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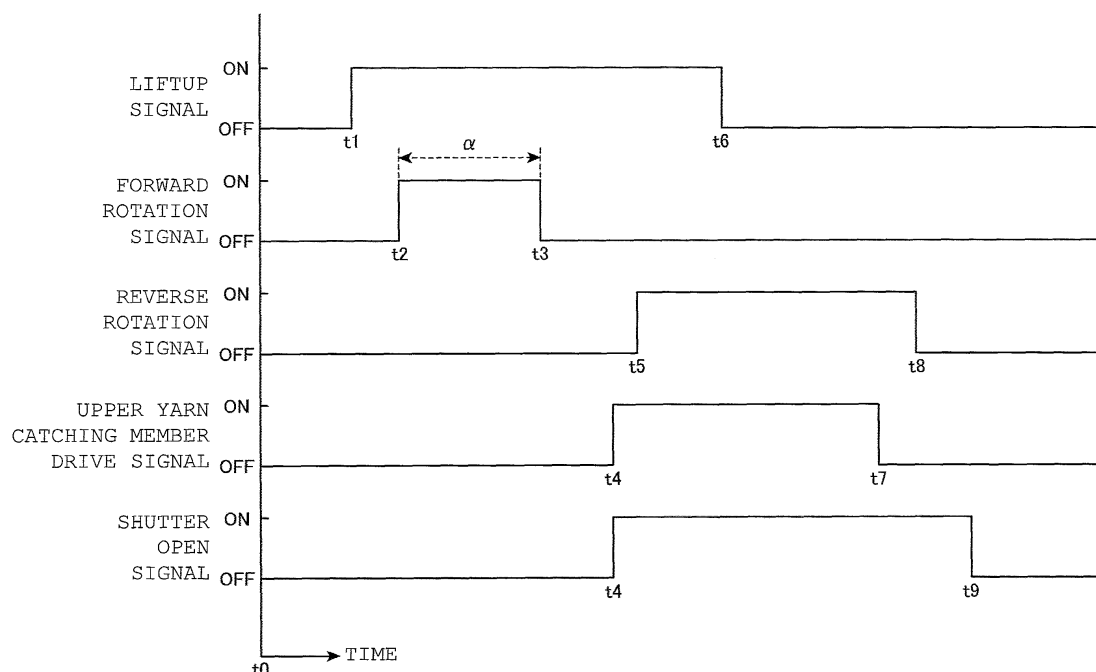
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(54) **YARN WINDING MACHINE**

(57) A winding unit (10) includes a cradle (23) adapted to hold a package (30), a contact roller (29) adapted to make contact with a surface of the package (30), an air cylinder (60) adapted to move the package (30) between a contacting position in which the package (30) makes contact with the contact roller (29) and a non-contacting position in which the package (30) is separat-

ed from the contact roller (29), and a package driving motor (41) adapted to rotatably drive the package (30). The package driving motor (41) carries out a forward rotation of rotating the package (30) in a winding direction for a set period α in a lift-up state in which the package (30) having a yarn end is separated from the contact roller (29) by the air cylinder (60).

FIG. 6



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

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

2. Description of the Related Art

[0002] As a conventional yarn winding machine, a yarn winding machine described in Japanese Unexamined Patent Publication No. 2012-218922, for example, is known. In the yarn winding machine described in Japanese Unexamined Patent Publication No. 2012-218922, when a yarn is cut during a winding operation of the yarn, a package is separated from a touch roller by a moving section and the package is rotated in a direction opposite to a winding direction by a package driving section. A yarn end of a yarn which continues to the package (yarn end of the package) is then caught by a yarn end catching section and handed to a splicer device, and this yarn end is connected to a yarn end of a yarn from a yarn supplying bobbin.

[0003] In the yarn winding machine described above, when the yarn is cut, the yarn end of the package sometimes attaches to the package depending on a material of the yarn and/or an amount of fluff and the like, for example. As a result, the yarn end is difficult to be caught by the yarn end catching section, and furthermore, a pull-out rate of the yarn end may be lowered.

BRIEF SUMMARY OF THE INVENTION

[0004] It is an object of the present invention to provide a yarn winding machine capable of detaching a yarn end from a package.

[0005] A yarn winding machine of the present invention includes a holding section adapted to hold a package; a touch roller adapted to make contact with a surface of the package held by the holding section; a moving section adapted to move the package between a position in which the package makes contact with the touch roller and a position in which the package is separated from the touch roller; and a package driving section adapted to rotatably drive the package, wherein the package driving section carries out a forward rotation of rotating the package in a winding direction for a set period in a separated state in which the package having a yarn end is separated from the touch roller by the moving section.

[0006] In such a yarn winding machine, the set period for forwardly rotating the package having the yarn end in the separated state is set, and the package can be forwardly rotated for the set period in the separated state when the yarn is disconnected, for example. The yarn end thus can be detached from the package by a centrifugal force of the rotation in the forward rotation.

[0007] In the yarn winding machine of the present invention, the package driving section may rotate the package at a first rotation speed for winding a yarn into the package and a second rotation speed for carrying out the forward rotation for the set period in the separated state, and the first rotation speed and the second rotation speed may be speeds different from one another. Thus, the package can be rotated at the rotation speeds respectively suitable for the winding operation and the forward rotation, respectively.

[0008] In the yarn winding machine of the present invention, the package driving section may change at least one of the set period and the second rotation speed according to a diameter of the package. Although easiness of attachment of the yarn end differs depending on a size of the diameter of the package, the above-described operation effect of detaching the yarn end from the package by the centrifugal force of the rotation can be controlled according to the easiness of attachment of the yarn end.

[0009] The yarn winding machine of the present invention may further include a determining section adapted to determine whether or not to carry out the forward rotation for the set period in the separated state based on a diameter of the package, wherein the package driving section may carry out the forward rotation for the set period in the separated state in accordance with a determination result of the determining section. The easiness of attachment of the yarn end differs depending on the size of the diameter of the package, but the presence or the absence of the forward rotation can be controlled according to the easiness of attachment of the yarn end.

[0010] In the yarn winding machine of the present invention, the package driving section may carry out the forward rotation for the set period in the separated state such that a peripheral speed of the package becomes constant. Thus, the operation effect of detaching the yarn end from the package by the centrifugal force of the rotation can be stably realized.

[0011] In the yarn winding machine of the present invention, the package driving section may carry out the forward rotation for the set period in the separated state such that a peripheral speed of the package becomes a speed corresponding to a diameter of the package. Thus, the force acting on the yarn end becomes constant, and the force of detaching the yarn end from the package can be stabilized.

[0012] The yarn winding machine of the present invention may further include a yarn catching section adapted to catch the yarn end. In this case, the yarn end detached from the package can be caught by the yarn catching section.

[0013] In the yarn winding machine of the present invention, the package driving section may carry out a reverse rotation of rotating the package in a direction opposite to the winding direction in the separated state after carrying out the forward rotation for the set period in the separated state. The yarn end thus can be further detached from the package.

[0014] In the yarn winding machine of the present invention, the package driving section may carry out a reverse rotation of rotating the package in a direction opposite to the winding direction after carrying out the forward rotation for the set period in the separated state and after the package is brought into contact with the touch roller by the moving section. Thus, when catching the yarn end of the package by the yarn catching section, for example, a distance between the yarn catching section and the package can be stabilized. The moving section moves the holding section to move the package between the contacting position and the separating position. The package driving section is arranged in the holding section. The package driving section rotatably drives the package directly. The package driving section is a rotation motor.

[0015] According to the present invention, a yarn winding machine capable of detaching the yarn end from the package is provided.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

FIG. 1 is a schematic view of an automatic winder including a winding unit according to one embodiment of the present invention;

FIG. 2 is a schematic view and a block diagram illustrating a schematic configuration of the winding unit;

FIG. 3 is a left side view illustrating the vicinity of a traverse device of the winding unit in an enlarged manner;

FIG. 4 is a right side view illustrating the vicinity of a cradle of the winding unit in an enlarged manner;

FIG. 5 is a left side view illustrating a package that moves to a non-contacting position and a contacting position;

FIG. 6 is a chart diagram illustrating one example of an operation of the winding unit; and

FIG. 7 is a chart diagram illustrating another example of the operation of the winding unit.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

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

[0018] First, an overall configuration of an automatic winder 1 including a winding unit (yarn winding machine) 10 according to the present embodiment will be described with reference to FIG. 1. "Upstream" and "downstream" respectively refer to upstream and downstream in a travelling direction of a yarn at the time of yarn winding.

[0019] As illustrated in FIG. 1, the automatic winder 1 includes a plurality of winding units 10 arranged in line, an automatic doffing device 80, and a machine control device 90 as main components. Each winding unit 10 is configured to wind a yarn 20 unwound from a yarn supplying bobbin 21 while traversing the yarn 20 to form a package (wound package) 30.

[0020] When the package 30 is fully wound in one of the winding units 10, the automatic doffing device 80 travels to a position of the relevant winding unit 10 to collect the fully-wound package 30 discharged from the winding unit 10 and supply an empty bobbin to the winding unit 10.

[0021] The machine control device 90 includes a setting section 91 and a display section 92 as main components. The setting section 91 can carry out the setting with respect to each winding unit 10 when an operator inputs a predetermined set value or selects an appropriate control method. The display section 92 is configured to be able to display winding status of the yarn 20 in each winding unit 10, content of trouble that occurred, and the like. The display section 92 may be configured by a touch panel, and the setting section 91 may be included in the display section 92.

[0022] Next, a description will be specifically made on a structure of the winding unit 10 with reference to FIG. 2. As illustrated in FIG. 2, each winding unit 10 includes a winding unit main body 16 and a unit control section 50 as main components.

[0023] The unit control section 50, for example, is configured to include a CPU, a RAM, a ROM, an I/O port, and a communication port. The ROM stores a program for controlling each component of the winding unit main body 16. Each component (details to be described later) of the winding unit main body 16 and the machine control device 90 are connected to the I/O port and the communication port, thus enabling communication of control information and the like. The unit control section 50 thus can control the operation of each component of the winding unit main body 16.

[0024] The winding unit main body 16 includes a yarn unwinding assisting device 12, a tension applying device 13, a splicer device (yarn joining device) 14, and a yarn monitoring device 15, in this order from the yarn supplying bobbin 21, on a yarn travelling path between the yarn supplying bobbin 21 and a contact roller (touch roller) 29.

[0025] A yarn supplying section 11 is arranged at a lower part of the winding unit main body 16. The yarn supplying section 11 is configured to hold the yarn supplying bobbin 21 transported by a bobbin transportation system (not illustrated) at a prescribed position.

[0026] The yarn unwinding assisting device 12 assists the unwinding of the yarn 20 from the yarn supplying bobbin 21 by lowering a regulating member 40 covering a core tube of the yarn supplying bobbin 21 accompanying unwinding of the yarn 20 from the yarn supplying bobbin 21. The regulating member 40 makes contact with a balloon of the yarn 20 formed at an upper part of the yarn supplying bobbin 21 by rotation and a centrifugal force

of the yarn 20 unwound from the yarn supplying bobbin 21 to control the balloon of the yarn 20 to an appropriate size, thus assisting the unwinding of the yarn 20. A sensor (not illustrated) for detecting a chase portion of the yarn supplying bobbin 21 is arranged in proximity to the regulating member 40. When this sensor detects lowering of the chase portion, the yarn unwinding assisting device 12 lowers the regulating member 40 by an air cylinder (not illustrated), for example, following the lowering of the chase portion.

[0027] The tension applying device 13 applies a predetermined tension on the travelling yarn 20. As the tension applying device 13, for example, a gate-type tension applying device may be used in which movable comb teeth are arranged with respect to fixed comb teeth. The movable comb teeth are swung by a rotary solenoid so that the movable comb teeth are engaged with or released from the fixed comb teeth. A disc-type tension applying device 13, for example, may be adopted instead of the gate-type tension applying device described above.

[0028] The splicer device 14 joins a lower yarn from the yarn supplying bobbin 21 and an upper yarn from the package 30 after the yarn monitoring device 15 detects a yarn defect and cuts the yarn, after yarn breakage while unwinding the yarn from the yarn supplying bobbin 21, and the like. Such a yarn joining device adapted to join the upper yarn and the lower yarn may be a mechanical knotter or a device that uses fluid such as compressed air.

[0029] The yarn monitoring device 15 includes a head 49 provided with a sensor (not illustrated) for detecting a thickness of the yarn 20, and an analyzer 52 for processing a yarn thickness signal from the sensor. The yarn monitoring device 15 detects a yarn defect such as slub by monitoring the yarn thickness signal from the sensor. A cutter 39 for immediately cutting the yarn 20 when the yarn defect is detected by the yarn monitoring device 15 is arranged in proximity to the head 49.

[0030] A lower yarn catching member 25 for catching a yarn end of the lower yarn and guiding the yarn end to the splicer device 14 is arranged below the splicer device 14. An upper yarn catching member 26 for catching a yarn end of the upper yarn and guiding the yarn end to the splicer device 14 is arranged above the splicer device 14. The lower yarn catching member 25 includes a lower yarn pipe arm 33, and a lower yarn suction mouth 32 formed at a distal end of the lower yarn pipe arm 33. The upper yarn catching member 26 includes an upper yarn pipe arm 36, and an upper yarn suction mouth (yarn catching section) 35 formed at a distal end of the upper yarn pipe arm 36.

[0031] The lower yarn pipe arm 33 and the upper yarn pipe arm 36 are configured to be swingable with shafts 34 and 37 as a center, respectively. An appropriate negative pressure source is connected to the lower yarn pipe arm 33 and the upper yarn pipe arm 36. The lower yarn pipe arm 33 is configured to generate a suction flow at the lower yarn suction mouth 32 so as to suck and catch

the yarn end of the lower yarn. The upper yarn pipe arm 36 is configured to generate a suction flow at the upper yarn suction mouth 35 so as to suck and catch the yarn end of the upper yarn. A shutter (not illustrated) is arranged on a basal end side of each of the lower yarn pipe arm 33 and the upper yarn pipe arm 36. Each shutter is opened/closed in accordance with the signal from the unit control section 50. The stopping and generation of the suction flow from the lower yarn suction mouth 32 and the upper yarn suction mouth 35 are thereby controlled.

[0032] The winding unit main body 16 includes a cradle (holding section) 23 adapted to removably support a winding bobbin 22, and a contact roller 29 adapted to be rotated when brought into contact with a peripheral surface of the winding bobbin 22 or a peripheral surface of the package 30. The winding unit main body 16 also includes an arm-type traverse device 70 in proximity to the cradle 23 to traverse the yarn 20, so that the yarn 20 can be wound into the package 30 while being traversed by the traverse device 70. A guide plate 28 is arranged slightly upstream of a traversing area. The guide plate 28 guides the yarn 20 from the upstream to the traversing area. A traverse supporting point portion 27 made of ceramic is provided further upstream of the guide plate 28. The traverse device 70 traverses the yarn 20 in a direction indicated with an arrow in FIG. 2 with the traverse supporting point portion 27 as a supporting point.

[0033] The cradle 23 is configured to be swingable with a swing shaft 48 as the center. The cradle 23 absorbs an increase in a yarn layer diameter of the package 30 accompanying the winding of the yarn 20 around the winding bobbin 22 by the swinging of the cradle 23. The cradle 23 includes a rotation speed sensor 24 adapted to measure a rotation speed of the package 30.

[0034] A package driving motor (package driving section) 41 configured by a servo motor is attached to the cradle 23. The winding bobbin 22 is rotatably driven by the package driving motor 41 to wind the yarn 20 around the winding bobbin 22. The package driving motor 41 can be rotatably driven in a forward rotation (hereinafter simply referred to as "forward rotation") of rotating the package 30 (winding bobbin 22) in the winding direction. Also, the package driving motor 41 can be rotatably driven in a reverse rotation (hereinafter simply referred to as "reverse rotation") of rotating the package 30 in an anti-winding direction, which is a direction opposite to the winding direction. A motor shaft of the package driving motor 41 is coupled with the winding bobbin 22 so as to be relatively non-rotatable when the winding bobbin 22 is supported by the cradle 23 (so-called direct drive type).

[0035] An operation of the package driving motor 41 is controlled by a package drive control section 42. The package drive control section 42 controls the operation and stop of the package driving motor 41 upon receiving an operation signal from the unit control section 50. The package driving motor 41 is not limited to a servo motor, and may be various types of motors such as a step motor

or an induction motor.

[0036] An angle sensor 44 adapted to detect an angle of the cradle 23 is attached to the swing shaft 48. The angle sensor 44 includes a rotary encoder, for example, and transmits an angle signal corresponding to the angle of the cradle 23 to the unit control section 50. Since the angle of the cradle 23 changes with the increase in a wound diameter of the package 30, the diameter of the package 30 can be detected by detecting the swing angle of the cradle 23 by the angle sensor 44. As the method of detecting the diameter of the package 30, an appropriate configuration that can detect the diameter of the package 30 such as a method using a hall IC or an absolute type sensor may be used other than the angle sensor 44.

[0037] The method of detecting the diameter of the package 30 includes, for example, a method of detecting based on a total length of the yarn 20 wound into the package 30, a winding speed of the yarn 20, and a type (thickness or the like) of the yarn 20. The method of detecting the diameter of the package 30 may also be a method of measuring the time from the start of winding of the yarn 20 around the package 30. Specifically, by obtaining the winding speed of the yarn 20 and the type (thickness or the like) of the yarn 20, and storing in advance a relationship between an elapsed time from the start of winding of the yarn 20 and the diameter of the package 30 in the unit control section 50, the diameter of the package 30 can be calculated based on the elapsed time.

[0038] The method of detecting the diameter of the package 30 may also be a method based on the travelling speed of the yarn 20 on the yarn travelling path between the yarn supplying bobbin 21 and the contact roller 29. Specifically, the yarn monitoring device or a dedicated yarn speed sensor is arranged on the yarn travelling path to detect the travelling speed of the yarn 20. In the unit control section 50, a winding angle is calculated based on the travelling speed and the traverse speed of the yarn 20, and a peripheral speed of the package 30 is calculated from the winding angle and the yarn travelling speed. The diameter of the package 30 can be calculated based on the rotation speed of the package 30 and the peripheral speed of the package 30. When obtaining the diameter of the package 30 through calculation, the configuration for detecting the angle of the cradle 23 such as the angle sensor 44 may be omitted.

[0039] As illustrated in FIG. 3, the traverse device 70 includes a traverse driving motor 76, an output shaft 77, and a traverse arm 74. FIG. 3 is a view seen in an axial direction of the contact roller 29. The rotation in the winding direction of the package 30 is a clockwise direction in FIG. 3, and the rotation in an anti-winding direction of the package 30 is a counterclockwise direction in FIG. 3.

[0040] The traverse driving motor 76 is a motor adapted to drive the traverse arm 74, and is configured by a servo motor and the like. As illustrated in FIG. 2, the operation of the traverse driving motor 76 is controlled by

a traverse control section 78. The traverse driving motor 76 may be other motors such as a step motor, a voice coil motor, or the like.

[0041] The traverse control section 78 is configured by a hardware and the like by a dedicated microprocessor, and controls the operation and the stop of the traverse driving motor 76 upon receiving a signal from the unit control section 50. Power of the traverse driving motor 76 is transmitted to a basal end portion of the traverse arm 74 through the output shaft 77 illustrated in FIG. 3. When a rotor of the traverse driving motor 76 is rotated forwardly and reversely, the traverse arm 74 is reciprocated in the perpendicular direction (left and right direction of FIG. 2 (winding width direction of the package 30)) on the plane of drawing of FIG. 3. The traverse arm 74 in FIG. 3 indicates a position at the end of the traverse.

[0042] A hook-shaped yarn guide section 73 is formed at a distal end portion of the traverse arm 74. The traverse arm 74 can guide the yarn 20 by the yarn guide section 73. The yarn 20 can be traversed when the traverse arm 74 is reciprocated while the yarn guide section 73 is guiding the yarn 20.

[0043] Next, the structure of the cradle 23 will be described with reference to FIGS. 4 and 5. As illustrated in FIG. 4, the winding unit main body 16 includes a rotation plate 17 rotatable around the swing shaft 48 as the center. The cradle 23 is configured to integrally swing with a rotation plate 17 around the swing shaft 48 as the center. A spring 18 for gradually reducing a contact pressure configured as a tension spring, and an air cylinder 60 are connected to the rotation plate 17. A predetermined rotation torque can be applied on the cradle 23 by the spring 18 and the air cylinder 60.

[0044] The air cylinder (moving section) 60 is configured as a double-acting cylinder which includes therein a piston 601. In FIG. 4, compressed air having an air pressure P1 is supplied to a cylinder chamber on the right side in the plane of drawing (side close to rotation plate 17) of the piston 601, and compressed air having an air pressure P2 is supplied to a cylinder chamber on the left side in the plane of drawing (side far from the rotation plate 17) of the piston 601.

[0045] An electro-pneumatic regulator 61 is connected to a pipe for supplying the compressed air having the air pressure P2 to the air cylinder 60. The electro-pneumatic regulator 61 can adjust the air pressure P2 in a stepless manner. The control of the air pressure P2 by the electro-pneumatic regulator 61 is carried out based on a control signal input from the unit control section 50.

[0046] When the air pressure P2 is reduced in the configuration of FIG. 4, the force of the air cylinder 60 pulling the cradle 23 increases, and thus the torque for rotating the cradle 23 towards the front side of the winding unit main body 16 with the swing shaft 48 as the center increases. The contact roller 29 is arranged further on the front side of the winding unit main body 16 than the swing shaft 48, and hence the contact pressure of the package 30 and the contact roller 29 can be enhanced by the

reduction of the air pressure P2. On the contrary, when the air pressure P2 is increased, the force of the air cylinder 60 pulling the cradle 23 weakens, and hence the torque for rotating the cradle 23 towards the rear side of the winding unit main body 16 around the swing shaft 48 as the center increases. The contact pressure of the package 30 and the contact roller 29 thus can be weakened. By further increasing the air pressure P2, the package 30 can be separated from the surface of the contact roller 29.

[0047] Based on the configuration described above, the air cylinder 60 can move the cradle 23 and move the package 30. Therefore, as illustrated in FIG. 5, the position of the package 30 is switched between a position (non-contacting position Q1) in which the package 30 is separated from the contact roller 29 and a position (contacting position Q2) in which the package 30 makes contact with the contact roller 29.

[0048] Returning back to FIG. 2, the unit control section 50 of the present embodiment transmits a drive signal to the package drive control section 42, and controls the rotational drive of the package driving motor 41. Specifically, when the yarn monitoring device 15 detects the yarn defect and the yarn cut is carried out or when the yarn breakage (hereinafter referred to as "yarn cut and the like") occurs during the unwinding from the yarn supplying bobbin 21, the unit control section 50 carries out the forward rotation of rotating the package 30, in the winding direction for a set period, in a separated state (lift-up state) of being lifted up to the non-contacting position Q1 and separated from the contact roller 29.

[0049] The unit control section 50 controls the catching operation (swinging of the lower yarn pipe arm 33 and the upper yarn pipe arm 36) of the lower yarn catching member 25 and the upper yarn catching member 26. The unit control section 50 moves the driving of the air cylinder 60 to move the cradle 23, and controls the movement of the package 30 between the non-contacting position Q1 and the contacting position Q2 (see FIGS. 4 and 5). The unit control section 50 controls the opening/closing of the shutter arranged in the lower yarn pipe arm 33 and the upper yarn pipe arm 36, and controls the stopping and the generation of the suction flow from the lower yarn suction mouth 32 and the upper yarn suction mouth 35.

[0050] In the winding unit 10 described above, when the yarn cut and the like occurred, the lower yarn and the upper yarn need to be joined in the splicer device 14. In the yarn joining operation, the lower yarn needs to be caught with the lower yarn suction mouth 32, and the upper yarn needs to be caught with the upper yarn suction mouth 35, and pulled out. The control of the pull-out operation of the upper yarn is carried out in the winding unit 10 when the yarn cut and the like occurred, and the pull-out method will be described in detail below with reference to FIG. 2 and FIGS. 4 to 6.

[0051] In FIG. 6, the horizontal axis indicates time and the vertical axis indicates the ON/OFF of each signal transmitted from the unit control section 50 (similarly in

FIG. 7 to be described later). The lift-up signal is a signal for driving the air cylinder 60 with the electro-pneumatic regulator 61 to lift-up the package 30 to the non-contacting position Q1. The forward rotation signal is a signal for forwardly rotating the package 30 by the package driving motor 41. The reverse rotation signal is a signal for reversely rotating the package 30 by the package driving motor 41. The upper yarn catching member drive signal is a signal for driving the upper yarn catching member 26 and swinging the upper yarn pipe arm 36 to bring the upper yarn suction mouth 35 closer to the package 30. A shutter open signal is a signal for generating the suction flow from the upper yarn suction mouth 35 with the shutter of the upper yarn pipe arm 36 in the opened state.

[0052] First, during the winding operation before the yarn cut and the like occur, the lift-up signal is turned OFF and the surface of the package 30 makes contact with the contact roller 29. The forward rotation signal is turned ON, and the package 30 is forwardly rotated by the package driving motor 41. At the time of the winding operation, the package driving motor 41 is controlled by the unit control section 50, and the rotation speed of the package 30 is assumed as a first rotation speed.

[0053] When the yarn cut and the like occurs during the winding operation, the forward rotation signal is turned OFF and the forward rotation of the package 30 is gradually decelerated to a stop (time t0). The factors of the yarn cut and the like include, for example, (A) when the yarn monitoring device 15 detects the yarn defect and the yarn 20 is cut by the cutter 39 during a steady winding period in which the yarn 20 is wound into the package 30 at a set winding speed; (B) when the yarn 20 is cut by an excessive tension and the like regardless of the cutter 39 during the steady winding period; (C) when the yarn monitoring device 15 detects abnormality of the yarn 20 and the cutting of the yarn 20 is executed by the cutter 39 during an acceleration winding period until the rotation of the package 30 reaches the set winding speed; and (D) when the yarn 20 unwound from the yarn supplying bobbin 21 runs out and a new yarn supplying bobbin 21 is set in the yarn supplying section 11.

[0054] At time t1, the lift-up signal is turned ON, the package 30 is lifted up to the non-contacting position Q1, and the contact between the package 30 and the contact roller 29 is released.

[0055] At time t2, the forward rotation signal is turned ON, and the forward rotation of the package 30 is started in the lift-up state in which the package 30 is lifted up to the non-contacting position Q1 (released state in which the contact between the package 30 and the contact roller 29 is released). During the set period α (i.e., from time t2 to time t3), the ON state of the forward rotation signal is maintained, and the forward rotation of the package 30 in the lift-up state is carried out. At time t3, the forward rotation signal is turned OFF, and the forward rotation of the package 30 is gradually decelerated to a stop.

[0056] During the forward rotation of the package 30 in the set period α , the package driving motor 41 is con-

trolled by the unit control section 50, and the rotation speed of the package 30 is set to a second rotation speed. The second rotation speed is a speed different from the first rotation speed, and is assumed to be a speed higher than the first rotation speed.

[0057] The set period α and the second rotation speed are set in the unit control section 50. The set period α and the second rotation speed may be a constant value, or may be set according to the diameter of the package 30 at the time of the occurrence of the yarn cut and the like. For example, if the diameter of the package 30 is large, a yarn end 30a is easily detached from the surface of the package 30, and hence the set period α can be set short and/or the second rotation speed can be set low. For example, if the diameter of the package 30 is small, the yarn end 30a is less likely to detach from the surface of the package 30, and hence the set period α can be set longer and/or the second rotation speed can be set higher. The second rotation speed may include a plurality of different speeds, or may be set so that the speed becomes higher in the middle (certain time point) of the forward rotation, for example.

[0058] The second rotation speed may be set so that the peripheral speed of the package 30 (the travelling speed of the yarn 20) becomes constant regardless of the diameter of the package 30. In other words, the package driving motor 41 may carry out the forward rotation for the set period α in the lift-up state so that the peripheral speed of the package 30 becomes constant regardless of the diameter of the package 30. The second rotation speed may be set so that the peripheral speed of the package 30 changes according to the diameter of the package 30. In other words, the package driving motor 41 may carry out the forward rotation for the set period α in the lift-up state so that the peripheral speed of the package 30 becomes the speed corresponding to the diameter of the package 30.

[0059] At time t4, the upper yarn catching member drive signal is turned ON, the upper yarn pipe arm 36 is swung so that the upper yarn suction mouth 35 approaches the package 30, and the upper yarn suction mouth 35 is moved to the yarn end catching position. At time t4, the shutter open signal is turned ON, the shutter of the upper yarn pipe arm 36 is opened, and the suction flow is generated from the upper yarn suction mouth 35. At time t5, the reverse rotation signal is turned ON, and the reverse rotation of the package 30 is started in the lift-up state. Thus, the yarn end 30a of the package 30 that reversely rotates in the lift-up state is sucked and caught by the upper yarn suction mouth 35.

[0060] At time t6, the lift-up signal is turned OFF, and the package 30 is moved to the contacting position Q2 where the package 30 makes contact with the contact roller 29. Thus, the yarn end 30a of the package 30 that reversely rotates while being located at the contacting position Q2 is sucked and caught by the upper yarn suction mouth 35 located in proximity to the surface of the package 30.

[0061] At time t7, the upper yarn catching member drive signal is turned OFF, and the upper yarn suction mouth 35 is moved towards the yarn joining position. Thus, the yarn end 30a of the package 30 is guided to the splicer device 14, and the yarn joining operation of the lower yarn caught by the lower yarn suction mouth 32 and the upper yarn caught by the upper yarn suction mouth 35 is started in the splicer device 14. At time t8, the reverse rotation signal is turned OFF, and the reverse rotation of the package 30 is gradually decelerated to a stop. At time t9, which corresponds to the time after the yarn joining operation is completed, the shutter open signal is turned OFF, the shutter of the upper yarn pipe arm 36 is closed, and the suction flow is stopped from the upper yarn suction mouth 35.

[0062] As described above, in the winding unit 10 of the present embodiment, when the set period for forwardly rotating, in the lift-up state, the package 30 having the yarn end 30a is set, and the yarn cut and the like occurred, the package 30 can be forwardly rotated additionally only for a set period α in the lift-up state. The yarn end 30a thus can be detached from the package 30 by a centrifugal force of the rotation when the package 30 is forwardly rotated. As a result, the pull-out rate of the upper yarn at the time of catching the upper yarn can be enhanced.

[0063] The package driving motor 41 can rotate the package 30 at the first rotation speed in the winding operation of the package 30 and the second rotation speed when forwardly rotating the package 30 for the set period α in the lift-up state. The first rotation speed and the second rotation speed are speeds different from one another. Thus, the package 30 can be rotated at the rotation speeds respectively suitable for the winding operation of the package 30 and the forward rotation in the lift-up state. In particular, the second rotation speed is higher than the first rotation speed, and the yarn end 30a can thus be further detached from the package 30.

[0064] In the package driving motor 41, at least one of the set period α and the second rotation speed can be changed according to the diameter of the package 30. Although easiness of attachment of the yarn end 30a differs depending on the size of the diameter of the package 30, the above-described operation effect of detaching the yarn end 30a from the package 30 by the centrifugal force of the rotation can be controlled according to the easiness of attachment of the yarn end 30a. A load applied on the package driving motor 41 can also be adjusted depending on the size of the diameter of the package 30.

[0065] In particular, when the diameter of the package 30 is large, the set period α can be set short and/or the second rotation speed can be set low, and thus safety in detaching the yarn end 30a can be enhanced. When the diameter of the package 30, to which the yarn end 30a easily attaches, is small, the set period α can be set long and/or the second rotation speed can be set high, and thus the centrifugal force of the rotation when forwardly rotating the package 30 in the lift-up state can be en-

hanced to further detach the yarn end 30a.

[0066] In the package driving motor 41, the forward rotation can be carried out for the set period α in the lift-up state so that the peripheral speed of the package 30 becomes constant regardless of the diameter of the package 30. Thus, the operation effect of detaching the yarn end 30a from the package 30 by the centrifugal force of the rotation can be stably realized. The load of the cradle 23 by the forward rotation can be reduced, and damage of the cradle 23 can also be suppressed.

[0067] In the package driving motor 41, the forward rotation can be carried out for the set period α in the lift-up state so that the peripheral speed of the package 30 becomes the speed corresponding to the diameter of the package 30. Thus, the force acting on the yarn end 30a becomes constant, and the force of detaching the yarn end 30a from the package 30 can be stabilized.

[0068] The winding unit 10 includes the upper yarn suction mouth 35 adapted to catch the yarn end 30a. In the winding unit 10 described above, the yarn end 30a can be detached from the package 30, and hence the yarn end 30a can be reliably caught by the upper yarn suction mouth 35. As a result, the occurrence of the pull-out mistake of the upper yarn can be reduced.

[0069] The package driving motor 41 forwardly rotates the package 30 for the set period α in the lift-up state, and then reversely rotates the package 30 in the lift-up state. The yarn end 30a thus can be further detached from the package 30.

[0070] FIG. 7 is a chart diagram illustrating another example of the operation of the winding unit 10. As illustrated in FIG. 7, when the yarn cut and the like occurs during the winding operation, the forward rotation signal may not be turned OFF and the forward rotation of the package 30 may not be gradually decelerated to a stop. Specifically, in a state where the forward rotation of the package 30 is continued, the lift-up signal is turned ON at time t1, the package 30 is lifted up to the non-contacting position Q1, and the contact between the package 30 and the contact roller 29 is released. In this case, the set period α' set in the unit control section 50 is the period from time t1 to time t3 at which the forward rotation signal is turned OFF.

[0071] In this example, the forward rotation is continued with the rotation speed of the package 30 made constant after the occurrence of the yarn cut and the like and until time t1 at which the package 30 is lifted up. However, the forward rotation may be continued while decelerating the package 30 at the deceleration at which the package 30 does not come to a stop.

[0072] As illustrated in FIG. 7, at time t6' (i.e., after time t3 at which the forward rotation signal is turned OFF and before time t4 at which the upper yarn catching member drive signal and the shutter open signal are turned ON), the lift-up signal may be turned OFF and the package 30 may be moved to the contacting position Q2. In this case, the package driving motor 41 reversely rotates the package 30 after forwardly rotating the package 30 for the set

period α' in the lift-up state and after moving the package 30 to the contacting position Q2. Thus, when catching the yarn end 30a by the upper yarn suction mouth 35 at time t4 to t7, the distance between the upper yarn suction mouth 35 and the package 30 can be stabilized.

[0073] One embodiment of the present invention has been described above, but the present invention is not limited to the above embodiment. In the embodiment described above, the package 30 is rotatably driven directly by the package driving motor 41, but in the present invention, the contact roller may be rotatably driven so that the package 30 is rotated accompanying the rotation of the contact roller.

[0074] The unit control section 50 of the embodiment described above may determine whether or not to forwardly rotate the package 30 for the set period α in the lift-up state based on the diameter of the package 30. The package driving motor 41 may forwardly rotate the package 30 for the set period α in the lift-up state according to the determination result of the unit control section 50. The easiness of attachment of the yarn end 30a differs depending on the size of the diameter of the package 30, and the presence or the absence of the forward rotation can be controlled according to the easiness of attachment of the yarn end 30a. The forward rotation of the package 30 in the lift-up state does not need to be performed on a constant basis when the yarn cut and the like occur, and thus the lowering of the production efficiency can be suppressed.

[0075] For example, the unit control section 50 may determine to forwardly rotate the package 30 for the set period α only when the diameter of the package 30 is smaller than or equal to a first set diameter, and the package driving motor 41 may forwardly rotate the package 30 for the set period α in the lift-up state only when the diameter of the package 30 is smaller than or equal to the first set diameter. In this case, if the diameter of the package 30 is greater than the first set diameter, the package 30 is not forwardly rotated for the set period α in the lift-up state, and the usual pull-out operation of the upper yarn is carried out. Thus, the yarn end 30a can be actively detached from the package 30 only when the diameter of the package 30 is small and the yarn end 30a is easily attached to the package 30, for example. The unit control section 50 in this case configures a determining section.

[0076] When the yarn cut and the like occurs, the usual pull-out operation of the upper yarn (pull-out operation of not forwardly rotating the package 30 for the set period α in the lift-up state) is first carried out to perform the yarn joining operation. At this time, the pull-out operation described above illustrated in FIGS. 5 and 6 may be carried out only when the upper yarn is detected by the yarn monitoring device 15 (at the time of catching mistake of the upper yarn by the upper yarn suction mouth 35). The forward rotation of the package 30 in the lift-up state does not need to be performed on a constant basis when the yarn cut and the like occur, and thus the lowering of the

production efficiency can be suppressed.

[0077] In the embodiment described above, the package drive control section 42, the traverse control section 78, and the unit control section 50 are separately arranged, but at least part of such control sections may be integrated. In the embodiment described above, a structure of moving the package 30 between the non-contacting position Q1 and the contacting position Q2 by the air cylinder 60 has been illustrated. However, a structure of moving the package 30 between the non-contacting position Q1 and the contacting position Q2 by a step motor and the like may be adopted. In the embodiment described above, the open/close operation of the shutter is controlled by the unit control section 50 to control the stop and generation of the suction flow from the upper yarn suction mouth 35, but the shutter may be constantly open. In this case, the control of the unit control section 50 can be simplified, for example.

[0078] In the embodiment described above, the package 30 may be reversely rotated once and then forwardly rotated for the set period α in the lift-up state. In this case, the yarn end 30a can be made to easily detach from the package 30. In the embodiment described above, the electro-pneumatic regulator 61 may be omitted, and the package 30 may be lifted up with only the turning ON/OFF of the air supply to the air cylinder 60. In the embodiment described above, the package 30 may be reversely rotated at the rotation speed at which the yarn end 30a can be detached for the set period in the lift-up state. In this case as well, the operation effect of being able to detach the yarn end 30a from the package 30 is obtained.

Claims

1. A yarn winding machine (10) comprising:

a holding section (23) adapted to hold a package (30);
 a touch roller (29) adapted to make contact with a surface of the package (30) held by the holding section (23);
 a moving section (60) adapted to move the package (30) between a position in which the package (30) makes contact with the touch roller (29) and a position in which the package (30) is separated from the touch roller (29); and
 a package driving section (41) adapted to rotatably drive the package (30),
 wherein the package driving section (41) carries out a forward rotation of rotating the package (30) in a winding direction for a set period (α , α') in a separated state in which the package (30) having a yarn end (30a) is separated from the touch roller (29) by the moving section (60).

2. The yarn winding machine (10) according to claim 1, wherein the package driving section (41) rotates

the package (30) at a first rotation speed for winding a yarn into the package (30) and at a second rotation speed for carrying out the forward rotation for the set period (α , α') in the separated state, the first rotation speed and the second rotation speed being speeds different from one another.

3. The yarn winding machine (10) according to claim 2, wherein the package driving section (41) changes at least one of the set period (α , α') and the second rotation speed according to a diameter of the package (30).

4. The yarn winding machine (10) according to any one of claims 1 to 3, further comprising a determining section (50) adapted to determine whether or not to carry out the forward rotation for the set period (α , α') in the separated state based on a diameter of the package (30), wherein the package driving section (41) carries out the forward rotation for the set period (α , α') in the separated state in accordance with a determination result of the determining section (50).

5. The yarn winding machine (10) according to any one of claims 1 to 4, wherein the package driving section (41) carries out the forward rotation for the set period (α , α') in the separated state such that a peripheral speed of the package (30) becomes constant.

6. The yarn winding machine (10) according to any one of claims 1 to 4, wherein the package driving section (41) carries out the forward rotation for the set period (α , α') in the separated state such that a peripheral speed of the package (30) becomes a speed corresponding to a diameter of the package (30).

7. The yarn winding machine (10) according to any one of claims 1 to 6, further comprising a yarn catching section (35) adapted to catch the yarn end.

8. The yarn winding machine (10) according to any one of claims 1 to 7, wherein the package driving section (41) carries out a reverse rotation of rotating the package (30) in a direction opposite to the winding direction in the separated state after carrying out the forward rotation for the set period (α , α') in the separated state.

9. The yarn winding machine (10) according to any one of claims 1 to 7, wherein the package driving section (41) carries out a reverse rotation of rotating the package (30) in a direction opposite to the winding direction after carrying out the forward rotation for the set period (α , α') in the separated state and after the package (30) is brought into contact with the touch roller (29) by the moving section (60).

10. The yarn winding machine (10) according to any one of claims 1 to 9, wherein the moving section (60) moves the package (30) between the contacting position and the separating position by moving the holding section (23). 5
11. The yarn winding machine (10) according to claim 10, wherein the package driving section (41) is arranged in the holding section (23). 10
12. The yarn winding machine (10) according to claim 11, wherein the package driving section (41) rotatably drives the package (30) directly.
13. The yarn winding machine (10) according to claim 12, wherein the package driving section (41) is a rotation motor. 15
14. A method for operating yarn winding machine (10) comprising the following steps: 20
- holding package (30) in a holding section (23);
- moving the package (30) between a position in which the package (30) makes contact with a touch roller (29) and a position in which the package (30) is separated from the touch roller (29); and 25
- driving the package (30), 30
- characterized by** rotating the package (30) in a winding direction for a set period (α , α') in a separated state in which the package (30) having a yarn end (30a) is separated from the touch roller (29). 35
15. The method according to claim 14, wherein a package driving section (41) rotates the package (30) at a first rotation speed for winding a yarn into the package (30) and at a second rotation speed for carrying out the forward rotation for the set period (α , α') in the separated state, the first rotation speed and the second rotation speed being speeds different from one another. 40
16. The method according to claim 15, wherein the package driving section (41) changes at least one of the set period (α , α') and the second rotation speed according to a diameter of the package (30). 45
17. The method according to any one of claims 14 to 16, further comprising determining whether or not to carry out the forward rotation for the set period (α , α') in the separated state based on a diameter of the package (30), 50
- wherein the forward rotation is carried out for the set period (α , α') in the separated state in accordance with a determination result. 55
18. The method according to any one of claims 14 to 17, wherein the forward rotation is carried out for the set period (α , α') in the separated state such that a peripheral speed of the package (30) becomes constant.
19. The method according to any one of claims 14 to 17, wherein the forward rotation is carried out for the set period (α , α') in the separated state such that a peripheral speed of the package (30) becomes a speed corresponding to a diameter of the package (30).
20. The method according to any one of claims 14 to 19, wherein a reverse rotation of rotating the package (30) in a direction opposite to the winding direction is carried out in the separated state after carrying out the forward rotation for the set period (α , α') in the separated state.
21. The method according to any one of claims 14 to 19, a reverse rotation of rotating the package (30) in a direction opposite to the winding direction is carried out after carrying out the forward rotation for the set period (α , α') in the separated state and after the package (30) is brought into contact with the touch roller (29).

FIG. 1

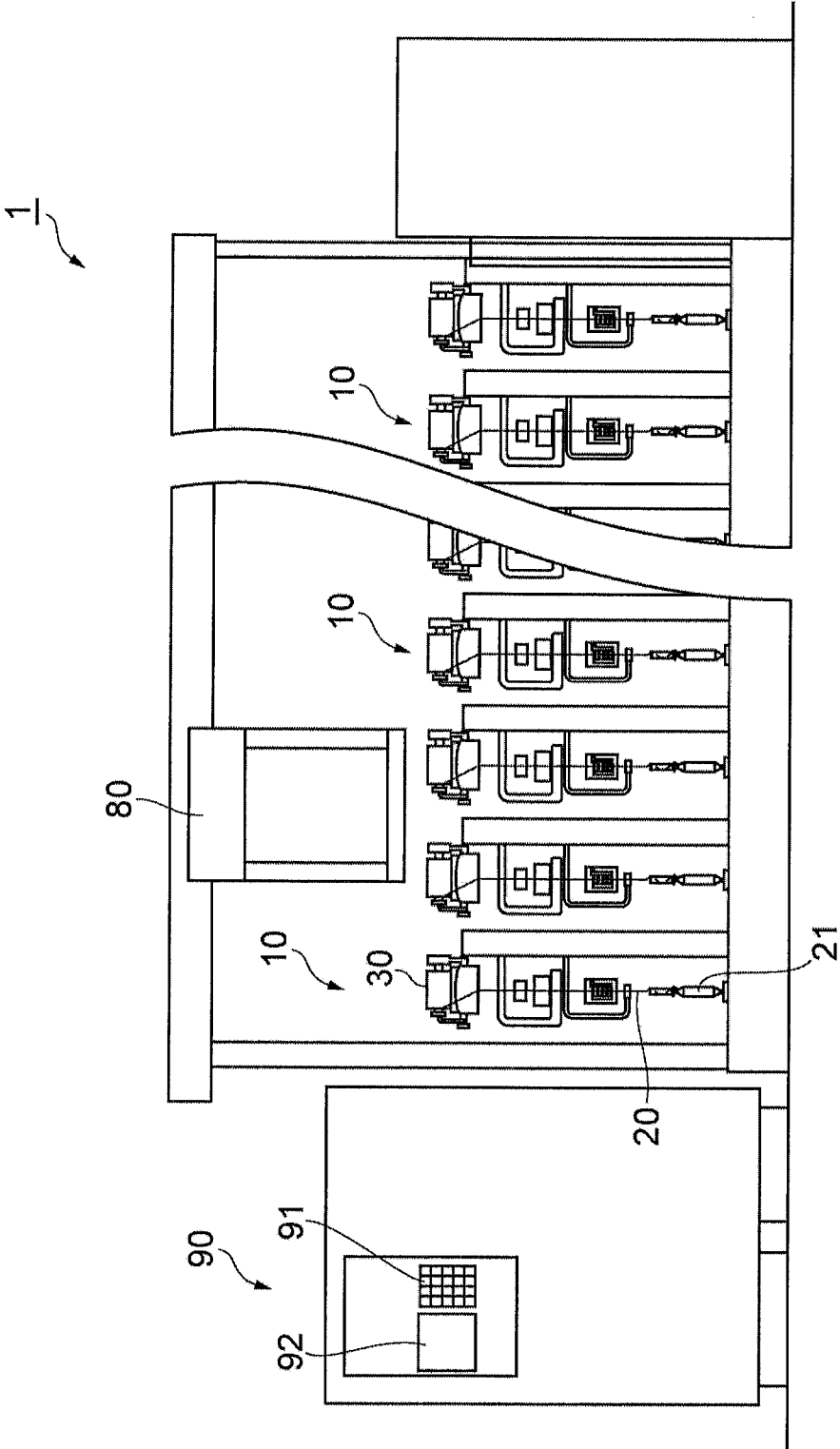


FIG. 2

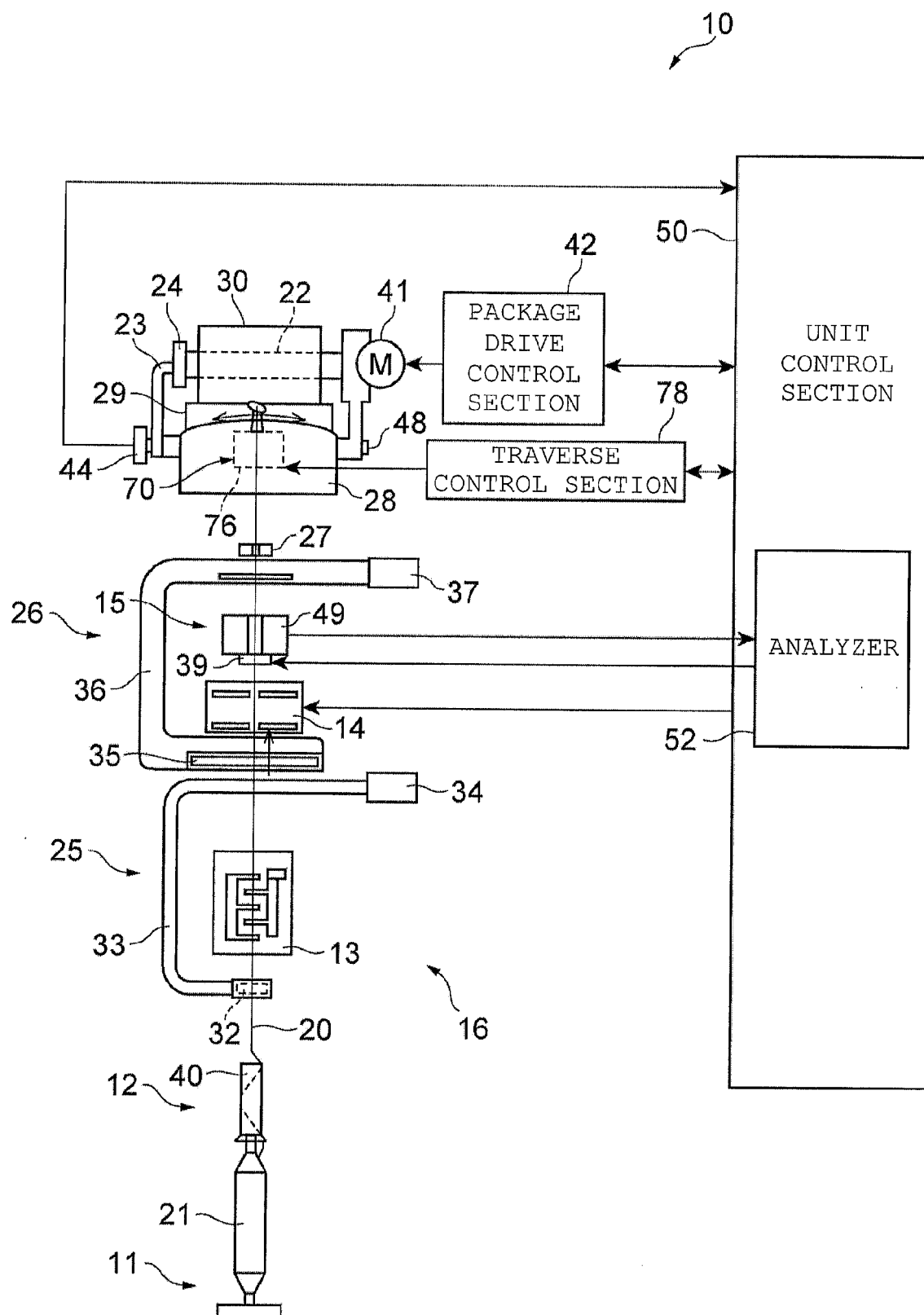


FIG. 3

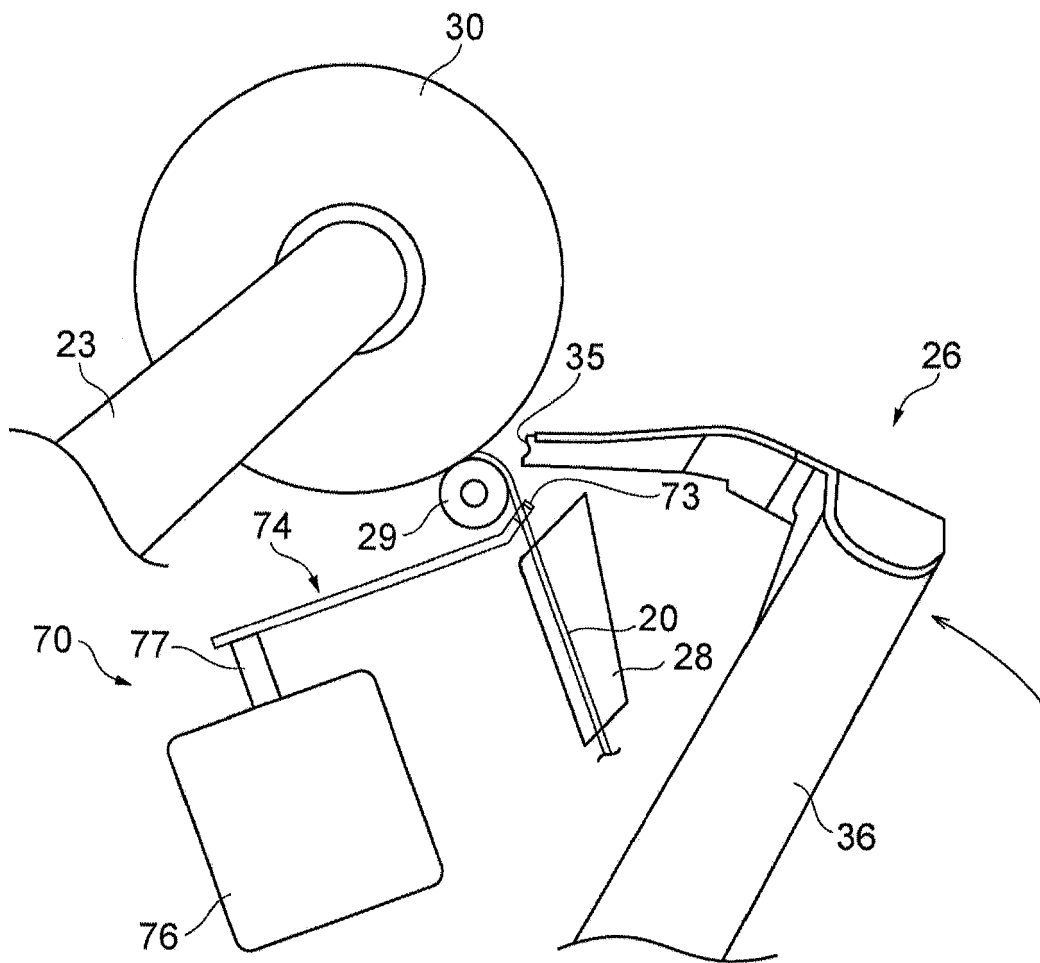


FIG. 4

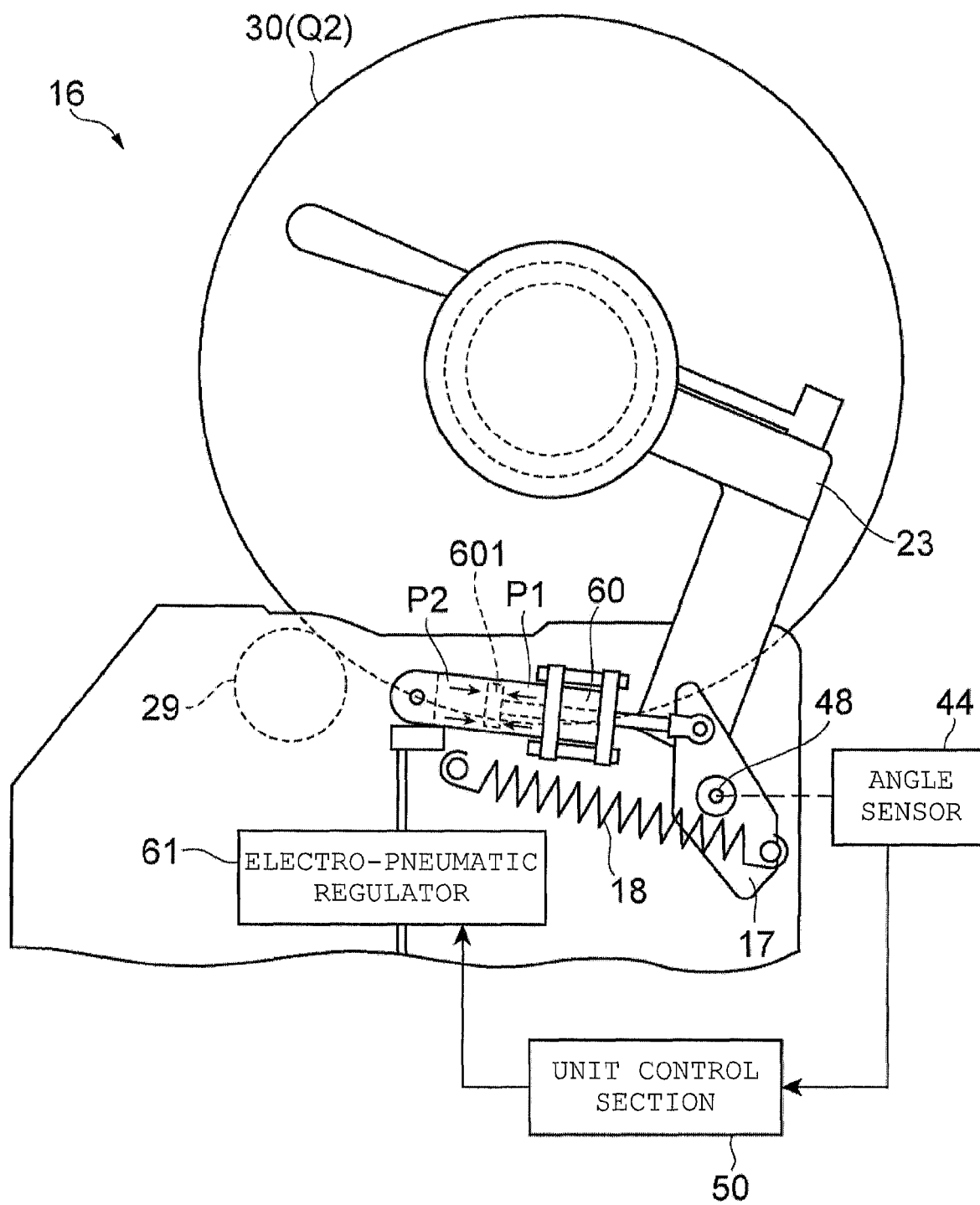


FIG. 5

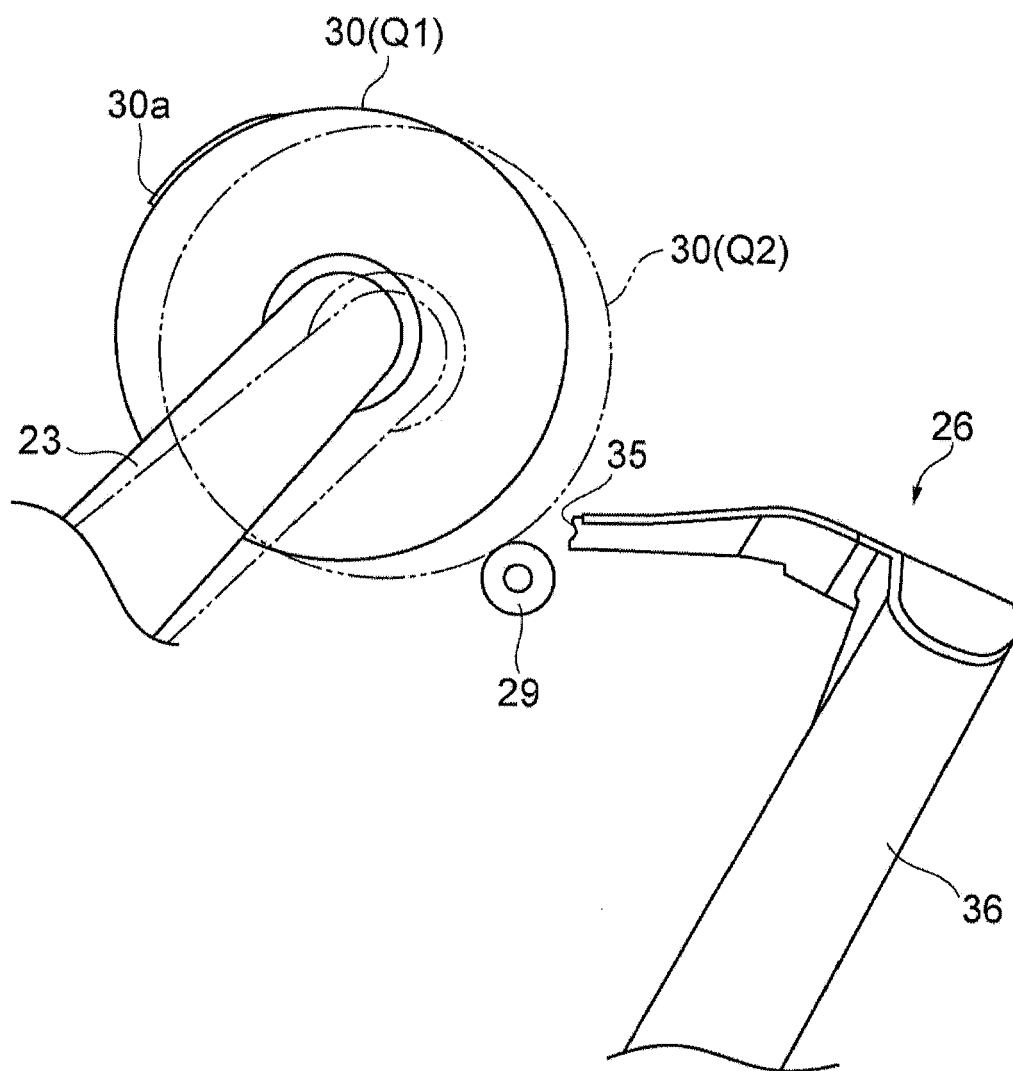


FIG. 6

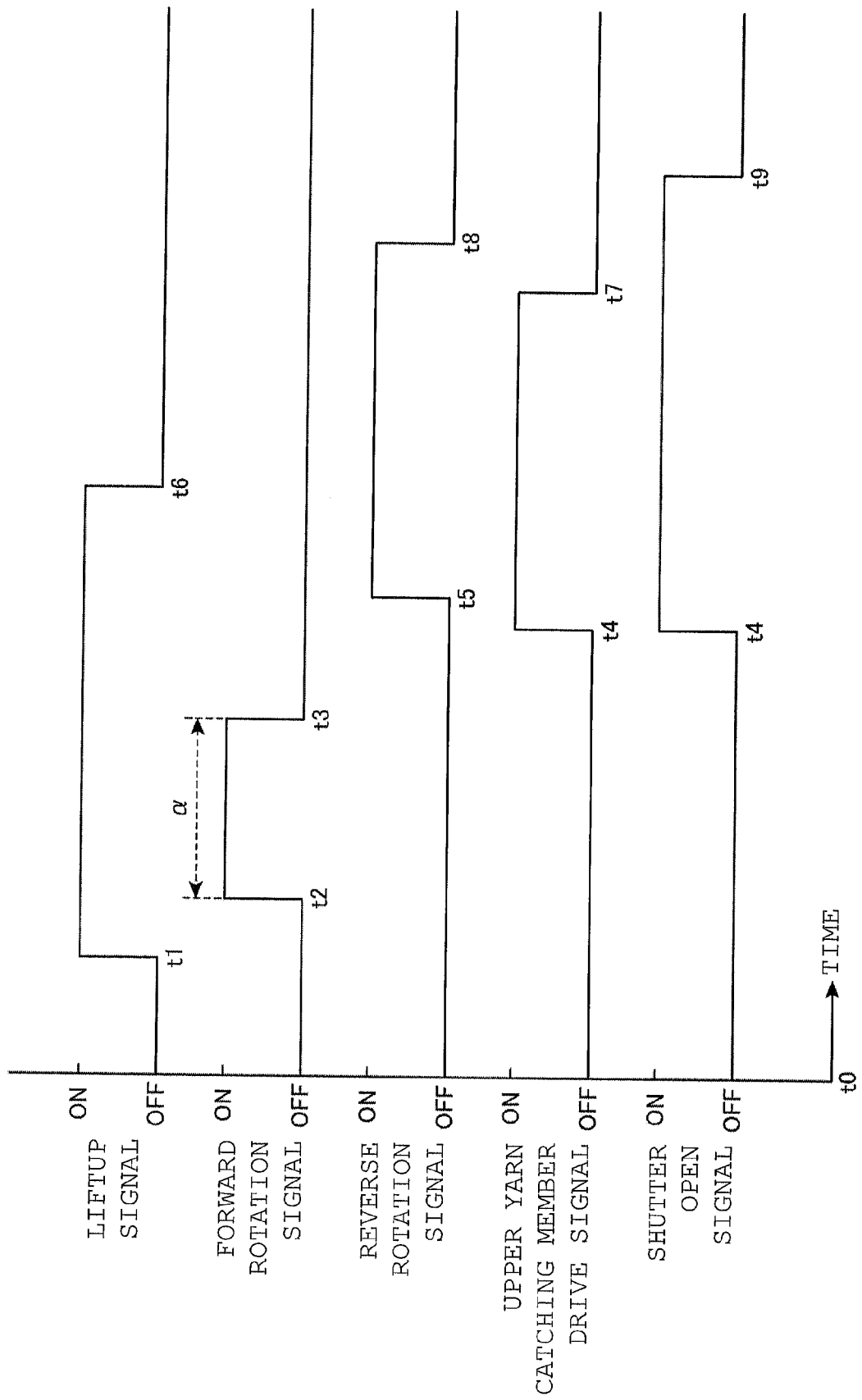
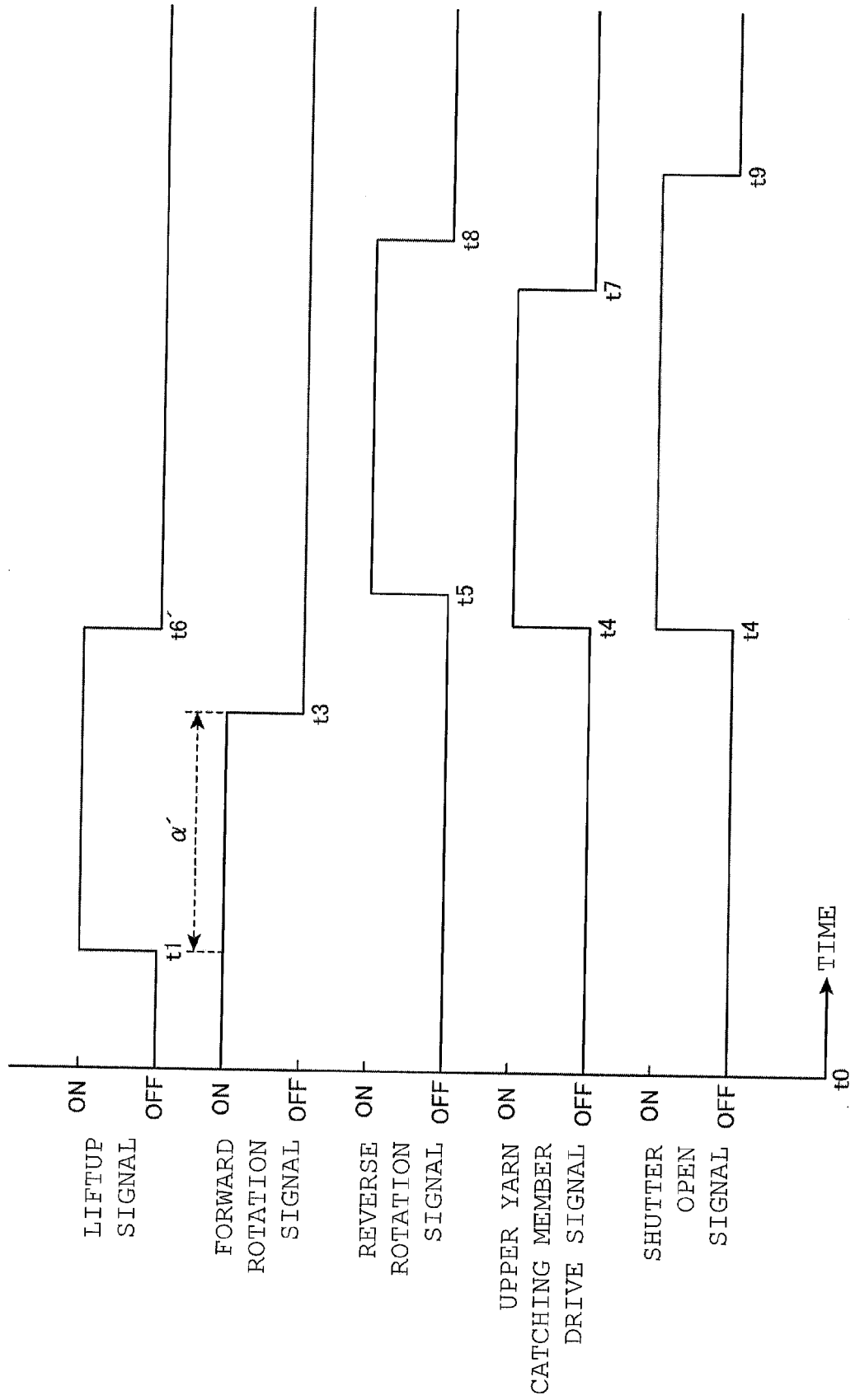


FIG. 7





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