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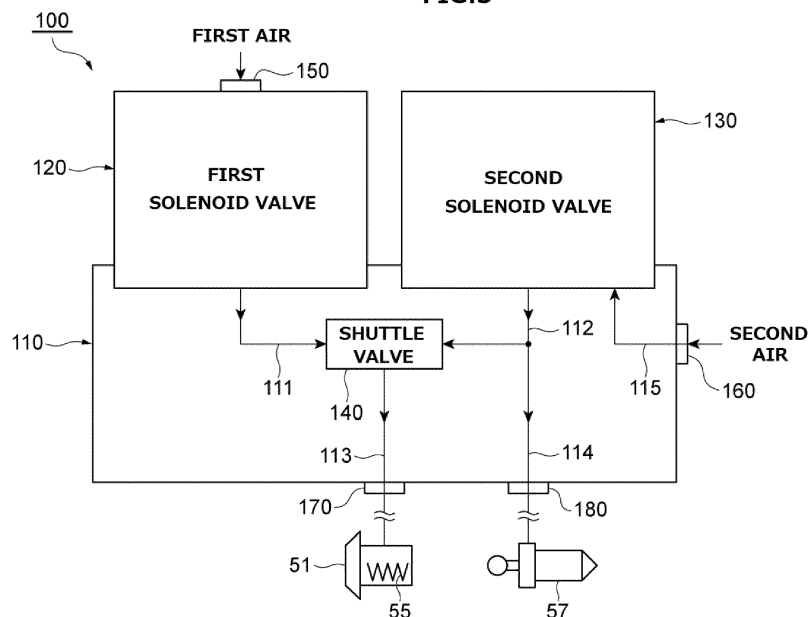
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(54) **SOLENOID VALVE UNIT AND AUTOMATIC WINDER**

(57) A solenoid valve unit (100) includes a casing (110) that houses therein a first input air coupler (150) for introducing a first air, a second input air coupler (160) for introducing a second air having a higher pressure than the first air, first to third flow paths (111 to 113), and a shuttle valve (140). The solenoid valve unit (100) includes first and second solenoid valves (120, 130) inte-

grated with the casing 110. The first air flows through the first flow path (111) and the second air flows through the second flow path (112). The third flow path (113) is connected via a shuttle valve (140) to a downstream side of the first flow path (111) and to a downstream side of the second flow path (112).

**FIG.5**



## Description

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

**[0001]** The present invention relates to a solenoid valve unit and an automatic winder.

#### 2. Description of the Related Art

**[0002]** For example, Japanese Patent Application Laid-Open No. 2001-106434 discloses a pipe joined device in which plural air pipes are joined detachably. The pipe joined device disclosed in Japanese Patent Application Laid-Open No. 2001-106434 includes an opening-closing part constituted by a spindle valve body or the like and a valve operating part including a lever or the like. In the pipe joined device disclosed in Japanese Patent Application Laid-Open No. 2001-106434, it is attempted to simultaneously open or close a plurality of air paths by operating the valve operating part.

**[0003]** In the above-described prior art, for example, sometimes there is a requirement of an air circuit capable of selectively switching between two air systems and outputting the air of the selected air system.

**[0004]** In such a case, various types of valves, air tubes for connecting those valves, air joints, etc. are required. As a result, the necessary resources (cost, space, assembly man-hours, etc.) increase.

### SUMMARY OF THE INVENTION

**[0005]** One object of the present invention is to provide a solenoid valve unit and an automatic winder that can reduce the necessary resources.

**[0006]** A solenoid valve unit according to one aspect of the present invention includes a casing that houses therein a first flow path through which a first air flows, a second flow path through which a second air having a pressure higher than the first air flows, and a third flow path connected via a shuttle valve to a downstream side of the first flow path and to a downstream side of the second flow path; a first solenoid valve that is integrated with the casing and controls flow of the first air to the first flow path; and a second solenoid valve that is integrated with the casing and controls flow of the second air to the second flow path. The casing includes a first outlet through which one of the first air and the second air flowing through the third flow path flows out.

**[0007]** An automatic winder according to another aspect of the present invention includes a holding part that holds a package by sandwiching the package; a brake section that controls a holding force and braking of the holding part according to the pressure of supplied air; and the above explained solenoid valve unit. The solenoid valve unit, when holding the package rotatably via the holding part by using the brake section, sets the first

solenoid valve in an open state and sets the second solenoid valve in a closed state, and supplies the first air to the brake section via the first outlet, and, when braking the package via the holding part by using the brake section, sets the second solenoid valve in an open state and supplies the second air to the brake section via the first outlet.

**[0008]** The above and other objects, features, advantages and technical and industrial significance of this invention will be better understood by reading the following detailed description of presently preferred embodiments of the invention, when considered in connection with the accompanying drawings.

### BRIEF DESCRIPTION OF THE DRAWINGS

#### **[0009]**

FIG. 1 is a front view of an automatic winder according to one embodiment.

FIG. 2 is a side view of a winder unit according to one embodiment.

FIG. 3 is a front view of a cradle according to one embodiment.

FIG. 4 is a cross-sectional view of a package brake according to one embodiment.

FIG. 5 is a view of a configuration of a solenoid valve unit according to one embodiment.

FIG. 6 is a perspective view of the solenoid valve unit according to one embodiment.

FIG. 7 is another perspective view of the solenoid valve unit according to one embodiment.

FIG. 8 is a view for explaining installation of the solenoid valve unit according to one embodiment.

### DETAILED DESCRIPTION

**[0010]** Exemplary embodiments of the present invention are explained in detail below with reference to the accompanying drawings. In the drawings, the same or similar elements will be denoted by the same reference numerals and redundant explanation will be omitted.

**[0011]** As shown in FIG. 1, an automatic winder 1 includes a plurality of winder units 3 arranged side by side, a main controller 5, and a doffing device 7. The main controller 5 can communicate with each of the winder units 3. An operator of the automatic winder 1 can collectively manage the winder units 3 by appropriately operating the main controller 5. Each of the winder units 3 forms a package P by unwinding a spun yarn Y from a yarn supplying bobbin SB and simultaneously winding the spun yarn Y around a winding bobbin WB while traversing the spun yarn Y. When the package P is fully wound (a state in which a specified amount of yarn has been wound) in a certain winder unit 3, the doffing device 7 travels to the position of the winder unit 3 and replaces the full package with an empty winding bobbin WB.

**[0012]** As shown in FIG. 2, the winder unit 3 includes

a unit control section 10, a yarn supplying device 12, and a winding device 14. The unit control section 10 includes, for example, a CPU (Central Processing Unit) and a ROM (Read Only Memory). A computer program for controlling various parts of the winder unit 3 is stored in the ROM. The CPU executes the computer program stored in the ROM.

**[0013]** The yarn supplying device 12 supports at a pre-determined position a yarn supplying bobbin SB placed on a not-shown conveying tray. The yarn supplying device 12 unwinds the spun yarn Y from the yarn supplying bobbin SB and pulls the unwound spun yarn Y from the yarn supplying bobbin SB. The yarn supplying device 12 supplies the spun yarn Y. The yarn supplying device 12 is not limited to the conveying tray type device but can be a magazine type device, for example.

**[0014]** The winding device 14 includes a cradle 16 and a winding drum 18. The cradle 16 holds a winding bobbin WB (or the package P) in a rotatable manner by sandwiching the winding bobbin WB between winding bobbin holders (holding parts) 19a and 19b (see FIG. 3). The cradle 16 can be switched between a state in which the package P is in contact with the winding drum 18 and a state in which the package P is separated from the winding drum 18 (lift-up state) by operation of a later-described lift-up cylinder 57.

**[0015]** The winding drum 18 traverses the spun yarn Y on the surface of the package P while rotating the package P. The winding drum 18 is rotationally driven by a not-shown drum driving motor. When the winding drum 18 is rotationally driven while the outer peripheral surface of the package P is in contact with the winding drum 18, the package P is driven to rotate. A helical traversing groove is formed on the outer peripheral surface of the winding drum 18. The spun yarn Y unwound from the yarn supplying bobbin SB is wound onto the surface of the package P while being traversed for a certain width by the traversing groove. As a result, the package P having a certain winding width can be formed.

**[0016]** Each of the winder units 3 includes, in a yarn running path between the yarn supplying device 12 and the winding device 14, in the below order from the yarn supplying device 12 side, an unwinding assisting device 20, a tension applying device 22, a tension detecting device 24, a yarn joining device 26, and a yarn monitoring device 28. A first catching and guiding device 30 and a second catching and guiding device 32 are arranged near the yarn joining device 26.

**[0017]** The unwinding assisting device 20 prevents the spun yarn Y that is being unwound from the yarn supplying bobbin SB from being excessively swung because of the centrifugal force thereby appropriately unwinding the spun yarn Y from the yarn supplying bobbin SB. The tension applying device 22 applies a predetermined tension to the running spun yarn Y. In the present embodiment, the tension applying device 22 is a gate type device including movable comb teeth and fixed comb teeth opposing the movable comb teeth.

**[0018]** The tension detecting device 24 detects the tension of the running spun yarn Y at a position between the yarn supplying device 12 and the winding device 14. When the spun yarn Y becomes disconnected for some reason between the yarn supplying device 12 and the winding device 14, the yarn joining device 26 joins the spun yarn Y (lower yarn) from the yarn supplying device 12 and the spun yarn Y (upper yarn) from the winding device 14.

**[0019]** The yarn monitoring device 28 monitors the state of the spun yarn Y running on the yarn path and detects the presence or absence of the yarn defect based on the result of the monitoring. The yarn defect is, for example, at least one among a thickness abnormality of the spun yarn Y, foreign substance contained in the spun yarn Y, a yarn breakage, and the like.

**[0020]** The first catching and guiding device 30 can pivot from a waiting position on the yarn supplying device 12 side to a catching position on the winding device 14 side. The first catching and guiding device 30 catches the upper yarn at the catching position and guides the caught upper yarn to the yarn joining device 26. The second catching and guiding device 32 can pivot from a waiting position on the yarn supplying device 12 side to a catching position on the winding device 14 side. The second catching and guiding device 32 catches the lower yarn and guides the caught lower yarn to the yarn joining device 26.

**[0021]** As shown in FIG. 3, the cradle 16 holds the package P. The cradle 16 includes a pair of cradle arms 16a and 16b. The cradle arms 16a and 16b are rotatable around an axis. The cradle arms 16a and 16b can pivot toward or away from the winding drum 18.

**[0022]** The winding bobbin holders 19a and 19b are rotatably mounted on the distal ends of the cradle arms 16a and 16b, respectively. The winding bobbin holders 19a and 19b are arranged opposing each other. The winding bobbin holders 19a and 19b constitute a holding part that holds the package P by sandwiching the package P. When the winding bobbin WB is mounted on the cradle 16, the winding bobbin holders 19a and 19b are attached to the axial ends of the winding bobbin WB. The winding bobbin holders 19a and 19b and the winding bobbin WB rotate integrally because of the frictional force.

**[0023]** As shown in FIG. 4, a package brake 51 is arranged at the distal end of the cradle arm 16a. The package brake 51 constitutes a brake section that controls a holding force and braking by the winding bobbin holders 19a and 19b according to the pressure of the air supplied thereto. The package brake 51 includes a housing 52, a bearing sleeve 53, a rotation support section 54, a first spring 55, and a second spring 56.

**[0024]** The bearing sleeve 53 is movable and non-rotatable with respect to the housing 52. The rotation support section 54 is arranged inside the bearing sleeve 53. The rotation support section 54 supports in a rotatable manner a shaft extending from the winding bobbin holder

19a. The first spring 55 is arranged between a bottom surface of the housing 52 and the bearing sleeve 53. The first spring 55 applies an urging force on the bearing sleeve 53 so that the bearing sleeve 53 is pressed toward the winding bobbin holder 19a. The second spring 56 is arranged between the bearing sleeve 53 and the rotation support section 54. In this configuration, when no air is supplied to the housing 52, the winding bobbin holder 19a can rotate freely with respect to the bearing sleeve 53.

**[0025]** On the other hand, when air is supplied to the inside of the housing 52, a contact part 53a of the bearing sleeve 53 contacts the winding bobbin holder 19a depending to the pressure of the air. In this case, because the winding bobbin holder 19a is sandwiched between the winding bobbin WB and the bearing sleeve 53, a frictional resistance is generated between the winding bobbin holder 19a and the contact part 53a. As a result, the rotation of the winding bobbin holder 19a can be controlled (braked) whereby the rotation of the winding bobbin WB (and the package P) can be controlled (braked). Also, as the bearing sleeve 53 advances toward the winding bobbin WB, the winding bobbin holder 19a is strongly pressed against the axial end of the winding bobbin WB. As a result, a frictional coupling between the winding bobbin holder 19a and the winding bobbin WB becomes strong and the winding bobbin WB less likely rotates idle with respect to the winding bobbin holder 19a. In this manner, the package brake (brake section) 51 is configured to simultaneously perform the rotation braking of the winding bobbin holder 19a and the pressing of the winding bobbin holder 19a toward the winding bobbin WB.

**[0026]** When a first air is supplied to the package brake 51, the force acting on the bearing sleeve 53 is greater than or equal to a certain value but less than a predetermined value. The first air is compressed air having a pressure of, for example, 0.1 MPa to 0.2 MPa. When the first air is supplied, the winding bobbin WB is sandwiched between the winding bobbin holders 19a and 19b with a strong force, but the winding bobbin WB rotation is not braked. However, some specifications may not require the first air. In a specification that does not require the first air, the pressure of the first air can be set to 0 MPa.

**[0027]** On the other hand, when a second air having a higher pressure than the first air is supplied to the package brake 51, the force acting on the bearing sleeve 53 becomes equal to or greater than the predetermined value. The second air is compressed air having a pressure of, for example, 0.3 MPa to 0.7 MPa. When the second air is supplied, the rotation of the winding bobbin WB is braked. Specifically, when the second air is supplied, because the bearing sleeve 53 frictionally engages with the winding bobbin holder 19a, a relative rotation between them is stopped.

**[0028]** A cylinder rod of the lift-up cylinder 57 shown in FIG. 5 is connected to the cradle arm 16a. The lift-up cylinder 57 is a device that moves the cradle 16 so that

the package P is separated from the winding drum 18. The lift-up cylinder 57 is driven when the second air is supplied. When the lift-up cylinder 57 extends, it is possible to rotate the cradle 16 so that the package P separates from the winding drum 18.

**[0029]** In the present embodiment, each of the winder units 3 of the automatic winder 1 includes a solenoid valve unit 100 shown in FIGS. 5, 6, and 7. The solenoid valve unit 100 is a device that can selectively switch between two air systems and output the air of the selected air system. More specifically, the solenoid valve unit 100 constitutes an air circuit that can selectively output one of the two airs, and also can output one of the two airs as it is. More specifically, the solenoid valve unit 100 outputs the first air when the first air is input, and when the second air is input while the first air is being input, the solenoid valve unit 100 substitutes the first air with the second air and also separately outputs the second air as it is.

**[0030]** The solenoid valve unit 100 includes a casing 110, a first solenoid valve 120, and a second solenoid valve 130. The casing 110 is made of fiber reinforced plastic including glass fiber. The casing 110 houses a first flow path 111, a second flow path 112, a third flow path 113, a fourth flow path 114, and a fifth flow path 115. The first to fifth flow paths 111 to 115 are, for example, passages (holes) formed in the casing 110.

**[0031]** The first flow path 111 is a flow path through which the first air output from the first solenoid valve 120 flows. The first flow path 111 is connected to an exit port of the first solenoid valve 120. The second flow path 112 is a flow path through which the second air output from the second solenoid valve 130 flows. The second flow path 112 is connected to an exit port of the second solenoid valve 130. The third flow path 113 is connected via a shuttle valve 140 to the downstream side of the first flow path 111 and to the downstream side of the second flow path 112. The third flow path 113 is a flow path through which one of the first air and the second air can flow.

**[0032]** The fourth flow path 114 is connected in the middle of the second flow path 112. The fourth flow path 114 is a flow path through which a part of the second air flowing through the second flow path 112 flows. The fifth flow path 115 is a flow path through which the second air flows from a later-explained second input air coupler 160 to the second solenoid valve 130. The fifth flow path 115 is connected to an inlet port of the second solenoid valve 130.

**[0033]** The shuttle valve 140 has an inlet connected to the first flow path 111, another inlet connected to the second flow path 112, and one outlet connected to the third flow path 113. The shuttle valve 140 is a valve in which the inlet on the high pressure side of the two inlets is connected to the outlet. The shuttle valve 140 outputs the first air to the third flow path 113 when the first air is input from the first flow path 111 but the second air is not input from the second flow path 112. The shuttle valve

140 outputs the second air on the high pressure side to the third flow path 113 when the first air is input from the first flow path 111 and the second air is input from the second flow path 112.

**[0034]** The first solenoid valve 120 controls the flow of the first air to the first flow path 111. Specifically, the first solenoid valve 120 can allow or block the flow of the first air through the first flow path 111. The first solenoid valve 120 is an always-open type solenoid valve that permits the flow of the first air when no electric power is supplied to the first solenoid valve 120. The first solenoid valve 120 includes a solenoid part and a valve part. The first solenoid valve 120 is not particularly limited, and various known solenoid valves can be used as the first solenoid valve 120. The first solenoid valve 120 is integrated with the casing 110. In the present embodiment, the term "integrate" includes being physically one or being merged into each other (the same definition holds true in the below explanation). For example, a part of the first solenoid valve 120 is constituted by the casing 110. The function of the first solenoid valve 120 is established by the presence of the casing 110.

**[0035]** The second solenoid valve 130 controls the flow of the second air to the second flow path 112. Specifically, the second solenoid valve 130 can allow or block the flow of the second air to the second flow path 112. The second solenoid valve 130 is an always-closed type solenoid valve that blocks the flow of the second air when no electric power is supplied to the second solenoid valve 130. The second solenoid valve 130 includes a solenoid part and a valve part. The second solenoid valve 130 is not particularly limited, and various known solenoid valves can be used as the second solenoid valve 130. The second solenoid valve 130 is integrated with the casing 110. For example, a part of the second solenoid valve 130 is constituted by the casing 110. The function of the second solenoid valve 130 is established by the presence of the casing 110. The first solenoid valve 120 and the second solenoid valve 130 are arranged side by side and close to each other.

**[0036]** The solenoid valve unit 100 includes a first input air coupler 150, the second input air coupler 160, a first output air coupler 170, and a second output air coupler 180. The first input air coupler 150 constitutes a first inlet for introducing the first air. The first input air coupler 150 (first inlet) is arranged on a side surface of the first solenoid valve 120. The first input air coupler 150 is connected to an inlet port of the first solenoid valve 120. The second input air coupler 160 constitutes a second inlet for introducing the second air. The second input air coupler (second inlet) 160 is arranged on a side surface 110a (see FIG. 6) of the casing 110. The second input air coupler 160 is connected to the upstream side of the fifth flow path 115.

**[0037]** The first output air coupler 170 constitutes a first outlet through which one of the first air and the second air flowing through the third flow path 113 flows out. The first output air coupler 170 (first outlet) is provided on a

side surface 110b (see FIG. 7), which opposes the side surface 110a, of the casing 110. The first output air coupler 170 is connected to the downstream side of the third flow path 113. The second output air coupler 180 constitutes a second outlet through which the second air flowing through the fourth flow path 114 flows out. The second output air coupler 180 is arranged on the side surface 110b of the casing 110 so as to be side by side of the first output air coupler 170. The second output air coupler 180 is connected to the downstream side of the fourth flow path 114.

**[0038]** As shown in FIGS. 6, 7, and 8, the casing 110 has an attaching part 190. As shown in FIG. 8, the solenoid valve unit 100 is attached to a unit frame F by using a fastening member (screw or the like) via the attaching part 190 of the casing 110. In the example shown in FIG. 8, a bracket B is interposed between the attaching part 190 and the unit frame F; however, this bracket B can be omitted.

**[0039]** A cable C is connected to each of the first and second solenoid valves 120 and 130. Electric power is supplied to the first and second solenoid valves 120 and 130 via those cables C. The supply of the electric power to the first and second solenoid valves 120 and 130 is controlled by the unit control section 10. An air tube is connected to each of the first input air coupler 150, the second input air coupler 160, the first output air coupler 170, and the second output air coupler 180.

**[0040]** In this solenoid valve unit 100, when the package P is to be held rotatably by the package brake 51 via the winding bobbin holders 19a and 19b, the second air is not input from the second input air coupler 160 but the first air is input into the solenoid valve unit 100 from the first input air coupler 150. Because no electric power is supplied by the unit control section 10 to the first solenoid valve 120 and the second solenoid valve 130, the first solenoid valve 120 is set in an open state and the second solenoid valve 130 is set in a closed state. As a result, the first air flows through the first solenoid valve 120, the first flow path 111, then flows through the third flow path 113 via the shuttle valve 140, and finally the first air is supplied to the package brake 51 via the first output air coupler 170. As a result, the package P is held rotatably.

**[0041]** On the other hand, in the solenoid valve unit 100, when braking the package P via the winding bobbin holders 19a and 19b by using the package brake 51, in addition to inputting the first air from the first input air coupler 150, the second air is input into the solenoid valve unit 100 from the second input air coupler 160. The electric power is supplied only to the second solenoid valve 130 by the unit control section 10. As a result, the first solenoid valve 120 is set in the open state, and the second solenoid valve 130 is also set in the open state. As a result, the second air flows through the fifth flow path 115 and the second solenoid valve 130 and then through the second flow path 112.

**[0042]** The second air flowing through the second flow path 112 then flows through the third flow path 113 via

the shuttle valve 140 and then the second air is supplied to the package brake 51 via the first output air coupler 170. The flow of the first air is blocked by the shuttle valve 140. At the same time, a part of the second air flowing through the second flow path 112 flows through the fourth flow path 114 and is supplied to the lift-up cylinder 57 via the second output air coupler 180. As a result, the package P is switched to the lift-up state and the package P is braked.

**[0043]** On the other hand, when the electric power is supplied to the first solenoid valve 120 by the unit control section 10 while the package P has been held rotatably by the package brake 51, the first solenoid valve 120 is set in the closed state and the flow of the first air is blocked by the first solenoid valve 120. As a result, the supply of the first air to the package brake 51 is stopped, and the held package P is released.

**[0044]** As explained above, the solenoid valve unit 100 includes the casing 110 that houses therein the first to third flow paths 111 to 113 and the shuttle valve 140, the first solenoid valve 120 integrated with the casing 110, and the second solenoid valve 130 integrated with the casing 110. The first output air coupler 170 is arranged in the casing 110. In this solenoid valve unit 100, because the first and second solenoid valves 120 and 130 and the casing 110 are integrated, it is possible to realize an air circuit capable of selectively switching and outputting one of the first air and the second air.

**[0045]** Thus, for example, it is possible to reduce the necessary space, to reduce the number of the required air tubes and air joints, to reduce the number of assembling steps, or the like. Therefore, necessary resources can be reduced. Further, it is possible to share the various parts such as the basic parts included in the first and second solenoid valves 120 and 130, thereby reducing the cost.

**[0046]** In the solenoid valve unit 100, the fourth flow path 114 is connected to the second flow path 112, and the second air flowing through the fourth flow path 114 can be output from the second output air coupler 180. This makes it possible to provide a system that outputs the high pressure second air as it is.

**[0047]** In the solenoid valve unit 100, the first and second output air couplers 170 and 180 are provided on the same side surface 110b of the casing 110. This makes it possible to align the output directions of the first air and the second air. Moreover, it becomes easy to lay the piping for supplying the air from the solenoid valve unit 100 to an external device (the package brake 51 and the lift-up cylinder 57).

**[0048]** In the solenoid valve unit 100, the first solenoid valve 120 is an always-open type solenoid valve that allows the first air to flow when no electric power is being supplied thereto. The second solenoid valve 130 is an always-closed type solenoid valve that blocks the flow of the second air when no electric power is being supplied thereto. Thus, for example, when no electric power can be supplied to the first and second solenoid valves 120

and 130 in case of a power failure, the first air having a pressure lower than that of the second air can be output. Thus, it is possible to enhance the safety.

**[0049]** The solenoid valve unit 100 includes the first input air coupler 150 and the second input air coupler 160. The first input air coupler 150 is arranged in the first solenoid valve 120. The second input air coupler 160 is arranged in the casing 110. The casing 110 further houses therein the fifth flow path 115 that causes the second air to flow from the second input air coupler 160 to the second solenoid valve 130. With this configuration, it is possible to concretely realize the input of the first air and the second air to the solenoid valve unit 100.

**[0050]** The automatic winder 1 includes the winding bobbin holders 19a and 19b, the package brake 51, and the solenoid valve unit 100. When holding the package P rotatably by the package brake 51, the first solenoid valve 120 is set in the open state, the second solenoid valve 130 is set in the closed state, and the first air is supplied to the package brake 51 via the first output air coupler 170. When braking the package P with the package brake 51, the second solenoid valve 130 is set in the open state and the second air is supplied to the package brake 51 via the first output air coupler 170. In this automatic winder 1, an air circuit for rotatably holding and braking the package P can be realized with the solenoid valve unit 100, and it is possible to reduce the resources necessary for realizing such an air circuit.

**[0051]** In the solenoid valve unit 100, the first solenoid valve 120 and the second solenoid valve 130 are arranged side by side and close to each other. In this configuration, the solenoid valve unit 100 can be made compact. In the automatic winder 1, the attaching part 190 of the casing 110 is fixed to the unit frame F. In this configuration, the solenoid valve unit 100 can be fixed to the automatic winder 1 via the casing 110.

**[0052]** Note that, the first solenoid valve 120 is a three-port solenoid valve. The first solenoid valve 120 has one more other port that is different from the inlet port to which the first air is input and the exit port from which the first air is output. The other port of the first solenoid valve 120 is sealed with a seal plug 124 (see FIG. 6) provided on the casing 110. In this first solenoid valve 120, the seal plug 124 and the first input air coupler 150 may be used in place of each other. In this case, the first solenoid valve 120 can be used as a solenoid valve of the always-closed type.

**[0053]** Similarly, the second solenoid valve 130 is a three-port solenoid valve. The second solenoid valve 130 has one more other port that is different from the inlet port to which the second air is input and the exit port from which the second air is output. The other port of the second solenoid valve 130 is sealed with a seal plug 134 (see FIG. 6) provided on the side surface of the second solenoid valve 130. In this second solenoid valve 130, the seal plug 134 and the second input air coupler 160 may be used in place of each other. In this case, the second solenoid valve 130 can be used as a solenoid

valve of the always-open type.

**[0054]** Exemplary embodiments of the present invention have been explained above; however, the present invention is not necessarily limited to those embodiments. Those embodiments can be modified in various ways without departing from the scope of the invention.

**[0055]** In the above embodiments, the fourth flow path 114 and the second output air coupler 180 for lifting up the package P are arranged in the casing 110; however, depending on the situation, the fourth flow path 114 and the second output air coupler 180 can be omitted.

**[0056]** In the above embodiment, the first output air coupler 170 and the second output air coupler 180 are arranged on the same side surface 110b of the casing 110; however, the first output air coupler 170 and the second output air coupler 180 can be arranged on different side surfaces of the casing 110.

**[0057]** In the above embodiment, a configuration in which the winder unit 3 includes the tension detecting device 24 is explained as an example; however, a device for detecting the tension of the spun yarn Y can be arranged in the yarn monitoring device 28.

**[0058]** In the above embodiment, a configuration in which the traversing groove is formed in the winding drum 18 and the traversing of the spun yarn Y is performed by using the traversing groove is explained as an example; however, the traversing of the spun yarn Y can be performed by using a traverse mechanism that is an arm type, a belt type, or a rotary type. If such a traverse mechanism is employed, a roller on which no traversing groove has been formed can be used as the auxiliary roller.

**[0059]** A solenoid valve unit according to one aspect of the present invention includes a casing that houses therein a first flow path through which a first air flows, a second flow path through which a second air having a pressure higher than the first air flows, and a third flow path connected via a shuttle valve to a downstream side of the first flow path and to a downstream side of the second flow path; a first solenoid valve that is integrated with the casing and controls flow of the first air to the first flow path; and a second solenoid valve that is integrated with the casing and controls flow of the second air to the second flow path. The casing includes a first outlet through which one of the first air and the second air flowing through the third flow path flows out.

**[0060]** In the above solenoid valve unit, because the first and second solenoid valves and the casing are integrated, it is possible to realize a desired air circuit as mentioned above (that is, an air circuit capable of selectively switching and outputting one of airs of two air systems). Thus, for example, it is possible to reduce the necessary space, to reduce the number of the required air tubes and air joints, to reduce the number of assembling steps, or the like. Therefore, necessary resources can be reduced.

**[0061]** In the above solenoid valve unit, the casing can include a fourth flow path connected to the second flow path, and can include a second outlet through which the

second air flowing through the fourth flow path flows out. This makes it possible to provide a system that outputs the high pressure second air as it is.

**[0062]** In the above solenoid valve unit, the first outlet and the second outlet can be arranged on the same surface of the casing. This makes it easy to lay the piping for supplying the air from the solenoid valve unit to an external device.

**[0063]** In the above solenoid valve unit, the first solenoid valve can be an always-open type solenoid valve that permits the flow of the first air when no electric power is being supplied thereto, and the second solenoid valve can be an always-closed type solenoid valve that blocks the flow of the second air when no electric power is being supplied thereto. Thus, for example, when no electric power can be supplied to the first and second solenoid valves in case of a power failure, the first air having a pressure lower than that of the second air can be output. Thus, it is possible to enhance the safety.

**[0064]** The above solenoid valve unit can further include a first inlet for introducing the first air and a second inlet for introducing the second air. The first inlet can be arranged in the first solenoid valve, the second inlet can be arranged in the casing. The casing can include a fifth flow path through which the second air flows from the second inlet to the second solenoid valve. With this configuration, it is possible to concretely realize the input of the first air and the second air to the solenoid valve unit.

**[0065]** An automatic winder according to another aspect of the present invention includes a holding part that holds a package by sandwiching the package; a brake section that controls a holding force and braking of the holding part according to the pressure of supplied air; and the above explained solenoid valve unit. The solenoid valve unit, when holding the package rotatably via the holding part by using the brake section, sets the first solenoid valve in an open state and sets the second solenoid valve in a closed state, and supplies the first air to the brake section via the first outlet, and, when braking the package via the holding part by using the brake section, sets the second solenoid valve in an open state and supplies the second air to the brake section via the first outlet.

**[0066]** In this automatic winder, an air circuit for rotatably holding and braking the package can be realized with the above solenoid valve unit, and it is possible to reduce the resources necessary for realizing such an air circuit.

**[0067]** According to the present invention, it is possible to provide a solenoid valve unit and an automatic winder capable of reducing the necessary resources.

**[0068]** In the above explanation, the meaning of "a plurality of" also includes "a predetermined number of".

**[0069]** Although the invention has been explained with respect to specific embodiments for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one

skilled in the art that fairly fall within the scope of the claims.

## Claims

### 1. A solenoid valve unit (100) comprising:

a casing (110) that houses therein a first flow path (111) through which a first air flows, a second flow path (112) through which a second air having a pressure higher than the first air flows, and a third flow path (113) connected via a shuttle valve (140) to a downstream side of the first flow path (111) and to a downstream side of the second flow path (112);

a first solenoid valve (120) that is integrated with the casing (110) and controls flow of the first air to the first flow path (111); and

a second solenoid valve (130) that is integrated with the casing (110) and controls flow of the second air to the second flow path (112), wherein the casing (110) includes a first outlet (170) through which one of the first air and the second air flowing through the third flow path (113) flows out.

### 2. The solenoid valve unit (100) as claimed in Claim 1, wherein

the casing (110) includes a fourth flow path (114) connected to the second flow path (112), and the casing (110) includes a second outlet (180) through which the second air flowing through the fourth flow path (114) flows out.

### 3. The solenoid valve unit (100) as claimed in Claim 2, wherein the first outlet (170) and the second outlet (180) are arranged on the same surface of the casing (110).

### 4. The solenoid valve unit (100) as claimed in any one of Claims 1 to 3, wherein

the first solenoid valve (120) is an always-open type solenoid valve that permits the flow of the first air when no electric power is being supplied thereto, and the second solenoid valve (130) is an always-closed type solenoid valve that blocks the flow of the second air when no electric power is being supplied thereto.

### 5. The solenoid valve unit (100) as claimed in any one of Claims 1 to 4, further comprising a first inlet (150) for introducing the first air and a second inlet (160) for introducing the second air, wherein the first inlet (150) is arranged in the first solenoid valve (120), the second inlet (160) is arranged in the casing (110), and the casing (110) includes a fifth flow path (115) through which the second air flows from the second

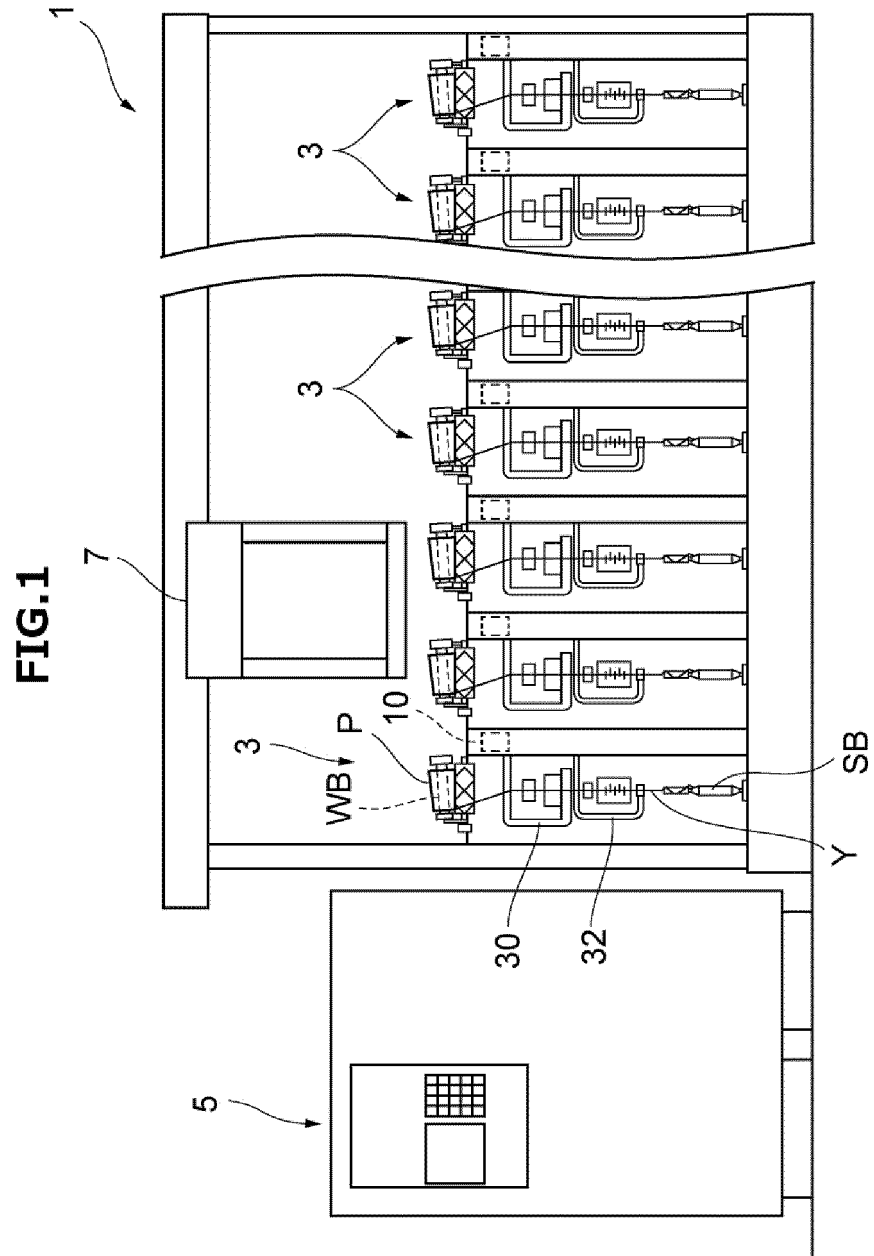
inlet (160) to the second solenoid valve (130).

### 6. An automatic winder (1) comprising:

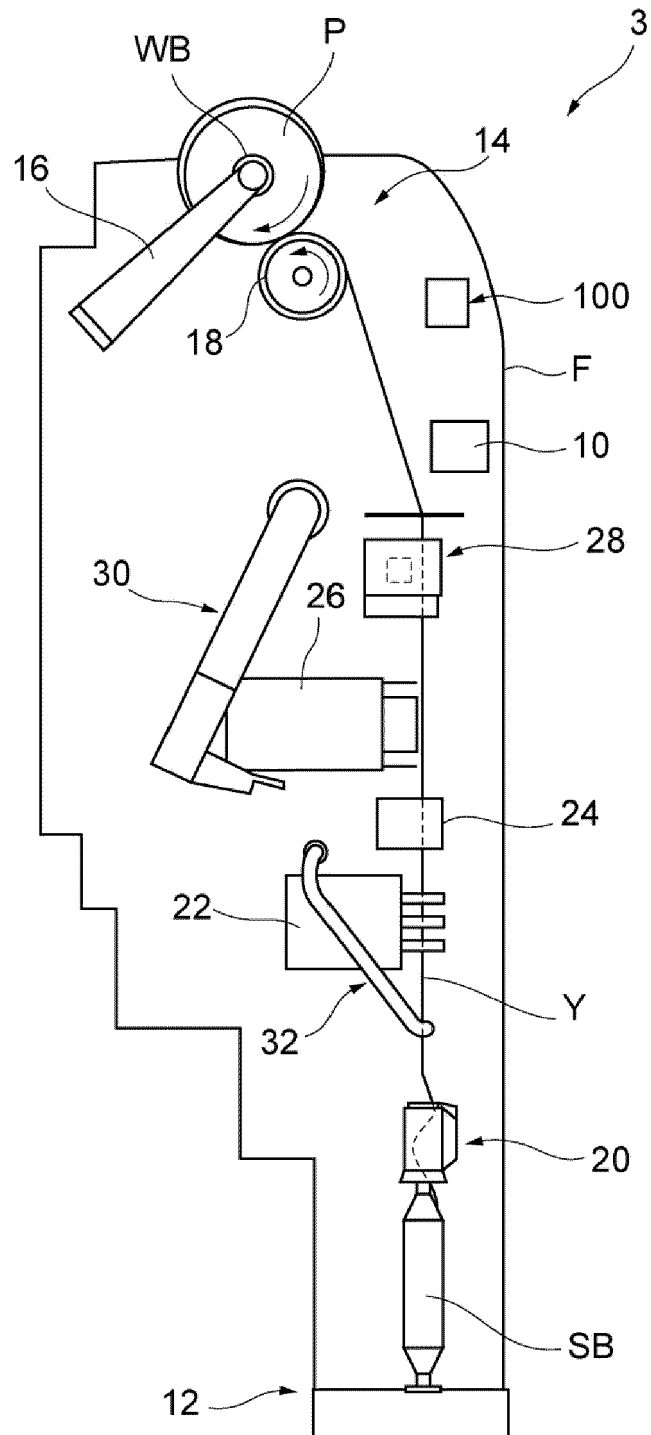
a holding part (19a, 19b) that holds a package (P) by sandwiching the package (P); a brake section (51) that controls a holding force and braking of the holding part (19a, 19b) according to the pressure of supplied air; and the solenoid valve unit (100) as claimed in any one of Claims 1 to 5, wherein the solenoid valve unit (100)

when holding the package (P) rotatably via the holding part (19a, 19b) by using the brake section (51), sets the first solenoid valve (120) in an open state and sets the second solenoid valve (130) in a closed state, and supplies the first air to the brake section (51) via the first outlet (170), and when braking the package (P) via the holding part (19a, 19b) by using the brake section (51), sets the second solenoid valve (130) in an open state and supplies the second air to the brake section (51) via the first outlet (170).





**FIG.2**



**FIG.3**

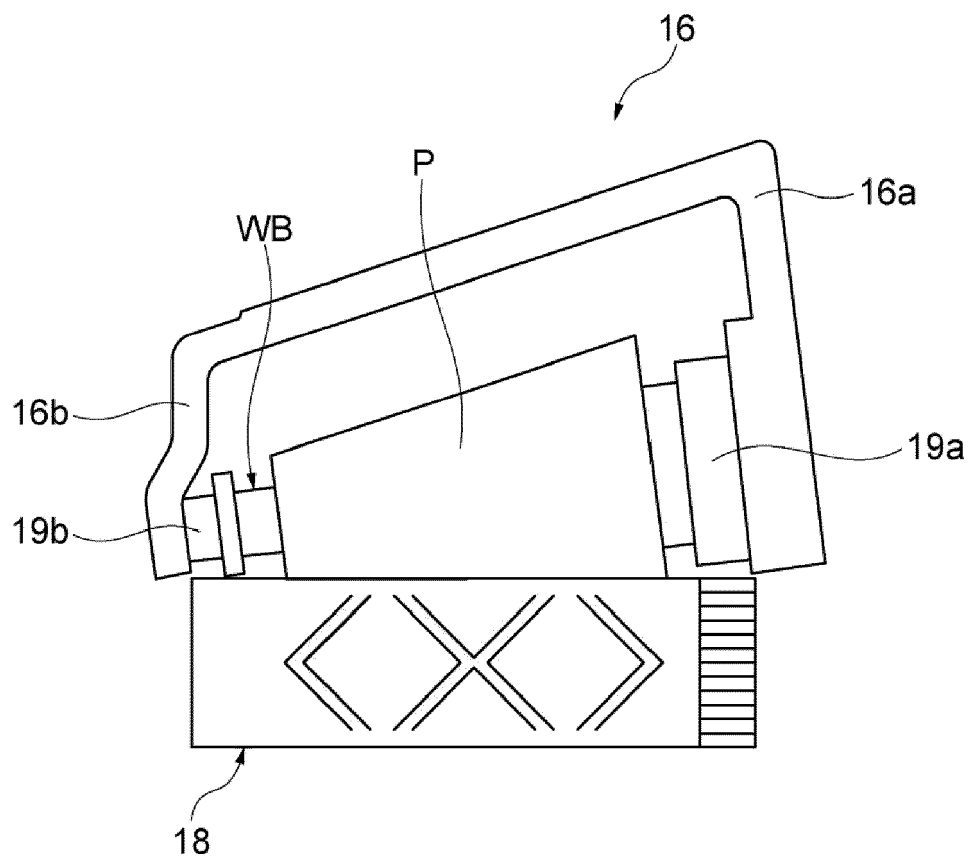


FIG. 4

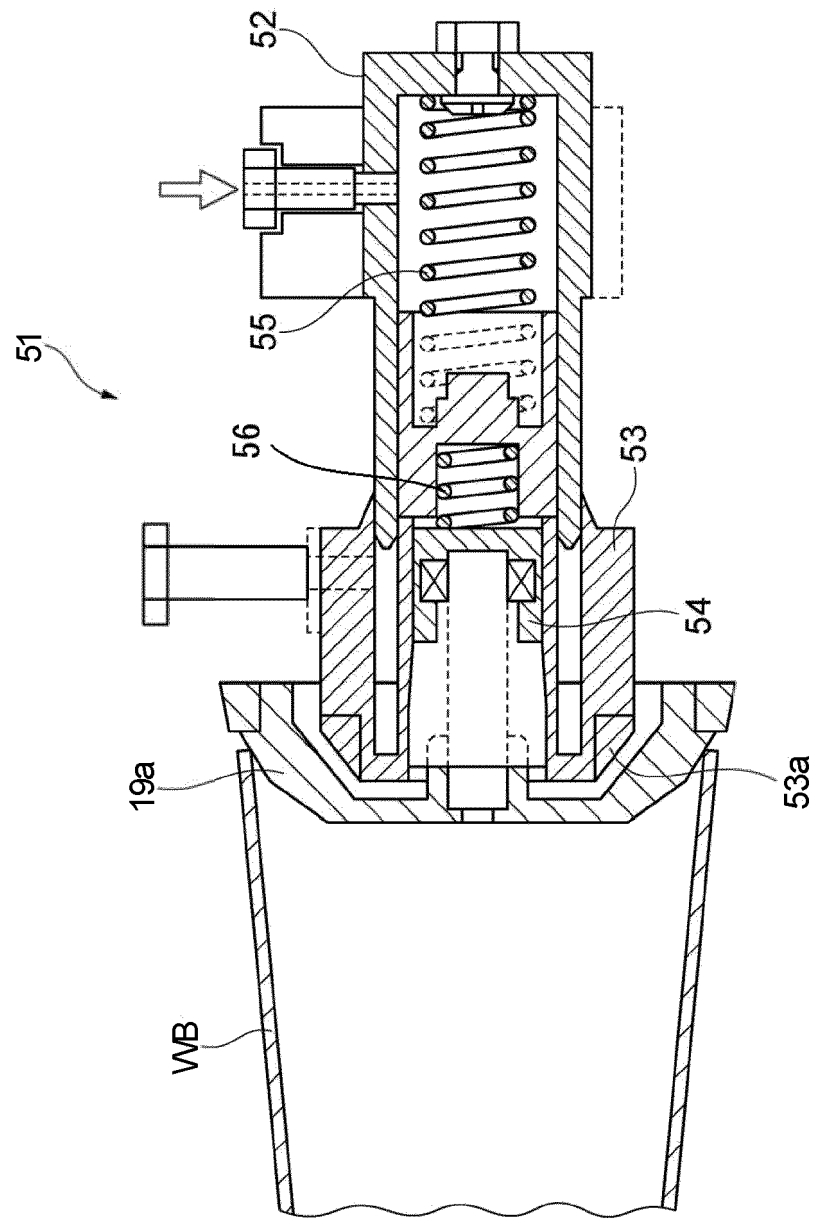
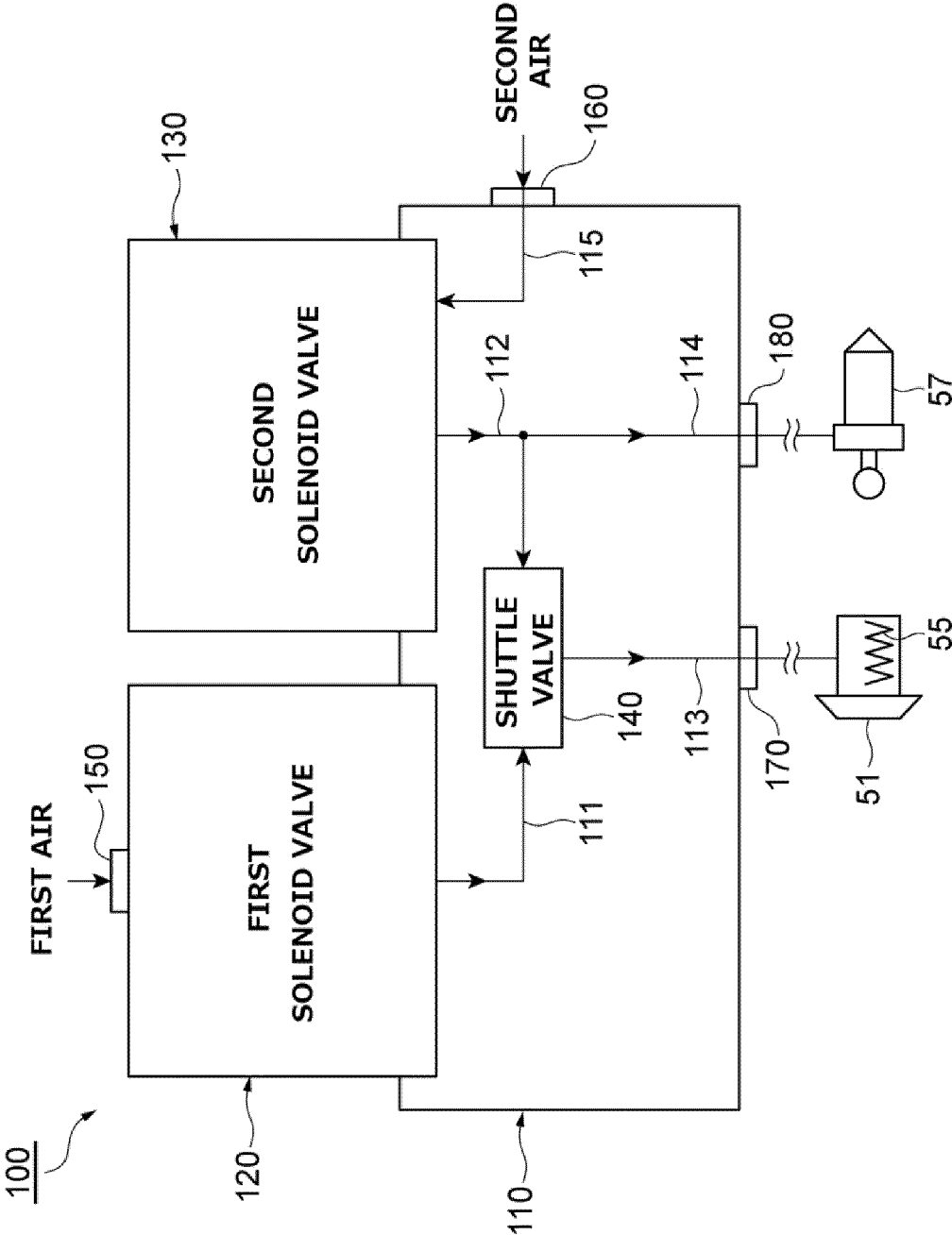


FIG.5



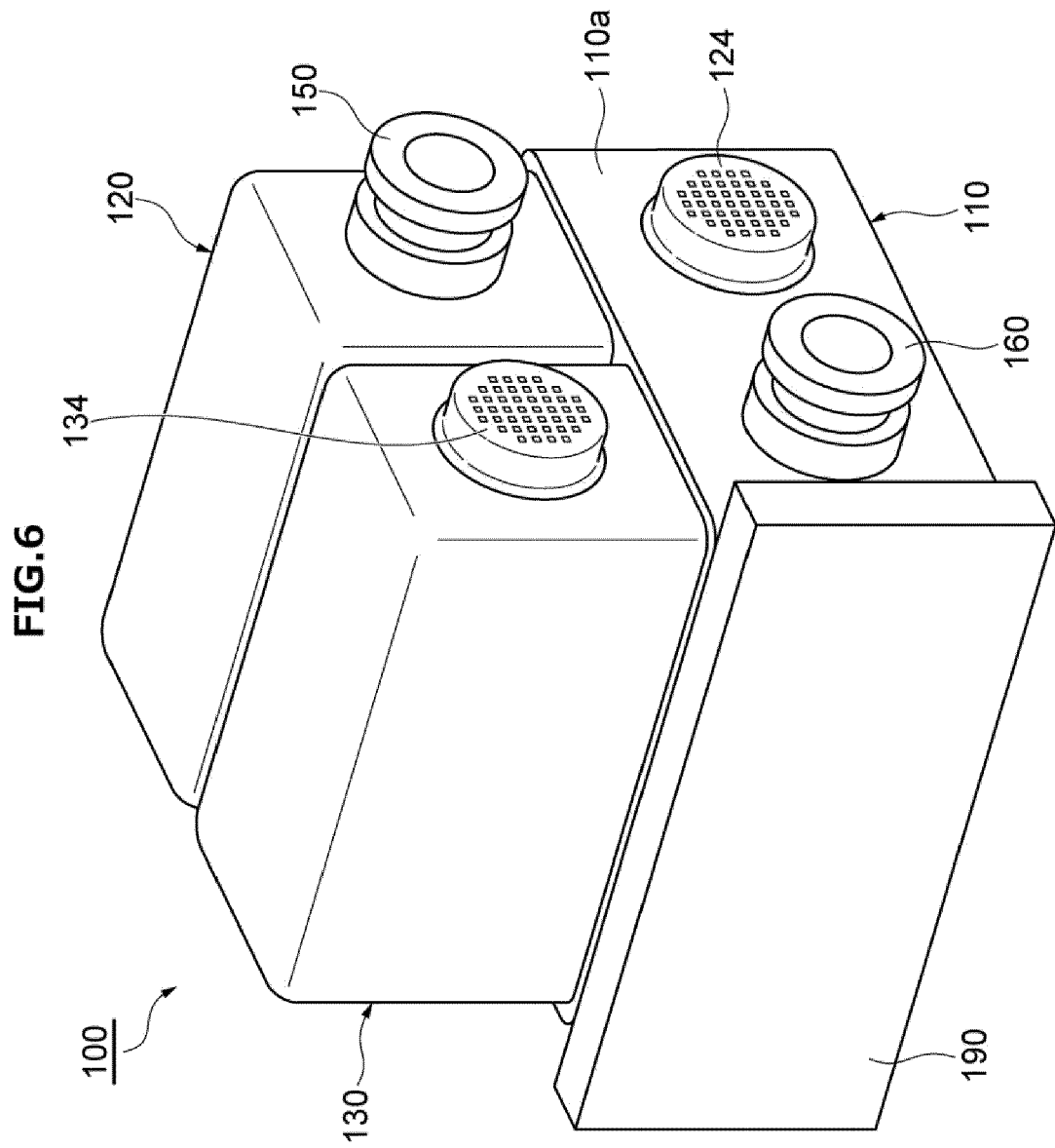
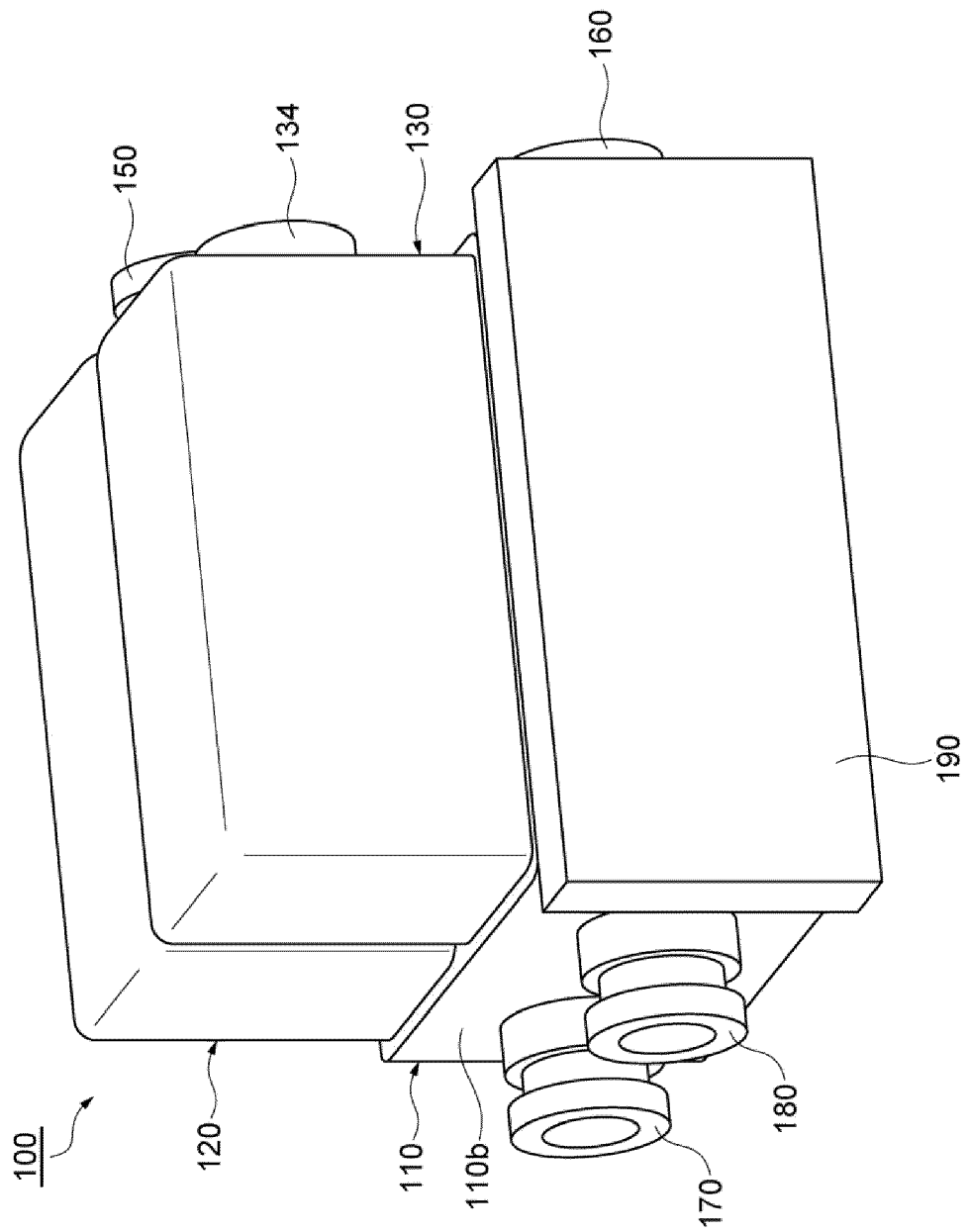
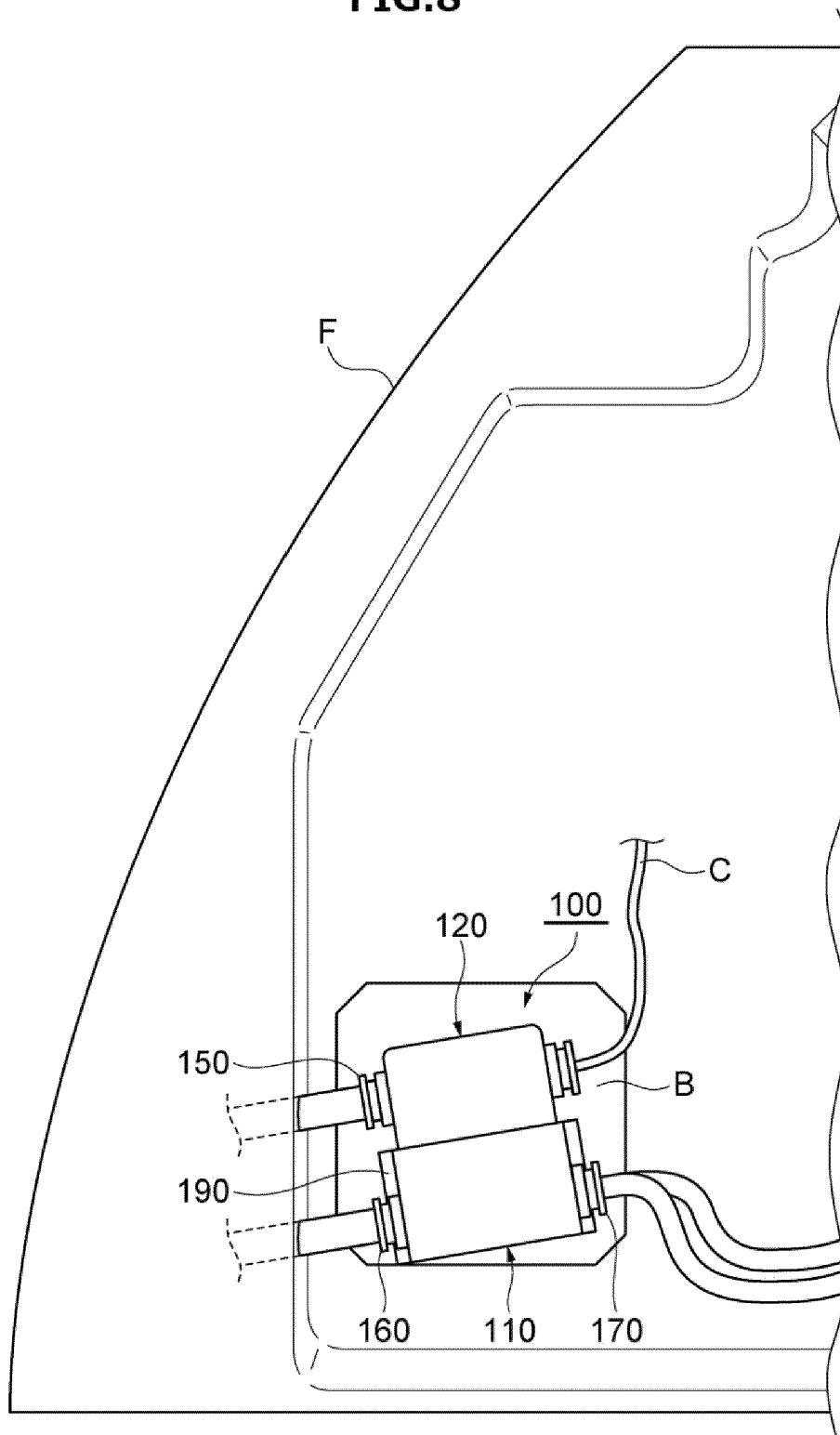


FIG. 7



**FIG.8**







## EUROPEAN SEARCH REPORT

Application Number  
EP 19 16 5457

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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                    |                                                                               |                                                                                                                                                                                                                                                                              |                                             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|
| Category                                                                                                                                                                                                                                               | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim                                                                                                                                                                                                                                                            | CLASSIFICATION OF THE APPLICATION (IPC)     |
| Y,D                                                                                                                                                                                                                                                    | EP 2 573 024 A2 (MURATA MACHINERY LTD [JP]) 27 March 2013 (2013-03-27)        | 2,3,6                                                                                                                                                                                                                                                                        | INV.<br>F15B13/08<br>F15B11/17<br>F15B13/02 |
| A                                                                                                                                                                                                                                                      | * paragraph [0028] - paragraph [0035];<br>figure 3 *                          | 4,5                                                                                                                                                                                                                                                                          |                                             |
|                                                                                                                                                                                                                                                        | * paragraph [0051] - paragraph [0056];<br>figures 2, 4 *                      |                                                                                                                                                                                                                                                                              |                                             |
|                                                                                                                                                                                                                                                        | * paragraph [0061] - paragraph [0062] *                                       |                                                                                                                                                                                                                                                                              |                                             |
| A                                                                                                                                                                                                                                                      | EP 2 862 826 A1 (MURATA MACHINERY LTD [JP]) 22 April 2015 (2015-04-22)        | 1-6                                                                                                                                                                                                                                                                          |                                             |
|                                                                                                                                                                                                                                                        | * paragraph [0038] - paragraph [0049];<br>figures 4-5 *                       |                                                                                                                                                                                                                                                                              |                                             |
| A                                                                                                                                                                                                                                                      | EP 0 846 640 A2 (SCHLAFHORST & CO W [DE])<br>10 June 1998 (1998-06-10)        | 1-6                                                                                                                                                                                                                                                                          |                                             |
|                                                                                                                                                                                                                                                        | * figures 1-4 *                                                               |                                                                                                                                                                                                                                                                              |                                             |
| A                                                                                                                                                                                                                                                      | EP 3 312 119 A1 (MURATA MACHINERY LTD [JP]) 25 April 2018 (2018-04-25)        | 1-6                                                                                                                                                                                                                                                                          |                                             |
|                                                                                                                                                                                                                                                        | * paragraph [0064] - paragraph [0067];<br>figure 5 *                          |                                                                                                                                                                                                                                                                              |                                             |
| A                                                                                                                                                                                                                                                      | EP 0 197 314 A1 (BOSCH GMBH ROBERT [DE])<br>15 October 1986 (1986-10-15)      | 1-5                                                                                                                                                                                                                                                                          | TECHNICAL FIELDS<br>SEARCHED (IPC)          |
|                                                                                                                                                                                                                                                        | * figures 1-5 *                                                               |                                                                                                                                                                                                                                                                              | F15B<br>B65H                                |
| X                                                                                                                                                                                                                                                      | EP 0 366 281 A1 (ROSS OPERATING VALVE CO [US]) 2 May 1990 (1990-05-02)        | 1                                                                                                                                                                                                                                                                            |                                             |
| Y                                                                                                                                                                                                                                                      | * column 12, line 10 - column 13, line 7;<br>figure 7 *                       | 2,3,6                                                                                                                                                                                                                                                                        |                                             |
|                                                                                                                                                                                                                                                        | * column 10, line 25 - line 32; figure 6 *                                    |                                                                                                                                                                                                                                                                              |                                             |
| The present search report has been drawn up for all claims                                                                                                                                                                                             |                                                                               |                                                                                                                                                                                                                                                                              |                                             |
| Place of search<br><b>Munich</b>                                                                                                                                                                                                                       |                                                                               | Date of completion of the search<br><b>9 October 2019</b>                                                                                                                                                                                                                    | Examiner<br><b>Díaz Antuña, Elena</b>       |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document |                                                                               | T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                             |

EPO FORM 1503 03.82 (P04C01)

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

EP 19 16 5457

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

09-10-2019

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|---------------------|----------------------------|---------------------|
| EP 2573024 A2                             | 27-03-2013          | CN 103010820 A             | 03-04-2013          |
|                                           |                     | EP 2573024 A2              | 27-03-2013          |
|                                           |                     | JP 2013067469 A            | 18-04-2013          |
| EP 2862826 A1                             | 22-04-2015          | CN 104555574 A             | 29-04-2015          |
|                                           |                     | EP 2862826 A1              | 22-04-2015          |
|                                           |                     | JP 2015081157 A            | 27-04-2015          |
| EP 0846640 A2                             | 10-06-1998          | DE 19650932 A1             | 10-06-1998          |
|                                           |                     | EP 0846640 A2              | 10-06-1998          |
|                                           |                     | JP 4181235 B2              | 12-11-2008          |
|                                           |                     | JP H10175778 A             | 30-06-1998          |
|                                           |                     | TR 199701453 A2            | 22-06-1998          |
|                                           |                     | US 5853137 A               | 29-12-1998          |
| EP 3312119 A1                             | 25-04-2018          | CN 107954259 A             | 24-04-2018          |
|                                           |                     | EP 3312119 A1              | 25-04-2018          |
|                                           |                     | EP 3375743 A1              | 19-09-2018          |
|                                           |                     | JP 2018065637 A            | 26-04-2018          |
| EP 0197314 A1                             | 15-10-1986          | DE 3512014 A1              | 02-10-1986          |
|                                           |                     | EP 0197314 A1              | 15-10-1986          |
|                                           |                     | JP H06100291 B2            | 12-12-1994          |
|                                           |                     | JP S61233273 A             | 17-10-1986          |
| EP 0366281 A1                             | 02-05-1990          | CA 1334922 C               | 28-03-1995          |
|                                           |                     | CN 1042221 A               | 16-05-1990          |
|                                           |                     | DE 68907308 D1             | 29-07-1993          |
|                                           |                     | DE 68907308 T2             | 30-09-1993          |
|                                           |                     | EP 0366281 A1              | 02-05-1990          |
|                                           |                     | ES 2043033 T3              | 16-12-1993          |
|                                           |                     | JP H0788844 B2             | 27-09-1995          |
|                                           |                     | JP H02245504 A             | 01-10-1990          |
|                                           |                     | RU 2028521 C1              | 09-02-1995          |
|                                           |                     | US 4930401 A               | 05-06-1990          |

EPO FORM P0459

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

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- JP 2001106434 A [0002]