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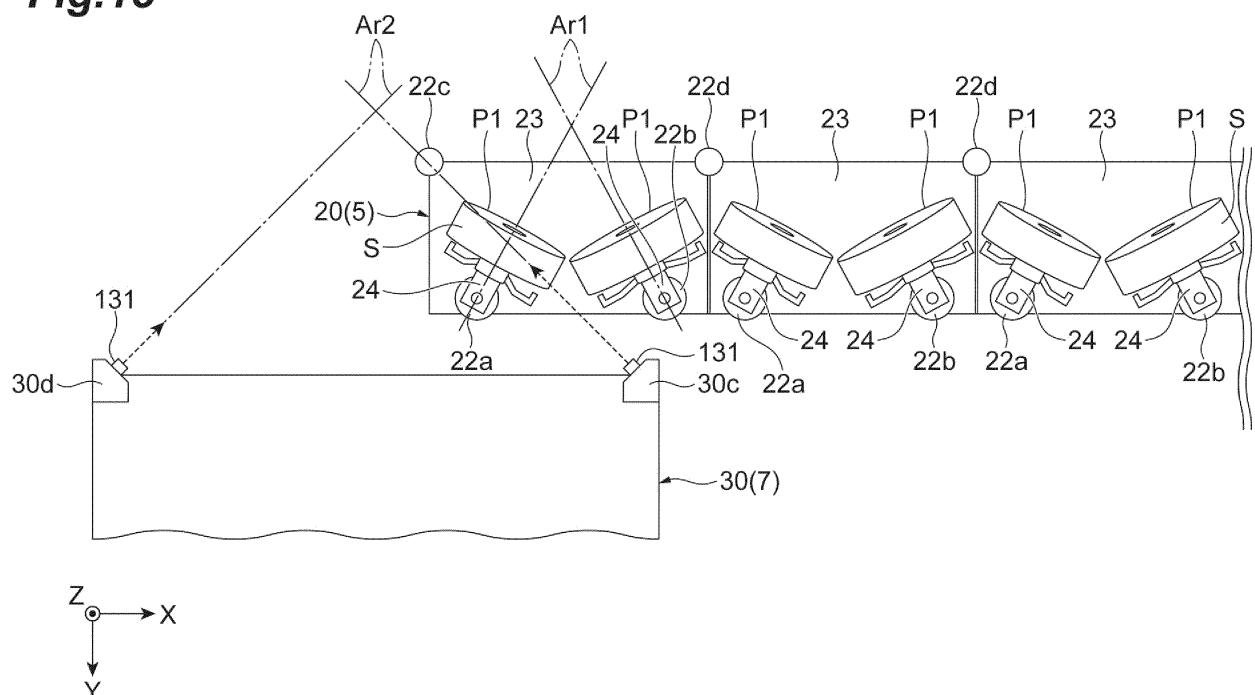
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(54) **PACKAGE EXCHANGING SYSTEM**

(57) A package exchanging system (100) includes: a running carrier (30) which is provided so as to be movable in one direction along creel stands (20) arranged in the one direction; a running control unit (90b) which controls the running of the running carrier (30); a sensor (131) which is provided in the running carrier (30) and acquires

a remaining amount of a yarn (Y) wound on a yarn supply package (P1) held by the creel stand (20); and a prediction unit (90a) which predicts a timing at which the yarn (Y) disappears from the yarn supply package (P1) on the basis of the remaining amount of the yarn (Y) acquired by the sensor (131).

Fig.15



Description

TECHNICAL FIELD

[0001] An aspect of the invention relates to a package exchanging system.

BACKGROUND

[0002] A false-twisting machine which false-twists a plurality of synthetic yarns supplied from a yarn supply package and winds the processed synthetic yarn in a winding device so as to form a winding package is known (for example, Patent Literature 1; Japanese Unexamined Patent Publication No. H6-200434). In the false-twisting machine, a pair of two pegs holding the yarn supply package is used in a creel stand holding the plurality of yarn supply packages so as to continuously supply the synthetic yarn. In this configuration, the synthetic yarn on the inner layer side of the yarn supply package supported by one peg is connected to the synthetic yarn on the outer layer side of the yarn supply package supported by the other peg. Accordingly, in the creel stand, even when the synthetic yarn of one yarn supply package disappears, the synthetic yarn can be continuously supplied since the synthetic yarn is supplied from the other yarn supply package.

[0003] In such a configuration, when the synthetic yarn of the yarn supply package disappears, there is a need to supply a new package and to join the synthetic yarn of the yarn supply package supported by one peg and the synthetic yarn of the yarn supply package supported by the other peg. Such a yarn joining operation (tail joining operation) is generally performed through human hands. Patent Literature 2 (Japanese Examined Patent Publication No. H7-68010) discloses a working carrier which is provided so as to run along such a creel stand and on which an operator performing a yarn joining operation and an exchange operation of the yarn supply package gets.

[0004] Patent Literature 2 discloses a package exchanging system (a yarn exchanging system) in which the working carrier is provided with a sensor for detecting the diameter of the yarn supply package held by the creel stand in three stages (full, half, and small). Accordingly, since the operator can determine that the exchange is not necessary in the full case, the exchange is soon necessary in the half case, and the exchange is necessary in the small case, it is possible to efficiently perform the yarn joining operation and the exchange operation of the yarn supply package held by the creel stand.

SUMMARY

[0005] However, in the conventional package exchanging system, the state of the yarn supply package can be determined only at the moment (sensing moment) detected by the sensor provided in the working carrier.

For this reason, there is a case in which the synthetic yarn of the yarn supply package disappears without acquiring a state in which the synthetic yarn of the yarn supply package is likely to disappear when the sensing interval time is long.

[0006] Here, an object of an aspect of the invention is to provide a package exchanging system capable of more efficiently performing a yarn joining operation and an exchange operation of a yarn supply package.

[0007] A package exchanging system according to an aspect of the invention is a package exchanging system used in a textile machine including a creel stand allowing a yarn supply package support portion to support a yarn supply package in which a synthetic yarn formed of a synthetic fiber is wound around a bobbin, a processing device processing the synthetic yarn supplied from the yarn supply package, and a winding device forming a winding package by winding the processed synthetic yarn, the package exchanging system including: a running unit which is provided so as to be movable in one direction along the creel stand disposed in the one direction; a running control unit which controls the running of the running unit; an acquisition unit which is provided in the running unit and acquires a remaining amount of the synthetic yarn wound on the yarn supply package held by the creel stand; and a prediction unit which predicts a timing at which the synthetic yarn disappears from the yarn supply package on the basis of the remaining amount of the synthetic yarn acquired by the acquisition unit.

[0008] In the package exchanging system with this configuration, since the remaining amount of the yarn wound on the yarn supply package is acquired at the time of sensing, it is possible to more specifically check the state of the yarn supply package as compared with a case in which the state of the yarn is acquired in three stages. Further, in the package exchanging system with this configuration, since a timing at which the yarn disappears from the yarn supply package is predicted on the basis of the acquired remaining amount of the yarn, it is possible to check the state of the yarn supply package at all times regardless of the sensing timing. As a result, it is possible to more efficiently perform the yarn joining operation and the exchange operation of the yarn supply package.

[0009] In the package exchanging system according to an aspect of the invention, the acquisition unit may be a sensor that detects a distance to an outer peripheral surface of the package in a radial direction of the package and the prediction unit may predict a timing at which the synthetic yarn disappears from the package on the basis of the distance detected by the sensor. In this configuration, it is possible to acquire the position of the outermost layer of the package, that is, the diameter of the package with a simple configuration. When the diameter of the package can be acquired, the remaining amount of the yarn can be predicted by a simple calculation.

[0010] In the package exchanging system according

to an aspect of the invention, the running control unit may move the running unit so that the distance of all yarn supply packages held by the creel stands is acquired at a predetermined time interval. In this configuration, since the remaining amount of the yarn is acquired at a predetermined time interval, it is possible to more accurately predict a timing at which the yarn disappears from the yarn supply package.

[0011] In the package exchanging system according to an aspect of the invention, the running unit may include a yarn joining device which connects yarn ends of the yarn supply packages, a guide device which guides the yarn end of the yarn supply package to the yarn joining device, and an exchange device which supplies the yarn supply package to the creel stand and collects the bobbin from the creel stand. Accordingly, it is possible to perform the yarn joining operation and the exchange operation of the yarn supply package by the running unit without using human hands.

[0012] In the package exchanging system according to an aspect of the invention, the running control unit may move the running unit to an exchange position of the yarn supply package predicted that the synthetic yarn disappears on the basis of the timing predicted by the prediction unit. Accordingly, it is possible to more efficiently perform the yarn joining operation and the exchange operation of the yarn supply package.

[0013] In the package exchanging system according to an aspect of the invention, the prediction unit and the running control unit may be provided in the running unit. In this configuration, the package exchanging system can be provided as the running unit.

[0014] The package exchanging system according to an aspect of the invention may further include a determination unit which determines whether or not a yarn joining portion is included in the winding package on the basis of a prediction result of the prediction unit. Here, there is a case in which a grade (rank) is classified depending on whether or not the yarn joining portion is included in the synthetic yarn wound as the winding package. In this configuration, the high-grade winding package can be simply selected.

[0015] According to an aspect of the invention, it is possible to more efficiently perform the yarn joining operation and the exchange operation of the yarn supply package.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

FIG. 1 is a diagram illustrating a configuration of a false-twisting system according to an embodiment.
FIG. 2 is a perspective view illustrating a package holding unit of a first transporting device.
FIG. 3 is a perspective view illustrating a yarn supply package to which an adapter is attached.
FIG. 4 is a perspective view illustrating a package holding unit of a second transporting device.

FIG. 5 is a perspective view illustrating a creel stand.

FIG. 6 is a perspective view illustrating a peg.

FIG. 7 is a perspective view illustrating a package exchanging device.

FIGS. 8A and 8B are perspective views illustrating a holding unit.

FIG. 9 is a diagram illustrating a configuration of an exchange unit.

FIG. 10 is a side view illustrating a collection device.

FIG. 11 is a side view illustrating a supply device.

FIG. 12 is a perspective view illustrating a yarn joining device.

FIG. 13 is a perspective view illustrating the yarn joining device.

FIG. 14 is a perspective view illustrating the yarn joining device.

FIG. 15 is a plan view illustrating a sensor that detects a remaining amount of a yarn in a package.

FIG. 16 is a plan view illustrating a sensor that detects a remaining amount of a yarn in a package.

FIG. 17 is a plan view illustrating a sensor that detects a remaining amount of a yarn in a package.

FIG. 18 is a block diagram illustrating a functional configuration of a package exchanging system.

DETAILED DESCRIPTION

[0017] Hereinafter, preferred embodiments of an aspect of the invention will be described in detail with reference to the accompanying drawings. In the description of the drawings, the same or corresponding components will be denoted by the same reference numerals and redundant description will be omitted.

[0018] As illustrated in FIG. 1, a false-twisting system 1 includes a false-twisting machine (textile machine) 2, a first transporting device 3, a second transporting device 4, a yarn supply unit 5, a package replenishing device 6, and a package exchanging device 7. The false-twisting system 1 includes a control device (not illustrated) which overall controls the false-twisting machine 2, the first transporting device 3, the second transporting device 4, the package replenishing device 6, and the package exchanging device 7. In the false-twisting system 1 according to this embodiment, each of the false-twisting machine 2, the first transporting device 3, the second transporting device 4, the yarn supply unit 5, the package replenishing device 6, and the package exchanging device 7 is provided as a plurality of units. In the following description, the "Z direction" illustrated in the drawing is the vertical direction (up and down direction), the "X direction" is the horizontal direction, and the "Y direction" is a horizontal direction perpendicular to the X direction and the Z direction.

[0019] The false-twisting system 1 manufactures a winding package P2 (see FIG. 4) by processing yarns Y (see FIG. 3) supplied from a plurality of yarn supply packages P1 (see FIG. 2). The yarn Y is, for example, a synthetic yarn made of thermoplastic synthetic fibers such

as polyester and polyamide. The yarn supply package P1 is formed by winding a partially oriented yarn (POY) on a yarn supply bobbin B1 (see FIG. 2). The winding package P2 is formed by winding a draw textured yarn (DTY) on a winding bobbin B2 (see FIG. 4).

[0020] The false-twisting machine 2 forms the winding package P2 by processing the yarn Y. The false-twisting machine 2 includes a main base (processing device) 2a and two winding tables 2b. The main base 2a is provided with a false-twisting device, a feeding roller, and the like. The winding table 2b is provided with a winding device, a doffing device, and the like. The main base 2a extends in the X direction. The winding table 2b extends in the X direction. The winding table 2b is disposed at a position facing the main base 2a in the Y direction (the width direction of the main base 2a). That is, two winding tables 2b are disposed at positions sandwiching the main base 2a.

[0021] The false-twisting machine 2 twists the yarns Y supplied from the plurality of yarn supply packages P1 and winds the processed yarn on the winding bobbin B2 so as to form the winding package P2 (see FIG. 4). The false-twisting machine 2 supplies the formed winding package P2 to the second transporting device 4.

[0022] The first transporting device 3 transports the yarn supply package P1. The first transporting device 3 runs along, for example, a first rail R1 suspended from a ceiling. For example, the first rail R1 is disposed between one false-twisting machine 2 and the other false-twisting machine 2 and between the winding table 2b and the yarn supply unit 5. The first transporting device 3 transports the yarn supply package P1 between a position where the yarn supply package P1 is supplied and a predetermined package replenishing device 6. As illustrated in FIG. 2, the first transporting device 3 includes a first package holding unit 3a. The first package holding unit 3a is suspended from the first rail R1. The first package holding unit 3a holds the plurality of (for example, twelve) yarn supply packages P1. The first package holding unit 3a supports the yarn supply package P1 by a support member (not illustrated) inserted into the yarn supply bobbin B1 of the yarn supply package P1.

[0023] As illustrated in FIG. 3, an adapter 10 is attached to the yarn supply package P1. The adapter 10 holds the yarn Y. The adapter 10 includes an attachment portion 11, a first holding unit 12, and a second holding unit 13. The attachment portion 11 is attached to the yarn supply bobbin B1 of the yarn supply package P1 so as to be rotatable in a synchronization manner. The attachment portion 11 has a cylindrical shape. The attachment portion 11 is attached to the end portion of the yarn supply bobbin B1 protruding from the side surface of the yarn supply package P1.

[0024] The first holding unit 12 holds a first yarn end Y1 of the yarn Y on the outer layer side of the yarn supply package P1. The first holding unit 12 is provided in the attachment portion 11. The first holding unit 12 includes a first arm 12a, a first gripper 12b, and a first yarn guide

12c. The first arm 12a extends in the radial direction of the attachment portion 11 while the base end side is fixed to the side surface of the attachment portion 11. The first gripper 12b grips the first yarn end Y1. The first gripper 12b is provided at the front end side of the first arm 12a. The first yarn guide 12c is provided in the first arm 12a.

[0025] The second holding unit 13 holds a second yarn end Y2 of the yarn Y on the inner layer side (tail side) of the yarn supply package P1. The second holding unit 13 is provided in the attachment portion 11. The second holding unit 13 includes a second arm 13a, a second gripper 13b, and a second yarn guide 13c. The second arm 13a extends in the radial direction of the attachment portion 11 while the base end side is fixed to the side surface of the attachment portion 11. The second arm 13a is disposed so as to be located on the same line as the first arm 12a. The second gripper 13b grips the second yarn end Y2. The second gripper 13b is provided at the front end side of the second arm 13a. The second yarn guide 13c is provided in the second arm 13a.

[0026] In the adapter 10, the first yarn end Y1 drawn from the outer layer side of the yarn supply package P1 is gripped by the first gripper 12b through the first yarn guide 12c of the first holding unit 12 and the second yarn end Y2 drawn from the inner layer side of the yarn supply package P1 is gripped by the second gripper 13b through the first yarn guide 12c of the first holding unit 12 and the second yarn guide 13c of the second holding unit 13. The adapter 10 is attached to the yarn supply package P1 by, for example, an operator. A bobbin cap BC (see FIG. 2) may be attached to the yarn supply bobbin B1 at an end portion opposite to the end portion to which the adapter 10 is attached.

[0027] As illustrated in FIG. 4, the second transporting device 4 transports the winding package P2. The second transporting device 4 runs along the first rail R1. The second transporting device 4 transports the winding package P2 between a predetermined false-twisting machine 2 and a storage facility (not illustrated) of the winding package P2. The second transporting device 4 includes a second package holding unit 4a. The second package holding unit 4a is suspended from the first rail R1. A plurality of (for example, sixteen) winding packages P2 are respectively held through the second package holding unit 4a. Specifically, the winding package P2 is held by supporting both end portions of each winding bobbin B2 with a package receiver.

[0028] As illustrated in FIG. 1, the yarn supply unit 5 supplies the yarn Y to the false-twisting machine 2. The yarn supply unit 5 is disposed adjacent to the false-twisting machine 2. The yarn supply unit 5 is disposed at a position facing the winding table 2b of the false-twisting machine 2 in the Y direction. The yarn supply unit 5 extends in the X direction. The yarn supply unit 5 includes a plurality of creel stands 20. The creel stand 20 holds the yarn supply package P1. The plurality of creel stands 20 are arranged in the X direction. In the yarn supply unit 5 according to this embodiment, the pair of creel stands

20 is arranged back to back in the Y direction.

[0029] As illustrated in FIG. 5, the creel stand 20 includes a creel base 21, four first columns 22a, 22b, 22c, and 22d, a partition plate 23, and a plurality of pegs 24. The creel base 21 is a frame-shaped frame body. Four first columns 22a to 22d are provided upright in the creel base 21. Four first columns 22a to 22d extend in the Z direction. Four first columns 22a to 22d are respectively arranged at predetermined intervals in the X direction and at predetermined intervals in the Y direction. The partition plate 23 is provided in the first columns 22a to 22d. The partition plates 23 are arranged at predetermined intervals in the Z direction of the first columns 22a to 22d. The partition plate 23 prevents the yarn supply package P1 from falling.

[0030] The peg 24 supports the yarn supply package P1. The peg 24 is provided in the first columns 22a and 22b. The plurality of (for example, eight) pegs 24 are arranged at predetermined intervals in the Z direction of the first columns 22a and 22b. The peg 24 is disposed between the pair of partition plates 23. The peg 24 provided in the first column 22a and the peg 24 provided in the first column 22b are arranged at the same height position. In the following description, the peg 24 provided in the first column 22a is referred to as a "first peg 24a" and the peg 24 provided in the first column 22b is referred to as a "second peg 24b".

[0031] The first peg 24a and the second peg 24b are used as pairs. In this configuration, the yarn Y of the yarn supply package P1 supported by the first peg 24a and the yarn Y of the yarn supply package P1 supported by the second peg 24b are connected to each other. Specifically, the first yarn end Y1 on the outer layer side or the second yarn end Y2 on the inner layer side of the yarn Y of the yarn supply package P1 supported by the first peg 24a is connected to the second yarn end Y2 on the inner layer side or the first yarn end Y1 on the outer layer side of the yarn supply package P1 supported by the second peg 24b. Accordingly, one yarn Y is supplied from the yarn supply package P1 supported by a pair of the first peg 24a and the second peg 24b.

[0032] As illustrated in FIG. 6, the peg 24 includes a yarn supply package support portion 25 and a peg body 26. The yarn supply package support portion 25 supports the yarn supply package P1. The yarn supply package support portion 25 includes package support members 25a and 25b and a rotation mechanism 25c. The package support members 25a and 25b are bar-shaped members. The package support members 25a and 25b are rotatably supported by the peg body 26. The package support members 25a and 25b extend in one direction, are parallel to each other, and are arranged with a predetermined gap therebetween. The peg 24 supports the yarn supply package P1 at two points by the package support members 25a and 25b.

[0033] A covering portion 25d is provided in one end portion of the package support member 25a in the extending direction. A covering portion 25e is provided in

one end portion of the package support member 25b in the extending direction. The covering portions 25d and 25e are formed of, for example, rubber (resin) or the like having a large friction coefficient. The covering portions 25d and 25e contact (come into contact with) the inner peripheral surface of the yarn supply bobbin B1 of the winding package P2. One end of the package support member 25a and one end of the package support member 25b are connected to each other by a connection member 25f.

[0034] The rotation mechanism 25c includes a driven pulley 25g, a drive pulley 25h, a power transmission belt 25i, and a first wheel 25j.

[0035] The driven pulley 25g is provided in the other end of the package support member 25a. The drive pulley 25h is provided in the other end of the package support member 25b. The power transmission belt 25i is stretched over the driven pulley 25g and the drive pulley 25h. The first wheel 25j is provided in the drive pulley 25h (the package support member 25b). In this embodiment, the first wheel 25j is a Geneva wheel that constitutes a Geneva mechanism. The first wheel 25j is rotated by the rotational driving of a first yarn joining driver 62a or a second yarn joining driver 63a of a yarn joining device 60 to be described later. In the yarn supply package support portion 25, the package support member 25a and the package support member 25b rotate in a synchronization manner by the rotation of the first wheel 25j.

[0036] The peg body 26 includes a peg body 26a and a rotation transmitting member 26b. The peg body 26a is a member having a rectangular parallelepiped shape. The peg body 26a supports the package support member 25a and the package support member 25b of the yarn supply package support portion 25 so as to be rotatable around the rotation shaft. The peg body 26a is provided with a regulation member 26c. The regulation member 26c has, for example, a disk shape. The regulation member 26c is disposed on one side surface of the peg body 26a. The regulation member 26c is attached by inserting the package support member 25a and the package support member 25b. The regulation member 26c faces the end surface of the yarn supply package P1 and regulates the movement of the yarn supply package P1 in the extending direction of the package support member 25a and the package support member 25b. An insertion hole 26d is formed in the peg body 26a. The first column 22a or the first column 22b of the creel stand 20 is inserted through the insertion hole 26d.

[0037] The rotation transmitting member 26b supports the peg body 26a. The peg body 26a is fixed to the upper end portion of the rotation transmitting member 26b. The rotation transmitting member 26b has a cylindrical shape. A hollow portion of the rotation transmitting member 26b communicates with the insertion hole 26d of the peg body 26a. The first columns 22a and 22b of the creel stand 20 are coaxially inserted through the rotation transmitting member 26b. The lower end portion of the rotation transmitting member 26b is provided with a second wheel 26e.

In this embodiment, the second wheel 26e is a Geneva wheel that constitutes a Geneva mechanism. The second wheel 26e rotates by the driving of the first rotation driver 36a or the second rotation driver 37a of a rotation device 35 to be described later. The peg body 26 rotates with the rotation of the second wheel 26e. Accordingly, the yarn supply package support portion 25 rotates. The peg 24 rotates between an exchange position where the yarn supply bobbin B1 is collected and the yarn supply package P1 is attached and a supply position where the yarn Y is supplied.

[0038] As illustrated in FIG. 1, the package replenishing device 6 supplies the yarn supply package P1 to the package exchanging device 7. The package replenishing device 6 temporarily stores the yarn supply package P1 transported by the first transporting device 3 and supplies the yarn supply package P1 to the package exchanging device 7. The package replenishing device 6 stores the plurality of (for example, four) yarn supply packages P1. The package replenishing device 6 includes a transfer mechanism (not illustrated) which transfers the yarn supply package P1 from the first transporting device 3.

[0039] The package exchanging device 7 collects the yarn supply bobbin B1 from the peg 24 and attaches the yarn supply package P1 to the peg 24. As illustrated in FIG. 7, the package exchanging device 7 runs along the second rail R2. The second rail R2 is laid on a floor and extends in the X direction (the arrangement direction of the creel stands 20). That is, the package exchanging device 7 runs along the X direction. The package exchanging device 7 moves between one end of the yarn supply unit 5 and the other end of the yarn supply unit 5 where the package replenishing device 6 is disposed.

[0040] The package exchanging device 7 includes a running carrier 30 (running unit), an elevating unit 31, a holding unit 32, and an exchange unit 33. Further, the package exchanging device 7 includes a control unit 90 which controls the operation of each unit.

[0041] The running carrier 30 includes a running base 30a and a column support portion 30b. The running base 30a has a rectangular parallelepiped shape. The running base 30a accommodates a wheel running along the second rail R2, a drive mechanism, and the like.

[0042] The column support portion 30b is provided upright on the running base 30a. The column support portion 30b includes four second columns 30c, 30d, 30e, and 30f and a wall portion 30g. The second columns 30c to 30f and the wall portion 30g extend in the Z direction. The second column 30c is disposed at one end portion in the X direction and one end portion in the Y direction in the running base 30a. The second column 30c is disposed at a corner portion of the running base 30a. The second column 30d is disposed at one end portion in the X direction and the other end portion in the Y direction in the running base 30a. The second column 30c and the second column 30d are disposed at positions facing each other in the Y direction. The second column 30d is disposed at a corner portion of the running base 30a.

[0043] The second column 30e is disposed at a position facing the second column 30c in the X direction so that a predetermined gap is formed with respect to the second column 30c. The second column 30f is disposed at the other end portion of the running base 30a in the Y direction between the second column 30c and the second column 30e in the X direction. The second column 30f is disposed so as to face the second column 30d in the X direction. The wall portion 30g extends in the X direction. The wall portion 30g is disposed at the other end portion in the X direction and the other end portion in the Y direction in the running base 30a. That is, the wall portion 30g is disposed at a corner portion of the running base 30a. The wall portion 30g is disposed so as to face the second column 30e in the Y direction and is disposed so as to face the second column 30f in the X direction.

[0044] The elevating unit 31 moves up and down with the operator on board. The elevating unit 31 is used during maintenance or the like. The elevating unit 31 is disposed at the other end portion in the X direction in the running base 30a of the running carrier 30. The elevating unit 31 includes a guide portion 31a and an elevating portion 31b.

[0045] The guide portion 31a is a guide rail. The guide portion 31a is disposed in the wall portion 30g of the column support portion 30b of the running carrier 30. The guide portion 31a extends in the Z direction. The elevating portion 31b is a working table on which the operator gets. The elevating portion 31b has a box shape. The elevating portion 31b is provided so as to be movable up and down in the Z direction along the guide portion 31a. The elevating portion 31b moves along the guide portion 31a by a drive mechanism (not illustrated).

[0046] The holding unit 32 holds the plurality of (for example, four) yarn supply packages P1. The holding unit 32 holds the yarn supply packages P1 as many as the yarn supply packages P1 held by the package replenishing device 6. The holding unit 32 receives the yarn supply package P1 supplied from the package replenishing device 6, temporarily stores the yarn supply package P1, and supplies the yarn supply package P1 to the exchange unit 33.

[0047] As illustrated in FIG. 8A and FIG. 8B, the holding unit 32 includes a main body frame 32a, a package support portion 32b, and a drive unit 32c. The main body frame 32a is disposed in the running base 30a of the running carrier 30. The main body frame 32a is disposed at one end portion of the running base 30a in the X direction.

[0048] The package support portion 32b supports the yarn supply package P1. The package support portion 32b is provided so as to be rotatable. The package support portion 32b rotates in the range of about 90°. The package support portion 32b rotates between a replenishment position (see FIG. 8B) in which the yarn supply package P1 is supplied from the package replenishing device 6 and a supply position (see FIG. 8A) in which the yarn supply package P1 is supplied to the exchange unit

33. The drive unit 32c rotates the package support portion 32b. The drive unit 32c is, for example, an air cylinder.

[0049] The exchange unit 33 exchanges the yarn supply bobbin B1 and the yarn supply package PI in the peg 24. Specifically, the exchange unit 33 collects the yarn supply bobbin B1 from the peg 24 and attaches the yarn supply package PI to the peg 24. As illustrated in FIG. 7, the exchange unit 33 is provided adjacent to the holding unit 32. As illustrated in FIG. 9, the exchange unit 33 includes a base 34, a rotation device 35, a collection device (exchange device) 40, a supply device (exchange device) 50, a yarn joining device 60, and a moving device 70.

[0050] The base 34 supports the rotation device 35, the collection device 40, the supply device 50, and the yarn joining device 60. The base 34 is provided so as to be movable up and down along the column support portion 30b of the running carrier 30. The base 34 is provided at a position accessible to the holding unit 32.

[0051] The rotation device 35 rotates the peg 24 of the creel stand 20. The rotation device 35 is fixed to the base 34. The rotation device 35 is disposed at a position facing the yarn supply unit 5 in the base 34. The rotation device 35 includes a first drive mechanism 36 and a second drive mechanism 37.

[0052] The first drive mechanism 36 rotates the first peg 24a of the creel stand 20. The first drive mechanism 36 includes a first rotation driver 36a and a first rotation arm portion 36b. The first rotation driver 36a rotates the second wheel 26e of the first peg 24a. The first rotation driver 36a is a Geneva driver that constitutes a Geneva mechanism. The first rotation driver 36a rotates by the rotational driving of a motor (not illustrated). The first rotation arm portion 36b supports the first rotation driver 36a. The first rotation arm portion 36b is provided so as to be swingable in the horizontal direction. The first rotation arm portion 36b is driven by, for example, a motor or an air cylinder (not illustrated).

[0053] The second drive mechanism 37 rotates the second peg 24b of the creel stand 20. The second drive mechanism 37 includes a second rotation driver 37a and a second rotation arm portion 37b. The second rotation driver 37a rotates the second wheel 26e of the second peg 24b. The second rotation driver 37a is a Geneva driver that constitutes a Geneva mechanism. The second rotation driver 37a rotates by the rotational driving of a motor (not illustrated). The second rotation arm portion 37b supports the second rotation driver 37a. The second rotation arm portion 37b is provided so as to be swingable in the horizontal direction. The second rotation arm portion 37b is driven by, for example, a motor or an air cylinder (not illustrated).

[0054] The rotation device 35 changes the direction of the peg 24 by rotating the peg 24 when attaching the yarn supply package PI to the peg 24. The rotation device 35 operates the first drive mechanism 36 or the second drive mechanism 37 corresponding to the target peg 24. For example, when the first drive mechanism 36 is op-

erated, the rotation device 35 swings the first rotation arm portion 36b so that the first rotation driver 36a engages with the second wheel 26e of the first peg 24a. The rotation device 35 rotates the first rotation driver 36a in one direction when the first rotation driver 36a engages with the second wheel 26e. In the peg 24, when the second wheel 26e rotates, the rotation transmitting member 26b rotates. Accordingly, the peg 24 rotates so that the front end portions of the package support members 25a and 25b face the exchange unit 33.

[0055] The collection device 40 collects the yarn supply bobbin B1 to which the adapter 10 is attached from the peg 24. As illustrated in FIG. 10, the collection device 40 includes a first support mechanism 41 and a first collection drive mechanism 42. The first support mechanism 41 supports the yarn supply bobbin B1. Further, the first support mechanism 41 moves forward and backward with respect to the peg 24 so as to collect the yarn supply bobbin B1. The first support mechanism 41 includes a first slide portion 41a and a first package support member 41b.

[0056] The first slide portion 41a includes a first linear guide 41c. A part of the first slide portion 41a can move in a predetermined direction through the first linear guide 41c. The first package support member 41b supports the yarn supply bobbin B1. The first package support member 41b is provided in a front end portion of the moving first slide portion 41a. The first package support member 41b extends in the extending direction of the first slide portion 41a.

[0057] The first collection drive mechanism 42 drives the first support mechanism 41. The first collection drive mechanism 42 includes a first slide rail 42a, a first collection drive unit 42b, a first elevating portion 42c, and a second collection drive unit 42d. The first slide rail 42a is connected to the first slide portion 41a. The first slide rail 42a moves a part of the first slide portion 41a in a reciprocating manner by the driving of the first collection drive unit 42b. The first collection drive unit 42b is, for example, an air cylinder. The first elevating portion 42c is connected to the first slide portion 41a. The first elevating portion 42c moves the first slide portion 41a up and down by the driving of the second collection drive unit 42d. Accordingly, the first slide portion 41a swings. The second collection drive unit 42d is, for example, a motor.

[0058] A collection operation of the yarn supply bobbin B1 by the collection device 40 will be described. The collection device 40 advances a part of the first slide portion 41a of the first support mechanism 41 by the first collection drive mechanism 42 with respect to the peg 24 rotated by the rotation device 35 so that the first package support member 41b is located in the hollow portion of the yarn supply bobbin B1. At this time, the collection device 40 swings the first slide portion 41a of the first support mechanism 41 downward by the first collection drive mechanism 42 so that the first package support member 41b is inclined with respect to the horizontal di-

rection. When the first package support member 41b is located at the hollow portion of the yarn supply bobbin B1, the collection device 40 swings the first slide portion 41a upward by the first collection drive mechanism 42 so that the first package support member 41b becomes horizontal. Accordingly, the first package support member 41b contacts the yarn supply bobbin B1 so that the yarn supply bobbin B1 is lifted and the yarn supply bobbin B1 is separated from the package support members 25a and 25b. The collection device 40 retracts a part of the first slide portion 41a of the first support mechanism 41 by the first collection drive mechanism 42. As described above, the collection device 40 collects the yarn supply bobbin B1 from the peg 24.

[0059] The supply device 50 supplies the yarn supply package P1 to the peg 24. As illustrated in FIG. 11, the supply device 50 includes a second support mechanism 51 and a second supply drive mechanism 52. The second support mechanism 51 supports the yarn supply package P1. Further, the second support mechanism 51 moves forward and backward with respect to the peg 24 so as to supply the yarn supply package P1. The second support mechanism 51 includes a second slide portion 51a and a second package support member 51b.

[0060] The second slide portion 51a includes a second linear guide 51c. A part of the second slide portion 51a can move in a predetermined direction through the second linear guide 51c. The second package support member 51b supports the yarn supply package P1. The second package support member 51b is provided in the front end portion of the moving second slide portion 51a. The second package support member 51b extends in the extending direction of the second slide portion 51a.

[0061] The second supply drive mechanism 52 drives the second support mechanism 51. The second supply drive mechanism 52 includes a second slide rail 52a, a first supply drive unit 52b, a second elevating portion 52c, and a second supply drive unit 52d. The second slide rail 52a is connected to the second slide portion 51a. The second slide rail 52a moves a part of the second slide portion 51a in a reciprocating manner by the driving of the first supply drive unit 52b. The first supply drive unit 52b is, for example, an air cylinder. The second elevating portion 52c is connected to the second slide portion 51a. The second elevating portion 52c moves the second slide portion 51a up and down by the driving of the second supply drive unit 52d. Accordingly, the second slide portion 51a swings. The second supply drive unit 52d is, for example, a motor.

[0062] An acquisition operation in which the supply device 50 acquires the yarn supply package P1 from the holding unit 32 will be described. The supply device 50 acquires the yarn supply package P1 from the holding unit 32 when the package exchanging device 7 moves. When the exchange unit 33 is stopped at a predetermined height position with respect to the holding unit 32, the supply device 50 advances a part of the second slide portion 51a of the second support mechanism 51 by the

second supply drive mechanism 52 with respect to the yarn supply package P1 supported by the package support portion 32b of the holding unit 32 so that the second package support member 51b is located in the hollow portion of the yarn supply package P1. At this time, the supply device 50 swings the second slide portion 51a of the second support mechanism 51 downward by the second supply drive mechanism 52 so that the second package support member 51b is inclined with respect to the horizontal direction. When the second package support member 51b is located at the hollow portion of the yarn supply package P1, the supply device 50 swings the second slide portion 51a upward by the second supply drive mechanism 52 so that the second package support member 51b becomes horizontal. Accordingly, the second package support member 51b contacts the yarn supply package P1 so that the yarn supply package P1 is lifted and the yarn supply package P1 is separated from the package support portion 32b. The supply device 50 retracts a part of the second slide portion 51a of the second support mechanism 51 by the second supply drive mechanism 52. As described above, the supply device 50 acquires the yarn supply package P1 from the holding unit 32.

[0063] A supply operation in which the supply device 50 supplies the yarn supply package P1 to the peg 24 will be described. The supply device 50 advances a part of the second slide portion 51a of the second support mechanism 51 by the second supply drive mechanism 52 with respect to the peg 24 from which the yarn supply bobbin B1 is separated so that the package support members 25a and 25b of the peg 24 are located in the hollow portion of the yarn supply package P1. When the package support members 25a and 25b of the peg 24 are located in the hollow portion of the yarn supply package P1, the supply device 50 swings the second slide portion 51a downward by the second supply drive mechanism 52 so that the second package support member 51b is inclined with respect to the horizontal direction. Accordingly, the package support members 25a and 25b of the peg 24 contact the yarn supply package P1 so that the yarn supply package P1 is supported by the peg 24 and the second package support member 51b is separated from the yarn supply package P1. The supply device 50 retracts a part of the second slide portion 51a of the second support mechanism 51 by the second supply drive mechanism 52. As described above, the supply device 50 attaches the yarn supply package P1 to the peg 24.

[0064] The yarn joining device 60 joins the yarn Y of the yarn supply package P1 supported by the first peg 24a and the yarn Y of the yarn supply package P1 supported by the second peg 24b. As illustrated in FIGS. 12, 13, and 14, the yarn joining device 60 includes a catching and guiding mechanism (a guide device) 61, a first rotation mechanism 62, a second rotation mechanism 63, and a yarn joining mechanism 64.

[0065] The yarn joining device 60 is provided so as to be movable by a movement mechanism (not illustrated)

in a direction (the Y direction) in which the exchange unit 33 faces the yarn supply unit 5. The yarn joining device 60 moves between a standby position in which the yarn joining device 60 is disposed in the base 34 and a yarn joining position in which the yarn joining device 60 moves toward the yarn supply unit 5 so as to advance outward in relation to the base 34.

[0066] The catching and guiding mechanism 61 catches the yarn Y of the yarn supply package P1 and guides the yarn Y to the yarn joining mechanism 64. The catching and guiding mechanism 61 catches the first yarn end Y1 of the yarn Y of the yarn supply package P1 supported by one peg 24 and the second yarn end Y2 of the yarn Y of the yarn supply package P1 supported by the other peg 24 and guides the yarns to the yarn joining mechanism 64. The catching and guiding mechanism 61 includes a suction portion 61a and a yarn joining arm portion 61b.

[0067] The suction portion 61a sucks and catches the yarn Y. The suction portion 61a includes a suction pipe 61c, a suction nozzle 61d, and a hook portion 61e. The suction nozzle 61d is provided in the front end portion of the suction pipe 61c. The suction nozzle 61d sucks the yarn Y. A negative pressure source (not illustrated) is connected to the suction pipe 61c. Accordingly, a suction flow is generated in the suction nozzle 61d. The base end side of the suction pipe 61c is connected to the yarn joining arm portion 61b. The hook portion 61e is provided at a position facing the suction nozzle 61d and the front end portion of the suction pipe 61c. The hook portion 61e locks the yarn Y entangled by the yarn joining device 60. The yarn joining arm portion 61b moves the suction portion 61a. The yarn joining arm portion 61b includes a link mechanism and a plurality of motors. The yarn joining arm portion 61b is supported by a bracket 61f.

[0068] Each of the first rotation mechanism 62 and the second rotation mechanism 63 operates the peg 24 so as to rotate the yarn supply package P1. Each of the first rotation mechanism 62 and the second rotation mechanism 63 rotates the yarn supply package P1 so that the yarn Y is fed from the yarn supply package P1 when guiding the yarn Y to the yarn joining mechanism 64 by the catching and guiding mechanism 61.

[0069] The first rotation mechanism 62 operates the first peg 24a. The first rotation mechanism 62 includes a first yarn joining driver 62a, a first motor 62b, and a first yarn joining arm portion 62c. The first yarn joining driver 62a is rotatably and axially supported by the first yarn joining arm portion 62c. The first yarn joining driver 62a is provided with a first driven pulley 62d. The first motor 62b is fixed to the first yarn joining arm portion 62c. A first drive pulley 62e is connected to the output shaft of the first motor 62b. The first motor 62b drives the first drive pulley 62e so as to rotate about an axis. A first power transmission belt 62f is stretched over the first driven pulley 62d and the first drive pulley 62e. Accordingly, the first yarn joining driver 62a rotates by the rotational driving of the first motor 62b.

[0070] The second rotation mechanism 63 operates the second peg 24b. The second rotation mechanism 63 includes a second yarn joining driver 63a, a second motor 63b, and a second yarn joining arm portion 63c. The second yarn joining driver 63a is rotatably and axially supported by the second yarn joining arm portion 63c. The second yarn joining driver 63a is provided with a second driven pulley 63d. The second motor 63b is fixed to the second yarn joining arm portion 63c. The second drive pulley 63e is connected to the output shaft of the second motor 63b. The second motor 63b drives the second drive pulley 63e so as to rotate around a shaft. A second power transmission belt 63f is stretched over the second driven pulley 63d and the second drive pulley 63e. Accordingly, the second yarn joining driver 63a rotates by the rotational driving of the second motor 63b.

[0071] The yarn joining mechanism 64 performs a yarn joining operation. The yarn joining mechanism 64 includes a splicer 66, a first guide mechanism 67, and a second guide mechanism 68.

[0072] The splicer 66 includes a yarn joining portion 66a and a pair of sandwiching mechanisms 66b and 66c. The yarn joining portion 66a entangles the yarn Y of the yarn supply package P1 supported by the first peg 24a and the yarn Y of the yarn supply package P1 supported by the second peg 24b. The sandwiching mechanisms 66b and 66c are provided at positions sandwiching the yarn joining portion 66a. The sandwiching mechanisms 66b and 66c sandwich the yarn Y inserted into the chamber of the yarn joining portion 66a.

[0073] As illustrated in FIGS. 12 and 13, the first guide mechanism 67 locks and guides the yarn Y. The first guide mechanism 67 includes a first hook 67a, a second hook 67b, and a third hook 67c. The first hook 67a, the second hook 67b, and the third hook 67c are provided so as to be swingable. The first hook 67a is provided with a potentiometer (not illustrated) that detects a tension of the yarn Y. The yarn joining device 60 controls the operation of the first motor 62b of the first rotation mechanism 62 on the basis of the detection result of the potentiometer. That is, the yarn joining device 60 draws the yarn Y from the yarn supply package P1 at a predetermined tension by adjusting the rotation amount (feed amount) of the yarn supply package P1 on the basis of the detection result of the potentiometer.

[0074] The second guide mechanism 68 locks and guides the yarn Y. The second guide mechanism 68 includes a first hook 68a, a second hook 68b, and a third hook 68c. The first hook 68a, the second hook 68b, and the third hook 68c are provided so as to be swingable. The first hook 68a is provided with a potentiometer (not illustrated) which detects the tension of the yarn Y. The yarn joining device 60 controls the operation of the second motor 63b of the second rotation mechanism 63 on the basis of the detection result of the potentiometer. That is, the yarn joining device 60 adjusts the rotation amount (feed amount) of the yarn supply package P1 on the basis of the detection result of the potentiometer and draws

the yarn Y from the yarn supply package PI with a predetermined tension.

[0075] A yarn joining operation of the yarn joining device 60 will be described. Specifically, an example of a case in which the yarn joining device 60 joins the first yarn end Y1 on the outer layer side of the yarn supply package PI supported by the first peg 24a and the second yarn end Y2 on the inner layer side of the yarn supply package PI supported by the second peg 24b will be described.

[0076] When the yarn joining operation starts, the yarn joining device 60 operates the first peg 24a by the first rotation mechanism 62 and operates the second peg 24b by the second rotation mechanism 63 so that the adapter 10 is rotated to a position in which the first yarn end Y1 and the second yarn end Y2 can be caught by the suction portion 61a as illustrated in FIG. 14. Specifically, in the first rotation mechanism 62, the first yarn joining driver 62a is engaged with the first wheel 25j of the first peg 24a and the first motor 62b is driven to rotate the first yarn joining driver 62a. Similarly, in the second rotation mechanism 63, the second yarn joining driver 63a is engaged with the first wheel 25j of the second peg 24b and the second motor 63b is driven to rotate the second yarn joining driver 63a. When the first yarn joining driver 62a and the second yarn joining driver 63a rotate, the yarn supply package PI supported by each of the first peg 24a and the second peg 24b rotates, so that the adapter 10 rotates. The yarn joining device 60 detects a detection object (not illustrated) provided in the adapter 10 by a sensor (not illustrated) and controls the first motor 62b and the second motor 63b on the basis of the detection result of the sensor so that the adapter 10 is rotated to a predetermined position.

[0077] When the adapter 10 is rotated, the yarn joining device 60 operates the yarn joining arm portion 61b of the catching and guiding mechanism 61 so that the suction portion 61a catches the first yarn end Y1 from the adapter 10 of the yarn supply package PI supported by the first peg 24a and catches the second yarn end Y2 from the adapter 10 of the yarn supply package PI supported by the second peg 24b. At this time, the yarn joining device 60 operates the first peg 24a by the first rotation mechanism 62 and operates the second peg 24b by the second rotation mechanism 63 so that the yarn supply package PI is rotated. Accordingly, the yarn Y is drawn out from the yarn supply package PI at a predetermined tension.

[0078] The yarn joining device 60 allows the suction portion 61a to hook the yarn Y having the first yarn end Y1 on the first guide mechanism 67 and guide the yarn Y to the splicer 66 and to hook the yarn Y having the second yarn end Y2 on the second guide mechanism 68 and guide the yarn Y to the splicer 66. When the yarn Y is guided to the splicer 66, the yarn joining device 60 performs the yarn joining operation of the splicer 66. Accordingly, the yarn joining device 60 joins the first yarn end Y1 on the outer layer side of the yarn supply package

PI supported by the first peg 24a and the second yarn end Y2 on the inner layer side of the yarn supply package PI supported by the second peg 24b.

[0079] The moving device 70 rotationally moves the collection device 40, the supply device 50, and the yarn joining device 60. The moving device 70 moves each of the collection device 40, the supply device 50, and the yarn joining device 60 to a work position for the peg 24. Further, the moving device 70 moves the collection device 40 and the supply device 50 to a work position for the holding unit 32. As illustrated in FIG. 9, the moving device 70 includes a rotation support portion 71 and an exchange unit driving unit 72.

[0080] The rotation support portion 71 supports the collection device 40, the supply device 50, and the yarn joining device 60. The rotation support portion 71 is provided in the base 34 so as to be rotatable around a rotation shaft extending in the vertical direction. The rotation support portion 71 supports the collection device 40, the supply device 50, and the yarn joining device 60 so that the collection device 40, the supply device 50, and the yarn joining device 60 are respectively disposed in three different directions when viewed from the direction of the rotation shaft of the rotation support portion 71.

[0081] The rotation support portion 71 includes a wheel (not illustrated). The wheel is a Geneva wheel that constitutes a Geneva mechanism. The exchange unit driving unit 72 rotates the rotation support portion 71. The exchange unit driving unit 72 is a Geneva driver that constitutes a Geneva mechanism. The exchange unit driving unit 72 rotates by the rotational driving of a motor (not illustrated). In the moving device 70, the rotation support portion 71 rotates by the driving of the exchange unit driving unit 72.

[0082] The moving device 70 stops the rotation support portion 71 at seven positions. The moving device 70 stops the rotation support portion 71 at a position in which the collection device 40 collects the yarn supply bobbin B1 from the first peg 24a, a position in which the collection device 40 collects the yarn supply bobbin B1 from the second peg 24b, a position in which the supply device 50 supplies the yarn supply package PI to the first peg 24a, a position in which the supply device 50 supplies the yarn supply package PI to the second peg 24b, a position in which the yarn joining device 60 performs a yarn joining operation, a position in which the supply device 50 acquires the yarn supply package PI from the holding unit 32, and a position in which the collection device 40 supplies the yarn supply bobbin B1 to the holding unit 32.

[0083] Although the entire false-twisting system 1 has been described above, the running carrier 30 which is one of characteristic parts of an aspect of the invention will be described in more detail below. As illustrated in FIG. 7, the second column 30c and the second column 30d of the running carrier 30 is provided with a sensor 131 (an acquisition unit) which acquires the remaining amount of the yarn Y wound on the yarn supply package

PI supported by the peg 24 of the creel stand 20.

[0084] The plurality of sensors 131 are provided in the vertical direction (the Z direction). The sensors 131 are provided as many as the pegs 24 arranged in the creel stand 20 in the vertical direction. In this embodiment, as illustrated in FIG. 5, eight pegs 24 are arranged in the creel stand 20 in the vertical direction. Thus, as illustrated in FIG. 7, eight sensors 131 are arranged in each of the second column 30c and the second column 30d in the vertical direction. Eight sensors 131 are disposed in each of the second column 30c and the second column 30d so as to correspond to the height positions where the peg 24 is fixed to the creel stand 20.

[0085] As illustrated in FIG. 15, the sensor 131 detects a distance to an outer peripheral surface S of the yarn supply package PI in the radial direction of the yarn supply package P1. In other words, the sensor 131 emits a detection medium (for example, light) in a direction along the radial direction of the yarn supply package PI so that the outer peripheral surface S of the yarn supply package PI is irradiated with the detection medium. The sensor 131 is, for example, a photoelectric sensor. More specifically, the sensor 131 is an analog sensor which outputs a signal according to a distance to the outer peripheral surface S of the yarn supply package P1. Thus, it is possible to acquire a distance from the installation position of the sensor 131 to the outer peripheral surface S of the yarn supply package PI when a signal output from the sensor 131 is analyzed.

[0086] The sensor 131 is provided in the running carrier 30 which moves substantially in parallel to the arrangement direction of the creel stands 20 (the X direction). For this reason, a distance between a measurement position in the X direction set in advance for each yarn supply package PI and a center (that is, the yarn supply bobbin B1) of the yarn supply package PI is constant at all times. Accordingly, when a distance to the outermost layer of the yarn Y (that is, the outer peripheral surface S) wound around the yarn supply bobbin B1 is measured, the diameter of the yarn Y wound around the yarn supply bobbin B1 (that is, the remaining amount of the yarn Y in the yarn supply package PI) can be derived. In this embodiment, the remaining amount of the yarn Y wound on the yarn supply package PI is derived by deriving a distance to the outer peripheral surface S of the yarn supply package P1 on the basis of a signal output from the analog sensor 131.

[0087] As illustrated in FIG. 15, the yarn supply package PI which supplies the yarn Y to the false-twisting machine 2 is disposed so as to be inclined from the X direction. Specifically, a pair of two yarn supply packages PI is disposed so as to face each other slightly inward. When viewed from above, extension lines Ar1 and Ar1 obtained by extending the rotation shafts of the pair of two yarn supply packages PI are disposed so as to intersect each other in a direction in which the false-twisting machine 2 is disposed (a direction in which the running carrier 30 is disposed).

[0088] The sensor 131 disposed in the second column 30c is provided so as to acquire a distance to the outer peripheral surface S of one of the pair of two yarn supply packages PI and the sensor 131 disposed in the second column 30d is provided so as to acquire a distance to the outer peripheral surface S of the other of the pair of two yarn supply packages P1. The sensor 131 disposed in the second column 30c and the sensor 131 disposed in the second column 30d are provided in a direction in which the emission directions Ar2 and Ar2 of the detection medium intersect a direction in which the false-twisting machine 2 is disposed (a direction in which the running carrier 30 is disposed).

[0089] The remaining amount of the yarn Y in the plurality of yarn supply packages PI supported by the creel stands 20 is acquired in such a manner that the running carrier 30 runs along the creel stand 20. That is, the remaining amount of the yarn Y in each yarn supply package PI is acquired on the basis of a distance to the outer peripheral surface S of the yarn supply package PI acquired by the sensor 131 when the running carrier 30 moves from one end to the other end of the creel stand 20.

[0090] For example, the running carrier 30 moves leftward along the creel stand 20 and acquires the remaining amount of the yarn Y in one of the yarn supply packages PI disposed as a pair (a pair of yarn supply packages PI) at the left end of the creel stand 20 by the sensor 131 disposed in the second column 30c as illustrated in FIG. 15. Next, the running carrier 30 moves rightward and acquires the remaining amount of the yarn Y in one of the yarn supply packages PI disposed as a second pair from the left end by the sensor 131 disposed in the second column 30c. Next, the running carrier 30 moves rightward and acquires the remaining amount of the yarn Y in the other of the yarn supply packages PI as a pair of the left end of the creel stand 20 by the sensor 131 disposed in the second column 30d as illustrated in FIG. 16. Next, the running carrier 30 moves rightward and acquires the remaining amount of the yarn Y of the other of the yarn supply packages PI disposed as a second pair from the left end of the creel stand 20 by the sensor 131 disposed in the second column 30d.

[0091] As illustrated in FIG. 17, the running carrier 30 moves rightward along the creel stand 20 while repeating the running of the running carrier 30 and the acquiring of the sensor 131 and acquires the remaining amount of the other of the yarn supply packages PI disposed as a pair of the right end of the creel stand 20 by the sensor 131 disposed in the second column 30d. With such a series of operations, the remaining amount of the yarn Y in all yarn supply packages PI supported by the creel stands 20 is acquired (sensed).

[0092] Next, the control unit 90 which is one of characteristic parts of an aspect of the invention will be described in more detail. The control unit 90 is an electronic control unit including a central processing unit (CPU), a read only memory (ROM), a random access memory (RAM), an I/O port, a communication port, and the like.

The ROM stores a program for controlling each of components. Further, each of the functions of the prediction unit 90a and the running control unit 90b described in the subsequent stage illustrated in FIG. 18 is executed under the control of the CPU by reading a predetermined computer software onto hardware such as a CPU and a main memory.

[0093] The prediction unit 90a predicts a timing at which the yarn Y disappears from the yarn supply package P1 on the basis of the remaining amount of the yarn Y in the yarn supply package P1 acquired by the sensor 131. In this embodiment, the prediction unit 90a predicts a timing at which the yarn Y disappears on the basis of a distance to the outer peripheral surface S of the yarn supply package P1 detected by the sensor 131. The timing at which the yarn Y disappears mentioned herein includes the time required until the yarn Y is completely drawn out from the yarn supply package P1 and disappears and the time when the yarn Y is completely drawn out from the yarn supply package P1 and disappears.

[0094] The prediction unit 90a of this embodiment receives an analog signal from the sensor 131 and analyzes the analog signal so as to derive a distance from the sensor 131 to the outer peripheral surface S of the yarn supply package P1. Next, the prediction unit 90a derives the remaining amount of the yarn Y in the yarn supply package P1, for example, on the basis of a corresponding relationship or the like between the remaining amount of the yarn Y in the yarn supply package P1 and the distance stored in a storage unit (not illustrated). Further, the prediction unit 90a predicts a timing at which the yarn Y disappears from the yarn supply package P1 on the basis of, for example, the yarn supply amount per unit time stored in the storage unit (the wound amount per unit time in the winding package P2) and the remaining amount of the yarn Y in the yarn supply package P1. Additionally, the method of deriving the timing at which the yarn Y disappears is not limited to the above-described contents.

[0095] The running control unit 90b controls the running of the running carrier 30. In this embodiment, the running control unit 90b moves the running carrier 30 so that the remaining amount of the yarn Y in all yarn supply packages P1 held by the creel stands 20 is acquired at a predetermined time interval. Further, the running control unit 90b moves the running carrier 30 to the exchange position of the yarn supply package P1 which is predicted that the yarn Y disappears on the basis of the timing at which the yarn Y disappears from the yarn supply package P1 and which is predicted by the prediction unit 90a.

[0096] Next, an overall control device 95 (see FIG. 18) which controls the entire false-twisting system 1 including the false-twisting machine 2, the first transporting device 3, the second transporting device 4, the package replenishing device 6, and the package exchanging device 7 will be described as one of characteristic parts of an aspect of the invention.

[0097] The overall control device 95 is an electronic

control unit including a CPU, a ROM, a RAM, an I/O port, a communication port, and the like. The ROM stores a program for controlling each of components. Further, each of the functions of the determination unit 95a described in the subsequent stage illustrated in FIG. 18 is executed under the control of the CPU by reading a predetermined computer software on hardware such as a CPU and a main memory. The overall control device 95 may include a display unit 95b such as a display that displays various kinds of information.

[0098] The determination unit 95a determines whether or not the yarn joining portion is included in the winding package P2 on the basis of the prediction result of the prediction unit 90a. The yarn joining portion starts the movement (feed) toward the winding package P2 from a timing at which the yarn Y disappears in the yarn supply package P1. Thus, when a time at which the yarn Y disappears in the yarn supply package P1 is derived, it is possible to derive a certain timing at which the yarn is wound as the winding package P2 on the basis of the winding speed or the like of the winding package P2. The determination unit 95a of this embodiment derives a timing at which the yarn joining portion is wound on the winding package P2 on the basis of the timing at which the yarn Y disappears from the yarn supply package P1 and which is predicted by the prediction unit 90a and the winding speed of the winding package P2 stored in the storage unit (not illustrated) or the like. The timing at which the yarn joining portion is wound on the winding package mentioned herein includes a time required until the yarn joining portion is wound on the winding package and a time when the yarn joining portion is wound on the winding package.

[0099] The overall control device 95 manages a time at which the winding bobbin B2 of the winding package P2 is set and a time at which the winding package P2 is discharged. The determination unit 95a determines whether or not the yarn joining portion is included in each winding package P2 on the basis of the previous management information and the timing at which the yarn joining portion is wound on the winding package P2. In the overall control device 95, a result (for example, information of the winding package P2 having the yarn joining portion) determined by the determination unit 95a is displayed on the display unit 95b or the like. Further, the information of the winding package P2 having the yarn joining portion may be transmitted to a terminal device 97 which is provided so as to communicate with the overall control device 95 and is carried by an operator or the like.

[0100] In the overall control device 95, the prediction result of the prediction unit 90a transmitted from the control unit 90 may be displayed on the display unit 95b. The display unit 95b may display a list of the time required until the yarn Y is completely drawn out from the yarn supply package P1 and disappears and the time when the yarn Y is completely drawn out from the yarn supply package P1 and disappears for each yarn supply package

PI held by the creel stand 20. In the overall control device 95, the list may be disposed on the terminal device 97. Additionally, the terminal device 97 may directly receive information on the time required until the yarn Y is completely drawn out from the yarn supply package PI and disappears and the time when the yarn Y is completely drawn out from the yarn supply package PI and disappears from the control unit 90 without using the overall control device 95.

[0101] In this embodiment, the package exchanging system 100 (see FIG. 18) that predicts a timing at which the yarn Y disappears from the yarn supply package PI is constructed by the running carrier 30, the sensor 131, the prediction unit 90a, the running control unit 90b, and the overall control device 95.

[0102] In the package exchanging system 100 of the above-described embodiment, since the remaining amount of the yarn Y wound on the yarn supply package PI is acquired at the time of performing the sensing, it is possible to check the state of the yarn supply package PI in more detail as compared with a case in which the state of the yarn Y is acquired in three stages. Further, in the package exchanging system 100 with this configuration, since a timing at which the yarn Y disappears from the yarn supply package PI is predicted on the basis of the acquired remaining amount of the yarn Y in the yarn supply package PI, it is possible to check the state of the yarn supply package PI at all times regardless of the sensing timing. As a result, it is possible to more efficiently perform the yarn joining operation and the exchange operation of the yarn supply package P1.

[0103] In the package exchanging system 100 of the above-described embodiment, the sensor 131 is a sensor that detects a distance to the outer peripheral surface S of the yarn supply package PI in the radial direction of the yarn supply package PI and the prediction unit 90a predicts a timing at which the yarn Y disappears from the yarn supply package P1 on the basis of the distance detected by the sensor 131. For this reason, it is possible to acquire the position of the outermost layer (the outer peripheral surface S) of the yarn supply package PI, that is, the diameter of the yarn supply package PI with a simple configuration. Since the diameter of the yarn supply package PI can be acquired, it is possible to predict the remaining amount of the yarn Y in the yarn supply package PI by a simple calculation.

[0104] In the package exchanging system 100 of the above-described embodiment, the running control unit 90b moves the running carrier 30 so that the remaining amount of the yarn Y in all yarn supply packages PI held by the creel stands 20 are acquired at a predetermined time interval. For this reason, since the remaining amount of the yarn Y in the yarn supply package PI is acquired at a predetermined time interval, it is possible to more accurately predict a timing at which the yarn Y disappears from the yarn supply package P1.

[0105] In the package exchanging system 100 of the above-described embodiment, the running carrier 30 in-

cludes the yarn joining device 60 which connects the yarn ends Y1 and Y2 of the yarn supply package PI, the catching and guiding mechanism 61 which guides the yarn ends Y1 and Y2 of the yarn supply package PI to the yarn joining device 60, the supply device 50 which supplies the yarn supply package PI to the creel stand 20, and the collection device 40 which collects the yarn supply bobbin B1 from the creel stand 20. For this reason, the yarn joining operation and the exchange operation of the yarn supply package PI can be performed by the running carrier 30 without using human hands.

[0106] In the package exchanging system 100 of the above-described embodiment, the running control unit 90b moves the running carrier 30 to an exchange position of the yarn supply package PI in which the yarn Y is predicted to disappear on the basis of a timing at which the yarn Y disappears from the yarn supply package PI and which is predicted by the prediction unit 90a. For this reason, the yarn joining operation and the exchange operation of the yarn supply package PI can be more efficiently performed.

[0107] In the package exchanging system 100 of the above-described embodiment, the prediction unit 90a and the running control unit 90b are provided in the running carrier 30. For this reason, the package exchanging system 100 can be provided as the running carrier 30.

[0108] The package exchanging system 100 of the above-described embodiment separately includes the determination unit 95a which determines whether or not the yarn joining portion is included in the winding package P2 on the basis of the prediction result of the prediction unit 90a. For this reason, it is possible to easily select the high-grade winding package P2.

[0109] Although the embodiment of an aspect of the invention has been described above, an aspect of the invention is not essentially limited to the above-described embodiment and can be modified into various forms without departing from the spirit thereof.

[0110] In the above-described embodiment, an example of a configuration of the package exchanging system 100 including the determination unit 95a of the overall control device 95 has been described, but the invention is not limited thereto. For example, a configuration of the package exchanging system 100 in which the prediction unit 90a and the running control unit 90b are mounted on the running carrier 30 without the function of the determination unit 95a may be employed. Further, a configuration of the package exchanging system 100 in which all of the prediction unit 90a, the running control unit 90b, and the determination unit 95a are mounted on the running carrier 30 may be employed. In the configuration according to these modified examples, the package exchanging system 100 can be provided as the running carrier.

[0111] Further, instead of the above-described modified example, the package exchanging system 100 may have a configuration in which all or any one of the prediction unit 90a, the running control unit 90b, and the

determination unit 95a may be mounted on not the running carrier 30 but a control device, a server device, or the like provided so as to communicate with the running carrier 30.

[0112] In the above-described embodiment, an example in which the yarn joining device 60, the catching and guiding mechanism 61, the supply device 50, and the collection device 40 are mounted on the running carrier 30 provided with the sensor 131 acquiring the remaining amount of the yarn Y wound on the yarn supply package PI has been described, but an aspect of the invention is not limited thereto. For example, the running carrier 30 provided with the sensor 131 may be the running carrier 30 which is not provided with any one of the yarn joining device 60, the catching and guiding mechanism 61, the supply device 50, and the collection device 40, but is provided with a working table on which an operator who performs the yarn joining operation and the exchange operation of the yarn supply package PI gets. Further, the running carrier 30 provided with the sensor 131 may be the running carrier 30 provided with any one of the yarn joining device 60, the catching and guiding mechanism 61, the supply device 50, and the collection device 40.

[0113] In the above-described embodiment, the running carrier 30 having a vehicle wheel has been described as an example of the running unit, but may be a running unit having a linear motion mechanism instead of the vehicle wheel.

[0114] In the above-described embodiment, the analog sensor 131 has been described as an example of the acquisition unit that acquires the remaining amount of the yarn Y wound on the yarn supply package PI, but an aspect of the invention is not limited thereto. For example, an imaging device capable of capturing an image of the outer peripheral surface of the yarn supply package PI may be provided and an image caught by the imaging device may be analyzed so as to acquire the remaining amount of the yarn Y wound on the yarn supply package P1.

[0115] In the above-described embodiment, an example in which the sensors 131 are provided in the running carrier 30 as many as the pegs 24 arranged in the creel stands 20 in the vertical direction has been described, but an aspect of the invention is not limited thereto. For example, one or more sensors 131 may be provided in the running carrier 30 so as to be movable up and down. Also in this case, it is possible to acquire the remaining amount of the yarn Y in all yarn supply packages PI held by the creel stands 20.

REFERENCE SIGNS LIST

[0116] 7... PACKAGE EXCHANGING DEVICE, 20...CREEL STAND, 30...RUNNING CARRIER (RUNNING UNIT), 30c...SECOND COLUMN, 30d...SECOND COLUMN, 40...COLLECTION DEVICE, 50...SUPPLY DEVICE, 60...JOINING DEVICE, 61... CATCHING AND

GUIDING MECHANISM (GUIDE DEVICE), 90...CONTROL UNIT, 90a...PREDICTION UNIT, 90b...RUNNING CONTROL UNIT, 95...OVERALL CONTROL UNIT, 95a...DETERMINATION UNIT, 95b...DISPLAY UNIT, 100...PACKAGE EXCHANGING SYSTEM, 131... SENSOR, P1...YARN SUPPLY PACKAGE, P2...WINDING PACKAGE, S...OUTER PERIPHERAL SURFACE, Y...YARN.

Claims

1. A package exchanging system (100) used in a textile machine (2) including a creel stand (20) allowing a yarn supply package support portion (25) to support a yarn supply package (PI) in which a synthetic yarn (Y) formed of a synthetic fiber is wound around a bobbin (B1), a processing device (2a) processing the synthetic yarn (Y) supplied from the yarn supply package (PI), and a winding device (2b) forming a winding package by winding the processed synthetic yarn (Y), the package exchanging system (100) comprising:

a running unit (30) which is provided so as to be movable in one direction along the creel stand (20) disposed in the one direction;
a running control unit (90b) which controls the running of the running unit (30);
an acquisition unit (131) which is provided in the running unit (30) and acquires a remaining amount of the synthetic yarn (Y) wound on the yarn supply package (PI) held by the creel stand (20); and
a prediction unit (90a) which predicts a timing at which the synthetic yarn (Y) disappears from the yarn supply package (PI) on the basis of the remaining amount of the synthetic yarn (Y) acquired by the acquisition unit (131).

2. The package exchanging system (100) according to claim 1,
wherein the acquisition unit (131) is a sensor (131) that detects a distance to an outer peripheral surface of the yarn supply package (PI) in a radial direction of the yarn supply package (P1), and
wherein the prediction unit (90a) predicts a timing at which the synthetic yarn (Y) disappears from the yarn supply package (PI) on the basis of the distance detected by the sensor (131).

3. The package exchanging system (100) according to claim 2,
wherein the running control unit (90b) moves the running unit (30) so that the distance of all yarn supply packages (PI) held by the creel stands (20) is acquired at a predetermined time interval.

4. The package exchanging system (100) according to any one of claims 1 to 3, wherein the running unit (30) includes a yarn joining device (60) which connects yarn ends of the yarn supply packages (PI), a guide device (61) which guides the yarn end of the yarn supply package (PI) to the yarn joining device (60), and an exchange device (50) which supplies the yarn supply package (PI) to the creel stand (20) and collects the bobbin (B1) from the creel stand (20). 5 10
5. The package exchanging system (100) according to any one of claims 1 to 4, wherein the running control unit (90b) moves the running unit (30) to an exchange position of the yarn supply package (PI) predicted that the synthetic yarn (Y) disappears on the basis of the timing predicted by the prediction unit (90a). 15
6. The package exchanging system (100) according to any one of claims 1 to 5, wherein the prediction unit (90a) and the running control unit (90b) are provided in the running unit (30). 20 25
7. The package exchanging system (100) according to any one of claims 1 to 6, further comprising: a determination unit (95a) which determines whether or not a yarn joining portion is included in the winding package on the basis of a prediction result of the prediction unit (90a). 30

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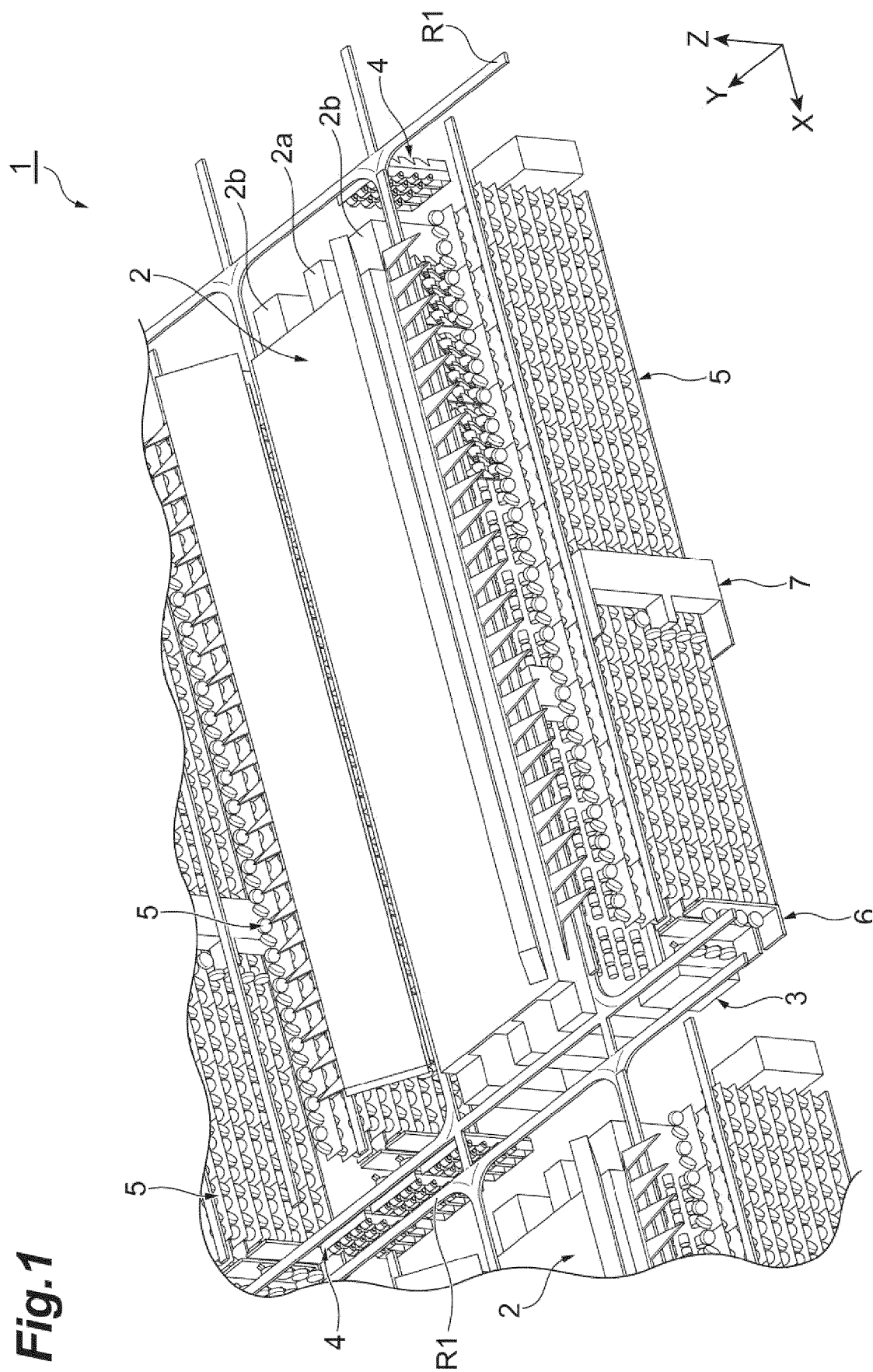


Fig.2

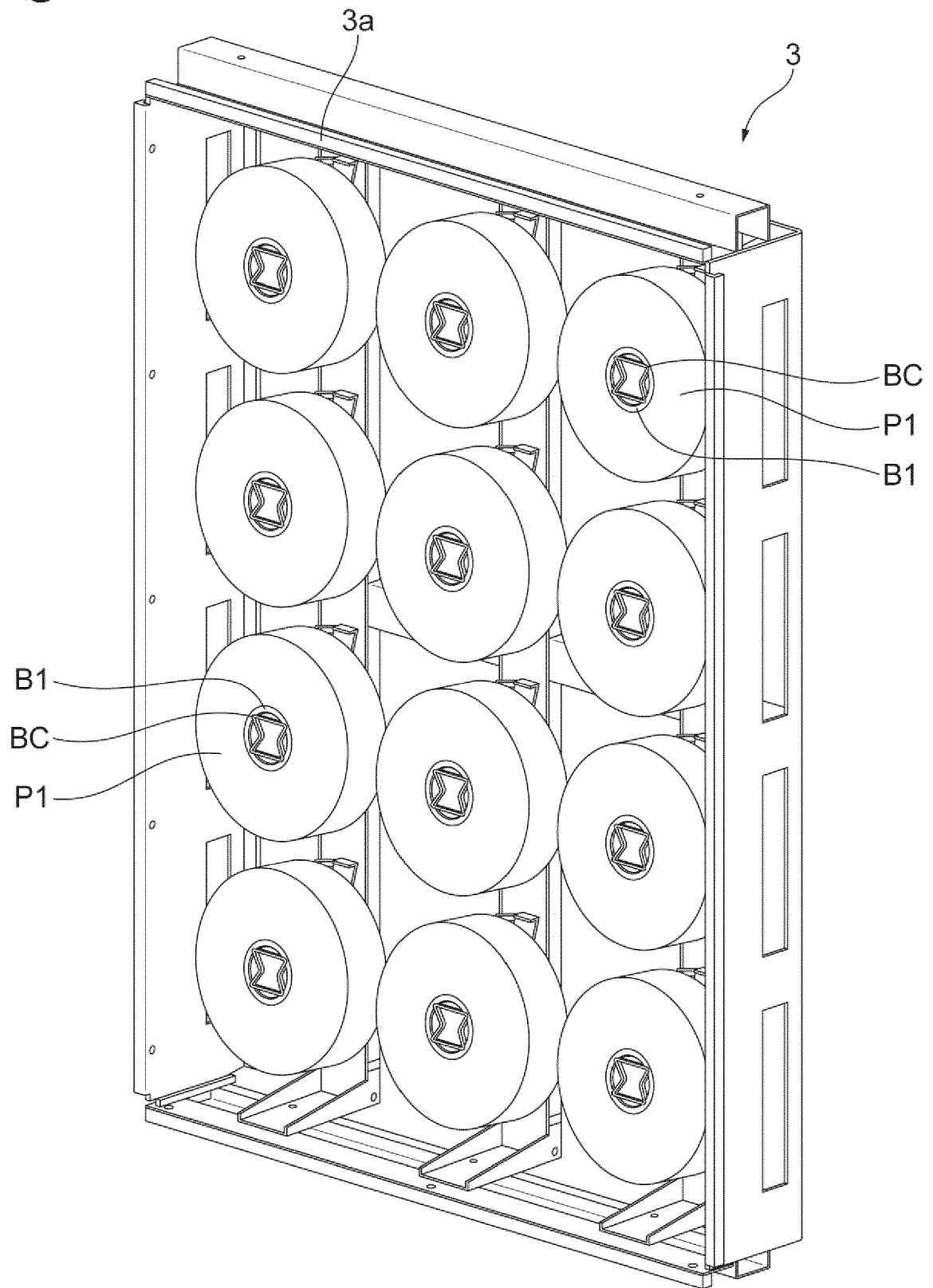


Fig.3

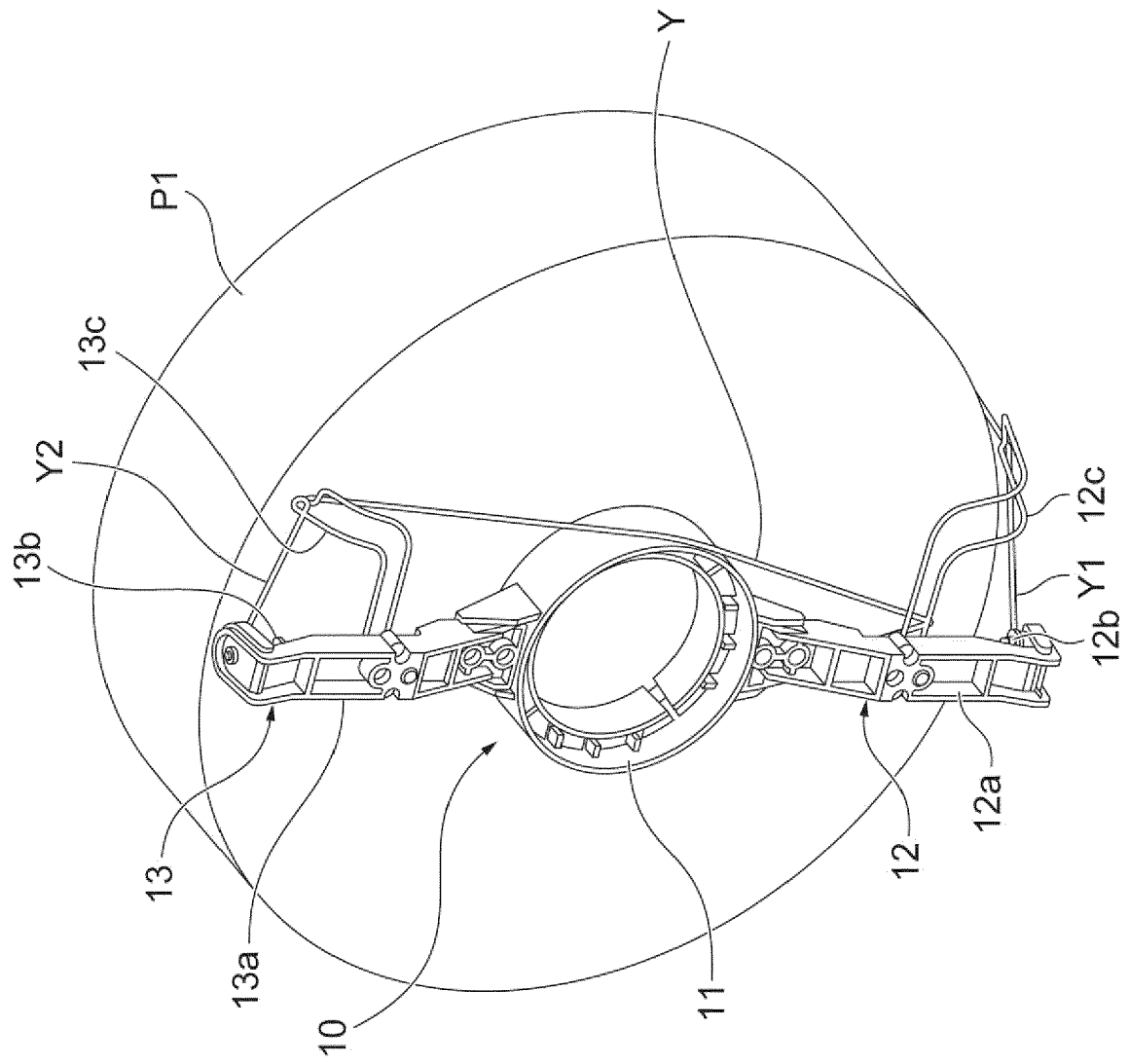


Fig.4

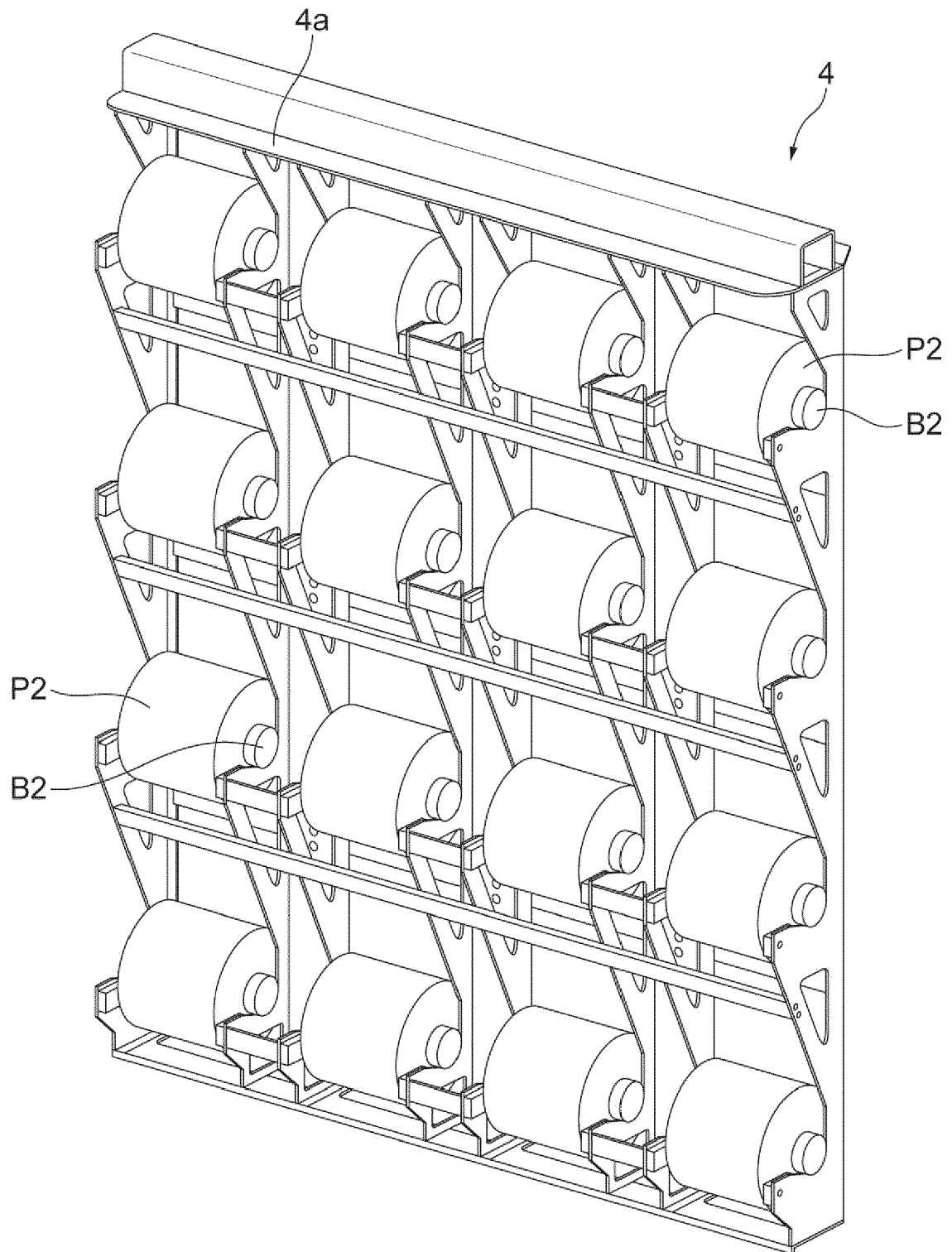


Fig.5

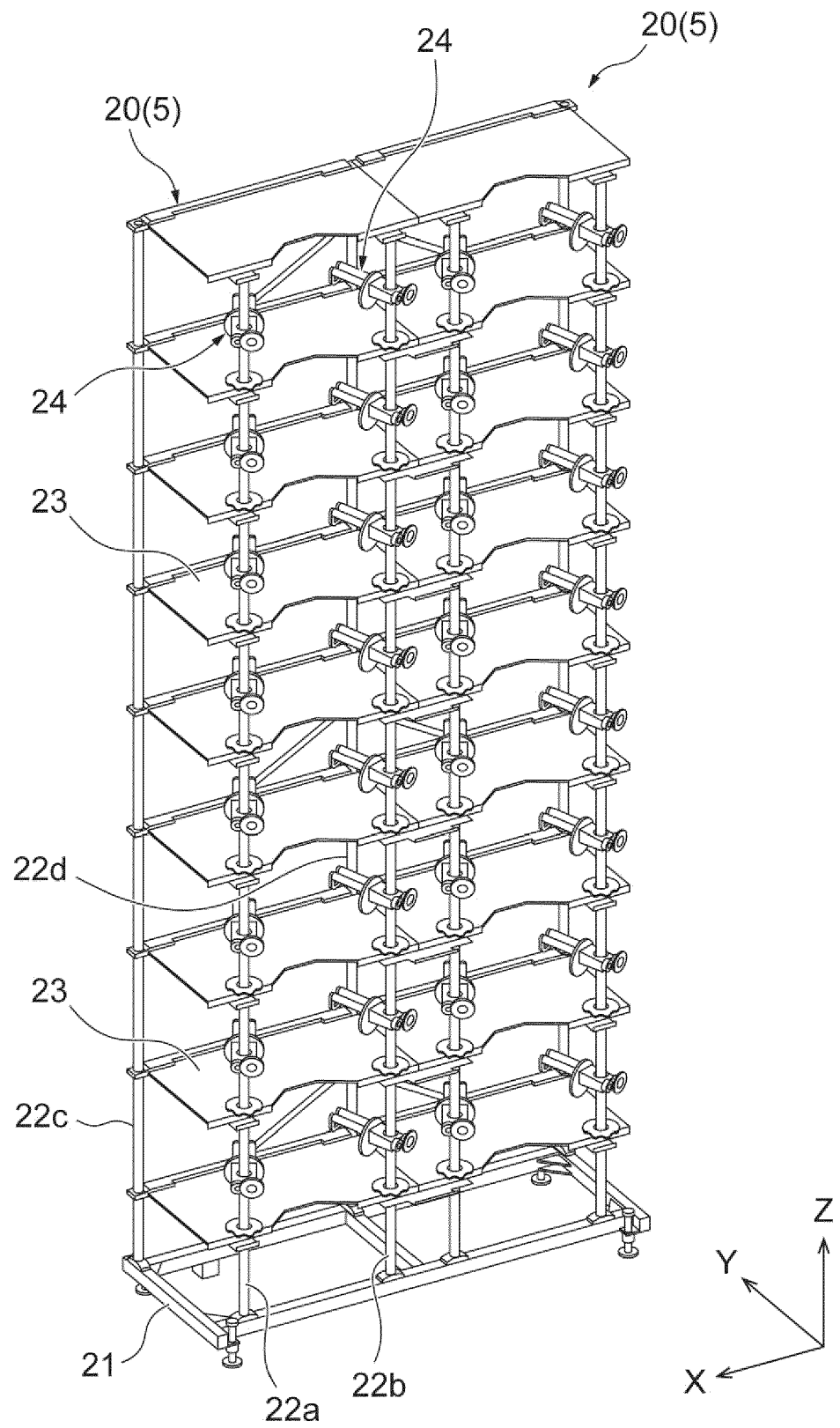


Fig. 6

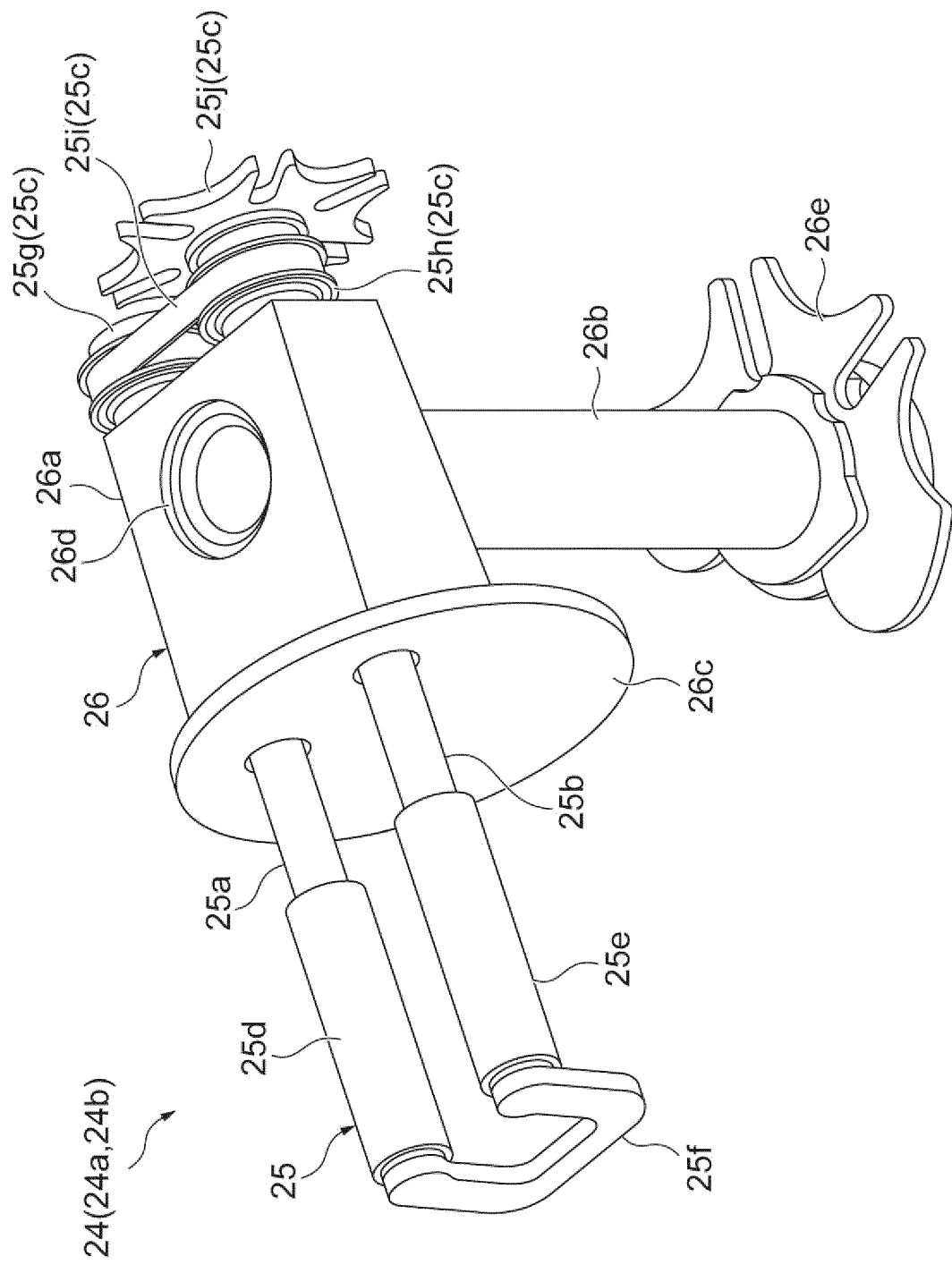


Fig.7

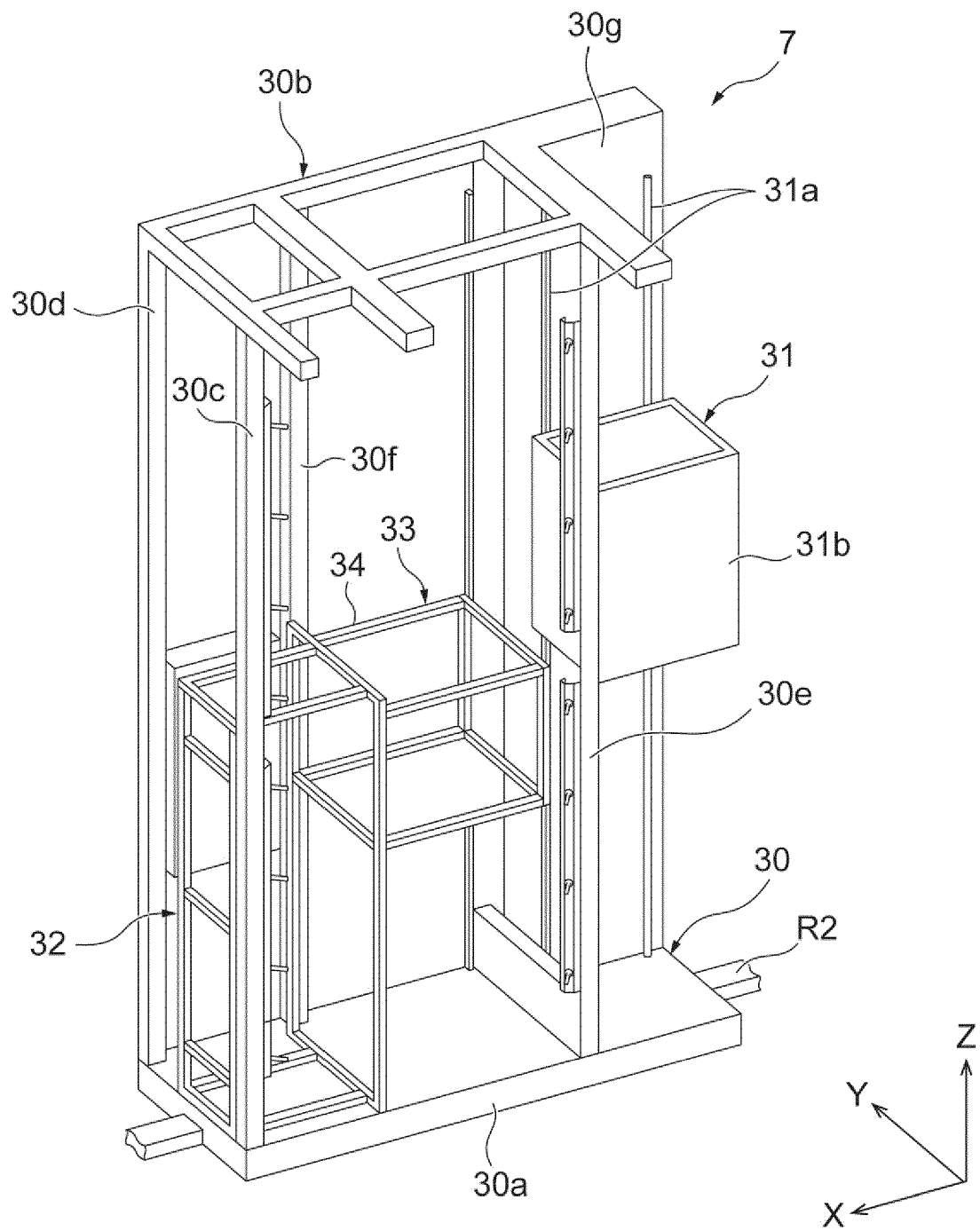


Fig. 8B

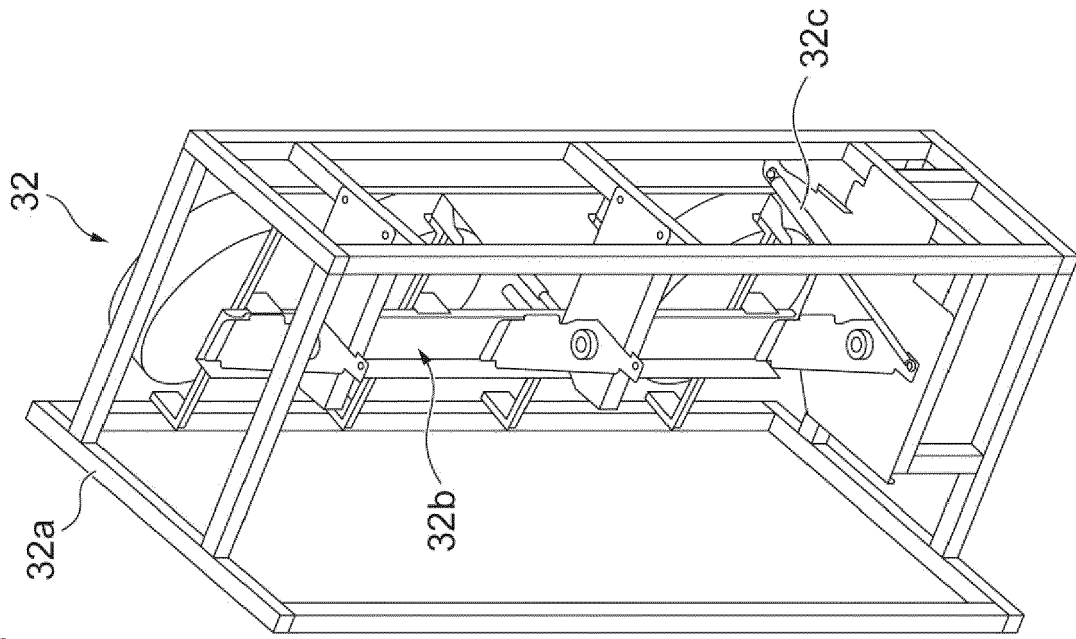


Fig. 8A

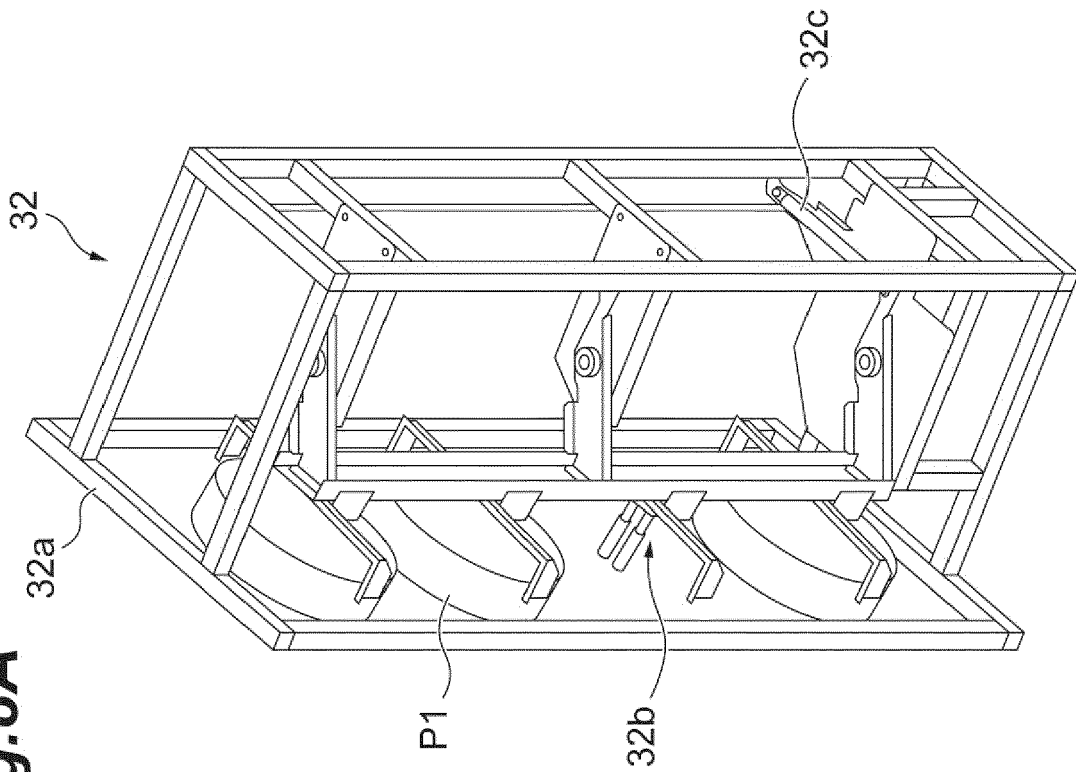


Fig.9

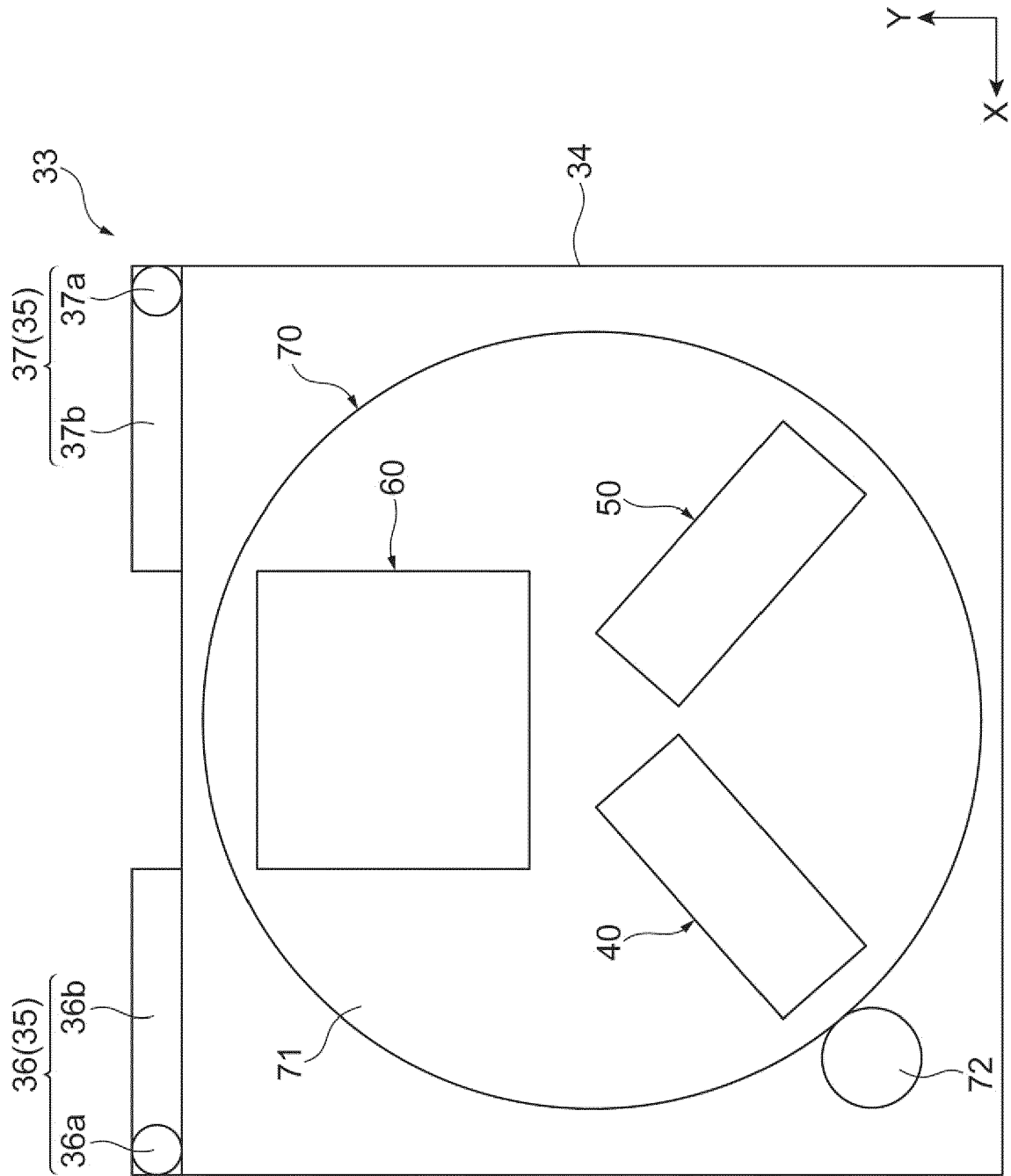


Fig.10

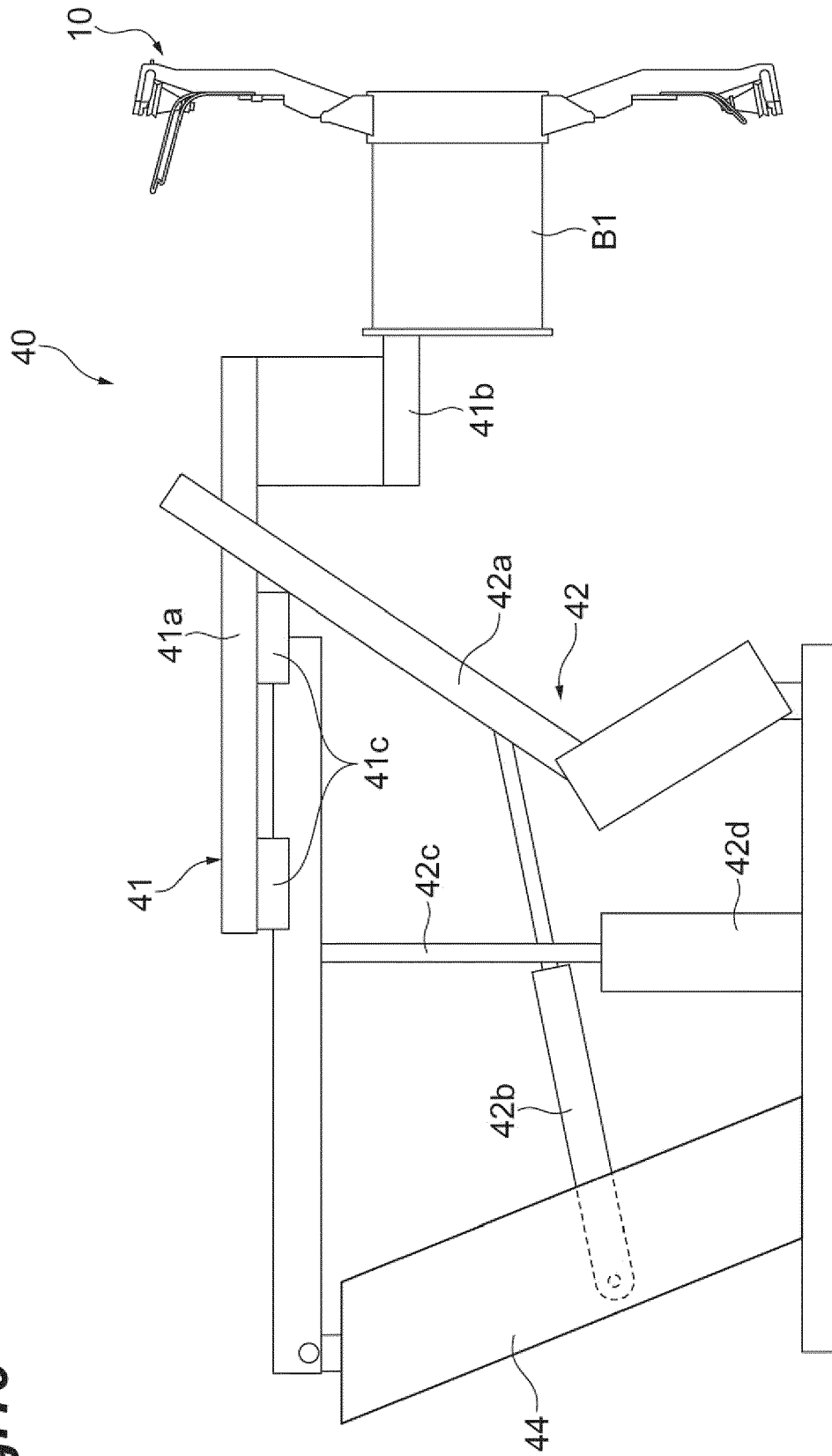


Fig.11

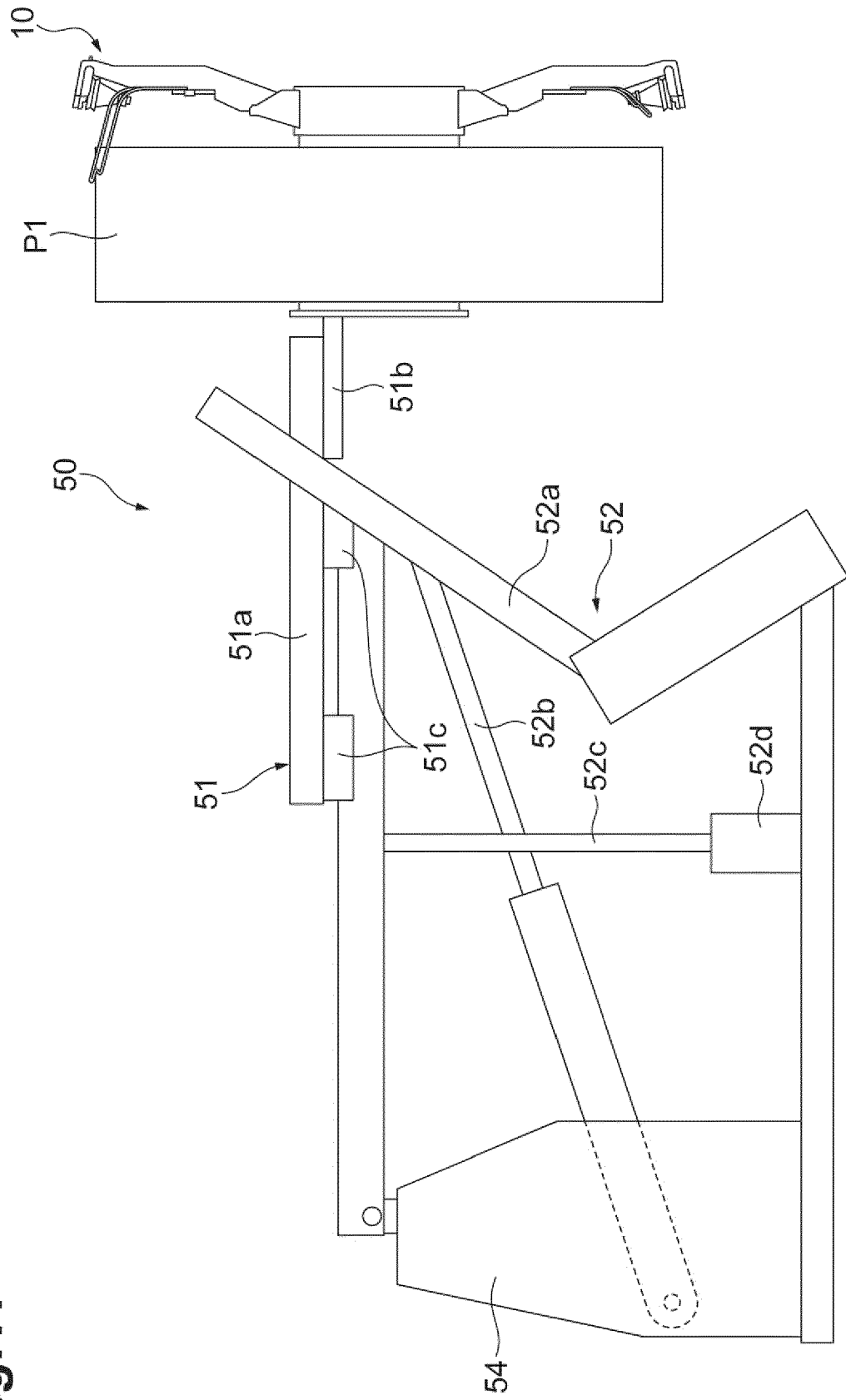


Fig.12

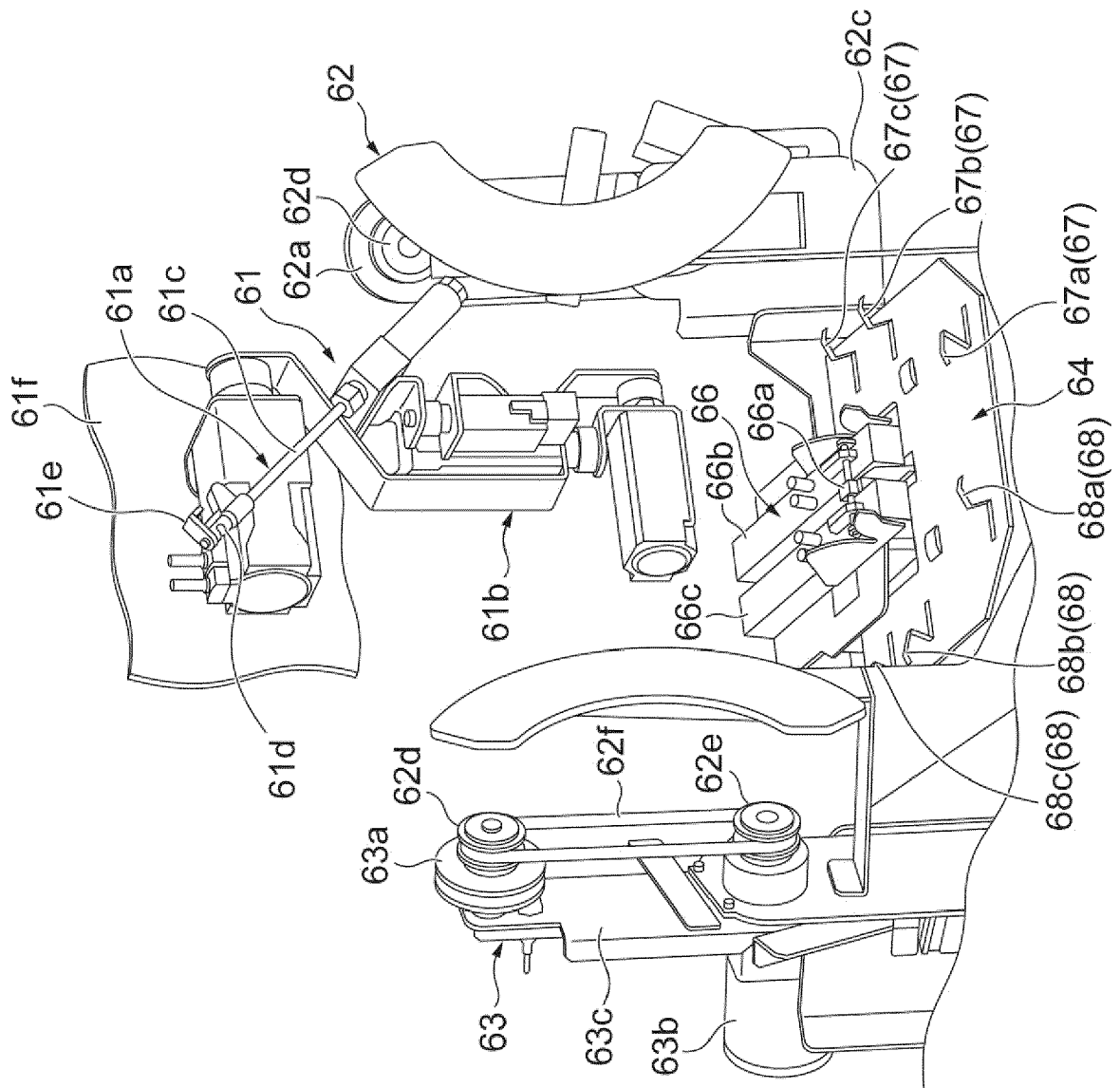


Fig.13

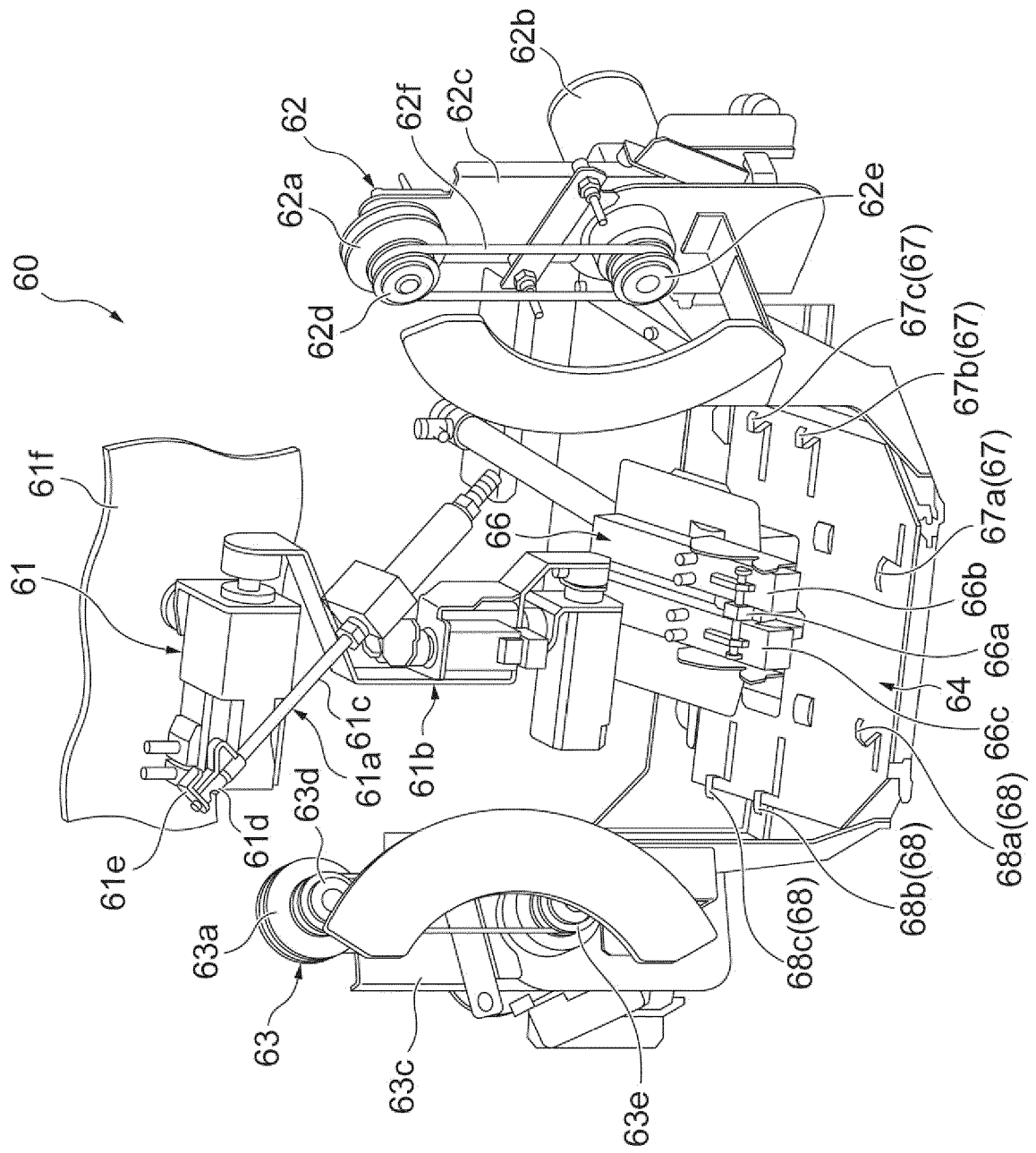


Fig.14

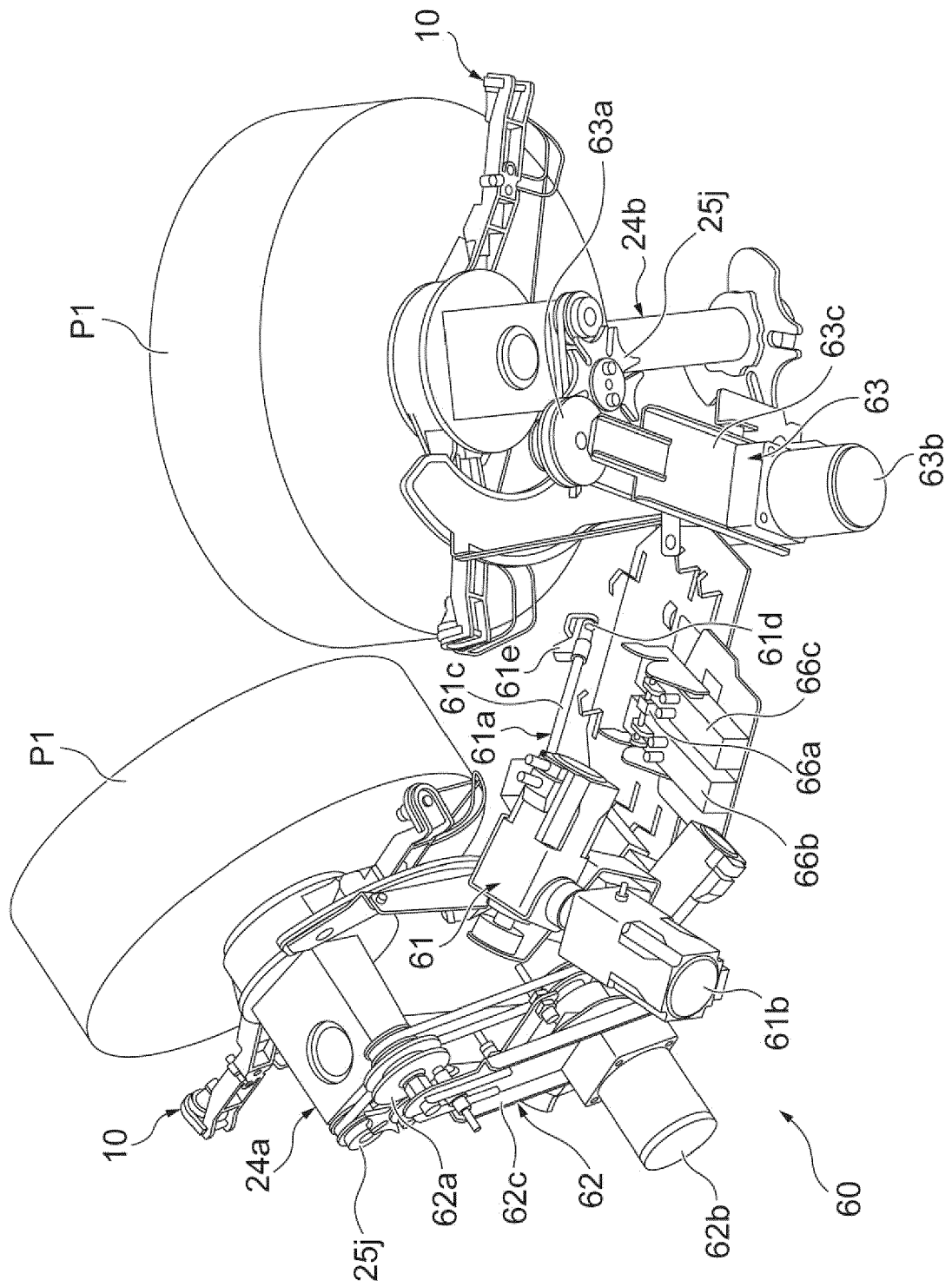


Fig. 15

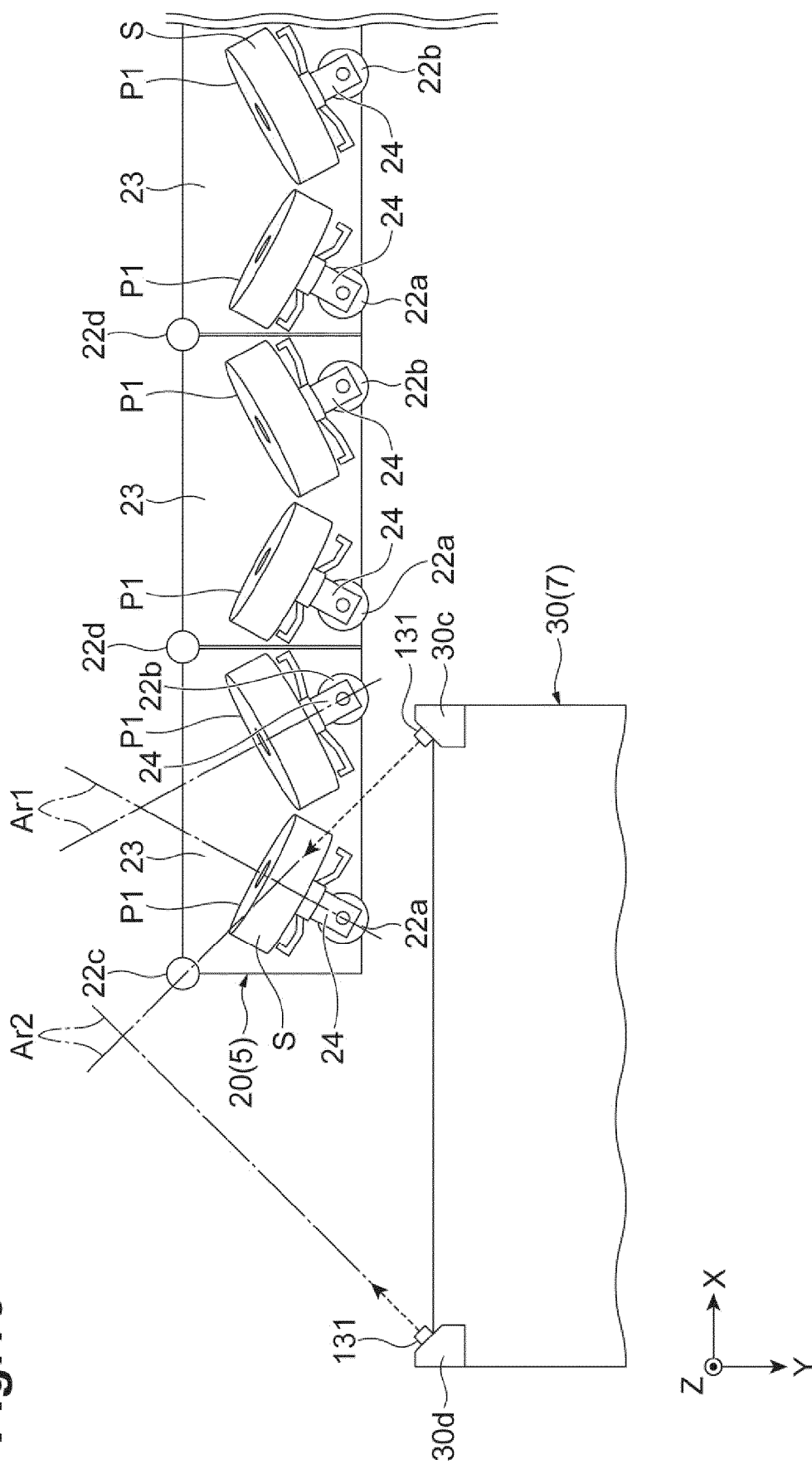


Fig.16

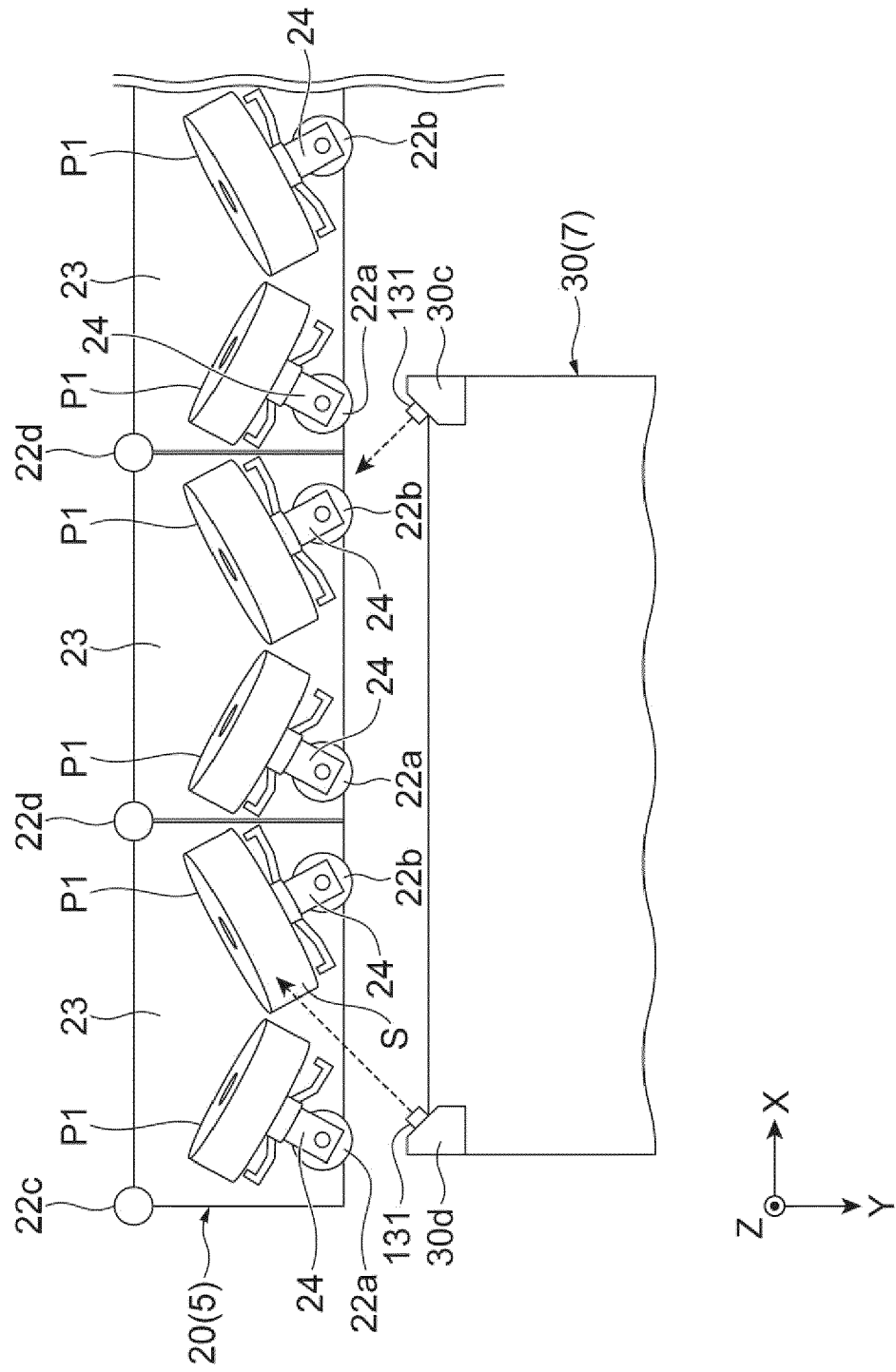
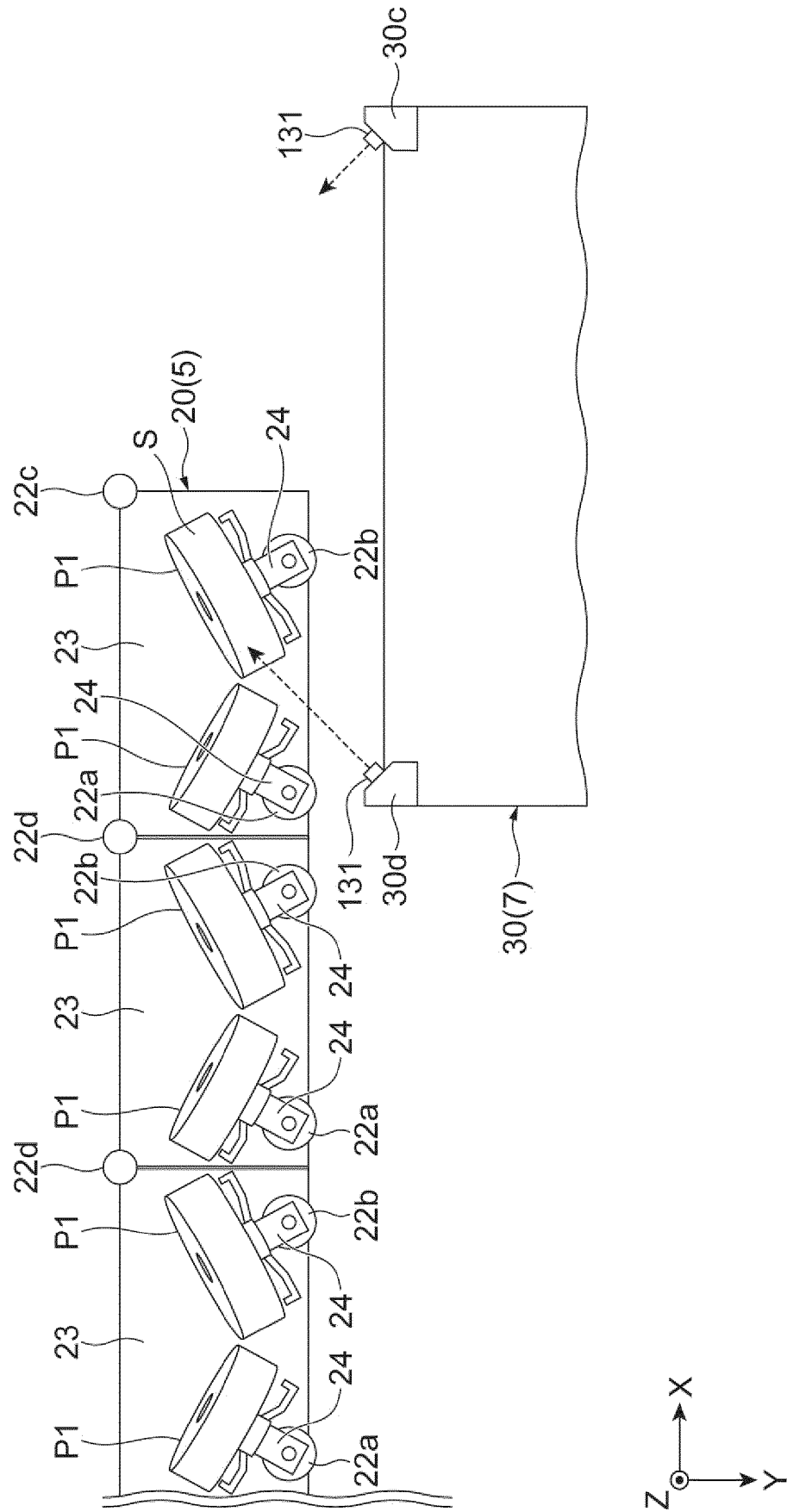
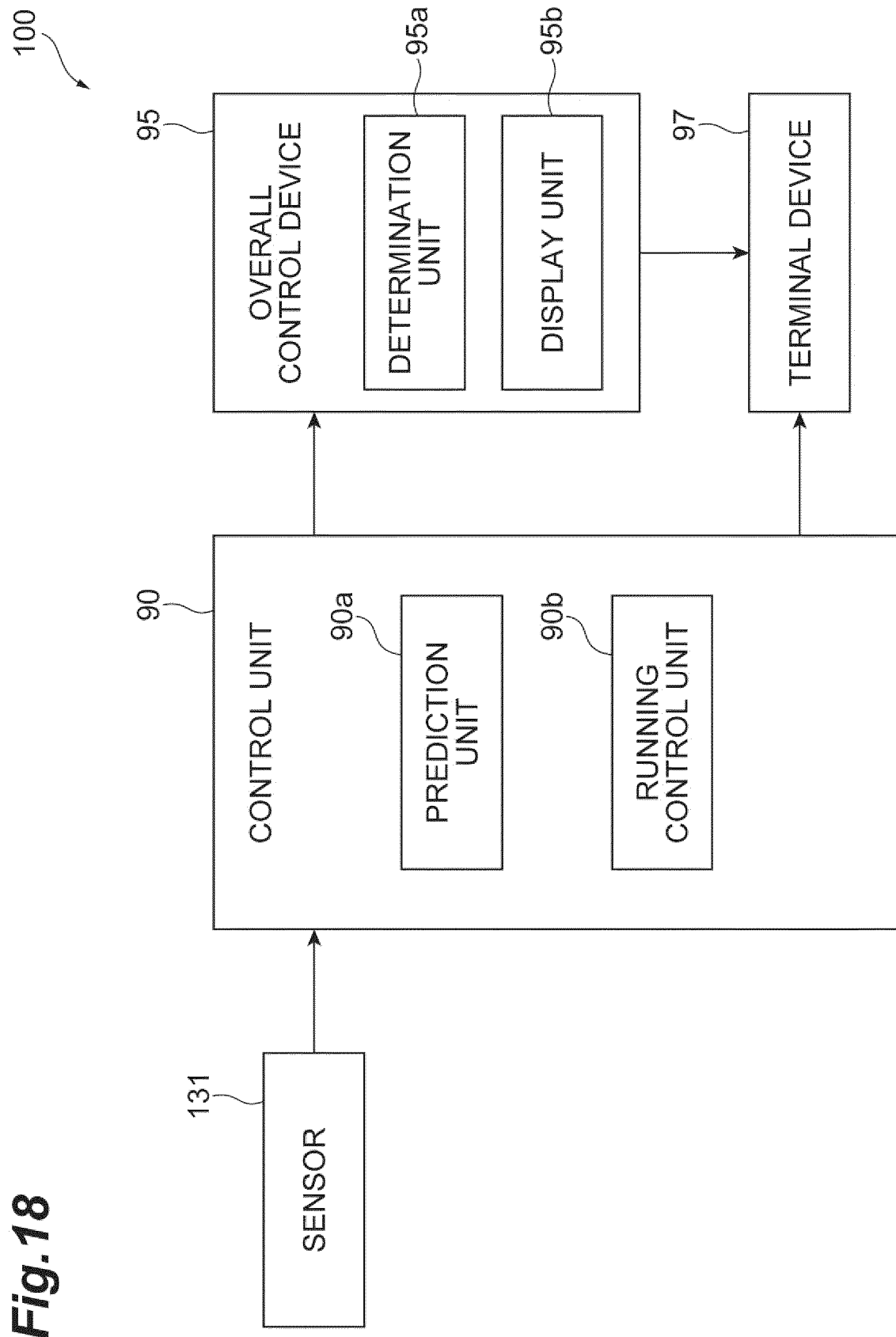


Fig. 17







EUROPEAN SEARCH REPORT

Application Number
EP 20 18 8116

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Place of search The Hague		Date of completion of the search 19 November 2020	Examiner Lemmen, René
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