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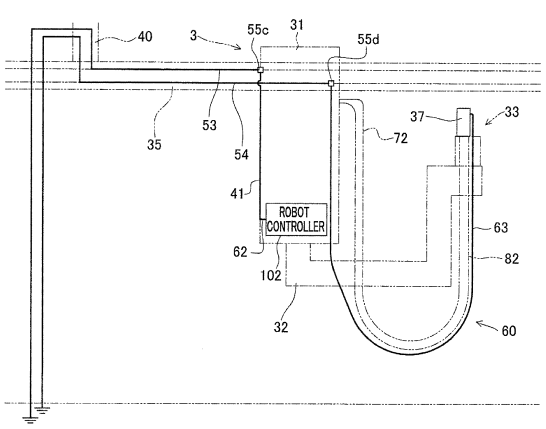
(54) WORK ROBOT AND TEXTILE MACHINE PROVIDED WITH WORK ROBOT

(57) Static electricity generated in a retaining portion is swiftly removed and an influence of the static electricity on a controller is restrained. A yarn threading robot 3 performing yarn threading to a take-up apparatus 2 includes a robot main body 31, a robotic arm 32 connected to the robot main body 31, a suction gun 37 attached to the robotic arm 32 to retain yarns, a robot controller 102, and a terminal 55d in contact with a grounded ground wire 54. A conductive path 60 is formed to extend from the suction gun 37 to the terminal 55d without passing the robot controller 102 so as to cause the suction gun 37 to be electrically conductive with the terminal 55d. The suction gun 37 is connected to the ground wire 54 via the conductive path 60 and the terminal 55d so as to be grounded. On this account, the static electricity generated in the suction gun 37 due to contact with the yarn Y is swiftly removed and the occurrence of adverse effects due to the flow of electric changes to the robot controller 102 is restrained.

FIG.9



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Description

[Technical Field]

[0001] The present invention relates to a work robot which performs a predetermined operation regarding yarns for a yarn processing apparatus, and relates to a textile machine including the work robot.

[Background]

[0002] As an example of the yarn processing apparatus, Patent Literature 1 discloses a spun yarn take-up apparatus which forms packages by winding yarns spun out from a spinning apparatus onto bobbins. To be more specific, the spun yarn take-up apparatus includes first and second godet rollers, fulcrum guides, traverse guides, etc. Yarns are wound onto the first and second godet rollers and are then threaded to the respective fulcrum guides. The yarns threaded onto the fulcrum guides are wound onto the bobbins while being traversed by the traverse guides.

[0003] In Patent Literature 1, yarn threading of spun-out yarns to the spun yarn take-up apparatus is carried out by an operator. To be more specific, the yarns are wound onto the first and second godet rollers while the yarns are sucked and retained by a suction gun. The yarns are then threaded to the respective fulcrum guides.

[Citation List]

[Patent Literatures]

[0004] [PTL 1] Japanese Unexamined Patent Publication No. 2015-78455

[Summary of the Invention]

[Technical Problem]

[0005] In consideration of factors such as improvement in production efficiency and cost reduction, the applicant of the present invention has tried to use a yarn threading robot in place of an operator for performing the above-described operation regarding yarns. For example, the yarn threading robot has an arm with a retaining portion which suck yarns, and threads yarns to godet rollers or the like by moving the arm at will.

[0006] In the above-described yarn threading robot, static electricity is likely to be generated, because the retaining portion makes contact with yarns and the retaining portion is charged with electricity. In particular, in the spun yarn take-up apparatus of Patent Literature 1, because the retaining portion sucks yarns serially spun out from the spinning apparatus, a large amount of electric charges tend to be accumulated in the retaining portion. When the electric charges flow to the control system of the robot, the control system may be adversely influenced.

[0007] An object of the present invention is to swiftly remove static electricity generated in a retaining portion and to restrain an influence of the static electricity on a controller.

[Solution to Problem]

[0008] According to the first aspect of the invention, a work robot performing a predetermined operation regarding yarns to at least one yarn processing apparatus includes: a robot main body; an arm member attached to the robot main body; a retaining portion attached to the arm member and retaining the yarns; a controller; and a first terminal in contact with a first ground member which is grounded, a conductive path being formed to extend from the retaining portion to the first terminal without passing the controller so as to cause the retaining portion to be electrically conductive with the first terminal, and the retaining portion being connected to the first ground member via the conductive path and the first terminal and grounded.

[0009] According to this aspect, in the work robot performing the predetermined operation regarding the yarns to the yarn processing apparatuses, the conductive path is formed to extend from the retaining portion retaining the yarns to the first terminal without passing the controller so as to cause the retaining portion to be electrically conductive with the first terminal. In other words, the retaining portion and the controller are not connected at least in series. The retaining portion is connected to the first ground member via the conductive path and the first terminal and grounded. On this account, the static electricity generated in the retaining portion due to contact with the yarns is swiftly removed and the occurrence of adverse effects due to the flow of electric changes to the controller is restrained.

[0010] According to the second aspect, the work robot of the first aspect is arranged such that the conductive path includes a wire extending from the retaining portion, and the wire is insulated from the controller.

[0011] Because the wire in the conductive path extends from the retaining portion and the wire is insulated from the controller, it is possible to prevent electric charges generated in the retaining portion from directly flowing to the controller from the wire.

[0012] According to the third aspect of the invention, the work robot of the second aspect is arranged such that at least part of the wire is provided in the robot main body, and the wire is insulated from the controller by an insulator.

[0013] Even when a part of the wire is provided in the robot main body as a ground path of the retaining portion, flow of electric charges generated in the retaining portion into the controller is restrained because the wire is insulated from the controller in the robot main body by the insulator.

[0014] According to the fourth aspect of the invention,

the work robot of the third aspect is arranged such that the insulator is an insulating cover which extends along the wire and covers the wire.

[0015] Insulation of the wire which is at least part of the ground path of the retaining portion from the ground path of the controller is ensured because the insulating cover extending along the wire covers the wire.

[0016] According to the fifth aspect of the invention, the work robot of any one of the first to fourth aspects is arranged such that the retaining portion is grounded through a ground path different from the ground path of the controller.

[0017] According to this aspect, because the retaining portion is grounded through a ground path different from the ground path of the controller, it is possible to certainly prevent electric charges generated in the retaining portion from flowing to the controller.

[0018] According to the sixth aspect of the invention, the work robot of the fifth aspect includes a second terminal in contact with a second ground member which is different from the first ground member and is grounded, the robot main body including an electrically-conductive frame, and a ground of the controller being electrically conductive with the second terminal via the frame.

[0019] While the ground of the controller is provided to be conductive with the second terminal via the conductive frame of the robot main body, the retaining portion is grounded via a conductive path which is different from the frame. It is therefore possible to certainly prevent electric charges generated in the retaining portion from flowing to the controller.

[0020] According to the seventh aspect of the invention, the work robot of any one of the first to fourth aspects is arranged such that both of the retaining portion and the controller are electrically conductive with the first terminal and are connected to the first ground member and grounded.

[0021] Even when both of the retaining portion and the controller are connected to the first ground member and grounded, because the conductive path causing the retaining portion to be conductive with the first terminal does not pass the controller, it is possible to restrain electric charges generated in the retaining portion from directly flowing to the controller.

[0022] According to the eighth aspect of the invention, the work robot of any one of the first to seventh aspects includes a running unit which causes the robot main body to run along a guide rail extending in a direction in which a plurality of the at least one yarn processing apparatus are lined up, the first terminal being provided on the running unit.

[0023] The work robot of this aspect runs across the yarn processing apparatuses along the guide rail, stops at a location in front of a yarn processing apparatus which is the target of operation, and performs the operation. In this arrangement, because the first terminal is provided on the running unit which is in contact with the guide rail, the ground path of the retaining portion is easily assured by providing the first ground member at or around the guide rail.

[0024] According to the ninth aspect of the invention, the work robot of the eight aspect is arranged such that the first ground member is provided along the guide rail, and the first terminal of the running unit is in contact with the first ground member.

[0025] According to this aspect, because the first ground member is provided along the guide rail, the first terminal is always in contact with the first ground member and hence electric charges generated in the retaining portion are certainly dissipated.

[0026] According to the tenth aspect of the invention, the work robot of the eighth or ninth aspect is arranged such that the running unit includes a wheel which is insulating at least at a contact surface where the wheel is in contact with the guide rail, and the first terminal is provided at a location different from the wheel.

[0027] When the contact surface of the wheel of the running unit, which is in contact with the guide rail, is insulating, electric charges generated in the retaining portion cannot be dissipated to the guide rail via the wheel. Even in such a case, according to the aspect above, because the first terminal is provided at a location different from the wheel of the running unit, electric charges generated in the retaining portion can be dissipated to the first ground member via the first terminal.

[0028] According to the eleventh aspect of the invention, the work robot of the tenth aspect is arranged such that the guide rail is provided at an upper part of a movement space of the robot main body, and the robot main body runs while hanging down from the guide rail.

[0029] When the wheel is insulating and the robot main body hangs down from the guide rail, grounding is difficult as compared to cases where the robot runs on the floor. Even in such a case, according to the aspect above, because the retaining portion is connected to the first ground member via the conductive path and the first terminal, the ground path is assured.

[0030] According to the twelfth aspect of the invention, the work robot of the eighth aspect is arranged such that the first ground member is the guide rail formed of a conductive member, and the first terminal of the running unit is in contact with the guide rail.

[0031] According to this aspect, because the guide rail made of a conductive member is the first ground member and the first terminal is in contact with the guide rail, electric charges generated in the retaining portion are certainly dissipated.

[0032] According to the thirteenth aspect of the invention, the work robot of the twelfth aspect is arranged such that the running unit includes a wheel made of a conductor, and the first terminal is the wheel.

[0033] When the wheel is made of a conductor, electric charges generated in the retaining portion can be dissipated to the guide rail via the wheel and the conductive path.

[0034] According to the fourteenth aspect of the inven-

tion, the work robot of the first aspect includes an extension portion extending from the retaining portion toward the first ground member, the conductive path includes a wire extending from the retaining portion, and at least part of the wire is provided along the extension portion.

[0035] According to this aspect, because the wire is provided along the extension portion which extends toward the first ground member from the retaining portion, the ground path of the retaining portion is assured at a location remote from the robot main body in which the controller is provided.

[0036] According to the fifteenth aspect of the invention, the work robot of the fourteenth aspect is arranged so that at least part of the extension portion and at least part of the wire pass the inside of the arm member, and the wire is insulated from the controller by an insulator.

[0037] According to this aspect, the extension portion and the wire passes the inside of the arm member, and the wire is insulated from the controller by the insulator. On this account, while flow of electric charges generated in the retaining portion into the controller is restrained, interference between these members and the arm member is prevented, with the result that the degree of freedom in movement of the arm member is high.

[0038] According to the sixteenth aspect of the invention, the work robot of the fourteenth or fifteenth aspect is arranged such that the retaining portion includes a sucking section sucking the yarns, and the extension portion is a hose connected to the sucking section.

[0039] According to this aspect, because the hose extends from the sucking section toward the first ground member, the wire bypasses the robot main body as the wire is arranged to extend toward the first ground member along the hose. It is therefore possible to ensure the separation of the ground path of the retaining portion from the ground path of the controller in the robot main body.

[0040] According to the seventeenth aspect of the invention, the work robot of the sixteenth aspect is arranged such that the hose is connected to a fluid pipe which is provided in a fixed manner, a hose-side coupler with the first terminal is attached to an end portion of the hose, the end portion being on the side opposite to the sucking section, and the first ground member is provided at a pipe-side coupler of the fluid pipe, the pipe-side coupler being connected to the hose-side coupler.

[0041] According to this aspect, because the ground path of the retaining portion is assured at the time of the attachment of the pipe-side coupler to the hose-side coupler, time and labor for assuring the ground path can be saved. Furthermore, the structure for assuring the ground path is simple.

[0042] According to the eighteenth aspect, the work robot of any one of the first to seventh aspects is arranged such that the conductive path includes a wire extending from the retaining portion, and the wire is either flexible or provided in a flexible member.

[0043] When the wire is either flexible or provided in a flexible member, the wire is able to follow the movement of the retaining portion when the retaining portion moves during the operation by the robot.

[0044] According to the nineteenth aspect of the invention, the work robot of any one of the first to eighteenth aspects is arranged such that each of the at least one yarn processing apparatus includes a take-up unit which is configured to take up the yarns spun out from a spinning unit of a spinning apparatus, and the controller causes the retaining portion to perform the predetermined operation while the retaining portion serially sucking and retaining the yarns spun out from the spinning unit.

[0045] When the yarn processing apparatus includes the take-up unit taking up the yarns spun out from the spinning apparatus, because the yarns are serially spun out from the spinning apparatus, the electric charge amount in the retaining portion tends to be large as the yarns serially rub against the retaining portion while the controller causes the retaining portion to perform the predetermined operation. Even in such a case, because in the aspect above the retaining portion and the controller are not connected at least in series, the static electricity generated in the retaining portion is swiftly removed and the occurrence of adverse effects due to the flow of electric changes to the controller is prevented.

[0046] According to the twentieth aspect of the invention, the work robot of any one of the first to nineteenth aspects is arranged such that the predetermined operation is yarn threading of the yarns retained by the retaining portion to the at least one yarn processing apparatus.

[0047] The work robot of the present invention is a yarn threading robot performing yarn threading to a yarn processing apparatus . Because the retaining portion is required to move the yarns while retaining the yarns in yarn threading, electric charges tend to be generated in the retaining portion due to contact with the yarns. Particularly in such an arrangement, it is advantageous in terms of the protection of the controller to arrange the retaining portion and the controller not to be connected at least in series and to swiftly dissipate the static electricity generated in the retaining portion.

[0048] According to the 21st aspect of the invention, a textile machine includes: a yarn processing apparatus; a ground member which is provided in the yarn processing apparatus and is grounded; and a work robot performing a predetermined operation regarding yarns to the yarn processing apparatus, the work robot comprising: a robot main body; an arm member attached to the robot main body; a retaining portion attached to the arm member and retaining the yarns; a controller; and a terminal in contact with the ground member, a conductive path being formed to extend from the retaining portion to the terminal without passing the controller so as to cause the retaining portion to be electrically conductive with the terminal, and the retaining portion being connected to the ground member via the conductive path and the terminal and grounded.

[0049] In the textile machine including the yarn processing apparatus, the ground member, and the work

robot, because the retaining portion of the work robot is grounded without passing the controller, the static electricity generated in the retaining portion is swiftly removed and the occurrence of adverse effects due to the flow of electric changes to the controller is restrained. As a result, the textile machine is stably operated.

[Brief Description of Drawings]

[0050]

[FIG. 1] FIG. 1 is a schematic diagram of a spun yarn take-up system of an embodiment of the present invention.
[FIG. 2] FIG. 2 is a block diagram illustrating an electric structure of the spun yarn take-up system.
[FIG. 3] FIG. 3 is a front view illustrating a take-up apparatus and a yarn threading robot.
[FIG. 4] FIG. 4 is a side view illustrating the take-up apparatus and the yarn threading robot.
[FIG. 5] FIG. 5 is a front view illustrating the yarn threading robot.
[FIG. 6] FIG. 6 is a cross section of a suction gun of the yarn threading robot.
[FIG. 7] Each of FIGs. 7(a) and 7(b) shows a running unit and its surroundings of the yarn threading robot.
[FIG. 8] FIG. 8 is an enlarged view of the running unit of the yarn threading robot.
[FIG. 9] FIG. 9 is a schematic view of a ground path of the suction gun and a ground path of a robot controller.
[FIG. 10] FIG. 10 is a flowchart of a series of steps of yarn threading.
[FIG. 11] FIG. 11 is a front view illustrating a yarn threading robot of a modification.
[FIG. 12] FIG. 12 is a side view illustrating a yarn threading robot of another modification.
[FIG. 13] FIG. 13 is a side view illustrating a yarn threading robot of another modification.
[FIG. 14] FIG. 14 is an enlarged view of a running unit of a yarn threading robot of another modification.
[FIG. 15] FIG. 15 is a schematic view of a ground path of a suction gun and a ground path of a robot controller.
[FIG. 16] FIG. 16 is an enlarged view of a running unit of a yarn threading robot of another modification.
[FIG. 17] FIG. 17 is a front view illustrating a take-up apparatus and a yarn threading robot of another modification.

[Preferred Embodiment of Invention]

[0051] The following will describe an embodiment of the present invention with reference to FIG. 1 to FIG. 10.

(Outline of Spun Yarn Take-Up System)

[0052] FIG. 1 is a schematic front view of a spun yarn take-up system 1 (textile machine of the present invention) of an embodiment. The spun yarn take-up system 1 includes members such as take-up apparatuses 2 (yarn processing apparatus of the present invention), a yarn threading robot 3 (work robot of the present invention), and a central controller 4. Hereinafter, the direction in which the take-up apparatuses 2 are lined up will be referred to as a left-right direction, as shown in FIG. 1. Furthermore, the direction orthogonal to the plane of FIG. 1 will be referred to as a front-rear direction and the direction orthogonal to the left-right direction and the front-rear direction will be referred to as an up-down direction.

[0053] The spun yarn take-up apparatuses 2 are lined up in the left-right direction and each of the spun yarn take-up apparatuses 2 takes up yarns Y spun out from a spinning unit 5 of a spinning apparatus provided above the spun yarn take-up apparatus 2, and forms packages P by winding the yarns Y onto winding bobbins B. The yarn threading robot 3 is provided in front of the take-up apparatuses 2, and performs yarn threading (predetermined operation in the present invention) for the take-up apparatuses 2 with the movement in the left-right direction. The central controller 4 is electrically connected to a later-described winding controller 101 of the take-up apparatus 2 and a robot controller 102 (controller of the present invention) of the yarn threading robot 3 (as shown in FIG. 2) and communicates with these controllers.

(Electric Structure of Spun Yarn Take-Up System)

[0054] The electric structure of the spun yarn take-up system 1 will be described with reference to FIG. 2. FIG. 2 is a block diagram showing the electric structure of the spun yarn take-up system 1. The spun yarn take-up system 1 includes the central controller 4 which serves to control the entire system. Each spun yarn take-up apparatus 2 is provided with a winding controller 101. The winding controller 101 is configured to control the operation of each driving unit of the take-up apparatus 2. In the yarn threading robot 3, a robot controller 102 is provided. The robot controller 102 is configured to control the operation of each driving unit of the yarn threading robot 3. The central controller 4 is communicably connected, wirelessly or by cable, with each winding controller 101 and each robot controller 102.

(Take-Up Apparatus)

[0055] The structure of the take-up apparatus 2 will be described with reference to FIG. 3 and FIG. 4. FIG. 3 is a front view showing the take-up apparatus 2 and the yarn threading robot 3. FIG. 4 is a side view showing the take-up apparatus 2 and the yarn threading robot 3.

[0056] As shown in FIG. 3 and FIG. 4, the take-up apparatus 2 includes a take-up unit 10 for taking up yarns Y spun out from the spinning unit 5 of the spinning apparatus (see FIG. 1) and a winding unit 13 for winding the taken-up yarns Y onto winding bobbins B and forming

packages P.

[0057] The take-up unit 10 includes a first godet roller 11, a second godet roller 12, an aspirator 15, and a yarn regulating guide 16.

[0058] The first godet roller 11 is a roller having an axis substantially in parallel to the left-right direction and is provided above a front end portion of the winding unit 13. The first godet roller 11 is rotationally driven by a first godet motor 111 (see FIG. 2) . The second godet roller 12 is a roller having an axis substantially in parallel to the left-right direction, and is provided above and rearward of the first godet roller 11. The second godet roller 12 is rotationally driven by a second godet motor 112 (see FIG. 2).

[0059] The second godet roller 12 is movably supported by a guide rail 14. The guide rail 14 extends obliquely upward and rearward. The second godet roller 12 is arranged to be movable along the guide rail 14 by a cylinder (not illustrated) . With this, the second godet roller 12 is movable between a winding position where winding of the yarns Y is performed and a yarn threading position which is close to the first godet roller 11 and where yarn threading is performed. In FIG. 4, the position of the second godet roller 12 at the winding position is indicated by full lines, whereas the position of the second godet roller 12 at the yarn threading position is indicated by one-dot chain lines.

[0060] The aspirator 15 is configured to suck and retain the yarns Y spun out from the spinning apparatus before yarn threading is performed by the yarn threading robot 3. The aspirator 15 is provided above the first godet roller 11.

[0061] The yarn regulating guide 16 is provided between the first godet roller 11 and the aspirator 15 with respect to the up-down direction. The yarn regulating guide 16 is, for example, a known yarn guide with a comb teeth shape. When the yarns Y are threaded thereon, the yarn regulating guide 16 regulates the interval between neighboring yarns Y to a predetermined value. The yarn regulating guide 16 is arranged to be movable in the left-right direction by a cylinder (not illustrated). With this, in the left-right direction, the yarn regulating guide 16 is movable between a protruding position where the guide protrudes as compared to the leading end portion of the first godet roller 11 and a retracted position where the guide falls within the range of the first godet roller 11.

[0062] The winding unit 13 includes fulcrum guides 21, traverse guides 22, a turret 23, two bobbin holders 24, and a contact roller 25.

[0063] The fulcrum guides 21 are provided for the yarns Y, respectively, and are lined up in the front-back direction. The traverse guides 22 are provided for the yarns Y, respectively, and are lined up in the front-rear direction. The traverse guides 22 are driven by a common traverse motor 116 (see FIG. 2) and reciprocate in the front-back direction. With this, the yarns Y threaded to the traverse guides 22 are traversed about the fulcrum guides 21.

[0064] The turret 23 is a disc-shaped member having an axis which is substantially in parallel to the front-rear direction. The turret 23 is rotationally driven by a turret motor 117 (see FIG. 2) . The two bobbin holders 24 have axes which are substantially in parallel to the front-back direction. The bobbin holders 24 are rotatably supported at an upper end portion and a lower end portion of the turret 23. The winding bobbins B are attached to each bobbin holder 24. The winding bobbins B are respectively provided for the yarns Y and lined up in the front-rear direction. The two bobbin holders 24 are rotationally driven by their respective winding motors 118 (see FIG. 2).

[0065] The contact roller 25 is a roller having an axis substantially in parallel to the front-rear direction and is provided immediately above the upper bobbin holder 24. The contact roller 25 is configured to make contact with the surfaces of the packages P supported by the upper bobbin holder 24. With this, the contact roller 25 applies a contact pressure to the surfaces of the unfinished packages P, to adjust the shape of each package P.

[0066] In the winding unit 13 structured as described above, when the upper bobbin holder 24 is rotationally driven, the yarns Y traversed by the traverse guides 22 are wound onto the winding bobbins B, with the result that the packages P are formed. When the formation of the packages P is completed, the turret 23 rotates to switch over the upper and lower positions of the two bobbin holders 24. As a result, the bobbin holder 24 having been at the lower position is moved to the upper position, which allows the yarns Y to be wound onto the winding bobbins B attached to the bobbin holder 24 having been moved to the upper position, to form packages P. The bobbin holder 24 to which the fully-formed packages P are attached is moved to the lower position, and the packages P are collected by an unillustrated package collector.

(Yarn Threading Robot)

[0067] The yarn threading robot 3 will be described with reference to FIG. 5 to FIG. 8. FIG. 5 is an enlarged front view of the yarn threading robot 3. FIG. 6 is a cross-section of a later-described suction gun 37 (retaining portion of the present invention). Each of FIGs. 7(a) and 7(b) shows a later-described running unit 34 and its surroundings. FIG. 8 is an enlarged view of the running unit 34.

[0068] The yarn threading robot 3 is provided to perform yarn threading to the take-up apparatuses 2. In front of and above the take-up apparatuses 2, two rails 35 (guide rail of the present invention) are provided along the direction in which the take-up apparatuses 2 are lined up (see FIG. 1). The two rails 35 are supported from the ceiling by a pillar 40 (see FIG. 1) . The yarn threading robot 3 hangs down from the two rails 35 and is movable in the left-right direction along the two rails 35. When a take-up apparatus 2 outputs a signal requesting yarn threading, the yarn threading robot 3 moves to a position in front of that take-up apparatus 2, and performs yarn

threading to the take-up unit 10 and the winding unit 13 of that take-up apparatus 2.

[0069] As shown in FIG. 5, main components of the yarn threading robot 3 are a robot main body 31, a robotic arm 32 (arm member of the present invention) which is attached to a lower portion of the robot main body 31, a yarn threading unit 33 attached to a leading end portion of the robotic arm 32, and the running unit 34 provided at an upper portion of the robot main body. The robot main body 31 is substantially rectangular parallelepiped in shape and includes members such as a metal frame 41 and a casing 42 accommodating the frame 41. In the robot main body 31, members such as the robotic arm 32 and a robot controller 102 for controlling the yarn threading unit 33 are mounted. The robot controller 102 is configured to control a later-described yarn threading unit 33, a movement motor 121, an arm motor 122, etc.

[0070] The robotic arm 32 is attached to the lower portion of the robot main body 31 to move the yarn threading unit 33 in three dimensions. The robotic arm 32 includes arms 32a and joints 32b connecting the arms 32a with one another. Each joint 32b incorporates therein an arm motor 122 (see FIG. 2) . As the arm motor 122 is driven, the arm 32a is rotated about the joint 32b. This arrangement allows the robotic arm 32 to move three-dimensionally.

[0071] The yarn threading unit 33 is used to, for example, retain the yarns Y in yarn threading and is attached to the leading end portion of the robotic arm 32. The yarn threading unit 33 includes the suction gun 37 by which the yarns Y are sucked and captured and a cutter 38 by which the yarns Y are cut.

[0072] As shown in FIG. 6, the suction gun 37 includes a suction pipe 37a extending linearly and a compressed air pipe 37b unitarily connected to an intermediate portion of the suction pipe 37a. One end portion of the suction pipe 37a has a suction port 37c (sucking section in the present invention) through which the yarns Y are sucked. The other end portion of the suction pipe 37a is connected to a waste yarn hose 82 (extension portion and hose of the present invention). One end portion of the compressed air pipe 37b communicates with the suction pipe 37a via a communication hole 37d. The other end portion of the compressed air pipe 37b is connected to a compressed air hose 72. The waste yarn hose 82 and the compressed air hose 72 are flexible and are movable in accordance with the movement of the suction gun 37. The communication hole 37d is inclined with respect to the suction pipe 37a so that one end of the communication hole 37d which faces the suction pipe 37a is close to the other end of the suction pipe 37a whereas the other end of the communication hole 37d which is far from the suction pipe 37a is close to the one end of the suction pipe 37a.

[0073] At a leading end portion of the suction pipe 37a, a lead wire 63 (wire of the present invention) electrically conductive with the suction gun 37 is provided. The lead wire 63 is a flexible and conductive member and is covered with an insulating cover 64 (insulator of the present invention) extending along the lead wire 63. The insulating cover 64 is an insulating member made of PVC, for example. The lead wire 63 will be detailed later.

[0074] As shown in FIG. 5 and FIG. 7(a), the compressed air hose 72 and the waste yarn hose 82 extend at a location outside the robot main body 31 and extend in a direction different from the directions in which the robotic arm 32 extends, and reach a location close to the running unit 34 which is at the upper portion of the robot main body 31. As shown in FIG. 7(a), a coupler 73 is provided at an end portion of the compressed air hose 72, which is opposite to the suction port 37c. Similarly, a coupler 83 (hose-side coupler of the present invention) is provided at an end portion of the waste yarn hose 82, which is opposite to the suction port 37c. The couplers 73 and 83 are supported from below by a supporting member 75. The supporting member 75 is supported from below by, for example, a cylinder (not illustrated). The cylinder is arranged to be drivable in the up-down direction. Above the couplers 73 and 83, a compressed air pipe 71 and a waste yarn pipe 81 (fluid pipe of the present invention) are provided in a fixed manner. A coupler 74 is provided for the compressed air pipe 71 whereas a coupler 84 (pipe-side coupler of the present invention) is provided for the waste yarn pipe 81. The couplers 74 and 84 are supported by a base 70 which is provided between the two rails 35. The coupler 73 is attachable to and detachable from the coupler 74, whereas the coupler 83 is attachable to and detachable from the coupler 84. With this arrangement, the supporting member 75 moves upward as the cylinder drives, with the result that the couplers 73 and 83 are attached to the couplers 74 and 84, respectively.

[0075] Compressed air supplied to the suction gun 37 via the compressed air hose 72 flows as indicated by a solid arrow in FIG. 6. That is to say, the compressed air flows from the one end side to the other end side of the suction pipe 37a when the air flows into the suction pipe 37a from the compressed air pipe 37b. On account of this flow of the compressed air, negative pressure is generated at the suction port 37c and suction force is generated (see dotted arrows in FIG. 6), with the result that the yarns Y spun out from the spinning apparatus are serially sucked through the suction port 37c. The yarns Y sucked from the suction port 37c are discharged to the waste yarn hose 82 along with the airflow in the suction pipe 37a.

[0076] The running unit 34 is provided to cause the robot main body 31 to run along the two rails 35. The running unit 34 is provided at the upper portion of the robot main body 31 as indicated by a two-dot chain line in FIG. 5. As shown in FIG. 7(a) and FIG. 7(b), the running unit 34 includes four insulative wheels 36 which are made of rubber or the like. Two of the four wheels 36 are on the upper surface of one of the rails 35, and the remaining two wheels 36 are on the upper surface of the other one of the rails 35. The robot main body 31 hangs down from

the two rails 35 at the four wheels 36. To put it differently, the two rails are provided in an upper portion of a movement space of the robot main body 31. The four wheels 36 are rotationally driven by the movement motor 121 (see FIG. 2). As the four wheels 36 are rotationally driven, the robot main body 31 runs in the left-right direction along the two rails 35.

[0077] As shown in FIG. 8, the running unit 34 includes four terminals 55 which are respectively in contact with two trolley wires 51 and 52, a ground wire 53 (second ground member of the present invention), and a ground wire 54 (first ground member of the present invention) which are provided along the rails 35. Each terminal 55 includes a brush 56 in contact with the corresponding one of the trolley wires 51 and 52 and the ground wires 53 and 54, and a spring 57 biasing the brush 56. The terminals 55a and 55b are power supply terminals in contact with the trolley wires 51 and 52, respectively. With this arrangement, power is supplied to the yarn threading robot 3. The ground wires 53 and 54 and the terminals 55c and 55d will be detailed later.

(Static Electricity Generated in Suction Gun)

[0078] With the arrangement above, the yarn threading robot 3 is able to run across the take-up apparatuses 2 and perform yarn threading to the take-up unit 10 and the winding unit 13 of each of the take-up apparatuses 2. In the yarn threading, as the yarns Y are sucked through the suction port 37c, the yarns Y rub against the suction port 37c, with the result that the suction gun 37 is charged and static electricity is generated. Because the yarns Y are serially spun out from the spinning unit 5, the yarns Y are serially sucked during the yarn threading. On this account, the electric charge amount in the suction gun 37 increases over time and a large amount of electric charges tends to be accumulated, and such electric charges may flow to the robot controller 102 and cause adverse effects such as malfunction. Under this circumstance, in the present embodiment, the yarn threading robot 3 has an arrangement for grounding the suction gun 37 in order to remove the static electricity generated in the suction gun 37 and prevent the occurrence of the adverse effects due to the flow of electric changes to the robot controller 102. The following will describe a ground path of the suction gun 37 and a ground path of the robot controller 102.

(Ground Path of Robot Controller)

[0079] To begin with, the ground path of the robot controller 102 will be described. FIG. 9 is a schematic view of the ground path of the suction gun 37 and the ground path of the robot controller 102. In FIG. 9, arrangements regarding the ground paths are indicated by full lines whereas other arrangements are indicated by two-dot chain lines.

[0080] As shown in FIG. 9, the robot controller 102 is grounded by a grounding wire 62 (ground of the present invention) connected to the robot controller 102, the frame 41 of the robot main body 31, the terminal 55c (second terminal of the present invention) of the running unit 34 (see FIG. 8, etc.), and the ground wire 53. The grounding wire 62 is electrically conductive with the frame 41 of the robot main body 31. As shown in FIG. 8, furthermore, the frame 41 extends to reach an upper portion of the robot main body 31 and conductive with the terminal 55c provided at around the upper portion of the robot main body 31. The terminal 55c is in contact with the ground wire 53, and the ground wire 53 extends along the rails 35, the pillar 40, etc. to reach the ground, i.e., is grounded. In this way, the ground path of the robot controller 102 is assured.

(Ground Path of Suction Gun)

[0081] Now, the ground path of the suction gun 37 will be described. As shown in FIG. 9, the suction gun 37 is grounded by the lead wire 63, the terminal 55d (first terminal or terminal of the present invention) of the running unit 34 (see FIG. 8, etc.), and the ground wire 54. From the suction gun 37 to the terminal 55d, a conductive path 60 is formed to cause the suction gun 37 to be conductive with the terminal 55d without passing the robot controller 102. In the present embodiment, the conductive path 60 is formed of the lead wire 63. As described above, the lead wire 63 is a flexible and conductive member and is covered with the insulating cover 64. As shown in FIG. 5 and FIG. 9, the lead wire 63 extends from the suction gun 37, is arranged along a part of the waste yarn hose 82, is parted from the waste yarn hose 82 and enters the inside of the robot main body 31, extends inside the robot main body 31, and reaches the running unit 34. In other words, a part of the lead wire 63 is provided in the robot main body 31. In this connection, because the lead wire 63 is covered with the insulating cover 64 (see FIG. 6), the lead wire 63 is insulated from the robot main body 31 and the robot controller 102. As shown in FIG. 8 and FIG. 9, the lead wire 63 is connected to the terminal 55d, and the terminal 55d is in contact with the ground wire 54. The ground wire 54 extends along the rails 35, the pillar 40, etc. to reach the ground, i.e., is grounded. In this way, the suction gun 37 is connected to the ground wire 54 via the lead wire 63 and the terminal 55d, and is therefore grounded via a ground path different from the ground path of the robot controller.

(Series of Steps of Yarn Threading)

[0082] The following will describe a series of steps of the yarn threading performed by the robot controller 102, with reference to FIG. 10. When yarn threading is required by a take-up apparatus 2, a signal requesting yarn threading is supplied from the winding controller 101 of that take-up apparatus 2 to the central controller 4. The central controller 4 sends, to the robot controller 102, a

signal instructing to perform yarn threading to that take-up apparatus 2.

[0083] To begin with, upon receiving the signal requesting yarn threading from the central controller 4, the robot controller 102 drives the movement motor 121 so as to move the yarn threading robot 3 to a location in front of the take-up apparatus 2 which requires the yarn threading (S201). Subsequently, the robot controller 102 drives the cylinder to elevate the couplers 73 and 83 together with the supporting member 75, so as to connect the couplers 73 and 83 with the couplers 74 and 84, respectively (S202).

[0084] Subsequently, while the suction gun 37 is serially sucking and capturing the yarns Y spun out from the spinning apparatus, the robot controller 102 suitably drives the yarn threading unit 33 and the arm motor 122 to move the suction gun 37 relative to the robot main body 31, so as to perform yarn threading to the take-up unit 10 and the winding unit 13 of the take-up apparatus 2 (S203). After the yarn threading, the robot controller 102 drives the cylinder to lower the couplers 73 and 83 together with the supporting member 75, so as to disconnect the couplers 73 and 83 from the couplers 74 and 84 (S204). Finally, the robot controller 102 sends a signal indicating the completion of the yarn threading to the central controller 4. Thereafter, when the central controller 4 sends a signal instructing restart of yarn winding to the winding controller 101, winding of the yarns Y by the take-up apparatus 2 is resumed (S205).

[0085] As described above, in the yarn threading robot 3 performing yarn threading to the take-up apparatus 2, the suction gun 37 retaining the yarns Y is connected to the ground wire 54 via the lead wire 63 and the terminal 55d and grounded, without passing the robot controller 102. Furthermore, the lead wire 63 and the robot controller 102 are insulated by the insulating cover 64. On this account, the static electricity generated in the suction gun 37 due to contact with the yarn Y is swiftly removed and the occurrence of adverse effects due to the flow of electric changes to the robot controller 102 is restrained.

[0086] In addition to the above, because the lead wire 63 extending from the suction gun 37 is insulated from the ground path of the robot controller 102, it is possible to prevent electric charges generated in the suction gun 37 from directly flowing to the robot controller 102 from the lead wire 63. In particular, even if the lead wire 63 as the ground path of the suction gun 37 is provided in the robot main body 31, insulation of the lead wire 63 from the ground path of the robot controller 102 is ensured because the insulating cover 64 extending along the lead wire 63 covers the lead wire 63.

[0087] In addition to the above, because the suction gun 37 is grounded through a ground path different from the ground path of the robot controller 102, it is possible to certainly prevent electric charges generated in the suction gun 37 from flowing to the robot controller 102.

[0088] In addition to the above, while the grounding wire 62 of the robot controller 102 is provided to be conductive with the terminal 55c via the conductive frame 41 of the robot main body 31, the suction gun 37 is grounded via the lead wire 63 which is different from the frame 41. It is therefore possible to certainly prevent electric charges generated in the suction gun 37 from flowing to the robot controller 102.

[0089] In addition to the above, the yarn threading robot 3 runs across the take-up apparatuses 2 along the rails 35, stops at a location in front of a take-up apparatus 2 which is the target of yarn threading, and performs the yarn threading. In this arrangement, because the terminal 55d is provided on the running unit 34 which is in contact with the rails 35, the ground path of the suction gun 37 is easily assured by providing a grounding member at or around the rails 35.

[0090] Furthermore, because the ground wire 54 is provided along the rails 35, the terminal 55d is always in contact with the ground wire 54 and hence electric charges generated in the suction gun 37 are certainly dissipated.

[0091] Because a contact surface of each wheel 36 in contact with the rail 35 is insulating, electric charges generated in the suction gun 37 cannot be dissipated to the rails 35 via the wheels 36. However, because the terminal 55d conductive with the lead wire 63 is provided at a location different from the wheels 36, electric charges generated in the suction gun 37 can be dissipated to the ground wire 54 via the terminal 55d.

[0092] Because the wheels 36 are insulating and the robot main body 31 hangs down from the rails 35, grounding is difficult as compared to cases where the robot runs on the floor. However, because the suction gun 37 is connected to the ground wire 54 via the lead wire 63 and the terminal 55d, the ground path is assured.

[0093] In addition to the above, because the lead wire 63 is flexible, the lead wire 63 is able to follow the movement of the suction gun 37. It is advantageous to arrange the lead wire 63 to be able to follow the movement of the suction gun 37, because the suction gun 37 is required to move the yarns Y while retaining the yarns Y in yarn threading.

[0094] In addition to the above, because the yarns Y are serially spun out from the spinning unit 5 of the spinning apparatus, the electric charge amount in the suction gun tends to be large as the yarns Y serially rub against the suction gun 37. Even in such a case, the static electricity generated in the suction gun 37 is swiftly removed and the occurrence of adverse effects due to the flow of electric changes to the robot controller 102 is prevented.

[0095] In addition to the above, because the suction gun 37 is required to move the yarns Y while retaining the yarns Y in yarn threading, electric charges tend to be generated in the suction gun 37 due to contact with the yarns. Particularly in such an arrangement, it is advantageous in terms of the protection of the robot controller 102 to swiftly dissipate the electric charges generated in the suction gun 37.

[0096] The following will describe modifications of the

above-described embodiment. The members identical with those in the embodiment above will be denoted by the same reference numerals and the explanations thereof are not repeated.

(1) While in the embodiment above the robot controller 102 is grounded via the frame 41 of the robot main body 31, the robot controller 102 may be grounded in such a way that a covered lead wire, etc. extends to reach the terminal 55c.

(2) In the embodiment above, the ground wire 54 extends to reach the ground. Alternatively, when the rails 35 and the pillar 40 are electrically conductive, the pillar 40 or a member connected to the pillar 40 may be grounded to facilitate dissipation of electric charged accumulated in the suction gun 37, and the ground wire 54 may be conductive with the rails 35. Furthermore, the ground wire 53 may be conductive with the rails 35.

(3) The lead wire 63 may be provided not along the inside of the robot main body 31 but along the outside thereof. For example, the casing 42 is made of an insulating material such as plastic, and the lead wire 63 is provided along the casing 42 in a yarn threading robot 3a as shown in FIG. 11. In this modification, the lead wire 63 may not be covered with an insulating cover. In this case, the casing 42 is equivalent to the insulator of the present invention.

(4) The lead wire 63 may not be provided along the robot main body 31. For example, as shown in FIG. 12, in a yarn threading robot 3b, the lead wire 63 is provided along the waste yarn hose 82 and reaches the coupler 83. An electrically conductive terminal 85 is provided at a leading end portion of the coupler 83, and is conductive with the lead wire 63. In this case, the terminal 85 is equivalent to the first terminal of the present invention. In the vicinity of the coupler 84, a ground wire 86 which is grounded along the waste yarn pipe 81 for example, is provided. In this case, the ground wire 86 is equivalent to the first ground member of the present invention. In this case, the terminal 85 is conductive with the ground wire 86 at the same time as the coupler 83 is attached to the coupler 84 (the step S202 described above), and the ground path of the suction gun 37 is assured. As such, because the lead wire 63 is provided along the waste yarn hose 82 which extends toward the ground wire 86, the ground path of the suction gun 37 is assured at a location remote from the robot main body 31 in which the robot controller 102 is provided. To put it differently, the lead wire 63 is provided to bypass the robot main body 31, and the ground path of the suction gun 37 is sufficiently separated from the ground path of the robot controller 102. Furthermore, because the ground path of the suction gun 37 is assured at the same time as the attachment of the coupler 83 to the coupler 84, time and labor for assuring the ground path can be saved. Furthermore, the structure for assuring the ground path is simple. While in this modification the lead wire 63 is provided along the waste yarn hose 82, the lead wire 63 may be provided along the compressed air hose 72, the terminal 85 may be provided on the coupler 73, and the ground wire 86 may be provided in the vicinity of the coupler 74.

(5) As a further modification of the modification (4), as shown in FIG. 13, the lead wire 63 and the waste yarn hose 82 may be arranged to pass the inside of the robotic arm 32 in a yarn threading robot 3c. The lead wire 63 is covered with the insulating cover 64 (see FIG. 6) in the same manner as in the embodiment above. In this case, interference between (i) the lead wire 63 and the waste yarn hose 82 and (ii) the robotic arm 32 or the take-up apparatus 2 is prevented while the lead wire 63 is insulated from the robot controller 102, with the result that the degree of freedom in movement of the robotic arm 32 is high.

(6) While in the embodiment above the suction gun 37 and the robot controller 102 are grounded through different ground paths, the disclosure is not limited to this arrangement. As the lead wire 63 is connected to an intermediate part of the ground path of the robot controller 102, the ground path of the suction gun 37 and the ground path of the robot controller 102 may be merged halfway. To be more specific, as shown in FIG. 14 and FIG. 15, in a yarn threading robot 3d, the lead wire 63 is electrically connected to the frame 41 of the robot main body 31. The frame 41 is electrically connected to the terminal 55c, and the terminal 55c is in contact with the ground wire 53. In this modification, a conductive path 60a by which the suction gun 37 is conductive with the terminal 55c without passing the robot controller 102 is formed by the lead wire 63 and a part of the frame 41. Both of the suction gun 37 and the robot controller 102 are therefore conductive with the terminal 55c, and grounded on account of the connection with the ground wire 53 via the terminal 55c. Also in this case, because the conductive path 60a does not pass the robot controller 102, it is possible to restrain electric charges generated in the suction gun 37 from directly flowing to the robot controller 102. In this modification, the terminal 55c is equivalent to the first terminal of the present invention. The ground wire 53 is equivalent to the first ground member of the present invention.

(7) A wheel may be electrically conductive and part of the ground path of the suction gun 37. For example, as shown in FIG. 16, in a yarn threading robot 3e, a wheel 90 is made of a conductive material such as metal and is conductive with the lead wire 63. In this case, the rails 35 are grounded through the pillar 40 and are conductive with the wheel 90. In this modification, the wheel 90 is equivalent to the first terminal of the present invention, and the rails 35 are equivalent to the first ground member of the present

invention. The suction gun 37 is therefore certainly grounded, and electric charges generated in the suction gun 37 are dissipated to the rails 35 through the wheel 90.

(8) Each take-up apparatus 2 may include a ground member. For example, in FIG. 17, a ground member 92 is attached to the outer side of the winding unit 13 of the take-up apparatus 2. A yarn threading robot 3f includes a terminal 91 conductive with the lead wire 63, and the terminal 91 is in contact with the ground member 92. In this way, the suction gun 37 may be grounded at a location to which the yarn threading robot 3f is moved, each time the robot is moved. The ground member 92 may not be attached to the take-up apparatus 2, as long as it is provided at a location where the terminal 91 is able to make contact with the ground member 92. Because the ground path of the suction gun 37 is assured as in this modification and the modifications described above, the spun yarn take-up system 1 is stably operated.

(9) The ground path of the suction gun 37 may be assured by a member different from the lead wire 63. For example, in the modification (4) described above, a wiring pattern for electric conduction, which is formed along the waste yarn hose 82, extends to reach the coupler 83. Also in this case, the waste yarn hose 82 is able to follow the movement of the suction gun 37.

(10) The yarn threading robot 3 may not include the running unit 34. For example, the robotic arm 32 may be driven while being fixed to one location, and perform yarn threading to one or more take-up apparatus 2.

(11) While the embodiment above describes the yarn threading robot 3 which performs yarn threading to the take-up unit 10 and the winding unit 13 of the take-up apparatus 2, the present invention is not limited to this arrangement, and is applicable to various work robots performing a predetermined operation regarding yarns to a yarn processing apparatus. In other words, a yarn threading robot may perform yarn threading to an apparatus which is different from a take-up apparatus taking up spun yarns . Alternatively, the operation performed by a work robot may be different from the above-described yarn threading. For example, the present invention may be applied to an automatic yarn threading device which performs yarn threading to a take up tube of a winding device of a draw texturing machine which draws and textures yarns (see Japanese Unexamined Patent Publication No. 2013-23385) . To be more specific, the automatic yarn threading device includes members such as a suction mouth, a cutter, a yarn providing arm, a yarn pressing arm, and a yarn supporting arm. The suction mouth is attached to a frame of a draw texturing unit and retains an intermediate part of each yarn supplied toward the take up tube. The cutter cuts the yarns retained by the suction mouth. The yarn providing arm causes the yarns having been cut by the cutter to oppose the take up tube. The yarn pressing arm presses the yarns opposing the take up tube onto the take up tube so that the yarns are closely in contact with the take up tube. The yarn supporting arm is attached to the yarn providing arm and supports the yarns by clamping the yarns between the yarn supporting arm and the yarn pressing arm. The yarn providing arm, etc. are driven by a motor, etc. The automatic yarn threading device causes the yarns to be closely in contact with the take up tube by the yarn pressing arm while supporting the yarns by clamping them between the yarn pressing arm and the yarn supporting arm. As the take up tube rotates in this state, yarn threading to the take up tube is performed. While the yarns are supported, electric charges are accumulated in the yarn supporting arm or the like, on account of contact with the yarns. The automatic yarn threading device may include a controller, and hence providing a path which bypasses the controller and dissipates electric charges is effective in this device. The winding device is equivalent to the yarn processing apparatus of the present invention. The automatic yarn threading device is equivalent to the work robot of the present invention. The yarn supporting arm is equivalent to the retaining portion of the present invention. The yarn providing arm is equivalent to the arm member of the present invention. Yarn threading to the take up tube is equivalent to the predetermined operation of the present invention.

(12) Alternatively, the present invention may be applied to a doffing device which, for example, supplies new bobbins to a winding device winding spun yarns onto bobbins (Japanese Unexamined Patent Publication No. 2015-147674). To be more specific, the doffing device includes a bobbin supply mechanism including a suction pipe retaining spun yarns and a controller. The controller controls the bobbin supply mechanism to supply a new bobbin to a winding device, then captures a spun yarn by the suction pipe, guides the spun yarn to the winding device, and performs so-called bunch winding, i.e., winds the spun yarn onto the circumference of the bobbin. Because electric charges due to static electricity are accumulated in the suction pipe while the spun yarn is being captured, providing a path which bypasses the controller and dissipates electric charges is effective in this device. The winding device is equivalent to the yarn processing apparatus of the present invention. The doffing device is equivalent to the work robot of the present invention. The suction pipe is equivalent to the retaining portion and the arm member of the present invention. Bunch winding is equivalent to the predetermined operation of the present invention.

(13) Alternatively, the present invention may be applied to a yarn joining wagon which performs a yarn

joining operation for a yarn spinning unit which generates and winds spun yarns (Japanese Unexamined Patent Publication No. 2015-199559) . To be more specific, the yarn joining wagon includes a yarn joining device performing yarn joining, a suction pipe retaining one of two yarns to be joined, a suction mouth retaining the other one of the yarns, and a controller. In a yarn spinning unit in which a yarn has been cut, the controller controls the yarn joining device to perform the yarn joining operation so as to interlace two yarns retained by the suction pipe and the suction mouth. Also in this yarn joining wagon, providing a path which bypasses the controller and dissipates electric charges is effective. The yarn spinning unit is equivalent to the yarn processing apparatus of the present invention. The yarn joining wagon is equivalent to the work robot of the present invention. The suction pipe is equivalent to the retaining portion and the arm member of the present invention. The same applies to the suction mouth. The yarn joining operation is equivalent to the predetermined operation of the present invention.

[Reference Signs List]

[0097]

1 spun yarn take-up system
2 take-up apparatus
3 yarn threading robot
5 spinning unit
10 take-up unit
31 robot main body
32 robot arm
34 running unit
35 rail
36 wheel
37 suction gun
37c suction port
41 frame
42 casing
53 ground wire
54 ground wire
55c terminal
55d terminal
60 conductive path
62 grounding wire
63 lead wire
64 insulating cover
72 compressed air hose
73 coupler
74 coupler
82 waste yarn hose
83 coupler
84 coupler
85 terminal
86 ground wire
90 wheel
91 terminal
92 ground member
102 robot controller
Y yarn

Claims

1. A work robot performing a predetermined operation regarding yarns to at least one yarn processing apparatus, comprising:

a robot main body;
an arm member attached to the robot main body;
a retaining portion attached to the arm member and retaining the yarns;
a controller; and
a first terminal in contact with a first ground member which is grounded,
a conductive path being formed to extend from the retaining portion to the first terminal without passing the controller so as to cause the retaining portion to be electrically conductive with the first terminal, and
the retaining portion being connected to the first ground member via the conductive path and the first terminal and
grounded.

2. The work robot according to claim 1, wherein,
the conductive path includes a wire extending from the retaining portion, and
the wire is insulated from the controller.

3. The work robot according to claim 2, wherein,
at least part of the wire is provided in the robot main body, and
the wire is insulated from the controller by an insulator.

4. The work robot according to claim 3, wherein, the insulator is an insulating cover which extends along the wire and covers the wire.

5. The work robot according to any one of claims 1 to 4, wherein, the retaining portion is grounded through a ground path different from the ground path of the controller.

6. The work robot according to claim 5, further comprising
a second terminal in contact with a second ground member which is different from the first ground member and is grounded, the robot main body including an electrically-conductive frame, and
a ground of the controller being electrically conductive with the second terminal via the frame.

7. The work robot according to any one of claims 1 to 4, wherein, both of the retaining portion and the controller are electrically conductive with the first terminal and are connected to the first ground member and grounded.

8. The work robot according to any one of claims 1 to 7, further comprising
a running unit which causes the robot main body to run along a guide rail extending in a direction in which a plurality of the at least one yarn processing apparatus are lined up, the first terminal being provided on the running unit.

9. The work robot according to claim 8, wherein, the first ground member is provided along the guide rail, and the first terminal of the running unit is in contact with the first ground member.

10. The work robot according to claim 8 or 9, wherein,
the running unit includes a wheel which is insulating at least at a contact surface where the wheel is in contact with the guide rail, and
the first terminal is provided at a location different from the wheel.

11. The work robot according to claim 10, wherein,
the guide rail is provided at an upper part of a movement space of the robot main body, and
the robot main body runs while hanging down from the guide rail.

12. The work robot according to claim 8, wherein,
the first ground member is the guide rail formed of a conductive member, and
the first terminal of the running unit is in contact with the guide rail.

13. The work robot according to claim 12, wherein,
the running unit includes a wheel which is made of a conductor, and
the first terminal is the wheel.

14. The work robot according to claim 1, further comprising an extension portion extending from the retaining portion toward the first ground member,
the conductive path includes a wire extending from the retaining portion, and
at least part of the wire is provided along the extension portion.

15. The work robot according to claim 14, wherein,
at least part of the extension portion and at least part of the wire pass the inside of the arm member, and
the wire is insulated from the controller by an insulator.

16. The work robot according to claim 14 or 15, wherein,
the retaining portion includes a sucking section sucking the yarns, and
the extension portion is a hose connected to the sucking section.

17. The work robot according to claim 16, wherein,
the hose is connected to a fluid pipe which is provided in a fixed manner,
a hose-side coupler with the first terminal is attached to an end portion of the hose, the end portion being on the side opposite to the sucking section, and
the first ground member is provided at a pipe-side coupler of the fluid pipe, the pipe-side coupler being connected to the hose-side coupler.

18. The work robot according to any one of claims 1 to 17, wherein, the conductive path includes a wire extending from the retaining portion, and
the wire is either flexible or provided in a flexible member.

19. The work robot according to any one of claims 1 to 18, wherein, each of the at least one yarn processing apparatus includes a take-up unit which is configured to take up the yarns spun out from a spinning unit of a spinning apparatus, and
the controller causes the retaining portion to perform the predetermined operation while the retaining portion serially sucking and retaining the yarns spun out from the spinning unit.

20. The work robot according to any one of claims 1 to 19, wherein, the predetermined operation is yarn threading of the yarns retained by the retaining portion to the at least one yarn processing apparatus.

21. A textile machine comprising:

a yarn processing apparatus;
a ground member which is provided in the yarn processing apparatus and is grounded; and
a work robot performing a predetermined operation regarding yarns to the yarn processing apparatus,
the work robot comprising:

a robot main body;
an arm member attached to the robot main body;
a retaining portion attached to the arm member and retaining the yarns;
a controller; and
a terminal in contact with the ground member,
a conductive path being formed to extend from the retaining portion to the terminal without passing the controller so as to cause the retaining portion to be electrically con-

ductive with the terminal, and
the retaining portion being connected to the ground member via the conductive path and the terminal and grounded.

FIG.1

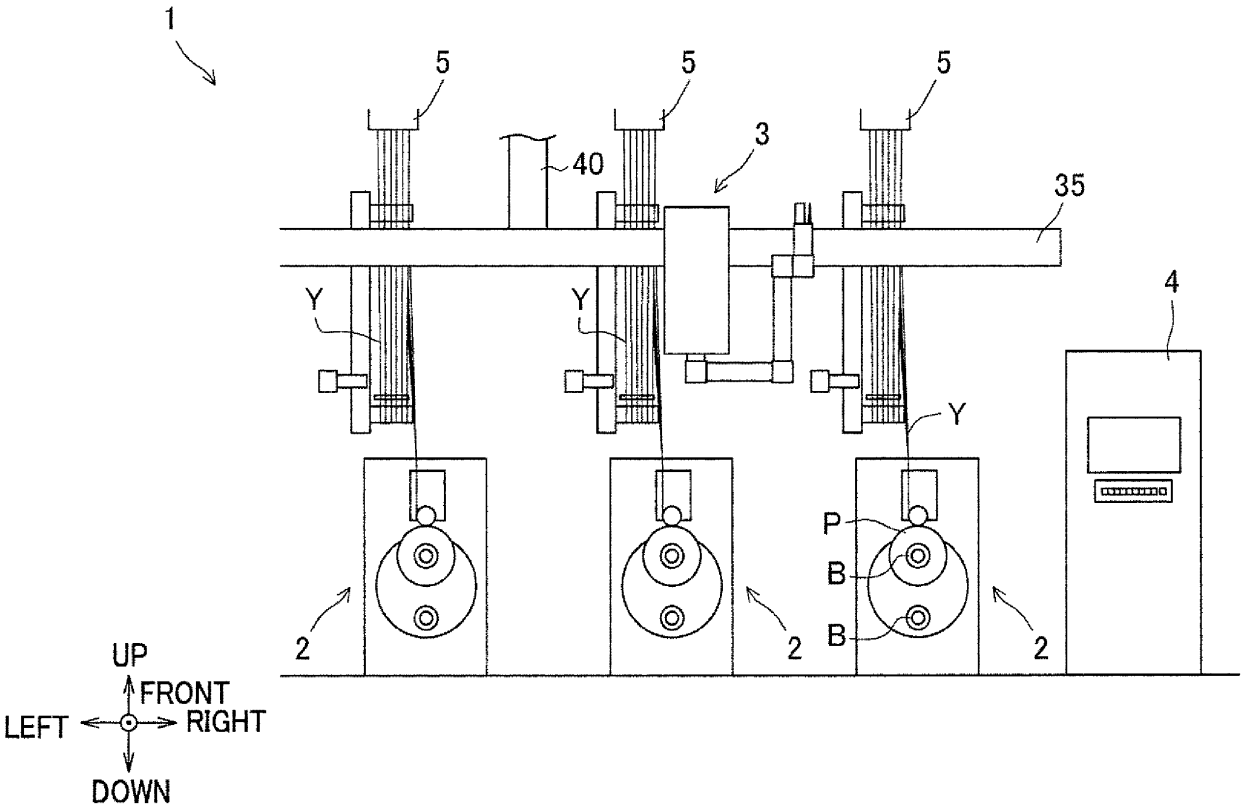


FIG.2

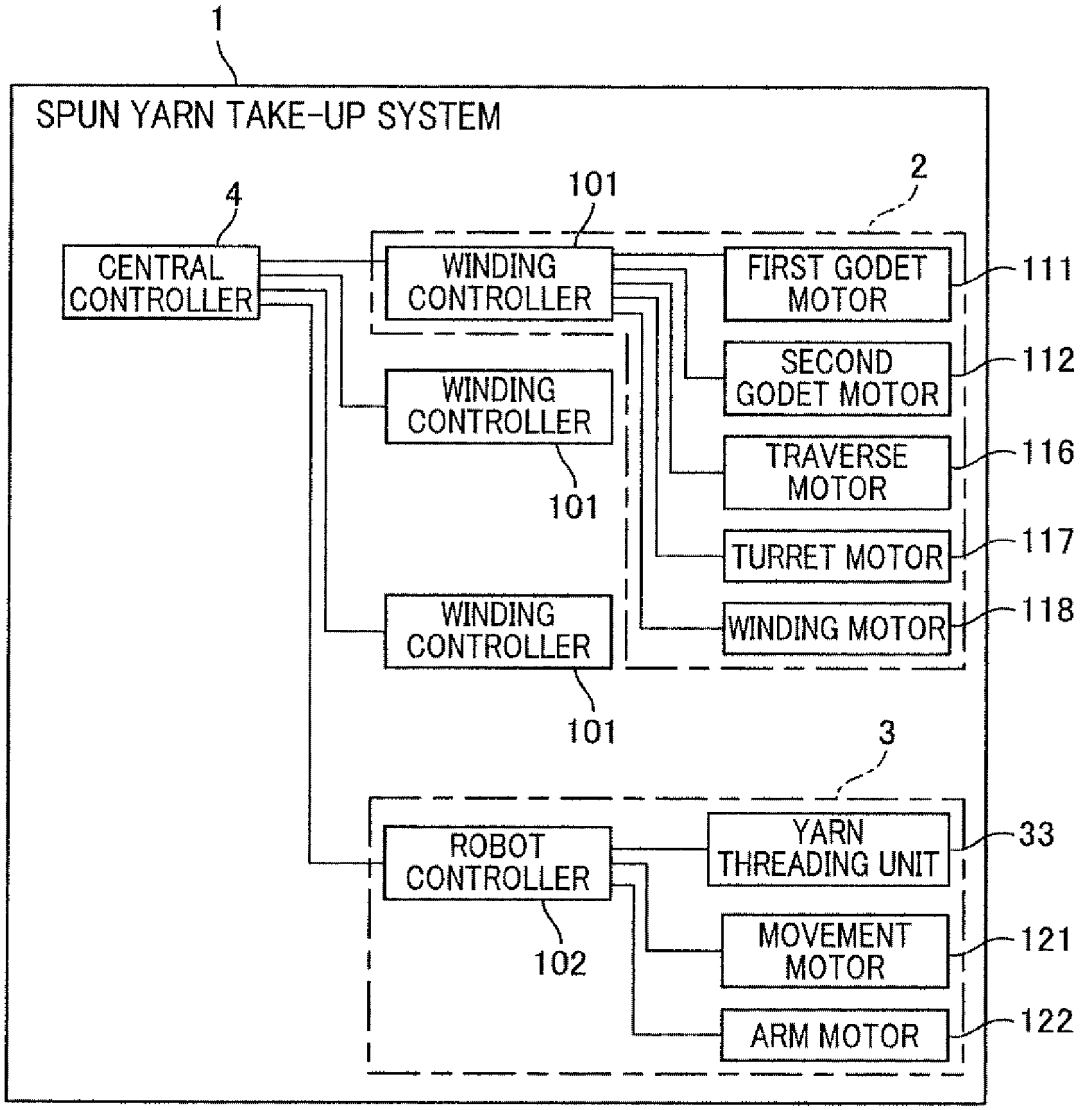
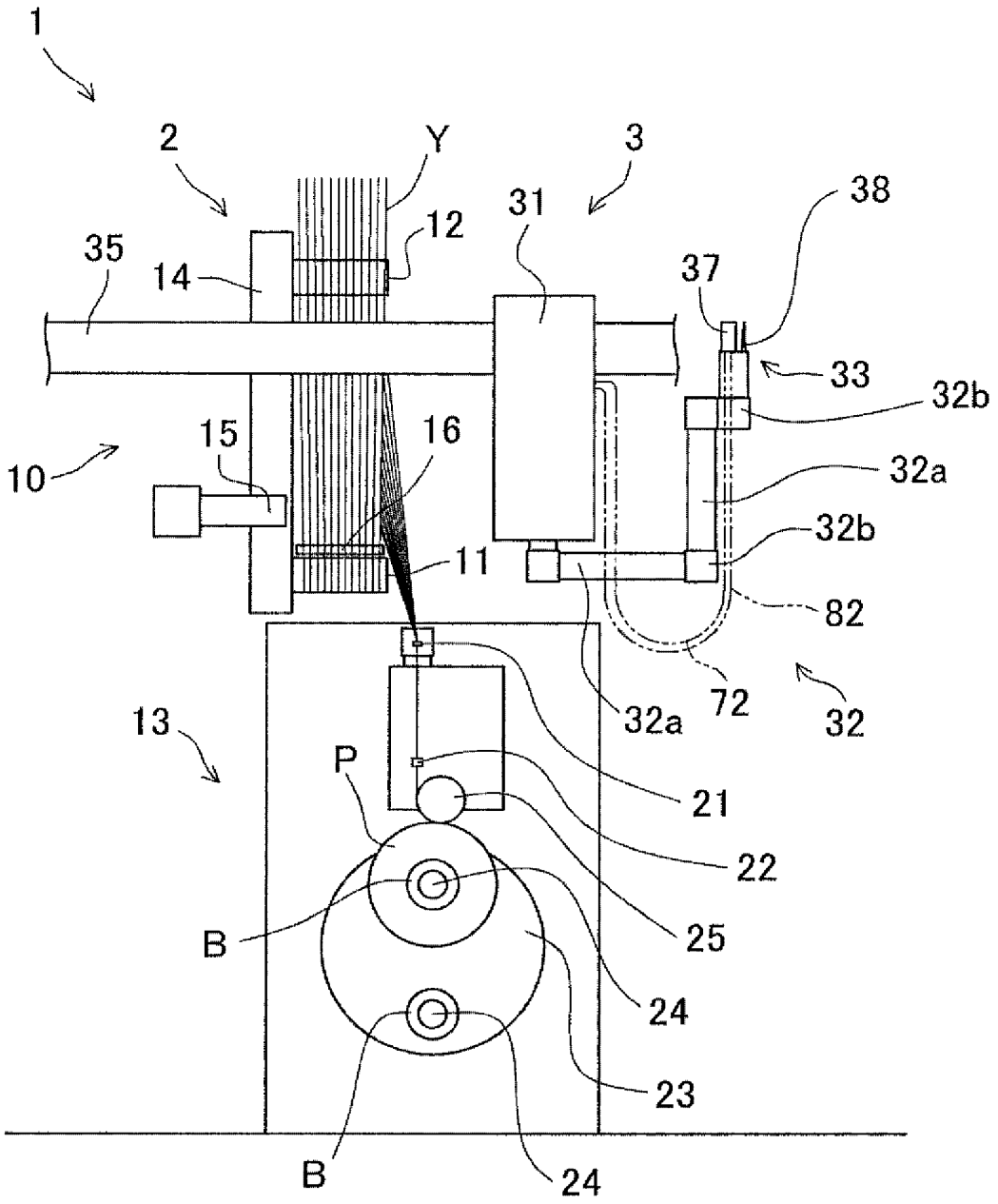

1
SPUN YARN TAKE-UP SYSTEM
4
CENTRAL CONTROLLER
101
WINDING CONTROLLER
2
FIRST GODET MOTOR
111
SECOND GODET MOTOR
112
TRAVERSE MOTOR
116
TURRET MOTOR
117
WINDING MOTOR
118
WINDING CONTROLLER
101
WINDING CONTROLLER
101
3
ROBOT CONTROLLER
102
YARN THREADING UNIT
33
MOVEMENT MOTOR
121
ARM MOTOR
122

FIG.3


1
2
Y
3
38
31
12
35
14
37
33
32b
15
16
10
32a
32b
11
82
72
32
32a
13
P
21
22
25
24
B
23
B
24

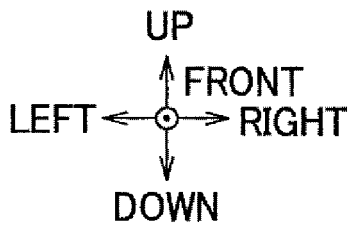

UP
FRONT
LEFT
RIGHT
DOWN

FIG.4

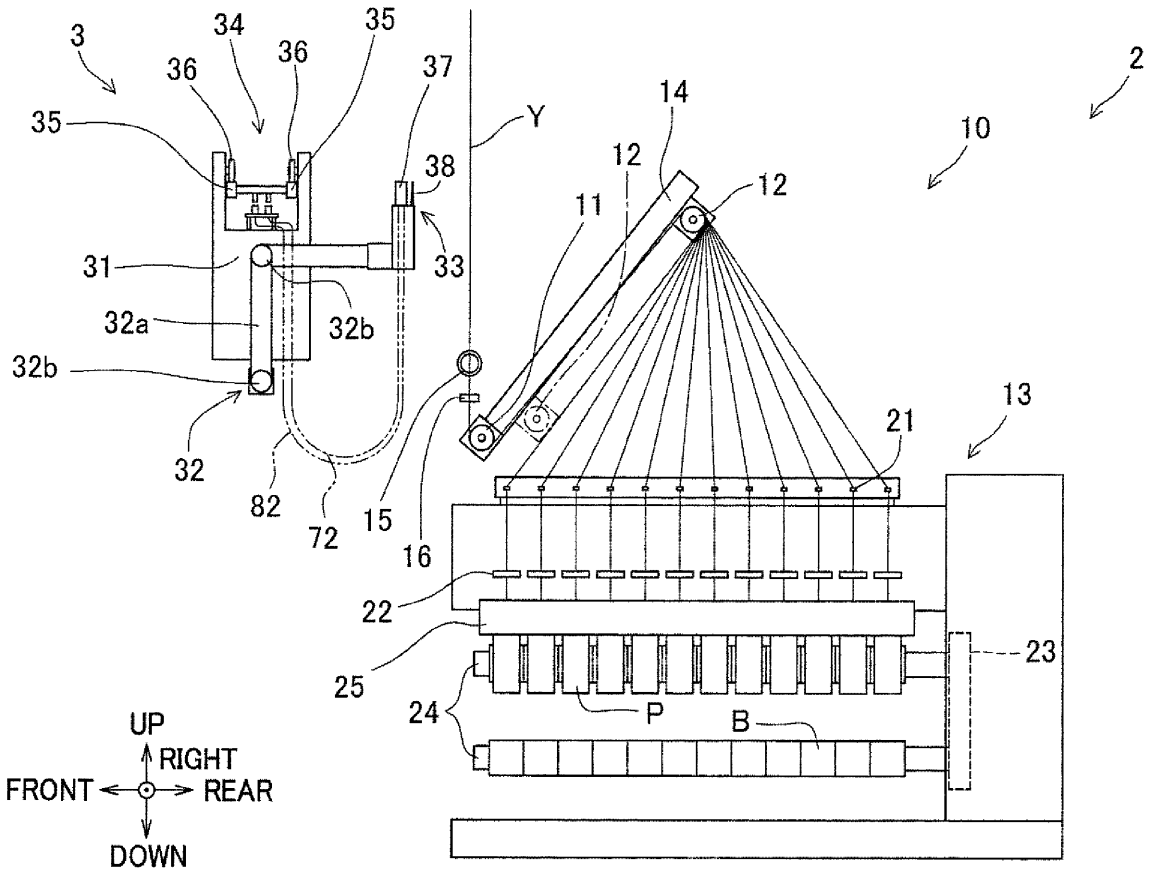

3
34
35
36
36
37
35
Y
2
14
10
12
12
38
11
31
33
32a
32b
32b
32
82
72
15
16
21
13
22
23
25
24
P
B
UP
RIGHT
FRONT
REAR
DOWN

FIG.5

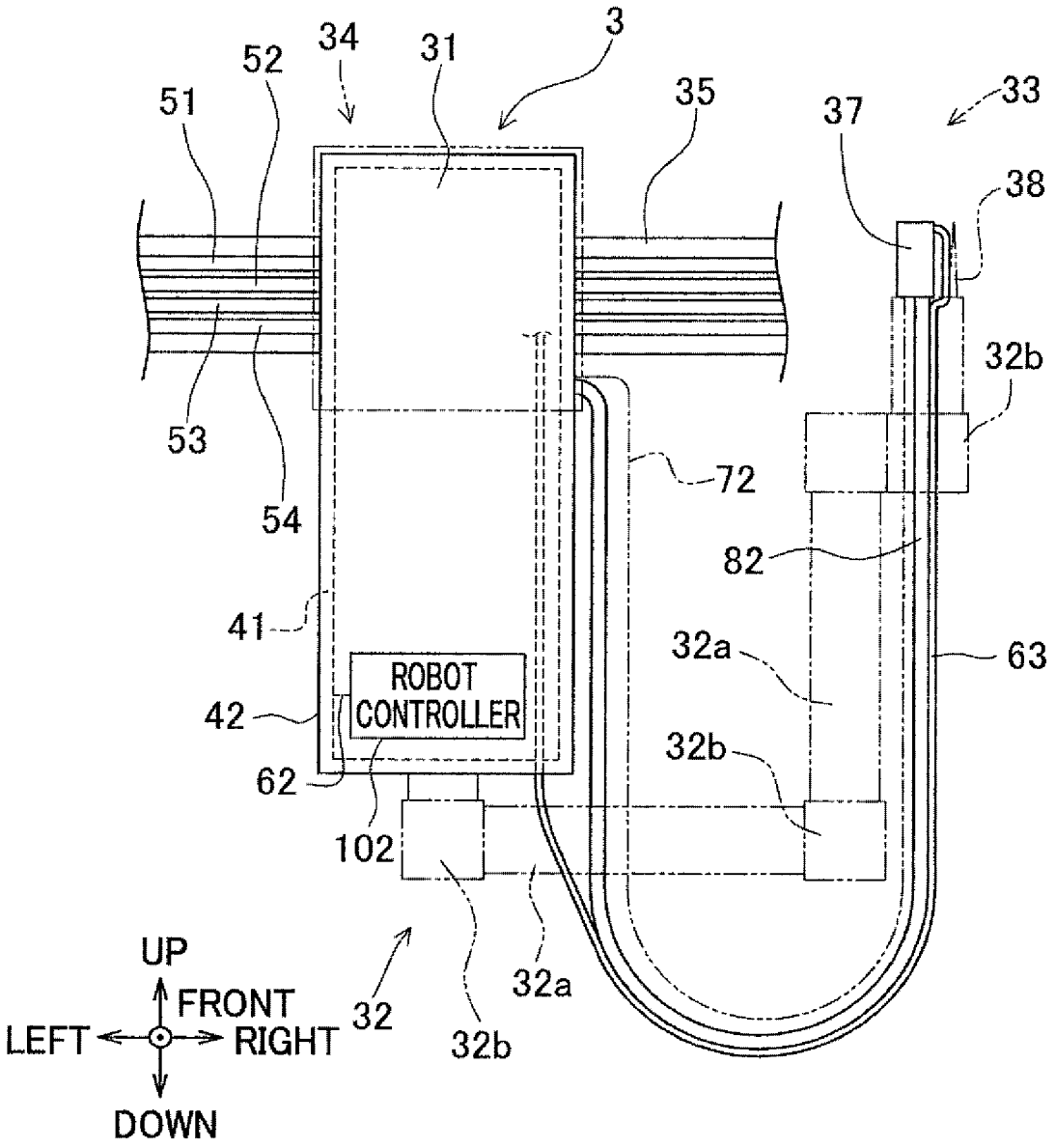

3
34
31
52
51
35
37
33
38
32b
53
54
72
82
41
32a
63
ROBOT
CONTROLLER
42
62
32b
102
32a
32
32b
UP
FRONT
LEFT
RIGHT
DOWN

FIG.6

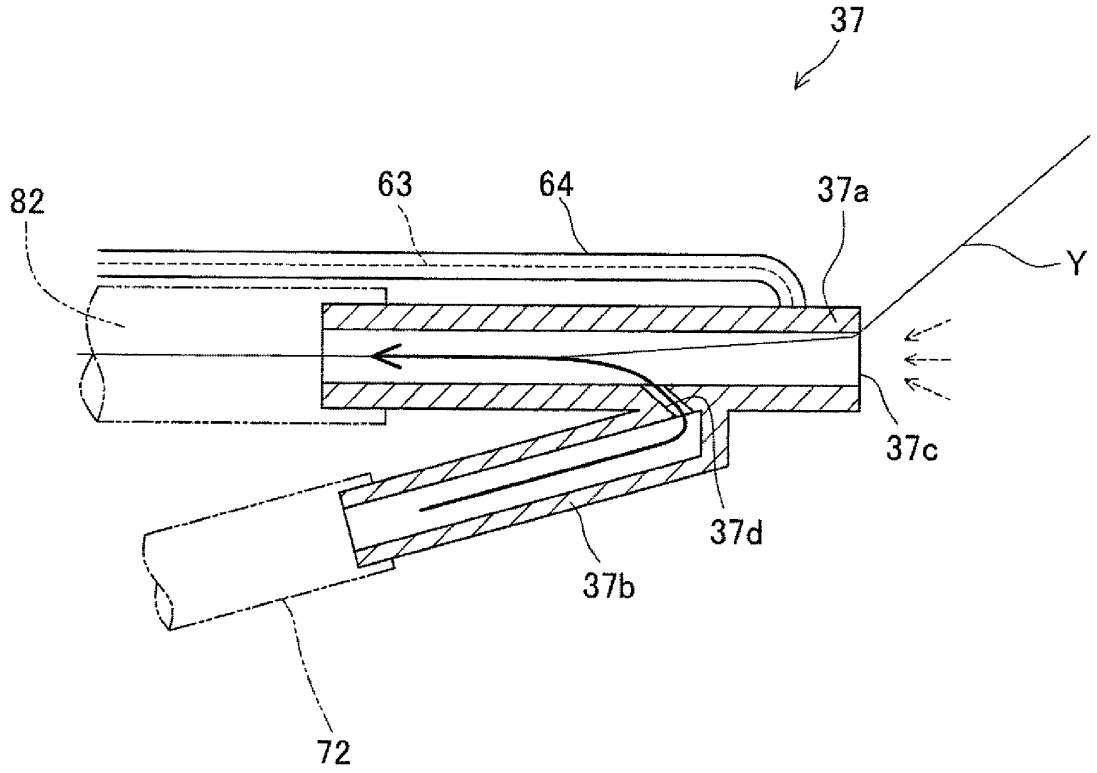


FIG.7

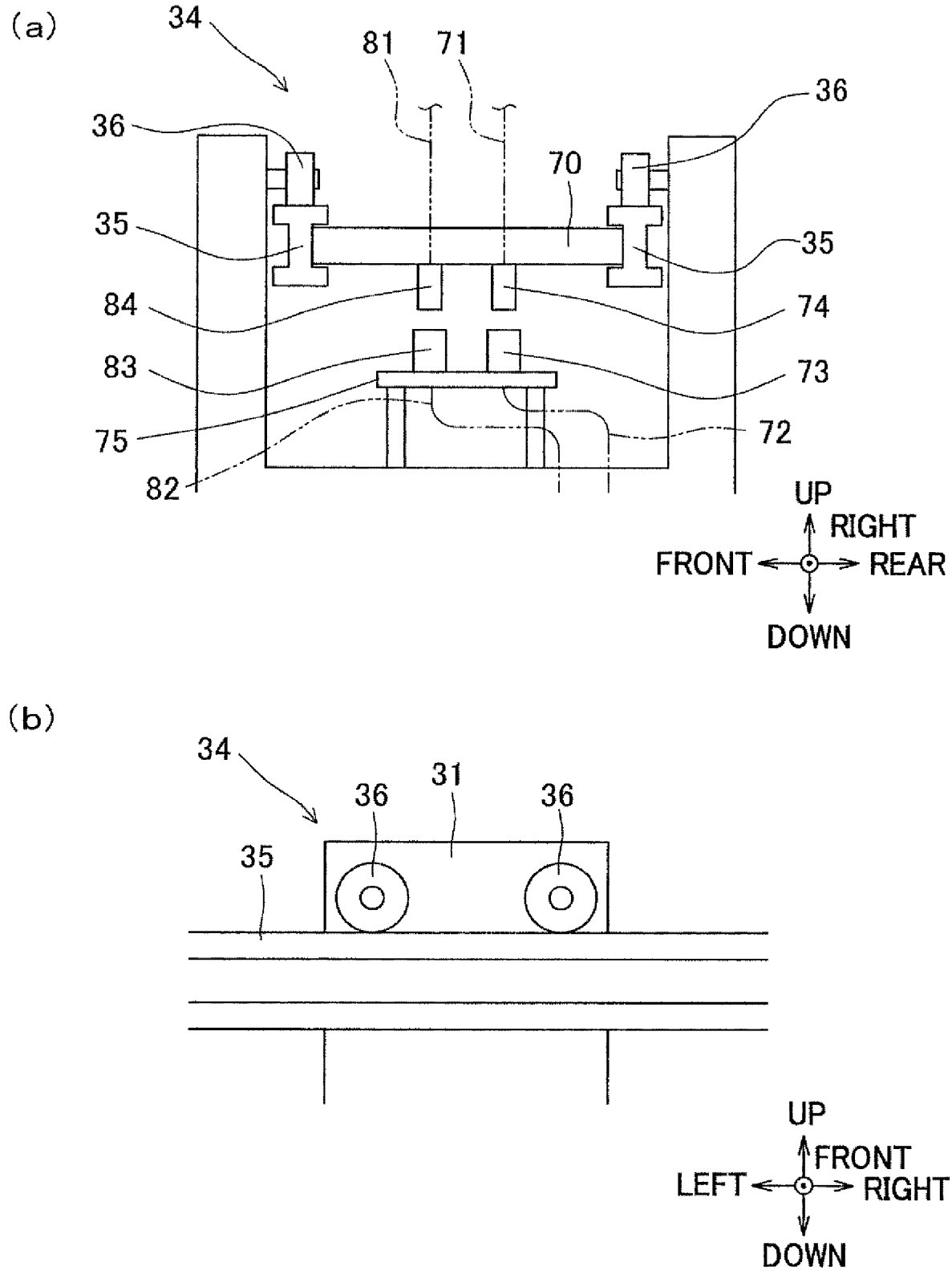

(a)
34
81
71
36
36
70
35
35
84
74
83
73
75
72
82
UP
RIGHT
FRONT
REAR
DOWN
(b)
34
36
31
36
35
UP
FRONT
LEFT
RIGHT
DOWN

FIG.8

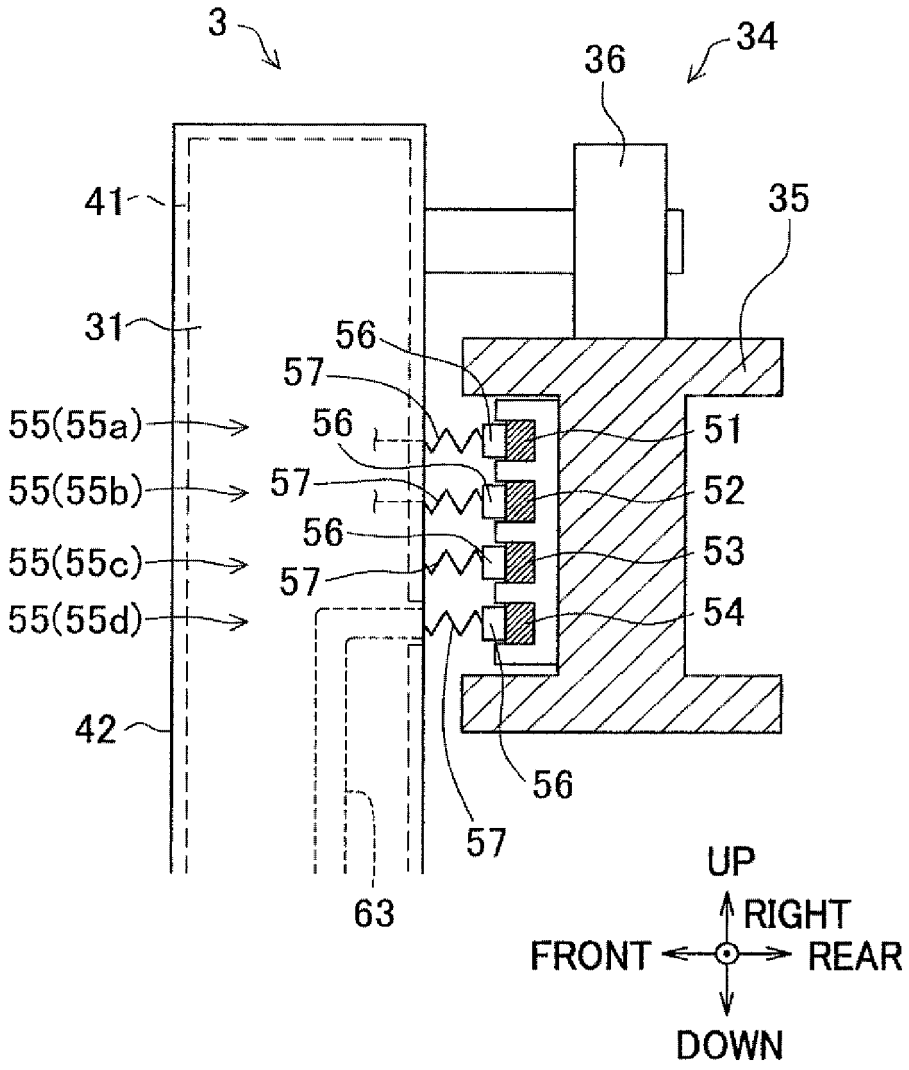

3
34
36
35
41
31
56
57
55(55a)
56
51
55(55b)
57
52
56
55(55c)
53
57
55(55d)
54
42
56
57
63
UP
RIGHT
FRONT
REAR
DOWN

FIG.9

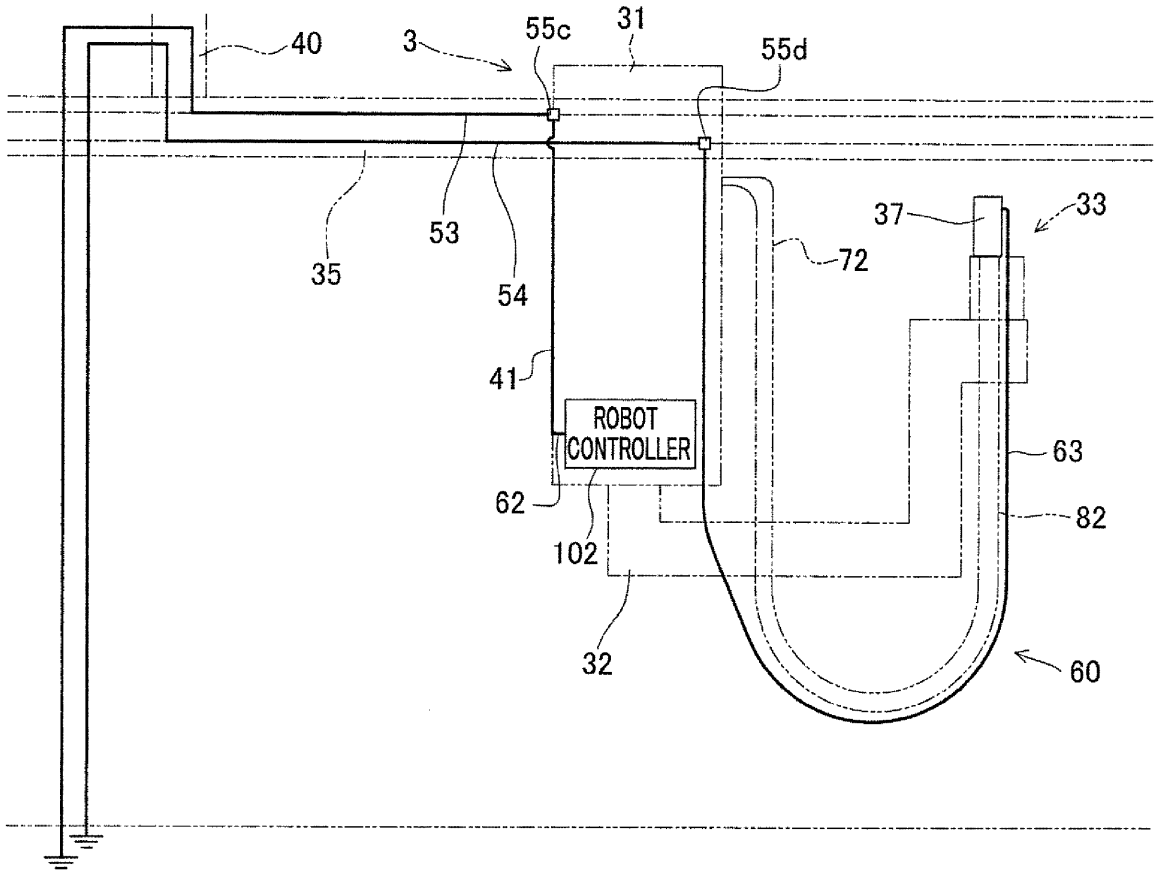

40
3
55c
31
55d
35
53
54
37
33
72
41
ROBOT
CONTROLLER
63
62
82
102
32
60

FIG.10

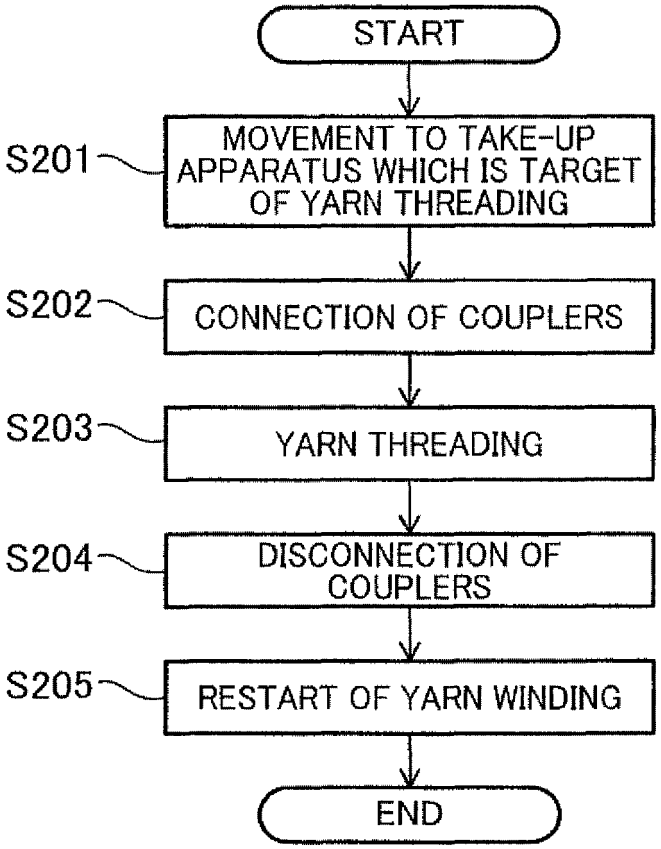

START
S201
MOVEMENT TO TAKE-UP APPARATUS WHICH IS TARGET OF YARN THREADING
S202
CONNECTION OF COUPLERS
S203
YARN THREADING
S204
DISCONNECTION OF COUPLERS
S205
RESTART OF YARN WINDING
END

FIG.11

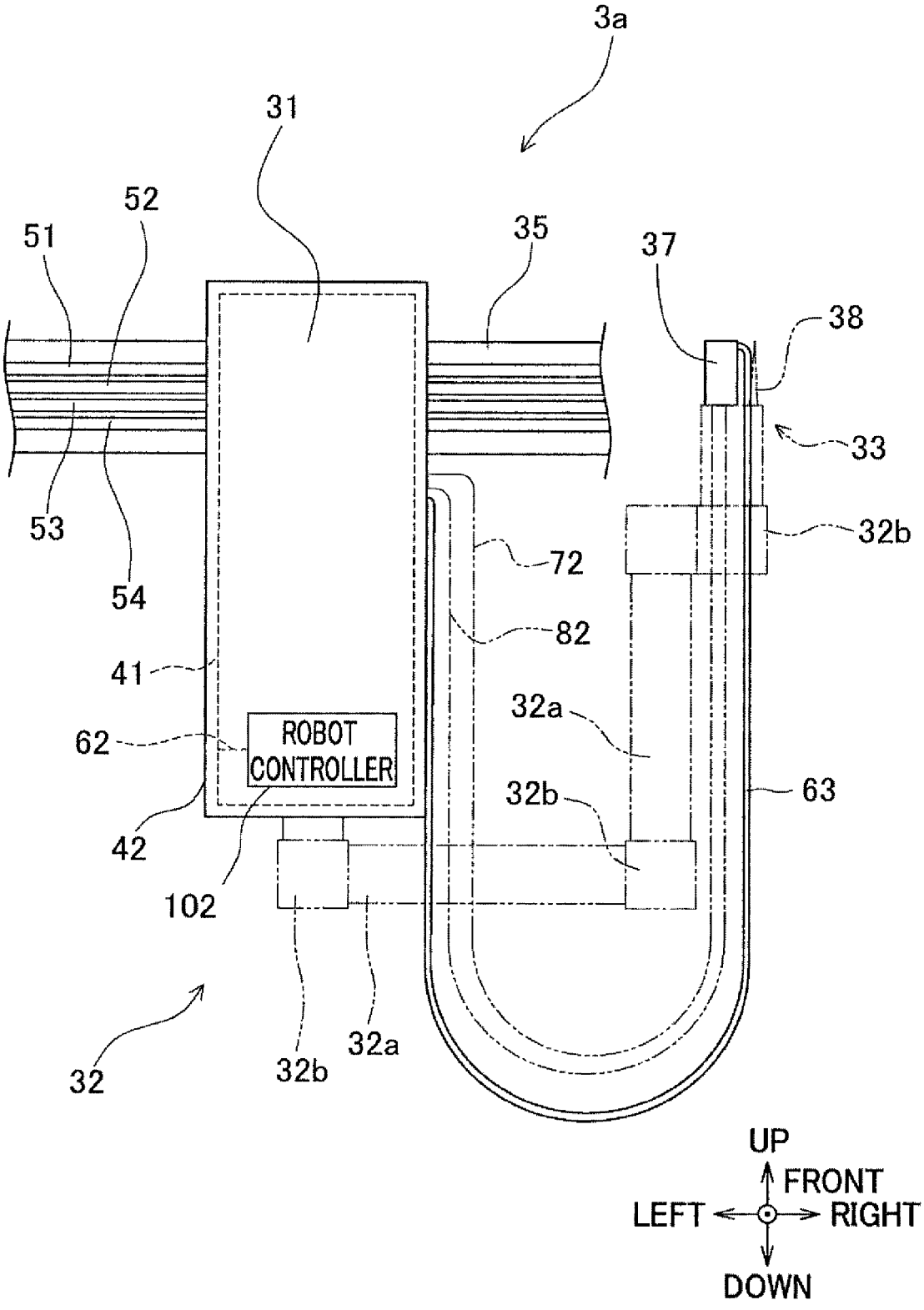

3a
31
52
51
35
37
38
33
32b
72
82
53
54
41
62
ROBOT CONTROLLER
32a
63
32b
42
102
32
32b
32a
UP
FRONT
LEFT
RIGHT
DOWN

FIG.12

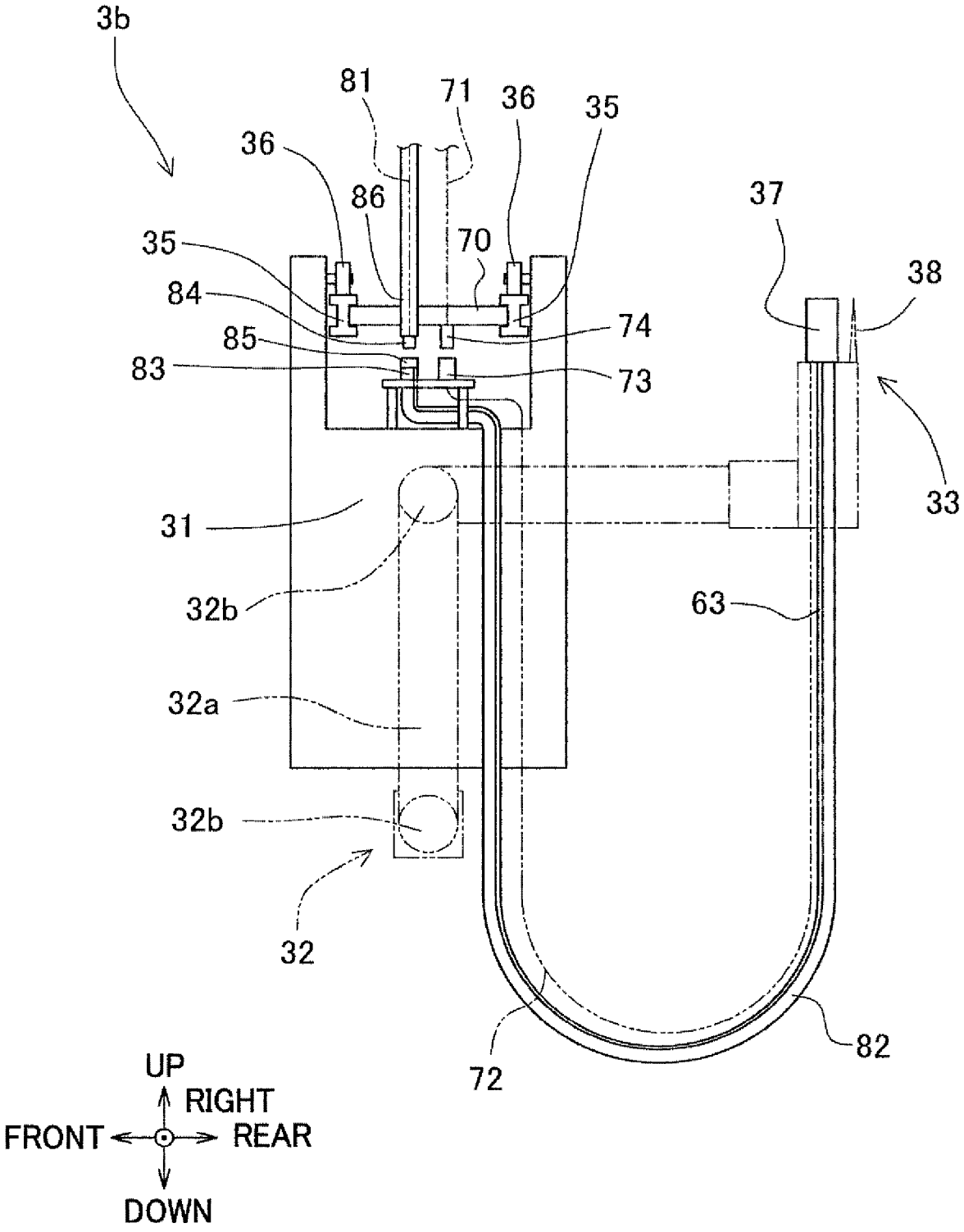

3b
81
71
36
35
36
86
37
35
70
38
84
74
85
83
73
33
31
32b
63
32a
32b
32
72
82
UP
RIGHT
FRONT
REAR
DOWN

FIG.13

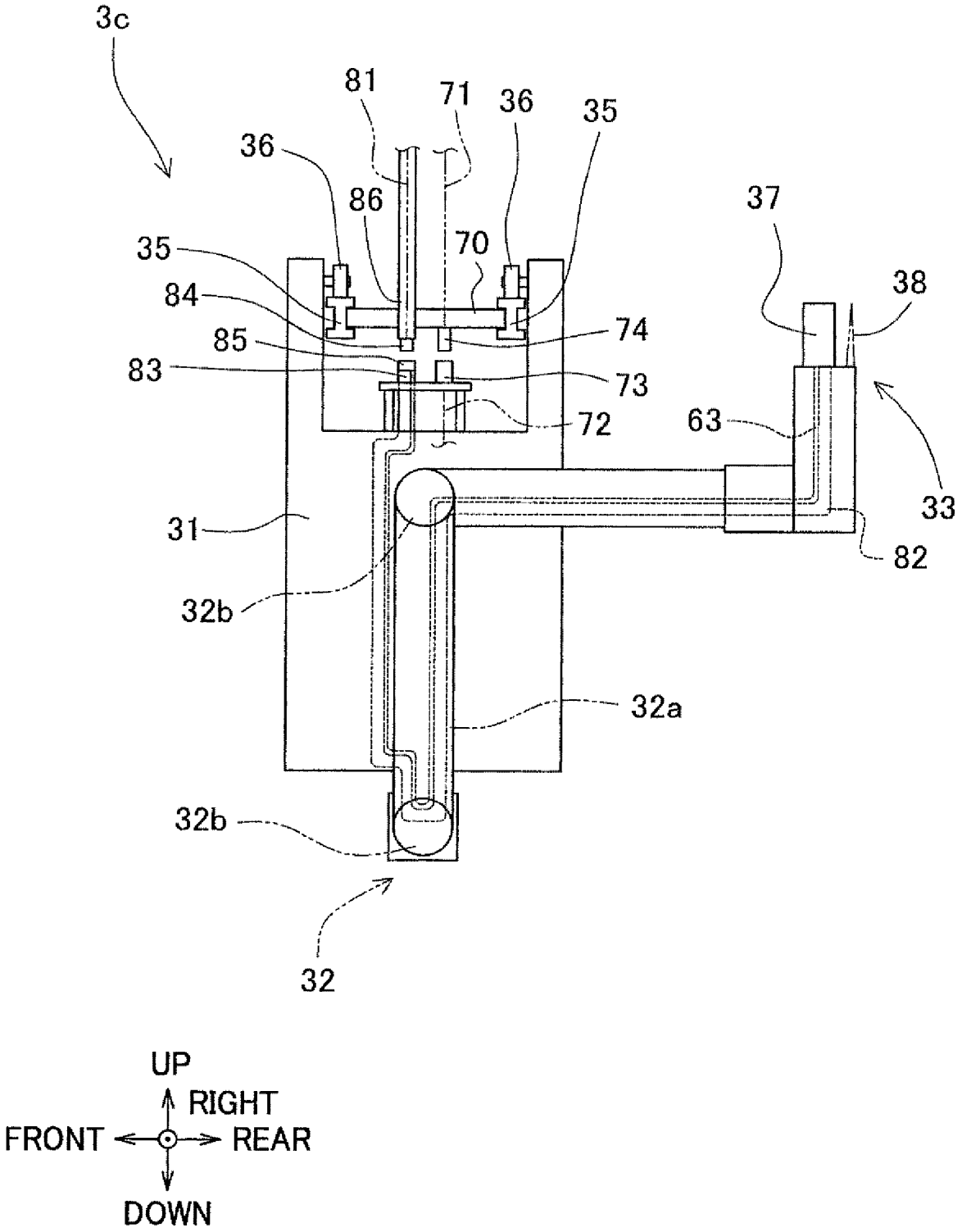

3c
81
71
36
35
36
86
37
70
35
38
84
74
85
83
73
72
63
33
31
82
32b
32a
32b
32
UP
RIGHT
FRONT
REAR
DOWN

FIG.14

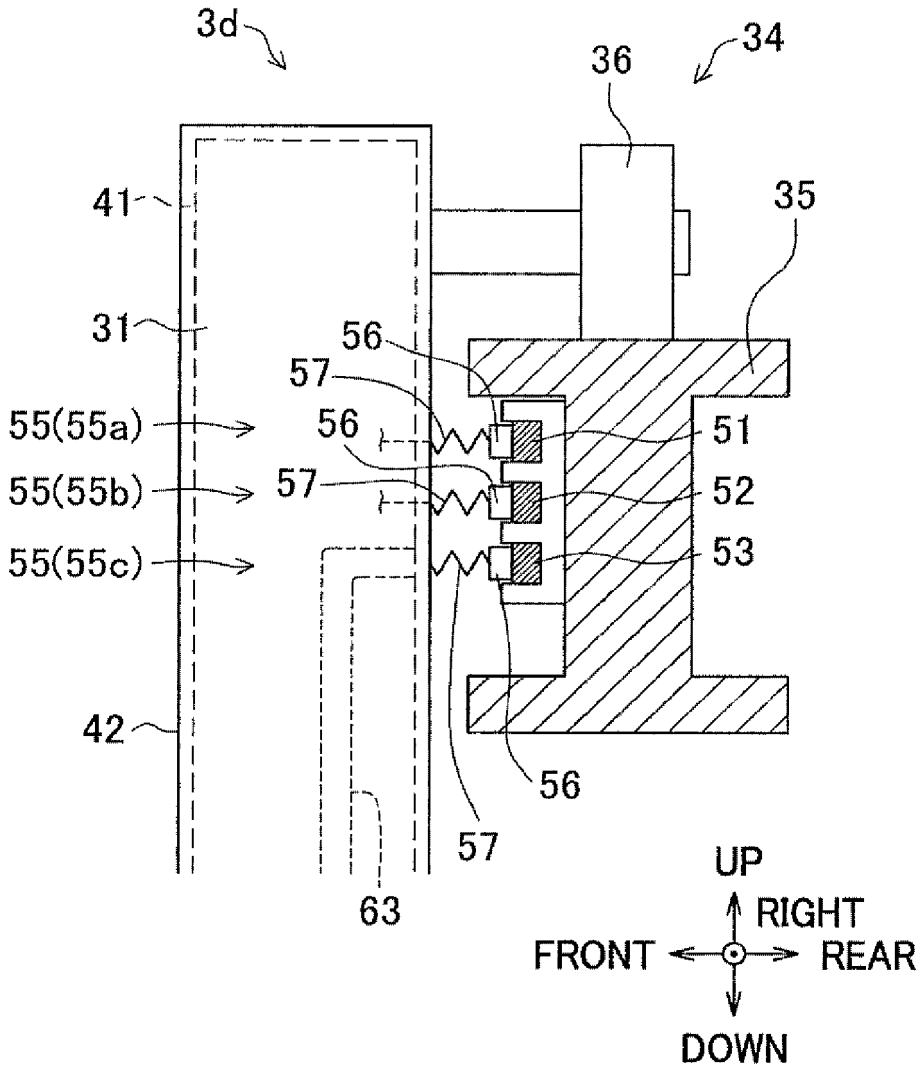

3d
34
36
35
41
31
56
57
55(55a)
56
51
55(55b)
57
52
55(55c)
53
42
56
57
63
UP
RIGHT
FRONT
REAR
DOWN

FIG.15

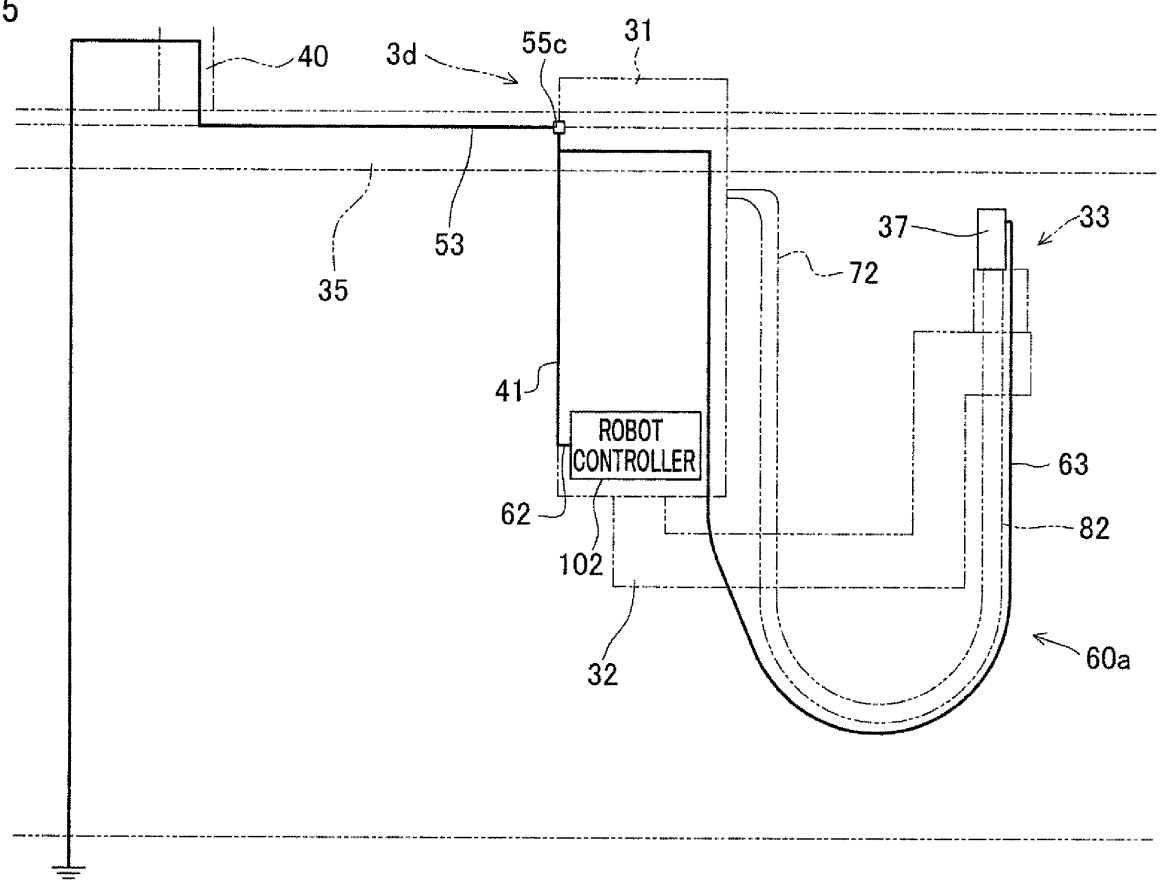

40
3d
55c
31
53
35
37
33
72
41
ROBOT
CONTROLLER
63
62
82
102
32
60a

FIG.16

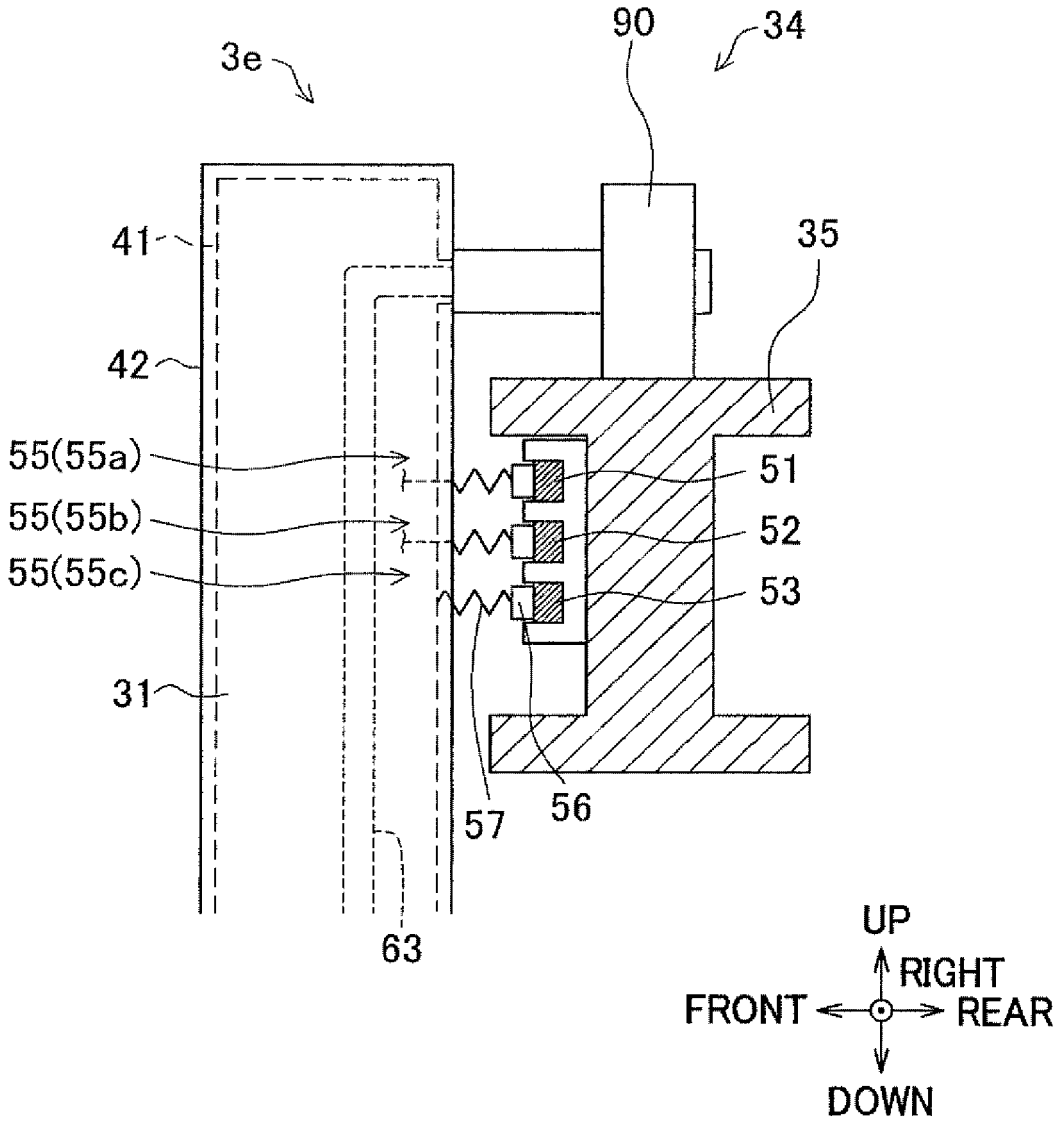
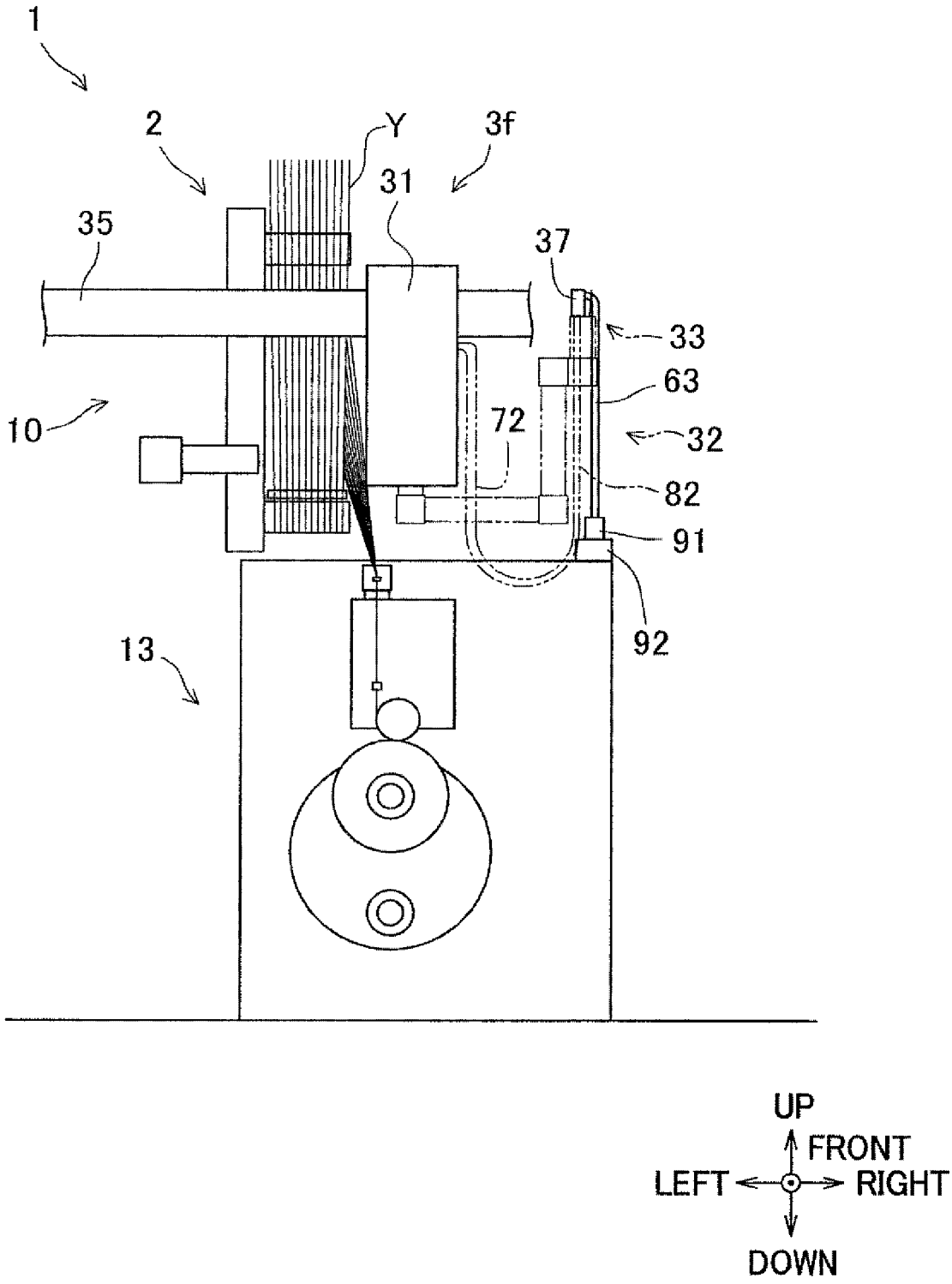

3e
90
34
41
35
42
55(55a)
55(55b)
55(55c)
51
52
53
31
57
56
63
UP
RIGHT
FRONT
REAR
DOWN

FIG.17



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/012789

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl. B65H51/16(2006.01)i, B25J19/06(2006.01)i, B65H67/08(2006.01)i, D01D7/00(2006.01)i, D02J1/22(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int. Cl. B65H51/16, B25J19/06, B65H67/08, D01D7/00, D02J1/22

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2018
Registered utility model specifications of Japan 1996-2018
Published registered utility model applications of Japan 1994-2018

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 149938/1976 (Laid-open No. 69543/1978) (TEIJIN LTD.) 10 June 1978, description, page 2, lines 7-16, page 8, line 12 to page 9, line 16, fig. 1 (Family: none)	1-9, 12-21 10-11
Y	WO 2015/198698 A1 (TMT MACHINERY, INC.) 30 December 2015, paragraph [0071] & CN 106414819 A	1-9, 12-21
Y	JP 2007-7673 A (NISSAN MOTOR CO., LTD.) 18 January 2007, paragraphs [0004], [0005] & US 2006/0289395 A1, paragraph [0006] & EP 1738855 A1 & CN 1896758 A	1-9, 12-21

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
07.06.2018	19.06.2018
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/012789

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2010-182923 A (HITACHI HIGH TECH CONTROL SYSTEMS CORP) 19 August 2010, paragraphs [0014]-[0031], fig. 1, 2 (Family: none)	5-9, 12-13, 18-20
A	JP 47-11565 Y1 (TEIJIN SEIKI CO., LTD.) 28 April 1972 (Family: none)	1

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Patent documents cited in the description

- JP 2015078455 A **[0004]**
- JP 2013023385 A **[0096]**
- JP 2015147674 A **[0096]**
- JP 2015199559 A **[0096]**