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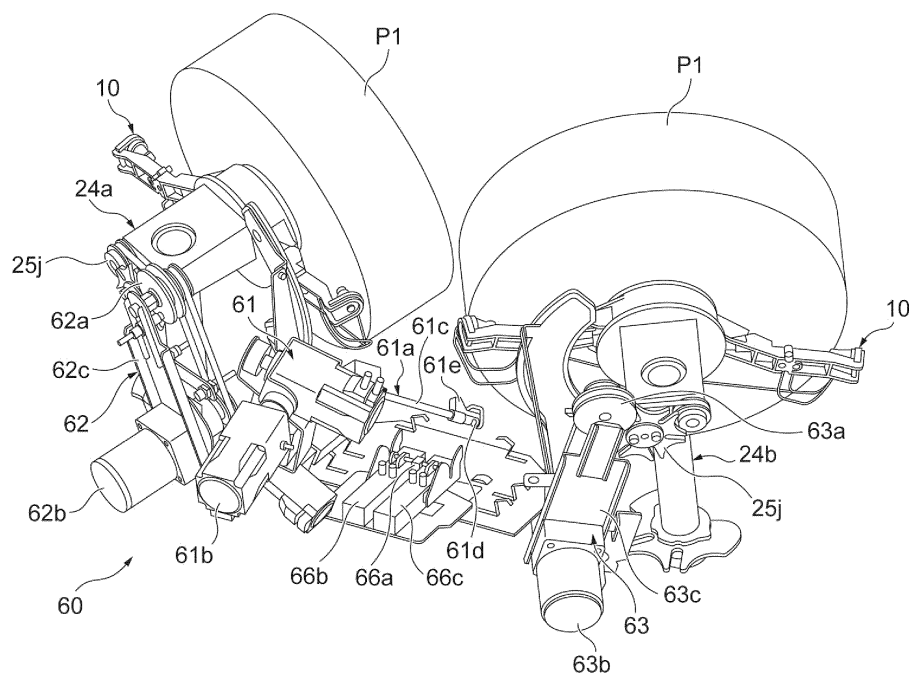
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(54) **YARN JOINING SYSTEM FOR SYNTHETIC YARN**

(57) A package exchanging device (7) includes: a splicer (66) which entangles a yarn end (Y1) and a yarn end (Y2); first hooks (67a) and (68a) and second hooks (67b) and (68b) which are provided so that a movable amount from an initial state increases in response to a tension acting on a yarn (Y) when the tension becomes larger than a predetermined value and are urged so as to return to the initial state when the tension acting on

the yarn (Y) is equal to or smaller than the predetermined value; a first motor (62b) and a second motor (63b) which drive a peg (24) rotatably supporting a yarn supply package (P1); and a drive control unit (90a) which controls a feeding amount of the yarn (Y) fed from the yarn supply package (P1) by controlling the first motor (62b) and the second motor (63b) so that the movable amount is in a first predetermined range.

Fig.14



Description

TECHNICAL FIELD

[0001] An aspect of the invention relates to a yarn joining system for synthetic yarn.

BACKGROUND

[0002] A false-twisting machine is known which false-twists a plurality of synthetic yarns supplied from yarn supply packages and winds the processed synthetic yarns so as to form a winding package in a winding device (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 packages is used in order to continuously supply the synthetic yarn in a creel stand holding the yarn supply packages. In this configuration, the synthetic yarn on an inner layer side of the yarn supply package supported by one peg is connected to the synthetic yarn on an 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 while 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, it is necessary 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 (a tail joining operation) is generally performed by human hands. Patent Literature 2 (Japanese Examined Patent Publication No. H7-68010) discloses a work carriage which is provided so as to be able to travel along such a creel stand and on which an operator who performs the exchange of the yarn supply package and the yarn joining operation rides.

SUMMARY

[0004] There has been a demand for carrying out the above-described yarn joining operation using a device without human intervention. In this case, it is necessary to draw the synthetic yarn from each of a pair of yarn supply packages and to guide the yarn to a yarn joining portion of a yarn joining device for entangling the synthetic yarn. At this time, when a tension acting on the synthetic yarn exceeds a predetermined range, the yarn is damaged so that the quality of the entangled portion is deteriorated. Accordingly, when a quality check passage rate of the entangled portion at the downstream step decreases, the production efficiency of the winding package in the false-twisting machine decreases.

[0005] Here, an object of an aspect of the invention is to provide a yarn joining system for synthetic yarn capa-

ble of drawing a yarn end of a yarn supply package and guiding the yarn end to a yarn joining device while a tension acting on a synthetic yarn is maintained in a certain range.

[0006] A yarn joining system for synthetic yarn according to an aspect of the invention is a yarn joining system for synthetic yarn used in a textile machine including a creel stand supporting a yarn supply package obtained by winding a synthetic yarn made of synthetic fibers on a bobbin by a yarn supply package support portion, a processing device processing the synthetic yarn supplied from the yarn supply package, and a winding device forming a winding package by winding the synthetic yarn subjected to the processing and used to draw a yarn end from each of a pair of two yarn supply packages supported by the yarn supply package support portion and to join the yarn ends, the yarn joining system for synthetic yarn including: a yarn joining portion which entangles a first yarn end corresponding to a yarn end of the one yarn supply package and a second yarn end corresponding to a yarn end of the other yarn supply package; a guide portion which guides the first yarn end and the second yarn end to the yarn joining portion; a locking portion which locks the synthetic yarn when the guide portion guides the first yarn end and the second yarn end to the yarn joining portion, the locking portion being provided so that a movable amount from an initial state increases in response to a tension acting on the synthetic yarn when the tension becomes larger than a predetermined value and is urged so as to return to the initial state when the tension acting on the synthetic yarn is equal to or smaller than the predetermined value; an operation mechanism which drives the yarn supply package support portion supporting the yarn supply package of the creel stand so as to be rotatable in a feeding direction; a running unit which moves a base supporting the yarn joining portion, the guide portion, the locking portion, and the operation mechanism along the creel stand; an acquisition unit which acquires a movable amount of the locking portion with respect to the base; and a drive control unit which controls a feeding amount of the synthetic yarn fed from the yarn supply package by controlling the operation mechanism so that the movable amount is in a first predetermined range.

[0007] Additionally, the synthetic yarn feeding direction mentioned herein is a concept including not only a direction in which the synthetic yarn is fed from the yarn supply package but also a direction in which the synthetic yarn is rewound on the yarn supply package. In the yarn joining system for synthetic yarn of this configuration, since the yarn supply package can be rotated in the feeding direction, it is possible to relieve the tension generated when drawing the yarn from the yarn supply package by the guide portion. Further, in the yarn joining system for synthetic yarn of this configuration, the tension generated when guiding the yarn end of the yarn supply package to the yarn joining device is acquired by the locking portion and the feeding amount of the yarn supply package

is controlled in response to the acquired tension. Accordingly, it is possible to draw the yarn end of the yarn supply package and guide the yarn end to the yarn joining device while the tension acting on the synthetic yarn is maintained in a certain range.

[0008] The yarn joining system for synthetic yarn according to an aspect of the invention may further include: a collection device which collects the bobbin supported by the yarn supply package support portion; and a supply device which attaches the yarn supply package to the yarn supply package support portion and the collection device and the supply device may be supported by the base. In this configuration, it is possible to cause the yarn joining system for synthetic yarn to perform the exchange operation and the yarn joining operation of the yarn supply package held on the creel stand without human intervention.

[0009] In the yarn joining system for synthetic yarn according to an aspect of the invention, the locking portion may be provided so as to be swingable with respect to the base and be provided so that a swing amount from an initial state increases in response to the tension when the tension acting on the synthetic yarn becomes larger than a predetermined value and the acquisition unit may acquire the swing amount of the locking portion with respect to the base. In this configuration, it is possible to obtain a simple and compact configuration of the locking portion moving so that the swing amount from the initial state increases in response to the tension.

[0010] In the yarn joining system for synthetic yarn according to an aspect of the invention, the locking portion may be provided so as to be movable in a range wider than the first predetermined range. In this configuration, even when the tension larger than the first predetermined range acts on the locking portion, the locking portion can swing in response to the tension. Accordingly, even when the tension larger than the first predetermined range unintentionally acts on the locking portion, the tension is relaxed and damage to the synthetic fiber or breakage thereof is reduced.

[0011] In the yarn joining system for synthetic yarn according to an aspect of the invention, the locking portion may include a first locking portion which locks the synthetic yarn wound on the one yarn supply package and a second locking portion which locks the synthetic yarn wound on the other yarn supply package. In this configuration, it is possible to appropriately adjust the tension of both of the synthetic yarn drawn from one yarn supply package and the synthetic yarn drawn from the other yarn supply package.

[0012] In an aspect of the invention, the yarn end of the yarn supply package can be drawn and guided to the yarn joining device while the tension acting on the synthetic fiber is maintained in a certain range.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

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 perspective view illustrating the yarn joining device and a catching and guiding mechanism.

FIG. 16 is a perspective view illustrating a configuration of one hook of a second guide mechanism.

FIG. 17 is a functional block diagram illustrating a functional configuration of a yarn joining device.

FIG. 18 is a perspective view illustrating the yarn joining device and the catching and guiding mechanism.

FIGS. 19A and 19B are perspective views illustrating the second guide mechanism locked to a yarn.

FIG. 20 is a perspective view illustrating the yarn joining device and the catching and guiding mechanism.

FIG. 21 is a perspective view illustrating the yarn joining device and the catching and guiding mechanism.

DETAILED DESCRIPTION

[0014] 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.

[0015] As illustrated in FIG. 1, a false-twisting system 1 includes a false-twisting machine (a 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 (a yarn joining system for synthetic yarn) 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.

[0016] 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).

[0017] The false-twisting machine 2 forms the winding package P2 by processing the yarn Y. The false-twisting machine 2 includes a main base (a 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.

[0018] The false-twisting machine 2 false-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.

[0019] 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.

[0020] 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.

[0021] 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.

[0022] 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.

[0023] 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.

[0024] 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 in-

cludes 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.

[0025] 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.

[0026] 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.

[0027] 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".

[0028] 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.

[0029] 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.

[0030] 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.

[0031] The rotation mechanism 25c includes a driven pulley 25g, a drive pulley 25h, a power transmission belt 25i, and a first wheel 25j.

[0032] 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.

[0033] 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 sup-

port 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.

[0034] 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.

[0035] 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.

[0036] 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.

[0037] The package exchanging device 7 includes a running carrier (a running unit) 30, an elevating unit 31, a holding unit (a holding device) 32, and an exchange unit 33. Further, the package exchanging device 7 includes a control unit (not illustrated) which controls the operation of each unit.

[0038] 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.

[0039] 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.

[0040] 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.

[0041] 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.

[0042] 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).

[0043] 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 replenish-

ing device 6, temporarily stores the yarn supply package PI, and supplies the yarn supply package PI to the exchange unit 33.

[0044] As illustrated in FIGS. 8A and 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.

[0045] 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 PI is supplied from the package replenishing device 6 and a supply position (see FIG. 8A) in which the yarn supply package PI 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.

[0046] 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 40, a supply device 50, a yarn joining device 60, and a moving device 70.

[0047] 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.

[0048] 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.

[0049] 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).

[0050] 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).

[0051] 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 operated, 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.

[0052] 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.

[0053] 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.

[0054] 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.

[0055] 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 direction. 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.

[0056] The supply device 50 supplies the yarn supply package PI 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.

[0057] 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.

[0058] 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.

[0059] An acquisition operation in which the supply device 50 acquires the yarn supply package PI from the holding unit 32 will be described. The supply device 50 acquires the yarn supply package PI 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 PI 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 PI, 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 PI so that the yarn supply package PI is lifted and the yarn supply package PI 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 PI from the holding unit 32.

[0060] A supply operation in which the supply device 50 supplies the yarn supply package PI 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 PI, 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 PI so that the yarn supply package PI 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 PI to the peg 24.

[0061] The yarn joining device 60 joins the yarn Y of the yarn supply package PI supported by the first peg 24a and the yarn Y of the yarn supply package PI 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 portion) 61, a first rotation mechanism (an operation mechanism) 62, a second rotation mechanism (an operation mechanism) 63, and a yarn joining mechanism 64.

[0062] 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.

[0063] The catching and guiding mechanism 61 catches the yarn Y of the yarn supply package PI 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 PI supported by one peg 24 and the second yarn end Y2 of the yarn Y of the yarn supply package PI 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.

[0064] 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.

[0065] 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 PI so that the

yarn Y is fed from the yarn supply package PI when guiding the yarn Y to the yarn joining mechanism 64 by the catching and guiding mechanism 61. Additionally, the rotation direction of the yarn supply package PI mentioned herein includes not only a direction (a feeding direction) in which the yarn Y is fed from the yarn supply packages PI and P1 but also a direction (a rewinding direction) in which the yarn Y is rewound on the yarn supply packages PI and P1.

[0066] 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.

[0067] 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.

[0068] The configurations of the first rotation mechanism 62 and the second rotation mechanism 63 will be described in more detail later.

[0069] 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.

[0070] 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 PI supported by the first peg 24a and the yarn Y of the yarn supply package PI 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.

[0071] 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 (a locking portion, a second locking portion) 67a, a second hook (a locking portion, a second locking portion) 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 (an acquisition unit) 164 (see FIG. 16) 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 164. 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 (feeding amount) of the yarn supply package P1 on the basis of the detection result of the potentiometer 164.

[0072] The second guide mechanism 68 locks and guides the yarn Y. The second guide mechanism 68 includes a first hook (a locking portion, a first locking portion) 68a, a second hook (a locking portion, a first locking portion) 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 164 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 164. That is, the yarn joining device 60 adjusts the rotation amount (feeding amount) of the yarn supply package P1 on the basis of the detection result of the potentiometer 164 and draws the yarn Y from the yarn supply package P1 with a predetermined tension.

[0073] 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 P1 supported by the first peg 24a and the second yarn end Y2 on the inner layer side of the yarn supply package P1 supported by the second peg 24b will be described.

[0074] 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 P1 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.

[0075] 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 P1 supported by the first peg 24a and catches the second yarn end Y2 from the adapter 10 of the yarn supply package P1 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 P1 is rotated. Accordingly, the yarn Y is drawn out from the yarn supply package P1 at a predetermined tension.

[0076] 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 P1 supported by the first peg 24a and the second yarn end Y2 on the inner layer side of the yarn supply package P1 supported by the second peg 24b.

[0077] 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.

[0078] 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.

[0079] 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.

[0080] 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.

[0081] As described above, the entire false-twisting system 1 has been described, but the package exchanging device 7 which is one of characteristics of an aspect of the invention will be described in more detail below. First, the first guide mechanism 67 and the second guide mechanism 68 will be described in more detail. Additionally, the first hook 67a, the second hook 67b, the third hook 67c, the first hook 68a, the second hook 68b, and the third hook 68c respectively have different installation positions and directions, but have the same configuration. Thus, here, as illustrated in FIG. 16, the second hook 68b will be described in detail and the detailed description of the first hook 67a, the second hook 67b, the third hook 67c, the first hook 68a, and the third hook 68c will be omitted. Further, in the description below, it is described that the potentiometer 164 is provided in each of the first hook 67a, the second hook 67b, the third hook 67c, the first hook 68a, the second hook 68b, and the third hook 68c, but the potentiometer 164 may be provided, for example, only in the first hook 67a and the first hook 68a.

[0082] As illustrated in FIG. 15, the second hook 68b is inserted through an insertion groove 65b formed in a base plate 65a which is a part of the base 65. As illustrated in FIG. 16, the second hook 68b is provided so that a front end portion 68bb disposed above the base plate 65a swings around a base end portion 68ba disposed below the base plate 65a and serving as a swing axis. The base end portion 68ba is fixed to a rotary guide 162 rotatably provided in a rotation shaft 161a fixed to a part of the base 65. Thus, when the yarn Y is locked to the second hook 68b and stress acts on the second hook 68b, the second hook 68b swings together with the rotary guide 162. The stress acting on the second hook 68b due to the yarn Y is proportional to the tension acting on

the yarn Y.

[0083] The rotary guide 162 is provided so that the swing amount (movable amount) from the initial state increases in response to stress acting on the second hook 68b when the stress is larger than a predetermined value and is urged so as to return to the initial state when the stress acting on the second hook 68b is equal to or smaller than a predetermined value. In the embodiment, the rotary guide 162 is connected to a fixing target portion 161b which is a part of the base 65 through an elastic member (for example, a spring member) 163. Accordingly, the second hook 68b is provided so that the swing amount (movable amount) from the initial state increases in response to stress when the stress acting on the second hook 68b is larger than a predetermined value and returns to the initial state when the stress acting on the second hook 68b is equal to or smaller than a predetermined value.

[0084] One end of the rotary guide 162 in the axial direction is connected to the potentiometer 164. The potentiometer 164 acquires the rotation amount of the rotary guide 162 with respect to the base plate 65a. The rotation amount which is acquired by the potentiometer 164 is acquired by a control unit 90 to be described later. Further, the rotary guide 162 is provided with a rotary solenoid 165 which forcibly rotates the rotary guide 162. The rotary solenoid 165 releases the yarn Y which is locked to the second hook 68b by forcibly rotating the second hook 68b in a direction of an arrow illustrated in FIG. 19. The rotary solenoid 165 is controlled by the control unit 90.

[0085] Next, the control unit 90 (see FIGS. 7 and 17) which is one of characteristics of an aspect of the invention will be described in more detail. The control unit 90 is an electronic control unit which includes a Central Processing Unit (CPU), a Read Only Memory (ROM), a Random Access Memory (RAM), an I/O port, and a communication port. The ROM stores a program for controlling each component. Further, each of the functions of a drive control unit 90a and a determination unit 90b to be described later is executed under the control of the CPU by reading predetermined computer software onto hardware such as a CPU and a main memory.

[0086] The drive control unit 90a controls the feeding amount of the yarn Y fed from each of the yarn supply packages PI and PI by controlling the first motor 62b of the first rotation mechanism 62 and the second motor 63b of the second rotation mechanism 63 so that the swing amount acquired by the potentiometer 164 is in a first predetermined range. Additionally, each of the first hook 67a, the second hook 67b, the third hook 67c, the first hook 68a, the second hook 68b, and the third hook 68c is provided so as to be movable in a range wider than the first predetermined range. The determination unit 90b determines whether the yarn joining operation of the yarn joining device 60 is successful on the basis of the rotation amount (the swing amount of the first hook 67a and the first hook 68a) acquired by the potentiometer

164 when the catching and guiding mechanism 61 is moved to an inspection position P61.

[0087] Next, the control of guiding the yarn end Y1 and the yarn end Y2 to the yarn joining mechanism 64 by the catching and guiding mechanism 61 in order to allow the yarn joining device 60 to join the yarn end Y1 on the outer layer side of the yarn supply package PI supported by the first peg 24a and the yarn end Y2 on the inner layer side of the yarn supply package PI supported by the second peg 24b will be described as one of characteristics of an aspect of the invention.

[0088] When the yarn joining operation is started, as illustrated in FIGS. 18 and 19A, the yarn joining device 60 moves the yarn joining arm portion 61b of the catching and guiding mechanism 61 so that the suction nozzle 61d is located at the adapter 10 of the yarn supply package PI supported by the second peg 24b and the yarn end Y2 is caught by the suction nozzle 61d. Next, the yarn joining device 60 moves the yarn joining arm portion 61b in this state so that the yarn Y of the yarn supply package PI supported by the second peg 24b is locked to the first hook 68a and the second hook 68b and then the suction nozzle 61d is moved toward the adapter 10 of the yarn supply package PI supported by the first peg 24a. Accordingly, the yarn Y is drawn from the yarn supply package PI supported by the second peg 24b.

[0089] Here, the control in which the catching and guiding mechanism 61 draws the yarn Y from the yarn supply package PI supported by the second peg 24b will be described. When the yarn end Y2 caught by the suction nozzle 61d is moved toward the first peg 24a while the yarn Y is locked to the first hook 68a and the second hook 68b, a tension is generated in the yarn Y and is transmitted as a stress to the first hook 68a and the second hook 68b as illustrated in FIG. 19B. Accordingly, the first hook 68a and the second hook 68b swing in a direction of an arrow illustrated in FIG. 19B in response to the tension generated in the yarn Y.

[0090] The control unit 90 rotates the yarn supply package PI supported by the second peg 24b in the feeding direction by controlling the second rotation mechanism 63 on the basis of the rotation amount of the rotary guide 162 acquired by the potentiometer 164. Specifically, the control unit 90 controls the feeding amount of the yarn Y fed from the yarn supply package PI by controlling the second rotation mechanism 63 so that the swing amount of the first hook 68a and the second hook 68b is in a first predetermined range. Additionally, here, the feeding amount of the yarn Y fed from the yarn supply package PI may be controlled by controlling the second rotation mechanism 63 so that the swing amount of at least one of the first hook 68a and the second hook 68b is in the first predetermined range.

[0091] In the embodiment, the swing amount of the first hook 68a and the second hook 68b is acquired as the rotation amount of the rotary guide 162 by the potentiometer 164. Thus, the control unit 90 controls the feeding amount of the yarn Y fed from the yarn supply package

PI by controlling the second rotation mechanism 63 so that the rotation amount acquired by the potentiometer 164 is in a second predetermined range corresponding to the first predetermined range.

[0092] For example, when the rotation amount acquired by the potentiometer 164 exceeds the second predetermined range, the second motor 63b is controlled so that the yarn supply package PI supported by the second peg 24b is rotated in the feeding direction. Accordingly, since the yarn Y is fed from the yarn supply package PI, the tension generated in the yarn Y is relaxed. Here, the first predetermined range is the swing amount of the first hook 68a and the second hook 68b converted from the tension range which does not damage the yarn Y.

[0093] Next, the catching and guiding mechanism 61 moves the yarn joining arm portion 61b so that the suction nozzle 61d catching the yarn end Y2 is moved to the yarn supply package PI supported by the first peg 24a and the yarn end Y1 is caught by the suction nozzle 61d. Next, as illustrated in FIG. 20, the yarn joining device 60 moves the yarn joining arm portion 61b while catching the yarn end Y1 and the yarn end Y2 so that the yarn Y of the yarn supply package PI supported by the first peg 24a is locked to the first hook 67a and the second hook 67b and the suction nozzle 61d is moved toward the yarn joining mechanism 64. Accordingly, the yarn Y is drawn from the yarn supply package PI supported by the first peg 24a. Additionally, the yarn Y is also fed from the yarn supply package PI supported by the second peg 24b.

[0094] Additionally, here, an example in which the yarn Y is locked to the first hook 68a and the second hook 68b and the yarn end Y2 is caught while catching the yarn end Y1 has been described. However, the yarn Y may be locked to the first hook 67a and the second hook 67b by opening the yarn end Y1 after maintaining the tension of the yarn Y locked to the first hook 68a and the second hook 68b by an appropriate method and catching only the yarn end Y2 using the suction nozzle 61d. That is, the yarn Y of the yarn supply package PI supported by the second peg 24b and the yarn Y of the yarn supply package P1 supported by the first peg 24a may be drawn separately so that the yarn Y of the yarn supply package PI supported by the second peg 24b is locked to the first hook 68a and the second hook 68b and then the yarn Y of the yarn supply package PI supported by the first peg 24a is locked to the first hook 67a and the second hook 67b.

[0095] Here, the control in which the catching and guiding mechanism 61 draws the yarn Y from the yarn supply package PI supported by the first peg 24a will be described. When the yarn end Y1 caught by the suction nozzle 61d is moved toward the yarn joining mechanism 64 while the yarn Y is locked to the first hook 67a and the second hook 67b, a tension is generated in the yarn Y and is transmitted as a stress to the first hook 67a and the second hook 67b. Accordingly, the first hook 67a and the second hook 67b swing in response to the tension generated in the yarn Y.

[0096] The control unit 90 rotates the yarn supply package PI supported by the first peg 24a in the feeding direction by controlling the first rotation mechanism 62 on the basis of the rotation amount of the rotary guide 162 acquired by the potentiometer 164. Specifically, the control unit 90 controls the feeding amount of the yarn Y fed from the yarn supply package PI by controlling the first rotation mechanism 62 so that the swing amount of the first hook 67a and the second hook 67b is in the first predetermined range. Additionally, here, the feeding amount of the yarn Y fed from the yarn supply package PI may be controlled by controlling the first rotation mechanism 62 so that the swing amount of at least one of the first hook 67a and the second hook 67b is in the first predetermined range.

[0097] In the embodiment, as described above, the swing amount of the first hook 67a and the second hook 67b is acquired as the rotation amount of the rotary guide 162 by the potentiometer 164. Thus, the control unit 90 controls the feeding amount of the yarn Y fed from the yarn supply package PI by controlling the first rotation mechanism 62 so that the rotation amount acquired by the potentiometer 164 is in the second predetermined range corresponding to the first predetermined range.

[0098] For example, when the rotation amount acquired by the potentiometer 164 exceeds the second predetermined range, the first motor 62b is controlled so that the yarn supply package PI supported by the first peg 24a is rotated in the feeding direction. Accordingly, since the yarn Y is fed from the yarn supply package PI, the tension generated in the yarn Y is relaxed. Additionally, the control of the first rotation mechanism 62 is continued even while the control unit 90 controls the first rotation mechanism 62.

[0099] As described above, the yarn joining device 60 rotates the yarn supply package PI in the feeding direction by controlling the second peg 24b using the second rotation mechanism 63 when drawing the yarn Y from the yarn supply package PI supported by the second peg 24b using the catching and guiding mechanism 61. Accordingly, the tension of the yarn Y when feeding the yarn Y from the yarn supply package PI can be maintained in a predetermined range. Similarly, the yarn joining device 60 rotates the yarn supply package PI in the feeding direction by controlling the first peg 24a using the first rotation mechanism 62 when drawing the yarn Y from the yarn supply package PI supported by the first peg 24a using the catching and guiding mechanism 61. Accordingly, the tension of the yarn Y when feeding the yarn Y from the yarn supply package PI can be maintained in a predetermined range.

[0100] Next, a determination method of determining whether or not the yarn end Y1 and the yarn end Y2 are appropriately joined (entangled) after the yarn joining device 60 joins the yarn end Y1 on the outer layer side of the yarn supply package PI supported by the first peg 24a and the yarn end Y2 on the inner layer side of the yarn supply package PI supported by the second peg

24b will be described as one of characteristics of an aspect of the invention.

[0101] The yarn entangled (joined) by the yarn joining device 60 (hereinafter, the yarn which is entangled by the yarn joining device 60 and in which the yarn end Y2 of the yarn Y of the yarn supply package PI supported by the second peg 24b is connected to the yarn end Y1 of the yarn Y of the yarn supply package PI supported by the first peg 24a is referred to as a "continuous yarn (a continuous synthetic yarn) Y0") is locked to the first hooks 67a and 68a and the second hooks 67b and 68b. The yarn joining device 60 operates the rotary solenoid 165 provided in the second hooks 67b and 68b and releases the locking to the second hooks 67b and 68b by the continuous yarn Y0. Accordingly, the continuous yarn Y0 is locked only to the first hooks 67a and 68a.

[0102] Next, the yarn joining device 60 locks the continuous yarn Y0 by the hook portion 61e by moving the yarn joining arm portion 61b of the catching and guiding mechanism 61 and positioning the hook portion 61e between the first hook 67a and the first hook 68a as illustrated in FIG. 21. More specifically, for example, the catching and guiding mechanism 61 catches the continuous yarn Y0 so that an entangled portion YC of the yarn end Y1 and the yarn end Y2 is located between the caught portion of the continuous yarn Y0 and the locking portion of the first hook 67a (which may be also the first hook 68a).

[0103] Next, the yarn joining device 60 moves the hook portion 61e upward to the predetermined inspection position P61 while catching the continuous yarn Y0 by the hook portion 61e. Due to the operation of the catching and guiding mechanism 61, a predetermined tension is generated in the continuous yarn Y0. The control unit 90 acquires the swing amount occurring in the first hook 67a and the first hook 68a at this time, that is, the rotation amount of the rotary guides 162 and 162 respectively acquired by the potentiometers 164 and 164. Additionally, the control unit 90 may acquire the swing amount occurring in at least one of the first hook 67a and the first hook 68a.

[0104] When the hook portion 61e is moved to the inspection position P61, the control unit 90 determines whether or not the yarn joining operation between the yarn end Y1 and the yarn end Y2 is successful on the basis of the rotation amount acquired by the potentiometers 164 and 164 provided in the first hook 67a and the first hook 68a. In other words, the control unit 90 determines whether the entangled portion YC has passed or failed. For example, the control unit 90 determines that the yarn joining operation between the yarn end Y1 and the yarn end Y2 is successful when the rotation amount acquired by the potentiometers 164 and 164 provided in the first hook 67a and the first hook 68a when the hook portion 61e is moved to the inspection position P61 is a predetermined value or more, that is, the continuous yarn Y0 has a predetermined tension.

[0105] On the other hand, the control unit 90 deter-

mines that the yarn joining operation between the yarn end Y1 and the yarn end Y2 is not successful by considering that the entangled portion YC is not complete (the entangled portion is disentangled when the yarn is pulled) or the yarn end Y1 and the yarn end Y2 are not completely connected to each other when the rotation amount acquired by the potentiometers 164 and 164 provided in the first hook 67a and the second hook 68b when the hook portion 61e is moved to the inspection position P61 is smaller than a predetermined value (also including a case in which the tension is zero), that is, the continuous yarn Y0 does not have a predetermined tension.

[0106] The control unit 90 may transmit the determination result to, for example, a portable terminal device of an operator or an overall control device (not illustrated) that overallly controls the 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. Further, the overall control device receiving the determination result may display the determination result on a display device or the like provided in the overall control device. Further, the transmission of the determination result to the portable terminal may be performed by the overall control device.

[0107] In the package exchanging device 7 of the above-described embodiment, since the yarn supply package PI can be rotated in the feeding direction, it is possible to relax the tension generated in the yarn Y when drawing the yarn Y from the yarn supply package PI using the catching and guiding mechanism 61. Further, in the package exchanging device 7, the tension generated when guiding the yarn end Y1 and the yarn end Y2 of the yarn supply package PI to the yarn joining device 60 is acquired by the first hooks 67a and 68a and the second hooks 67b and 68b and the feeding amount of the yarn supply package PI is controlled in response to the acquired tension. Accordingly, the yarn end Y1 and the yarn end Y2 of the yarn supply package PI can be drawn and guided to the yarn joining device 60 while the tension acting on the yarn Y is maintained in a certain range.

[0108] The package exchanging device 7 of the above-described embodiment includes the yarn joining device 60 which connects the yarn end Y1 and the yarn end Y2 of the yarn supply package PI, the catching and guiding mechanism 61 which guides the yarn end Y1 and the yarn end 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 exchange operation of the yarn supply package PI and the yarn joining operation can be performed by the package exchanging device 7 without human hands.

[0109] In the package exchanging device 7 of the above-described embodiment, the first hooks 67a and 68a and the second hooks 67b and 68b are provided so as to be swingable with respect to the base plate 65a

and are provided so that the swing amount from the initial state increases in response to the tension acting on the yarn Y when the tension becomes larger than a predetermined value. For this reason, the configuration of the locking portion which needs to be provided so that the movable amount from the initial state increases in response to the tension can be made easy and compact.

[0110] In the package exchanging device 7 of the above-described embodiment, the first hooks 67a and 68a and the second hooks 67b and 68b are provided so as to be movable in a range wider than the first predetermined range. For this reason, even when the tension larger than the first predetermined range acts on the first hooks 67a and 68a and the second hooks 67b and 68b, the swing can occur in response to the tension. Accordingly, even when the tension larger than the first predetermined range unintentionally acts on the first hooks 67a and 68a and the second hooks 67b and 68b, the tension is relaxed and damage to the yarn Y or breakage thereof is reduced.

[0111] The package exchanging device 7 of the above-described embodiment includes each of the first hook 68a and the second hook 68b for locking the yarn end Y2 drawn from the yarn supply package PI supported by the second peg 24b and the first hook 67a and the second hook 67b for locking the yarn end Y1 drawn from the yarn supply package PI supported by the first peg 24a. Accordingly, it is possible to appropriately adjust the tension of both of the yarn Y drawn from the yarn supply package PI supported by the second peg 24b and the yarn Y drawn from the yarn supply package PI supported by the first peg 24a.

[0112] As described above, an embodiment of an aspect of the invention has been described, but 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.

[0113] In the package exchanging device 7 of the above-described embodiment, an example in which the first hook 68a and the second hook 68b for locking the yarn end Y2 drawn from the yarn supply package PI supported by the second peg 24b and the first hook 67a and the second hook 67b for locking the yarn end Y1 drawn from the yarn supply package PI supported by the first peg 24a are arranged with the yarn joining mechanism 64 interposed therebetween has been described, but an aspect of the invention is not limited thereto. The arrangement positions of these hooks (the locking portions) do not matter as long as the arrangement positions are on a route in which the catching and guiding mechanism 61 guides the yarn to the yarn joining device 60. Further, the number of the hooks is not also limited to the above-described embodiment and the hooks may be appropriately arranged.

[0114] In the package exchanging device 7 of the above-described embodiment, an example in which one catching and guiding mechanism 61 catches both of the yarn end Y2 drawn from the yarn supply package PI sup-

ported by the second peg 24b and the yarn end Y1 drawn from the yarn supply package PI supported by the first peg 24a and guides the yarn ends to the yarn joining device 60 has been described, but an aspect of the invention is not limited thereto. For example, the package exchanging device 7 may be provided with each of a catching and guiding mechanism for catching the yarn end Y2 drawn from the yarn supply package PI supported by the second peg 24b and a catching and guiding mechanism for catching the yarn end Y1 drawn from the yarn supply package PI supported by the first peg 24a.

[0115] In the package exchanging device 7 of the above-described embodiment, an example of catching the continuous yarn Y0 by the hook portion 61e when guiding the yarn to the inspection position P61 has been described, but the continuous yarn Y0 may be caught by, for example, the suction nozzle 61d.

[0116] In the above-described embodiment, the running carrier 30 having the vehicle wheels 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 wheels.

REFERENCE SIGNS LIST

[0117] 7... PACKAGE EXCHANGING DEVICE (YARN JOINING SYSTEM FOR SYNTHETIC YARN), 20...CREEL STAND, 30...RUNNING CARRIER (RUNNING UNIT), 40...COLLECTION DEVICE, 50...SUPPLY DEVICE, 60...JOINING DEVICE, 61...CATCHING AND GUIDING MECHANISM (GUIDE PORTION), 61d...SUCTION NOZZLE, 61e... HOOK PORTION, 64...JOINING MECHANISM, 65...BASE, 67a... FIRST HOOK (LOCKING PORTION, SECOND LOCKING PORTION), 67b... SECOND HOOK (LOCKING PORTION, SECOND LOCKING PORTION), 68a... FIRST HOOK (LOCKING PORTION, FIRST LOCKING PORTION), 68b... SECOND HOOK (LOCKING PORTION, FIRST LOCKING PORTION), 90...CONTROL UNIT, 90a...DRIVE CONTROL UNIT, 90b...DETERMINATION UNIT, 162...ROTARY GUIDE, 164...POTENTIOMETERS (ACQUISITION UNIT), 165...ROTARY SOLENOID, P1...YARN SUPPLY PACKAGE, P61...INSPECTION POSITION, Y0...CONTINUOUS YARN (CONTINUOUS SYNTHETIC YARN), Y1...YARN END (FIRST YARN END), Y2...YARN END (SECOND YARN END), YC...ENTANGLED PORTION.

Claims

1. A yarn joining system for synthetic yarn (7) used in a textile machine (2) including a creel stand (20) supporting a yarn supply package (PI) obtained by winding a synthetic yarn (Y) made of synthetic fibers on a bobbin (B1) by a yarn supply package support portion (25), 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 (P2) by winding the synthetic yarn (Y) subjected to the processing and used to draw a yarn end from each of a pair of two yarn supply packages (PI) supported by the yarn supply package support portion (25) and to join the yarn ends, the yarn joining system for synthetic yarn (7) comprising:

a yarn joining portion (66a) which entangles a first yarn end (Y1) corresponding to a yarn end of the one yarn supply package (PI) and a second yarn end (Y2) corresponding to a yarn end of the other yarn supply package (PI);

a guide portion (61) which guides the first yarn end (Y1) and the second yarn end (Y2) to the yarn joining portion (66a);

a locking portion (67a, 67b, 68a, 68b) which locks the synthetic yarn (Y) when the guide portion (61) guides the first yarn end (Y1) and the second yarn end (Y2) to the yarn joining portion (66a), the locking portion (67a, 67b, 68a, 68b) being provided so that a movable amount from an initial state increases in response to a tension acting on the synthetic yarn (Y) when the tension becomes larger than a predetermined value and is urged so as to return to the initial state when the tension acting on the synthetic yarn (Y) is equal to or smaller than the predetermined value;

an operation mechanism (62,63) which drives the yarn supply package support portion (25) supporting the yarn supply package (PI) of the creel stand (20) so as to be rotatable in a feeding direction;

a running unit (30) which moves a base (65) supporting the yarn joining portion (66a), the guide portion (61), the locking portion (67a, 67b, 68a, 68b), and the operation mechanism (62,63) along the creel stand (20);

an acquisition unit (164) which acquires a movable amount of the locking portion (67a, 67b, 68a, 68b) with respect to the base (65); and a drive control unit (90a) which controls a feeding amount of the synthetic yarn (Y) fed from the yarn supply package (PI) by controlling the operation mechanism (62,63) so that the movable amount is in a first predetermined range.

2. The yarn joining system for synthetic yarn (7) according to claim 1, further comprising:

a collection device (40) which collects the bobbin (B1) supported by the yarn supply package support portion (25); and

a supply device (50) which attaches the yarn supply package (PI) to the yarn supply package support portion (25), wherein the collection device (40) and the supply

device (50) are supported by the base (65).

3. The yarn joining system for synthetic yarn (7) according to claim 1 or 2,
wherein the locking portion (67a, 67b, 68a, 68b) is provided so as to be swingable with respect to the base (65) and is provided so that a swing amount from an initial state increases in response to the tension when the tension acting on the synthetic yarn (Y) becomes larger than a predetermined value, and wherein the acquisition unit (164) acquires the swing amount of the locking portion (67a, 67b, 68a, 68b) with respect to the base (65). 5 10
4. The yarn joining system for synthetic yarn (7) according to any one of claims 1 to 3,
wherein the locking portion (67a, 67b, 68a, 68b) is provided so as to be movable in a range wider than the first predetermined range. 15 20
5. The yarn joining system for synthetic yarn (7) according to any one of claims 1 to 4,
wherein the locking portion (67a, 67b, 68a, 68b) includes a first locking portion (68a, 68b) which locks the synthetic yarn (Y) wound on the one yarn supply package (PI) and a second locking portion (67a, 67b) which locks the synthetic yarn (Y) wound on the other yarn supply package (PI). 25 30 35 40 45 50 55

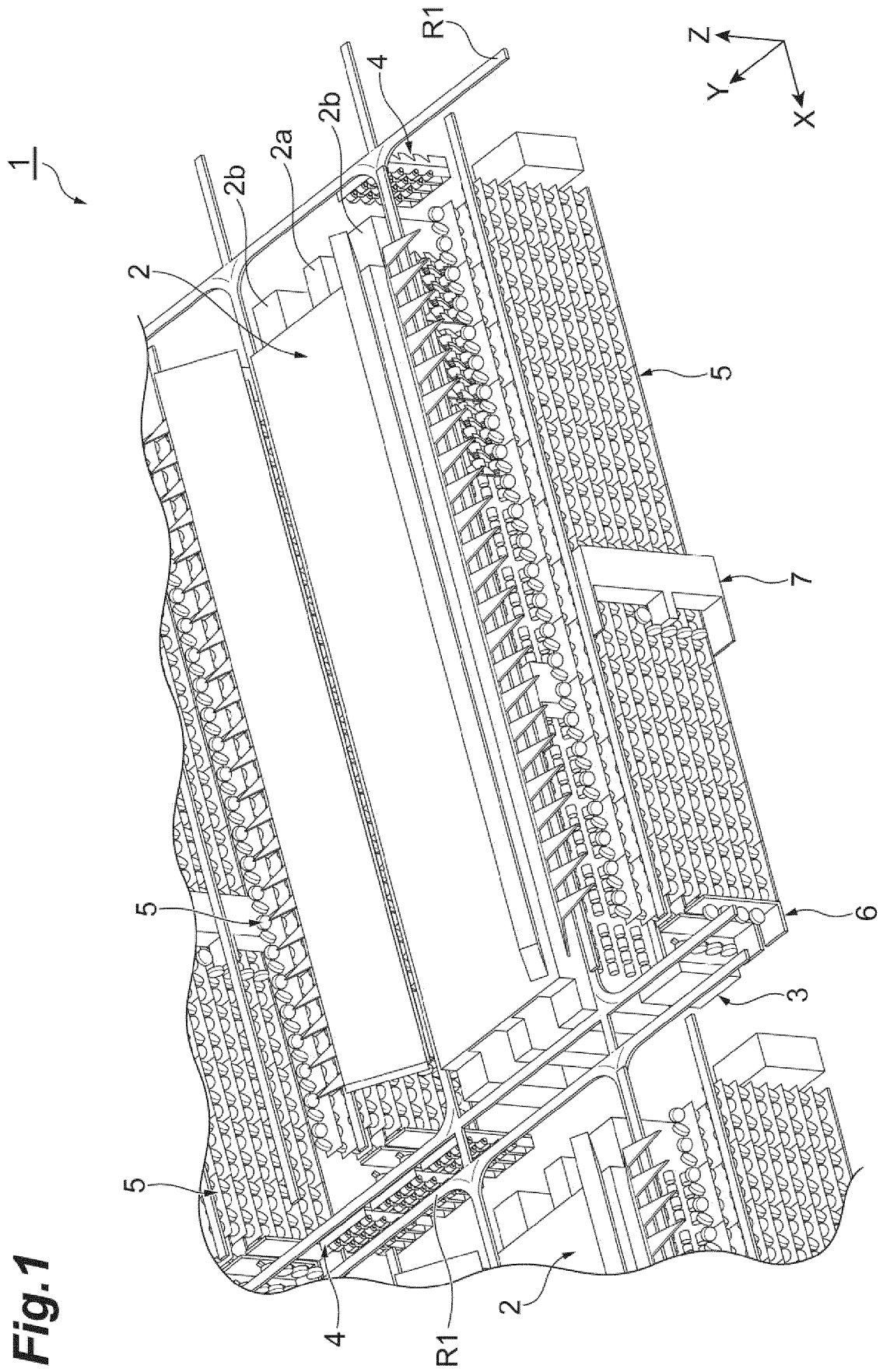


Fig.2

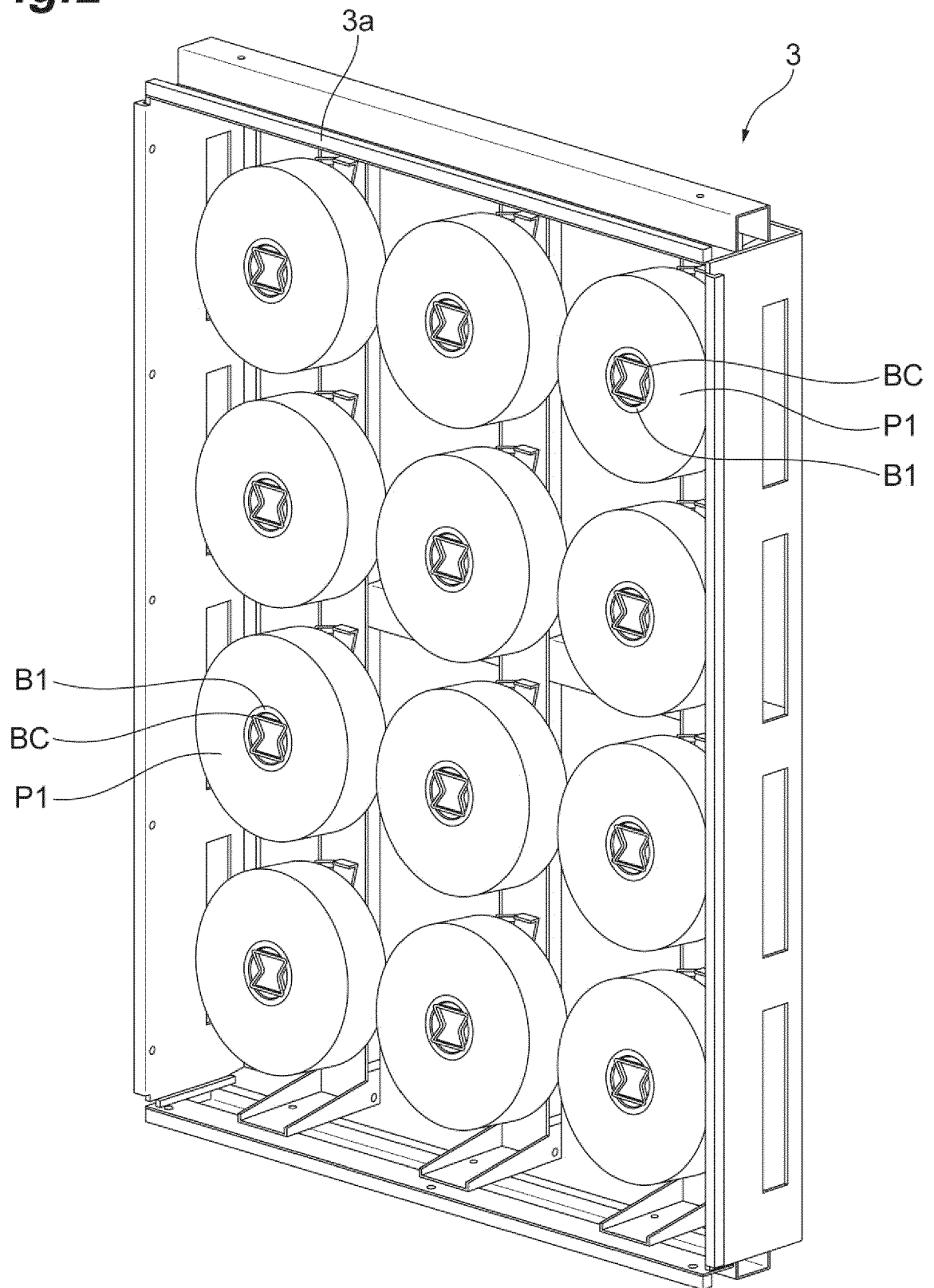


Fig.3

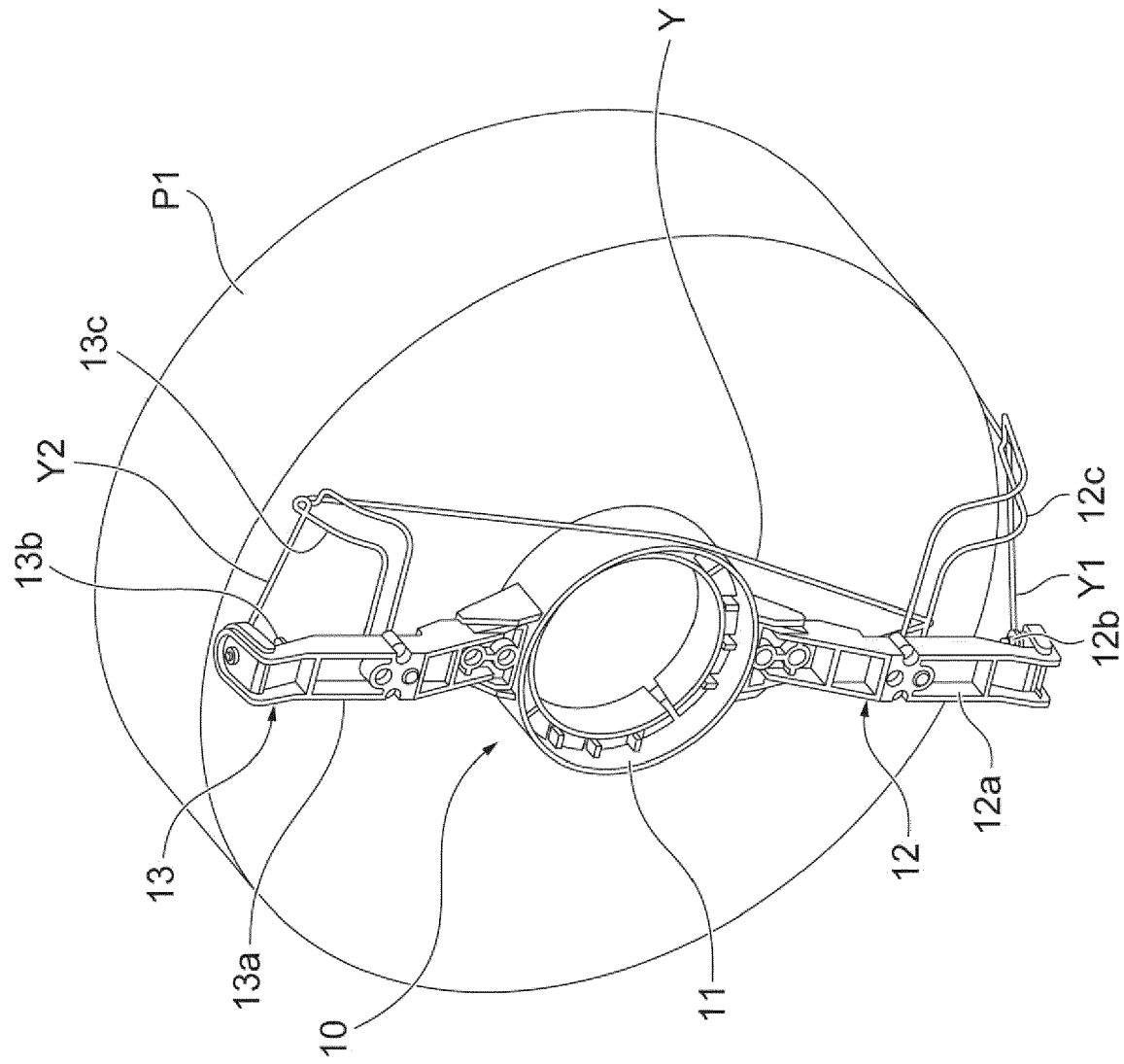


Fig.4

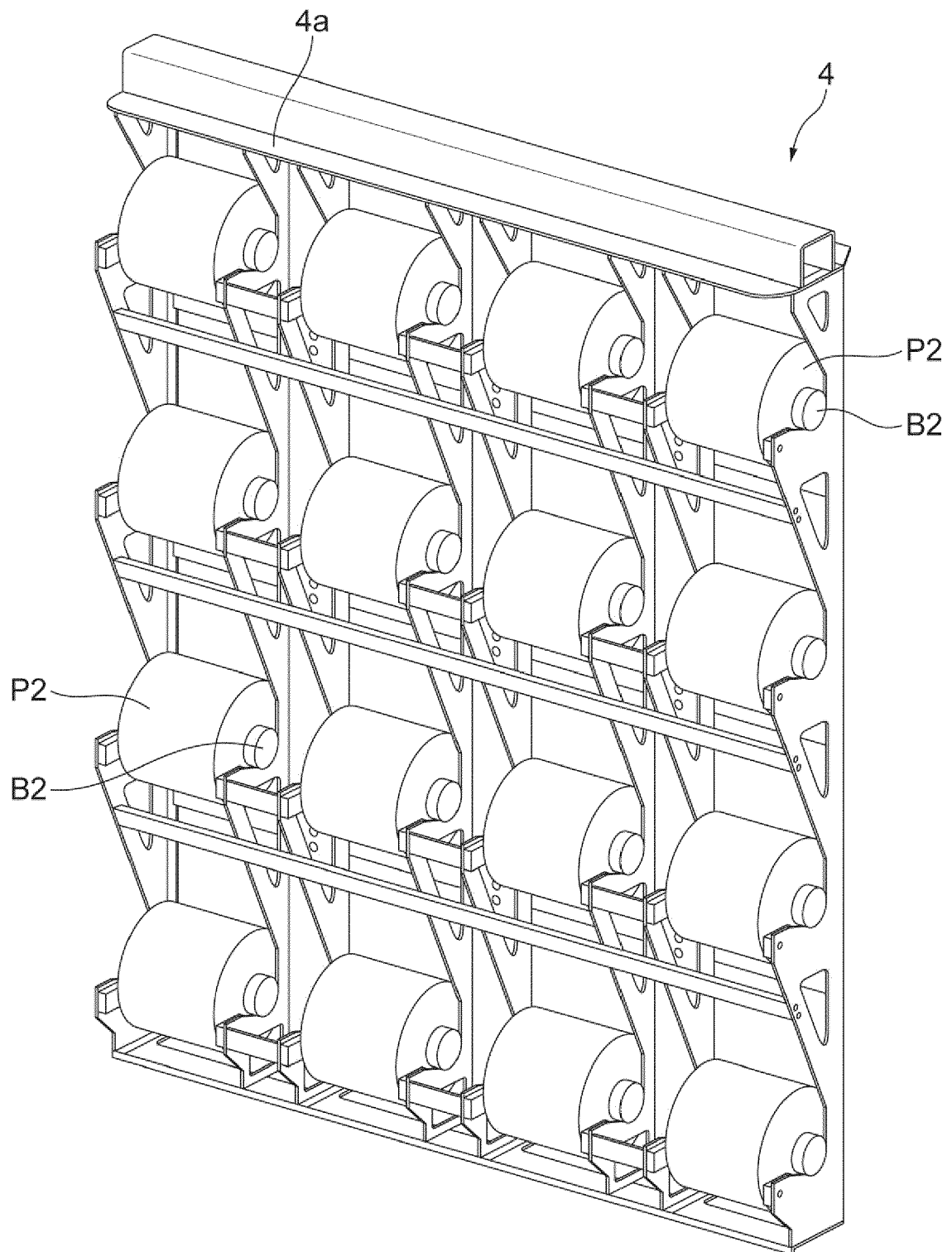


Fig.5

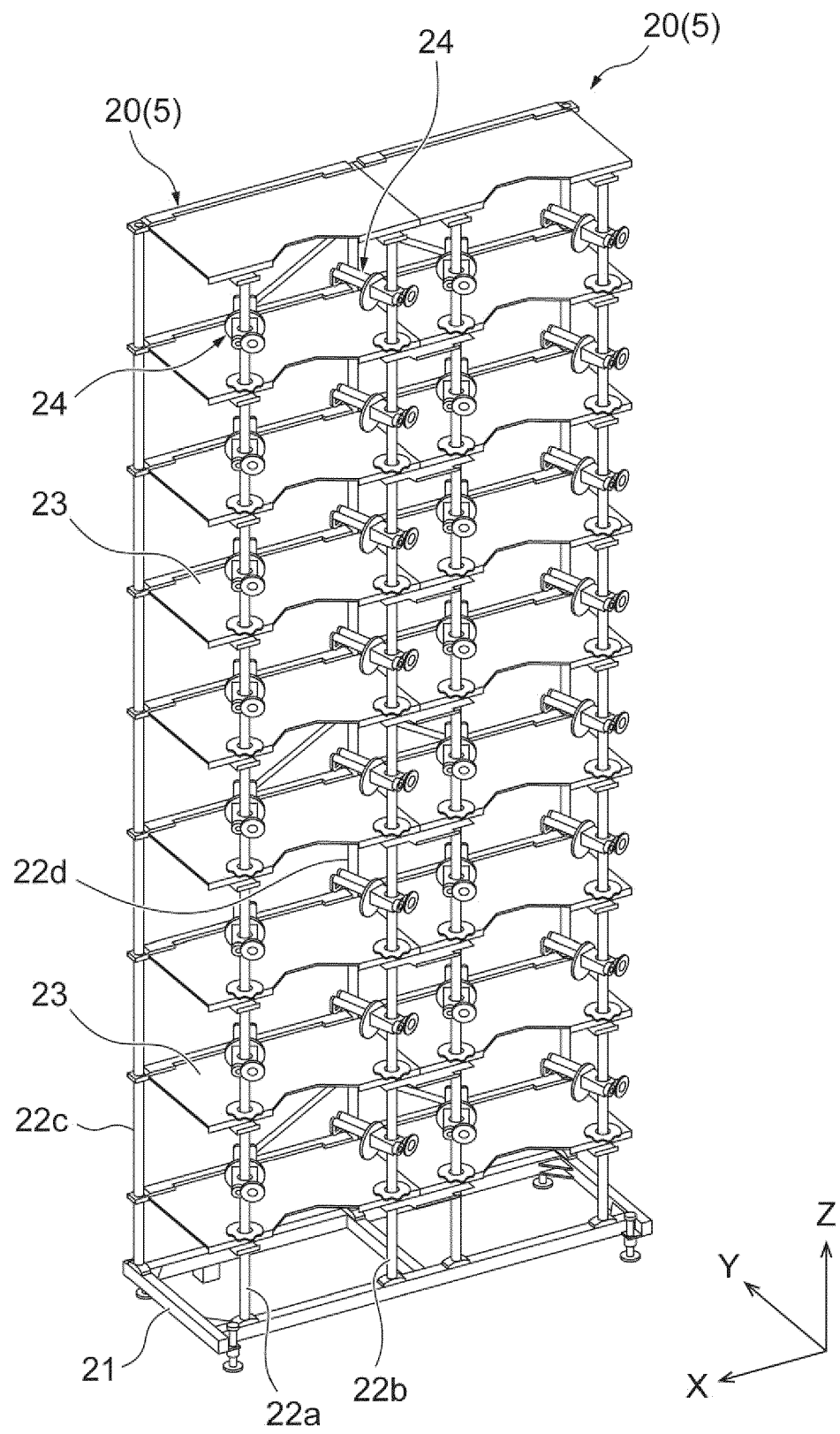


Fig.6

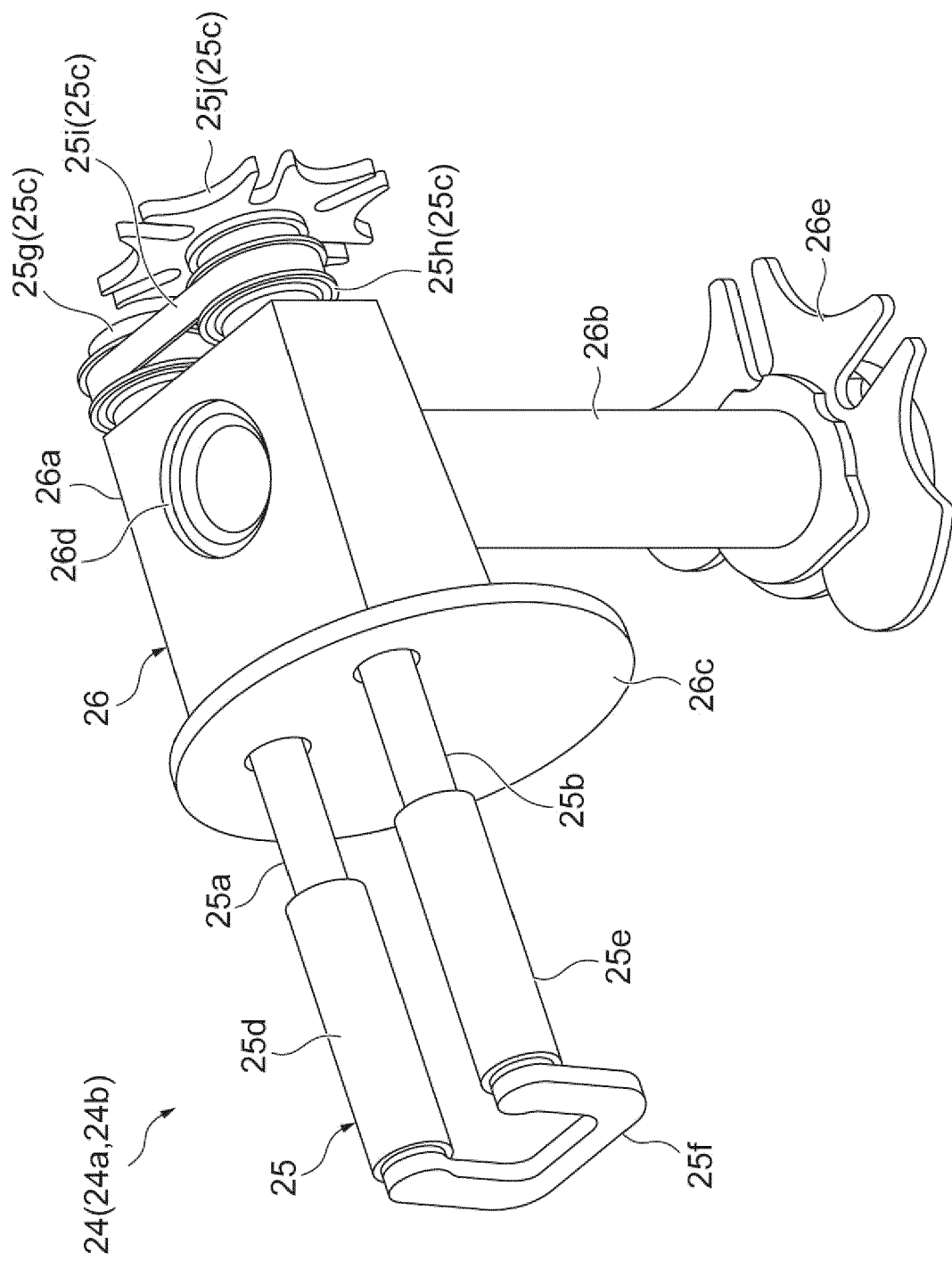


Fig.7

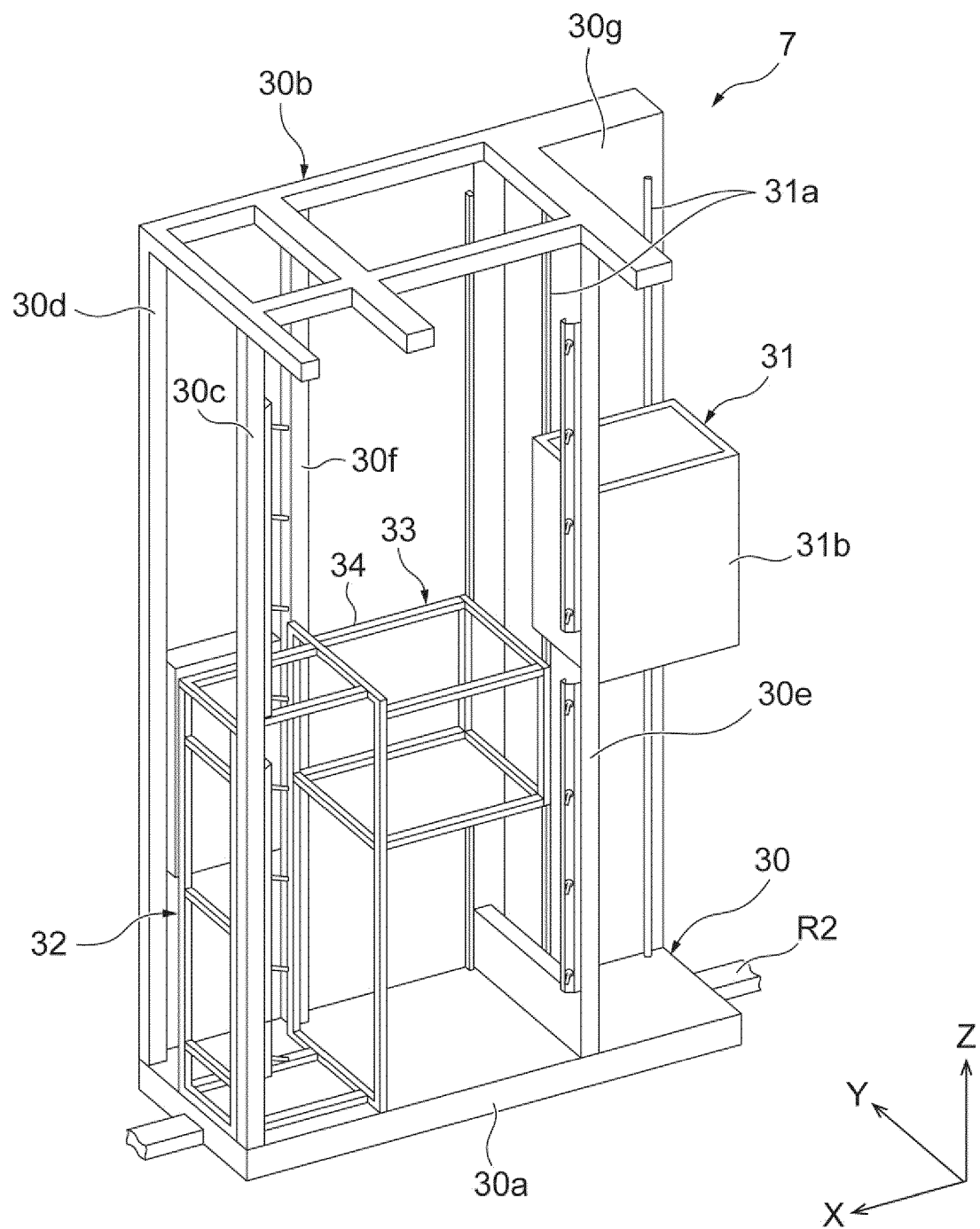


Fig.8B

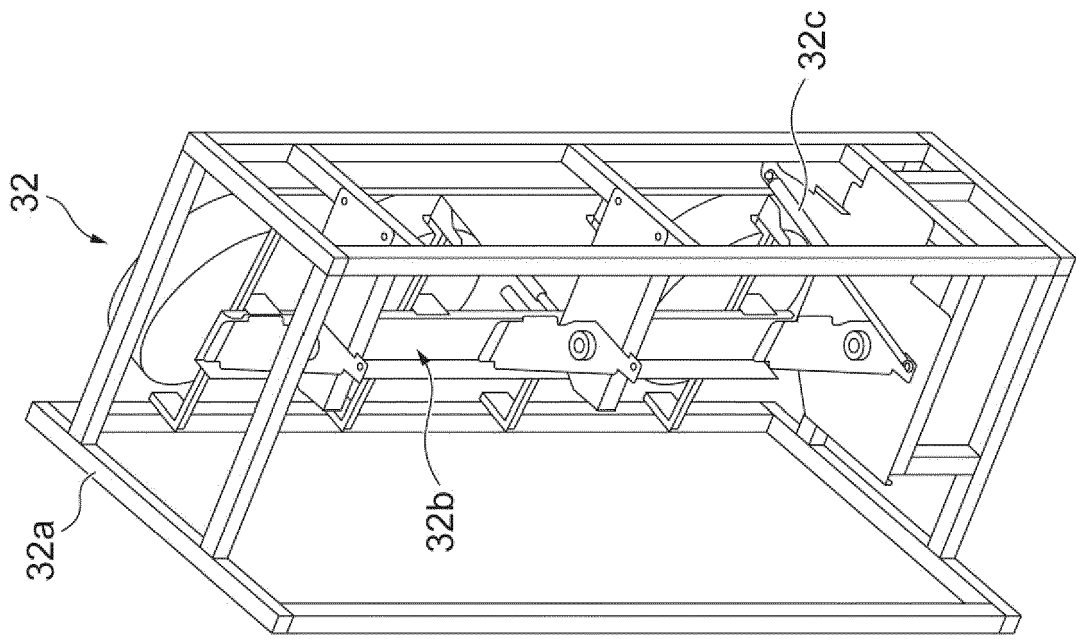


Fig.8A

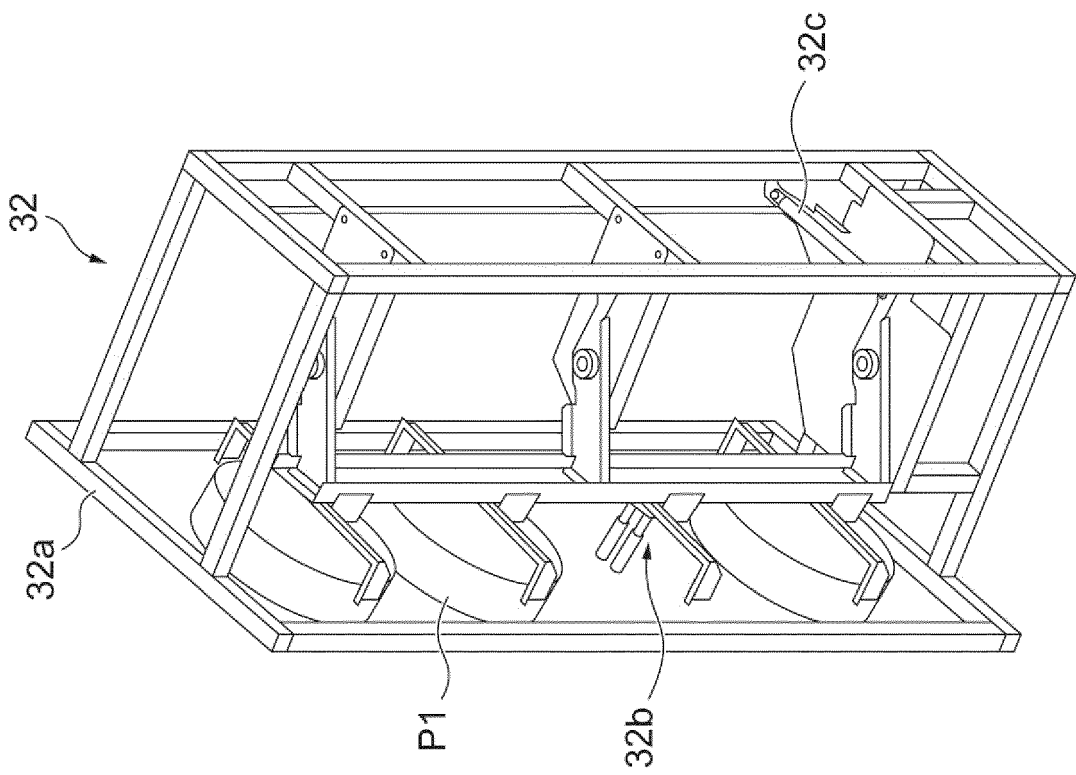


Fig. 9

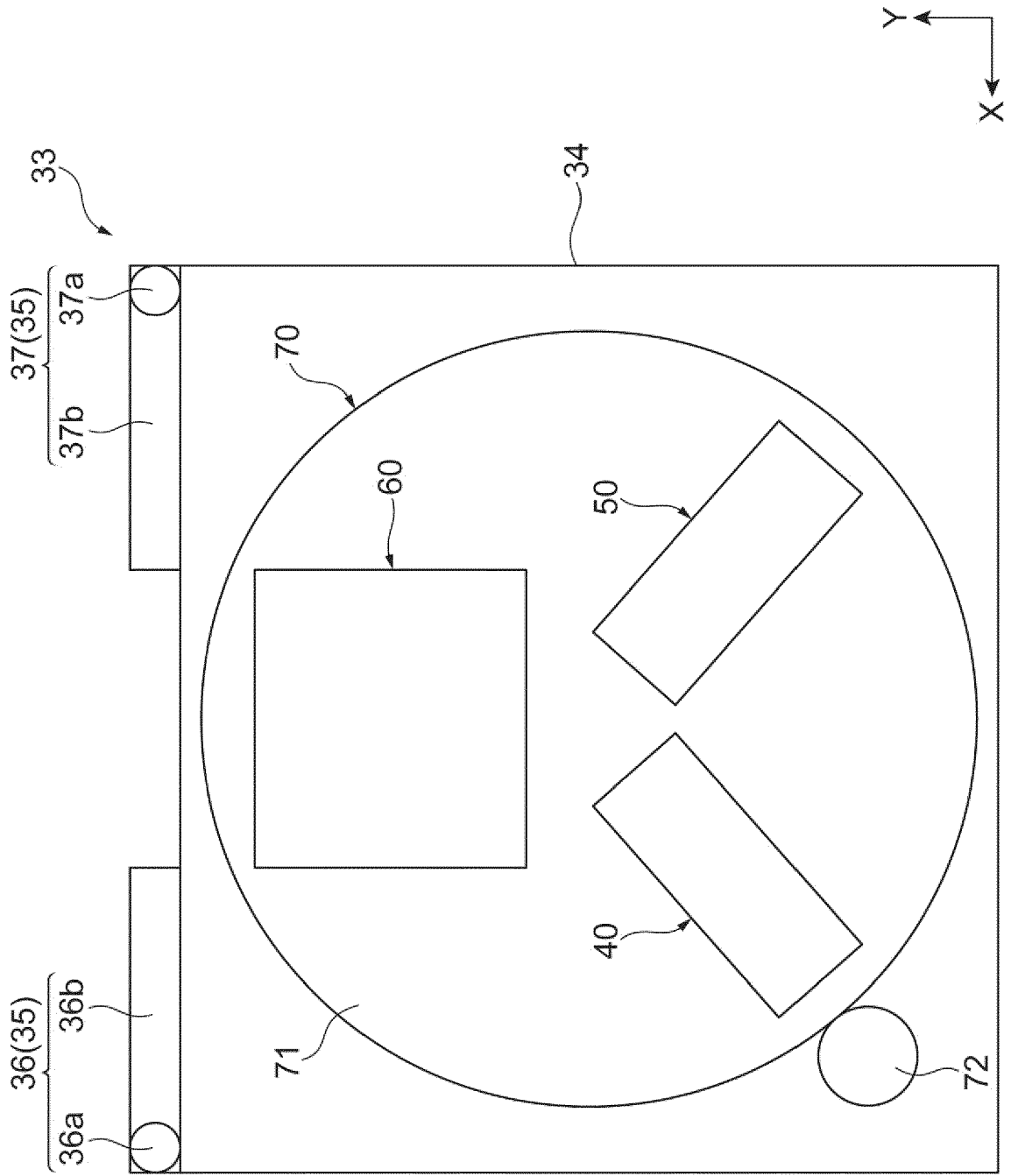


Fig. 10

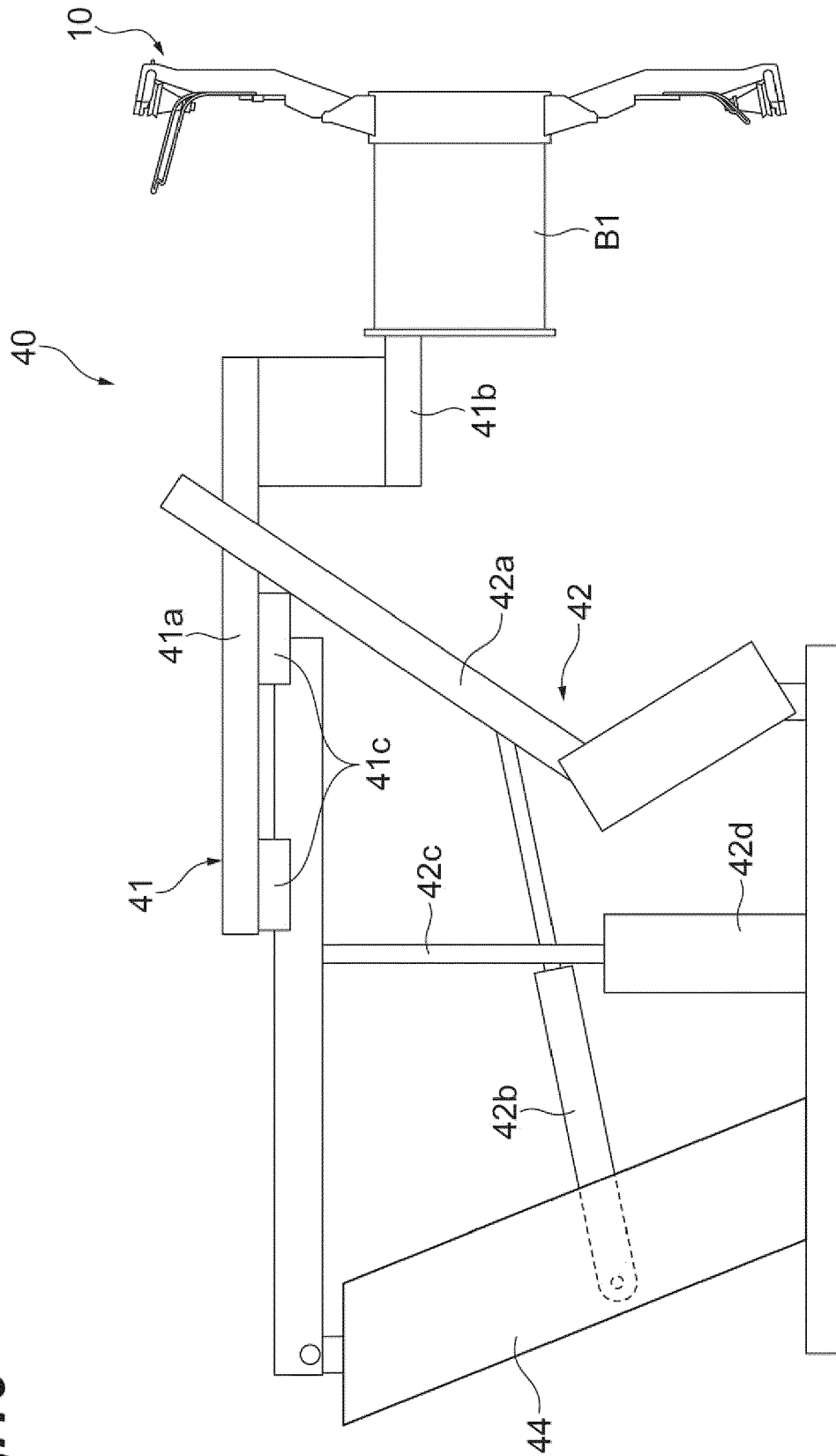


Fig.11

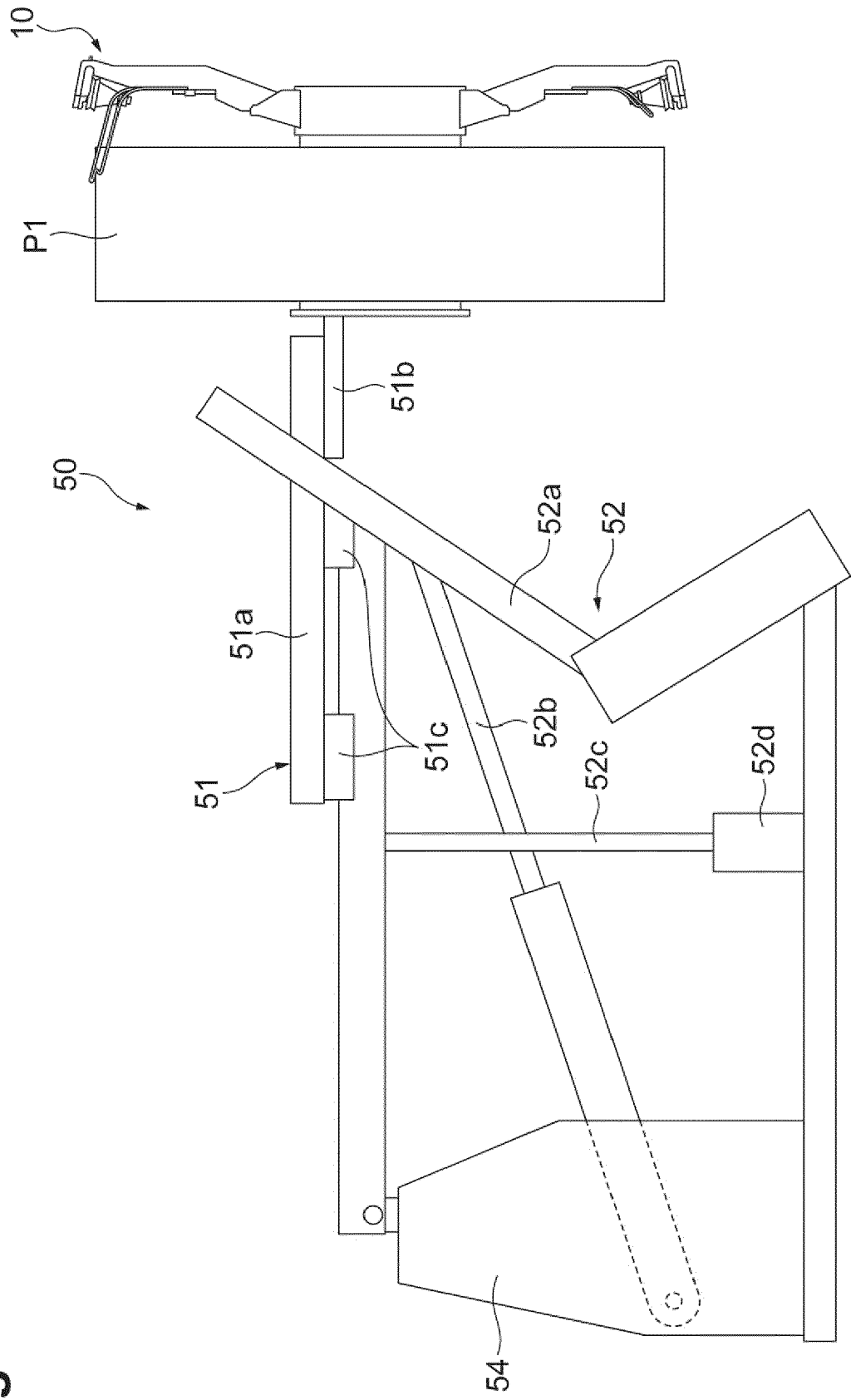


Fig.12

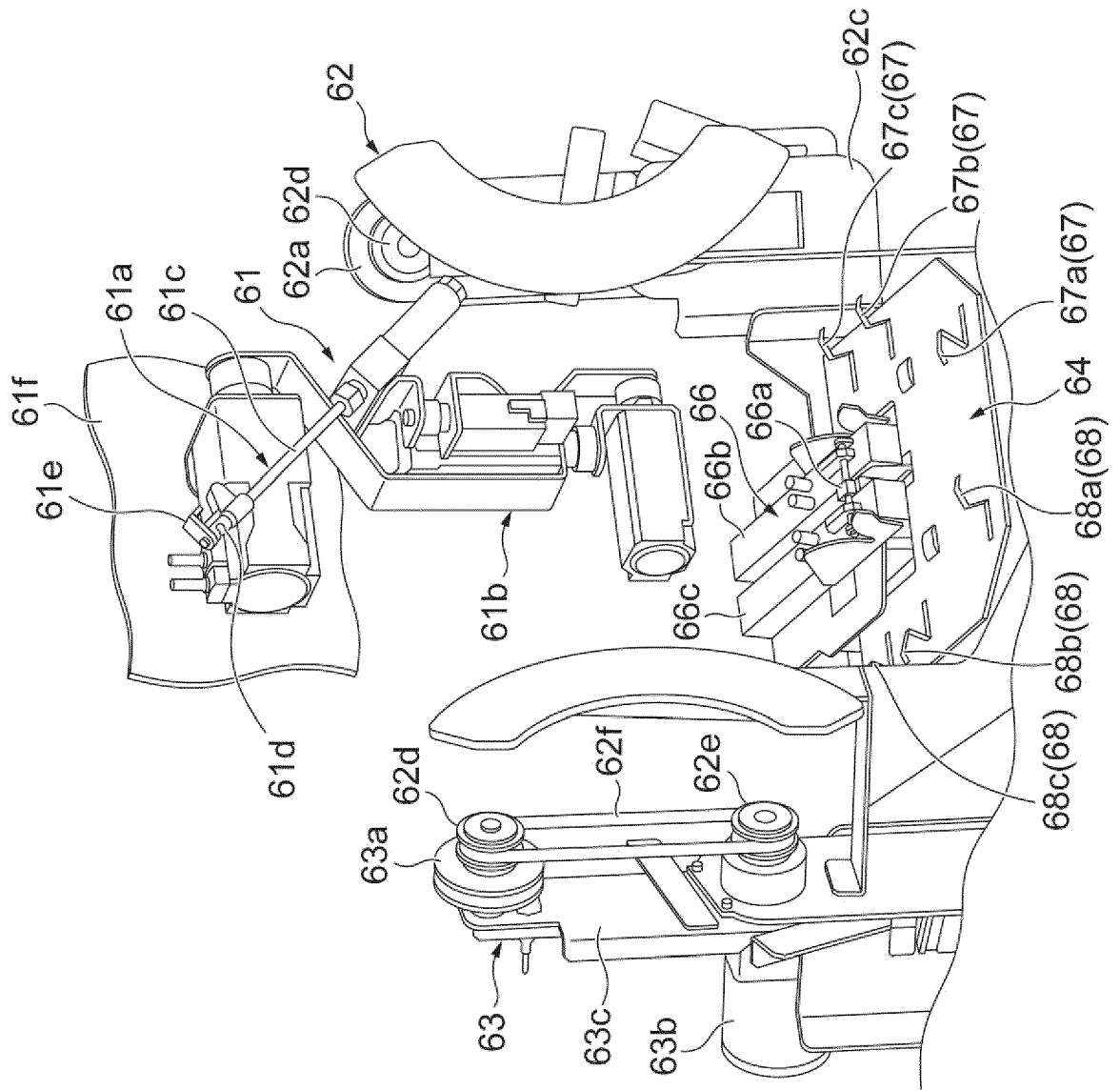


Fig.13

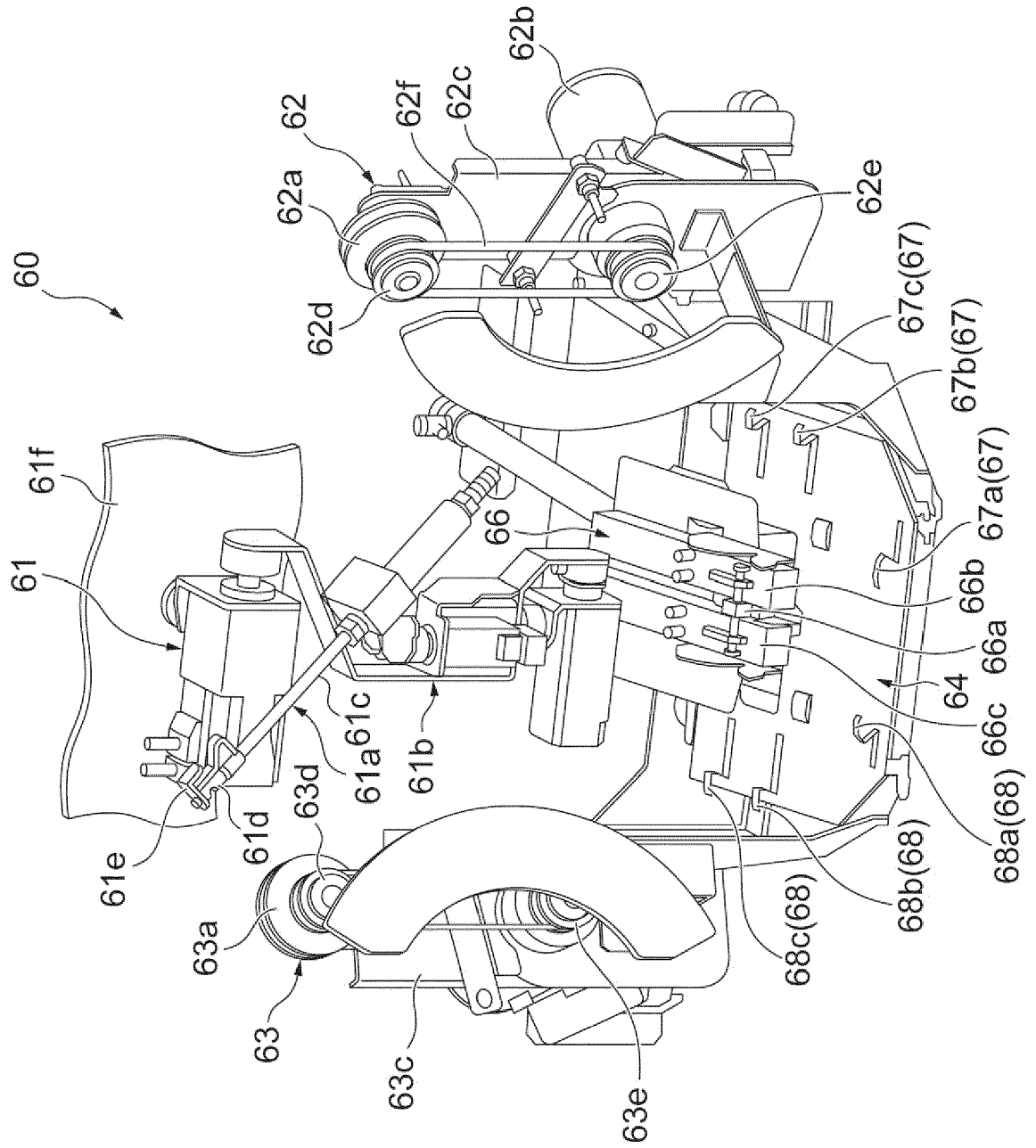


Fig.14

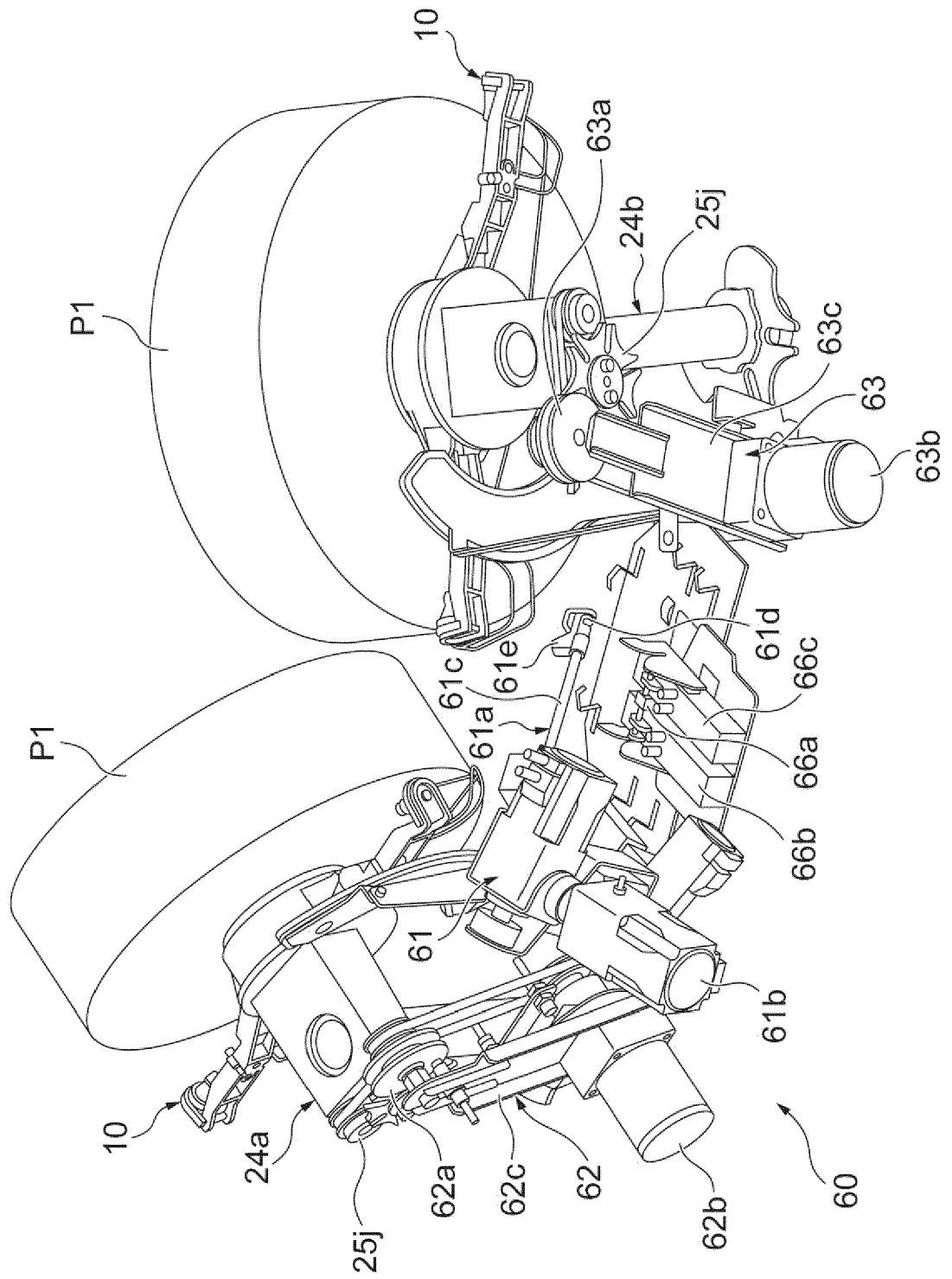
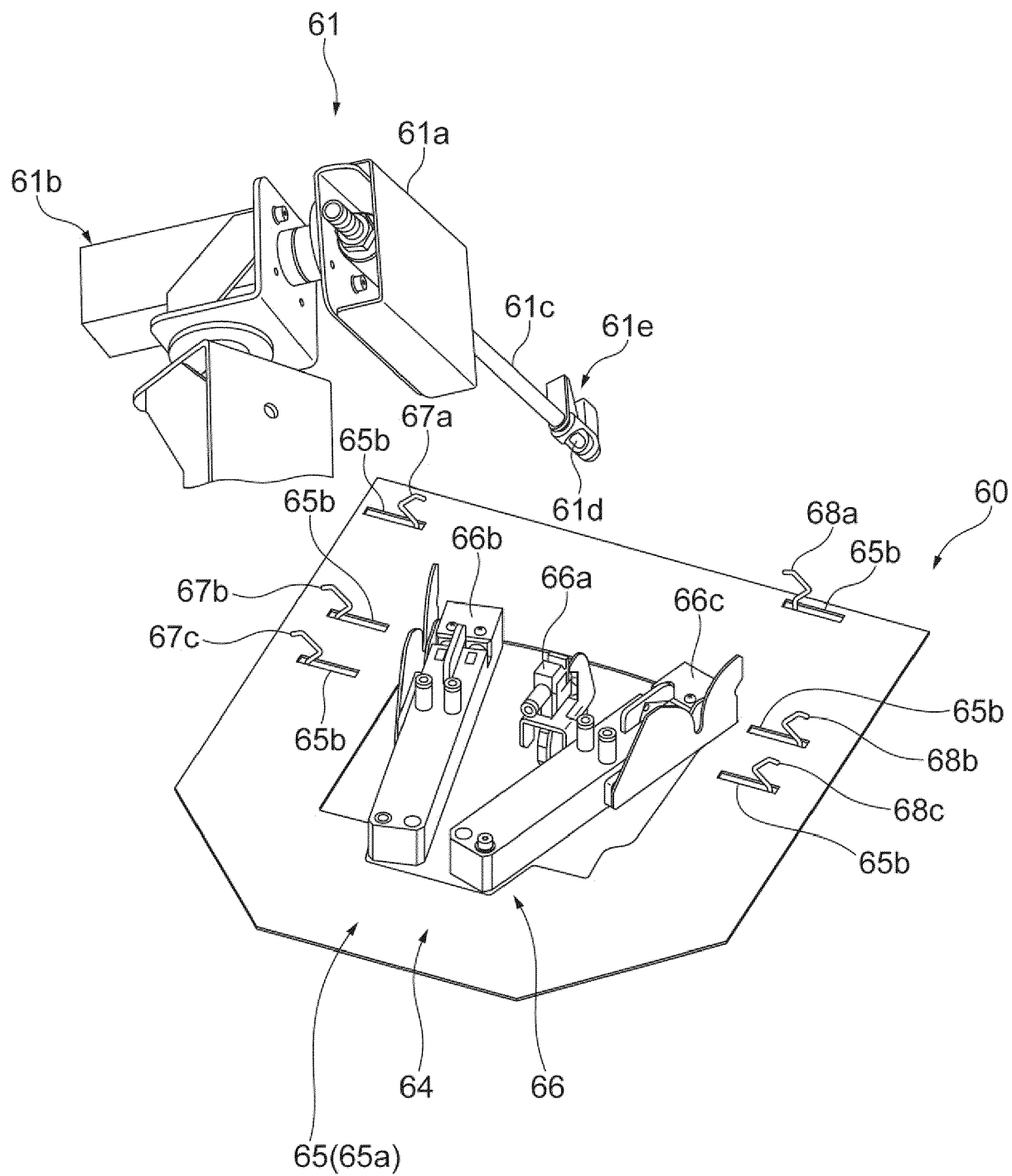


Fig. 15



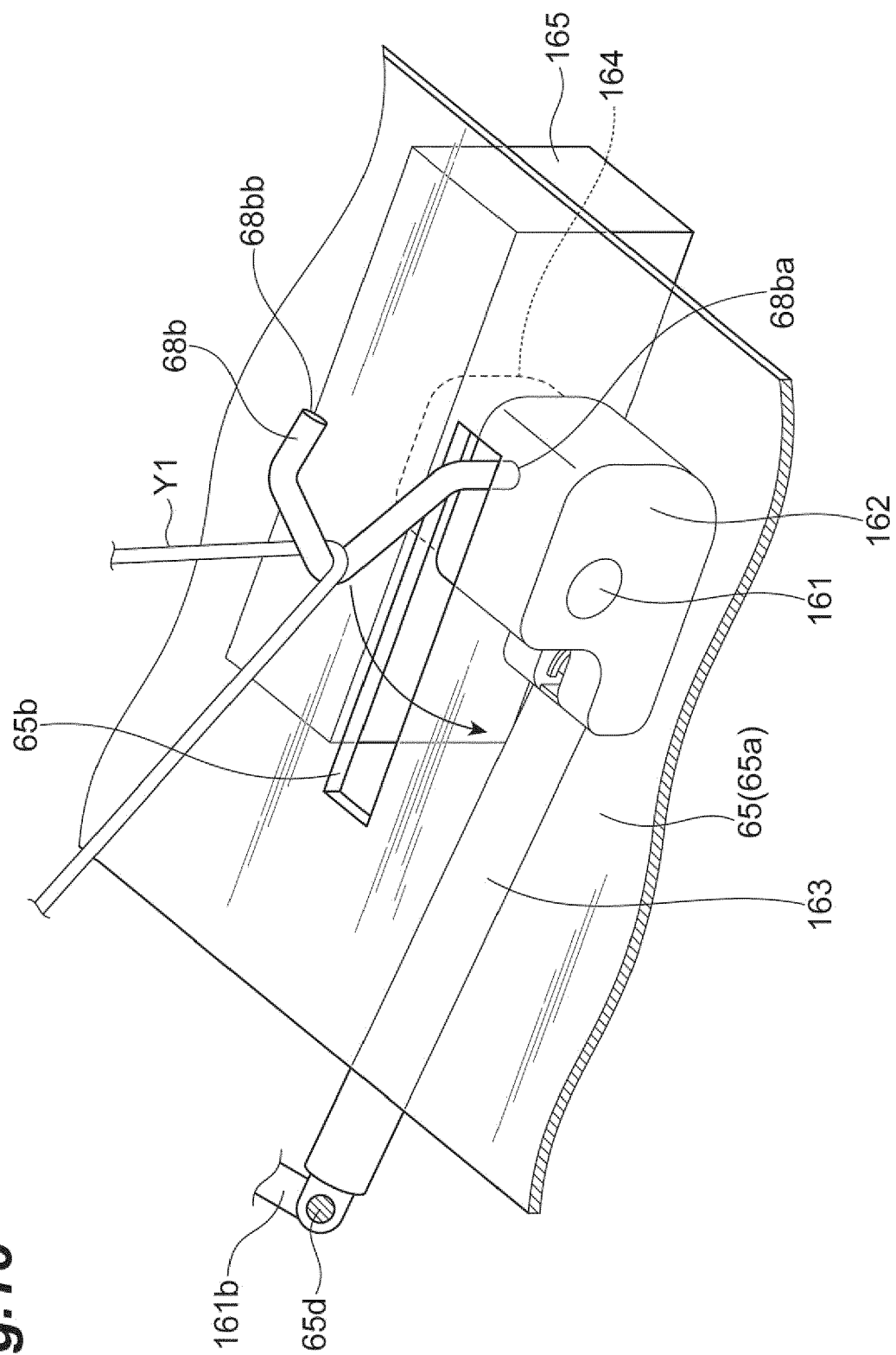


Fig. 16

Fig.17

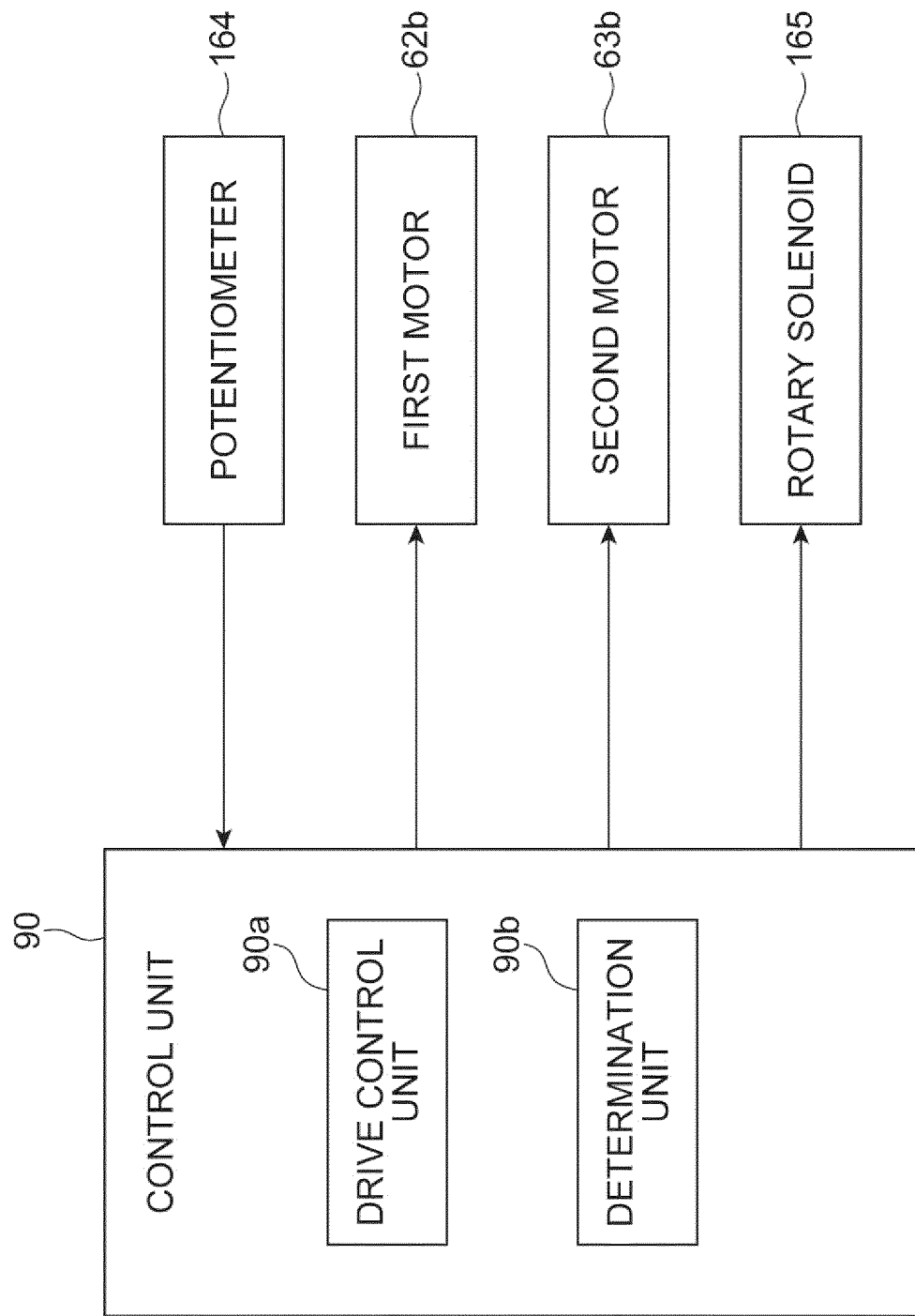


Fig.18

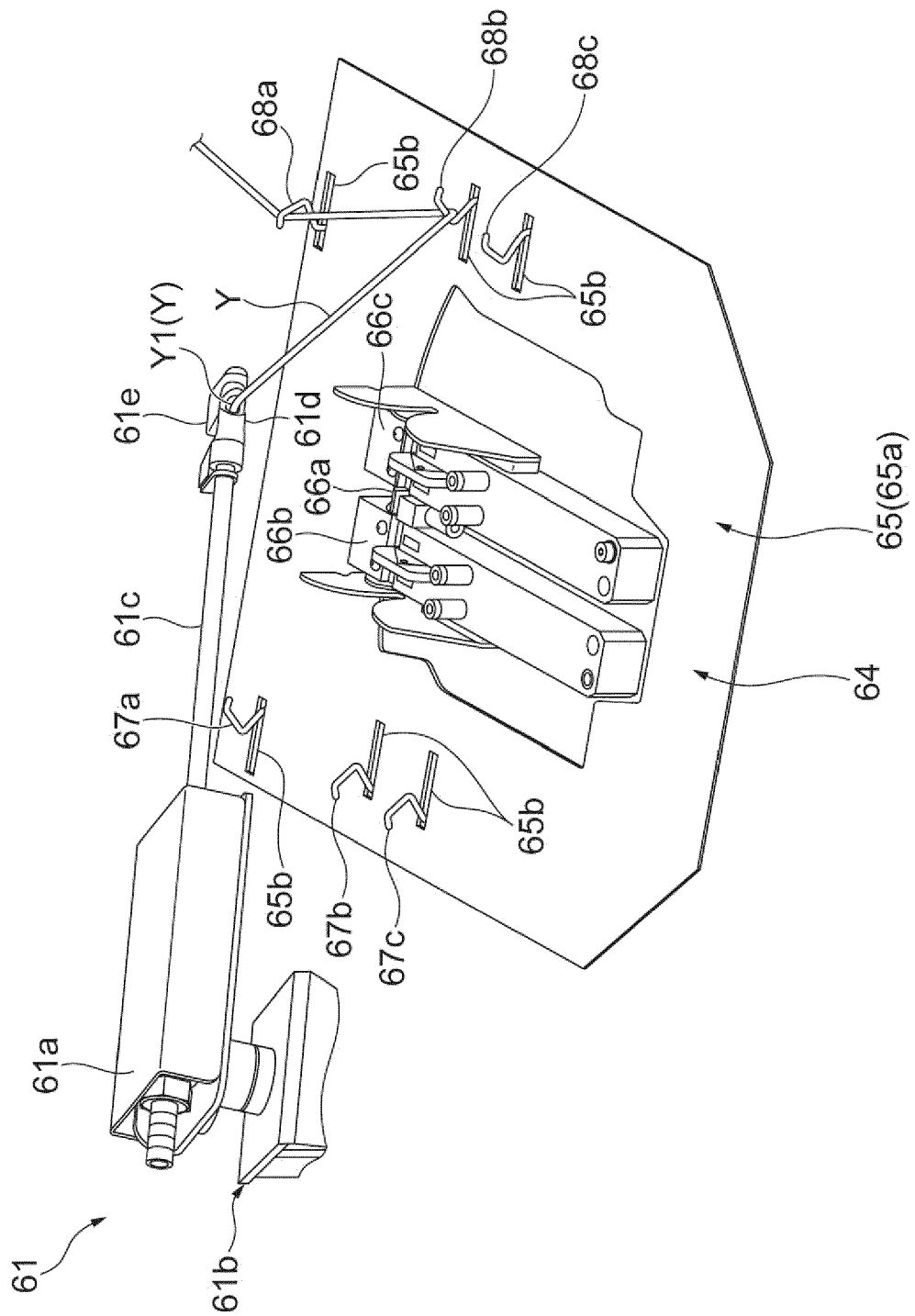


Fig.19A

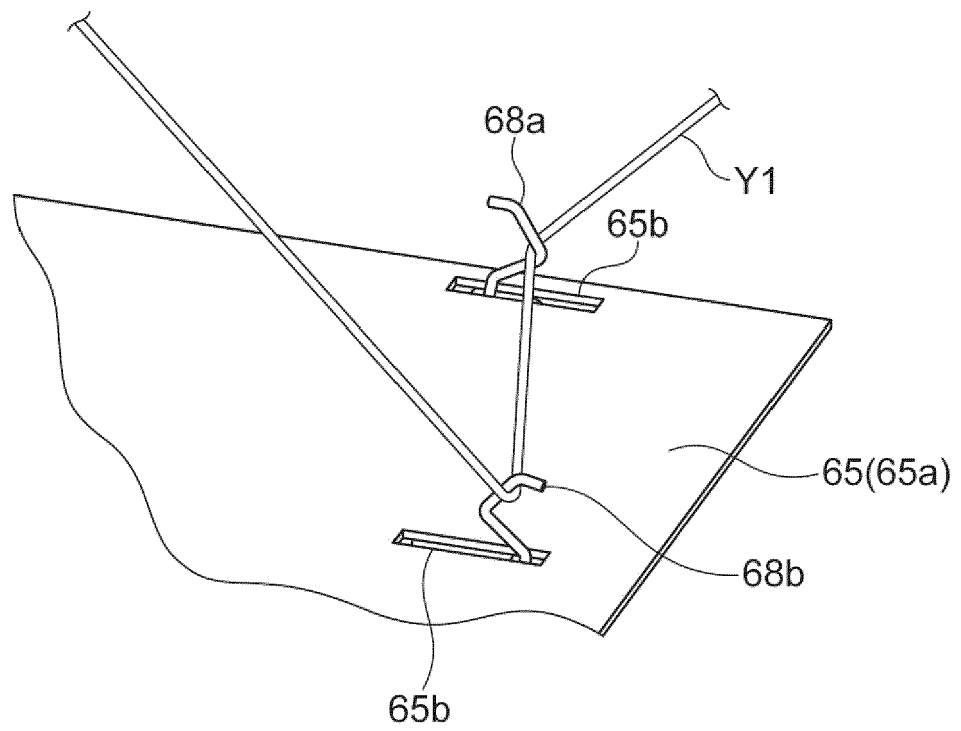


Fig.19B

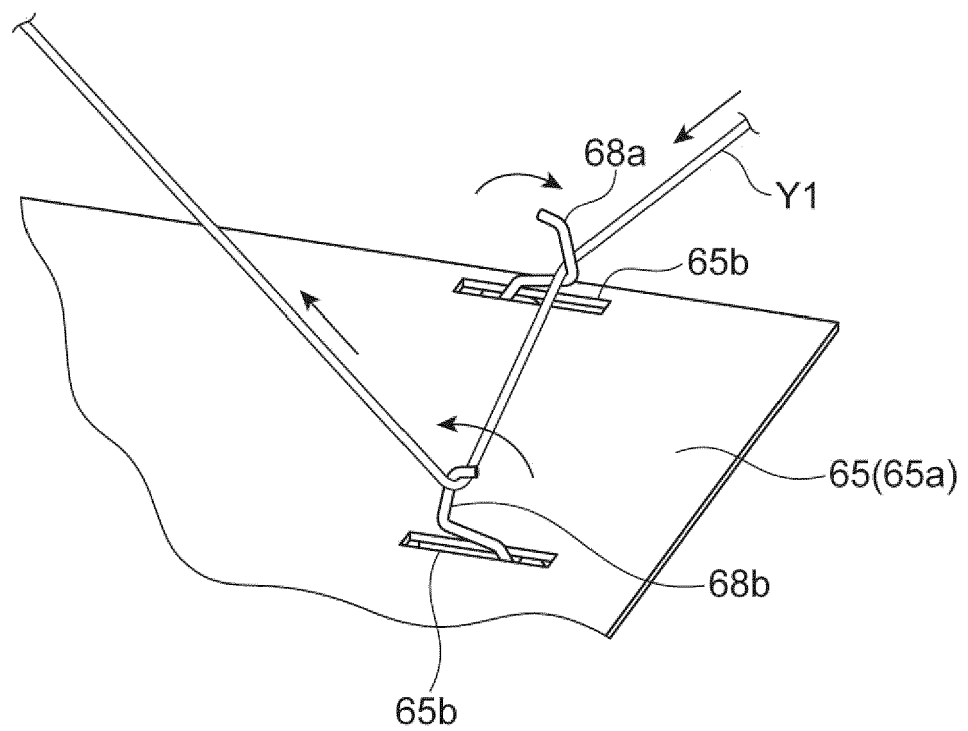


Fig. 20

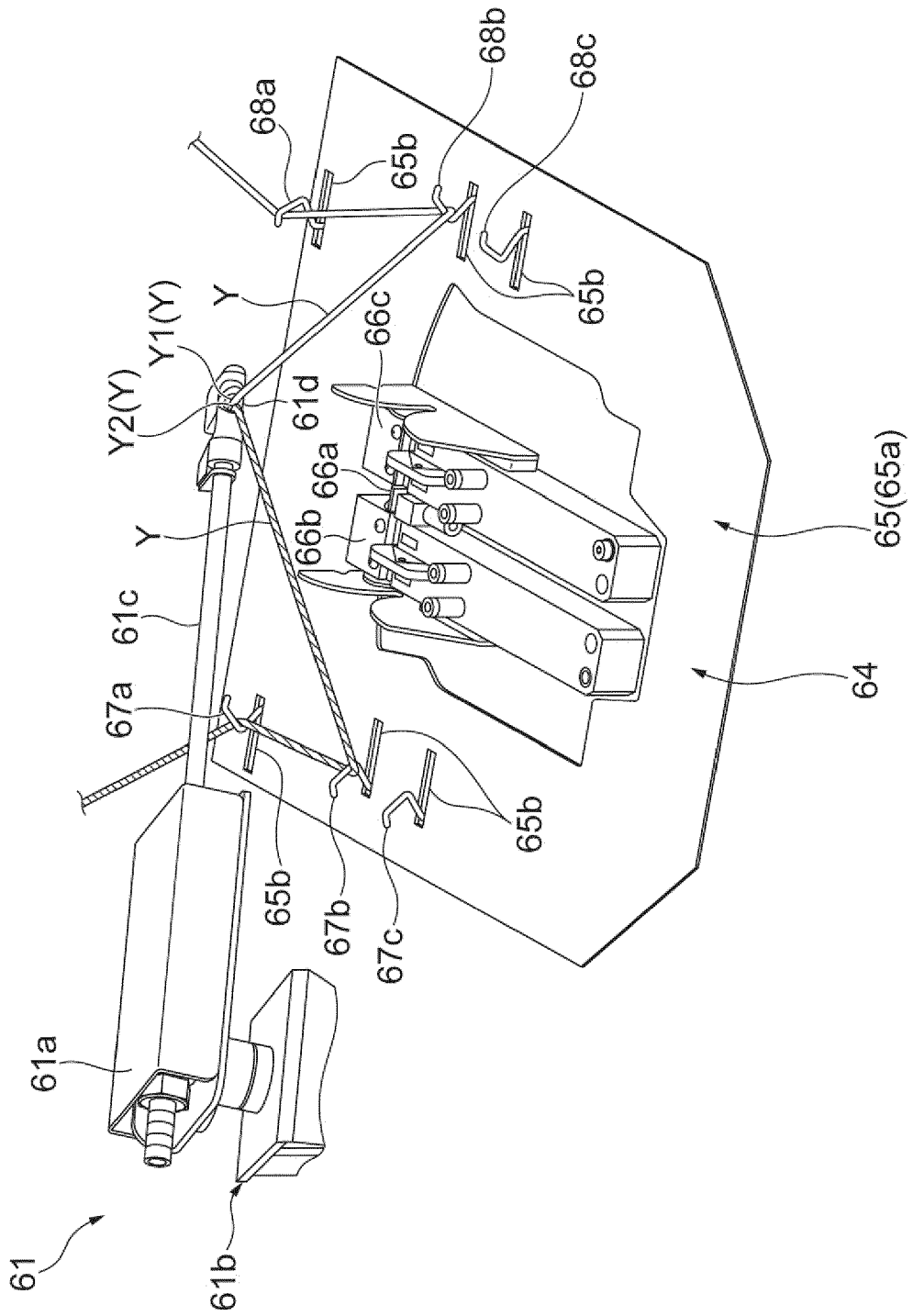
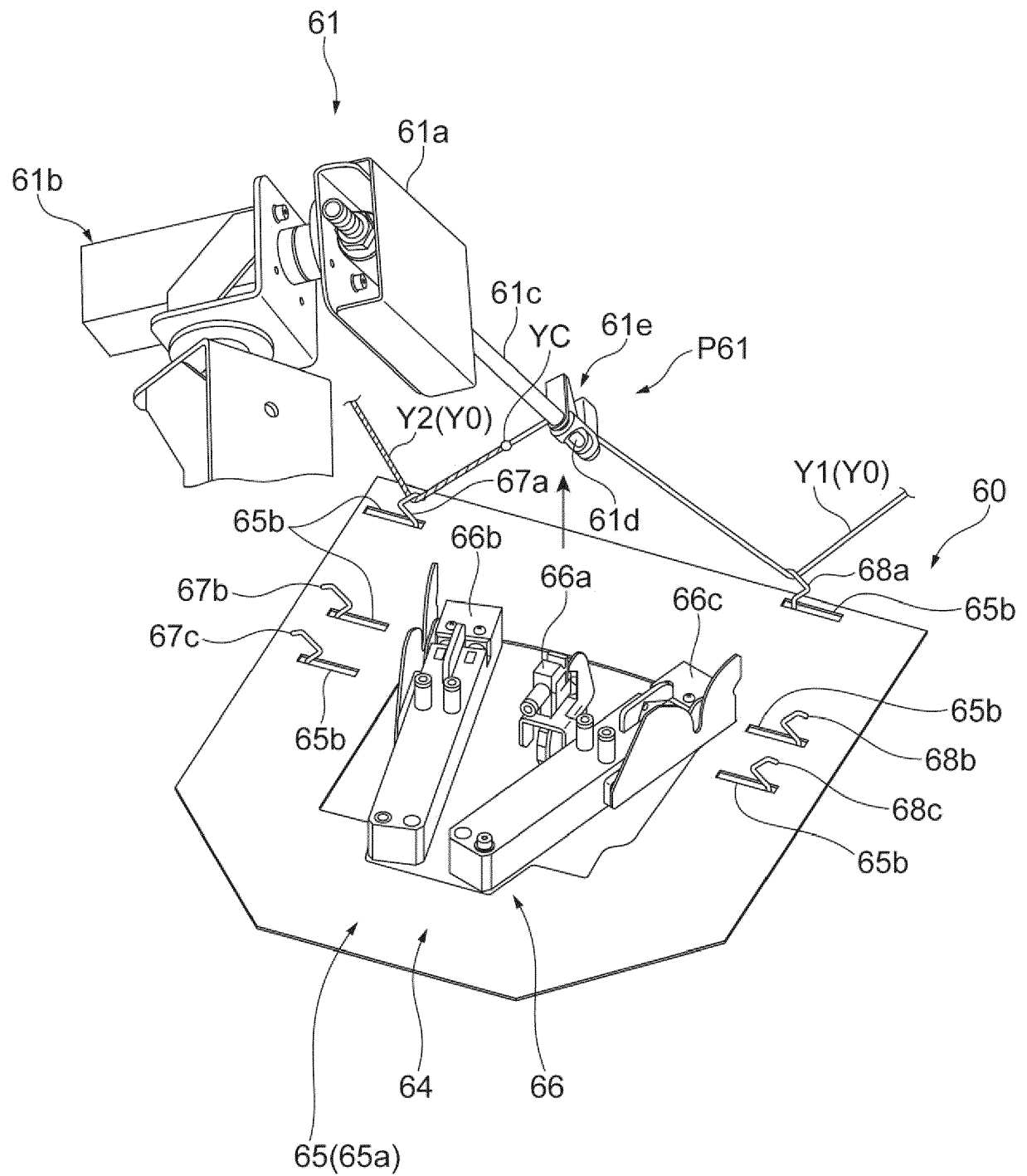


Fig.21





EUROPEAN SEARCH REPORT

Application Number
EP 20 18 8273

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	DE 43 44 786 A1 (MURATA MACHINERY LTD [JP]) 30 June 1994 (1994-06-30) * column 7, line 11 - column 8, line 8; figures *	1-5	INV. B65H49/12 B65H69/06 B65H67/02 B65H59/38
A	US 5 143 125 A (TSUDAKOMA IND CO LTD [JP]) 1 September 1992 (1992-09-01) * column 3, lines 40-68 * * column 7, lines 46-56; figures *	1-5	
			TECHNICAL FIELDS SEARCHED (IPC)
			B65H
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 7 December 2020	Examiner Lemmen, René
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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