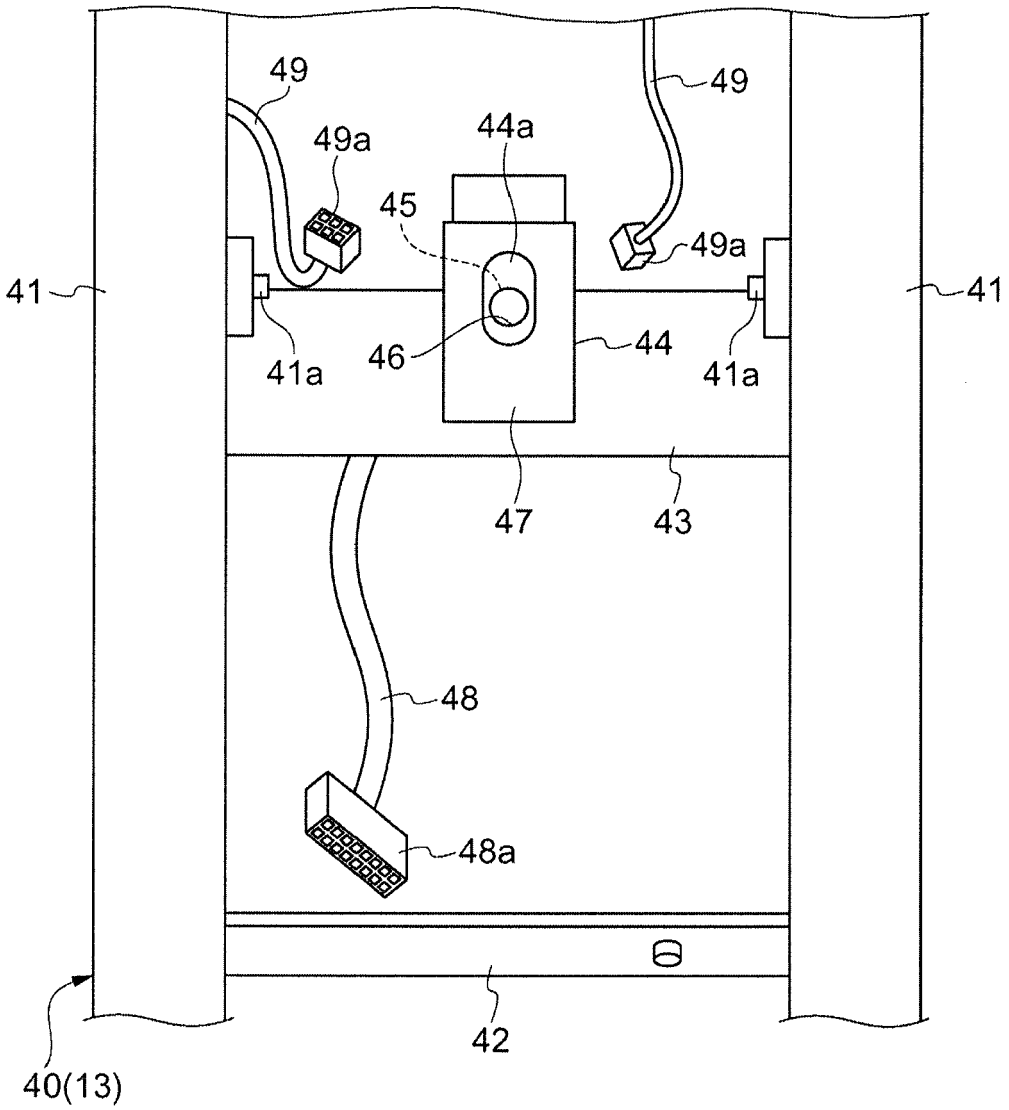


FIG.12



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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