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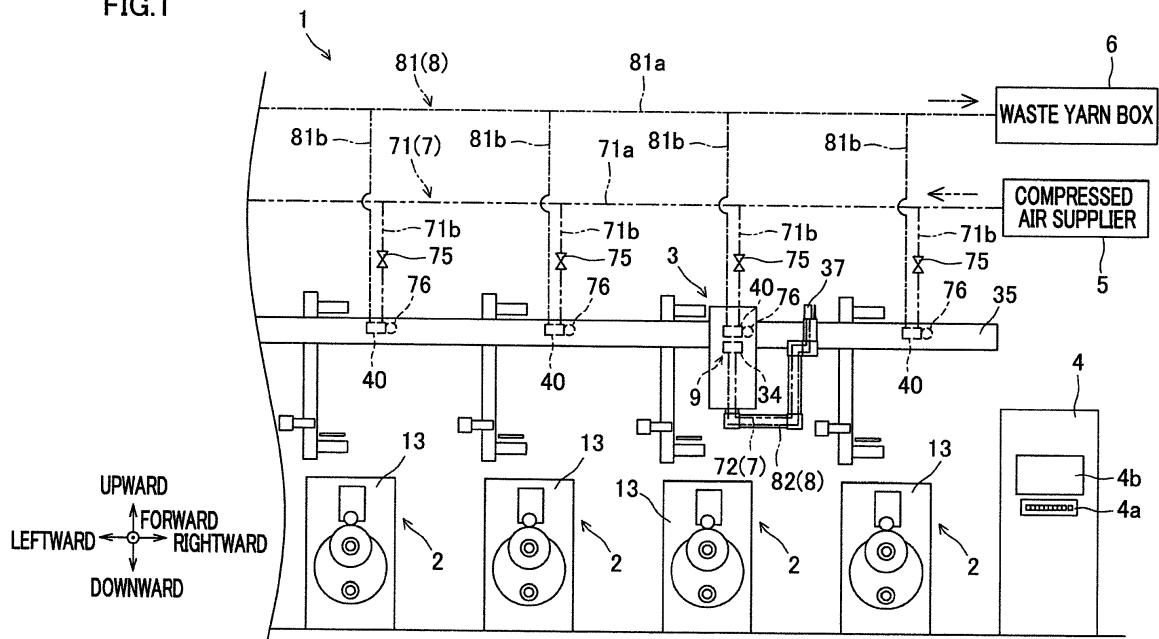
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(54) SPUN YARN TAKE-UP SYSTEM AND YARN THREADING ROBOT

(57) An object is to arrange a movable yarn threading robot not to require a long hose for supplying compressed fluid to the yarn threading robot. In a spun yarn take-up system 1 including spun yarn take-up apparatuses 2 lined up in a predetermined direction and a yarn threading robot 3 movable in the predetermined direction and including a suction gun 37, a compressed air supply passage 7 from a compressed air supplier 5 to the suction gun 37

is divided into a system-side compressed air hose 71 extending from the compressed air supplier 5 to the spun yarn take-up apparatuses 2 and a robot-side compressed air hose 72 provided on the yarn threading robot 3, and the system-side compressed air hose 71 and the robot-side compressed air hose 72 are arranged to be attached to and detachable from each other.

FIG.1



Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a spun yarn take-up system and a yarn threading robot.

[0002] For example, Patent Literature 1 (Japanese Unexamined Patent Publication No. 53-106815) recites an automatic yarn threading device for performing yarn threading onto a spun yarn take-up apparatus which is configured to form packages by winding spun-out yarns. This automatic yarn threading device is arranged such that yarn threading onto a roller or the like of the spun yarn take-up apparatus is performed as the device is driven while yarns are sucked and retained by a suction gun.

[0003] While Patent Literature 1 does not give details of the suction gun, the suction gun used is recited in, for example, Patent Literature 2 (Japanese Unexamined Patent Publication No. 53-143746). The suction gun (device for capturing and guiding yarns) recited in Patent Literature 2 generates a negative pressure at a leading end portion of the suction gun as a passage in which compressed fluid flows from the leading end portion toward the base end portion is provided inside the suction gun. In this case, the suction gun is connected to a hose through which the compressed fluid is supplied. FIG. 2 of Patent Literature 1 shows a member which seems to be a hose.

SUMMARY OF THE INVENTION

[0004] In order to improve the efficiency in production of packages, spun yarn take-up systems in each of which many spun yarn take-up apparatuses are lined up have been typically used. In such a spun yarn take-up system, in order to allow plural spun yarn take-up apparatuses by a single automatic yarn threading device (hereinafter, a yarn threading robot) to perform yarn threading, the yarn threading robot may be arranged to be movable in directions in which the spun yarn take-up apparatuses are lined up. In such an arrangement, however, the hose by which the compressed fluid is supplied to a sucking retaining unit (suction gun) of the yarn threading robot is required to be long in accordance with the traveling range of the yarn threading robot. As the long hose is pulled around, the hose may have short life or may interfere with another member.

[0005] The present invention has been done to solve the problem above, and an object of the present invention is to arrange a yarn threading robot, which is movable, not to require a long hose for supplying compressed fluid to the yarn threading robot.

[0006] A spun yarn take-up system of the present invention includes: spun yarn take-up apparatuses which are lined up in a predetermined direction; a yarn threading robot which is movable in the predetermined direction and is capable of performing yarn threading onto the spun yarn take-up apparatuses; and a compressed fluid sup-

plier configured to supply compressed fluid to the yarn threading robot, wherein, the yarn threading robot includes a sucking retaining unit configured to generate a negative pressure when the compressed fluid is supplied from the compressed fluid supplier and is configured to perform the yarn threading while sucking and retaining a yarn by the sucking retaining unit, a supply passage for supplying the compressed fluid from the compressed fluid supplier to the sucking retaining unit includes: a system-side supply pipe extending from the compressed fluid supplier to the spun yarn take-up apparatuses; a robot-side supply pipe connected to the sucking retaining unit; a system-side supply pipe connecting member attached to a downstream end of the system-side supply pipe; and a robot-side supply pipe connecting member attached to an upstream end of the robot-side supply pipe, and the robot-side supply pipe connecting member and the system-side supply pipe connecting member are arranged to be detachable from each other and attachable to each other.

[0007] In the spun yarn take-up system of the present invention, the passage for supplying compressed fluid from the compressed fluid supplier to the sucking retaining unit of the yarn threading robot is divided into the system-side supply pipe and the robot-side supply pipe, and these pipes are attachable and detachable. On this account, the robot-side supply pipe of the yarn threading robot is only required to be long enough for the connection with the system-side supply pipe, and is not required to be very long for the connection to the compressed fluid supplier. For this reason, even if the yarn threading robot is arranged to be movable, it is unnecessary to provide a long hose to the yarn threading robot for supplying compressed fluid.

[0008] In the spun yarn take-up system of the present invention, preferably, one of the robot-side supply pipe connecting member and the system-side supply pipe connecting member is a male coupler and the other one is a female coupler.

[0009] This makes it possible to easily construct the robot-side supply pipe connecting member and the system-side supply pipe connecting member.

[0010] In the spun yarn take-up system of the present invention, preferably, the robot-side supply pipe connecting member is a female coupler and the system-side supply pipe connecting member is a male coupler.

[0011] The female coupler is formed of a plurality of components including a sleeve and locking balls, and is typically more expensive than the male coupler. Cost reduction is achieved by setting the robot-side supply pipe connecting member as the female coupler and setting the system-side supply pipe connecting member as the male coupler, because only one robot-side supply pipe connecting member is required whereas a plurality of system-side supply pipe connecting members are required.

[0012] In the spun yarn take-up system of the present invention, preferably, the yarn threading robot includes

a driving unit which is configured to move the robot-side supply pipe connecting member to be attached to or detached from the system-side supply pipe connecting member.

[0013] This arrangement achieves cost reduction because only one driving unit for attaching or detaching the robot-side supply pipe connecting member to or from the system-side supply pipe connecting member is required to be attached to the yarn threading robot.

[0014] In the spun yarn take-up system of the present invention, preferably, the system-side supply pipe is formed of a main pipe connected to the compressed fluid supplier and sub pipes branched from the main pipe toward the spun yarn take-up apparatuses, the system-side supply pipe connecting members are attached to downstream ends of the sub pipes, and on-off valves are provided at intermediate parts of the sub pipes.

[0015] According to this arrangement, because the compressed fluid is supplied to a desired part at a desired time by suitably opening and closing the on-off valves, unnecessary consumption of the compressed air is restrained.

[0016] Preferably, the spun yarn take-up system of the present invention further includes: a controller configured to control the driving unit and the on-off valves; and detection units configured to detect connected states between the system-side supply pipe connecting members and the robot-side supply pipe connecting member and send a detection signal to the controller, when the yarn threading is performed for a predetermined one of the spun yarn take-up apparatuses, the controller controlling the driving unit so as to connect the robot-side supply pipe connecting member to a predetermined one of the system-side supply pipe connecting members corresponding to the predetermined one of the spun yarn take-up apparatuses, and in response to the detection signal which indicates that the predetermined one of the system-side supply pipe connecting members is in the connected state and is sent from the predetermined one of the detection units, the controller opening a predetermined one of the on-off valves corresponding to the predetermined one of the system-side supply pipe connecting members.

[0017] With this control, because supply of the compressed fluid before the connection of the robot-side supply pipe connecting member with the predetermined system-side supply pipe connecting member is certainly prevented, unnecessary consumption of the compressed fluid is further effectively restrained.

[0018] In the spun yarn take-up system of the present invention, preferably, when the yarn threading onto the predetermined one of the spun yarn take-up apparatuses ends, the controller closes the predetermined one of the on-off valves and drives the driving unit so as to detach the robot-side supply pipe connecting member from the predetermined one of the system-side supply pipe connecting members.

[0019] With this control, because detachment of the

robot-side supply pipe connecting member from the predetermined system-side supply pipe connecting member during the supply of the compressed fluid is certainly prevented, unnecessary consumption of the compressed fluid is further effectively restrained.

[0020] Preferably, the spun yarn take-up system of the present invention further includes a yarn waste unit to which the yarn sucked by the sucking retaining unit is wasted, wherein, a passage for wasting the yarn, which extends from the sucking retaining unit to the yarn waste unit, includes: a robot-side discharge pipe connected to the sucking retaining unit; a system-side discharge pipe extending from the spun yarn take-up apparatuses to the yarn waste unit; a robot-side discharge pipe connecting member attached to a downstream end of the robot-side discharge pipe; and a system-side discharge pipe connecting member attached to an upstream end of the system-side discharge pipe, and the robot-side discharge pipe connecting member and the system-side discharge pipe connecting member are arranged to be detachable from each other and attachable to each other.

[0021] According to this arrangement, being similar to the passage for supplying the compressed fluid, the passage for discharging the yarn from the sucking retaining unit of the yarn threading robot to the yarn waste unit is divided into the robot-side discharge pipe and the system-side discharge pipe, and these pipes are arranged to be attachable and detachable. On this account, the robot-side discharge pipe of the yarn threading robot is only required to be long enough for the connection with the system-side discharge pipe, and is not required to be very long for the connection to the yarn waste unit. For this reason, even if the yarn threading robot arranged to be movable, it is unnecessary to provide a long hose to the yarn threading robot for wasting the yarn.

[0022] In the spun yarn take-up system of the present invention, preferably, one of the robot-side discharge pipe connecting member and the system-side discharge pipe connecting member is a male coupler and the other one is a female coupler.

[0023] This makes it possible to easily construct the robot-side discharge pipe connecting member and the system-side discharge pipe connecting member.

[0024] In the spun yarn take-up system of the present invention, preferably, the robot-side discharge pipe connecting member is a female coupler and the system-side discharge pipe connecting member is a male coupler.

[0025] As described above, the female coupler is typically more expensive than the male coupler. Cost reduction is achieved by setting the robot-side discharge pipe connecting member as the female coupler and setting the system-side discharge pipe connecting member as the male coupler, because only one robot-side discharge pipe connecting member is required whereas a plurality of system-side discharge pipe connecting members are required.

[0026] A yarn threading robot of the present invention, which is movable in a predetermined direction and is ca-

pable of performing yarn threading onto spun yarn take-up apparatuses lined up in the predetermined direction, includes: a sucking retaining unit configured to generate a negative pressure when compressed fluid is supplied from an external compressed fluid supplier and capable of sucking and retaining a yarn; a robot-side supply pipe connected to the sucking retaining unit and receiving the compressed fluid from the compressed fluid supplier; and a robot-side supply pipe connecting member attached to an upstream end of the robot-side supply pipe, wherein, the robot-side supply pipe connecting member is attachable to and detachable from a system-side supply pipe connecting member attached to a downstream end of the system-side supply pipe extending from the compressed fluid supplier to the spun yarn take-up apparatuses.

[0027] According to the present invention, because the robot-side supply pipe is arranged to be attachable to and detachable from the system-side supply pipe, the robot-side supply pipe is only required to be long enough for the connection with the system-side supply pipe, and is not required to be very long for the connection to the compressed fluid supplier. For this reason, even if the yarn threading robot is arranged to be movable, it is unnecessary to provide a long hose to the yarn threading robot for supplying compressed fluid.

[0028] Preferably, the yarn threading robot of the present invention further includes: a robot-side discharge pipe connected to the sucking retaining unit and discharging the yarn sucked by the sucking retaining unit to an external yarn waste unit; and a robot-side discharge pipe connecting member attached to a downstream end of the robot-side discharge pipe, wherein the robot-side discharge pipe connecting member is attachable to and detachable from a system-side discharge pipe connecting member attached to an upstream end of the system-side discharge pipe extending from the spun yarn take-up apparatuses to the yarn waste unit.

[0029] According to this arrangement, because the robot-side discharge pipe is arranged to be attachable to and detachable from the system-side discharge pipe, the robot-side discharge pipe is only required to be long enough for the connection with the system-side discharge pipe, and is not required to be very long for the connection to the yarn waste unit. For this reason, even if the yarn threading robot arranged to be movable, it is unnecessary to provide a long hose to the yarn threading robot for discharging the yarn therefrom.

[0030] Preferably, the yarn threading robot of the present invention further includes: a supporting component supporting both the robot-side supply pipe connecting member and the robot-side discharge pipe connecting member; and a driving unit configured to move the supporting component so that the robot-side supply pipe connecting member is attached to or detached from the system-side supply pipe connecting member and the robot-side discharge pipe connecting member is attached to or detached from the system-side discharge pipe con-

necting member.

[0031] With this arrangement, because only one driving unit is required to move the robot-side supply pipe connecting member and the robot-side discharge pipe connecting member, the number of components is reduced and hence cost reduction is achieved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032]

FIG. 1 is a schematic diagram of a spun yarn take-up system of an embodiment.

FIG. 2 is a front elevation of a spun yarn take-up apparatus and a yarn threading robot.

FIG. 3 is a profile of the spun yarn take-up apparatus and the yarn threading robot.

FIG. 4 is a block diagram showing an electric structure of the spun yarn take-up system.

FIG. 5 is a cross section of a suction gun.

FIG. 6 is a profile of a coupling device.

FIG. 7 is a bottom view of a supporting unit.

FIG. 8 is an arrow view at a cross section along the VIII-VIII line in FIG. 7.

FIG. 9 is a cross section of a male coupler and a female coupler.

FIG. 10 is a cross section showing attachment and detachment of the male coupler and the female coupler.

FIG. 11 is a flowchart showing a series of steps regarding yarn threading.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0033] The following will describe a preferred embodiment of the present invention.

(Overall Structure of Spun Yarn Take-Up System)

[0034] FIG. 1 is a schematic diagram of a spun yarn take-up system of the present embodiment. The spun yarn take-up system 1 of the present embodiment includes a plurality of spun yarn take-up apparatuses 2 lined up in one horizontal direction, a yarn threading robot 3 configured to perform yarn threading onto the spun yarn take-up apparatuses 2, a central controller 4 configured to control each spun yarn take-up apparatus 2 and the yarn threading robot 3, a compressed air supplier 5 configured to supply compressed air (an example of compressed fluid) to the yarn threading robot 3, and a waste yarn box 6 in which yarns from the yarn threading robot 3 are wasted. In the present embodiment, for all spun yarn take-up apparatuses 2 of the spun yarn take-up system 1, one yarn threading robot 3, one compressed air supplier 5, and one waste yarn box 6 are provided. In order to avoid complication, yarns are not shown in FIG. 1. Hereinafter, the direction in which the spun yarn take-up apparatuses 2 are lined up will be referred to as a left-

right direction, and the direction which is horizontal and orthogonal to the left-right direction will be referred to as a front-back direction.

(Spun Yarn Take-Up Apparatus)

[0035] Now, the spun yarn take-up apparatus 2 will be detailed. FIG. 2 is a front elevation of the spun yarn take-up apparatus 2 and the yarn threading robot 3. FIG. 3 is a profile of the spun yarn take-up apparatus 2 and the yarn threading robot 3. FIG. 4 is a block diagram showing an electric structure of the spun yarn take-up system 1.

[0036] The spun yarn take-up apparatus 2 is configured to take up yarns Y spun out from an unillustrated spinning apparatus and form packages P by winding the yarns Y onto bobbins B, respectively. To be more specific, the spun yarn take-up apparatus 2 sends the yarns Y spun out from the unillustrated spinning apparatus to a winding unit 13 by a first godet roller 11 and a second godet roller 12, and form the packages P by winding the yarns Y onto the bobbins B, respectively, by the winding unit 13.

[0037] 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. 4).

[0038] The second godet roller 12 has 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. 4). The second godet roller 12 is movably supported by a guide rail 14. The guide rail 14 obliquely extends as a negative slope in the forward direction. The second godet roller 12 is arranged to be movable by a cylinder 113 (see FIG. 4) along a guide rail 14. With this, the second godet roller 12 is movable between a winding position (indicated by full lines in FIG. 3) where winding of the yarns Y is carried out and a yarn threading position (indicated by dashed lines in FIG. 3) where the second godet roller 12 is close to the first godet roller 11 and yarn threading is carried out.

[0039] The spun yarn take-up apparatus 2 further includes an aspirator 15 and a yarn regulating guide 16. The aspirator 15 is configured to suck and retain the yarns Y spun out from the spinning apparatus in advance, before the yarn threading robot 3 performs yarn threading. The aspirator 15 extends along the left-right direction. At a right end portion thereof, a suction port 15a is formed to suck the yarns Y. The aspirator 15 is provided slightly above the first godet roller 11 so that the suction port 15a is positioned in the vicinity of the yarns Y.

[0040] The yarn regulating guide 16 is provided between the first godet roller 11 and the aspirator 15 in 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 neighbor-

ing yarns Y. The yarn regulating guide 16 is arranged to be movable in the left-right direction (the axial direction of the first godet roller 11) by a cylinder 114 (see FIG. 4). 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.

[0041] The winding unit 13 includes plural fulcrum guides 21, plural traverse guides 22, a turret 23, two bobbin holders 24, and a contact roller 25.

[0042] The fulcrum guides 21 are provided for the respective yarns Y and are lined up in the front-back direction. The traverse guides 22 are provided for the respective yarns Y and are lined up in the front-back direction. The traverse guides 22 are driven by a common traverse motor 116 (see FIG. 4) and reciprocate in the front-back direction. With this, the yarns Y threaded onto the traverse guides 22 are traversed about the fulcrum guides 21.

[0043] The turret 23 is a disc-shaped member having an axis which is substantially in parallel to the front-back direction. The turret 23 is rotationally driven by a turret motor 117 (see FIG. 4). The two bobbin holders 24 have axes substantially in parallel to the front-back direction and are rotatably supported at an upper end portion and a lower end portion of the turret 23, respectively. To each bobbin holder 24, bobbins B provided for the respective yarns Y are attached to be lined up in the front-back direction. Each of the two bobbin holders 24 is rotationally driven by an individual winding motor 118 (see FIG. 4).

[0044] As the upper bobbin holder 24 is rotationally driven, the yarns Y traversed by the traverse guides 22 are wound onto the bobbins B, with the result that packages P are formed. After the completion of the formation of the package P, the positions of the two bobbin holders 24 are changed upside down as the turret 23 is rotated. As a result, the bobbin holder 24 which is on the lower side moves to the upper side, and a package P can be formed by winding a yarn Y onto a bobbin B attached to this bobbin holder 24. In the meanwhile, the bobbin holder 24 on the upper side moves to the lower side, and the packages P are collected by an unillustrated package collector.

[0045] The contact roller 25 is a roller having an axis substantially in parallel to the front-back direction and is provided immediately above the upper bobbin holder 24. The contact roller 25 makes contact with the surfaces of the packages P attached to the upper bobbin holder 24, so as to apply a contact pressure to the surface of each package P on which the yarn Y is being wound, in order to adjust the shape of each package P.

(Yarn Threading Robot)

[0046] Now, the yarn threading robot 3 will be described. The yarn threading robot 3 includes a main body

31, a robot arm 32, and a yarn threading unit 33.

[0047] The main body 31 is rectangular parallelepiped in shape. Inside the main body 31, a robot controller 102 (see FIG. 4) or the like is mounted for controlling operations of the robot arm 32 and the yarn threading unit 33. The main body 31 hangs down from the two guide rails 35 and is movable in the left-right direction along the two guide rails 35. These two guide rails 35 are provided forward of the spun yarn take-up apparatuses 2 and are spaced apart from each other in the front-back direction. The two guide rails 35 extend in the left-right direction across the spun yarn take-up apparatuses 2. In other words, the yarn threading robot 3 is provided forward of the spun yarn take-up apparatuses 2 and is arranged to be movable in the left-right direction.

[0048] Four wheels 36 are provided at an upper end portion of the main body 31. Two of these four wheels 36 are provided on the upper surface of each guide rail 35. The four wheels 36 are rotationally driven by a movement motor 121 (see FIG. 4). As the four wheels 36 are rotationally driven, the main body 31 moves in the left-right direction along the two guide rails 35. To grasp the position of the yarn threading robot 3 in the left-right direction, the yarn threading robot 3 is provided with an encoder 123 (see FIG. 4) which is configured to detect a position of the yarn threading robot 3 in the left-right direction.

[0049] The robot arm 32 is attached to the lower surface of the main body 31. The robot arm 32 includes arms 32a and joints 32b connecting the arms 32a with one another. Each joint 32b includes an arm motor 122 (see FIG. 4). As the arm motor 122 is driven, the arm 32a is swung about the joint 32b. In this way, the robot arm 32 is driven in a three-dimensional manner.

[0050] The yarn threading unit 33 is attached to the leading end portion of the robot arm 32. The yarn threading unit 33 is provided with a suction gun 37 for sucking and retaining the yarns Y and a cutter 38 for cutting the yarns Y.

[0051] FIG. 5 is a cross section of the suction gun 37. The suction gun 37 includes a suction pipe 37a extending linearly and a compressed air pipe 37b which is connected to and integrated with an intermediate part of the suction pipe 37a. One end portion of the suction pipe 37a has a suction port 37c for sucking the yarns Y, whereas the other end portion of the suction pipe 37a is connected to a robot-side waste yarn hose 82. One end portion of the compressed air pipe 37b communicates with the suction pipe 37a via a communication hole 37d, whereas the other end portion of the compressed air pipe 37b is connected to a robot-side compressed air hose 72. The communication hole 37d is inclined with respect to the suction pipe 37a so as to form an obtuse angle with the other end side of the suction pipe 37a.

[0052] As indicated by the arrow in FIG. 5, in the suction gun 37 arranged as above, compressed air introduced into the suction pipe 37a from the compressed air pipe 37b flows from the one end side to the other end side of

the suction pipe 37a. A negative pressure is generated at the suction port 37c due to this flow, and it becomes possible to suck the yarns Y through the suction port 37c. The yarns Y sucked through the suction port 37c are discharged to the robot-side waste yarn hose 82 on account of the airflow inside the suction pipe 37a. The yarn threading robot 3 performs yarn threading while sucking and retaining the yarns Y by the suction gun 37.

[0053] The yarn threading robot 3 further includes a robot-side connection unit 34 which is a part of the coupling device which will be described later. The robot-side connection unit 34 will be detailed below.

(Compressed Air Supply Passage and Waste Yarn Passage)

[0054] The spun yarn take-up system 1 is provided with a compressed air supply passage 7 through which compressed air is supplied from the compressed air supplier 5 to the suction gun 37 of the yarn threading robot 3 as indicated by the two-dot chain lines in FIG. 1 and a waste yarn passage 8 through which the yarns Y are wasted from the suction gun 37 to the waste yarn box 6 as indicated by the dashed lines in FIG. 1.

[0055] The compressed air supply passage 7 is divided into a system-side compressed air hose 71 extending from the compressed air supplier 5 to the spun yarn take-up apparatuses 2 and a robot-side compressed air hose 72 provided in the yarn threading robot 3. Similarly, the waste yarn passage 8 is divided into a system-side waste yarn hose 81 extending from the spun yarn take-up apparatuses 2 to the waste yarn box 6 and a robot-side waste yarn hose 82 provided in the yarn threading robot 3. The attachment and detachment of the system-side compressed air hose 71 to and from the robot-side compressed air hose 72 and the attachment and detachment of the system-side waste yarn hose 81 to and from the robot-side waste yarn hose 82 are carried out by the coupling device 9 which is formed of a system-side connection unit 40 and a robot-side connection unit 34. The coupling device 9 will be detailed later.

[0056] The system-side compressed air hose 71 is formed of a main hose 71a connected to the compressed air supplier 5 and sub hoses 71b branched from the main hose 71a toward the spun yarn take-up apparatuses 2. At the downstream end of each sub hose 71b, the system-side connection unit 40 is provided. At the upstream end of the robot-side compressed air hose 72, the robot-side connection unit 34 is provided. At an intermediate part of each sub hose 71b, an on-off valve 75 which is controllable by the central controller 4 is provided.

[0057] The system-side waste yarn hose 81 is formed of a main hose 81a connected to the waste yarn box 6 and sub hoses 81b branched from the main hose 81a toward the spun yarn take-up apparatuses 2. At the upstream end of each sub hose 81b, the system-side connection unit 40 is provided. At the downstream end of the robot-side waste yarn hose 82, the robot-side connection

unit 34 is provided.

[0058] When the robot-side connection unit 34 of the yarn threading robot 3 is connected to any system-side connection unit 40 of each spun yarn take-up apparatus 2 (to be more specific, this indicates later-described connection between couplers), the system-side compressed air hose 71 is connected to the robot-side compressed air hose 72 and the system-side waste yarn hose 81 is connected to the robot-side waste yarn hose 82. As a result, it becomes possible to supply the compressed air from the compressed air supplier 5 to the suction gun 37 and to waste the yarns Y from the suction gun 37 to the waste yarn box 6. Each spun yarn take-up apparatus 2 is provided with a connection sensor 76 which is configured to detect the establishment of connection between each system-side connection unit 40 and the robot-side connection unit 34.

(Coupling Device)

[0059] Now, the coupling device 9 will be described. As shown in FIG. 1, the coupling device 9 includes the system-side connection unit 40 and the robot-side connection unit 34. A plurality of system-side connection units 40 are provided to correspond to the respective spun yarn take-up apparatuses 2. Each system-side connection unit 40 is provided in the vicinity of the corresponding spun yarn take-up apparatus 2. To be more specific, above the winding unit 13 of each spun yarn take-up apparatus 2, each system-side connection unit 40 is sandwiched between and fixed to the front and rear, i.e., two guide rails 35. The robot-side connection unit 34 is attached to the upper surface of the main body 31 of the yarn threading robot 3 to be below the system-side connection unit 40 (see FIG. 3).

[0060] FIG. 6 is a profile of the coupling device 9. The system-side connection unit 40 is provided with a male coupler 73 connected to the system-side compressed air hose 71 and a male coupler 83 connected to the system-side waste yarn hose 81. In the meanwhile, the robot-side connection unit 34 is provided with a female coupler 74 connected to the robot-side compressed air hose 72 and a female coupler 84 connected to the robot-side waste yarn hose 82. As the male coupler 73 is connected to the female coupler 74, the system-side compressed air hose 71 is connected to the robot-side compressed air hose 72. Meanwhile, as the male coupler 83 is connected to the female coupler 84, the system-side waste yarn hose 81 is connected to the robot-side waste yarn hose 82.

[0061] The system-side connection unit 40 includes two fixed components 41 fixed to the respective guide rails 35, a plate-shaped fixed base 42 which is substantially horizontally provided across the two fixed components 41 and is fixed to the fixed components 41, a plate-shaped movable base 43 substantially horizontally provided below the fixed base 42, two guide cylinders 44 attached to the movable base 43, and the two male cou-

plers 73 and 83 fixed to the movable base 43. As detailed below, because the male couplers 73 and 83 are attached to the movable base 43, a positional displacement between the couplers is correctable.

[0062] The male couplers 73 and 83 are inserted into unillustrated attaching holes formed in the movable base 43 and fixed, so that the axes of these couplers are substantially in parallel to the up-down direction. Parts of the male couplers 73 and 83, which protrude downward from the movable base 43, are inserted into and connected to the respective female couplers 74 and 84. Parts of the male couplers 73 and 83, which protrude upward from the fixed base 42, are connected to the system-side compressed air hose 71 (sub hose 71b) and the system-side waste yarn hose 81 (sub hose 81b), respectively.

[0063] The robot-side connection unit 34 includes a plate-shaped base member 51 fixed to the upper surface of the main body 31 of the yarn threading robot 3, two stick-shaped guide components 52 extending upward from the base member 51, two slidable components 53 externally fitted to the two guide components 52 to be movable in the up-down direction, a plate-shaped first supporting component 54 substantially horizontally fixed to the two slidable components 53, two pin components 55 extending upward from the first supporting component 54, a plate-shaped second supporting component 56 substantially horizontally fixed to the two pin components 55, and a cylinder 57 attached to the lower surface of the first supporting component 54.

[0064] The female couplers 74 and 84 are inserted into unillustrated attaching holes formed in the second supporting component 56 and fixed, so that the axes of these couplers are substantially in parallel to the up-down direction. Parts of the female couplers 74 and 84, which protrude upward from the second supporting component 56, are inserted into and connected to the respective male couplers 73 and 83. Parts of the female couplers 74 and 84, which protrude downward from the second supporting component 56, are connected to the robot-side compressed air hose 72 and the robot-side waste yarn hose 82, respectively.

[0065] As the first supporting component 54 is moved upward by the cylinder 57 while the male coupler 73 is arranged to oppose the female coupler 74 and the male coupler 83 is arranged to oppose the female coupler 84, the female couplers 74 and 84 fixed to the second supporting component 56 are moved upward together with the first supporting component 54, and the male couplers 73 and 83 are inserted into the female couplers 74 and 84 in a relative manner. As a result, the male coupler 73 and the female coupler 74 are connected to each other and the male coupler 83 and the female coupler 84 are connected to each other. In this regard, as the pin component 55 is inserted into the guide cylinder 44 and guided, it is possible to restrain the female couplers 74 and 84 from tilting in the up-down direction.

(Positional Displacement Correction Function)

[0066] Now, a positional displacement correction function of the system-side connection unit 40 will be described. When the male coupler 73 (83) is coaxial with the female coupler 74 (84), the male coupler 73 (83) is connectable to the female coupler 74 (84) without any problem. In the meanwhile, when the stop position of the yarn threading robot 3 is displaced from the target position due to an error of the encoder 123 or the like, the shaft center of the male coupler 73 (83) is displaced from the shaft center of the female coupler 74 (84) in the horizontal direction, with the result that the male coupler 73 (83) may not be correctly connected to the female coupler 74 (84). To correctly connect the male coupler 73 (83) with the female coupler 74 (84) even in such a case, the system-side connection unit 40 has the positional displacement correction function to correct the above-mentioned displacement.

[0067] FIG. 7 is a bottom view of the system-side connection unit 40, and FIG. 8 is an arrow view at a cross section along the VIII-VIII line in FIG. 7. As described above, the system-side connection unit 40 includes the fixed base 42 which is substantially horizontally provided across the two fixed components 41 and the movable base 43 which is substantially horizontally provided below the fixed base 42. Each of the fixed base 42 and the movable base 43 is rectangular in plan view. The male couplers 73 and 83 are fixed to the movable base 43.

[0068] To the fixed base 42, two positioning bolts 45 and two retaining bolts 46 are fixed. The two positioning bolts 45 are provided at two corner portions of the rectangular fixed base 42, which are diagonally opposite to each other. The two retaining bolts 46 are provided at two corner portions of the rectangular fixed base 42, which are diagonally opposite to each other and are different from the two corner portions where the positioning bolts 45 are provided. To put it differently, in plan view, the two retaining bolts 46 are on the respective sides of the line L connecting the two positioning bolts 45.

[0069] Each positioning bolt 45 is provided to extend downward from the fixed base 42 and includes a shaft portion 45a screwed into the fixed base 42 and a positioning portion 45b provided below the shaft portion 45a. The positioning portion 45b is conical in shape and the diameter thereof increases downward. In the movable base 43, a positioning hole 43a in which the positioning bolt 45 is inserted is formed. The diameter of this positioning hole 43a is longer than the diameter of the shaft portion 45a and shorter than the maximum diameter of the positioning portion 45b. At a lower end portion of the inner circumferential surface of the positioning hole 43a, a tapered surface 43b is formed along the external shape of the positioning portion 45b. With this structure, the movable base 43 positioned by the positioning portion 45b of the positioning bolt 45 is retained by the positioning bolt 45.

[0070] The retaining bolt 46 is provided to extend

downward from the fixed base 42, and includes a shaft portion 46a screwed into the fixed base 42 and a retaining portion 46b provided below the shaft portion 46a. The retaining portion 46b is disc-shaped and longer in diameter than the shaft portion 46a. The retaining portion 46b is provided so that a retaining washer 47 which is longer in external diameter than the retaining portion 46b is placed thereon. In the movable base 43, a retaining hole 43c in which the retaining bolt 46 is inserted is formed. The diameter of this retaining hole 43c is longer than the diameter of the shaft portion 46a and shorter than the external diameter of the retaining washer 47. With this structure, the movable base 43 is retained by the retaining bolt 46 via the retaining washer 47.

[0071] The system-side connection unit 40 is provided with two springs 48 which bias the movable base 43 downward. The two springs 48 are provided in the vicinity of the inner side of the retaining bolt 46 to be side by side with the retaining bolt 46 in the front-back direction. To put it differently, in plan view, the two springs 48 are on the respective sides of the line L connecting the two positioning bolts 45.

[0072] In the fixed base 42 and the movable base 43, housing holes 42a and 43d are formed, respectively, to house the springs 48. The upper end of the housing hole 42a and the lower end of the housing hole 43d are closed by lid members 49, respectively. The springs 48 housed in the housing holes 42a and 43d are not fixed to the upper and lower lid members 49. The housing hole 42a is substantially identical in diameter with the spring 48, and relative movement of the fixed base 42 and the spring 48 in the horizontal direction is restricted. The housing hole 43d is longer in diameter than the spring 48, and relative movement of the movable base 43 and the spring 48 in the horizontal direction is allowed.

[0073] Between the fixed base 42 and the movable base 43, a sheet member 50 made of resin is provided. The sheet member 50 is preferably made of a material with the friction coefficient lower than those of the fixed base 42 and the movable base 43. Examples of this material include resins such as ultrahigh molecular weight polyethylene (UHMW), polyacetal (POM), polyamide (PA6/nylon 6), tetrafluoroethylene (PTFE/Teflon). Alternatively, the sheet member 50 may be made of a non-iron metal material with the friction coefficient of 0.5 or lower. At suitable positions of the sheet member 50, holes are formed to allow the positioning bolts 45, the retaining bolts 46, the springs 48, etc. described above to be inserted.

[0074] As shown in FIG. 8(a), when the male couplers 73 and 83 are not connected to the female couplers 74 and 84, the movable base 43 is engaged with the positioning bolts 45 on account of the weight of the base and the biasing force from the springs 48 (engagement of the tapered surface 43b with the positioning portion 45b), with the result that a positioned state is achieved. In this regard, because the movable base 43 is retained not only by the two positioning bolts 45 but also by the two retain-

ing bolts 46 (retaining washers 47), the positioned state is stably maintained. Furthermore, because the movable base 43 is biased by the two springs 48, it is possible to prevent a part of the movable base 43 from being floated from the positioning bolt 45 and the retaining bolt 46 (retaining washer 47) and tilted from the horizontal direction.

[0075] FIG. 8(b) shows a state in which the displacement between the axis of the male couplers 73 and 83 and the axis of the female couplers 74 and 84 has been corrected by the movement of the male couplers 73 and 83 by the distance d . As the female couplers 74 and 84 move upward, as shown in FIG. 8(b), the female couplers 74 and 84 make contact with the male couplers 73 and 83 from below, with the result that the male couplers 73 and 83 move upward. Consequentially, the movable base 43 to which the male couplers 73 and 83 are fixed moves upward, and hence the movable base 43 is disengaged from the positioning bolts 45. As a result, the movable base 43 becomes movable in the horizontal direction, i.e., in a movable state, within a range of difference between the diameter of the shaft portion 45a of the positioning bolt 45 and the inner diameter of the positioning hole 43a of the movable base 43. On this account, even when the axis of the male coupler 73 (83) is displaced from the axis of the female coupler 74 (84) in the horizontal direction, the displacement is correctable by moving the male coupler 73 (83) in the horizontal direction, and the male coupler 73 (83) becomes connectable to the female coupler 74 (84). In the fixed base 42, notches 42b are formed by cutting around the male couplers 73 and 83 and the guide cylinders 44 in order not to prevent the horizontal movement of the male couplers 73 and 83 and the guide cylinders 44 fixed to the movable base 43, when the movable base 43 is in the movable state.

(Specific Structure of Couplers)

[0076] Now, a specific structure which allows the male coupler 73 (83) to be connected to the female coupler 74 (84) by simply inserting the former into the latter in a relative manner will be described. In spite of small differences in size and shape, the male coupler 83 is basically identical with the male coupler 73 and the female coupler 74 is basically identical with the female coupler 84. The following will therefore describe the specific structure of the male coupler 73 and the female coupler 74.

[0077] FIG. 9 is a cross section of the male coupler 73 and the female coupler 74. FIG. 10 is a cross section showing attachment and detachment of the male coupler 73 and the female coupler 74. FIG. 9 and FIG. 10 do not show the hoses connected to the respective couplers.

[0078] The male coupler 73 is fixed to the movable base 43 of the system-side connection unit 40 and is cylindrical in shape. On the outer circumferential surface of the male coupler 73, an annular groove 73a with which an O-ring 80 is fitted and an engaging portion 73b with which locking balls 94 can be engaged and which is an-

nular groove in shape are formed.

[0079] The female coupler 74 includes an outer cylindrical portion 91 fixed to the second supporting component 56 of the robot-side connection unit 34, an inner cylindrical portion 92 provided inside the outer cylindrical portion 91, a spring 93 biasing the inner cylindrical portion 92 toward the leading end side of the female coupler 74, and locking balls 94 provided at the inner cylindrical portion 92. The inner cylindrical portion 92 includes a large diameter portion 92a on the leading end side, a small diameter portion 92b on the base end side, which is shorter in inner diameter than the large diameter portion 92a, and a level difference portion 92c formed at the border between the large diameter portion 92a and the small diameter portion 92b. The male coupler 73 can be inserted into the large diameter portion 92a but cannot be inserted into the small diameter portion 92b. To put it differently, as the male coupler 73 is inserted into the large diameter portion 92a, the leading end of the male coupler 73 makes contact with the level difference portion 92c, and hence the inner cylindrical portion 92 can be pressed toward the base end side by the male coupler 73.

[0080] At the large diameter portion 92a of the inner cylindrical portion 92, a plurality of housing holes 92d are formed in the circumferential direction, and the locking balls 94 are housed in the respective housing holes 92d. Each locking ball 94 housed in the housing hole 92d is arranged to be able to at least partially protrude radially inward and outward from the housing hole 92d. At the leading end portion of the inner circumferential surface of the outer cylindrical portion 91, a concave retreat portion 91a is formed as an annular notch. On the base end side of the retreat portion 91a, a protruding portion 91b is formed so that the inner circumferential surface thereof protrude radially inward as compared to the retreat portion 91a. When the inner cylindrical portion 92 is not pressed toward the base end side, each locking ball 94 is at least partially retractable to the retreat portion 91a.

[0081] The attachment and detachment of the male coupler 73 to and from the female coupler 74 will be described. To attach or detach the male coupler 73 to or from the female coupler 74, the female coupler 74 is moved in the up-down direction by driving the cylinder 57 of the robot-side connection unit 34. Hereinafter, the position of the female coupler 74 when the male coupler 73 and the female coupler 74 are not connected and in a standby state as shown in FIG. 10(a) will be referred to as an initial position, whereas the position of the female coupler 74 when the male coupler 73 and the female coupler 74 are connected to each other and in a connected state as shown in FIG. 10(c) will be referred to as a connected position.

[0082] To connect the male coupler 73 to the female coupler 74, the female coupler 74 is moved upward from the initial position by driving the cylinder 57 of the robot-side connection unit 34. As a result, the male coupler 73 is inserted into the female coupler 74 in a relative manner. As shown in FIG. 10(b), when the leading end of the male

coupler 73 is in contact with the level difference portion 92c of the inner cylindrical portion 92, the engaging portion 73b of the male coupler 73 opposes the locking balls 94. As the female coupler 74 in this state is further moved upward to the connected position as shown in FIG. 10(c), the male coupler 73 presses the inner cylindrical portion 92 toward the base end side of the female coupler 74 against the biasing force of the spring 93, with the result that the connected state is established. At this stage, because the locking balls 94 are pressed radially inward by the inner circumferential surface of the protruding portion 91b, the locking balls 94 are engaged with the engaging portion 73b of the male coupler 73 and the male coupler 73 is engaged with the inner cylindrical portion 92. Furthermore, the airtight state is maintained by the O-ring 80.

[0083] The inner diameter of the male coupler 73 is arranged to be substantially identical with the inner diameter of the small diameter portion 92b of the female coupler 74 (e.g., both 1 inch), in order to prevent the formation of a level difference between the male coupler 73 and the female coupler 74 in the connected state. As FIG. 10(c) clearly shows, when the female coupler 74 is in the connected position, the spring 93 is not fully contracted, and hence there is a space into which the male coupler 73 is able to further press the inner cylindrical portion 92 toward the base end side of the female coupler 74.

[0084] In a known coupling device, locking balls are moved by operating a sleeve provided on a female coupler. This sleeve, however, does not make contact with a male coupler, and it is therefore necessary to operate the sleeve in addition to the insertion of the male coupler into the female coupler. In this regard, in the present embodiment, as described above, the locking balls 94 are provided at the inner cylindrical portion 92. When the male coupler 73 is inserted into the female coupler 74 in a relative manner, the inner cylindrical portion 92 is pressed and the locking balls 94 are moved. As a result, it is possible to attach and detach the male coupler 73 to and from the female coupler 74 simply by inserting the male coupler 73 into the female coupler 74 in a relative manner and by taking the former off from the latter.

[0085] When the male coupler 73 and the female coupler 74 become in the connected state, the cylinder 57 maintains the female coupler 74 at the connected position during the yarn threading. With this, the contact between the inner cylindrical portion 92 and the male coupler 73 is maintained by the biasing force of the spring 93, and hence the connected state of the male coupler 73 and the female coupler 74 is maintained.

[0086] To disconnect the male coupler 73 from the female coupler 74, the female coupler 74 is moved downward from the connected position by driving the cylinder 57. As a result, as shown in FIG. 10(b), the outer cylindrical portion 91 moves downward relative to the inner cylindrical portion 92, and the retreat portion 91a of the outer cylindrical portion 91 is positioned to oppose the

locking balls 94. At this stage, the locking balls 94 are disengaged from the engaging portion 73b of the male coupler 73 and retreated to the retreat portion 91a, with the result that the male coupler 73 is disengaged from the inner cylindrical portion 92. As the female coupler 74 in this state is further moved downward to the initial position as shown in FIG. 10(a), the male coupler 73 is disconnected from the female coupler 74.

[0087] As described above, because in the present embodiment the connected state is maintained as the cylinder 57 maintains the female coupler 74 at the connected position, the connected state can be basically maintained without using the locking balls 94. However, as described above, a high internal pressure (e.g., about 1.0MPa) is applied to the male coupler 73 and the female coupler 74 in the connected state, because compressed air flows therein. If the locking balls 94 are not provided, the inner cylindrical portion 92 may move toward the base end side of the female coupler 74 away from the male coupler 73, with the result that the connected state may be canceled. If the locking balls 94 are provided, because the male coupler 73 is engaged with the inner cylindrical portion 92 in the connected state, the inner cylindrical portion 92 does not move to the base end side of the female coupler 74 away from the male coupler 73 even if a high internal pressure is applied, with the result that the connected state is maintained with certainty. Because a high internal pressure is not applied to the male coupler 83 and the female coupler 84 of the waste yarn passage 8, it is unnecessary to provide locking balls 94 at the female coupler 84.

(Electric Structure of Spun Yarn Take-Up System)

[0088] Now, an electric structure of the spun yarn take-up system 1 will be described. As shown in FIG. 1, the spun yarn take-up system 1 includes the central controller 4 which is configured to control the entire system. The central controller 4 includes an operation unit 4a which allows an operator to perform settings and a display 4b which displays a screen for helping the settings and a screen displaying states of the components. As shown in FIG. 4, each spun yarn take-up apparatus 2 is provided with a winding controller 101, and this winding controller 101 controls driving units of the spun yarn take-up apparatus 2. The yarn threading robot 3 is provided with a robot controller 102, and this robot controller 102 controls driving units of the yarn threading robot 3.

[0089] The central controller 4 is connected by wireless or by wire with each winding controller 101 and the robot controller 102 so as to be able to communicate therewith. To the central controller 4, a detection signal from the encoder 123 of the yarn threading robot 3 and a detection signal from the connection sensor 76 provided to correspond to each spun yarn take-up apparatus 2 are input. The central controller 4 controls the on-off valve 75 provided on each sub hose 71b of the system-side compressed air hose 71.

(Series of Steps Regarding Yarn Threading)

[0090] When yarn threading is necessary at a spun yarn take-up apparatus 2, a signal indicating a request of yarn threading is sent from the winding controller 101 of that spun yarn take-up apparatus 2 to the central controller 4. In response to this, in order to restart the winding of the yarns Y at this spun yarn take-up apparatus 2, the yarn threading robot 3 is instructed to execute yarn threading onto the spun yarn take-up apparatus 2. When the yarn threading robot 3 is not executing yarn threading, each on-off valve 75 is closed.

[0091] FIG. 11 is a flowchart showing a series of steps regarding yarn threading. The central controller 4 moves the yarn threading robot 3 to a position in front of a predetermined spun yarn take-up apparatus 2 which is the target of yarn threading (step S1). At this stage, the robot controller 102 controls the movement motor 121 with reference to the detection signal from the encoder 123 to stop the yarn threading robot 3 so that the robot-side connection unit 34 of the yarn threading robot 3 opposes the corresponding system-side connection unit 40 of the predetermined spun yarn take-up apparatus 2.

[0092] When the movement of the yarn threading robot 3 to the predetermined spun yarn take-up apparatus 2 is completed, the robot controller 102 drives the cylinder 57 of the robot-side connection unit 34 to move the female couplers 74 and 84 upward from the initial position to the connected position (step S2). As a result, the female coupler 74 is connected to a predetermined male coupler 73 corresponding to the predetermined spun yarn take-up apparatus 2 and the female coupler 84 is connected to a predetermined male coupler 83 corresponding to the predetermined spun yarn take-up apparatus 2.

[0093] When a signal indicating that the female coupler 74 is connected with the predetermined male coupler 73 is sent from the connection sensor 76 corresponding to the predetermined male coupler 73 (step S3), then the central controller 4 opens the on-off valve 75 corresponding to the predetermined male coupler 73 (step S4). As a result, the compressed air supply passage 7 is established from the compressed air supplier 5 to the suction gun 37 of the yarn threading robot 3 via the system-side compressed air hose 71, the male coupler 73, the female coupler 74, and the robot-side compressed air hose 72. In the meanwhile, because no on-off valve is provided on the system-side waste yarn hose 81, once the female coupler 84 is connected to the predetermined male coupler 83, the waste yarn passage 8 is established from the suction gun 37 to the waste yarn box 6 via the robot-side waste yarn hose 82, the female coupler 84, the male coupler 83, and the system-side waste yarn hose 81.

[0094] When negative pressure is generated at the suction port 37c of the suction gun 37 of the yarn threading robot 3 and it becomes possible to suck and retain the yarns Y by the suction gun 37, the robot controller 102 suitably drives the yarn threading unit 33 and the arm motor 122 to execute yarn threading onto the pre-

determined spun yarn take-up apparatus 2 (step S5). When the yarn threading is finished, the central controller 4 closes the on-off valve 75 (step S6), and the robot controller 102 drives the cylinder 57 to move the female couplers 74 and 84 downward from the connected position to the initial position (step S7). As a result the female coupler 74 is disconnected from the predetermined male coupler 73 and the female coupler 84 is disconnected from the predetermined male coupler 83. Then the winding of the yarns Y at the predetermined spun yarn take-up apparatus 2 is resumed (step S8).

(Advantageous Effects)

[0095] In the spun yarn take-up system 1 of the present embodiment, the compressed air supply passage 7 (passage for supplying compressed fluid) from the compressed air supplier 5 (compressed fluid supplier) to the suction gun 37 (sucking retaining unit) of the yarn threading robot 3 is divided into the system-side compressed air hose 71 (system-side supply pipe) and the robot-side compressed air hose 72 (robot-side supply pipe), and these hoses are detachable. On this account, the robot-side compressed air hose 72 of the yarn threading robot 3 is only required to be long enough for the connection with the system-side compressed air hose 71, and is not required to be very long for the connection to the compressed air supplier 5. For this reason, even if the yarn threading robot 3 is arranged to be movable, it is unnecessary to provide a long hose to the yarn threading robot 3 for supplying compressed air (compressed fluid).

[0096] In the spun yarn take-up system 1 of the present embodiment, one of the robot-side supply pipe connecting member provided at the upstream end of the robot-side compressed air hose 72 and the system-side supply pipe connecting member provided at the downstream end of the system-side compressed air hose 71 is a male coupler, and the other one of the connecting members is a female coupler. As such, the system has a simple structure.

[0097] In the spun yarn take-up system 1 of the present embodiment, the robot-side supply pipe connecting member is the female coupler 74 whereas the system-side supply pipe connecting member is the male coupler 73. The female coupler 74 is formed of a plurality of components including the outer cylindrical portion 91, the inner cylindrical portion 92, the spring 93, and the locking balls 94, and is typically more expensive than the male coupler 73. Cost reduction is achieved by setting the robot-side supply pipe connecting member as the female coupler 74 and setting the system-side supply pipe connecting member as the male coupler 73, because only one robot-side supply pipe connecting member is required whereas a plurality of system-side supply pipe connecting members are required.

[0098] In the spun yarn take-up system 1 of the present embodiment, the yarn threading robot 3 includes the cylinder 57 (driving unit) configured to move the female cou-

pler 74 on the robot side to be attached to or detached from the male coupler 73 on the system side. This arrangement achieves cost reduction because only one cylinder 57 for attaching or detaching the female coupler 74 to or from the male coupler 73 is required to be attached to the yarn threading robot 3.

[0099] In the spun yarn take-up system 1 of the present embodiment, the system-side compressed air hose 71 includes the main hose 71a (main pipe) connected to the compressed air supplier 5 and sub hoses 71b (sub pipes) branched from the main hose 71a toward the spun yarn take-up apparatuses 2, and the male couplers 73 are attached to the downstream ends of the sub hoses 71b and the on-off valves 75 are provided at intermediate parts of the sub hoses 71b. Because the compressed air is supplied to a desired part at a desired time by suitably opening and closing the on-off valves 75, unnecessary consumption of the compressed air is restrained.

[0100] In the spun yarn take-up system 1 of the present embodiment, a controller (formed of the central controller 4 and the robot controller 102) configured to control the cylinder 57 and the on-off valves 75 and connection sensors 76 (detection units) configured to detect the connection states between the male couplers 73 and the female couplers 74 and send a detection signal to the controller are further provided. When yarn threading is executed for a predetermined spun yarn take-up apparatus 2, the controller drives the cylinder 57 to connect the female coupler 74 with a predetermined male coupler 73 corresponding to the predetermined spun yarn take-up apparatus 2, and upon receiving the detection signal indicating that the predetermined male coupler 73 is in the connected state from a predetermined connection sensor 76, the controller opens a predetermined on-off valve 75 corresponding to the predetermined male coupler 73. Because supply of the compressed air before the connection of the female coupler 74 with the predetermined male coupler 73 is certainly prevented, unnecessary consumption of the compressed air is further effectively restrained.

[0101] In the spun yarn take-up system 1 of the present embodiment, when the yarn threading onto the predetermined spun yarn take-up apparatus 2 is finished, the controller closes the predetermined on-off valve 75 and then drives the cylinder 57 to detach the female coupler 74 from the predetermined male coupler 73. Because detachment of the female coupler 74 from the predetermined male coupler 73 during the supply of the compressed air is certainly prevented, unnecessary consumption of the compressed air is further effectively restrained.

[0102] In the spun yarn take-up system 1 of the present embodiment, being similar to the compressed air supply passage 7, the waste yarn passage 8 (passage for wasting yarns) from the suction gun 37 of the yarn threading robot 3 to the waste yarn box 6 (yarn waste unit) is divided into the robot-side waste yarn hose 82 and the system-side waste yarn hose 81, and these members are arranged to be detachable. On this account, the robot-side

waste yarn hose 82 of the yarn threading robot 3 is only required to be long enough for the connection with the system-side waste yarn hose 81, and is not required to be very long for the connection to the waste yarn box 6. For this reason, even if the yarn threading robot 3 is arranged to be movable, it is unnecessary to provide a long hose to the yarn threading robot 3 for wasting the yarns Y.

[0103] In the spun yarn take-up system 1 of the present embodiment, one of the robot-side discharge pipe connecting member provided at the downstream end of the robot-side waste yarn hose 82 and the system-side discharge pipe connecting member provided at the upstream end of the system-side waste yarn hose 81 is a male coupler, and the other one of the connecting members is a female coupler. As such, the system has a simple structure.

[0104] In the spun yarn take-up system 1 of the present embodiment, the robot-side discharge pipe connecting member is the female coupler 84 whereas the system-side discharge pipe connecting member is the male coupler 83. As described above, the female coupler 84 is typically more expensive than the male coupler 83. Cost reduction is achieved by setting the robot-side discharge pipe connecting member as the female coupler 84 and setting the system-side discharge pipe connecting member as the male coupler 83, because only one robot-side discharge pipe connecting member is required whereas a plurality of system-side discharge pipe connecting members are required.

[0105] In the yarn threading robot 3 of the present embodiment, because the robot-side compressed air hose 72 is detachable from the system-side compressed air hose 71, the robot-side compressed air hose 72 is only required to be long enough for the connection with the system-side compressed air hose 71, and is not required to be very long for the connection to the compressed air supplier 5. For this reason, even if the yarn threading robot 3 is arranged to be movable, it is unnecessary to provide a long hose to the yarn threading robot 3 for supplying compressed air.

[0106] In the yarn threading robot 3 of the present embodiment, because the robot-side waste yarn hose 82 is detachable from the system-side waste yarn hose 81, the robot-side waste yarn hose 82 is only required to be long enough for the connection with the system-side waste yarn hose 81, and is not required to be very long for the connection to the waste yarn box 6. For this reason, even if the yarn threading robot 3 is arranged to be movable, it is unnecessary to provide a long hose for discharging the yarns Y from the yarn threading robot 3.

[0107] In the yarn threading robot 3 of the present embodiment, the second supporting component 56 (supporting component) supporting both of the female couplers 74 and 84 and the cylinder 57 configured to move the second supporting component 56 so that the female coupler 74 is attached or detached from the male coupler 73 and the female coupler 84 is attached to or detached from the male coupler 83 are further provided. This ar-

rangement achieves cost reduction because only one cylinder 57 for moving the female couplers 74 and 84 is required and hence the number of components is reduced.

(Other embodiments)

[0108] Although the embodiment of the present invention has been described, the present invention is not limited to the above and can be suitably changed within the scope of the present invention as described below.

[0109] For example, in the embodiment above, connecting members provided on the system side are the male couplers 73 and 83 whereas connecting members provided on the robot side are the female couplers 74 and 84. Alternatively, connecting members on the system side may be female couplers whereas connecting members on the robot side may be male couplers.

[0110] In the embodiment above, the male coupler 73 (83) is attached to or detached from the female coupler 74 (84) by moving the female coupler 74 (84) on the robot side. Alternatively, the detachment or attachment of the male coupler 73 (83) from and to the female coupler 74 (84) may be performed by moving the male couplers 73 and 83 on the system side.

[0111] In the embodiment above, the male coupler 73 (83) connected to the female coupler 74 (84) as the female coupler 74 (84) on the robot side moves upward. Alternatively, the male coupler 73 (83) may be connected to the female coupler 74 (84) as the male coupler 73 (83) on the system side moves downward. Alternatively, the male coupler 73 (83) may move upward whereas the female coupler 74 (84) may move downward.

[0112] In the embodiment above, the system-side connection unit 40 is provided above the robot-side connection unit 34, and the system-side connection unit 40 has the positional displacement correction function. Alternatively, the robot-side connection unit 34 may be provided above the system-side connection unit 40 and the robot-side connection unit 34 may have the positional displacement correction function.

[0113] In the embodiment above, the positioning bolts 45 function as positioning members. A specific example of the positioning member, however, is not limited to the bolt. For example, the positioning member may be fixed to the fixed base 42 by welding.

[0114] In the embodiment above, the sheet member 50 is provided between the fixed base 42 and the movable base 43 in order to improve the slidability of the movable base 43. Alternatively, in place of the sheet member 50, a material with a low friction coefficient may be applied to the lower surface of the fixed base 42 or the upper surface of the movable base 43, or one of these surfaces may be processed to improve the slidability. When the slidability is deteriorated due to abrasion or the like, the sheet member 50 as in the embodiment above is preferable, because the sheet member 50 is replaceable.

[0115] In the embodiment above, the female couplers 74 and 84 on the robot side are attached to the common second supporting component 56. In this regard, because the female couplers 74 and 84 may not be attached to a common component, the female couplers 74 and 84 may be individually moved.

[0116] While in the embodiment above the system-side connection unit 40 is fixed to the guide rails 35 for the yarn threading robot 3, the system-side connection unit 40 may be fixed to a different position.

[0117] In the embodiment above, one compressed air supplier 5 and one waste yarn box 6 are provided for all spun yarn take-up apparatuses 2 of the spun yarn take-up system 1. Alternatively, a compressed air supplier 5 and a waste yarn box 6 may be provided for each spun yarn take-up apparatus 2, or a compressed air supplier 5 and a waste yarn box 6 may be provided for a predetermined number of spun yarn take-up apparatuses 2.

[0118] In the embodiment above, one yarn threading robot 3 is provided for all spun yarn take-up apparatuses 2 of the spun yarn take-up system 1. Alternatively, a yarn threading robot 3 may be provided for a predetermined number of spun yarn take-up apparatuses 2.

[0119] In the embodiment above, all of the series of steps regarding the yarn threading is automatically executed by the yarn threading robot 3 and the central controller 4. Alternatively, at least one of the steps may be executed by an operator. For example, the male coupler 73 (83) may be attached to or detached from the female coupler 74 (84) by the operator, or the on-off valve 75 may be opened or closed by the operator.

[0120] In the embodiment above, the on-off valve 75 is provided upstream of the male coupler 73. Alternatively, in place of the on-off valve 75, a female coupler 74 with valve may be used and the valve may be automatically opened in connection.

[0121] The target of control by the central controller 4 and the target of control by the robot controller 102 are not limited to those described in the embodiment above. For example, the central controller 4 may control specific operations of the yarn threading robot 3. Furthermore, the robot controller 102 may control the on-off valve 75 and/or receive a detection signal from the connection sensor 76.

[0122] In the embodiment above, the "system-side supply pipe", the "robot-side supply pipe", the "system-side discharge pipe", and the "robot-side discharge pipe" of the present invention are hoses. Alternatively, these pipes may be metal pipes instead of hoses, for example.

[0123] While in the embodiment above the yarn threading robot 3 hangs down from the guide rails 35, the yarn threading robot 3 may not be arranged in this way. For example, the yarn threading robot 3 may be arranged to run on the floor.

[0124] In the embodiment above, when the male coupler 73 (83) is connected to the female coupler 74 (84), the movable base 43 is shifted from the positioning state to the movable state as the female coupler 74 (84) makes

contact with the male coupler 73 (83) from below in a relative manner. Alternatively, the movable base 43 may be shifted from the positioning state to the movable state as a pin component 55 shown in FIG. 6 makes contact with and is inserted into the guide cylinder 44. When the movable base 43 is shifted to the movable state on account of the contact between the pin component 55 and the guide cylinder 44, the correction of displacement is further certainly carried out.

Claims

1. A spun yarn take-up system comprising:

spun yarn take-up apparatuses which are lined up in a predetermined direction;
 a yarn threading robot which is movable in the predetermined direction and is capable of performing yarn threading onto the spun yarn take-up apparatuses; and
 a compressed fluid supplier configured to supply compressed fluid to the yarn threading robot, wherein,
 the yarn threading robot includes a sucking retaining unit configured to generate a negative pressure when the compressed fluid is supplied from the compressed fluid supplier and is configured to perform the yarn threading while sucking and retaining a yarn by the sucking retaining unit,
 a supply passage for supplying the compressed fluid from the compressed fluid supplier to the sucking retaining unit includes:

a system-side supply pipe extending from the compressed fluid supplier to the spun yarn take-up apparatuses;
 a robot-side supply pipe connected to the sucking retaining unit;
 a system-side supply pipe connecting member attached to a downstream end of the system-side supply pipe; and
 a robot-side supply pipe connecting member attached to an upstream end of the robot-side supply pipe, and
 the robot-side supply pipe connecting member and the system-side supply pipe connecting member are arranged to be detachable from each other and attachable to each other.

2. The spun yarn take-up system according to claim 1, wherein, one of the robot-side supply pipe connecting member and the system-side supply pipe connecting member is a male coupler and the other one is a female coupler.

3. The spun yarn take-up system according to claim 2, wherein, the robot-side supply pipe connecting member is a female coupler and the system-side supply pipe connecting member is a male coupler.

4. The spun yarn take-up system according to any one of claims 1 to 3, wherein, the yarn threading robot includes a driving unit which is configured to move the robot-side supply pipe connecting member to be attached to or detached from the system-side supply pipe connecting member.

5. The spun yarn take-up system according to claim 4, wherein, the system-side supply pipe is formed of a main pipe connected to the compressed fluid supplier and sub pipes branched from the main pipe toward the spun yarn take-up apparatuses, the system-side supply pipe connecting members are attached to downstream ends of the sub pipes, and on-off valves are provided at intermediate parts of the sub pipes.

6. The spun yarn winding system according to claim 5, further comprising:

a controller configured to control the driving unit and the on-off valves; and
 detection units configured to detect connected states between the system-side supply pipe connecting members and the robot-side supply pipe connecting member and send a detection signal to the controller,
 when the yarn threading is performed for a predetermined one of the spun yarn take-up apparatuses, the controller driving the driving unit so as to connect the robot-side supply pipe connecting member to a predetermined one of the system-side supply pipe connecting members corresponding to the predetermined one of the spun yarn take-up apparatuses, and in response to the detection signal which indicates that the predetermined one of the system-side supply pipe connecting members is in the connected state and is sent from the predetermined one of the detection units, the controller opening a predetermined one of the on-off valves corresponding to the predetermined one of the system-side supply pipe connecting members.

7. The spun yarn take-up system according to claim 6, wherein, when the yarn threading onto the predetermined one of the spun yarn take-up apparatuses ends, the controller closes the predetermined one of the on-off valves and drives the driving unit so as to detach the robot-side supply pipe connecting member from the predetermined one of the system-side supply pipe connecting members.

8. The spun yarn take-up system according to any one of claims 1 to 7, further comprising a yarn waste unit to which the yarn sucked by the sucking retaining unit is wasted, wherein, a passage for wasting the yarn, which extends from the sucking retaining unit to the yarn waste unit, includes:

a robot-side discharge pipe connected to the sucking retaining unit;
 a system-side discharge pipe extending from the spun yarn take-up apparatuses to the yarn waste unit;
 a robot-side discharge pipe connecting member attached to a downstream end of the robot-side discharge pipe; and
 a system-side discharge pipe connecting member attached to an upstream end of the system-side discharge pipe, and
 the robot-side discharge pipe connecting member and the system-side discharge pipe connecting member are arranged to be detachable from each other and attachable to each other.

9. The spun yarn take-up system according to claim 8, wherein, one of the robot-side discharge pipe connecting member and the system-side discharge pipe connecting member is a male coupler and the other one is a female coupler.

10. The spun yarn take-up system according to claim 9, wherein, the robot-side discharge pipe connecting member is a female coupler and the system-side discharge pipe connecting member is a male coupler.

11. A yarn threading robot which is movable in a predetermined direction and is capable of performing yarn threading onto spun yarn take-up apparatuses lined up in the predetermined direction, comprising:

a sucking retaining unit configured to generate a negative pressure when compressed fluid is supplied from an external compressed fluid supplier and capable of sucking and retaining a yarn;
 a robot-side supply pipe connected to the sucking retaining unit and receiving the compressed fluid from the compressed fluid supplier; and
 a robot-side supply pipe connecting member attached to an upstream end of the robot-side supply pipe, wherein,
 the robot-side supply pipe connecting member is attachable to and detachable from a system-side supply pipe connecting member attached to a downstream end of the system-side supply pipe extending from the compressed fluid supplier to the spun yarn take-up apparatuses.

12. The yarn threading robot according to claim 11, further comprising:

a robot-side discharge pipe connected to the sucking retaining unit and discharging the yarn sucked by the sucking retaining unit to an external yarn waste unit; and
 a robot-side discharge pipe connecting member attached to a downstream end of the robot-side discharge pipe, wherein
 the robot-side discharge pipe connecting member is attachable to and detachable from a system-side discharge pipe connecting member attached to an upstream end of the system-side discharge pipe extending from the spun yarn take-up apparatuses to the yarn waste unit.

13. The yarn threading robot according to claim 12, further comprising:

a supporting component supporting both the robot-side supply pipe connecting member and the robot-side discharge pipe connecting member; and
 a driving unit configured to move the supporting component so that the robot-side supply pipe connecting member is attached to or detached from the system-side supply pipe connecting member and the robot-side discharge pipe connecting member is attached to or detached from the system-side discharge pipe connecting member.

FIG.1

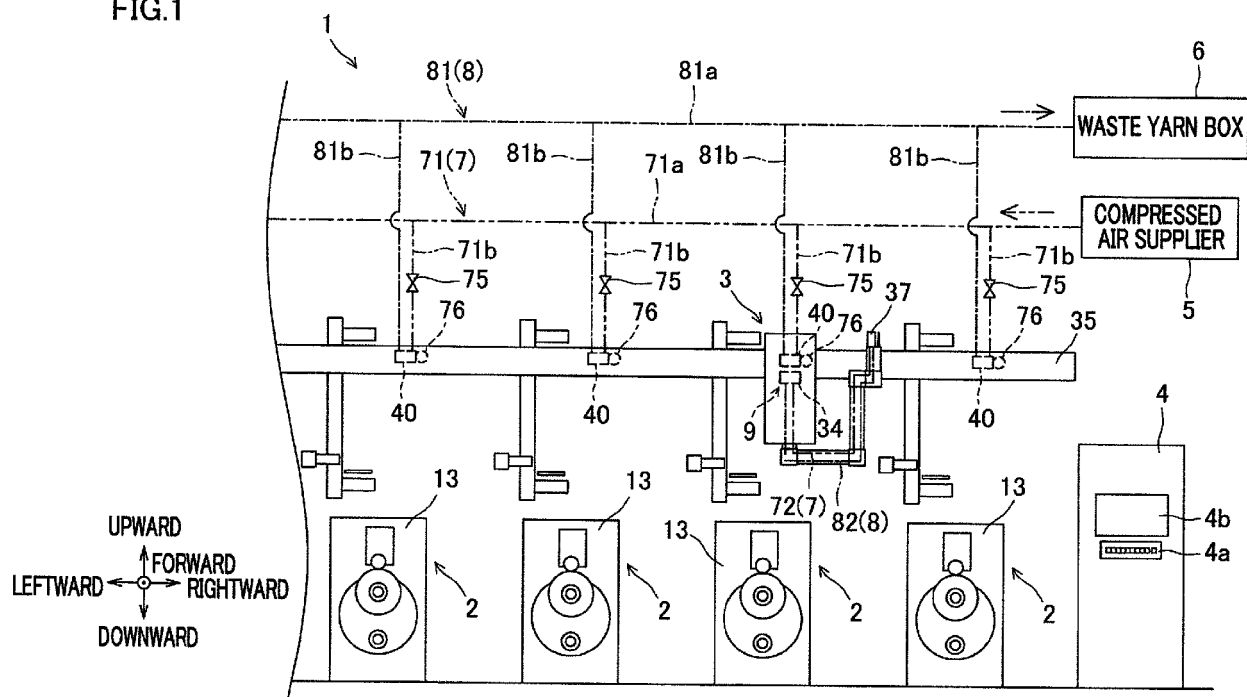


FIG.2

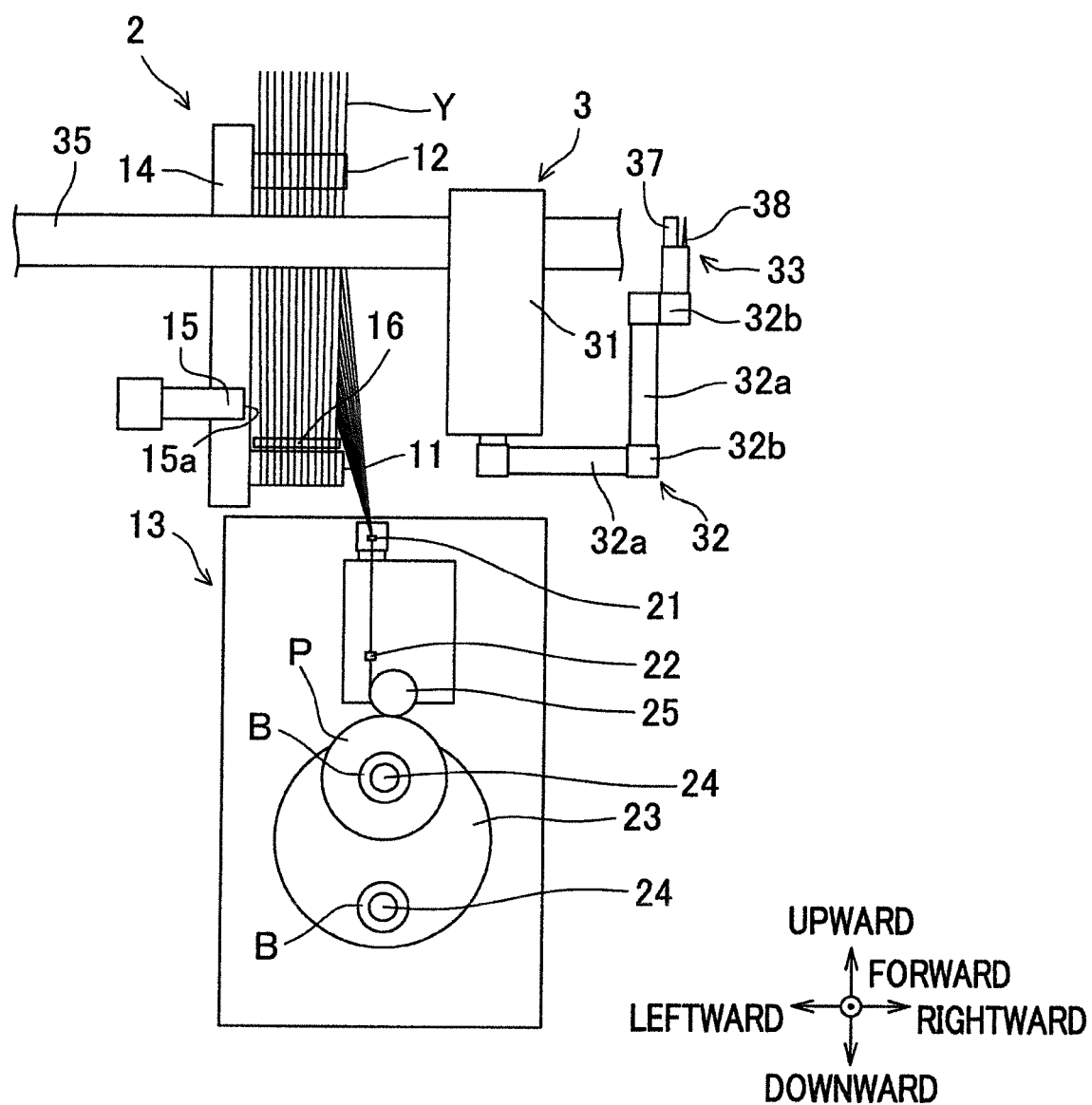


FIG.3

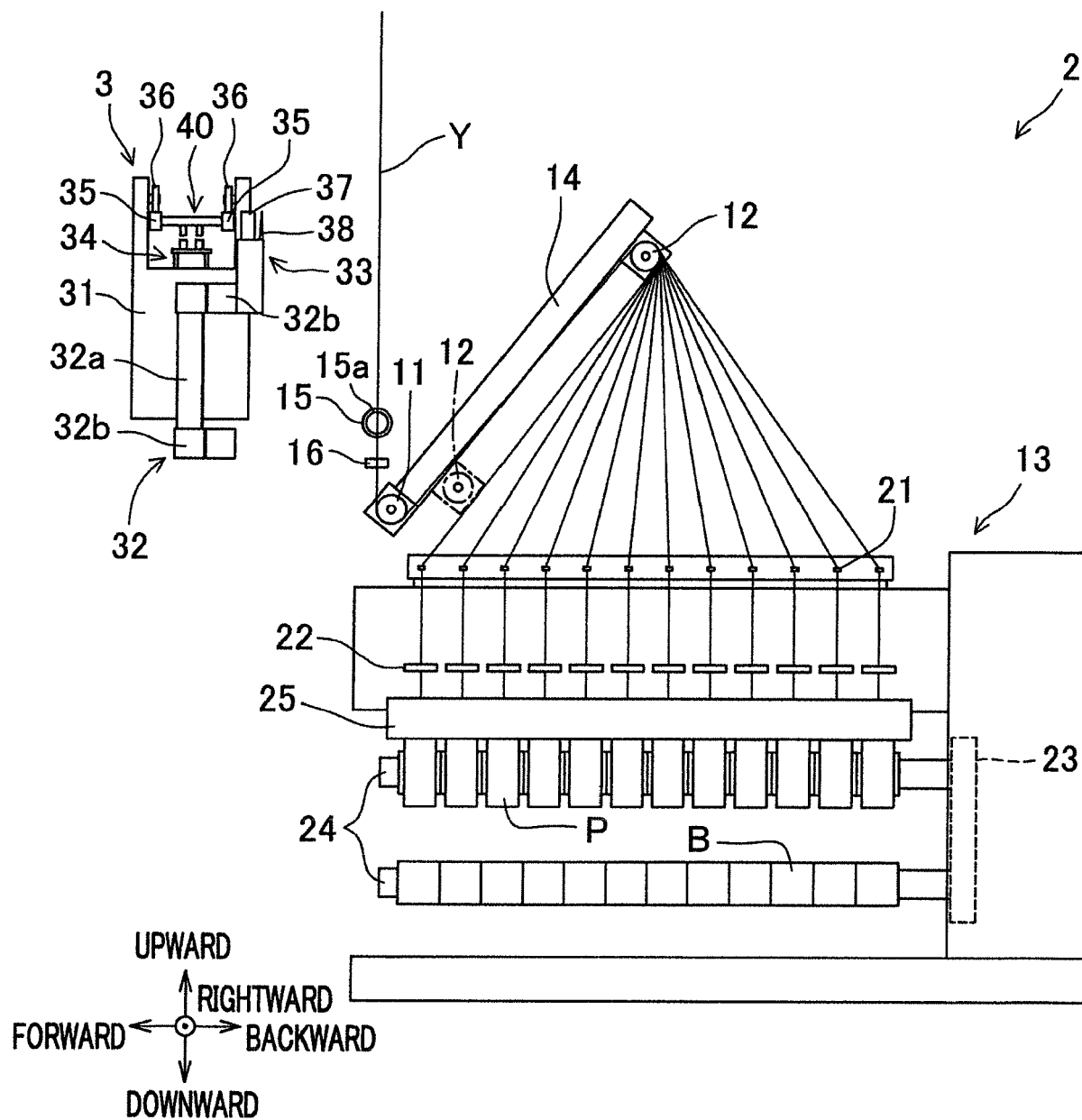


FIG.4

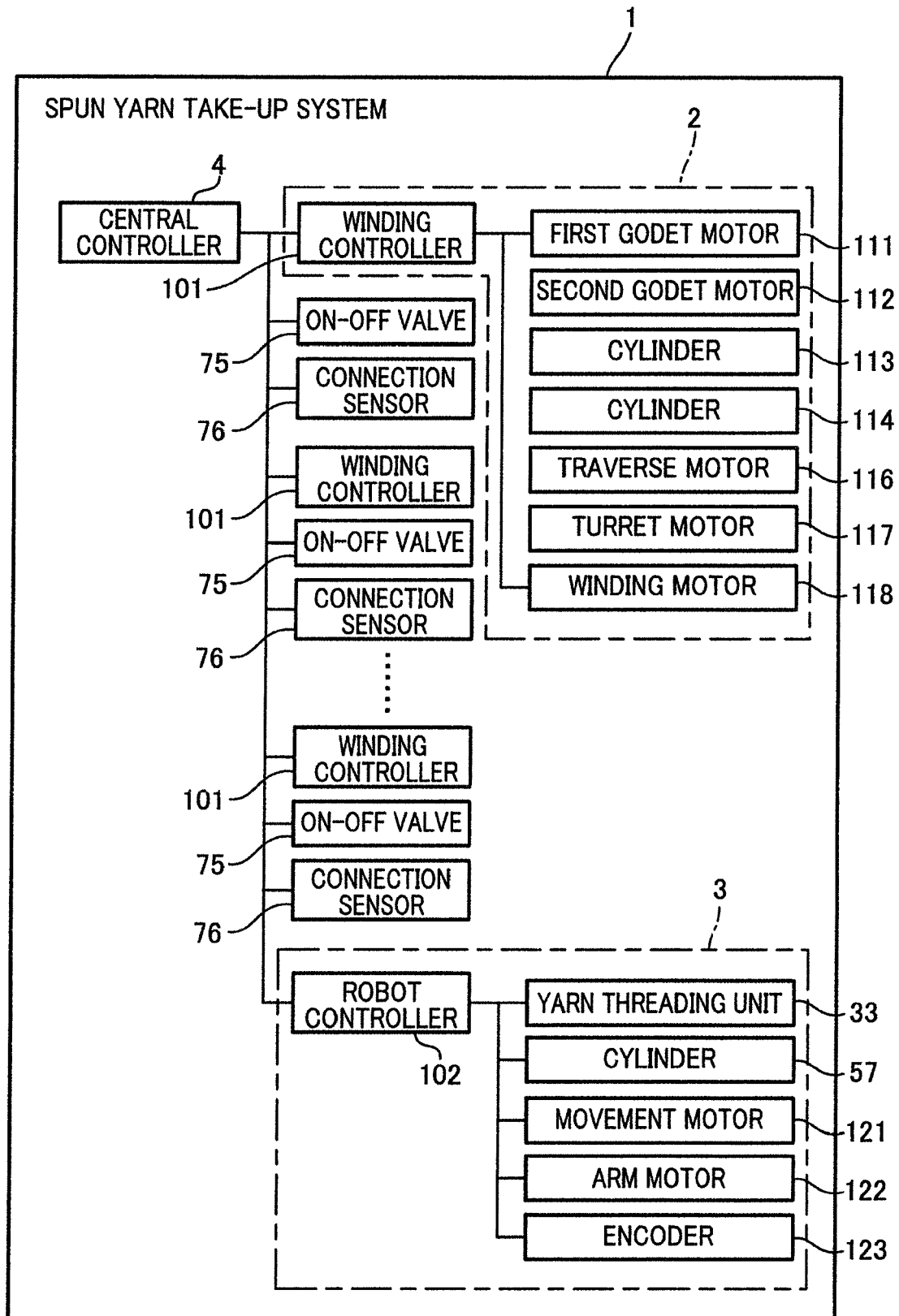


FIG.5

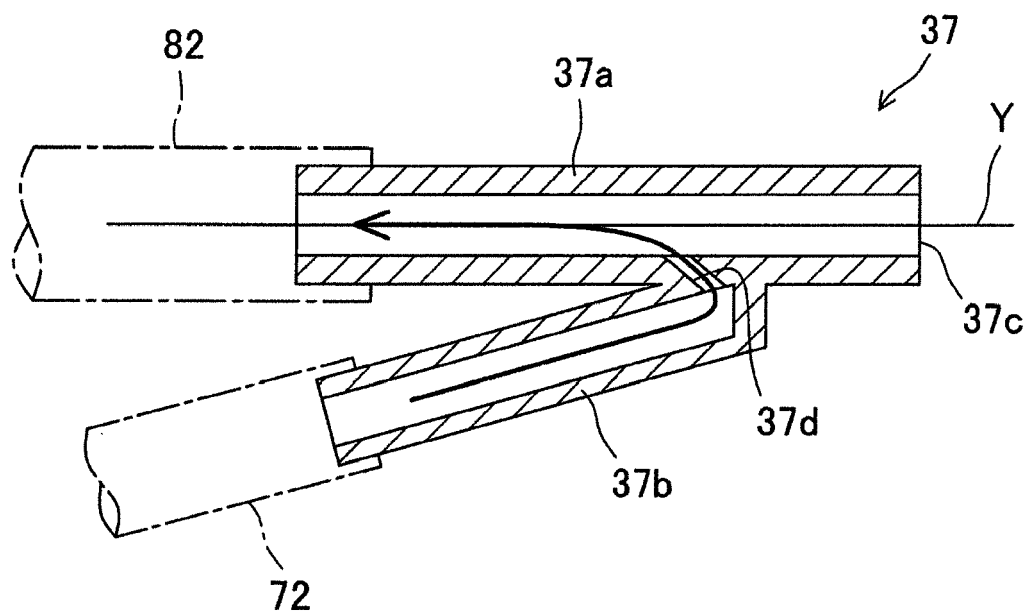


FIG.6

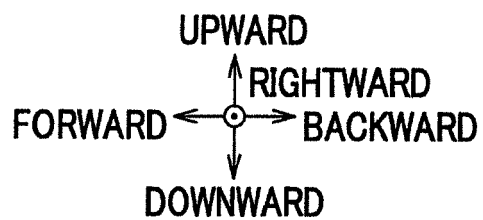
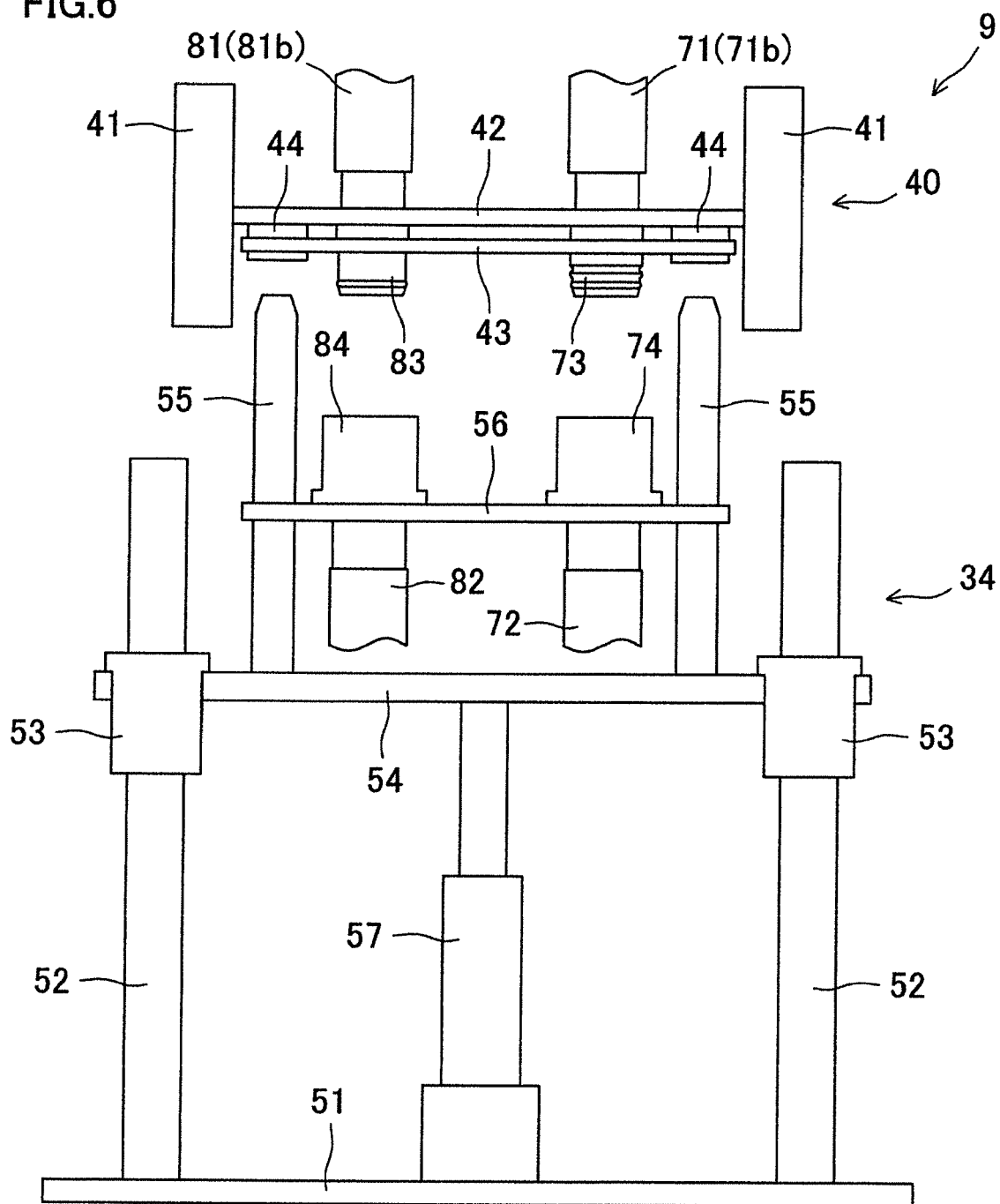


FIG.7

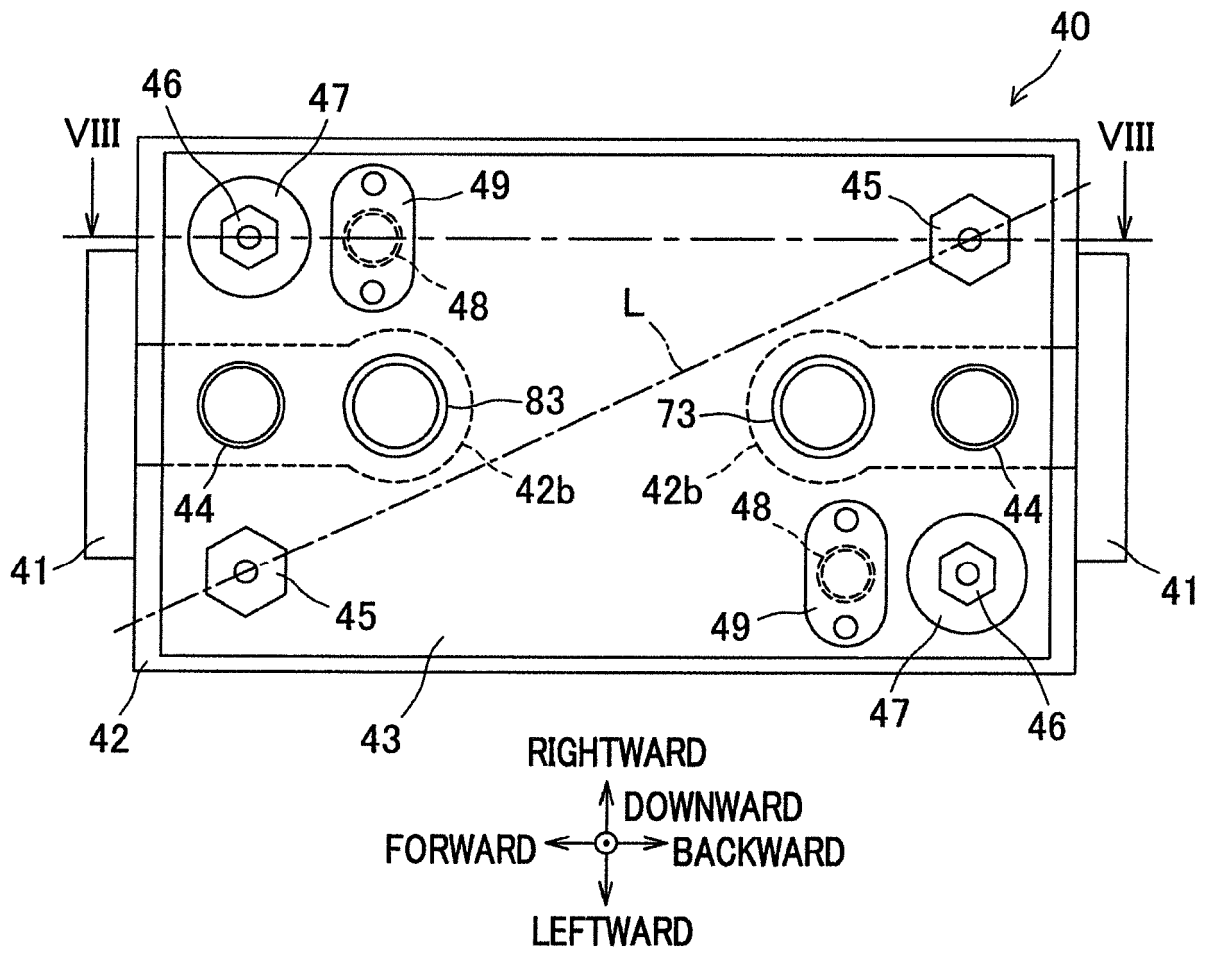


FIG.8

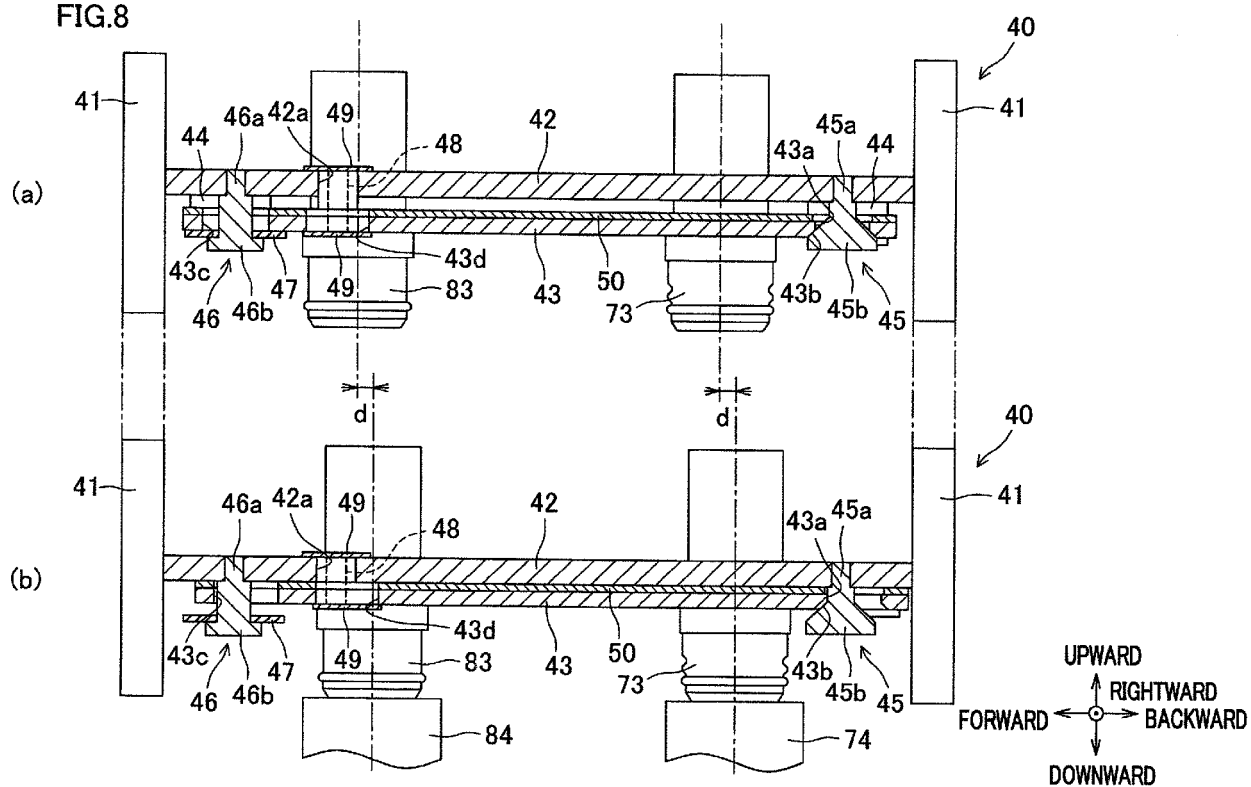


FIG.9

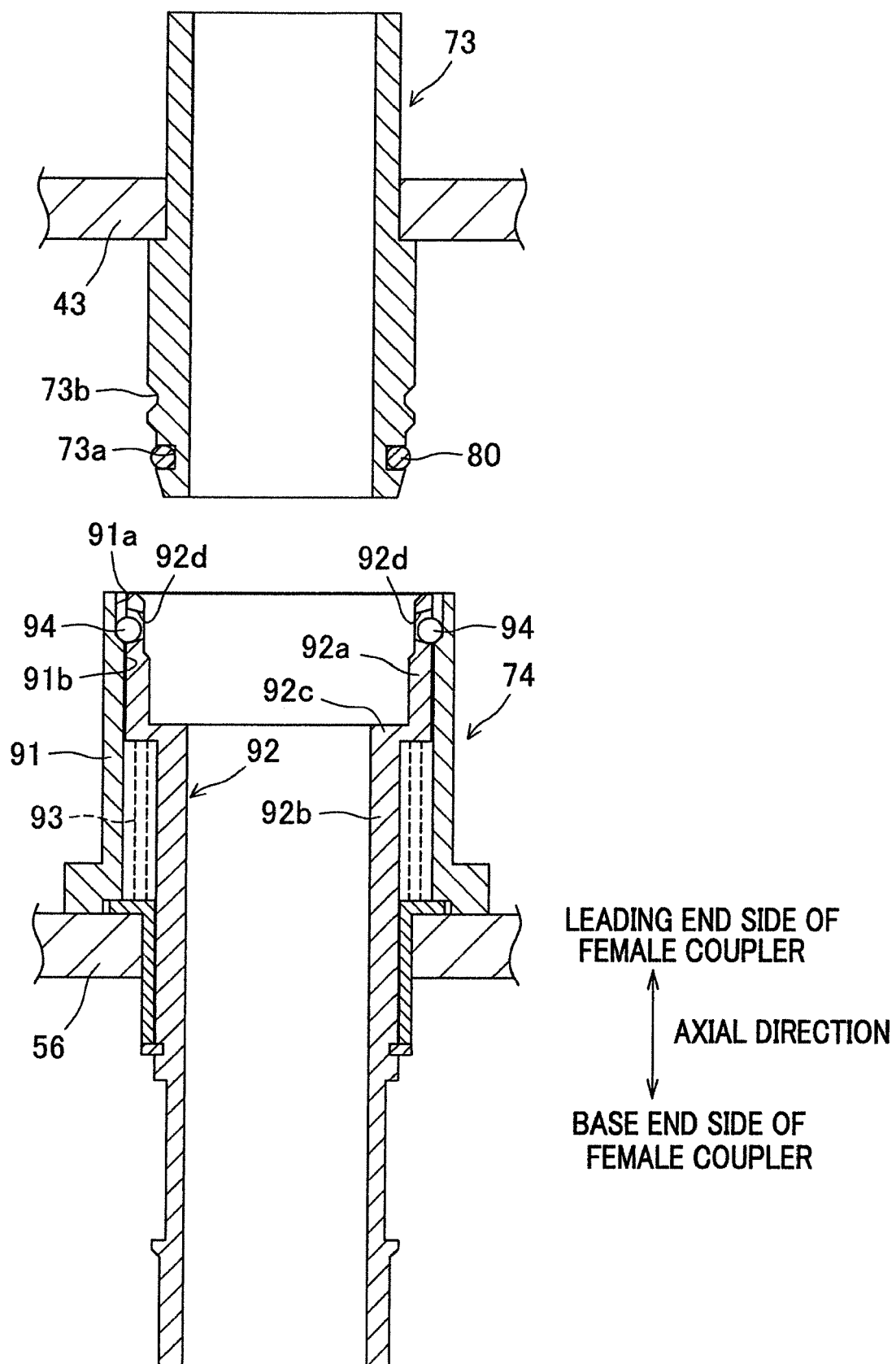


FIG.10

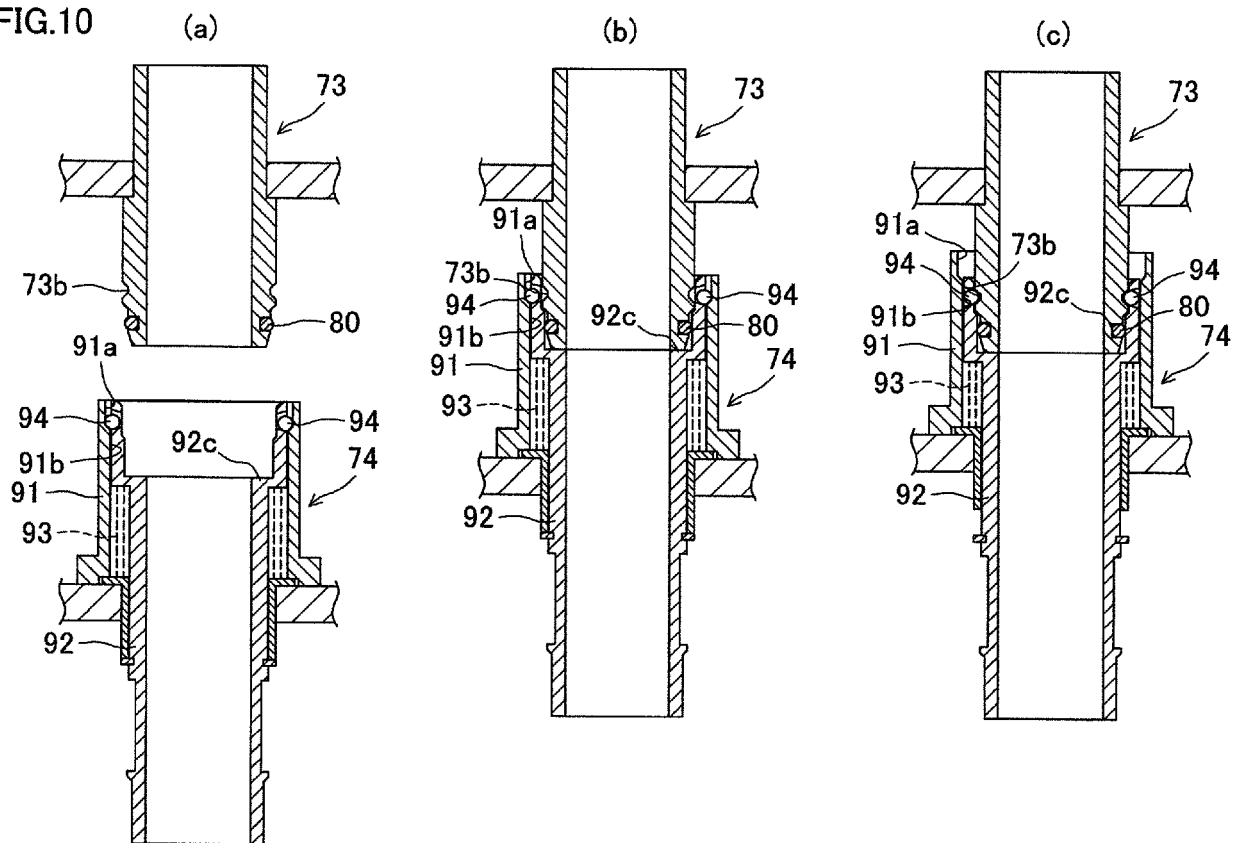
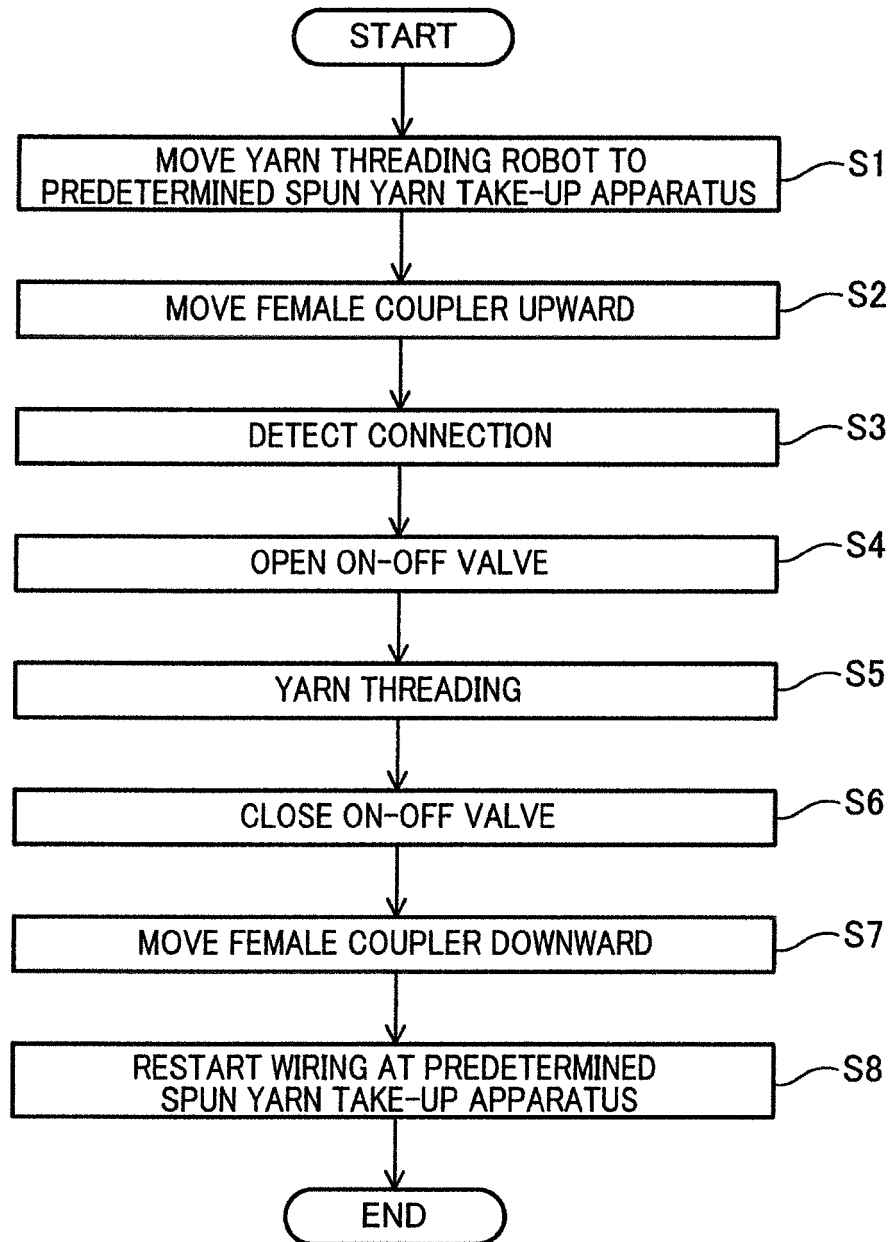


FIG.11





EUROPEAN SEARCH REPORT

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A,D	JP S53 106815 A (TEIJIN LTD) 18 September 1978 (1978-09-18)	1-13	
	* abstract; figures * -----		
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			B65H D01D
Place of search		Date of completion of the search	Examiner
The Hague		16 February 2018	Lemmen, René
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