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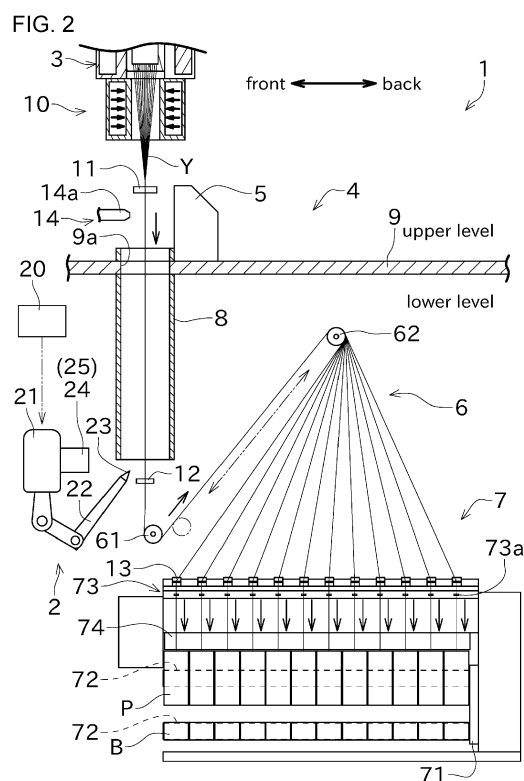
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(54) **YARN THREADING ROBOT AND SPINNING AND WINDING SYSTEM**

(57) [Problem to be solved] To provide a compact yarn threading robot capable of reducing noise in the on-site environment where yarn is produced. [Solution] A yarn threading robot 2 threads yarn Y continuously spun from the spinning device 3 to the spinning take-up device 4. The yarn threading robot 2 includes a robot main body 21, a winder 25, and a robot arm 22. The winder 25 is located on the robot main body 21 so that the yarn Y continuously spun from the spinning device 3 is wound and stored onto the winder 25. The robot arm 22 has a hand part 23 that engages with the yarn Y between the spinning device 3 and the winder 25. The robot arm 22 operates the hand part 23 to thread the yarn Y between the spinning device 3 and the winder 25 to the spinning take-up device 4. The robot arm 22 is attached to the robot main body 21. The robot arm 22 moves the hand part 23 with respect to the robot main body 21.



Description

TECHNICAL FIELD

[0001] The present invention relates to a yarn threading robot and a spinning and winding system equipped with the yarn threading robot.

BACKGROUND ART

[0002] In conventional spinning and winding systems that generate and wind yarn from molten raw materials, a configuration is known in which a yarn threading robot is used to perform yarn threading operation under a situation where the yarn is continuously supplied from an upstream spinning machine. PTL 1 discloses this type of yarn threading robot.

[0003] The yarn threading robot of PTL 1 includes a robot arm, and a sucker is located at the end of the robot arm. This robot performs the yarn threading operation while the sucker holds the yarn supplied from the upstream side. The yarn sucked by the sucker is disposed of in a waste box connected to the sucker. This prevents the yarn from slacking and allows the yarn threading robot to properly perform the yarn threading operation.

PRIOR-ART DOCUMENTS

PATENT DOCUMENTS

[0004] PTL 1: Japanese Unexamined Patent Publication No. 2021-123814

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0005] In conventional yarn threading robots such as those disclosed in PTL 1, the robot arm needs to support the weight of the suction injector, which holds a group of the yarn, and the compressed air pipeline and related portions, which supply compressed air. Therefore, it is necessary to secure the strength of the robot arm, making it difficult to downsize the robot. In addition, because the conventional yarn threading robot is configured to suck the yarn by negative pressure, it makes a lot of noise due to air noise, and improvement is requested.

[0006] The present invention was made in view of the above circumstances, and its purpose is to provide a compact yarn threading robot capable of reducing noise in the on-site environment.

MEANS FOR SOLVING THE PROBLEMS AND EFFECTS THEREOF

[0007] The problem to be solved by the present invention is as described above, and next, means for solving the problem and effects thereof will be described.

[0008] According to the first aspect of the present invention, a yarn threading robot with the following configuration is provided. That is, this yarn threading robot threads yarn continuously spun from a spinning device to a yarn processing device. The yarn threading robot includes a robot main body, a winder, and a robot arm. The winder is located on the robot main body so that the yarn continuously from the spinning device is wound and stored onto the winder. The robot arm has a yarn engaging part that engages with the yarn between the spinning device and the winder. The robot arm operates the yarn engaging part to thread the yarn between the spinning device and the winder to the yarn processing device. The robot arm is attached to the robot main body. The robot arm moves the yarn engaging part with respect to the robot main body.

[0009] This allows the yarn threading robot to store the yarn on the winder located on the robot main body. As a result, there is no need to suck the yarn and discharge it directly into a separately installed waste yarn container or the like. Therefore, it is no longer necessary to mount a suction device such as a suction gun, which is heavy, on the tip of the robot arm, and the robot arm can be made smaller and lower power output. In addition, the noise can be reduced compared to the configuration in which the yarn is held by suction force due to negative pressure.

[0010] In the yarn threading robot, it is preferred that a cross section of a middle portion in an axis direction of the winder is smaller in diameter than cross sections of end portions in the axis direction of the winder.

[0011] This prevents the yarn from dropping out of the winder and allows for suitable yarn storage.

[0012] The yarn threading robot preferably includes a yarn discharger that discharges the yarn stored on the winder from the winder.

[0013] This allows the yarn wound on the winder to be easily discharged.

[0014] In the yarn threading robot, it is preferred that a diameter of the winder is changeable.

[0015] This allows the yarn wound on the winder to be easily discharged in a compact manner by decreasing the diameter of the winder.

[0016] It is preferable that the yarn threading robot is configured as follows. That is, the winder is configured to be changeable between a contracted-diameter state and an expanded-diameter state. In the expanded-diameter state, a cross section of a middle portion in an axis direction of the winder is smaller in diameter than cross sections of end portions in the axis direction of the winder.

[0017] This prevents the yarn from dropping out of the winder and allows for suitable yarn storage.

[0018] The yarn threading robot preferably includes a yarn discharger that discharges the yarn stored on the winder from the winder.

[0019] This allows the yarn wound on the winder to be easily discharged.

[0020] It is preferable that the yarn threading robot is

configured as follows. That is, the winder is configured to be changeable into a contracted-diameter state and an expanded-diameter state. A through hole is formed in the yarn discharger. The winder in the contracted-diameter state can be inserted into the through hole of the yarn discharger.

[0021] As a result, the yarn can be suitably discharged by the yarn discharger pushing the yarn wound on the winder in a state where the winder is inserted into the through hole of the yarn discharger.

[0022] It is preferable that the yarn threading robot is configured as follows. That is, the winder has a plurality of rod members that can rotate integrally. The plurality of rod members are lined up circumferentially about a rotation center of the winder. Each of the rod members is arranged in a skew position with respect to the rotation center and is movable in a direction approaching and moving away from the rotation center.

[0023] This allows the diameter of the winder to be easily changed with a simple configuration.

[0024] According to the second aspect of the present invention, a spinning and winding system with the following configuration is provided. That is, the spinning and winding system includes a spinning device, a yarn processing device, and a yarn threading robot. The spinning device spins yarn continuously. The yarn processing device takes up or winds the yarn continuously spun from the spinning device. The yarn threading robot threads the yarn continuously spun from the spinning device to the yarn processing device. The yarn threading robot includes a robot main body, a winder, and a robot arm. The winder is located on the robot main body so that the yarn the yarn continuously spun from the spinning device is wound and stored onto the winder. The robot arm has a yarn engaging part that engages with the yarn between the spinning device and the winder. The robot arm operates the yarn engaging part to thread the yarn between the spinning device and the winder to the yarn processing device. The robot arm is attached to the robot main body. The robot arm moves the yarn engaging part with respect to the robot main body.

[0025] This simplifies and reduces the output of the spinning and winding system, and also suppresses noise in the spinning and winding system due to negative pressure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026]

FIG. 1 is a diagonal view showing a schematic configuration of a spinning and winding system according to one embodiment of the present invention.

FIG. 2 is a schematic view showing a configuration of a spinning and winding unit.

FIG. 3 is a block diagram briefly showing a control structure of the spinning and winding system.

FIG. 4 is a schematic view showing a configuration

of a yarn lowering device.

FIG. 5 is a diagonal view showing the configuration of a yarn threading robot.

FIG. 6 is a side view showing the configuration of the yarn threading robot.

FIG. 7 is a diagonal view showing a situation where the diameter of the winder is decreased.

FIG. 8 is a diagonal view showing a situation where the yarn discharger discharges the yarn wound onto the winder.

FIG. 9 is a schematic diagram showing a modification of the winder.

EMBODIMENT FOR CARRYING OUT THE INVENTION

[0027] Next, embodiments of the present invention will be described with reference to the drawings.

[0028] A spinning and winding system 100 shown in FIG. 1 is a system for generating synthetic fiber yarn Y and winding it to form a package P. In the spinning and winding system 100, the yarn Y of synthetic fibers is produced by extruding molten synthetic fiber material. The spinning and winding system 100 is installed in a building having multiple levels in the plant.

[0029] The spinning and winding system 100 has a plurality of spinning and winding units 1 as shown in FIG. 1. The spinning and winding system 100 includes a centralized control device 101, for controlling operation of each spinning and winding unit 1 and a yarn threading robot 2. The centralized control device 101 is connected to each of the spinning and winding units 1 and a robot controller 20 of the yarn threading robot 2, by wired or wireless communication.

[0030] The yarn threading robot (yarn threading device) 2 shown in FIG. 2 is provided to be shared by multiple spinning and winding units 1. The yarn threading robot 2 can travel along a rail, not shown, between the multiple spinning and winding units 1 according to a control command from the robot controller 20.

[0031] Hereinafter, "upstream" and "downstream" mean upstream and downstream in a direction in which the generated yarn Y runs during winding of it. The left-right direction means a direction in which the plurality of spinning and winding units 1 are lined up. The direction perpendicular to both the left-right direction and the up-down direction is referred to as front-back direction.

[0032] Each of the spinning and winding units 1 includes a spinning device 3, a spinning take-up device (yarn processing device) 4, and a spinning and winding unit controller 102. The spinning and winding unit 1 has actuators including a motor or the like that drive various devices. The spinning and winding unit controller 102 controls operation of the actuators according to a control command from the centralized control device 101. The spinning take-up device 4 is located downstream of the spinning device 3. The spinning take-up device 4 mainly includes a yarn lowering device 5, a take-up part 6, and a winding device (yarn winding device) 7.

[0033] The spinning take-up device 4 performs guiding the yarn Y and the like during winding of the yarn Y. The spinning take-up device 4 includes various yarn processors in addition to the take-up part 6 and the winding device 7. These yarn processors include, for example, a lubricant guide 11 and a yarn holding device 14. Details of the lubricant guide 11 and the yarn holding device 14 will be described later.

[0034] A building in which the spinning and winding system 100 is installed is separated into an upper level and a lower level by a partition floor 9. The spinning device 3 is installed on the upper level. The yarn lowering device 5, which is part of the spinning take-up device 4, is installed on the upper level. The take-up part 6 and the winding device 7, which are part of the spinning take-up device 4, are installed on the lower level.

[0035] Yarn passage holes 9a are formed at the partition floor 9. Each of the yarn passage holes 9a is provided for each spinning and winding unit 1. A plurality of pieces of yarn Y spun by the spinning device 3 can pass through the yarn passage hole 9a. The yarn passage holes 9a constitute a passage for sending the plurality of pieces of yarn Y to the lower level.

[0036] An inter-floor tube 8 formed in a duct-like shape is fixed to the partition floor 9 to connect to the yarn passage hole 9a. The inter-floor tube 8 prevents yarn sway caused by wind or other external factors in the process of multiple pieces of yarn Y running from the upper level to the lower level.

[0037] On the upper level, the yarn holding device 14 is provided near the yarn passage hole 9a formed at the partition floor 9. The yarn holding device 14 includes a yarn suction device 14a and a cutter (not shown). When some abnormality occurs in yarn Y or each device in part of the spinning take-up device 4 (for example, the take-up part 6 or the winding device 7) or the like in a downstream side, the yarn holding device 14 cuts the plurality of pieces of yarn Y running downstream from the spinning device 3 by the cutter. Furthermore, the yarn holding device 14 temporarily holds an upstream side (the spinning device 3 side) of the plurality of pieces of yarn Y which are cut, by sucking them with the yarn suction device 14a. Thus, the plurality of pieces of yarn Y spun by the spinning device 3 are sucked into the yarn suction device 14a of the yarn holding device 14 and are held without running to the take-up part 6 and the winding device 7. The yarn holding device 14 continues to hold the yarn until the abnormality is resolved.

[0038] The spinning device 3 includes a plurality (for example, 12) of spinning ports, not shown. Molten polymer in a hot state is supplied to the spinning ports by a polymer supply device (not shown) including a gear pump or the like. The spinning device 3 extrudes the molten polymer from each of the spinning ports. As a result, the yarn Y is spun from the respective spinning port of the spinning device 3. The number of spinning ports (in other words, the number of pieces of yarn Y spun in the spinning device 3) is not limited to 12.

[0039] In the upper level of the spinning and winding system 100, a cooling device 10 and the lubricant guides 11 are installed.

[0040] The cooling device 10 is located immediately below the spinning device 3. The cooling device 10 includes a plurality of cooling cylinders, not shown. Cooling air is supplied to each of the cooling cylinders through cooling air pipes that are not shown. Yarn Y passing through the cooling cylinders is cooled by the cooling air and solidified.

[0041] The lubricant guides 11 is located below the cooling device 10. The lubricant guides 11 are installed in the same number as the number of pieces of yarn Y spun in the spinning device 3. Each of the plurality of lubricant guides 11 applies lubricant to each of the pieces of yarn Y passing through. The plurality of pieces of yarn Y to which the lubricant is applied pass through the yarn passage hole 9a formed in the partition floor 9 to the lower level.

[0042] The yarn lowering device 5 is used to lower the plurality of pieces of yarn Y from the upper level to the lower level where the winding device 7 and other devices are installed. The yarn threading operation refers to a process of threading the yarn Y from the spinning device 3 to the bobbin B of the winding device 7 after setting the yarn to the take-up part 6 along a predetermined path. This yarn threading operation makes the winding device 7 ready to wind the yarn Y to form the package P.

[0043] The yarn lowering device 5 mainly includes, as shown in FIG. 4, a guide member 51, an elevator 52, and a yarn sucker 53. The yarn lowering device 5 may be configured to be equipped with a cart. Each part of the yarn lowering device 5 is driven by a respective yarn lowering device drive motor 59 that operates according to a control command from the centralized control device 101.

[0044] The guide member 51 is used to guide the elevator 52 in the up-down direction when the elevator 52 is raised or lowered. The guide member 51 is made of, for example, a chain member in which many elemental parts are arranged in a row and each rotatably connected to the other.

[0045] When yarn lowering work is not being performed, the guide member 51 is stored in a wound-up state. When yarn lowering work is being performed, the guide member 51 passes through the yarn passage hole 9a formed in the partition floor 9 and is positioned so that it extends in the up-down direction across the upper level and the lower level. The guide member 51 is not limited to the above configuration as long as it can guide the elevator 52 in the up-down direction. For example, the guide member 51 may be made of an elongated member extending in the up-down direction.

[0046] The elevator 52 is attached so that it can be raised and lowered in the up-down direction along the guide member 51. As shown in FIG. 4, the elevator 52 includes a support 54 and a holder 55. The support 54 is formed in a shape of an elongated plate and is installed so as to extend in the up-down direction. The holder 55

is attached to the lower end of the support 54.

[0047] The holder 55 includes two yarn holding rollers 55a. The two yarn holding rollers 55a are arranged side by side in the left-right direction of the spinning and winding system 100. Each of the yarn holding rollers 55a is configured, for example, as a roller rotatably supported. Each of the yarn holding rollers 55a is attached so that its axis extends in the front-back direction. The two yarn holding rollers 55a are located on both sides of the support 54 in the left-right direction with the support 54 between them.

[0048] A ring-shaped groove formed in a substantial V-shape in cross-section is formed at an outer circumference of each of the yarn holding rollers 55a. The two yarn holding rollers 55a are lowered from above against the portion of the yarn Y guided in a substantially horizontal direction, causing the yarn Y to enter the groove. The plurality of pieces of yarn Y held by the yarn holding rollers 55a move to the deepest portion of the groove by guiding of the V-shaped groove. As a result, the plurality of piece of yarn Y are converged, which facilitates capturing them by a robot arm 22 which will be described later.

[0049] The yarn sucker 53 is used to temporarily suck and hold a plurality of pieces of yarn Y spun from the spinning device 3 during the yarn lowering work. The yarn sucker 53 includes, for example, a suction gun. The plurality of pieces of yarn Y suctioned by the yarn sucker 53 are disposed into a waste yarn container or the like which is not shown, via a suction hose (not shown) connected to the yarn sucker 53.

[0050] In this configuration, as the elevator 52 moves from a standby position in the upper level to a delivery position in the lower level in a state where intermediate portions of the plurality of pieces of yarn Y are held on the two yarn holding rollers 55a, the plurality of pieces of yarn Y can be lowered.

[0051] As shown in FIG. 2, a yarn regulation guide 12 is installed upstream of the take-up part 6. The yarn regulation guide 12 can be, for example, a comb-shaped member at which 12 guide grooves according to the number of pieces of the yarn Y are formed. The yarn regulation guide 12 is located on the lower level and near the take-up part 6. The yarn regulation guide 12 is movable in a direction parallel to the direction in which the plurality of spinning and winding units 1 are lined up. The yarn regulation guide 12 is driven by a guide actuator (not shown) including, for example, a cylinder.

[0052] The take-up part 6 is used to take up a plurality of pieces of yarn Y running downward from the upper level. The take-up part 6 includes a take-up frame 60 and two godet rollers 61, 62. Hereinafter, the godet roller located upstream in the direction in which the yarn Y runs is referred to as upstream godet roller 61, and the godet roller located downstream is referred to as downstream godet roller 62.

[0053] During winding of the yarn Y, the yarn regulation guide 12 is substantially positioned directly above the

upstream godet roller 61. In the following description, this position is referred to as "operating position".

[0054] During the yarn threading operation, the yarn regulation guide 12 is positioned in a position that is displaced in the left-right direction from a position directly above the upstream godet roller 61. This makes the yarn threading operation easy. In the following description, the position of the yarn regulation guide 12 during the yarn threading operation will be referred to as "preparing position".

[0055] The upstream godet roller 61 is positioned on the take-up frame 60 so that it is located almost directly below the operating position of the yarn regulation guide 12. The upstream godet roller 61 is driven by an upstream godet motor 61a. On the other hand, the downstream godet roller 62 can move, as shown by a chain line arrow in FIG. 2, between a yarn threading position close to the upstream godet roller 61 and a package forming position directly above the winding device 7. The downstream godet roller 62 is driven by a downstream godet motor 62a. These upstream godet motor 61a and the downstream godet motor 62a operate according to a control command from the spinning and winding unit controller 102.

[0056] During the yarn threading operation, the downstream godet roller 62 is lowered to the yarn threading position near the upstream godet roller 61. When the yarn threading operation is completed, the downstream godet roller 62 rises to the package forming position.

[0057] The winding device 7 winds the plurality of pieces of yarn Y running from the take-up part 6 to form the packages P. The winding device 7 mainly includes a turret 71, two bobbin holders 72, a traverse device 73, and a contact roller 74.

[0058] The turret 71 is installed so that it can rotate. Each of the two bobbin holders 72 is rotatably supported by the turret 71. Each of the bobbin holders 72 is elongated in the front-back direction. The two bobbin holders 72 are positioned on opposite sides of each other across an axis of rotation of the turret 71. As the turret 71 rotates, the positions of the two bobbin holders 72 are swapped.

[0059] Specifically, one of the two bobbin holders 72 is at the winding position on the upper side and the other is at the lower standby position on the lower side, respectively. The bobbin holder 72 at the winding position is close proximity to the contact roller 74, while the bobbin holder 72 at the standby position is away from the contact roller 74. A plurality of bobbins B are mounted on each of the bobbin holders 72. The plurality of bobbins B are lined up in the longitudinal direction of the bobbin holder 72.

[0060] The traverse device 73 includes a plurality of traverse guides 73a corresponding to the plurality of bobbins B. Each traverse guide 73a is arranged to correspond to each bobbin B. The traverse guides 73a are driven by a traverse motor 73b, which operates according to a control command of the spinning and winding unit controller 102. As each of the traverse guides 73a recip-

rotate in a direction parallel to the longitudinal direction of the bobbin holder 72, the pieces of yarn Y are wound onto the bobbins B while being traversed.

[0061] The contact roller 74 contacts the outer circumferences of the plurality of packages P formed on the respective bobbins B and applies a contact pressure to each of the plurality of packages P. The contact roller 74 is driven by a winding motor 70, which is operated according to a control command of the spinning and winding unit controller 102.

[0062] The yarn threading robot 2 is located on the lower level of the building, as shown in FIG. 2. The yarn threading robot 2 is capable of traveling between the plurality of spinning and winding units 1 and automatically performs the yarn threading operation on each spinning and winding unit 1.

[0063] The yarn threading robot 2 includes a robot main body 21, the robot controller 20, the robot arm 22, a hand part 23, and a yarn storage 24. The operation of each part of the yarn threading robot 2 is controlled by the robot controller 20 mounted on the robot main body 21. The robot controller 20 shown in FIG. 3 is a known computer including a CPU, a ROM, a RAM, and the like.

[0064] A guide rail, not shown, is provided on the lower level. The guide rail extends along the direction in which the plurality of spinning and winding units 1 are lined up (along the left-right direction). The robot main body 21 includes a traveling motor 21a. By driving the traveling motor 21a, the robot main body 21 can travel along the guide rail.

[0065] The robot arm 22 is configured as an articulated type and is attached to the robot main body 21. The robot arm 22 is driven by an arm drive motor 22a and can perform three-dimensional movements. The hand part (yarn engaging part, guide part) 23 which can catch and guide the yarn Y is mounted to the tip of the robot arm 22. A cutter, not shown, may be attached to the hand part 23. The operation of the traveling motor 21a and the arm drive motor 22a is controlled by the robot controller 20, as shown in FIG. 7. That is, the traveling of the robot main body 21 and the movement of the robot arm 22 is controlled by the robot controller 20. The position of the cutter is not limited to the hand part 23, but may be attached to the robot main body 21.

[0066] The hand part 23 is an end effector attached to the end of the robot arm 22 and is shaped to guide a plurality of pieces of yarn Y. As an example, the hand part 23 has a pair of finger parts that can be opened and closed. When the finger parts are closed, a hole that can hold the yarn Y is formed. With the finger parts closed, the yarn Y can run through inside the holes. When the finger parts are opened, the yarn Y can be inserted into and out of the hole. The configuration of the hand part 23 is not limited to the above and may be formed in other shapes as long as it can engage with the yarn Y for guidance.

[0067] The yarn storage 24 is used to wind and store a plurality of pieces of the yarn Y spun by the spinning

device 3 when the yarn threading robot 2 performs the yarn threading operation. As shown in FIG. 2, the yarn storage 24 is, for example, located at the rear surface of the robot main body 21. The rear surface of the robot main body 21 can also be said to be the surface facing the spinning and winding unit 1. The position where the yarn storage 24 is located is not limited to the rear surface of the robot main body 21, but it may be located on the side surface or the bottom surface.

[0068] The yarn storage 24 mainly includes a winder 25 and a waste yarn discharge plate (yarn discharger) 26, as shown in FIG. 5.

[0069] The winder 25 is arranged to extend from the back of the robot main body 21 toward the spinning and winding unit 1 in the front-back direction. The winder 25 is rotatably mounted to the robot main body 21. The winder 25 is made of a swift yarn winder that can be changed between a contracted-diameter state and an expanded-diameter state, and includes a central shaft body (central rod) 25a and an expanding and contracting part 25b installed around the central shaft body 25a.

[0070] The central shaft body 25a is a rod-shaped member, projecting in a generally horizontal direction. The central shaft body 25a is located at the center of rotation of the winder 25. The expanding and contracting part 25b includes a plurality of first support rods 25c, a plurality of second support rods 25d, a plurality of connecting rods (rod members) 25e, a fixed boss 25f, and a moving sleeve 25g. The number of the first support rods 25c, the second support rods 25d and the connecting rods 25e each constituting the winder 25 is equal.

[0071] Each of the first support rods 25c, the second support rods 25d and the connecting rods 25e is a straightly elongated rod member. The fixed boss 25f is fixed to a tip of the central shaft body 25a. The moving sleeve 25g in a cylindrical shape is supported at a base portion of the central shaft body 25a. The moving sleeve 25g can move along the longitudinal direction of the central shaft body 25a. The fixed boss 25f and moving sleeve 25g rotate integrally with the central shaft body 25a.

[0072] One end of each of the first support rods 25c (hereinafter referred to as "moving end") is connected to the moving sleeve 25g via a hinge. The other end of each of the first support rods 25c is connected to the connecting rod 25e via a hinge. One end of each of the second support rods 25d (hereinafter referred to as "fixed end") is connected to the fixed boss 25f via a hinge. The other end of each of the second support rods 25d is connected to the connecting rod 25e via a hinge. The phase at which the first support rod 25c is attached to the moving sleeve 25g corresponds to the phase at which the second support rod 25d is attached to the fixed boss 25f.

[0073] That is, regarding the first support rod 25c and the second support rod 25d, the ends opposite to the side attached to the moving sleeve 25g or the fixed boss 25f are connected to each other via the connecting rod 25e. The plurality of connecting rods 25e arranged circumferentially around the central shaft body 25a sub-

stantially constitute an outer surface around which the yarn Y can be wound.

[0074] The robot main body 21 includes a motor, not shown. The motor can drive the central shaft body 25a to rotate. The first support rods 25c, the second support rods 25d, and the connecting rods 25e rotate integrally with the central shaft body 25a.

[0075] One longitudinal end of each connecting rod 25e is connected to the first support rod 25c and the other end is connected to the second support rod 25d. The first support rod 25c is connected via the connecting rod 25e to, not the second support rod 25d whose connecting point corresponds in phase to this support rod 25c, but the second support rod 25d whose connecting point differs in phase to this support rod 25c by one or more. As a result, each of the connecting rods 25e is in a skew position with respect to the axial direction of the central shaft body 25a (in other words, the center of rotation of the winder 25). Thus, the outer circumference of the winder 25 essentially resembles a one-sheet hyperboloid centered on the central shaft body 25a. This outer circumferential surface is concave so that the cross section of its middle portion in the axis direction is the smallest in diameter of the entire axial direction. The concave portion (dropout prevention structure) 25h thus formed prevents the yarn Y wound by the winder 25 from dropping out in the axial direction.

[0076] The moving sleeve 25g to which the moving end of the first support rod 25c is connected moves along the central shaft body 25a, driven by a drive mechanism (not shown), etc., for example.

[0077] As the moving sleeve 25g moves toward the tip end of the central shaft body 25a, in conjunction with this movement, the plurality of connecting rods 25e move away from the central shaft body 25a in the radial direction. As a result, the winder 25 is in the expanded-diameter state in which the diameter is large.

[0078] As the moving sleeve 25g moves toward the base of the central shaft body 25a, in conjunction with this movement, the plurality of connecting rods 25e move closer to the central shaft body 25a in the radial direction. As a result, the winder 25 is in the contracted-diameter state in which the diameter is small.

[0079] When winding the yarn Y, the moving sleeve 25g is controlled to be at a predetermined position, as shown in FIG. 5. As a result, the winder 25 is in the expanded-diameter state in which its diameter is a predetermined value. In this expanded-diameter state, the diameter of the cross section at the middle portion in the axis direction is smaller than diameters of the cross sections of the end portions in the axis direction.

[0080] The waste yarn discharge plate 26 is formed in a ring shape and is movable along the central shaft body 25a of the winder 25 and away from the robot main body 21. Specifically, the waste yarn discharge plate 26 is movable between a standby position near the robot main body 21 and a remaining-yarn discharge position away from the robot main body 21 (closer to the tip end of the central

shaft body 25a).

[0081] As shown in FIG. 8, pushing rods 26a oriented in a direction perpendicular to the waste yarn discharge plate 26 and extendable in this direction are attached to the waste yarn discharge plate 26, for example. A through hole is formed in the center of the waste yarn discharge plate 26. The winder 25 in the contracted-diameter state where its diameter is small can pass through the hole in the waste yarn discharge plate 26. By extending and retracting the pushing rods 26a, the waste yarn discharge plate 26 moves between the standby position and the remaining-yarn discharge position.

[0082] Next, the yarn threading operation by the yarn threading robot 2 will now be described. FIGS. 5 and 6 show the yarn storage 24 when the yarn Y is stored during the yarn threading operation performed by the yarn threading robot 2. FIGS. 7 and 8 show the yarn storage 24 when the stored yarn Y is discharged after the yarn threading operation.

[0083] In the spinning and winding unit 1, for example in the case of a preparation stage before starting the forming of the package P, in the case of a yarn breakage for some reason, or the like, it is necessary to perform the yarn threading operation to thread the plurality of pieces of yarn Y spun from the spinning device 3 to the take-up part 6 and the like before starting (restarting) winding of yarn Y by the winding device 7.

[0084] In this embodiment, the yarn lowering work that the plurality of pieces of yarn Y are lowered from the spinning device 3 from the upper level to the lower level is performed by an operator operating the yarn lowering device 5. The yarn threading operation at the lower level is automatically performed by the yarn threading robot 2.

[0085] Before starting the yarn lowering work, the operator moves the yarn lowering device 5 to the target spinning and winding unit 1. The operator then removes the yarn sucker 53 from the yarn lowering device 5, and at the same time or before that, makes the yarn sucker 53 put into operation. The operator uses the yarn sucker 53 to suck and hold a plurality of pieces of yarn Y spun from the spinning device 3 upstream from the lubricant guides 11.

[0086] The operator then threads the plurality of pieces of yarn Y suctioned and held by the yarn sucker 53 to the lubricant guides 11. After threading the plurality of pieces of yarn Y on the lubricant guides 11, or after the yarn lowering device 5 has moved to the target spinning and winding unit 1, the operator makes the guide member 51 of the yarn lowering device 5 span across the two levels through the yarn passage hole 9a at appropriate timing.

[0087] The operator then takes yarn threading tool (not shown) in a hook shape for example, from an appropriate place and, between the yarn sucker 53 and the lubricant guides 11, catches the yarn Y sucked and held by the yarn sucker 53 on the yarn threading tool. After the plurality of pieces of the yarn Y are caught on the yarn threading tool, the operator moves the yarn threading tool so

that the plurality of pieces of yarn Y between the yarn sucker 53 and the yarn threading tool are positioned directly under the two yarn holding rollers 55a provided by the holder 55 of the yarn lowering device 5.

[0088] In this state, when the operator removes the yarn threading tool, the plurality of pieces of yarn Y (i.e., the intermediate portions of pieces of the yarn Y) between the lubricant guides 11 and the yarn sucker 53 are caught on the two yarn holding rollers 55a. Accordingly, the plurality of pieces of yarn Y are converged by the two yarn holding rollers 55a.

[0089] After the yarn lowering preparation work is completed, the operator operates an operation switch or the like which is not shown, to start the yarn lowering operation by the yarn lowering device 5. When the yarn lowering operation is started, the elevator 52 of the yarn lowering device 5 moves along the guide member 51 to the delivery position of the lower level. As a result, the plurality of pieces of yarn Y that are held on the two yarn holding rollers 55a move to the lower position. Thus, the intermediate portions of the plurality of pieces of yarn Y held by the yarn sucker 53 are transported by the yarn lowering device 5 to the vicinity of the yarn regulation guide 12.

[0090] During or after the yarn threading operation described above, the yarn threading robot 2 moves to the target spinning and winding unit 1 according to the operation command of the centralized control device 101. Upon arrival at the target spinning and winding unit 1, the yarn threading robot 2 makes the hand part 23 attached at the tip end of the robot arm 22 operate. The hand part 23 moves to a position close to the plurality of pieces of yarn Y held by any of the yarn holding rollers 55a of the yarn lowering device 5 and engages with the pieces of yarn Y.

[0091] The robot arm 22 guides the captured yarn Y to the winder 25. The winder 25 starts rotating before or after the robot arm 22 starts the yarn catching operation described above. By the robot arm 22 guiding the yarn Y guided to the winder so that, for example, it circles around the circumference of the winder 25, the yarn is wound around the winder 25 which rotates. As a result, substantial securing of the yarn Y to the winder 25 is realized and the winding of the yarn Y begins. This results in a state where the hand part 23 engages with the yarn Y between the spinning device 3 and the winder 25.

[0092] After the winding of the yarn Y by the winder 25 has started, the yarn threading robot 2 cuts the yarn Y downstream from the winder 25 (for example, between the winder 25 and the yarn holding roller 55a) with the cutter not shown, attached to the hand part 23 or the robot main body 21. The yarn Y downstream of the cut point is sucked by the yarn sucker 53 of the yarn lowering device 5 and discharged to the waste yarn container not shown. The yarn Y may be cut by a cutter installed separately from the yarn threading robot 2. The cutting of the yarn Y may be performed before the winding of the yarn Y captured by the hand part 23 by the winder 25 is

started.

[0093] The yarn threading robot 2 then moves the robot arm 22, while the plurality of pieces of the yarn Y are being stored by the winder 25, so that the yarn Y is threaded to the yarn regulation guide 12, the take-up part 6 (upstream godet roller 61 and downstream godet roller 62), and the plurality of fulcrum guides 13, in that order.

[0094] The yarn threading robot 2 then moves the robot arm 22 so that the hand part 23 is positioned at a predetermined position which is below the upper bobbin holder 72, and each of the plurality of pieces of yarn Y is brought into contact with the respective bobbin B.

[0095] At the same time as or shortly before the robot arm 22 guides the yarn Y to the bobbin B, the winding device 7 begins its winding operation. By winding the yarn Y around an end of the rotating bobbin B, an end of the yarn Y is secured to the bobbin B. When the winding operation is started, the traverse guides 73a reciprocate in the direction parallel to an axial direction of the bobbin B in conjunction with the rotation of the bobbin B. During the reciprocating movement of the traverse guides 73a, the yarn Y is hooked on each of the traverse guides 73a. Thereafter, each of the pieces of the yarn Y can be wound onto the bobbin B while being traversed by the traverse guide 73a. As a result, the packages P can be formed.

[0096] After securing the plurality of pieces of yarn Y to the plurality of bobbins B, the yarn threading robot 2 cuts the yarn Y between the yarn sucker 53 and the bobbin B at a point close to the bobbin B by means of a cutter which is not shown. The plurality of pieces of yarn Y between the yarn sucker 53 and the hand part 23 of the yarn threading robot 2, which are cut, are wound by the winder 25.

[0097] The yarn threading robot 2 then moves to the waste yarn container, which is not shown. In this embodiment, this waste yarn container is located, for example, near a standby position where the yarn threading robot 2 waits when no yarn threading operation is being performed.

[0098] After arriving at the waste yarn container, the yarn threading robot 2 moves the moving sleeve 25g toward the robot main body 21. As a result, the diameter of the winder 25 is decreased as shown in FIG. 7. Immediately after that, the yarn threading robot 2 moves the waste yarn discharge plate 26 by advancing the pushing rod 26a from the robot main body 21 to the axial end side of the central shaft body 25a, as shown in FIG. 8. As a result, the waste yarn discharge plate 26 can discharge the yarn Y wound on the winder 25 from the tip of the winder 25.

[0099] During the yarn threading operation, the spinning of the spinning device 3 does not stop, so that the yarn Y is continuously supplied from the upstream side. Since the yarn Y is wound onto the winder 25 to be stored, the yarn threading robot 2 of this embodiment can keep the yarn Y near the hand part 23 of the robot arm 22 from becoming slack without providing a suction port on the hand part 23 that uses negative pressure. Therefore, the

weight that the robot arm 22 must support is reduced because a flexible negative pressure piping does not need to be attached to the robot arm 22. As a result, the configuration of the robot arm 22 can be simplified and the cost can be reduced. In addition, since no air noise is generated at the hand part 23, the noise can be reduced well.

[0100] As described above, the yarn threading robot 2 of this embodiment threads the yarn Y continuously spun from the spinning device 3 to the spinning take-up device 4. The yarn threading robot 2 includes the robot main body 21, the winder 25, and the robot arm 22. The winder 25 is located on the robot main body 21 so that the yarn Y continuously spun from the spinning device 3 is wound and stored onto the winder 25. The robot arm 22 has the hand part 23 that engages with the yarn Y between the spinning device 3 and the winder 25. The robot arm 22 operates the hand part 23 to thread the yarn Y between the spinning device 3 and the winder 25 to the spinning take-up device 4. The robot arm 22 is attached to the robot main body 21. The robot arm 22 moves the hand part 23 with respect to the robot main body 21.

[0101] This allows the yarn threading robot 2 to store the yarn Y on the winder 25 located on the robot main body 21. As a result, there is no need to suck the yarn Y and discharge it directly into a separately installed waste yarn container or the like. Therefore, it is no longer necessary to mount a suction device such as a suction gun, which is heavy, on the tip of the robot arm 22, and the robot arm 22 can be made smaller and lower power output. In addition, the noise can be reduced compared to the configuration in which the yarn Y is held by suction force due to negative pressure.

[0102] In the yarn threading robot 2 of this embodiment, the cross section of the middle portion in the axis direction of the winder 25 is smaller in diameter than the cross sections of the end portions in the axis direction of the winder.

[0103] This prevents the yarn Y from dropping out of the winder 25 and allows the yarn Y to be suitably stored.

[0104] The yarn threading robot 2 of this embodiment includes the waste yarn discharge plate 26 that discharges the yarn Y stored on the winder 25 from the winder 25.

[0105] This allows the yarn Y wound on the winder 25 to be easily discharged.

[0106] In the yarn threading robot 2 of this embodiment, the diameter of the winder 25 is changeable.

[0107] This allows the yarn Y wound on the winder 25 to be easily discharged in a compact manner by decreasing the diameter of the winder 25.

[0108] In the yarn threading robot 2 of this embodiment, the winder 25 is configured to be changeable between the contracted-diameter state and the expanded-diameter state. In the expanded-diameter state, the cross section of the middle portion in the axis direction of the winder 25 is smaller in diameter than the cross sections of the end portions in the axis direction of the winder 25.

[0109] This prevents the yarn Y from dropping out of

the winder 25 and allows for suitable yarn storage.

[0110] The yarn threading robot 2 of this embodiment includes the waste yarn discharge plate 26 that discharges the yarn Y stored on the winder 25 from the winder 25.

[0111] This allows the yarn Y wound on the winder 25 to be easily discharged.

[0112] The yarn threading robot 2 of this embodiment, the winder 25 is configured to be changeable between the contracted-diameter state and the expanded-diameter state. The through hole is formed in the waste yarn discharge plate 26. The winder 25 in the contracted-diameter state can be inserted into the through hole of the waste yarn discharge plate 26.

[0113] As a result, the yarn Y can be suitably discharged by the waste yarn discharge plate 26 pushing the yarn Y wound on the winder 25 in the state where the winder 25 is inserted into the through hole of the waste yarn discharge plate 26.

[0114] In the yarn threading robot 2 of this embodiment, the winder 25 includes the plurality of connecting rods 25e that can rotate integrally. The plurality of connecting rods 25e are lined up circumferentially about the central shaft body 25a located at the rotation center of the winder 25. Each connecting rod 25e is arranged in a skew position with respect to the central shaft body 25a and is movable in the direction approaching and away from the central shaft body 25a.

[0115] This allows the diameter of the winder 25 to be easily changed with a simple configuration.

[0116] The spinning and winding system 100 of this embodiment includes the spinning device 3, the spinning take-up device 4, and the yarn threading robot 2. The spinning device 3 spins yarn Y continuously. The spinning take-up device 4 takes up or winds the yarn Y continuously spun from the spinning device 3. The yarn threading robot 2 threads the yarn Y continuously spun from the spinning device 3 to the spinning take-up device 4. The yarn threading robot 2 includes the robot main body 21, the winder 25, and the robot arm 22. The winder 25 is located on the robot main body 21 so that the yarn Y continuously spun from the spinning device 3 is wound and stored onto the winder 25. The robot arm 22 has the hand part 23 that engages with the yarn Y between the spinning device 3 and the winder 25. The robot arm 22 operates the hand part 23 to thread the yarn Y between the spinning device 3 and the winder 25 to the spinning take-up device 4. The robot arm 22 is attached to the robot main body 21. The robot arm 22 moves the hand part 23 with respect to the robot main body 21.

[0117] This simplifies and reduces the output of the spinning and winding system 100, and also suppresses noise of the spinning and winding system 100 due to negative pressure.

[0118] While some preferred embodiments of the present invention have been described above, the foregoing configurations may be modified, for example, as follows. The modification can be singly made and any combination of several modifications can be made.

[0119] In the yarn lowering operation, instead of the yarn sucker 53, a plurality of pieces of yarn Y may be sucked and held by the yarn suction device 14a of yarn holding device 14.

[0120] The guide member 51 may include an elongated rod-shaped member and may be installed in each spinning and winding unit 1 through the yarn passage hole 9a.

[0121] The hand part 23 of the yarn threading robot 2 may be formed in other shapes, such as hooks, rollers, etc., as long as it can catch and guide the yarn Y.

[0122] The yarn holding roller 55a may be configured to be detachable. In this case, the yarn threading robot 2 holds the yarn holding roller 55a with the hand part 23 and guides the yarn Y via the yarn holding roller 55a.

[0123] In the waste yarn discharge plate 26, the yarn passage hole may be formed at a position different from the center for the winder 25 in the contracted-diameter state to pass through. The waste yarn discharge plate 26 may be omitted. In this case, the pushing rod 26a can directly push out and discharge the waste yarn wound on the winder 25.

[0124] The winder 25 of this embodiment can be modified, for example, as shown in FIG. 9. The winder 25 of this modification shown in FIG. 9 includes a plurality of support rods 25p and a plurality of yarn contact plates 25q. The plurality of support rods 25p are lined up circumferentially at each of the tip and root of the central shaft body 25a. One end of each support rod 25p is connected to the central shaft body 25a via a hinge. In each support rod 25p, the opposite end to the central shaft body 25a is connected via a hinge to the yarn contact plate 25q.

[0125] A plurality of yarn contact plates 25q are lined up circumferentially around the central shaft body 25a. Each yarn contact plate 25q is formed in an elongated plate shape. The longitudinal direction of each yarn contact plate 25q is parallel to the central shaft body 25a.

[0126] Each of the plurality of support rods 25p is installed to swing about an end connecting to the central shaft body 25a. As the support rods 25p swing, the yarn contact plates 25q move closer to the central shaft body 25a, as shown by the chain lines in FIG. 9. This reduces the distance between the yarn contact plate 25q and the central shaft body 25a. In other words, the diameter of the winder 25 becomes smaller. This configuration can easily achieve the interlocking of the waste yarn discharge plate 26 and the winder 25. The yarn contact plate 25q can be formed not in a straight line, but in a curved line with its middle portion in a longitudinal direction bent closer to the central shaft body 25a. In this case, the outer circumference of the winder 25 can be made concave, substantially like the concave portion 25h described above.

[0127] The orientation of the winder 25 can be modified arbitrarily according to the arrangement of the yarn storage 24. For example, the orientation of the winder 25 can be changed so that the tip of the winder 25 is facing down-

ward. This allows the yarn Y wound on the winder 25 to fall under its own weight and be discharged. Regardless of the arrangement of the yarn storage 24, the robot arm 22 can grab the wound yarn Y and move it out of the winder 25 for discharging. In this case, the robot arm 22 also serves as the yarn discharger.

[0128] The yarn threading robot 2 of this application may also be applied when the winding operation of yarn Y is temporarily stopped and a plurality of pieces of yarn Y are sucked and held by an aspirator installed near the yarn regulation guide 12, and the yarn threading operation is performed by pulling the yarn Y from the aspirator or the yarn regulation guide 12.

DESCRIPTION OF REFERENCE NUMERALS

[0129]

2	Yarn threading robot
3	Spinning device
4	Spinning take-up device (yarn processing device)
21	Robot main body
22	Robot arm
23	Hand part (yarn engaging part)
25	Winder
25e	Connecting rod (rod member)
26	Waste yarn discharge plate (yarn discharger)
100	Spinning and winding system
Y	Yarn

Claims

1. A yarn threading robot (2) for threading yarn continuously spun from a spinning device (3) to a yarn processing device (4), comprising:
 - a robot main body (21);
 - a winder (25) located on the robot main body (21) so that the yarn continuously spun from the spinning device (3) is wound and stored onto the winder (25); and
 - a robot arm (22) attached to the robot main body (21), having a yarn engaging part (23) that engages with the yarn between the spinning device (3) and the winder (25) and operates the yarn engaging part (23) to thread the yarn between the spinning device (2) and the winder (25) to the yarn processing device (4), wherein the robot arm (22) moves the yarn engaging part (23) with respect to the robot main body (21).
2. The yarn threading robot according to claim 1, wherein a cross section of a middle portion in an axis direction of the winder (25) is smaller in diameter than cross sections of end portions in the axis direction of the winder (25).

3. The yarn threading robot according to claim 1 or 2, comprising a yarn discharger (26) that discharges the yarn stored on the winder (25) from the winder (25).

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4. The yarn threading robot (2) according to claim 1 or 2, wherein a diameter of the winder (25) is configured to be changeable.

5. The yarn threading robot (2) according to claim 4, wherein the winder (25) is configured to be changeable between a contracted-diameter state and an expanded-diameter state, and in the expanded-diameter state, a cross section of a middle portion in an axis direction of the winder (25) is smaller in diameter than cross sections of end portions in the axis direction of the winder (25).

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6. The yarn threading robot (2) according to claim 4, comprising a yarn discharger (26) that discharges the yarn stored on the winder (25) from the winder (25).

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7. The yarn threading robot (2) according to claim 6, wherein

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the winder (25) is configured to be changeable between a contracted-diameter state and an expanded-diameter state, a through hole is formed in the yarn discharger (26), and the winder (25) in the contracted-diameter state can be inserted into the through hole of the yarn discharger (26).

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8. The yarn threading robot (2) according to any one of claims 4 to 7, wherein

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the winder (25) has a plurality of rod members (25e) that can rotate integrally, the plurality of rod members (25e) are lined up circumferentially about a rotation center of the winder (25), and each of the rod members (25e) is arranged in a skew position with respect to the rotation center and is movable in a direction approaching and moving away from the rotation center.

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9. A spinning and winding system comprises:

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a spinning device (3) that spins yarn continuously, a yarn processing device (4) for taking up or winding the yarn continuously spun from the spinning device (3); and a yarn threading robot (2) for threading the yarn continuously spun from the spinning device to the yarn processing device (4), wherein the yarn

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threading robot (2) includes:

a robot main body (21); a winder (25) located on the robot main body (21) so that the yarn continuously spun from the spinning device (3) is wound and stored onto the winder (25); and a robot arm (22) attached to the robot main body (21), having a yarn engaging part that engages with the yarn between the spinning device (3) and the winder (25) and operates the yarn engaging part (23) to thread the yarn between the spinning device (3) and the winder (25) to the yarn processing device (4), and the robot arm (21) moves the yarn engaging part (23) with respect to the robot main body (21).

10. The spinning and winding system according to claim 9, wherein a cross section of a middle portion in an axis direction of the winder (25) is smaller in diameter than cross sections of end portions in the axis direction of the winder (25).

11. The spinning and winding system according to claim 9 or 10, comprising a yarn discharger (26) that discharges the yarn stored on the winder (25) from the winder (25).

12. The spinning and winding system according to claim 9 or 10, wherein a diameter of the winder (25) is configured to be changeable.

13. The spinning and winding system according to claim 12, wherein

the winder (25) is configured to be changeable between a contracted-diameter state and an expanded-diameter state, and in the expanded-diameter state, a cross section of a middle portion in an axis direction of the winder (25) is smaller in diameter than cross sections of end portions in the axis direction of the winder (25).

14. The spinning and winding system according to claim 12, comprising a yarn discharger (26) that discharges the yarn stored on the winder (25) from the winder (25).

15. The spinning and winding system according to claim 14, wherein

the winder (25) is configured to be changeable between a contracted-diameter state and an expanded-diameter state, a through hole is formed in the yarn discharger

(26), and
the winder (25) in the contracted-diameter state
can be inserted into the through hole of the yarn
discharger (26).

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16. The spinning and winding system according to any
one of claims 12 to 15, wherein

the winder (25) has a plurality of rod members
(25e) that can rotate integrally,
the plurality of rod members (25e) are lined up
circumferentially about a rotation center of the
winder (25), and
each of the rod members (25e) is arranged in a
skew position with respect to the rotation center
and is movable in a direction approaching and
moving away from the rotation center.

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FIG. 1

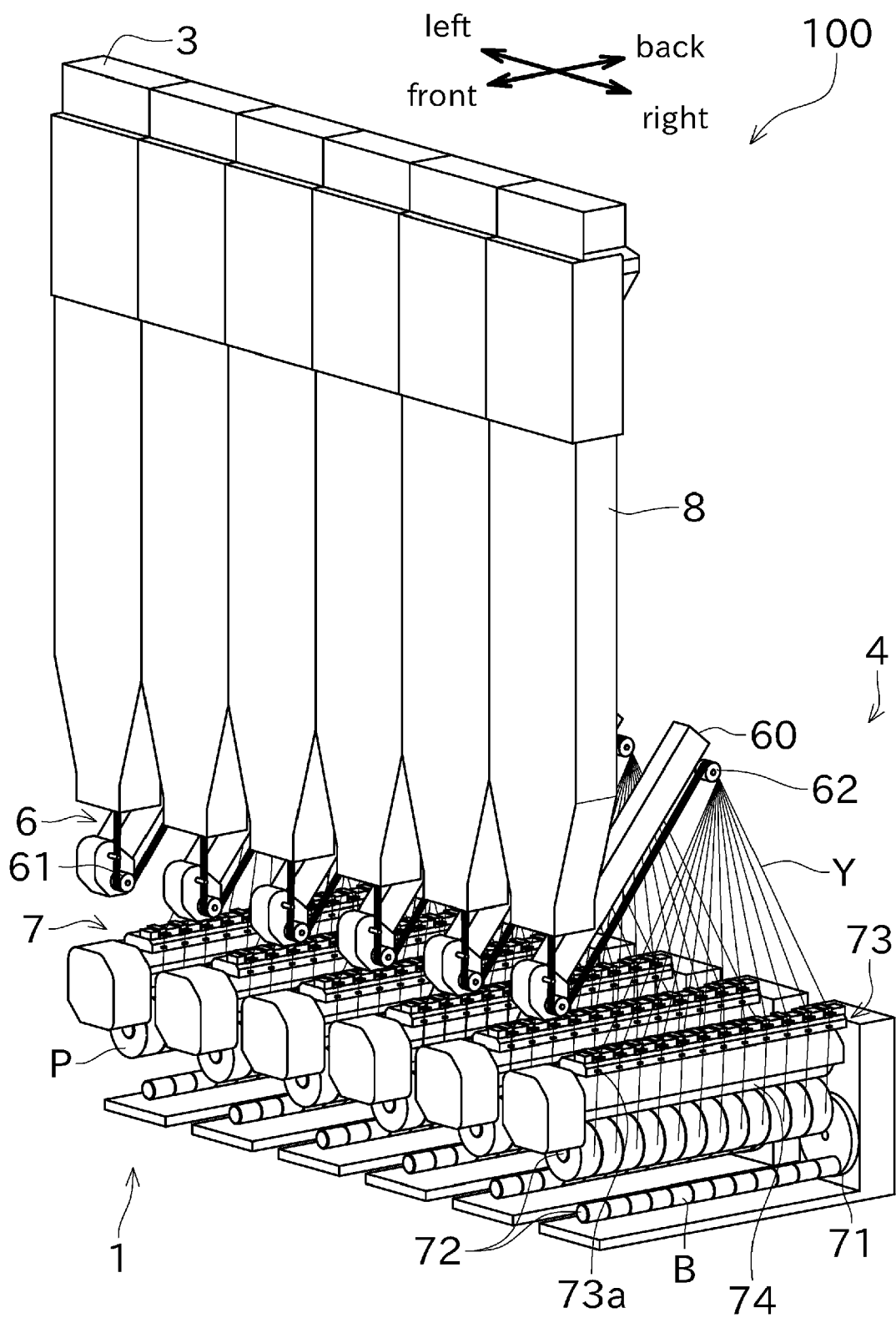


FIG. 2

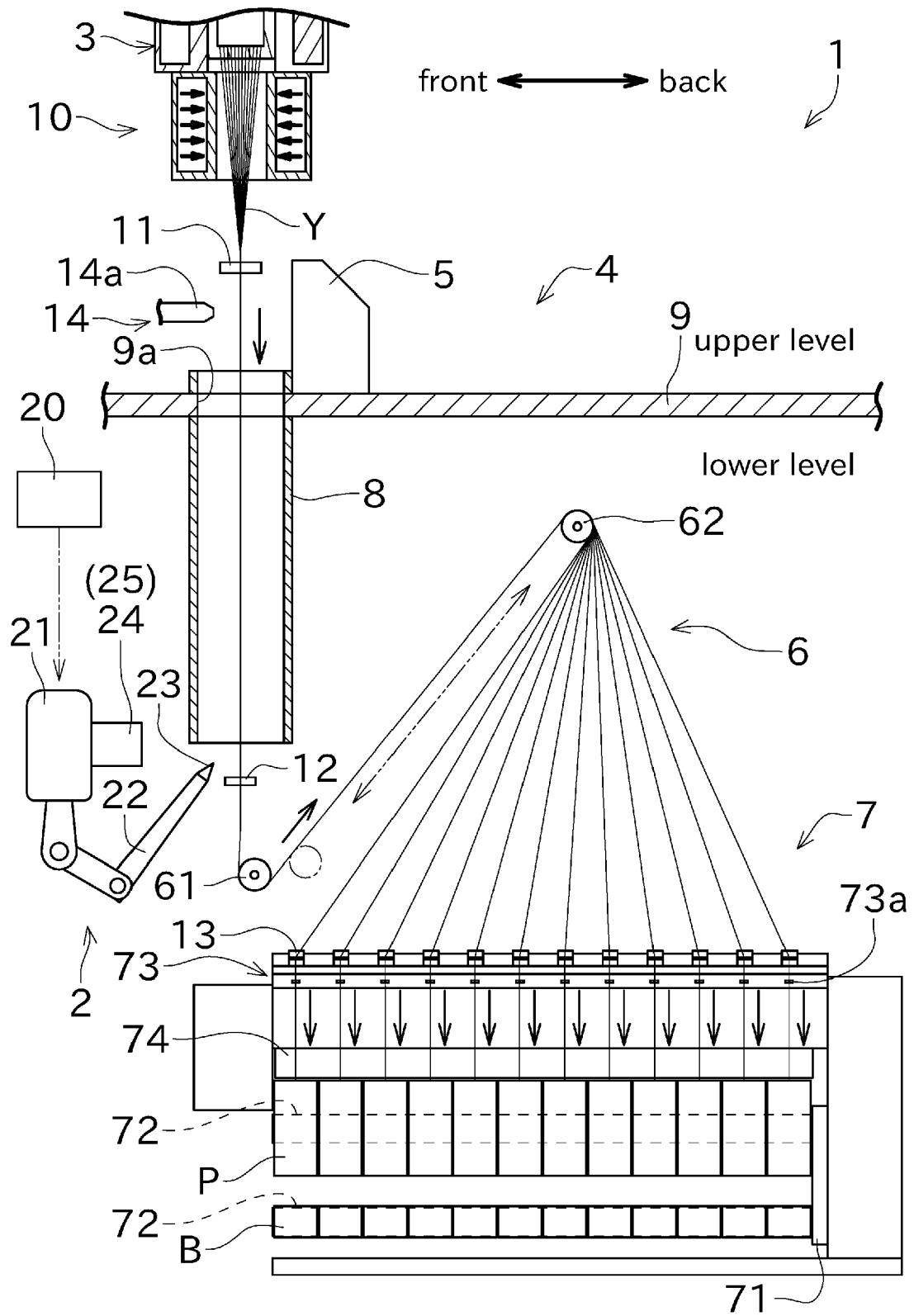


FIG. 3

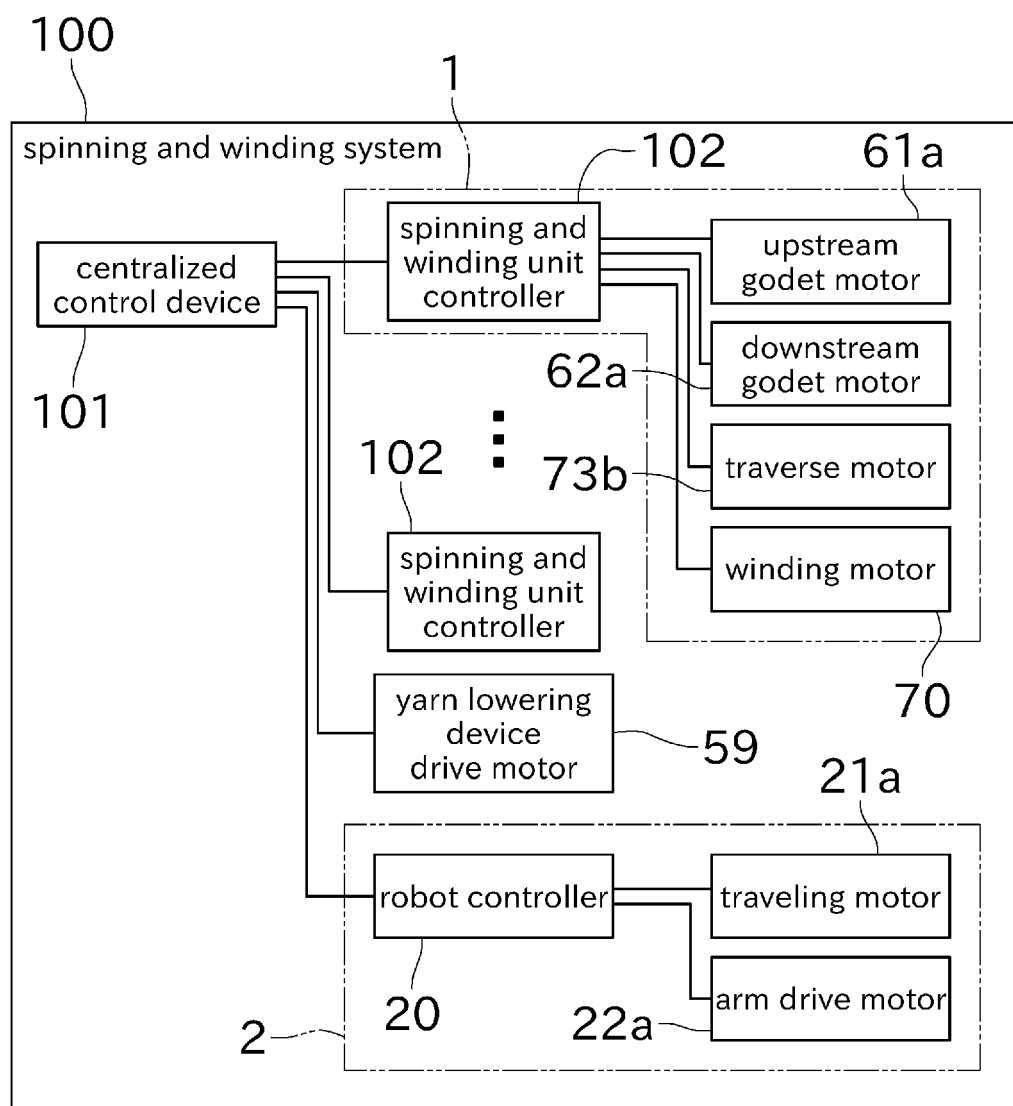


FIG. 4

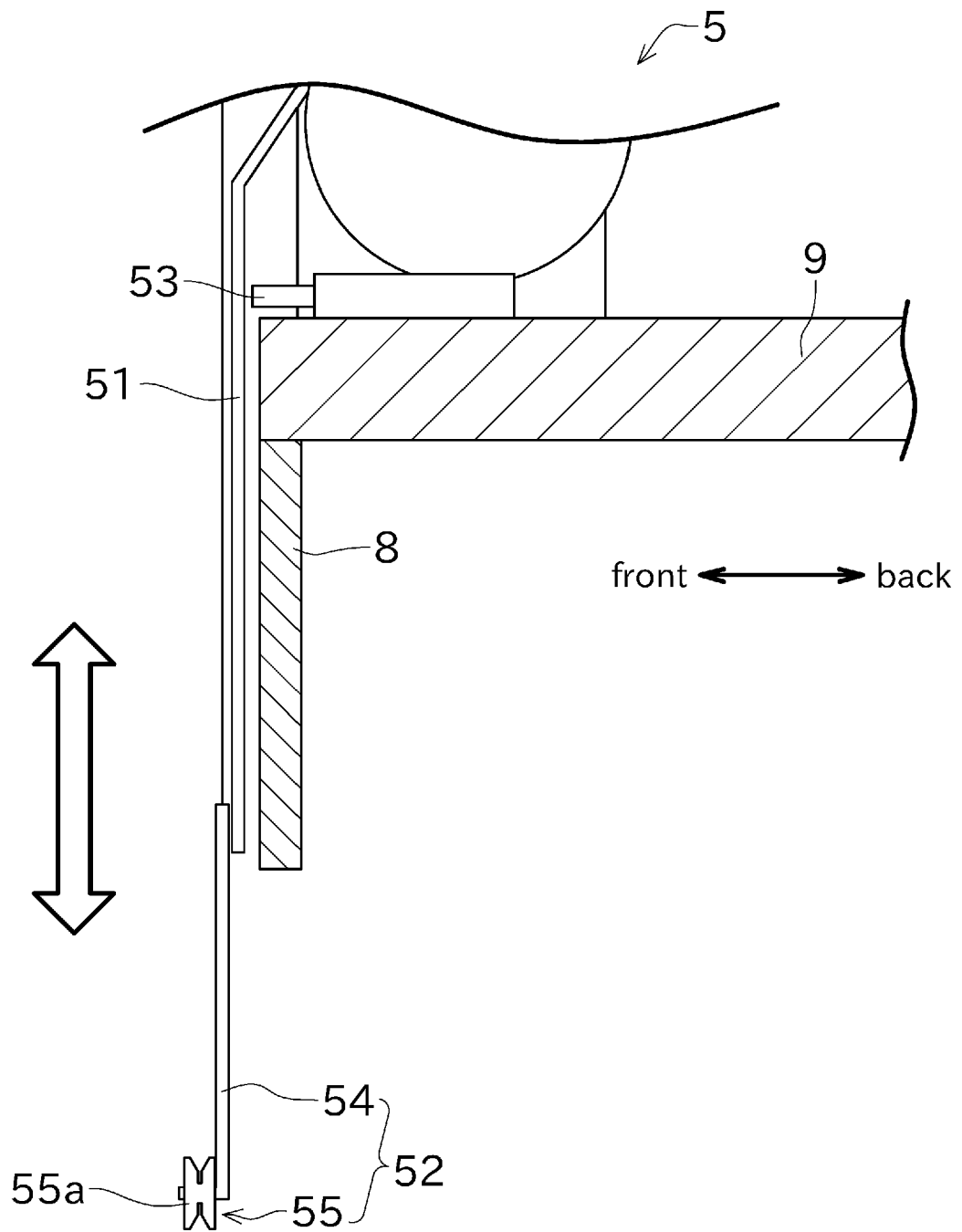


FIG. 5

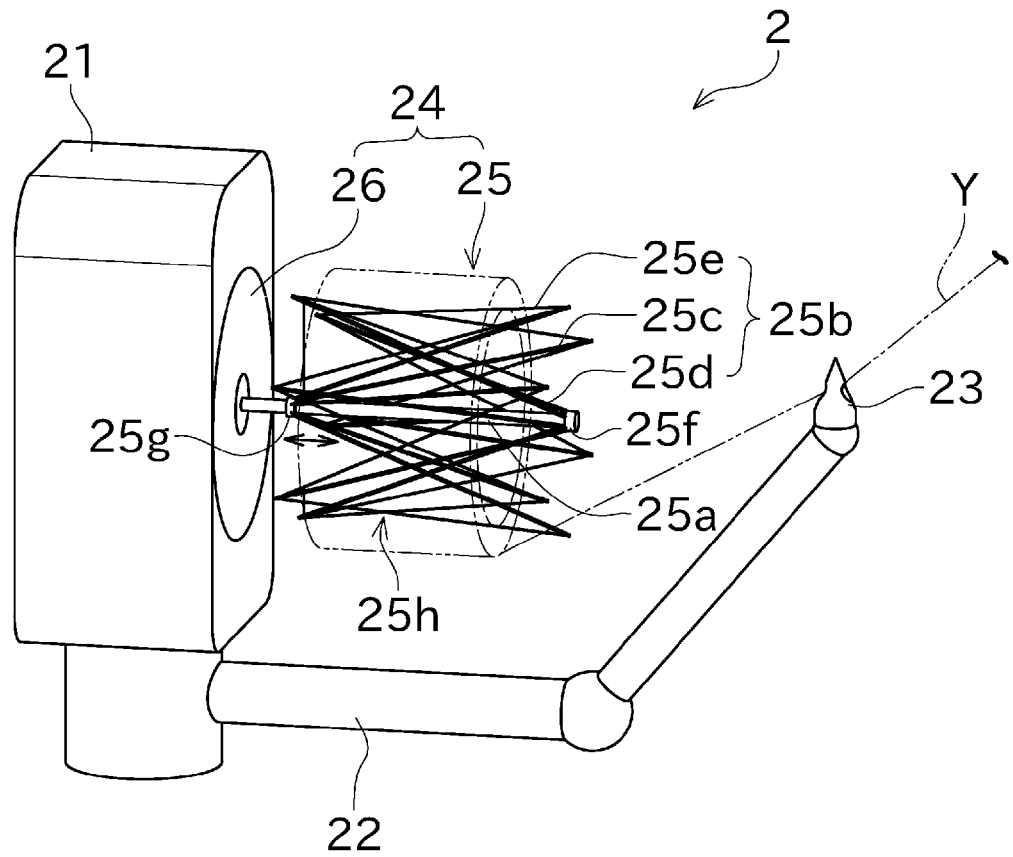


FIG. 6

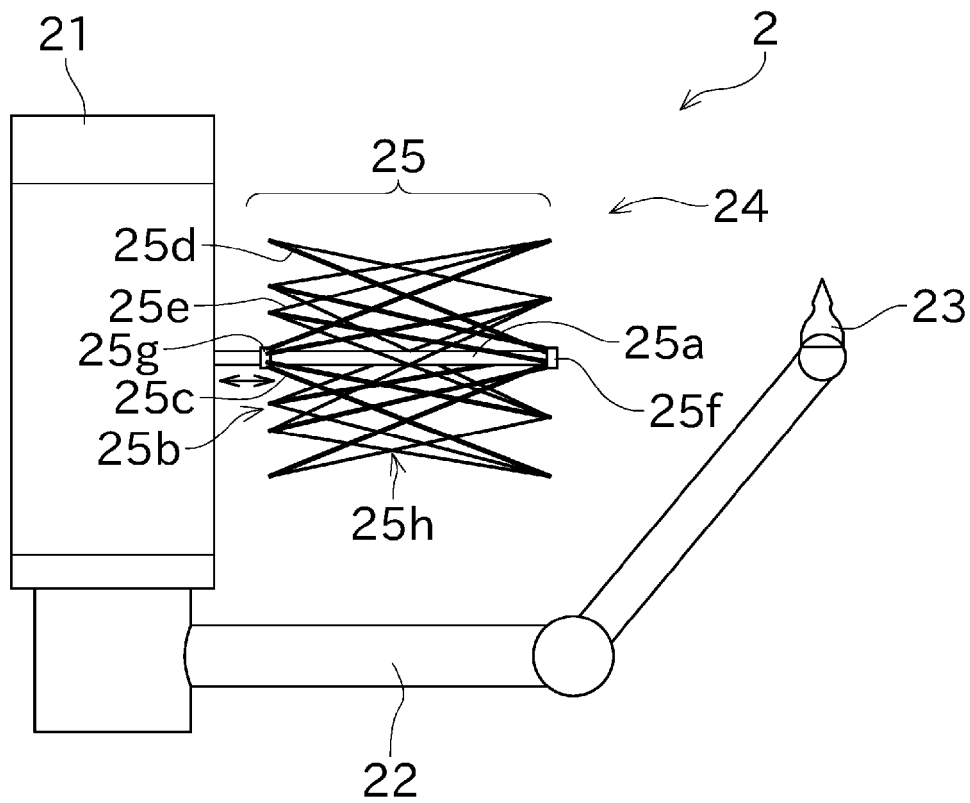


FIG. 7

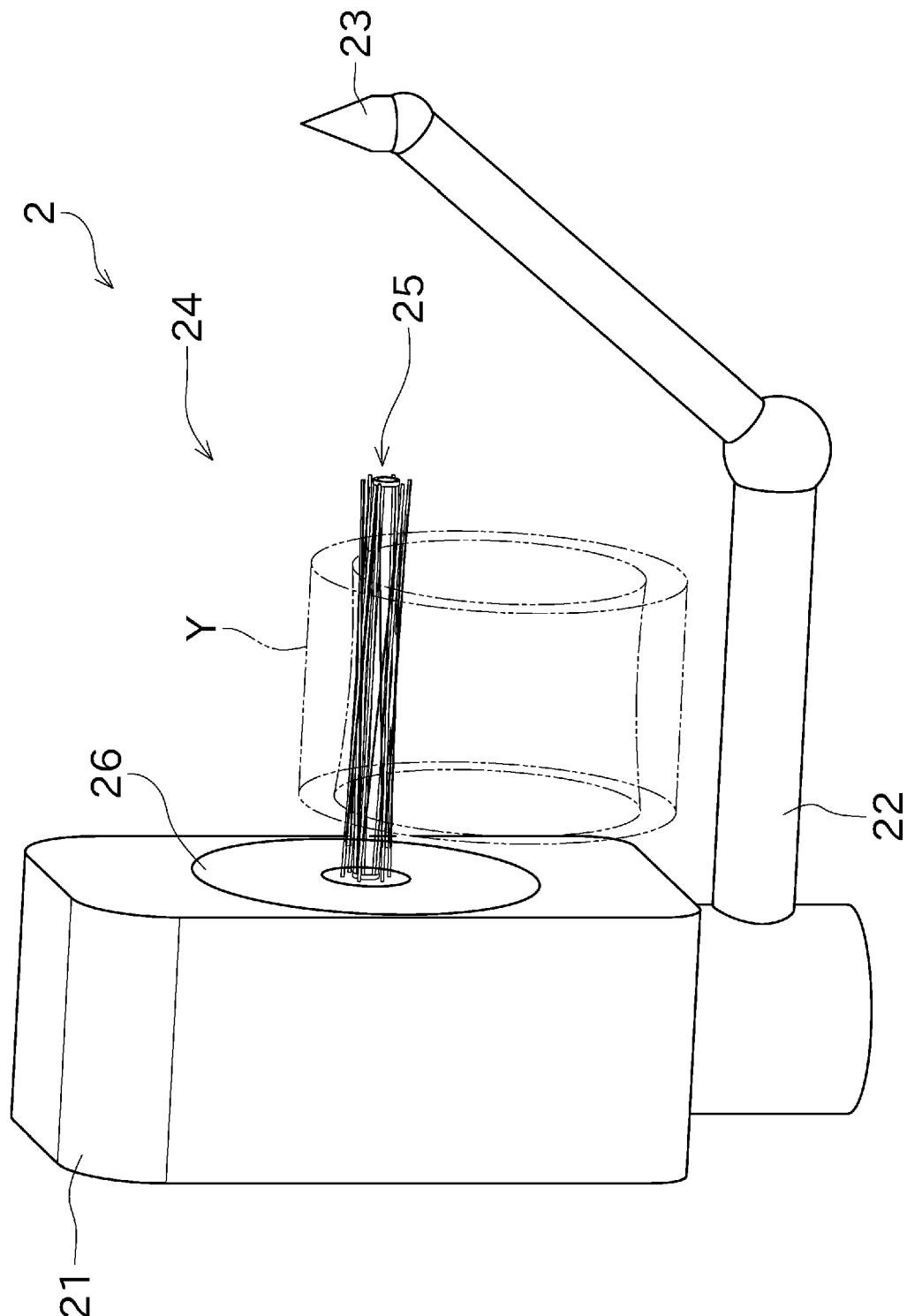


FIG. 8

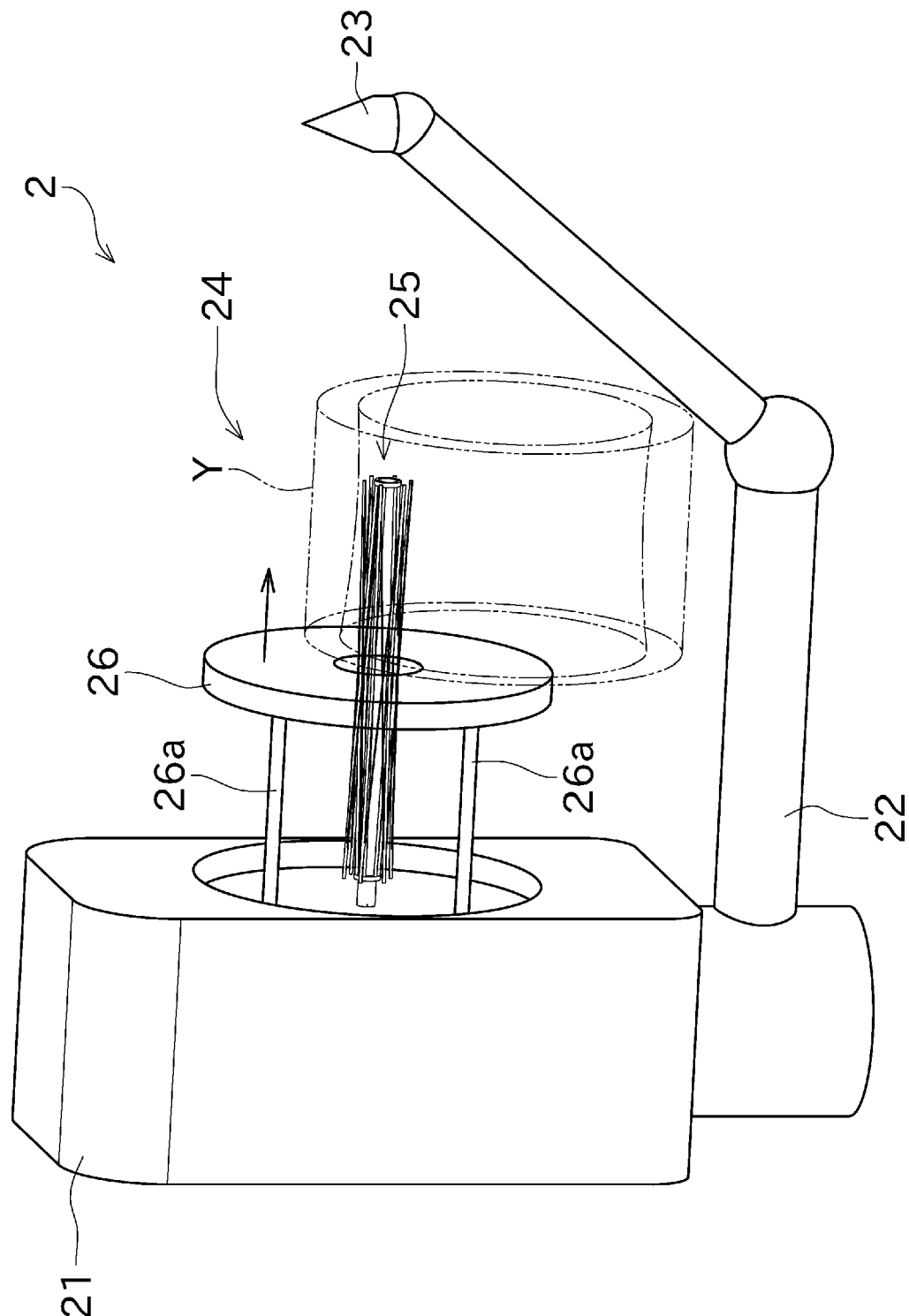
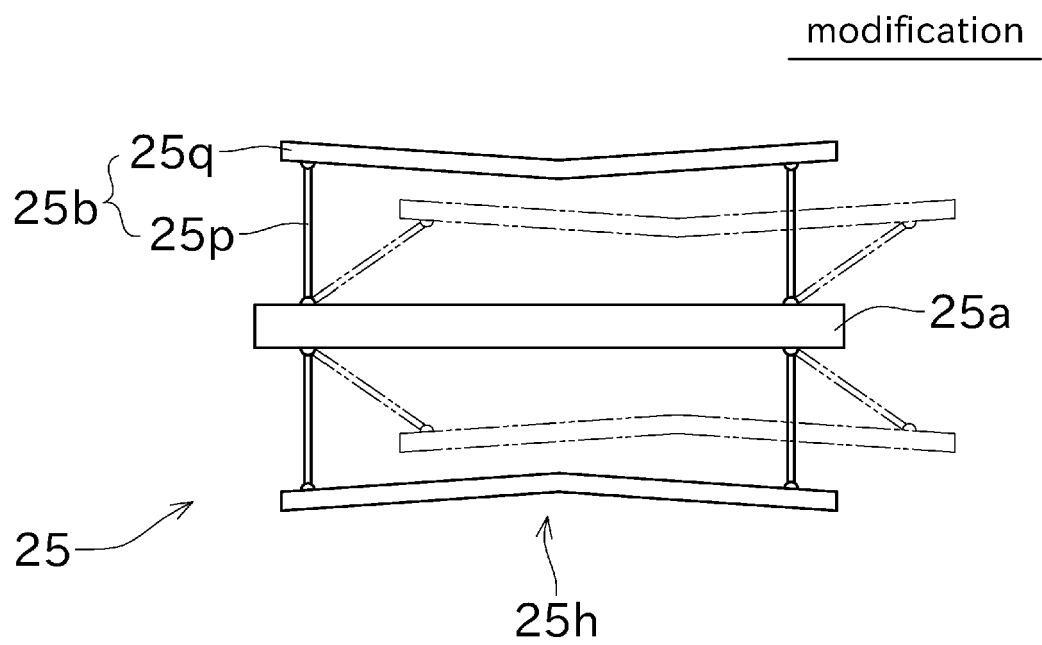


FIG. 9





EUROPEAN SEARCH REPORT

Application Number

EP 23 20 6013

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP S60 15361 A (TORAY INDUSTRIES) 26 January 1985 (1985-01-26)	1, 3-6, 9, 11-14	INV. B65H54/26
A	* abstract; figures 1-4 *	2, 7, 8, 10, 15, 16	B65H54/86

A	EP 3 162 923 A1 (TMT MACHINERY INC [JP]) 3 May 2017 (2017-05-03)	1, 9	
	* paragraphs [0052], [0053]; figure 1 *		

A	EP 3 725 720 A1 (TMT MACHINERY INC [JP]) 21 October 2020 (2020-10-21)	1, 9	
	* paragraphs [0050] - [0060]; figure 2 *		

			TECHNICAL FIELDS SEARCHED (IPC)
			B65H D01D
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		5 March 2024	Pussemier, Bart
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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

EP 23 20 6013

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
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05-03-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP S6015361 A	26-01-1985	NONE	

EP 3162923 A1	03-05-2017	CN 106829621 A	13-06-2017
		EP 3162923 A1	03-05-2017
		JP 6681307 B2	15-04-2020
		JP 2017082376 A	18-05-2017
		TW 201714810 A	01-05-2017

EP 3725720 A1	21-10-2020	CN 111826735 A	27-10-2020
		EP 3725720 A1	21-10-2020
		JP 7253431 B2	06-04-2023
		JP 2020176337 A	29-10-2020
		TW 202108490 A	01-03-2021

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2021123814 A [0004]