(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 378 870 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
05.06.2024 Bulletin 2024/23

(21) Application number: **24166767.4**

(22) Date of filing: **17.02.2021**

(51) International Patent Classification (IPC):
B65H 57/00 *(2006.01)* ***B65H 63/036*** *(2006.01)*
B65H 57/16 *(2006.01)* ***D01D 7/00*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
B65H 57/003; B65H 57/16; B65H 63/036;
B65H 2701/3132; D01D 7/00

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **11.03.2020 JP 2020041770**

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
21157614.5 / 3 878 784

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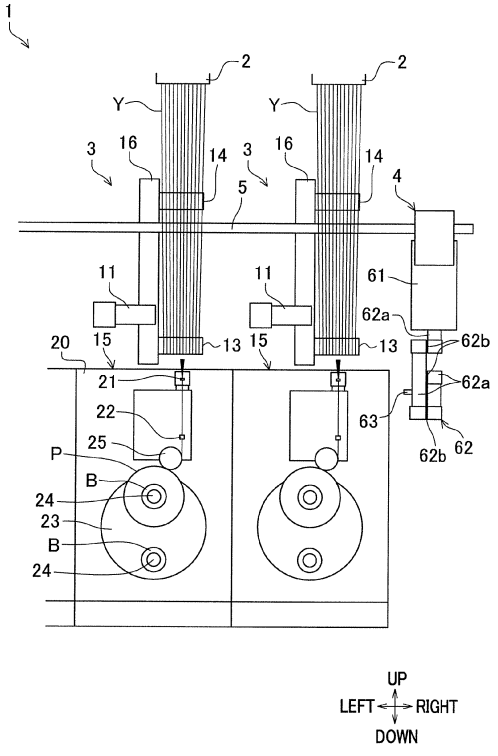
Remarks:
This application was filed on 27.03.2024 as a divisional application to the application mentioned under INID code 62.

(54) TEXTILE MACHINE

(57) Defects that may occur when a yarn threading target member does not properly move are suppressed. A spun yarn take-up machine 1 (textile machine) processing at least one yarn Y includes a fulcrum guide 21 (yarn threading target member) to which the yarn Y is threaded, a drive unit 30 configured to move the fulcrum guide 21 between a production position and a yarn threading position, a location information detection unit 70 configured to detect information regarding movement of the fulcrum guide 21 by the drive unit 30, and a controller. The controller determines whether the movement of the fulcrum guide 21 is properly done, based on a result of detection by the location information detection unit 70.

FIG.1



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a textile machine.

[0002] A spun yarn take-up machine (textile machine) recited in each of Patent Literatures 1 and 2 (Japanese Laid-Open Patent Publication No. 2017-82379 and Japanese Laid-Open Patent Publication No. 2015-78455) includes a take-up unit which is configured to form packages by winding yarns onto bobbins while traversing the yarns. The take-up unit includes fulcrum guides which are lined up to correspond to the respective bobbins and function as fulcrums when the yarns are traversed. The fulcrum guides are moved by, for example, an air cylinder between a production position where the yarns are wound onto the bobbins and a yarn threading position where the fulcrum guides are close to one another as compared to the production position. To the fulcrum guides at the yarn threading position, yarns are threaded by a yarn threading robot (see Patent Literature 1) or an operator (see Patent Literature 2).

SUMMARY OF THE INVENTION

[0003] When a drive unit such as the air cylinder does not properly operate on account of, for example, clogging due to yarn dust, a yarn threading target member such as the fulcrum guides cannot properly move. In such a case, the following defect occurs, for example.

[0004] Although not described in Patent Literature 1, in an arrangement in which a yarn is threaded to a yarn threading target member by a yarn threading robot, it is considered, for example, that movement of the yarn threading target member is completed when a predetermined time elapses from the start of the movement, and then yarn threading is performed. On this account, the yarn threading may not be successfully done if the yarn threading is performed in a state in which the yarn threading target member is displaced from the desired position.

[0005] Furthermore, no matter whether the yarn threading is performed by the yarn threading robot or the operator, winding of the yarn may start in a state in which the fulcrum guides are displaced from the desired position, if the fulcrum guides do not properly return the production position. As a result, packages may not be properly formed.

[0006] An object pf the present invention is to suppress defects that may occur when a yarn threading target member does not properly move.

[0007] According to a first aspect of the invention, a textile machine that processes at least one yarn includes: a yarn threading target member to which the at least one yarn is threaded; a drive unit configured to move the yarn threading target member between a predetermined production position and a yarn threading position different from the production position; a detection unit configured to detect information regarding movement of the yarn threading target member by the drive unit; and a controller, the controller determining whether the movement of the yarn threading target member is proper based on a result of detection by the detection unit.

[0008] According to this aspect of the invention, the yarn threading can be performed when it is determined that the movement of the yarn threading target member is properly done, and the yarn threading may be, for example, terminated when it is determined that the movement of the yarn threading target member is not properly done. It is therefore possible to suppress defects that may occur when the yarn threading target member does not properly move.

[0009] According to a second aspect of the invention, the textile machine of the first aspect further includes an automatic yarn threading device configured to perform yarn threading to the yarn threading target member, the controller continuing an operation of the automatic yarn threading device only when it is determined that the movement of the yarn threading target member is proper.

[0010] It is therefore possible in this aspect to reliably prevent unintentional yarn threading by the yarn threading robot, when there is a defect in the movement of the yarn threading target member.

[0011] According to a third aspect of the invention, the textile machine of the first or second aspect further includes a notification unit configured to notify information, when it is determined that a failure occurs in the movement of the yarn threading target member, the controller causing the notification unit to notify information indicating occurrence of a failure.

[0012] According to this aspect of the invention, when there is a defect in the movement of the yarn threading target member, the operator is prompted to perform an immediate action.

[0013] According to a fourth aspect of the invention, the textile machine of any one of the first to third aspects is arranged such that the detection unit is configured to detect information regarding a position of the yarn threading target member.

[0014] According to this aspect of the invention, it is possible to easily determine whether the movement of the yarn threading target member is proper, by using the information regarding the position of the yarn threading target member.

[0015] According to a fifth aspect of the invention, the textile machine of the fourth aspect is arranged such that the location information detection unit is a limit switch configured to detect information indicating whether the yarn threading target member is at a target position.

[0016] According to this aspect of the invention, because a limit switch that is typically inexpensive is used, it is possible to easily determine whether the yarn threading target member has reached the target position, while suppressing the increase in production cost of the textile machine.

[0017] According to a sixth aspect of the invention, the

textile machine of the fourth or fifth aspect is arranged such that the drive unit includes an air cylinder.

[0018] Because the thrust force of the air cylinder is typically lower than that of, for example, an electric motor, the movement of the yarn threading target member may be obstructed even by, for example, slight clogging due to yarn dust. In such an arrangement, determination of whether the movement of the yarn threading target member is proper or not based on a result of detection by the location information detection unit is effective.

[0019] According to a seventh aspect of the invention, the textile machine of any one of the first to fifth aspects is arranged such that the drive unit includes an electric motor.

[0020] When, for example, a gap between the movable portion of the electric motor and a fixed portion is clogged with yarn dust or the like, the electric motor may be excessively loaded and broken. According to the aspect of the invention, the electric motor is stopped when it is determined that a defect has occurred in the movement of the yarn threading target member. It is therefore possible to suppress the load on the electric motor from becoming excessive.

[0021] According to an eighth aspect of the invention, the textile machine of the seventh aspect is arranged such that the detection unit is configured to detect information regarding a position of a movable portion of the electric motor.

[0022] According to this aspect of the invention, it is possible to indirectly obtain the information regarding the position of the yarn threading target member by utilizing the information regarding the position of the movable portion. It is therefore possible to determine whether the movement of the yarn threading target member is properly done, even when the information regarding the location of the yarn threading target member cannot be directly obtained.

[0023] According to a ninth aspect of the invention, the textile machine of the seventh or eighth aspect is arranged such that the electric motor is a stepping motor, and the detection unit is configured to detect step-out of the stepping motor.

[0024] According to this aspect of the invention, it is possible to determine whether the motor is properly driven by utilizing information regarding the step-out. It is therefore possible to determine whether the movement of the yarn threading target member is properly done, even when the information regarding the location of the yarn threading target member cannot be obtained.

[0025] According to a tenth aspect of the invention, the textile machine of any one of the first to ninth aspects further includes: a bobbin holder which supports bobbins on which two or more yarns are wound, respectively, the supported bobbins being aligned in an axial direction of the bobbins; and traverse guides which are aligned in the axial direction to correspond to the respective bobbins and are configured to traverse the respective yarns, the yarn threading target member including fulcrum guides which are aligned in the axial direction to correspond to the respective traverse guides and function as fulcrums when the yarns are traversed, and the fulcrum guides being movable between: a distanced position which is the production position, where the yarns are wound onto the respective bobbins; and a gathered position which is the yarn threading position, where intervals of the fulcrum guides in the axial direction are short as compared to intervals of the fulcrum guides in the distanced position.

[0026] Because the fulcrum guides are required to move between the distanced position and the gathered position over a long distance, the fulcrum guides are likely to fail to reach the target position when the drive unit does not properly operate. In such an arrangement, determination of whether the movement of the yarn threading target member is proper or not based on a result of detection by the detection unit is effective.

[0027] According to an eleventh aspect of the invention, the textile machine of the tenth aspect is arranged such that the detection unit is configured to detect information regarding whether the fulcrum guides are properly provided at the distanced position.

[0028] When the fulcrum guides are deviated from the distanced position at the time of the winding of the yarns onto the bobbins, the yarns threaded to the fulcrum guides may not be properly wound onto the bobbins, and hence the yarns wound onto the bobbins may be wasteful. In such an arrangement, determination of whether the movement of the fulcrum guides is proper or not based on a result of detection by the detection unit is effective.

[0029] According to a twelfth aspect of the invention, the textile machine of the tenth or eleventh aspect is arranged such that the detection unit is configured to detect information regarding whether the fulcrum guides are properly provided at the gathered position.

[0030] When the fulcrum guides are deviated from the gathered position at the time of the threading of the yarns to the fulcrum guides, the yarn threading to the fulcrum guides may not be properly done. In such an arrangement, determination of whether the movement of the fulcrum guides is proper or not based on a result of detection by the detection unit is effective.

BRIEF DESCRIPTION OF THE DRAWINGS

[0031]

FIG. 1 is a front elevation of a spun yarn take-up machine of an embodiment.

FIG. 2 is a profile of members such as a take-up unit.

FIG. 3 is a block diagram showing an electric structure of the spun yarn take-up machine.

FIG. 4 shows a drive unit.

Each of FIG. 5(a) and FIG. 5(b) illustrates movement of fulcrum guides.

FIG. 6 is a schematic representation of a yarn thread-

ing execution unit.
FIGs. 7(a) and 7(b) show a first separator, and FIG. 7(c) shows a second separator.
FIG. 8 is a flowchart of processes of yarn threading.
FIG. 9(a) to FIG. 9(f) are explanatory views of the processes of the yarn threading.
FIG. 10(a) and FIG. 10(b) are explanatory views of the processes of the yarn threading.
FIG. 11 is an explanatory view of the processes of the yarn threading.
FIG. 12 shows a drive unit of a modification.
FIG. 13 shows a drive unit of another modification.
FIG. 14(a) and FIG. 14(b) are explanatory views of a location information detection unit of a further modification.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0032] The following will describe an embodiment of the present invention. Hereinafter, directions shown in FIG. 1 and FIG. 2 will be consistently used as an up-down direction, a left-right direction, and a front-rear direction, for convenience of explanation. The up-down direction is a vertical direction in which the gravity acts. The left-right direction is orthogonal to the up-down direction and is a direction in which later-described take-up units 3 are aligned. The front-rear direction is a direction orthogonal to both the up-down direction and the left-right direction. Moreover, a direction in which a yarn Y runs is referred to as a yarn running direction. An axial direction of later-described bobbins B, which is substantially parallel to the front-rear direction, is referred to as a bobbin axial direction (axial direction of the present invention).

(Spun Yarn Take-Up Machine)

[0033] The following will outline a spun yarn take-up machine 1 (a textile machine of the present invention) of an embodiment, with reference to and FIG. 1. FIG. 1 is a front view of the spun yarn take-up machine 1. As shown in FIG. 1, the spun yarn take-up machine 1 includes plural spinning apparatuses 2, plural take-up units 3 provided to correspond to the respective spinning apparatuses 2, a yarn threading robot 4 (an automatic yarn threading device of the present invention), and an integrated controller 100 (see FIG. 3).

[0034] The spinning apparatuses 2 are aligned in the left-right direction. Each spinning apparatus 2 spins out plural yarns Y (e.g., 12 yarns). The take-up units 3 are located below the spinning apparatuses 2. The take-up units 3 are aligned in the left-right direction to correspond to the respective spinning apparatuses 2. Each take-up unit 3 is configured to take up yarns Y spun out from the spinning apparatus 2 and form packages P by simultaneously winding the yarns Y onto plural (e.g., 12) bobbins B. The yarn threading robot 4 is configured to move along a rail 5 extending in the left-right direction and to perform yarn threading to each take-up unit 3.

[0035] The integrated controller 100 (see FIG. 3) is, for example, a typical computer. The integrated controller 100 is electrically connected to unit controllers 101 configured to control the respective take-up units 3 and a yarn threading controller 102 configured to control the yarn threading robot 4 (see FIG. 3). The integrated controller 100 integrally controls the entire spun yarn take-up machine 1 in association with the unit controllers 101 and the yarn threading controller 102.

(Take-Up Unit)

[0036] The following will describe the structure of the take-up unit 3 with reference to FIG. 2 and FIG. 3. FIG. 2 is a side view of the take-up unit 3 and the yarn threading robot 4. FIG. 3 is a block diagram showing an electric structure of the spun yarn take-up machine 1. As shown in FIG. 2, the take-up unit 3 includes an aspirator 11, a regulatory guide 12, a first godet roller 13, a second godet roller 14, and a winding unit 15.

[0037] The aspirator 11 is provided at a front end portion of the take-up unit 3. The aspirator 11 is arranged to suck and retain yarns spun out from the spinning apparatus 2 in advance, before yarn threading to the take-up unit 3.

[0038] The regulatory guide 12 is, for example, a known comb-teeth-shaped yarn guide. As shown in FIG. 2, the regulatory guide 12 is provided below the aspirator 11. The first regulatory guide 12 is arranged to cause the yarns Y to be lined up in the left-right direction. The regulatory guide 12 regulates the movement of the yarns Y in the left-right direction such that, when the yarns Y are threaded, the interval between neighboring yarns Y is equal to a predetermined distance. The regulatory guide 12 is moved in the left-right direction by, e.g., an air cylinder 111 (as shown in FIG. 3). The regulatory guide 12 is movable between a production position (see two-dot chain lines in FIG. 9(d)) where the yarns Y are wound onto the bobbins B and a yarn threading position (see solid lines in FIG. 9(d)) where yarn threading is performed.

[0039] The first godet roller 13 is a roller having an axis substantially in parallel to the left-right direction. As shown in FIG. 2, the first godet roller 13 is provided below the regulatory guide 12. The first godet roller 13 is rotationally driven by an unillustrated motor so as to feed the yarns Y to the downstream side in the yarn running direction.

[0040] The second godet roller 14 is a roller having an axis substantially in parallel to the left-right direction. As shown in FIG. 2, the second godet roller 14 is provided above and rearward of the first godet roller 13. The second godet roller 14 is rotationally driven by an unillustrated motor so as to feed the yarns Y to the downstream side in the yarn running direction. The second godet roller 14 is movably supported by a guide rail 16 which obliquely extends upward and rearward. The second godet roller 14 is movable along a guide rail 16 by, for example, a

movement motor 112 (see FIG. 3) and unillustrated members such as a pulley pair, a belt, and an air device. With this, the second godet roller 14 is movable between a production position (indicated by solid lines in FIG. 2) where the yarns Y are wound onto the bobbins B and a yarn threading position (indicated by two-dot chain lines in FIG. 2) where the second godet roller 14 is close to the first godet roller 13 and yarn threading is carried out.

[0041] The winding unit 15 is configured to form packages P by winding the yarns Y onto the respective bobbins B. As shown in FIG. 2, the winding unit 15 is provided below members such as the first godet roller 13 and the second godet roller 14. The winding unit 15 includes a frame 20, fulcrum guides 21 (a yarn threading target member of the present invention), traverse guides 22, a turret 23, two bobbin holders 24, a contact roller 25, and a unit controller 101.

[0042] The frame 20 is a member which is placed on, for example, a floor of a factory, and to which components of the winding unit 15 are attached or in which components of the winding unit 15 are accommodated. As shown in FIG. 2, the frame 20 includes a base portion 20a which is provided on the floor surface and extends in the front-rear direction, a rear portion 20b which vertically extends from a rear end portion of the base portion 20a, and an upper portion 20c which extends forward from an upper part of the rear portion 20b.

[0043] Each of the fulcrum guides 21 is a guide about which a yarn Y is traversed by each traverse guide 22. As shown in FIG. 2, the fulcrum guides 21 are provided for the respective yarns Y and are aligned in the front-rear direction. Each fulcrum guide 21 has a groove 21a (see FIG. 5(a) and FIG. 5(b)) which is open to the rear side. A yarn Y can be housed in each fulcrum guide 21 as the yarn Y is inserted into the groove 21a from the rear side. Each fulcrum guide 21 has a cylindrical attachment portion 21b that is open in the front-rear direction. The attachment portion 21b is movably attached to a guide supporter 26 that extends in the front-rear direction (see FIG. 5(a) and FIG. 5(b)). The guide supporter 26 is, for example, a hollow cylindrical member fixed to the upper portion 20c of the frame 20. When yarn threading is performed, the fulcrum guides 21 are moved in the front-rear direction along the guide supporter 26 by a later-described driving unit 30.

[0044] The traverse guides 22 are provided for the respective yarns Y, and are aligned in the front-rear direction. Each traverse guide 22 is, for example, a known blade-type guide. The traverse guide 22 is reciprocally driven in the front-rear direction by, for example, an unillustrated motor. Because of this, the yarns Y are traversed about the fulcrum guides 21 in the front-rear direction.

[0045] The turret 23 is a disc-shaped member having an axis substantially parallel to the front-rear direction. The turret 23 is rotationally driven by a motor which is not illustrated. The two bobbin holders 24 have axes in parallel to the front-rear direction, respectively, and are rotatably supported at an upper end portion and a lower end portion of the turret 23. The bobbins B provided for the respective yarns Y are attached to each bobbin holder 24 so as to be aligned in the front-rear direction (bobbin axial direction), and are rotatably supported by each bobbin holder 24. Each of the two bobbin holders 24 is rotationally driven by an individual motor (not illustrated).

[0046] The contact roller 25 is a roller having an axis substantially 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.

[0047] The unit controller 101 (see FIG. 3) includes members such as a CPU, a ROM, and a RAM, and is configured to control members such as the air cylinder 111 and the movement motor 112. The unit controller 101 further includes an operation unit 121 (as shown in FIG. 3) provided so as to be operated by an operator, and a notification unit 122 (as shown in FIG. 3) for notifying the operator of information. The operation unit 121 includes, e.g., an unillustrated operation button. The notification unit 122 includes, e.g., an unillustrated alarm lamp. The unit controller 101 is electrically connected to the integrated controller 100 (as shown in FIG. 3), and communicates with the integrated controller 100.

[0048] In the winding unit 15 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 bobbins B, with the result that the packages P are formed. When the formation of the packages P is completed, the turret 23 is rotated 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 bobbins B attached to the bobbin holder 24 having been moved to the upper position, to form packages P.

(Drive Unit)

[0049] The following will describe the drive unit 30 which is configured to move the fulcrum guides 21, with reference to FIG. 4, FIG. 5(a), and FIG. 5(b). FIG. 4 shows the drive unit 30. FIG. 5(a) and FIG. 5(b) show the movement of the fulcrum guides 21. As shown in FIG. 4, the drive unit 30 includes an air cylinder 31 and a movable member 32. As the air cylinder 31 moves the movable member 32 connected to the rearmost fulcrum guide 21, the fulcrum guides 21 are moved.

[0050] The air cylinder 31 is, for example, a rodless cylinder extending in the front-rear direction. The air cylinder 31 is controlled by the unit controller 101 (see FIG. 3). As shown in FIG. 4, the air cylinder 31 is, for example, accommodated inside the guide supporter 26. The air cylinder 31 includes a cylinder main body 33, a piston 34

accommodated in the cylinder main body 33 and movable in the front-rear direction, and a slider 35 connected to the piston 34 and provided outside the cylinder main body 33.

[0051] The cylinder main body 33 extends in the front-rear direction. Inside the cylinder main body 33, a cylinder chamber 33a and a cylinder chamber 33b are formed. The cylinder chamber 33a is formed in front of the piston 34. The cylinder chamber 33a is connected to a pipe 36a extending toward the outer side of the guide supporter 26. The cylinder chamber 33b is formed behind the piston 34. The cylinder chamber 33b is connected to the pipe 36b extending toward the outer side of the guide supporter 26. The pipe 36a and the pipe 36b are connected to a supply port (not illustrated) for supplying compressed air or a discharge port (not illustrated) for discharging compressed air, via, for example, a known four-way electromagnetic valve (not illustrated). The four-way electromagnetic valve is able to switch the state of the drive unit 30 between a first state and a second state that are described below. In the first state, the pipe 36a is connected to the supply port whereas the pipe 36b is connected to the discharge port. In the second state, the pipe 36b is connected to the supply port whereas the pipe 36a is connected to the discharge port. When the drive unit 30 is in the first state, compressed air is supplied to the cylinder chamber 33a whereas compressed air is discharged from the cylinder chamber 33b. As a result, the piston 34 and the slider 35 move rearward (as indicated by solid lines in FIG. 4). Meanwhile, when the drive unit 30 is in the second state, the piston 34 and the slider 35 move forward (as indicated by two-dot chain lines in FIG. 4). To the slider 35, for example, an unillustrated magnet is fixed.

[0052] The movable member 32 is attached to the guide supporter 26 and is arranged to be movable in the front-rear direction (bobbin axial direction) along the guide supporter 26. To the movable member 32, the rearmost fulcrum guide 21 (fulcrum guide 21R) is fixed (see FIG. 5(a) and FIG. 5(b)). To the movable member 32, for example, an unillustrated magnet is fixed. The movable member 32 is therefore connected to the slider 35 by magnetic force. When the slider 35 moves in the front-rear direction, the movable member 32 follows the slider 35 on account of the magnet force, and moves in the bobbin axial direction together with the fulcrum guide 21R (which is the rearmost one of the fulcrum guides 21).

[0053] The above-described fulcrum guides 21 are connected to one another by, for example, an unillustrated belt. To be more specific, two fulcrum guides 21 neighboring each other in the front-rear direction (bobbin axial direction) are connected to each other by the belt. When the movable member 32 and the fulcrum guide 21R move rearward, the other fulcrum guides 21 are pulled by the belt and move rearward. When the fulcrum guide 21R reaches the rear end of the movable range, the fulcrum guides 21 are lined up at substantially equal intervals that are defined by the length of the belt (see FIG. 5(a)). In this state, the fulcrum guides 21 are positioned directly above the corresponding bobbins B (see FIG. 2)). The position of the fulcrum guides 21 in this state is termed a distanced position (equivalent to a production position in the present invention) . When the movable member 32 and the fulcrum guide 21R move forward, the attachment portion 21b of each of the other fulcrum guides 21 is pressed by the fulcrum guide 21R. As a result, the fulcrum guides 21 move to gather on the front side. In this state, the fulcrum guides 21 are close to one another (i.e., the intervals are narrow) as compared to the case where the fulcrum guides 21 are at the distanced position. The position of the fulcrum guides 21 in this state is termed a gathered position (equivalent to a yarn threading position in the present invention). In this way, the fulcrum guides 21 are movable between the distanced position and the gathered position different from the distanced position.

(Yarn Threading Execution Unit)

[0054] The take-up unit 3 includes a yarn threading execution unit 40 (as shown in FIG. 6) configured to thread the yarns Y having been threaded to the fulcrum guides 21 to the traverse guides 22 and the bobbins B. An explanation will be given with reference to FIG. 6, FIG. 7(a), and FIG. 7(b). FIG. 6 is a schematic representation of the yarn threading execution unit 40. FIGs. 7(a) and 7(b) show a later-described first separator 42. FIG. 7(c) shows a second separator 43 described later, viewed along an arrow VII in FIG. 6.

[0055] As shown in FIG. 6, the yarn threading execution unit 40 includes, for example, a yarn convergence guide 41, the first separator 42, and the second separator 43. The yarn convergence guide 41 is configured to converge the yarns Y at a front end portion of the take-up unit 3. The first separator 42 temporarily holds the yarns Y having been threaded to the respective fulcrum guides 21. The second separator 43 performs operations such as receiving the yarns Y from the first separator 42 and moving the yarns Y to positions close to the bobbins B.

[0056] The yarn convergence guide 41 is provided at a front end portion of the take-up unit 3. As shown in FIG. 1, the yarn convergence guide 41 is attached to a leading end of an arm-like swing member 44 which is swingable about the front-rear direction which is a swing axial direction. The swing member 44 is swung by, e.g., an air cylinder 113 (as shown in FIG. 3). Because of this, the yarn convergence guide 41 is swingable between an initial position (indicated by solid lines in FIG. 6) positioned at a right end portion of the take-up unit 3 and a handover position (indicated by dotted lines in FIG. 6) which is to the left of the initial position.

[0057] As shown in FIGs. 7(a) and 7(b), the first separator 42 includes a guide member 51 extending in the front-rear direction and holding units 52 movably attached to the guide member 51 so as to be aligned in the front-rear direction. The guide member 51 is configured

to be movable in the left-right direction by, e.g., an air cylinder 114 (as shown in FIG. 3). The guide member 51 is movable between an initial position (as shown by sold lines in FIG. 6) and a handover position (as shown by dotted lines in FIG. 6) to the left of the initial position. As shown in FIGs. 7(a) and 7(b), each holding unit 52 includes a main body 52a and a protrusion 52b that prevents the yarns Y from dropping off. The holding units 52 are connected to each other by, e.g., an unillustrated belt, and moved in the front-rear direction by, e.g., an air cylinder 115 (as shown in FIG. 3). To be more specific, the holding units 52 are movable between a first position (as shown in FIG. 7(a)) where intervals of the holding units 52 in the front-rear direction are substantially identical with the intervals of the bobbins B in the front-rear direction and a second position (as shown in FIG. 7(b)) where the holding units 52 are gathered on the front side as compared to the first positions.

[0058] The second separator 43 is provided to the left of the first separator 42. The second separator 43 includes an arm-like swing member 53 which extends in the front-rear direction and which is swingable about a swing axial center parallel to the front-rear direction, and holding units 54 fixed to a leading end of the swing member 53. For example, as shown in FIG. 7(c), insertion spaces 54a into which the yarns Y are inserted are formed at the end portions of the holding units 54 opposite to the swing member 53, so as to be aligned in the front-rear direction. At an inlet of each insertion space 54a, protrusions 54b and 54c are provided to prevent the yarns Y from dropping off. The swing member 53 and the holding units 54 are swung by, e.g., an air cylinder 116 (as shown in FIG. 3). The swing member 53 and the holding units 54 are therefore movable between a predetermined retracted position (indicated by solid lines in FIG. 6) and a receiving position (indicated by dotted lines in FIG. 6) to the right of the retracted position, where the yarns Y are received from the first separator 42. Although not illustrated, the second separator 43 is arranged to be able to cause the reciprocating traverse guides 22 to capture the yarns Y by moving the holding units 54 leftward from the receiving position after receiving the yarns Y from the first separator 42.

[0059] The yarn threading execution unit 40 includes an unillustrated yarn gathering unit. The yarn gathering unit is arranged to temporarily detach a yarn Y captured by the traverse guide 22 from the traverse guide 22 and guides the detached yarn Y to an unillustrated slit of a bobbin B. The yarn gathering unit is not detailed in this disclosure. For details, see Japanese Unexamined Patent Publication No. 2017-154891, for example.

(Yarn Threading Robot)

[0060] Referring back to FIG. 2, the structure of the yarn threading robot 4 will be described. The yarn threading robot 4 includes a main body 61, a robotic arm 62, a yarn threading unit 63, and a yarn threading controller 102 (see FIG. 3).

[0061] The main body 61 is substantially rectangular parallelepiped in shape. The main body 61 is moved in the left-right direction by a movement motor 131 (see FIG. 3). The robotic arm 62 is attached to the lower surface of the main body 61. The robotic arm 62 includes arms 62a and joints 62b connecting the arms 62a with each other. Each joint 62b incorporates therein an arm motor 132 (see FIG. 3). As the arm motor 132 is driven, the arms 62a are swung about the joints 62b. The yarn threading unit 63 is attached to a leading end portion of the robotic arm 62. The yarn threading unit 63 includes a suction 64, a cutter 65, and a yarn threading assisting member 66 (see FIG. 5(b)). The suction 64 is configured to suck and retain the yarns Y during the yarn threading. The cutter 65 is configured to cut the yarns Y when the yarns Y are handed over from the aspirator 11 to the yarn threading unit 63 (described later). The yarn threading assisting member 66 includes retaining grooves 66a (see FIG. 5(b)) and retains the yarns Y by the respective retaining grooves 66a.

[0062] The yarn threading controller 102 (see FIG. 3) includes a CPU, a ROM, and a RAM, and is configured to control the movement motor 131, the arm motor 132, and the yarn threading unit 63. After moving the main body 61 to a position in front of a take-up unit 3 which is the target of yarn threading, the yarn threading controller 102 performs the yarn threading to that take-up unit 3 by controlling the robotic arm 62, while causing the yarn threading unit 63 to retain the yarns Y. The yarn threading controller 102 is electrically connected to the integrated controller 100 (as shown in FIG. 3), and communicates with the integrated controller 100.

[0063] Before giving details of the yarn threading, the following will describe a possible problem occurring in known spun yarn take-up machines, and detail the spun yarn take-up machine 1 of the present embodiment.

(Known Problem)

[0064] In known cases, it is determined that the movement of the fulcrum guides 21 is completed when, for example, a predetermined time elapses from the start of the movement of the fulcrum guides 21 by the unit controller 101, and yarn threading is performed by the yarn threading robot 4. When, for example, the air cylinder 31 does not properly operate and the fulcrum guides 21 do not properly move, the fulcrum guides 21 are not properly located at the gathered position or the distanced position. When the fulcrum guides 21 are not properly located at the gathered position, the yarn threading robot 4 may fail the yarn threading. Meanwhile, when the fulcrum guides 21 do not properly return from the gathered position to the distanced position, winding of the yarns Y may start in a state in which the fulcrum guides 21 are deviated from desired locations. As a result, packages may not be properly formed, and hence the wound yarns Y and the time required for the winding may be wasted.

[0065] A reason why the air cylinder 31 does not properly operate is, for example, increase in a load on account of clogging due to yarn dust between the cylinder main body 33 and the slider 35. The yarn dust include, for example, powder generated as part of the running yarn Y is ground due to abrasion with a guide member such as a fulcrum guide 21. Because such yarn dust may enter, for example, the internal space of the guide supporter 26, it is difficult to completely prevent the clogging due to yarn dust. Another reason is that, when a supply source of compressed air is shared between a lot of air cylinders including the air cylinder 31, the pressure of the compressed air may be insufficient when plural air cylinders operate simultaneously. In such a case, the air cylinder are less likely to operate properly. Under these circumstances, in the present embodiment, the spun yarn take-up machine 1 is arranged as described below, in order to suppress defects that may occur when the fulcrum guides 21 (yarn threading target members) do not properly move. To be more specific, a later-described location information detection unit 70 is provided in the vicinity of the fulcrum guides 21.

(Details of Structure of Spun Yarn Take-Up Machine)

[0066] Referring back to FIG. 5(a) and FIG. 5(b), the structure of the spun yarn take-up machine 1 (to be more specific, the structure at around the fulcrum guide 21) will be detailed. As described above, the movable member 32 is attached to the guide supporter 26 to be movable in the front-rear direction. A left end portion of the movable member 32, for example, protrudes leftward as compared to the left end of each fulcrum guide 21. In the vicinity of such a movable member 32, the location information detection unit 70 (a detection unit of the present invention) is provided to detect information regarding the current location of the fulcrum guides 21. To put it differently, the location information detection unit 70 is configured to detect information regarding the movement of the fulcrum guides 21. The location information detection unit 70 includes a first limit switch 71 and a second limit switch 72 (both of which correspond to a limit switch of the present invention) that are configured to detect information indicating whether the fulcrum guides 21 are at a target position. The first limit switch 71 and the second limit switch 72 are, for example, switch devices in each of which a known touch-type micro switch is provided. The driving mechanism of the micro switch may be a known plunger, hinge lever, or the like. Alternatively, the first limit switch 71 and the second limit switch 72 (limit switches) may be known contactless proximity sensors. As contactless proximity sensors that are the limit switches, an electromagnetic induction sensor or a sensor configured to detect the approach of a metal body by a Hall effect sensor may be used. The first limit switch 71 and the second limit switch 72 are electrically connected to the unit controller 101. The descriptions below assume that the first limit switch 71 and the second limit switch 72 are contact-type limit switches.

[0067] The first limit switch 71 is arranged to detect whether the movable member 32 and the fulcrum guide 21R (the rearmost one of the fulcrum guides 21) are properly at the gathered position. As shown in FIG. 5(a) and FIG. 5(b), the first limit switch 71 is provided in front of the left end portion of the movable member 32. The first limit switch 71 is provided to the left of the fulcrum guides 21. The fulcrum guides 21 do not therefore interfere with the first limit switch 71 when moving in the bobbin axial direction. The first limit switch 71 is arranged to make contact with the left end portion of the movable member 32 when the movable member 32 reaches the gathered position. When the movable member 32 is in contact with the first limit switch 71, the first limit switch 71 is in an on state. When the movable member 32 is not in contact with the first limit switch 71, the first limit switch 71 is in an off state. With this arrangement, the first limit switch 71 is able to detect information regarding whether the movement of the movable member 32 to the gathered position is properly done. In connection with the first limit switch 71, the gathered position is equivalent to a target position of the present invention.

[0068] The second limit switch 72 is arranged to detect whether the movable member 32 and the fulcrum guide 21R are properly positioned at the distanced position. As shown in FIG. 5(a) and FIG. 5(b), the second limit switch 72 is provided behind the left end portion of the movable member 32. The second limit switch 72 is provided at a substantially same position as the first limit switch 71 in the left-right direction. Furthermore, the second limit switch 72 is provided to overlap the left end portion of the movable member 32 in the left-right direction. The second limit switch 72 is arranged to make contact with the left end portion of the movable member 32 when the movable member 32 reaches the distanced position. When the movable member 32 is in contact with the second limit switch 72, the second limit switch 72 is in an on state. When the movable member 32 is not in contact with the second limit switch 72, the second limit switch 72 is in an off state. With this arrangement, the second limit switch 72 is able to detect information regarding whether the movement of the movable member 32 to the distanced position is properly done. In connection with the second limit switch 72, the distanced position is equivalent to a target position of the present invention.

(Determination Regarding Movement of Fulcrum Guide in Yarn Threading, Etc.)

[0069] With reference to FIG. 8 to FIG. 11, the following will describe determination of whether the movement of the fulcrum guides 21 at the time of yarn threading to the take-up unit 3 is proper or not and a process performed based on the determination, together with specific processes of the yarn threading. FIG. 8 is a flowchart of processes of the yarn threading. Each of FIG. 9(a) to FIG. 11 is an explanatory view of the processes of the yarn

threading. FIG. 9(d) is viewed along an arrow D in FIG. 9(c). The yarn threading is performed as the integrated controller 100, the unit controller 101, and the yarn threading controller 102 cooperate and control the components of the take-up unit 3 and the components of the yarn threading robot 4. In the present embodiment, a combination of the integrated controller 100, the unit controller 101, and the yarn threading controller 102 is equivalent to a controller of the present invention.

[0070] In an initial state, the yarns Y are sucked and retained by the aspirator 11 (see FIG. 9(a)). The yarn threading starts in this state (S101). To be more specific, a signal that instructs a take-up unit 3 to perform an operation necessary for the yarn threading is sent from the integrated controller 100 to the unit controller 101 of a take-up unit 3 which is the target of yarn threading. Furthermore, a signal which instructs the main body 61 of the yarn threading robot 4 to move to a position in front of that take-up unit 3 is sent from the integrated controller 100 to the yarn threading controller 102. The yarn threading controller 102 controls the movement motor 131 in accordance with the signal to move the main body 61 in the left-right direction.

[0071] The unit controller 101 then controls the components of the take-up unit 3 to start to move the components that are targets of the yarn threading from the production position to the yarn threading position (S102). To be more specific, the movement motor 112 starts to move the second godet roller 14 to the yarn threading position and the air cylinder 31 starts to move the fulcrum guides 21 to the gathered position (yarn threading position).

[0072] Subsequently, the unit controller 101 determines whether the fulcrum guides 21 properly reach the gathered position (yarn threading position) before a predetermined time elapses from the start of the movement of the fulcrum guides 21. To be more specific, in the next step S103, when the movable member 32 makes contact with the first limit switch 71 and the first limit switch 71 is switched on (Yes in S103), the unit controller 101 determines that the fulcrum guides 21 properly reach the gathered position. Meanwhile, when the first limit switch 71 is in the off state (No in S103), the unit controller 101 repeats the step S103 until a predetermined time elapses (No in S104).

[0073] When the predetermined time elapses from the start of the movement of the fulcrum guides 21 to the gathered position while the first limit switch 71 is in the off state (Yes in S104), the unit controller 101 determines that a defect occurs in the movement of the fulcrum guides 21 to the gathered position. The yarn threading is stopped accordingly. To be more specific, the unit controller 101 stops the components of the take-up unit 3 and sends a signal indicating that a defect has occurred in the movement of the fulcrum guides 21, to the integrated controller 100. The integrated controller 100 sends a signal instructing the stop of the yarn threading to the yarn threading controller 102. Furthermore, the unit controller 101 controls a notification unit 122 to output information indicating that a defect has occurred in the movement of the fulcrum guides 21 (S105). Based on the information notified by the notification unit 122, the operator checks the state of the take-up unit 3. In addition to this, the operator performs maintenance of the take-up unit 3 according to need.

[0074] Meanwhile, when the first limit switch 71 is switched on before the predetermined time elapses (Yes in S103), the unit controller 101 immediately sends a signal indicating that the movement of the fulcrum guides 21 is proper to the integrated controller 100. Based on the signal sent from the unit controller 101, the integrated controller 100 sends a signal instructing the continuation of the operation of the yarn threading robot 4 to the yarn threading controller 102. Based on this signal, the yarn threading controller 102 operates the yarn threading robot 4. To be more specific, the yarns Y are cut by the cutter 65 while the suction 64 is positioned in the vicinity of the yarns Y sucked and retained by the aspirator 11. As a result, the yarns Y are handed over from the aspirator 11 to the yarn threading unit 63 (S106) (see FIG. 9(b)). In this way, the operation of the yarn threading robot 4 is continued only when it is determined that the movement of the fulcrum guides 21 is properly done.

[0075] In the subsequent step S107, the yarn threading robot 4 performs the yarn threading to the regulatory guide 12, the first godet roller 13, and the second godet roller 14. To be more specific, the yarn threading controller 102 moves, by using the robotic arm 62, the leading end portion of the yarn threading unit 63 to a location which is below, behind, and to the right of the first regulatory guide 12 (see FIG. 9(c) and two-dot chain lines in FIG. 9(d)). The unit controller 101 then moves the regulatory guide 12 from the production position (see two-dot chain lines in FIG. 9(d)) to the yarn threading position (see solid lines in FIG. 9(d)). Subsequently, the yarn threading controller 102 moves the yarn threading unit 63 forward so as to thread the yarns Y to the regulatory guide 12. Subsequently, the yarn threading controller 102 moves the leading end portion of the yarn threading unit 63 to the base end side in the axial direction of the first godet roller 13 (see FIG. 9(e)). At the same time, the unit controller 101 moves the first regulatory guide 12 from the yarn threading position to the production position (see FIG. 9(e)). Subsequently, the yarn threading controller 102 moves the yarn threading unit 63 so as to thread the yarns Y to the first godet roller 13 and to the second godet roller 14 in order (see FIG. 9(f)).

[0076] In the next step S108, the yarn threading robot 4 performs the yarn threading to the fulcrum guides 21. To be more specific, the yarns Y are retained to be distanced from one another by the yarn threading assisting member 66 of the yarn threading unit 63 (see FIG. 5(b)). Subsequently, the yarn threading controller 102 controls the robotic arm 62 to move the yarn threading unit 63 to a predetermined position on the rear side (see two-dot chain lines in FIG. 5(b)). Furthermore, the yarn threading

controller 102 moves the yarn threading unit 63 obliquely leftward and forward (as indicated by an arrow in FIG. 5(b)). As a result, the yarns Y are threaded to the corresponding fulcrum guides 21 (see FIG. 10(a)).

[0077] In the subsequent step S109, the unit controller 101 starts to move the second godet roller 14 and the fulcrum guides 21 to the production position. Subsequently, the unit controller 101 determines whether the fulcrum guides 21 properly return the distanced position (production position) before a predetermined time elapses from the start of the movement of the fulcrum guides 21. To be more specific, in the next step S110, when the movable member 32 makes contact with the second limit switch 72 and the second limit switch 72 is switched on (Yes in S110), the unit controller 101 determines that the fulcrum guide 21 properly reach the distanced position. Meanwhile, when the second limit switch 72 is in the off state (No in S110), the unit controller 101 repeats the step S110 until a predetermined time elapses (No in Sill) .

[0078] When the predetermined time elapses from the start of the movement of the fulcrum guides 21 to the distanced position while the second limit switch 72 is in the off state (Yes in S111), the unit controller 101 determines that a defect occurs in the movement of the fulcrum guides 21 to the distanced position. The yarn threading is stopped accordingly, in the same manner as in the step S105. Furthermore, the unit controller 101 controls a notification unit 122 to output information indicating that a defect has occurred in the movement of the fulcrum guides 21 (S112).

[0079] Meanwhile, when the second limit switch 72 is switched on before the predetermined time elapses (Yes in S110; see FIG. 10(b)), the unit controller 101 sends a signal indicating that the movement of the fulcrum guides 21 is proper to the integrated controller 100. Furthermore, the unit controller 101 moves the yarn convergence guide 41 from an initial position (see solid lines in FIG. 6) to a handover position (see dotted lines in FIG. 6). Furthermore, the unit controller 101 moves holding units 52 of the first separator 42 from a first position to a second position (see FIG. 7(b) and FIG. 10(b)).

[0080] Based on the signal sent from the unit controller 101, the integrated controller 100 sends a signal instructing the continuation of the operation of the yarn threading robot 4 to the yarn threading controller 102. Based on this signal, the yarn threading controller 102 operates the yarn threading robot 4. Subsequently, the yarn threading controller 102 moves the yarn threading unit 63 by using the robotic arm 62 and threads the yarns Y to the yarn convergence guide 41 (S113). Because of this, the yarns Y are placed immediately behind the corresponding holding units 52, respectively (see FIG. 7(b) and FIG. 10(b)).

[0081] In the next step S114, the yarn threading to the bobbins B is performed. To be more specific, the unit controller 101 returns the holding units 52 to the first position (see FIG. 7(a) and FIG. 11) and moves the second separator 43 to the receiving position (see dotted lines in FIG. 6). Furthermore, the unit controller 101 moves the first separator 42 to the handover position (see dotted lines in FIG. 6) and then moves the holding units 52 to the second position again. Because of this, the yarns Y are handed over from the first separator 42 to the second separator 43 (this action is not shown in the figures). Thereafter, the unit controller 101 moves the holding units 54 of the second separator 43 leftward from the receiving position (this action is not shown in the figures). As a result of this, the yarns Y are caught by the traverse guides 22. Furthermore, the unit controller 101 causes a yarn gathering unit (not illustrated) to temporarily detach the yarns Y from the traverse guides 22 and guide the yarns Y to slits of the bobbins B. In this way, the yarns Y are threaded to the bobbins B. Thereafter, the unit controller 101 causes the yarn gathering unit to return the yarns Y to positions where the yarns Y are caught by the traverse guides 22. When the yarns Y are caught by the traverse guides 22 again, the yarn threading is finished and winding of the yarns Y by the take-up unit 3 starts (S115).

[0082] As described above, the yarn threading can be performed when it is determined that the movement of the fulcrum guides 21 is properly done, and the yarn threading may be, for example, terminated when it is determined that the movement of the yarn threading target member is not properly done. It is therefore possible to suppress defects that may occur when the fulcrum guides 21 do not properly move.

[0083] In addition to the above, the operation of the yarn threading robot 4 is continued only when it is determined that the movement of the fulcrum guides 21 is properly done. It is therefore possible to reliably prevent unintentional yarn threading by the yarn threading robot 4, when there is a defect in the movement of the fulcrum guides 21.

[0084] In addition to the above, when it is determined that a defect has occurred in the movement of the fulcrum guides 21, information indicating the occurrence of the defect is output by the notification unit 122. With this arrangement, when there is a defect in the movement of the fulcrum guides 21, the operator is prompted to perform an immediate action.

[0085] The location information detection unit 70 is configured to detect information regarding the location of the fulcrum guides 21. It is possible to easily determine whether the movement of the fulcrum guides 21 is properly done, by utilizing such information.

[0086] In addition to the above, because a limit switch that is typically inexpensive is used as the location information detection unit 70, it is possible to easily determine whether the yarn threading target member has reached the target position, while suppressing the increase in production cost of the textile machine.

[0087] Because the thrust force of the air cylinder 31 of the drive unit 30 is typically lower than that of, for example, an electric motor, the movement of the fulcrum guides 21 may be obstructed even by, for example, slight clogging due to yarn dust. In such an arrangement, de-

termination of whether the movement of the fulcrum guides 21 is proper or not based on a result of detection by the location information detection unit 70 is effective.

[0088] The fulcrum guides 21 (in particular the rearmost fulcrum guide 21R) are required to move over a long distance between the distanced position and the gathered position. On this account, the fulcrum guides 21 are likely to fail to reach the target position when the drive unit 30 does not properly operate. In such an arrangement, determination of whether the movement of the fulcrum guides 21 is proper or not based on a result of detection by the location information detection unit 70 is effective.

[0089] When the fulcrum guides 21 are deviated from the distanced position at the time of the winding of the yarns Y onto the bobbins, the yarns Y threaded to the fulcrum guides 21 may not be properly wound onto the bobbins B, and hence the yarns wound onto the bobbins B may be wasteful. In such an arrangement, determination of whether the movement of the fulcrum guides 21 to the distanced position is proper or not based on a result of detection by the second limit switch 72 of the location information detection unit 70 is effective.

[0090] When the fulcrum guides 21 are deviated from the gathered position at the time of the threading of the yarns Y to the fulcrum guides 21, the yarn threading to the fulcrum guides 21 may not be properly done. In such an arrangement, determination of whether the movement of the fulcrum guides 21 to the gathered position is proper or not based on a result of detection by the first limit switch 71 of the location information detection unit 70 is effective.

[0091] 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) In the embodiment above, when the fulcrum guides 21 are properly moved to a target position (the distanced position or the gathered position), the unit controller 101 immediately continues the operation of the yarn threading robot 4. The disclosure, however, is not limited to this arrangement. For example, the unit controller 101 may determine that the fulcrum guides 21 are properly moved to the target position after the above-described predetermined time has elapsed.

(2) While the location information detection unit 70 includes both the first limit switch 71 and the second limit switch 72, the disclosure is not limited to this arrangement. The location information detection unit 70 may include only one of the first limit switch 71 and the second limit switch 72.

(3) The location information detection unit 70 may include, for example, an optical position sensor in place of the first limit switch 71 and the second limit switch 72. Alternatively, for example, the location information detection unit 70 may include an unillustrated camera for taking pictures. The unit controller 101 may perform image recognition based on the taken pictures, and determine whether the fulcrum guides 21 are properly moved to the target position based on a result of the image recognition.

(4) While in the embodiment above the drive unit 30 includes the air cylinder 31, the disclosure is not limited to this arrangement. For example, as shown in FIG. 12, a winding unit 15A may include a drive unit 30A including an electric motor 81 with a rotational shaft 81a (movable portion of the present invention), in place of the drive unit 30. The drive unit 30A is, for example, a known ball screw mechanism including a ball screw 83 and a nut 84. The ball screw 83 is connected to the rotational shaft 81a by, for example, a coupling 82, and extends in the front-rear direction. The ball nut 84 is screwed to the ball screw 83. A slider 85 is fixed to the nut 84. The slider 85 is connected to the above-described movable member 32 by magnetic force. The winding unit 15A may or may not include the above-described location information detection unit 70. The winding unit 15A may include, for example, a rotary encoder 86 (detection unit of the present invention) either in addition to the location information detection unit 70 or in place of the location information detection unit 70. To put it differently, the electric motor 81 may be a servo motor. The rotary encoder 86 is configured to detect information of the rotational angle of the rotational shaft 81a of the electric motor 81 (i.e., information regarding the position of the rotational shaft 81a). The unit controller 101 controls the electric motor 81 so that the fulcrum guides 21 move over a predetermined target distance. The unit controller 101 may calculate the moving distance of the fulcrum guides 21 by utilizing a detection result of the rotary encoder 86. The unit controller 101 may determine whether the fulcrum guides 21 properly reaches the target position by comparing the calculated moving distance with the target distance.

[0092] When a gap between the rotational shaft 81a of the electric motor 81 and a fixed portion (e.g., a housing) is clogged with yarn dust or the like, the electric motor 81 may be excessively loaded and broken. In this regard, in the modification, the electric motor 81 is stopped when it is determined that a defect has occurred in the movement of the fulcrum guides 21. It is therefore possible to suppress the load on the electric motor 81 from becoming excessive. By utilizing information regarding the rotational angle of the rotational shaft 81a (i.e., the position of the rotational shaft 81a), it is possible to indirectly acquire the location information of the fulcrum guides 21. It is therefore possible to determine whether the movement of the fulcrum guides 21 is properly done, even when the information regarding the location of the fulcrum guides 21 cannot be directly obtained. Alternatively, an unillus-

trated potentiometer may be provided instead of the rotary encoder 86. An unillustrated linear motor having a movable portion (not illustrated) capable of moving substantially linearly may be provided instead of the electric motor 81 having the rotational shaft 81a. In this case, an unillustrated linear encoder may be provided in place of the rotary encoder 86. The linear encoder may detect information regarding the position of the movable portion of the linear motor.

[0093] (5) As another modification of the modification (4) described above, as shown in FIG. 13, for example, a drive unit 30B of a winding unit 15B may include a stepping motor 91 driven by a pulse signal, as an electric motor. The stepping motor 91 may be, for example, driven by a driver 92 (detection unit of the present invention) electrically connected to the unit controller 101. The driver 92 may be arranged to be able to detect step-out of the stepping motor 91. When the loading torque on a rotational shaft 91a of the stepping motor 91 becomes large, the rotation of the rotational shaft 91a may be slowed down and the fulcrum guide 21 may not smoothly move. Furthermore, typically, when the loading torque on the rotational shaft 91a of the stepping motor 91 becomes large, a motor current flowing in the motor increases. On this account, the driver 92 may detect the step-put by, for example, comparing the motor current flowing in the stepping motor 91 with a normal motor current. The unit controller 101 may determine whether the movement of the fulcrum guides 21 is properly done, based on a result of detection by the driver 92 (i.e., a result of detection regarding the movement of the fulcrum guides 21) . As a specific example, the unit controller 101 may send, to the driver 92, information regarding the target distance over which the fulcrum guides 21 are required to move. Based on the information of the target distance, the driver 92 sends a required number of pulse signals to the stepping motor 91. The unit controller 101 may determine that a failure has occurred in the movement of the fulcrum guides 21 when, for example, the step-out has occurred at least a predetermined number of times. In this case, the unit controller 101 may determine that a failure has occurred in the movement of the fulcrum guides 21 before the predetermined time elapses from the start of the movement of the fulcrum guides 21. Alternatively, the unit controller 101 may determine that a failure has occurred in the movement of the fulcrum guides 21 when the step-out is detected simultaneously with the sending of the last pulse signal from the driver 92 to the stepping motor 91. Alternatively, the unit controller 101 may store the upper limit of the motor current, and may immediately determine that a failure has occurred in the movement of the fulcrum guides 21 when the motor current flowing in the stepping motor 91 exceeds the upper limit.

[0094] With these arrangements, it is possible to determine whether the movement of the fulcrum guides 21 is properly done, even when the information regarding the location of the fulcrum guides 21 cannot be obtained. The step-out may not be detected by the driver 92 as described above. For example, the unit controller 101 may store information of a normal motor current, and detect the step-out by comparing an actual motor current with the normal motor current. In this case, the unit controller 101 is equivalent to the detection unit of the present invention.

[0095] (6) As described above, the limit switches may be contactless proximity sensors, for example. This will be specifically described below with reference to FIG. 14(a) and FIG. 14(b). As shown in FIG. 14(a) and FIG. 14(b), a location information detection unit 70C of a winding unit 15C includes a first limit switch 71C and a second limit switch 72C in place of the first limit switch 71 and the second limit switch 72 that are described above. The first limit switch 71C and the second limit switch 72C may be, for example, known magnetic proximity sensors configured to detect the approach of a conductive member such as a metal member by utilizing electromagnetic induction. The switches may be different from such sensors. As a detection piece, a metal plate 73 extending in the front-rear direction may be fixed to, for example, a lower end portion of the movable member 32. The first limit switch 71C and the second limit switch 72C are provided outside the traveling range of the metal plate 73 in order not to interfere with the metal plate 73. As shown in FIG. 14(a) and FIG. 14(b), for example, the first limit switch 71C and the second limit switch 72C may be provided below the metal plate 73. In other words, for example, the first limit switch 71C may be provided so that the metal plate 73 is positioned directly above the first limit switch 71C when the fulcrum guides 21 are at the gathered position (see FIG. 14(a)). The second limit switch 72 may be provided so that the metal plate 73 is positioned directly above the second limit switch 72 when the fulcrum guides 21 are at the distanced position (see FIG. 14(b)). The unit controller 101 may determine whether the movement of the fulcrum guide 21 is properly done based on a result of detection by the above-described location information detection unit 70C.

[0096] (7) When a defect has occurred in the movement of the fulcrum guides 21, notification by the notification unit 122 may not be performed. When a defect has occurred in the movement of the fulcrum guides 21, the unit controller 101 may simply stop the take-up unit 3, for example.

[0097] (8) When a defect has occurred in the movement of the fulcrum guides 21, the yarn threading may not be immediately stopped. For example, when a defect has occurred in the movement of the fulcrum guides 21, the unit controller 101 may return the fulcrum guides 21 to the original position (one of the distanced position and the gathered position) and then move the fulcrum guides 21 to the target position (the other one of the distanced position and the gathered position) again.

[0098] (9) While in the embodiment above the detection unit such as the location information detection unit 70 detects information regarding the movement of the

fulcrum guides 21, the disclosure is not limited to this arrangement. Another detection unit may be provided to detect information regarding the movement of other yarn threading target members (e.g., the regulatory guide 12, the second godet roller 14, and the holding units 52) to which the yarns Y are threaded.

[0099] (10) The spun yarn take-up machine 1 may not include the yarn threading robot 4. The spun yarn take-up machine 1 may be arranged so that at least part of the yarn threading is performed by an operator.

[0100] (11) The above-described air cylinder 31 may not be accommodated in the guide supporter 26. The slider 35 and the movable member 32 may be connected to each other by a member different from the magnet (e.g., a connecting tool such as a screw).

[0101] (12) While in the embodiment above the unit controller 101 and the yarn threading controller 102 indirectly communicate with each other over the integrated controller 100, the disclosure is not limited to this arrangement. The unit controller 101 and the yarn threading controller 102 may directly communicate with each other.

[0102] (13) While in the embodiment above a combination of the integrated controller 100, the unit controller 101, and the yarn threading controller 102 is equivalent to the controller of the present invention, the disclosure is not limited to this arrangement. For example, the unit controller 101 and the yarn threading controller 102 described above may not be provided. The integrated controller 100 may control the take-up units 3 and the yarn threading robot 4. In this case, the integrated controller 100 is equivalent to the controller of the present invention.

[0103] (14) while the above-described spun yarn take-up machine 1 includes plural take-up units 3, the disclosure is not limited to this arrangement. Only one take-up unit 3 may be included.

[0104] (15) While in the embodiment above the yarns Y are sucked and retained by the aspirator 11 in the initial state before the start of the yarn threading, the disclosure is not limited to this arrangement. For example, in the vicinity of the spinning apparatus 2, an unillustrated yarn bring-down device (see e.g., Japanese Laid-Open Patent Publication No. 2017-82376) may be provided to bring yarns Y down while retaining the yarns Y spun out from a spinning apparatus 2. The yarn threading robot 4 may directly receive the yarns Y from the yarn bring-down device at the time of the yarn threading.

[0105] (16) A detection unit configured to detect information regarding the movement of a yarn threading target member may be provided not only in the spun yarn take-up machine 1 but also in various textile machines configured to process at least one yarn. For example, in a draw texturing machine (textile machine) recited in Japanese Laid-Open Patent Publication No. 2016-223034, a yarn threading target member to which a yarn is threaded may be arranged to be movable between a production position and a yarn threading position. A detection unit may be provided in the draw texturing machine.

[0106] The following are further embodiments of the present invention:

Item 1. A textile machine (1) processing at least one yarn (Y), comprising:

a yarn threading target member (21) to which the at least one yarn (Y) is threaded;
a drive unit (30, 30A, 30B) configured to move the yarn threading target member (21) between a predetermined production position and a yarn threading position different from the production position;
a detection unit (70, 86, 92) configured to detect information regarding movement of the yarn threading target member (21) by the drive unit (30, 30A, 30B); and
a controller (100, 101, 102),
the controller (100, 101, 102) determining whether the movement of the yarn threading target member (21) is proper based on a result of detection by the detection unit (70, 86, 92) .

Item 2. The textile machine (1) according to item 1, further comprising:

an automatic yarn threading device (4) configured to perform yarn threading to the yarn threading target member (21),
the controller (100, 101, 102) continuing an operation of the automatic yarn threading device (4) only when it is determined that the movement of the yarn threading target member (21) is proper.

Item 3. The textile machine (1) according to item 1 or 2, further comprising

a notification unit (122) configured to notify information,
when it is determined that a failure occurs in the movement of the yarn threading target member (21), the controller (100, 101, 102) causing the notification unit (122) to notify information indicating occurrence of a failure.

Item 4. The textile machine (1) according to any one of items 1 to 3, wherein, the detection unit (70) is configured to detect information regarding a position of the yarn threading target member (21).

Item 5. The textile machine (1) according to item 4, wherein, the detection unit (70) is a limit switch (71, 72) configured to detect information indicating whether the yarn threading target member (21) is at a target position.

Item 6. The textile machine (1) according to item 4 or 5, wherein, the drive unit (30) includes an air cyl-

inder (31) .

Item 7. The textile machine (1) according to any one of items 1 to 5, wherein, the drive unit (30A, 30B) includes an electric motor (81, 91).

Item 8. The textile machine (1) according to item 7, wherein, the detection unit (86) is configured to detect information regarding a position of a movable portion (81a) of the electric motor (81).

Item 9. The textile machine (1) according to item 7 or 8, wherein,

the electric motor (91) is a stepping motor (91), and
the detection unit (92) is configured to detect step-out of the stepping motor (91).

Item 10. The textile machine (1) according to any one of items 1 to 9, further comprising:

a bobbin holder (24) which supports bobbins (B) on which two or more yarns (Y) are wound, respectively, the supported bobbins (B) being aligned in an axial direction of the bobbins (B); and
traverse guides (22) which are aligned in the axial direction to correspond to the respective bobbins (B) and are configured to traverse the respective yarns (Y),
the yarn threading target member (21) including fulcrum guides (21) which are aligned in the axial direction to correspond to the respective traverse guides (22) and function as fulcrums when the yarns (Y) are traversed, and
the fulcrum guides (21) being movable between:

a distanced position which is the production position, where the yarns (Y) are wound onto the respective bobbins (B); and
a gathered position which is the yarn threading position, where intervals of the fulcrum guides (21) in the axial direction are short as compared to intervals of the fulcrum guides (21) in the distanced position.

Item 11. The textile machine (1) according to item 10, wherein, the detection unit (70, 86, 92) is configured to detect information regarding whether the fulcrum guides (21) are properly provided at the distanced position.

Item 12. The textile machine (1) according to item 10 or 11, wherein, the detection unit (70, 86, 92) is configured to detect information regarding whether the fulcrum guides (21) are properly provided at the gathered position.

Claims

1. A textile machine (1) processing at least one yarn (Y), comprising:

a yarn threading target member (21) to which the at least one yarn (Y) is threaded;
a drive unit (30, 30A, 30B) configured to move the yarn threading target member (21) between a predetermined production position and a yarn threading position different from the production position;
a detection unit (70, 86, 92) configured to detect information regarding movement of the yarn threading target member (21) by the drive unit (30, 30A, 30B); and
a controller (100, 101, 102),
the controller (100, 101, 102) determining whether the movement of the yarn threading target member (21) is proper based on a result of detection by the detection unit (70, 86, 92).

2. The textile machine (1) according to claim 1, wherein

the textile machine (1) is configured to perform a process of winding the at least one yarn (Y) onto at least one bobbin (B), respectively, and
the production position is a position of the yarn threading target member (21), where the at least one yarn (Y) is wound onto the at least one bobbin (B), respectively.

3. The textile machine (1) according to claim 1 or 2, further comprising:

an automatic yarn threading device (4) configured to perform yarn threading to the yarn threading target member (21),
the controller (100, 101, 102) continuing an operation of the automatic yarn threading device (4) only when it is determined that the movement of the yarn threading target member (21) is proper.

4. The textile machine (1) according to any one of claims 1 to 3, further comprising

a notification unit (122) configured to notify information,
when it is determined that a failure occurs in the movement of the yarn threading target member (21), the controller (100, 101, 102) causing the notification unit (122) to notify information indicating occurrence of a failure.

5. The textile machine (1) according to any one of claims 1 to 4, wherein, the detection unit (70) is configured to detect information regarding a position of

the yarn threading target member (21).

6. The textile machine (1) according to claim 5, wherein, the detection unit (70) is a limit switch (71, 72) configured to detect information indicating whether the yarn threading target member (21) is at a target position.

7. The textile machine (1) according to claim 5 or 6, wherein, the drive unit (30) includes an air cylinder (31).

8. The textile machine (1) according to any one of claims 1 to 6, wherein, the drive unit (30A, 30B) includes an electric motor (81, 91).

9. The textile machine (1) according to claim 8, wherein, the detection unit (86) is configured to detect information regarding a position of a movable portion (81a) of the electric motor (81).

10. The textile machine (1) according to claim 8 or 9, wherein,

the electric motor (91) is a stepping motor (91), and
the detection unit (92) is configured to detect step-out of the stepping motor (91).

11. The textile machine (1) according to any one of claims 1 to 10, further comprising:

a bobbin holder (24) which supports bobbins (B) on which two or more yarns (Y) are wound, respectively, the supported bobbins (B) being aligned in an axial direction of the bobbins (B); and
traverse guides (22) which are aligned in the axial direction to correspond to the respective bobbins (B) and are configured to traverse the respective yarns (Y),
the yarn threading target member (21) including fulcrum guides (21) which are aligned in the axial direction to correspond to the respective traverse guides (22) and function as fulcrums when the yarns (Y) are traversed, and
the fulcrum guides (21) being movable between:

a distanced position which is the production position, where the yarns (Y) are wound onto the respective bobbins (B); and
a gathered position which is the yarn threading position, where intervals of the fulcrum guides (21) in the axial direction are short as compared to intervals of the fulcrum guides (21) in the distanced position.

12. The textile machine (1) according to claim 11, wherein, the detection unit (70, 86, 92) is configured to detect information regarding whether the fulcrum guides (21) are properly provided at the distanced position.

13. The textile machine (1) according to claim 11 or 12, wherein, the detection unit (70, 86, 92) is configured to detect information regarding whether the fulcrum guides (21) are properly provided at the gathered position.

FIG.1

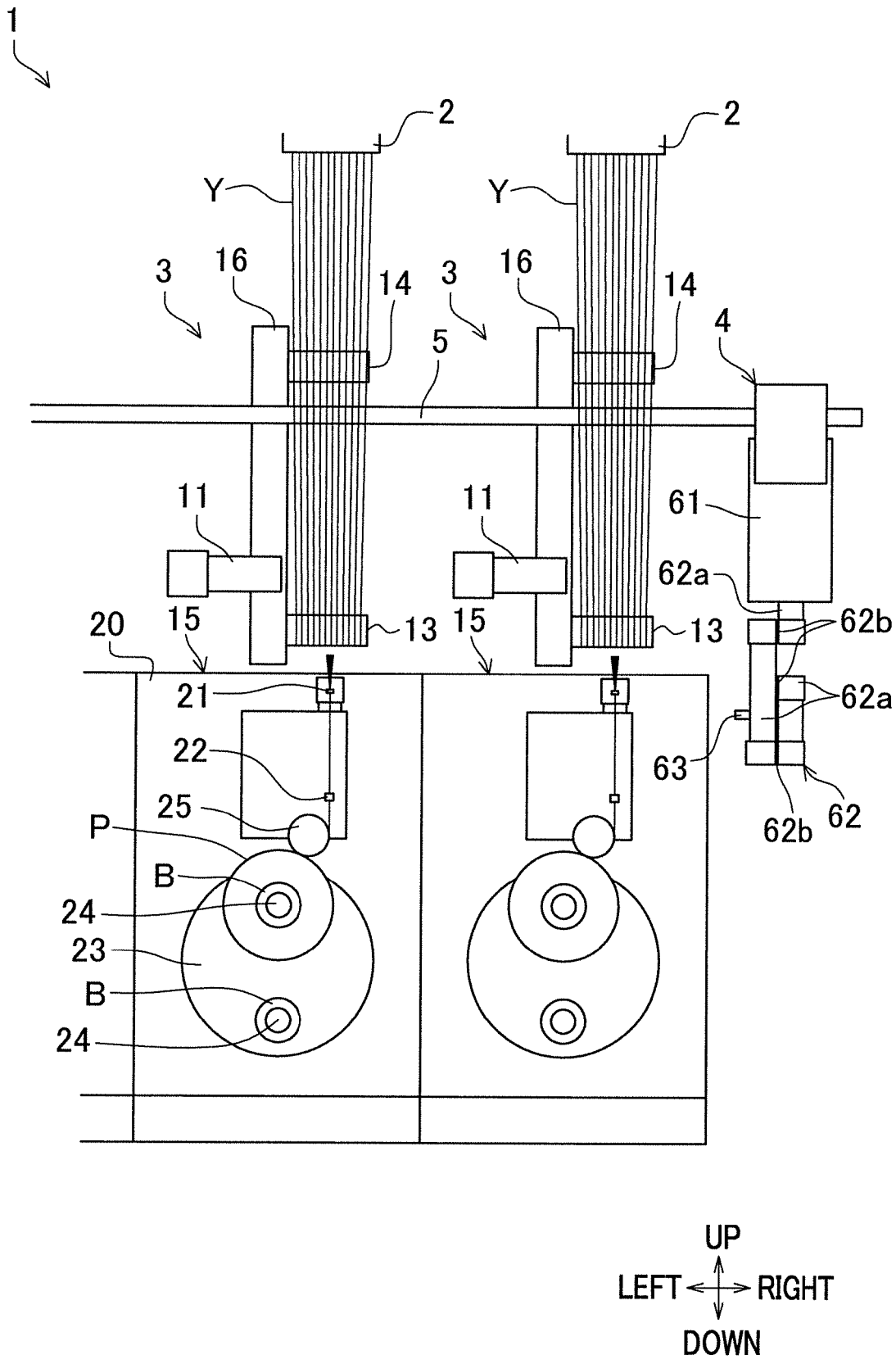

1
2
2
Y
Y
3
16
14
3
16
14
4
5
11
11
61
62a
20
15
13
15
13
62b
21
62a
22
63
25
62
62b
P
B
24
23
B
24
UP
LEFT
RIGHT
DOWN

FIG.2

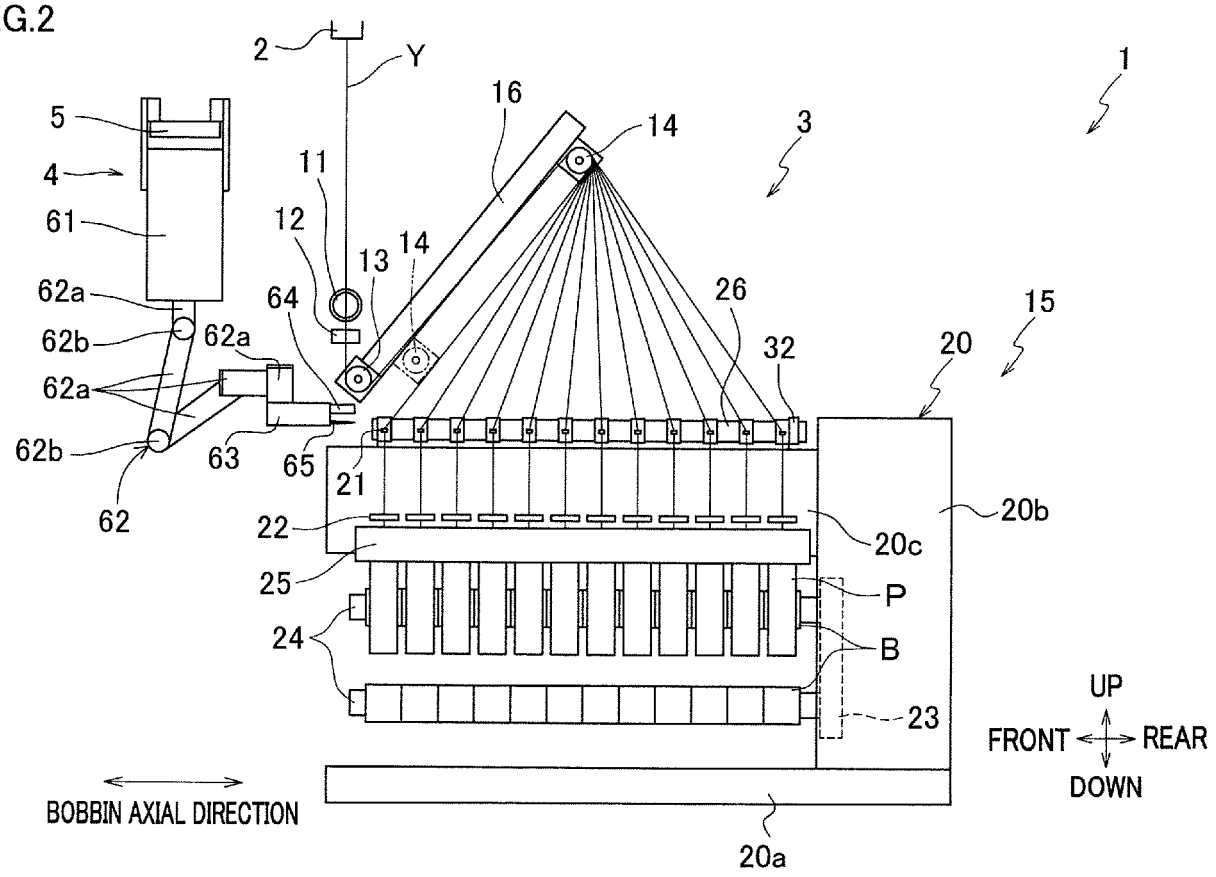

2
Y
1
16
14
3
5
4
11
12
13
14
61
62a
64
26
15
62b
62a
32
20
62a
62b
63
65
21
62
22
20b
20c
25
P
24
B
23
UP
FRONT
REAR
DOWN
BOBBIN AXIAL DIRECTION
20a

FIG.3

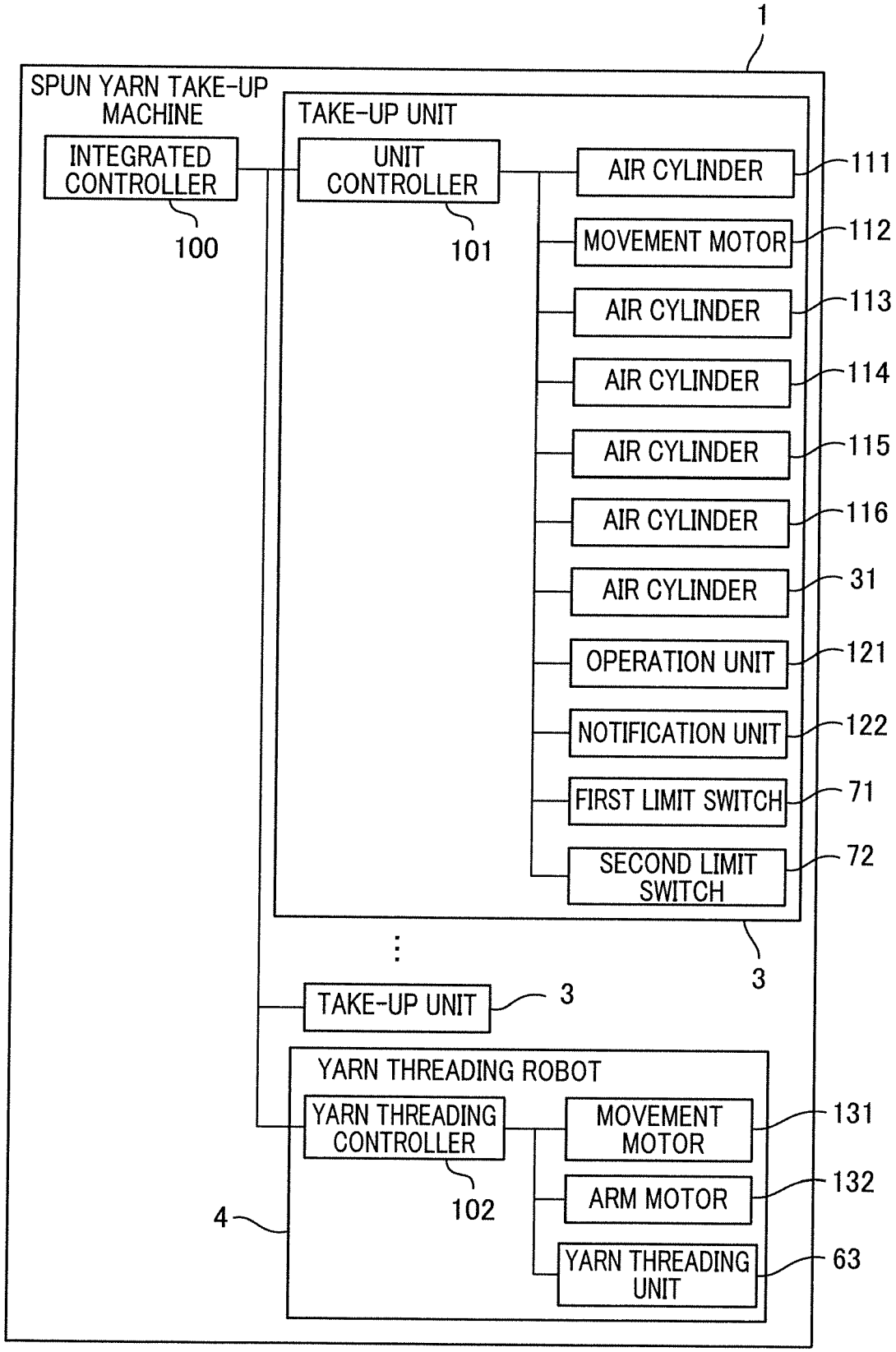

1
SPUN YARN TAKE-UP MACHINE
INTEGRATED CONTROLLER
100
TAKE-UP UNIT
UNIT CONTROLLER
101
AIR CYLINDER
111
MOVEMENT MOTOR
112
AIR CYLINDER
113
AIR CYLINDER
114
AIR CYLINDER
115
AIR CYLINDER
116
AIR CYLINDER
31
OPERATION UNIT
121
NOTIFICATION UNIT
122
FIRST LIMIT SWITCH
71
SECOND LIMIT SWITCH
72
3
TAKE-UP UNIT
3
YARN THREADING ROBOT
YARN THREADING CONTROLLER
102
4
MOVEMENT MOTOR
131
ARM MOTOR
132
YARN THREADING UNIT
63

FIG.4

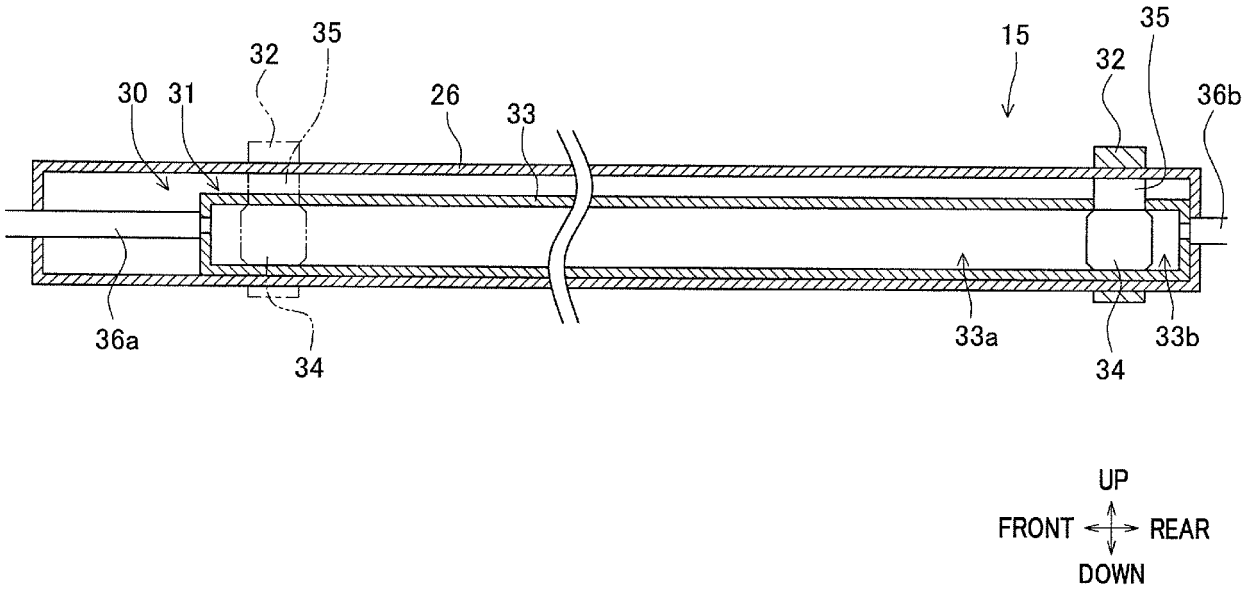


FIG.5

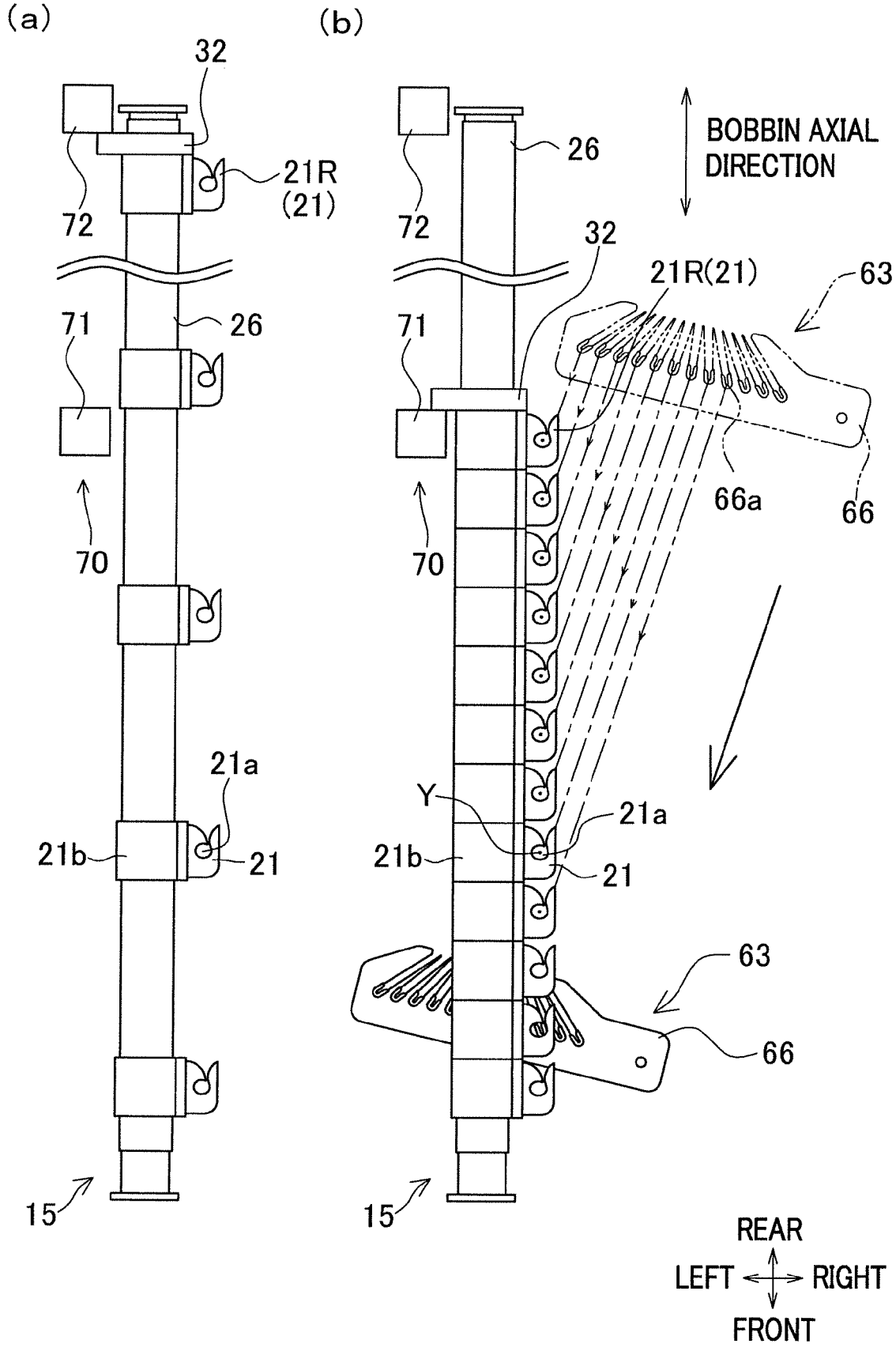

(a)
(b)
32
21R
(21)
72
71
26
70
21a
21b
21
15
BOBBIN AXIAL
DIRECTION
21R(21)
63
66a
66
Y
REAR
LEFT
RIGHT
FRONT

FIG.6

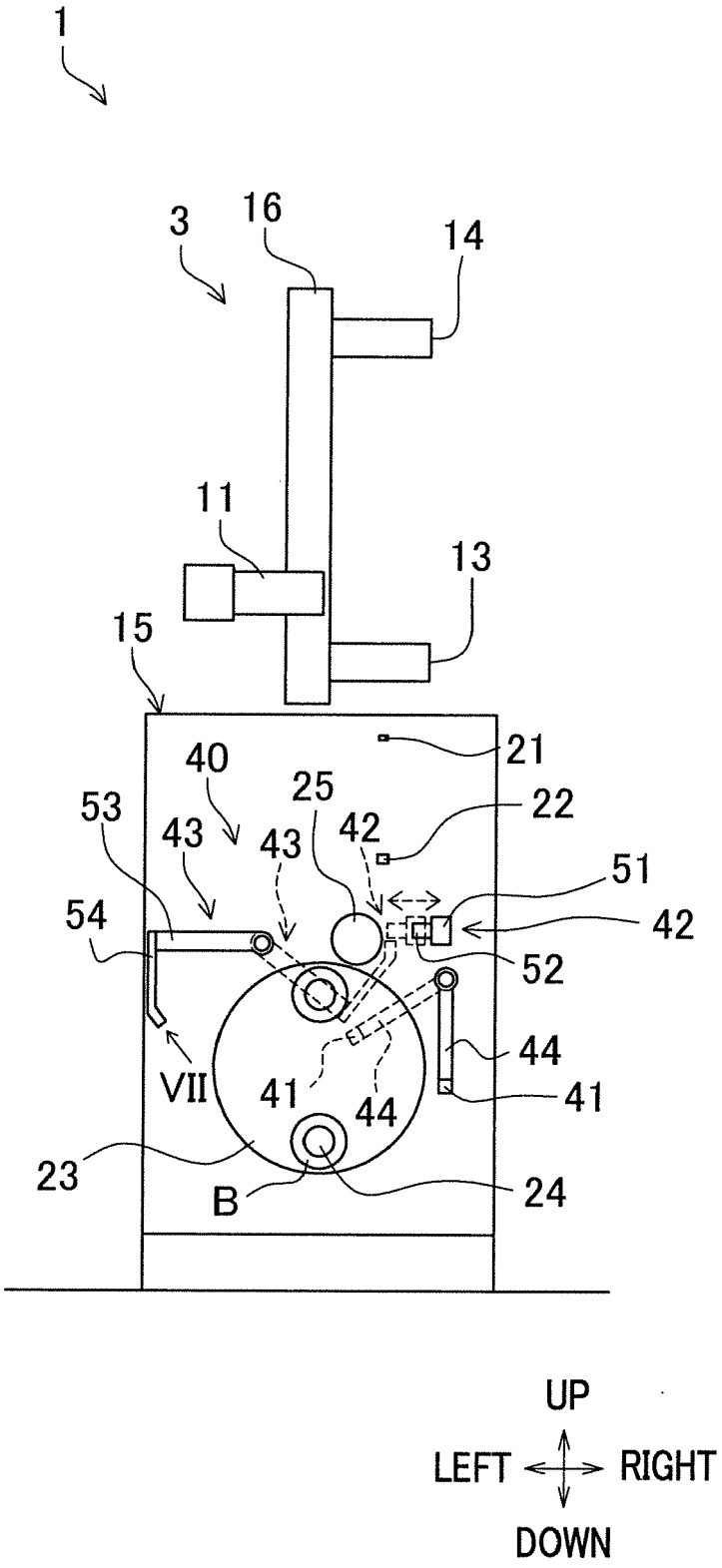

1
3
16
14
11
13
15
21
40
25
22
53
43
43
42
51
54
42
52
44
VII
41
44
41
23
B
24
UP
LEFT
RIGHT
DOWN

FIG.7

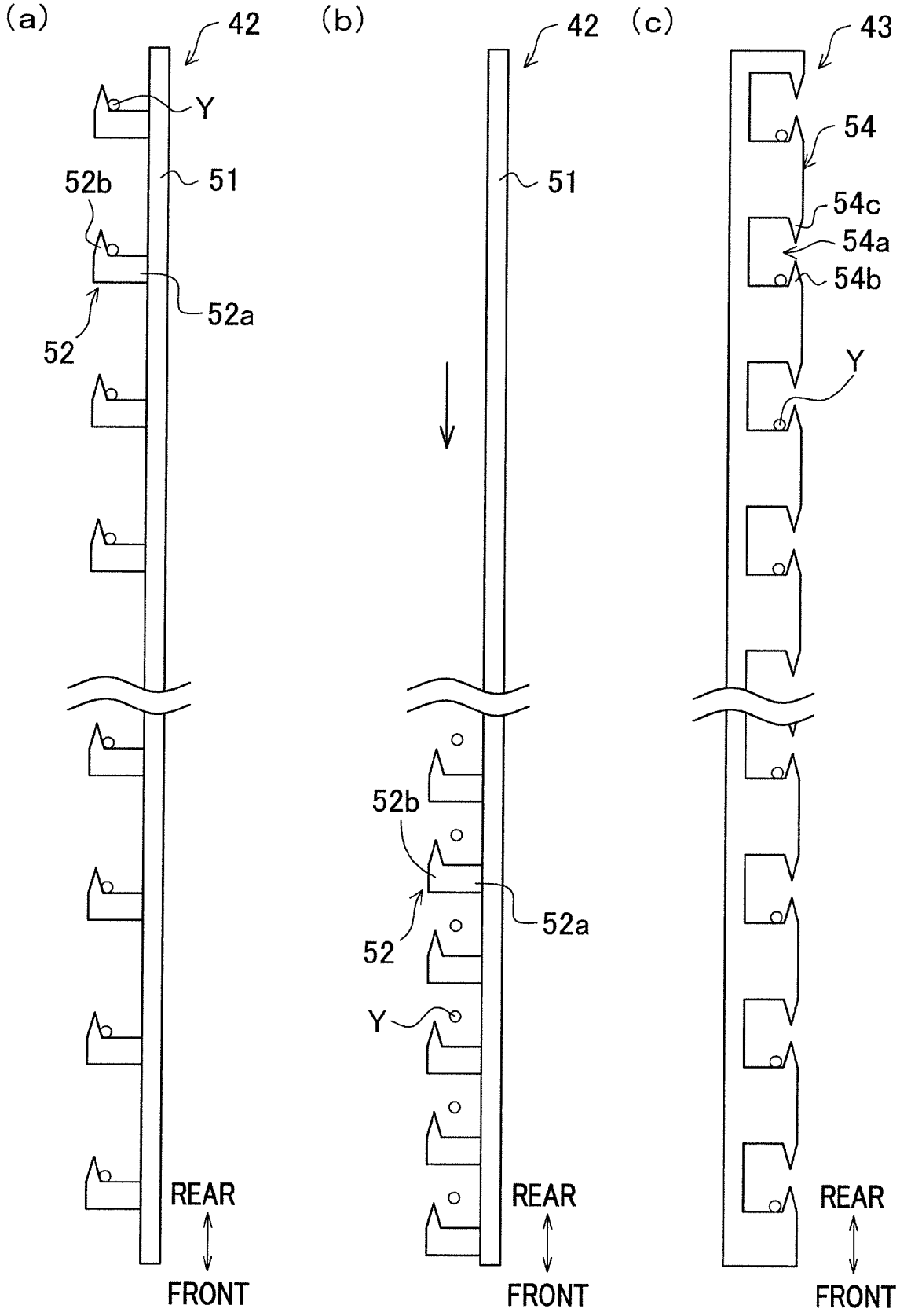

(a)
42
Y
52b
51
52a
52
REAR
FRONT
(b)
42
51
52b
52a
52
Y
REAR
FRONT
(c)
43
54
54c
54a
54b
Y
REAR
FRONT

FIG.8

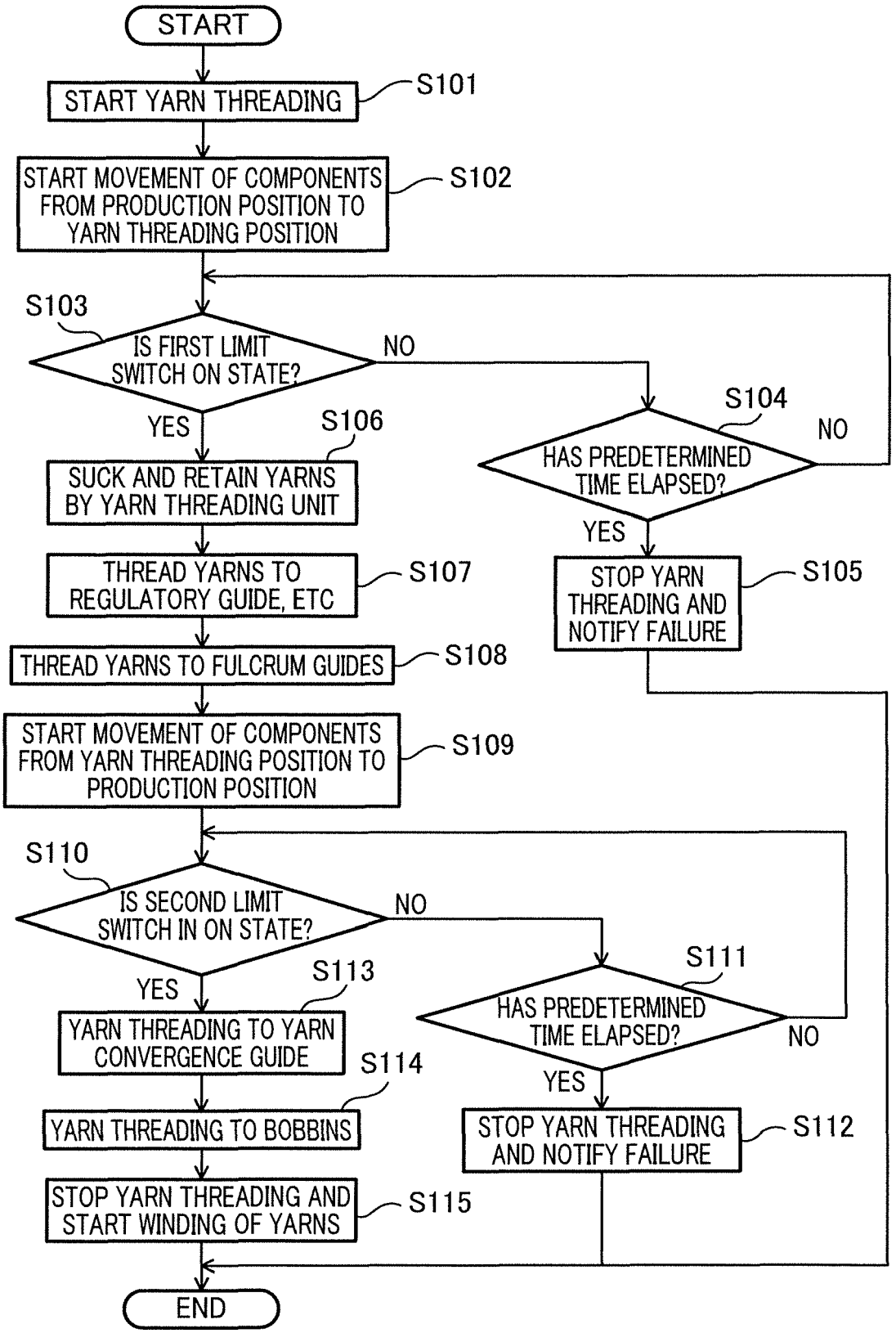

START
START YARN THREADING
S101
START MOVEMENT OF COMPONENTS FROM PRODUCTION POSITION TO YARN THREADING POSITION
S102
S103
IS FIRST LIMIT SWITCH ON STATE?
NO
YES
S104
HAS PREDETERMINED TIME ELAPSED?
NO
YES
S105
STOP YARN THREADING AND NOTIFY FAILURE
S106
SUCK AND RETAIN YARNS BY YARN THREADING UNIT
THREAD YARNS TO REGULATORY GUIDE, ETC
S107
THREAD YARNS TO FULCRUM GUIDES
S108
START MOVEMENT OF COMPONENTS FROM YARN THREADING POSITION TO PRODUCTION POSITION
S109
S110
IS SECOND LIMIT SWITCH IN ON STATE?
NO
YES
S111
HAS PREDETERMINED TIME ELAPSED?
NO
YES
S112
STOP YARN THREADING AND NOTIFY FAILURE
S113
YARN THREADING TO YARN CONVERGENCE GUIDE
S114
YARN THREADING TO BOBBINS
STOP YARN THREADING AND START WINDING OF YARNS
S115
END

FIG.9

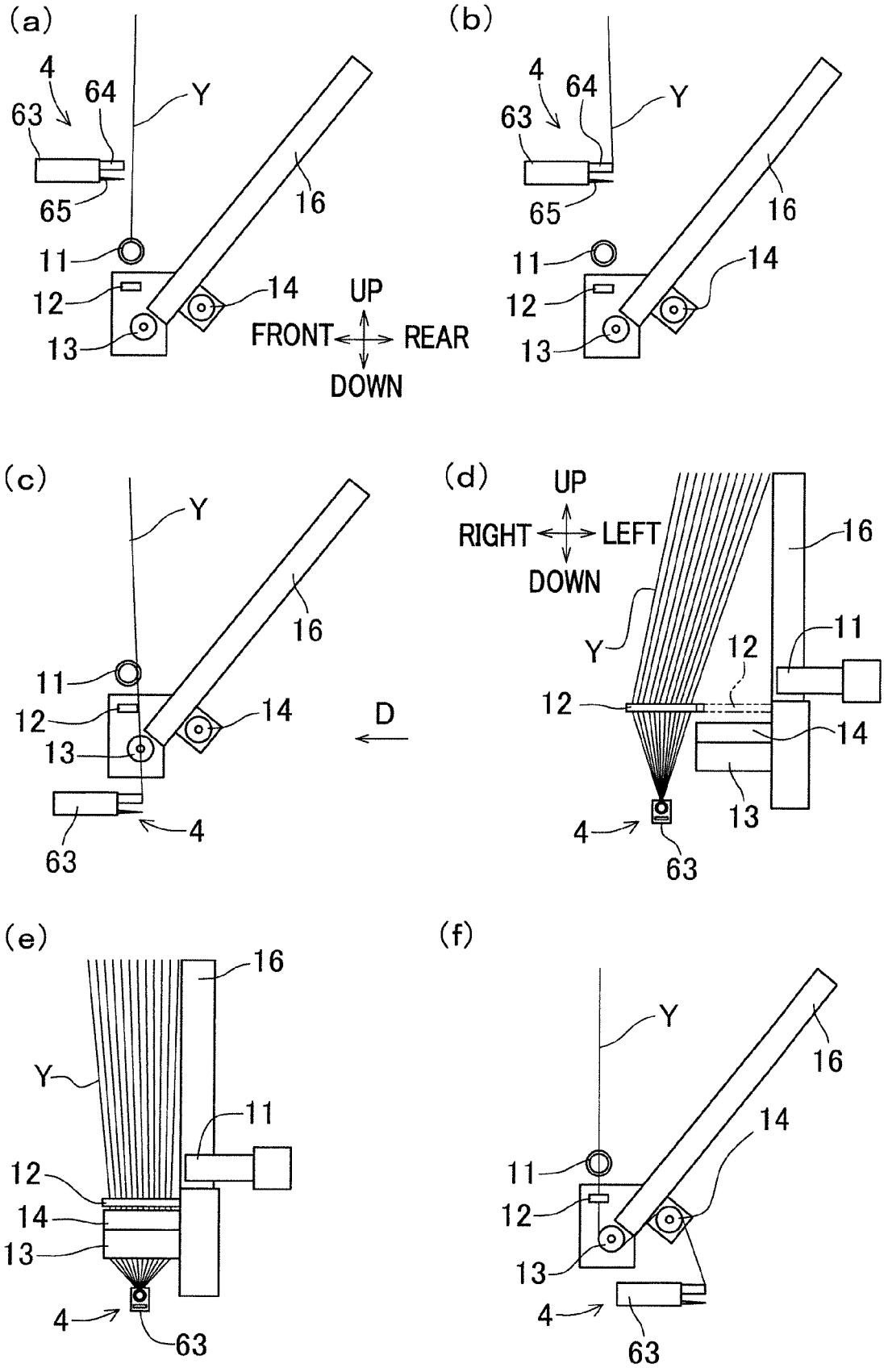
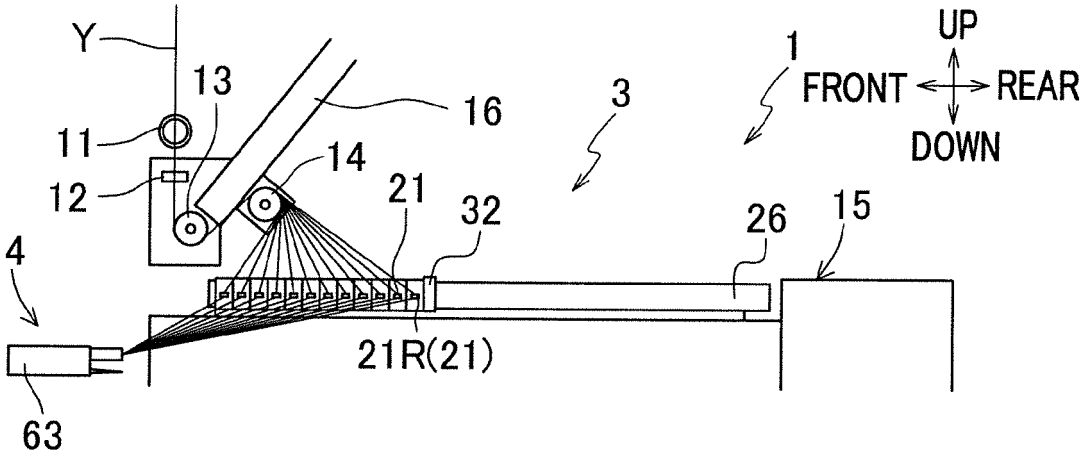

(a)
4
64
63
Y
65
16
11
12
14
13
UP
FRONT
REAR
DOWN
(b)
4
64
63
Y
65
16
11
14
12
13
(c)
Y
16
11
12
14
13
D
4
63
(d)
UP
RIGHT
LEFT
DOWN
16
Y
12
11
12
14
13
4
63
(e)
16
Y
11
12
14
13
4
63
(f)
Y
16
14
11
12
13
4
63

FIG.10

(a)


Y
13
11
12
16
14
3
1
UP
FRONT
REAR
DOWN
21
32
26
15
4
21R(21)
63

(b)

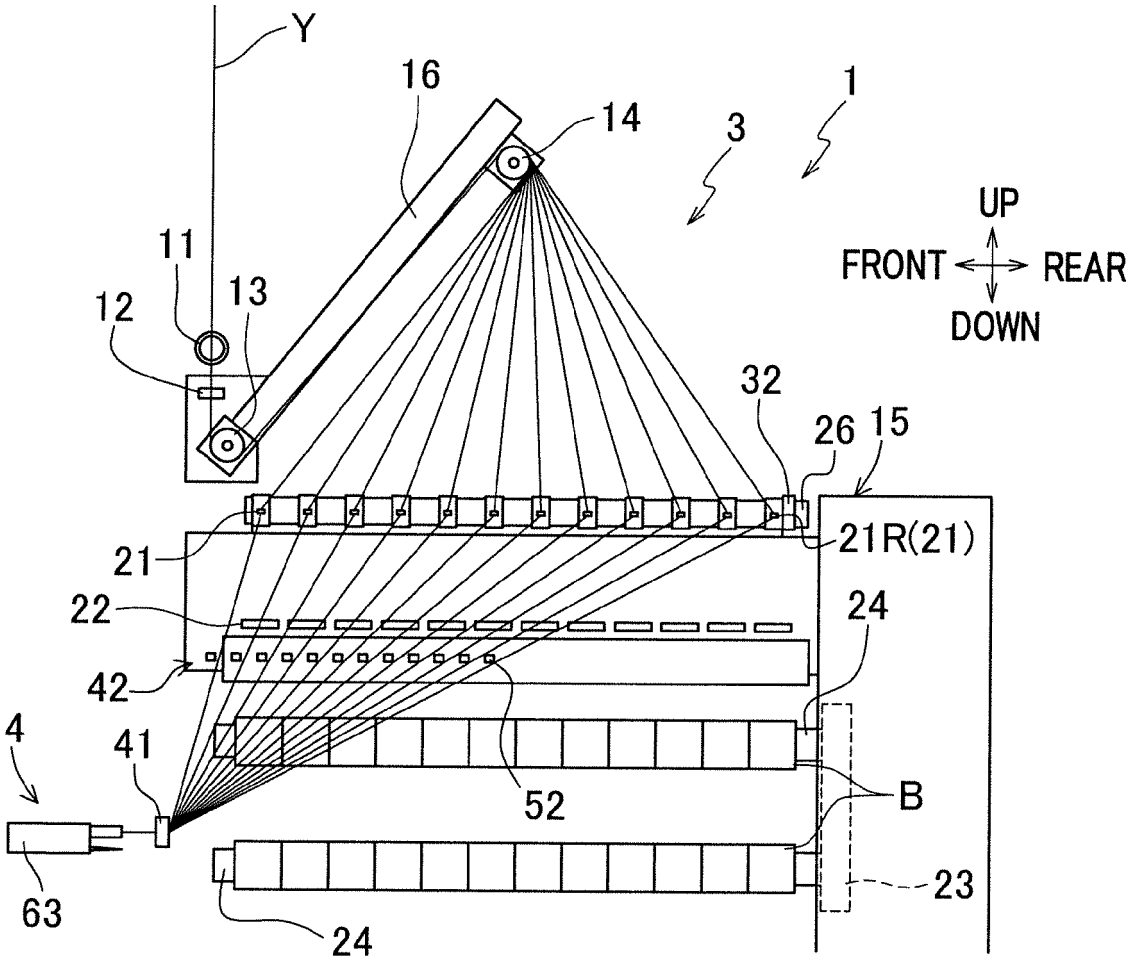

Y
16
14
3
1
UP
FRONT
REAR
DOWN
11
13
12
32
26
15
21R(21)
21
22
24
42
4
41
52
B
63
23
24

FIG.11

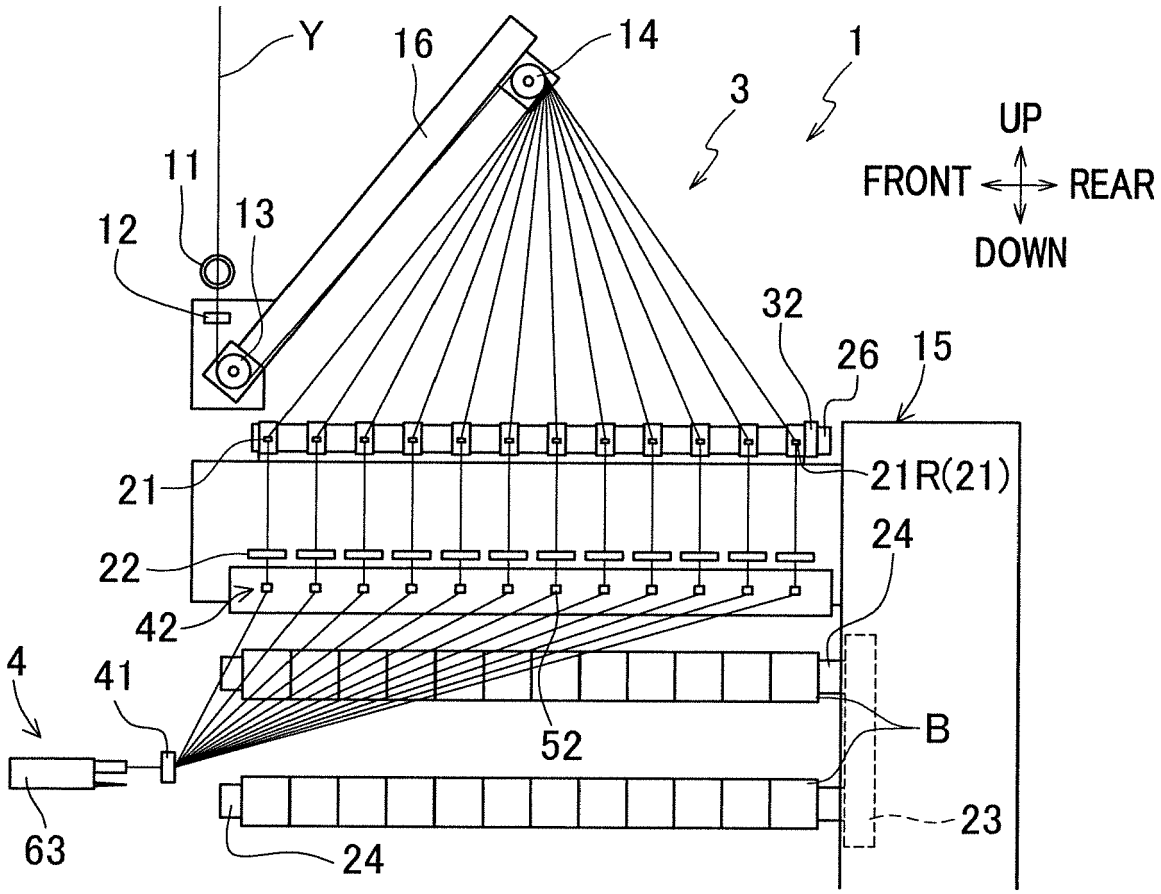

Y
16
14
1
3
UP
FRONT
REAR
DOWN
11
12
13
32
26
15
21
21R(21)
22
24
42
4
41
52
B
63
24
23

FIG.12

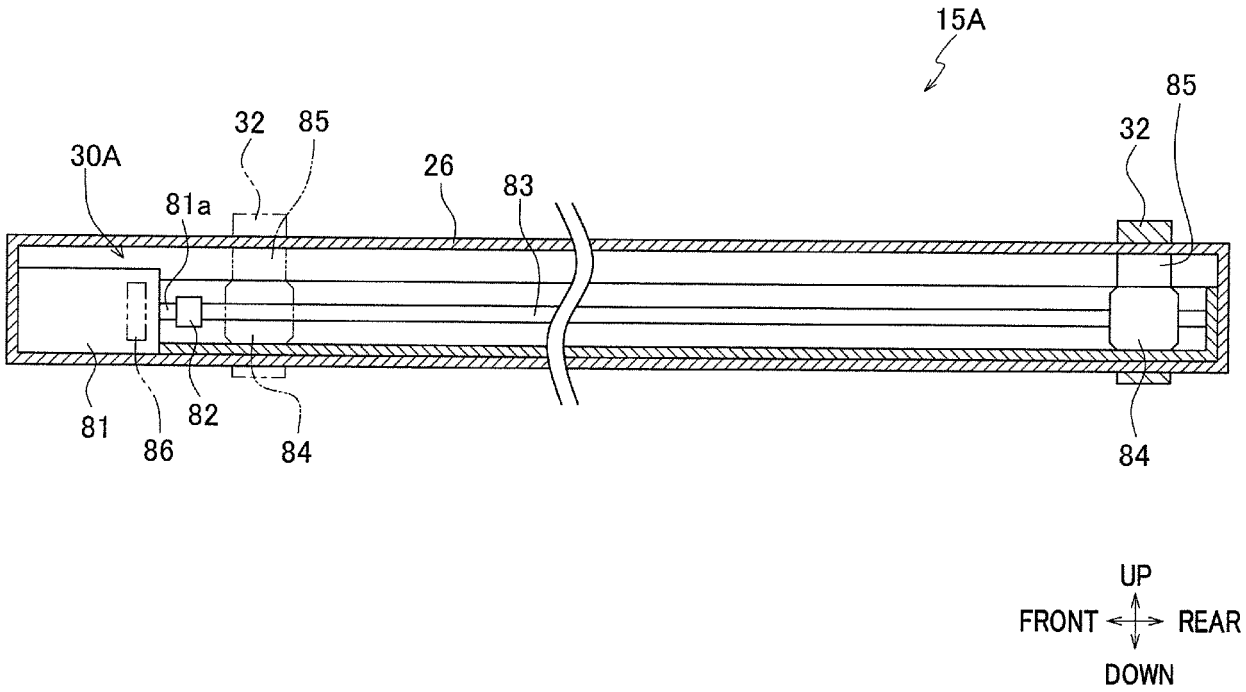


FIG.13

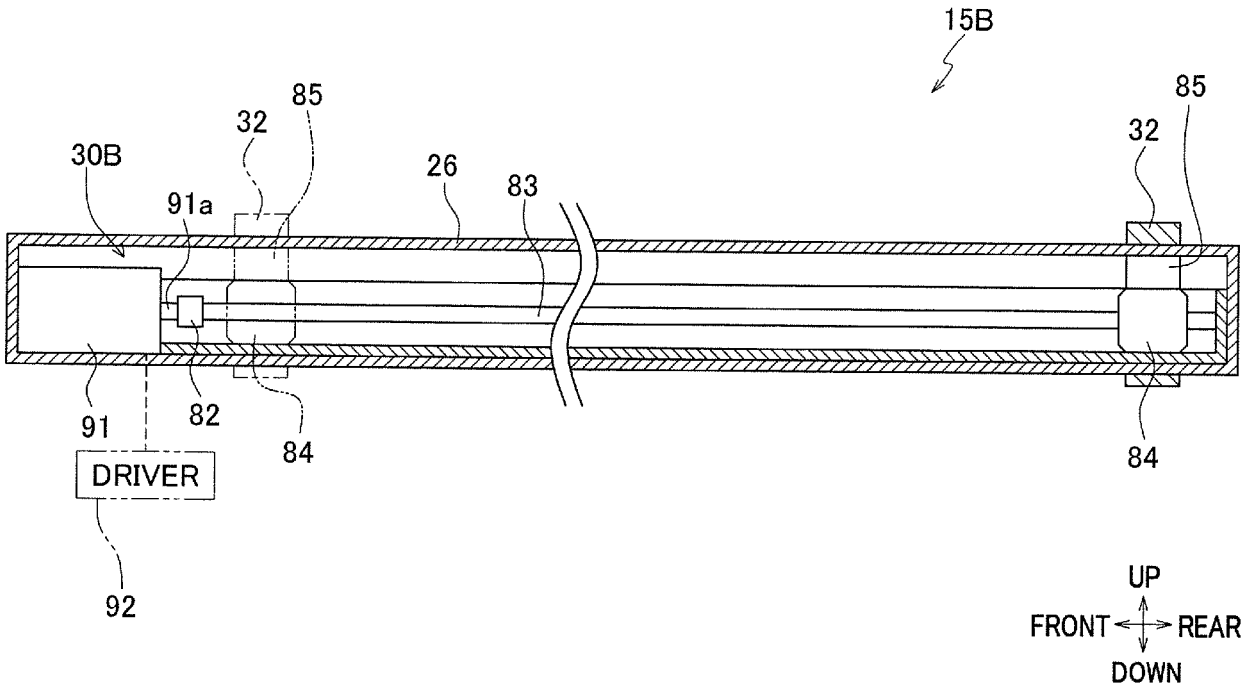
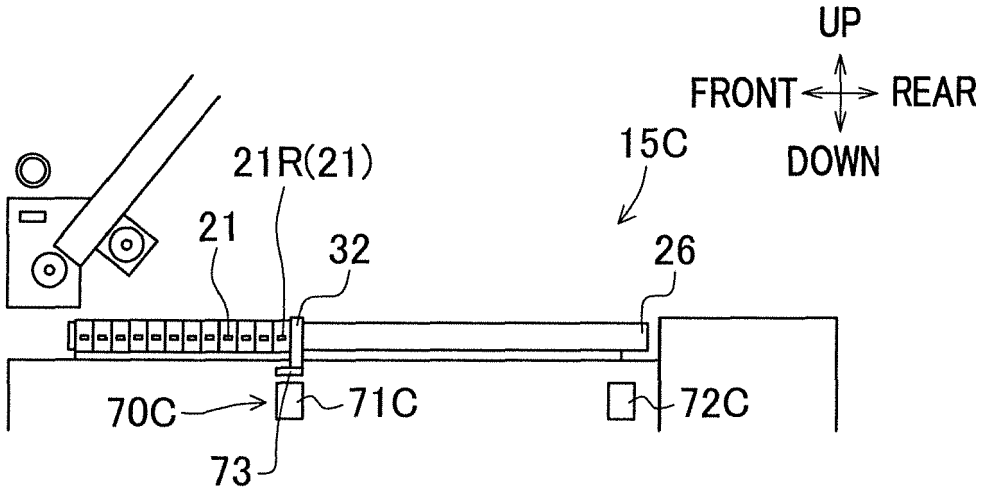
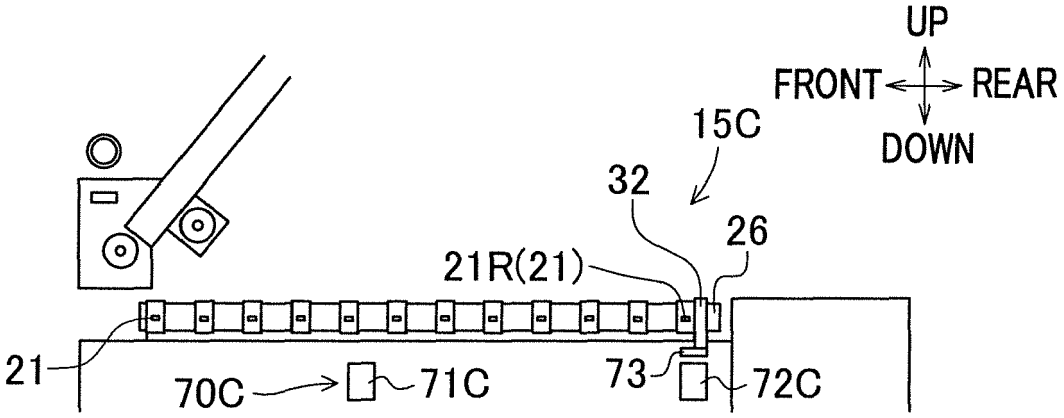

15B
85
32
30B
91a
26
83
85
32
91
82
84
84
DRIVER
92
UP
FRONT
REAR
DOWN

FIG.14

(a)


UP
FRONT
REAR
DOWN
15C
21R(21)
21
32
26
70C
71C
72C
73

(b)


UP
FRONT
REAR
DOWN
15C
32
26
21R(21)
21
70C
71C
73
72C

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EUROPEAN SEARCH REPORT

Application Number
EP 24 16 6767

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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X	JP H05 78012 A (TORAY INDUSTRIES) 30 March 1993 (1993-03-30) * paragraphs [0029] - [0031]; figures *	1,2,4-10	
X	JP S61 23090 A (MURATA MACHINERY LTD) 31 January 1986 (1986-01-31) * figures *	1,2,4-10	
X	US 4 942 729 A (GUETTLER HERMANN [DE] ET AL) 24 July 1990 (1990-07-24) * column 6, lines 18-42 * * column 7, lines 1-13; figures *	1,3,5,6	TECHNICAL FIELDS SEARCHED (IPC) B65H D01D D01F
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	19 April 2024	Lemmen, René

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